Transmission Price Control Review

2007-2011

Efficiency Study and Forecast Opex

Final Draft 3 Report

29th September 2006

List of Revisions

Version	Date	Pages Affected	Revision History
TPA TPCR Efficiency Study d1	13/2/06	All	First Draft Report Issued to Ofgem
TPA TPCR Efficiency Study d2	20/3/06	All	Major changes compared to draft 1 are as follows: 1. Network Strategy Section now before Engineering Services. 2. Opex sections modified to link to Exec Summary points. 3. Full development of O&T and Shrinkage Sections 4. Additional information received, in particular related to SO activities and Capex Unit Costs 5. Capex Business Case section updated for Avonbridge in particular 6. Capex Delivery Review section now includes project execution reviews and review of unit costs
TPA TPCR Efficiency Study d3	13/4/06		Some changes made to Capex section following additional Avonbridge information.
TPA TPCR Efficiency Study Final Draft 1	22/5/06	All	1. Removal of SO Opex and Shrinkage Aspects (now to be completed separately). 2. Finalisation of Historic Opex sections, including development of Appendices for detail from Network Strategy section. 3. Finalisation of Historic Capex, 4. Addition of sections on Forecast Network Strategy and Engineering Services Opex, previously produced as separate documents
TPA TPCR Efficiency Study and Forecast Opex Final Draft 2	5/7/06	All Sections	Changes to finalise outstanding notes and comments. Title Changed to specifically include Forecast Opex
TPA TPCR Efficiency Study and Forecast Opex Final Draft 3	29/9/06	All	Amendments following comments from National Grid. Update to Include 05/06 actuals

TABLE OF CONTENTS

Appendices

SECTION 1. EXECUTIVE SUMMARY

TPA Solutions ('TPA') were appointed to provide technical support in relation to Ofgem's work on the forthcoming Transmission Price Control Review (TPCR) for National Grid's gas transmission business, with the following specific objectives:

- Review Historic Direct Opex and Capex performance for the period 2002/3 – 2004/5
- Review National Grid's proposals for Forecast Direct Opex for the remaining period of the current PCR period and the next TPCR period 2007-2012

Direct Opex relates to the activities associated with management and development of the network assets, and excludes shared services, IT and other overheads.

TPA's findings from this study related to System Operator Costs (historic opex and capex, and forecast capex) will be presented in a separate report. TPA has been engaged separately to review National Grid's proposals for Forecast Capex for the period 2005 – 2012. All figures are expressed in 2004/5 prices unless otherwise stated. [1]

The summary conclusions of our review are set out below.

1.1 Historic Capex Performance – General Findings

TPA has reviewed the Capital Programme for the period 2002/3 – 2004/5 and our findings are as follows:

- For the first 3 years of the current period, the capex underspend is estimated to be £200M mainly due to lower than forecast shipper demand for off peak transportation capacity from St Fergus

- For the full 5 year PCR Period, National Grid is forecasting a total capex of £702.8M compared to an allowance in the TO Price Control of £860M, with significant investment related to Easington baseline taking place in the last 2 years of the PCR period. Whilst capex for off-peak capacity is forecast to underspend by £332M (out of £415M allowed), and demand-related capex to underspend by £68M, there is a forecast overspend of £236M on additional entry capacity (below baseline levels), mostly to increase physical capacity at Easington to accommodate gas up to baseline (a significant portion of which has been booked by Ormen Lange shippers).

- Lower than forecast peak demand has occurred during the PCR period driven by lower growth in CCGT and CHP as a result of lower wholesale electricity prices in 2001 to 2002. There were no major new supply or storage developments in the 2002 to 2005 period, with the major offshore development, Ormen Lange scheduled for Oct 2007.

[1] *Figures are as submitted by National Grid in the HBPQ in Q4 2005, with clarifications in Q1 2006 (notably TP1135 which updated the capex forecast figures for the 5 year period). National Grid have subsequently provided updated capex actuals figures for 2005/06, and these are shown where appropriate. However, TPA has not received any further update to the forecast for the 5 year period, hence the aggregate 5 year forecast figures do not take account of the updated 05/06 data.*

- TPA finds that National Grid has negotiated an acceptable overall outcome for IPPC related compressor station investment with the Environmental Agency and Scottish Environmental Protection Agency (subject to confirmation that this is in place) and that delayed capex in this area has been efficient.

- TPA believes that the justification for a 5% additional capacity margin used by National Grid in its network planning should be reviewed in the light of changing circumstances including reduced entry capacity utilisation, installation of additional electrically driven compression capacity and other factors. This is explored in more detail in the Forecast Capex report.

- The delivery of the capital programme is entirely outsourced and appears to be generally efficient though TPA believes the increasing pressure on project schedules and poor capex forecasting is, at least in part, a result of National Grid's strategy of approving projects at an early stage after a minimal amount of feasibility work. This may not be appropriate in all cases, though it is not in itself inefficient.

- TPA recommends that as a matter of urgency given the IPPC (Integrated Pollution Prevention and Control) related programme, National Grid develops an appropriate asset management response to reduced future gas supplies at St Fergus, considering sale and relocation of assets, providing benefits in relation to Flow and Operating Margins and lower NTS opex and capex (this is explored in a note at the end of Section 5.6 and set out more fully in the forward capex report)

1.2 Historic Capex Performance – Specific Comments

In relation to the 2002-2005 programme, TPA makes the following specific comments:

- TPA believes that, whilst there was a Business Case in December 2002 for the £58M investment for the Aberdeen to Lochside pipeline, with a justification solely on the basis of avoided buy-back costs in summer 2005, within 2 months of the December 2002 Project Approval that case had been significantly weakened as a result two developments in January 2003 - the absence of St Fergus auction signals and the decision to land Ormen Lange gas at Easington rather than St Fergus. TPA believes that National Grid should have raised these fundamental changes in assumptions with Ofgem in Q1 2003 with an outcome that this project should have been cancelled and additional investment focused on Easington.

- Further, it appears likely that the £169M capacity expansion programme to increase St Fergus peak capacity from 140 to 160 mcmd between 2002 and 2005 (St Fergus to Aberdeen pipeline, Aberdeen to Lochside pipeline, pipeline uprating and 45MW increase in power at Bathgate/Avonbridge) will have limited future utilisation due to Ormen Lange landing at Easington and the forecast (at the time) decline of the UKCS in the sector supplying St. Fergus. The maximum flow of 145 mcmd was reached in 2004/5 and this is still below the level of capacity, 147.5 mcmd, prior to Aberdeen to St Fergus, Avonbridge (expansion part), Aberdeen to Lochside and associated uprating projects

- TPA believes that future regime design and SO incentives need to take into account this experience in order to avoid similar over-provision of capacity for such a short peak, whether at entry or exit.

- In the event that circumstances change causing projects to have to be cancelled after Feasibility/Conceptual design stages (e.g. Ormen Lange to Easington), the present arrangements may incentivise National Grid to complete projects in order to avoid significant adverse impact on the P&L.

- TPA believes that whilst there was a reasonable case to replace the existing compressors at Bathgate with a new facility known as Avonbridge, there were deficiencies in the approval process. Whilst the increase in capacity from 30MW to 45MW and in standby from 50% to 100% had a reasonable Business Case, the optimum option of additional electricity driven machines was not selected, and not discussed as an option in the approval paper.

- TPA believes that there was a good Business Case for projects to increase capacity in the Bacton area as a result of Interconnector related gas imports and new demands.

- TPA believes that National Grid has delivered pipeline and compressor projects completed in 2002-2005 at generally reasonable unit costs though some of the overspends at Avonbridge compressor station and in relation to the St Fergus to Aberdeen pipeline could have been mitigated with alternative contracting strategies and additional work prior to awarding the main design and construction contracts. Such alternative strategies could have reduced costs on these projects by around £20M, however, TPA accepts that the strategy was reasonable at the time and has resulted in lower costs on other projects completed during this period.

1.3 Historic Opex Performance – General Findings

TPA has reviewed the total direct operational expenditure associated with gas related activities (£126.4M for 2004/05, £117.5M for 03/04, and £130.9M for 02/03) with a view to assessing the operational efficiency of National Grid in incurring these costs. These costs are split between Gas TO and SO, such that for 04/05, £39M was attributed to Gas TO and around £88M to SO (of which £76M were non-controllable costs associated with System Operation, mostly shrinkage). The controllable direct cost element for TO and SO was £51M and it against this level that TPA's comments are made. SO Cost Analysis and Findings have been extracted from this report at Ofgem's request, and will be provided in a separate report.

Our findings are as follows:

- Direct asset management and field related operating costs appear to be reasonable, reflecting the maturity of the business, and there are no significant areas that are candidates for material cost reductions unless assets are decommissioned.

- TPA has examined the Asset Management process and related policies and the contribution that they make to the safety of employees, the public and the environment, the security of the gas supply and the management and development of the National Transportation System and finds that they are broadly effective, relevant and consistent with best practice.

- There is little scope to extend inspection and maintenance intervals to significantly reduce operational expenditure and remain within the constraints imposed by legislation and best practice.

- The asset management functions have been undertaken with appropriate resources in an economic and efficient manner taking into account the scale and distribution of the asset. Although some reduction in costs have been achieved, over the period to date, it is unlikely that significant reductions can be made for the remainder of the period given the level of capital expenditure and asset commissioning.

- National Grid has not implemented a unified work and asset management system. The benefits of an integrated work and asset management system have been reviewed in the period but the business case for such a system could not be justified.

1.4 Historic Opex Performance – Specific Comments

TPA makes the following specific observations in relation to Gas Opex:

- Network Strategy technical competencies and capability have been reviewed and additional staff have been recruited to strengthen core skill areas in control systems, rotating machinery and pipeline integrity. Given the capital expenditure in these areas the increased capability seems appropriate.

- Escalating opex expenditure is being incurred due to what National Grid term "emerging defects". Failures are routinely investigated and there is proactive inspection of gas generators and power turbines, by boroscope examination, to identify potential faults which may lead to failure. Failure and defect information is used to identify and propose assets for repair or replacement. There are 'review and challenge' proposals to validate and optimise repair and replacement projects taking into account the medium term (up to 2012) gas supply and demand forecast.

- There have been no examples of loss of capacity (and use of the capacity buy-back mechanism) in relation to compressor stations other than in connection with new plant at Aberdeen and Carnforth and National Grid has not adequately demonstrated any unusual reduction in performance due to age or condition.

- The interaction of compressor related costs (maintenance, breakdown, replacement and emissions reduction) is an important area that TPA will further review in the Forward capex report in the context of the compressor replacement and IPPC capex programmes. TPA is supportive of provision of sufficient opex to ensure efficiency in capex spend.

- Site visits by TPA staff to compressor stations at Kings Lynn, Peterborough and Bathgate have indicated that the general condition of valves and associated pipework is poor and such equipment has not been maintained in accordance with good industry practice, leading to increased risk of failures and the requirement for replacement capex that may not have been necessary had an efficient painting and maintenance regime been in place.

- Pipeline and AGI maintenance is a low cost activity in compliance with statutory requirements with little room for additional saving.

- Significant compensation costs may accrue as a result of loss of landfill rights associated with Quarrying. Together with Crop and Drainage claims these will remain items of uncertainty.

1.5 Review of National Grids Proposals for Forecast Opex

Network Strategy

Network Strategy costs and FTE levels in the forward period are higher than those of the base year. National Grid argue that the increase in costs is appropriate given the projected capital expenditure and increase in the size of the asset base, the challenge of managing aging assets and the requirements to develop and manage serviceability, higher levels of activity to demonstrate compliance with safety legislation and industry standards, the implementation and management of systems and reporting on emissions under IPPC and EUETS regulations and real pay growth.

In most instances TPA have found National Grid arguments to be well founded but consider that there are areas where efficiencies might be applied to the National Grid forward opex proposal. These are as follows.

- The asset management review process is now established and there is experience within Network Strategy of operating the process and no additional asset groups have been identified where deterioration is anticipated. TPA considers that efficiencies could be made in this area given the increased technical capability within Network strategy and support from Engineering Services.

- The consultancy costs for safety compliance appears high compared with another COMAH site operator and a review of methodologies and further market testing may produce efficiencies.

- Whilst there are increased statutory requirements for environmental monitoring and reporting, as National Grid gain experience and develop a systematic approach to environmental data management and compliance reporting, TPA considers that efficiencies could be made in this area.

- Whilst the size of the asset base will increase due to capital expenditure, efficiencies may be possible through the acquisition of new asset records in electronic format and the proposed IDMS Livelink system.

- The impact of exit reforms, when Distribution Network Operators become responsible for demand forecasting and the level of capex through the period, the profile of proposed capital expenditure in the forward period and potential reductions in the level of capital expenditure present an opportunity to make efficiencies in the planning area.

Engineering Services

Engineering Services costs are forecast to remain relatively flat apart from an increase in opex from £13.7M in 2004/05 to £16.3Mn 2011/12 on Terminals and Compressors. This is a 19% increase represented directly by the increase in FTE, i.e. 22 new FTE compared to the current 143 FTE (94 compressors + 49 terminals) on terminals and compressors.

- We have questioned the compressor manning strategy going forward as it appears from the 2005 plan cycle that 6 compressor stations are forecast to have zero running from 2009 to 2013. We have therefore included an assessment of redundant compressor stations and the implication on staffing. There may therefore be scope for saving 24 FTE (4 staff per station) by decommissioning redundant stations. Potential maximum staff and maintenance costs saving may be in the order of £97k pa per FTE (based on 2004/05

T&C opex of £13.7m and 141 FTE) suggesting a high-end sensitivity of £2.3m pa from 2009/10. Set against this direct saving would however be consequential additional costs of redeployment, retraining or redundancy costs.

- There would also be decommissioning costs which are currently exampled by Bathgate at a one-off £2.0m and issues of how the regulatory regime will treat redundant assets and their value in the RAV. TPA therefore suggest regulatory treatment of redundant assets is considered and developed to incentivise opex savings based on redundant plant

- We have reviewed the philosophy of manning at Compressor Stations and TPA accepts the principle of distinct and discrete skills sets in mechanical, electrical and instrumentation disciplines and the consequent qualifications required. It is unrealistic to combine these skills due to their diverse technical nature and it is an intrinsic consequence of the equipment and plant on site that these skills are required.

- Cost per km of pipeline and AGI maintenance increases from £552 per km in 2004/05 to £830 per km in 2011/12 however this is largely as a consequence of investment in gas quality monitoring and in marker post remediation, the underlying maintenance cost per km remaining level.

- A programme of corrosion control painting and coating has been assessed and recognised for AGI's. No similar programme is evident for compressor stations and in view of experiences during site visits we would expect a similar assessment.

- There is no evidence of alternative business strategies for PMC to manage a risk of loss of DN business, and any potential loss would therefore be managed within current opex constraints. The risk of loss is therefore illustrated as sensitivity, however we would expect NG to have mitigation plans in place to either replace potential loss of contracts with alternative external income or reorganise the PMC capability. Upward Opex pressure of £5.1m may result as a potential loss should DN chargeable business be lost.

- We recognise however the importance of the CEME capability to the security of the network and support its continuation

- Legitimate claims will continue to arise due to sterilisation of land opportunities as a result of pipeline work and each case will depend on its relative merits. Negotiation with claimants and using specialist consultants is carried out and where it is justified alternative pipeline routing may be an option and should be considered.

- We do not see why exhaust stacks is taken as an additional new controllable opex item and what may distinguish this one from other new items in Non Routine Maintenance. Therefore we suggest it is included in National Support and Non Routine Maintenance. However TPA recognise the technical merit of this work

- TPA note that taking the new business plan additions out of the 2011/12 forecast indicates an underlying ongoing opex level some 11% below 2004/05 outturn.

General

- Within the cost figures submitted to Ofgem, National Grid have presented a "UK Transmission Efficiency Challenge" as achieving a £30m saving on the total forecast opex of the business by 2011/12 (para 118 main narrative). These savings do not have a detailed allocation, although National Grid have indicated that they anticipate that £8M of the savings will be delivered in the gas business in three main areas:
  - Transmission Business Process Review,
  - Reduction in real pay growth
  - Improvements in procurement

- The Transmission Efficiency Challenge will influence the above findings particularly with respect to the proposed merger of Network Strategy and Engineering Services (which is the key element of the Business Process Review which has been announced). Our view given the current information is that there may be potential savings in Engineering Services within technical expertise in Non-routine Maintenance (National Support) as a consequence of the Network Strategy /Engineering Services merger. This may amount to 2 FTE with effect from date of implementation of new organisation structures. In addition, by merging Directorates there could be a rationalization in Level 3 Managers and associated support, together giving a saving of around £700k per annum which would be available by the start of the price control period. TPA believes that further savings as a result of the merger may require approval for the HSE Safety Case if it combines the informed buyer capability with the delivery capability, and so has not made any further assumptions about potential savings.

- National Grid has also indicated that the introduction of electrically driven compressors will reduce gas opex by £1.4M per annum at the end of the programme.

- Included in 2011/12 forecasts across the whole gas business is a real pay increase of 2%. Assessment of this is outside the scope of TPA remit but for example, may amount to in the order of £0.3m pa based on October 2005 Engineering Services GTS management accounts salaries costs for Engineering Services. TPA would suggest appropriate consultants review the National Grid performance and reward strategy to confirm its validity and level of appropriateness.

- General Efficiencies amounting to a 1% abatement of costs in Network Strategy and Engineering Services are also included in National Grid's FBPQ submission figures. (Para 113 Main Narrative) Like the Transmission Efficiency Challenge these efficiencies are unspecified and unallocated, and are already included in the cost line submitted to Ofgem for each department. TPA's range analysis therefore builds on top of this saving which National Grid has already built in to its forecast costs.

SECTION 2. INTRODUCTION

This report has been commissioned to provide Technical Consultancy Support to Ofgem for the Transmission Price Control Review. [redacted]. The report is designed to assist Ofgem in assessing the efficiency of opex and capex incurred during the 2002-2007 price control period, and in reviewing the forward plans for opex for the 2007 – 2011 price control period.

The report is intended to inform Ofgem's proposals for revised gas transmission revenue controls to be effective from April 2007.

The contract for this work was won at open tender by TPA Solutions. TPA Solutions ('TPA') has not engaged subcontractors for this work, although it has engaged experts to advise on certain areas (for example Network Planning & Modelling and Compression). We have worked together as one team and each author has read the contributions of the others.

2.1 Scope and Objectives

The scope of our work was set out in the terms of the Invitation to Tender from Ofgem dated 13th October 2005, [redacted]. This was modified to specifically include the direct opex associated with SO covered by the Internal SO Incentive and the External Gas Cost incentive (Shrinkage), agreed in a meeting with Ofgem on 30.11.06 and confirmed by subsequent email correspondence.

Our scope has covered:

- the gas-related operations of the five main departments within National Grid, (Engineering Services, Network Strategy, Operations & Trading, Commercial and Transmission Finance) and
- the capital expenditure associated with the National Transmission System.

TPA Solution's efficiency study has not included any assessment of shared services such as IS, Legal or Insurance. Other consultants are reviewing these elements of costs.

At Ofgem's request we have subsequently extracted our analysis of SO Costs, (Operations & Trading Historic and Future Opex, Shrinkage, and SO Historic Capex) into a separate report.

The objectives of our work on have been as follows (reproduced from the ITT):

Assessment of historical Asset Management Opex and Performance

- To review NGGT's operational efficiency during 2001/02-2004/05;
- To identify any scope for improvement during 2001/02-2004/05 in policy and practice that may lead to lower costs or better performance taking into account international best practice;
- To identify any scope for further efficiency gains by establishing the relative efficiency of NGGT's asset management costs and performance in relation to international comparators; and
- To review the NTS opex plan proposed by NGGT for 2005/06 – 2011/12 and identify scope for efficiency improvement;

Assessment of historical Capex and Performance

- To assess at a high level the policies, procedures approach, systems, assumptions and data used by NGGT to plan and implement network investment;
- To assess, using an objective measure, the efficiency of the planning and execution of the NTS capital programme and associated outputs during the period 2001/0 – 2004/05;
- To identify scope for improvement in capex policy and practice that may lead to lower costs, more timely investment, and/or better system performance; and
- To provide independent view of the level of capex that should have been incurred and the associated outputs.

2.2 Process

National Grid and Ofgem agreed a formal process for request and provision of information and TPA Solutions has taken care to adhere to this process at all times. This is the first time that gas and electricity price control reviews have been undertaken simultaneously. Other consultants have been engaged by Ofgem to review other aspects of National Grid's business, and National Grid and Ofgem co-ordinated all our information requests through one process. We recognise that National Grid have devoted a significant effort to collating data, answering our questions and providing presentations to us. [redacted].

During September/October 2005, National Grid prepared a response to Ofgem's Historic Business Plan questionnaire (HBPQ). At the outset of our study (the end of November 2005) TPA reviewed the HBPQ documents in detail, and submitted an initial list of 40 questions, including requests for more detailed information such as activity-based costings and capex project approval papers.

[redacted]. Much information and clarification was also gained through our meetings with National Grid.

National Grid have stated that the Merger in 2002 has resulted in significant difficulties in providing information such as activity-based costing for the gas business, and that the HBPQ response data 'is based on a re-cut of the years 2002/03 and 2003/04 to better reflect the organisation prevailing in 2004/05 and allow more accurate comparisons to be made over the time series. Original management accounting reports for earlier years where available will not readily compare to this data.' (National Grid's response to question TP1003 and TP1004) National Grid agreed with Ofgem that no information for the years 2001/02 would be provided for the gas business.

National Grid has provided some information in relation to benchmarking of their operations, although only for 2004/5 to date. We have reviewed the benchmarking information, and commented on it as appropriate in our discussion of the activities of each department. Also, TPA has sought external comparator information in certain areas where it is likely to be particularly valuable, for example in relation to the various cost elements of a pipeline project, and this is discussed in the relevant section

We are grateful to Ofgem staff for their support throughout our data gathering, analysis and preparation of this report.

The report is structured as follows:

- Section 1 is the Executive Summary
- Section 2 is this Introduction
- Section 3 sets the context for the historic period which we have reviewed, by describing supply/demand assumptions as set out at the time of last price control, and also actual developments through the period 2001-2005.
- Section 4 describes the National Grid organisation as it relates to Gas Transmission Activities and reviews in detail the historic operating costs of the two main TO departments Engineering Services, Network Strategy.
- Section 5 reviews the business case for capex investment
- Section 6 reviews the efficiency of project delivery for pipelines and compressor capex projects
- Section 7 reviews National Grid's proposals for forecast opex for Network Strategy and Engineering Services.

SECTION 3. SUPPLY - DEMAND DEVELOPMENTS 2002-2005

To put our report in context, this section reviews supply demand developments during this price control period, relative to the assumptions made in the last Price Control Review. Demand-side developments are reviewed first, followed by Supply-side developments. In the 2000 Price Control Review submissions National Grid presented two demand cases which were called Strong Demand and Baseline Demand. These were combined with two supply cases (Interconnector Balance and St. Fergus Expansion) to create three investment scenarios as follows:-

- Strong Demand & Interconnector Balance
- Strong Demand & St. Fergus Expansion
- Baseline Demand & Interconnector Balance

A summary of the assumptions utilised in these scenarios is presented in each relevant section below, followed by a discussion of actual developments.

3.1 Demand-side developments 2002-2005

3.1.1 Assumptions in the 2000 PCR

The description provided by National Grid of the key assumptions for the two different demand scenarios presented as part of the 2000 Price Control Review process was as follows:-

Baseline Case

This case assumed a period of recession will occur which has the net effect of causing a decline in the rate of growth in demand for gas, both in the domestic and non-domestic sectors. The other significant general assumptions that influenced this case were:

- Increased efficiency as various sectors replaced existing equipment/appliances. This was supported by the fact that EU legislation had been put in place requiring new plant to be more efficient, for example the tightening of minimum efficiency standards for domestic central heating boilers. This assumption was further substantiated by the fact that some 80% of all gas central heating installations are system replacements or upgrades. The introduction of the Climate Change Levy, aimed at reducing energy consumption, impacts on demand growth in non-domestic markets.
- Greater sectoral shift from manufacturing to service driving down total consumption in the non-domestic sector
- The other specific assumptions were:
  - Greater penetration of renewables into the CHP market reduces the number of new gas-fired CHP demands
  - Despite the removal of the Stricter Consents Policy there would not be a dash for new gas fired plant.
  - The Corrib field off the west coast of Ireland would be developed and substitute for part of the gas exported from the UK
  - Shearwater Elgin Area Line (SEAL) gas would be exported via the European Interconnector bypassing the Transco network entirely

Strong Demand

This case envisaged strong growth in all sectors with prospects for the British economy remaining favourable over the medium term, based on steady economic growth and low inflation. Gas would remain highly competitive in price terms, with:

- Non-domestic growth continuing, with strong generic growth and CHP growth
- Continued growth in the power generation sector, with gas' share of generation increasing from 40% to 50%
- Exports to Ireland and Europe growing, but with SEAL by-pass to the European Interconnector
- Domestic sector growth coming from new connections, with significant impact of the Affordable Warmth programme. Continuation of the stable level of average domestic consumption and the assumption that insulation/efficiency gains would be offset by an increased "comfort factor".

3.1.2 Actual Demand-side Developments 2002-2005

In this period, based on the 2000 Price Control Review submission, National Grid had expected to see sustained growth in the gas market with a drop in peak demand occurring in 2004/5 (as a result of the forecast commencement of gas flows from the Corrib field into Ireland – reducing exports from the UK) followed by a lower level of annual growth from that year onwards. National Grid has however, experienced much lower levels of peak demand growth in this period with only a small number of new connections being made to the NTS and limited requests for firm capacity (see tables below). Deeside power station also opted for an interruptible gas supply. This period turned out to be a very quiet period for demand-led NTS investment.

3.1.3 Requests for new NTS Capacity 2002-2005

A. New power generation plants

Site Name	Commencement of gas flow	Peak day demand (GWh/d)	Supply Type
Immingham	March 2004	46.9	Firm
Spalding	March 2004	42.0	Firm

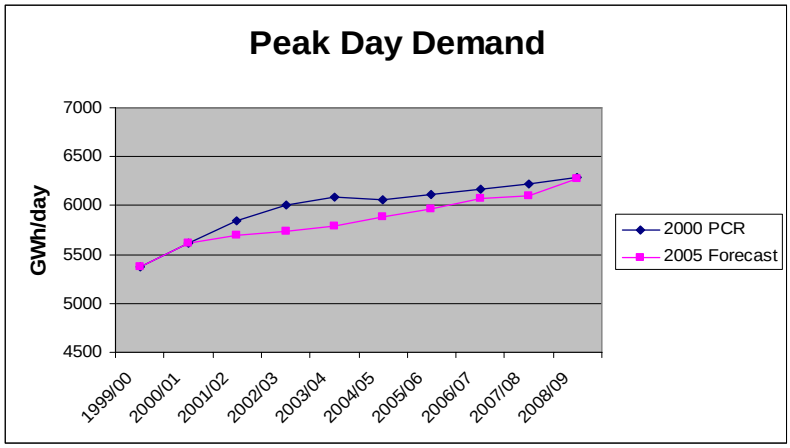
B. Existing loads switching supply types

Site Name	Type of Change	Peak day demand (GWh/d)	Date of Change
Deeside	Firm to Int	28.5	Nov 04
Keadby	Int to firm	36.1	Jun 02
Little Barford	Int to firm	35.2	Aug 03

C New other demands

Site Name	Commencement of gas flow	Peak day demand (GWh/d)	Supply Type
Goole Glass	Nov 03	1.6	Firm

The effect of this downturn is illustrated by the graph below which shows the comparison between total 1 in 20 peak day demand as forecast in the 2000 PCR and the outturn figures.



Source: National Grid

There were a number of factors outlined by National Grid as being the cause of this decline when compared to the original assumptions, but the most significant driver was the dynamics of the gas and electricity markets. Very low electricity prices in 2001-2002 led to abandonment or deferral of CCGT and CHP projects with a CHP level of 4.8GWh of capacity in 2000 remaining unchanged in the period.

3.1.4 1 in 20 Peak Demands

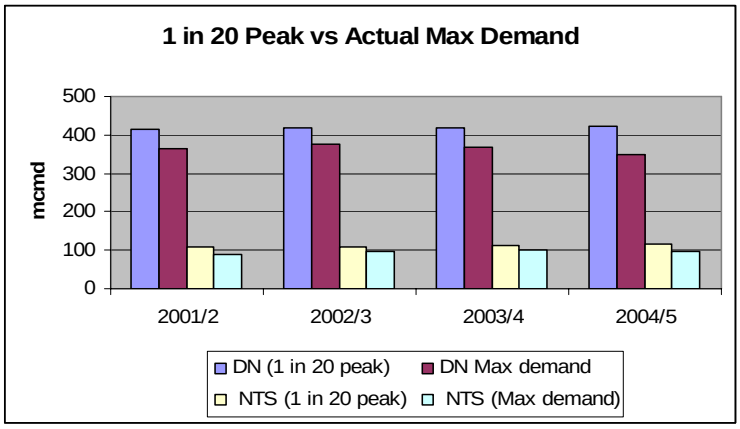
The table and graph below show the 1 in 20 peak day figures for the period 2001/2 to 2004/5, shown against the actual maximum demand that occurred in MCMD.

Peak and Actual Demands

	2001/2	2002/3	2003/4	2004/5
DN (1 in 20 peak)	416	420	420	423
DN Max demand	365	377	368	350
NTS (1 in 20 peak)	110	110	111	117
NTS (Max demand)	91	98	99	98
Total (1 in 20 peak)	526	530	530	540
Total (Max demand)	**456**	**475**	**467**	**449**

Source: National Grid

Peak and Actual Demands



Source: National Grid

This illustrates the fact that recent mild winters have resulted in demand levels being significantly below the design basis for the NTS as required by the 1 in 20 peak day licence requirement.

3.2 Supply-side developments 2002-2005

3.2.1 Assumptions in the 2001 Price Control Review

The description provided by National Grid of the key assumptions for the two different scenarios presented as part of the 2000 PCR process was as follows:-

St. Fergus Expansion

The greatest impact that could reasonably be anticipated was that all future discoveries of new gas supplies would be landed at St. Fergus (West of Shetland and Norwegian gas) with a forecast maximum flow at St. Fergus of 200 mcmd.

Interconnector Balance

This case assumed that the supply deficit would be met by a combination of limited additional supplies at all terminals, with the UK-Continent Interconnector providing a match with a forecast maximum flow at St. Fergus of 155 mcmd.

The initial submission by National Grid (the Base Case) was for investment based on the Baseline Demand/Interconnector Balance scenario, but, following consultation with the industry, this was amended in a revised Strategic Base Plan to reflect a substantial increase in investment with a revised St. Fergus Base Case.

The new level of investment in capacity was split into three categories, additional investment to meet specific statutory obligations, resilience and summer flexibility. National Grid stated at the time that the most efficient means of meeting the summer flexibility requirement was by increasing peak entry capacity.

In the final licence provisions for the 2002-7 period, allowance was made for some of the increase, but the amount for resilience was not included. The specific expansion at St.

Fergus had been developed on the assumption that new Norwegian gas from the Ormen Lange development would come to the UK via the St Fergus terminal.

3.2.2 Actual Supply-side Developments in 2002-2005

This period was, as in the case of the demand side, a quiet period with no new terminals or storage facilities commissioned. However, there have been a number of significant developments that impact the levels of future capex and the utilisation of St Fergus related assets.

3.2.2.1 Ormen Lange – St Fergus impact

The key development that resulted in a change in the supply pattern was the decision by the owners of the Ormen Lange offshore Norway development to land their gas at Easington. In January 2003, the Norwegians informed National Grid that, subject to UK and Norwegian government approval, it was their intention to land Ormen Lange gas through a new pipeline to Easington. The completion date for the pipeline (later known as Langeled) was Oct 2006, with gas from the Ormen Lange field to flow from Oct 2007.

The decision by National Grid to continue with St. Fergus expansion projects after the Ormen Lange decision to land at Easington and the St. Fergus capacity position is discussed in Section 5.

3.2.2.2 Long Term System Entry Capacity Auctions

As part of the 2000 PCR process the concept of specific output measures was introduced. Ofgem introduced the NTS Transmission Operator (TO) price control and the NTS System Operator (SO) price control, which are two different types of incentive mechanism. The combination of these was introduced to provide clearly defined output measures as the basis for the overall price control mechanism. The output measures were defined as TO and SO Baselines. The TO Baseline is the agreed entry capacity set within the price control as part of an overall package of output measures to allow NG to provide that capacity efficiently. It is based on a theoretical maximum physical capacity analysis. The SO Baseline is set at 90% of the TO Baseline. The Baselines are entry point specific. Details of the figures that were incorporated in the National Grid Licence at the time of the PCR are provided in the following table in MCMD (converted from GWh/d using a conversion factor of 1mcmd = 10.833 GWh/d).

Baseline Capacities included in the Licence

MCMD	2002/3	2003/4	2004/5	2005/6	2006/7
Bacton	126.83	136.71	152.77	161.08	161.08
Barrow	67.48	65.63	65.63	65.73	65.73
Easington	91.85	81.88	94.80	98.03	98.03
St. Fergus	140.31	142.99	150.28	152.13	154.80
Teesside	75.60	68.40	69.33	70.25	70.25
Theddlethorpe	62.96	52.16	73.02	78.28	78.28
Glenmavis	9.14	9.14	9.14	9.14	9.14
Partington	19.85	19.85	19.85	19.85	19.85
Avonmouth	13.75	13.75	13.75	13.75	13.75
Isle of Grain	20.12	20.12	20.12	20.12	20.12
Dynevor Arms	4.62	4.62	4.62	4.62	4.62
Hornsea	16.15	16.15	16.15	16.15	16.15
Hatfield Mr Stge	4.98	4.98	4.98	4.98	4.98
Hatfield Mr Onsh	0.09	0.09	0.09	0.09	0.09
Aldborough	0.00	21.51	21.51	21.51	21.51
Cheshire	0.00	0.00	9.88	14.86	19.75
Hole House Farm	2.40	2.40	2.40	2.40	2.40
Wytch Farm	0.30	0.30	0.30	0.30	0.30
Burton Point	5.08	5.08	5.08	5.08	5.08
Total	**661.52**	**665.76**	**733.70**	**758.35**	**765.92**
1 in 20 Peak Day	**529.59**	**530.43**	**540.28**	**546.87**	**557.76**

Source: Ofgem

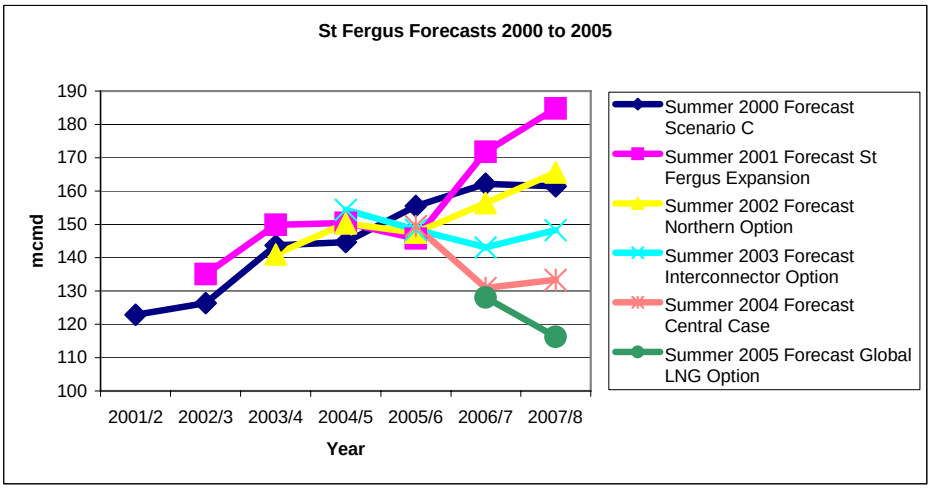
The forecasts for the various entry points for 2005/6 presented by National Grid for the St Fergus Base at the time of the PCR are shown in the table below, compared with the latest forecast produced in 2005. An additional comparison has been included to show the highest delivery levels that were achieved at the supply terminals in the 2005/6 winter. Note these did not occur on the same day. Storage is not included as demand was not sufficiently high to provide a meaningful comparison.

Forecasts for St Fergus Base. All figures in mcmd ***Source: National Grid***

Scenario	2000 Forecast St Fergus Base	2005 Forecast All 2005 scenarios	Difference	2005/6 Actuals	Difference
Bacton	100	132	+32	78 + 47(I/C)	+25
Barrow	44	29	-15	30	-14
Easington	32	17	-15	20	-12
St Fergus	155	146	-9	131	-24
Teesside	38	30	-8	34	-4
Theddlethorpe	28	23	-5	30	+2
Point Of Ayr	5	2	-3	5	0
Grain	(storage)	13	+13	17	+17
Storage	231	120	-111		
Total	**633**	**512**	**-121**		
1 in 20 Demand	565	550	-15		

A selection of the forecast scenarios prepared by National Grid for St. Fergus entry is shown in the graph below.

Forecast Scenarios



Source: National Grid

3.2.2.3 Capacity Auctions and Expansion Projects

Long term entry capacity (LTSEC) auctions were first held in January 2003. These were designed to allow shippers to indicate their requirements for entry capacity. There were a number of important developments in the period 2002-2005:

i) Summer capacity

The January 2003 auctions indicated that there was no shipper requirement to provide high levels of capacity to input gas at St Fergus during summer months. In1998-99 there had been constraints in summer at St Fergus due to the seasonal reduction in demand from the Glasgow –Edinburgh belt which, in effect, reduced the capacity to take gas from St Fergus. Whilst this had always existed, the requirement for high summer flows from St Fergus was new.

As a result of these auctions, National Grid abandoned any further projects (after Aberdeen to Lochside pipeline) to provide higher levels of summer capacity.

ii) Ormen Lange – Easington impact

Whilst Easington has not received long term capacity bids above Baseline, as a result of auction bids by shippers who are bringing gas down the Langeled pipeline, National Grid is making significant investment in the Easington area in order to bring physical capacity up to baseline. This will be discussed in the future capex report as there was minimal capex prior to 1 April 2005

iii) New Supplies at Bacton

National Grid has also carried out projects to increase physical entry capacity at Bacton as a result of new gas importation developments, the BBL pipeline and the expansion of the importation capability of the UK-Continent Interconnector

iv) New System Entry Points

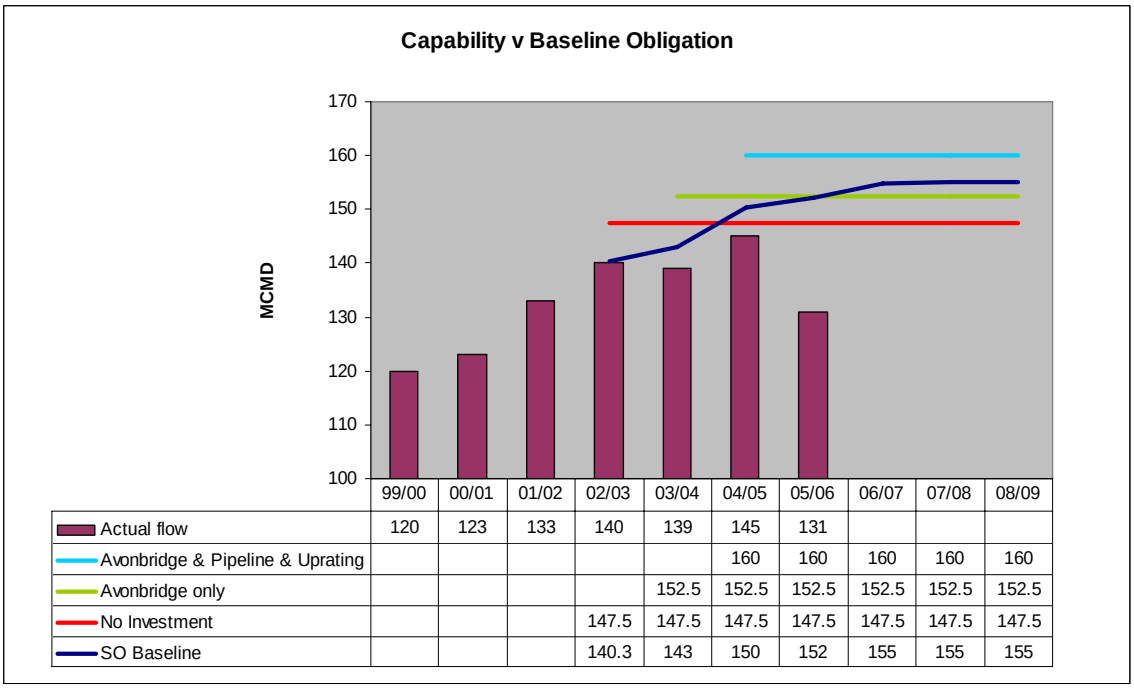
The LTSEC auctions in September and November 2004 triggered investment in a New System Entry Point at Milford Haven, with 2 LNG projects by ExxonMobil/Qatar Petroleum (South Hook) and BG/Petroplus (Dragon)

The 2004 auctions also created a new System Entry Point at Barton Stacey but this does not require any investment. In addition, auctions in 2005 have indicated the need for additional capacity at the Isle of Grain. The capex associated with Milford Haven and Isle of Grain is discussed in the future capex report as, prior to 1 April 2005 there was limited capex as a result of these auctions.

v) St Fergus

The graph below shows the rising Baseline capacity at St Fergus together with the actual peak flows to date. The capacity expansion projects carried out to increase the baseline are also shown. These are discussed in Section 5.

St Fergus Basline Capacity and Actual Peak Flows



	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09
Actual flow	120	123	133	140	139	145	131			
Avonbridge & Pipeline & Uprating						160	160	160	160	160
Avonbridge only					152.5	152.5	152.5	152.5	152.5	152.5
No Investment				147.5	147.5	147.5	147.5	147.5	147.5	147.5
SO Baseline				140.3	143	150	152	155	155	155

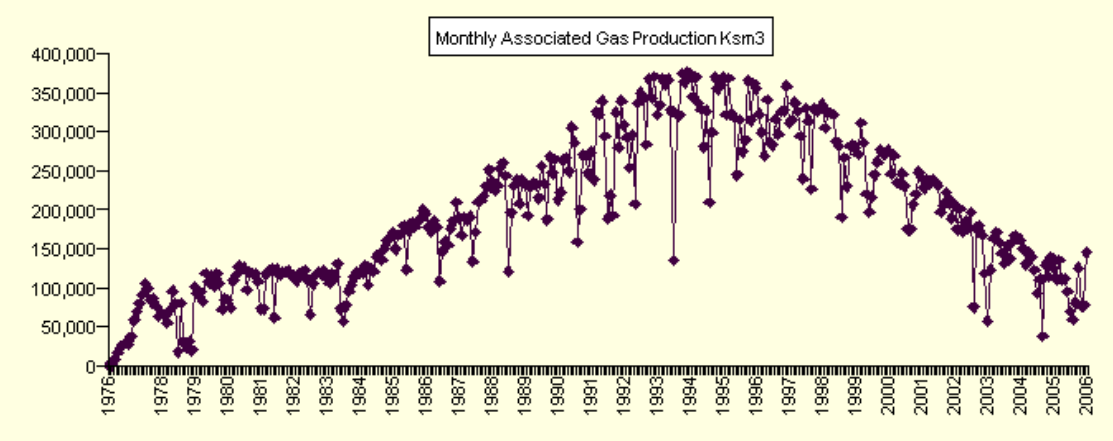
Source: National Grid

3.3 St. Fergus - Major Field Decline Analysis

In the absence of a response from National Grid to our latest questions on the future for new supplies at St. Fergus, TPA have been investigating the public domain data that is available from the DTI on the decline in gas supplies from the major UKCS fields that are delivered to this terminal.

The following graphs taken from the latest data on the DTI website show that substantial decline has occurred in the production from these major fields.

Beryl

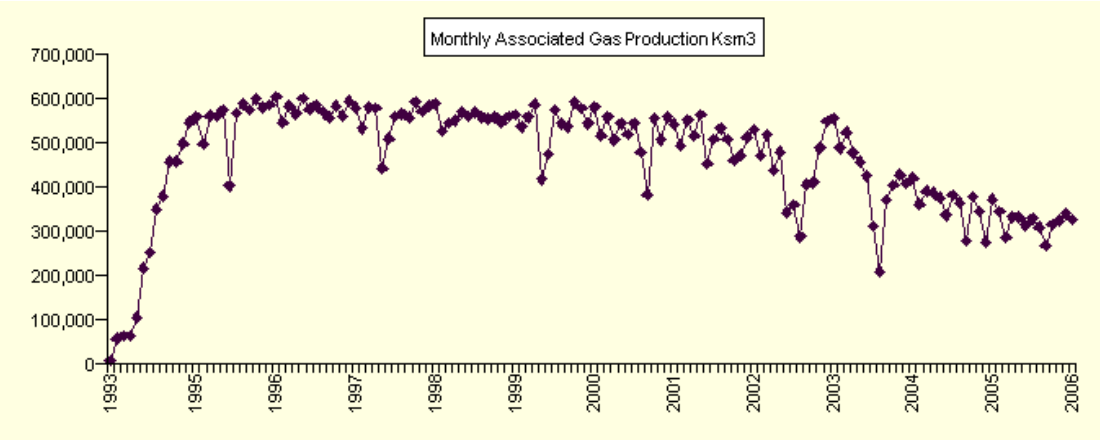


Source: DTI Website

Beryl - Reserves 43 bcm – Gross production to date 69.4 bcm - Peak Production 4 bcm (1994) - Production now 1.2 bcm

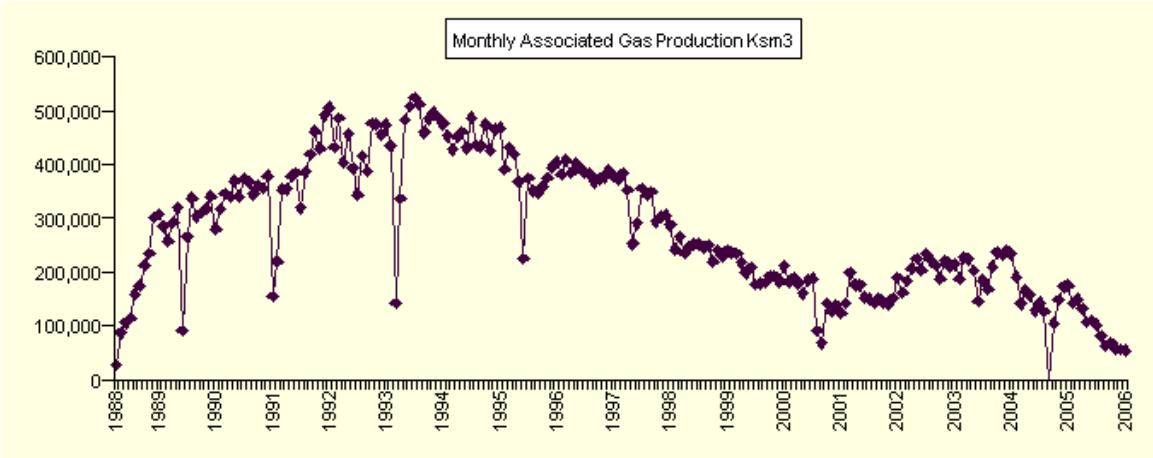
Brae

East



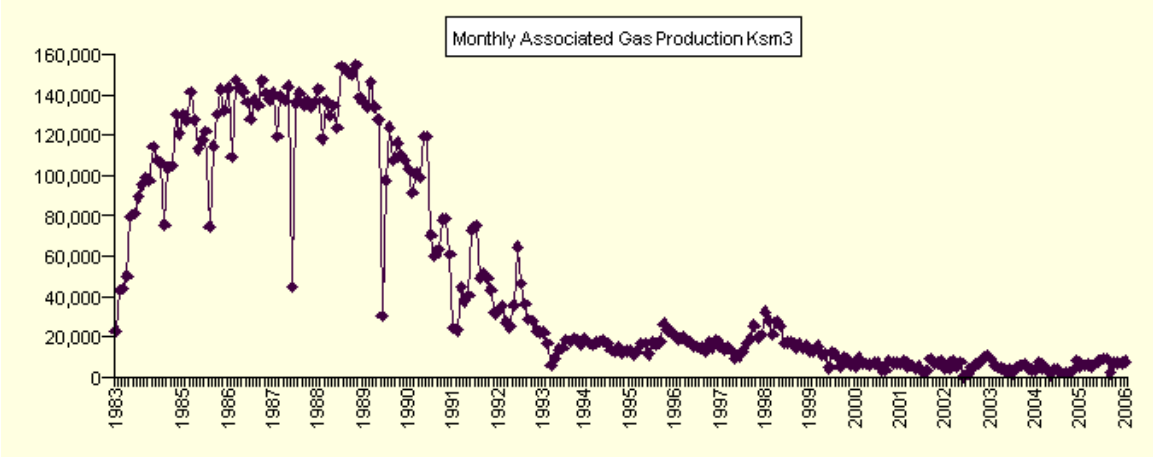
Source: DTI Website

Central



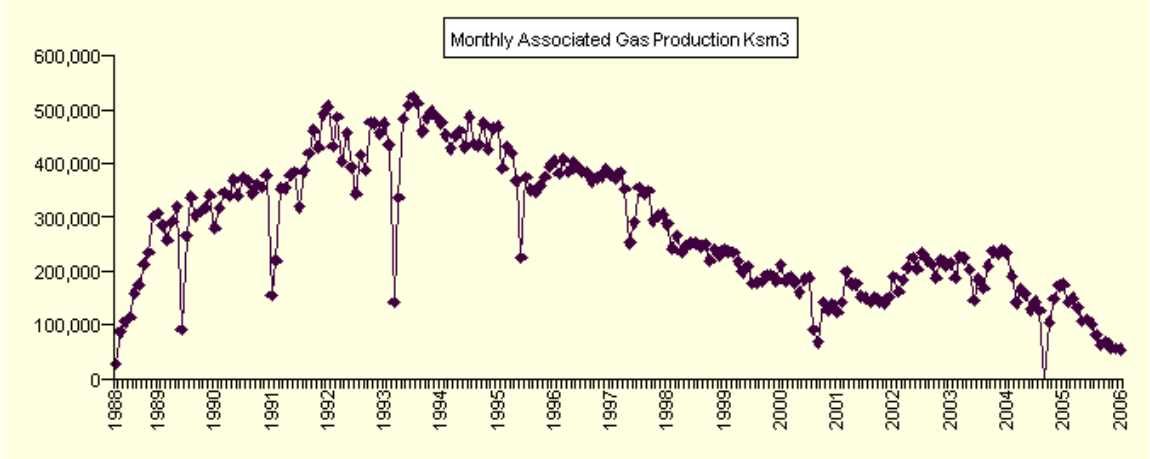
Source: DTI Website

South



Source: DTI Website

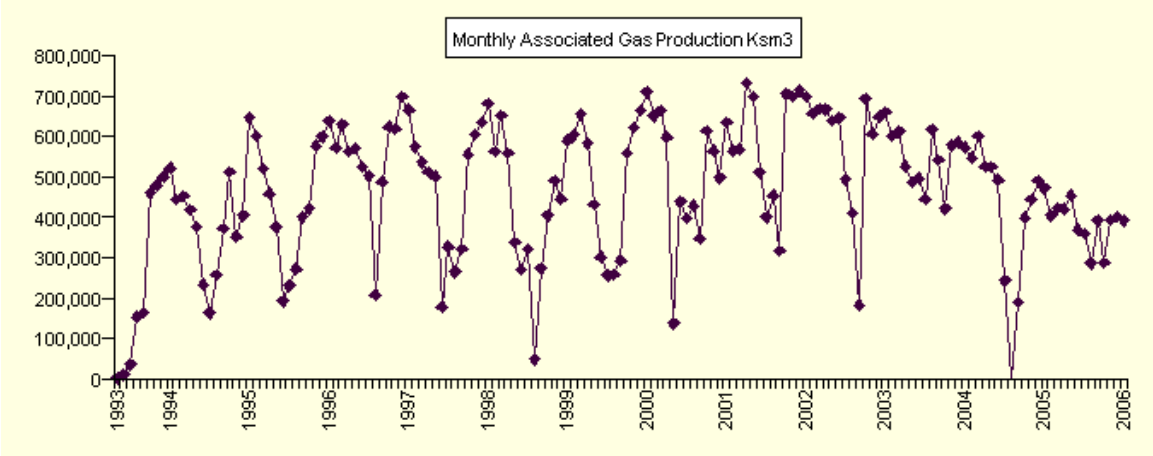
North



Source: DTI Website

Brae Area - Reserves 54.5 bcm – Gross production to date 142 bcm - Peak Production 11.8 bcm (1996) - Production now 5.6 bcm

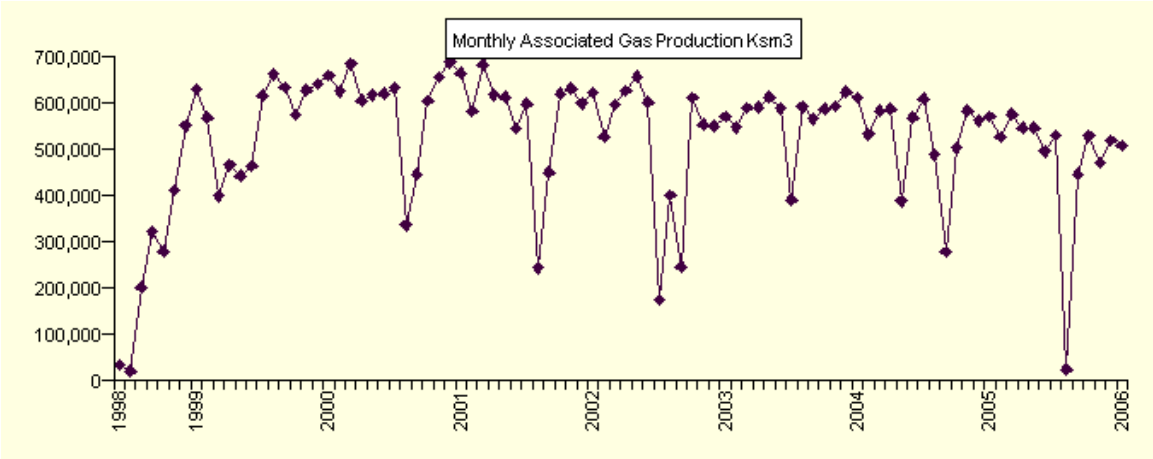
Bruce



Source: DTI Website

Bruce - Reserves 80.8 bcm - Production to date 71.6 bcm - Peak Production 7 bcm (2002) - Production now 4.7 bcm

Britannia



Source: DTI Website

Britannia - Reserves 71 bcm - Production to date 48.2 bcm - Peak Production 7.2 bcm (2000) - Production now 5.8 bcm

SAGE Offshore Pipeline System

Reserves 239.7 bcm - Production to date 148.4 bcm

FLAGS & Fulmar Offshore Pipeline System

Reserves 192.5 bcm - Production to date 174.7 bcm

3.3.1 Future for St. Fergus

All the above indicates is that all the major gas fields that are delivering gas into St. Fergus are in a state of substantial decline. Some have been for many years and only very small developments (other than Norwegian imports) have been replacing these large fields.

It would take a massive leap of faith to envisage a significant new development or large import quantities that could replace these declining reserves and to bring the level of supplies at St. Fergus to the level of the current Baseline.

SECTION 4. OPEX

4.1 INTRODUCTION

The main operational departments of National Grid are Network Strategy, which has overall asset management responsibility, Engineering Services, which is responsible for maintenance of the gas transmission system and Operations and Trading, responsible for physical and commercial operations. The costs of these departments, and the Commercial and Transmission Finance support sections, are allocated between Transmission Operator (TO) and System Operator (SO) forms of control as follows:

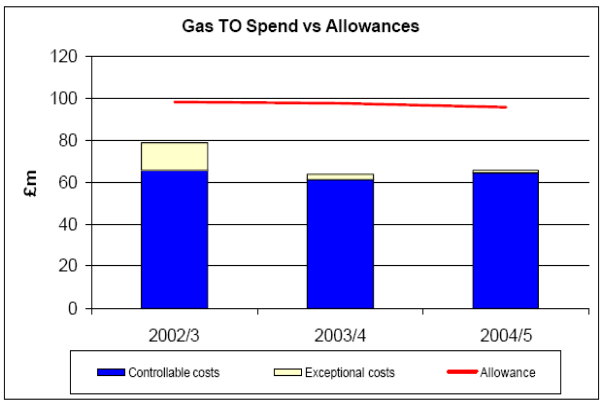
Allocation of Costs to TO and SO as shown in National Grid's HBPQ submission

	TO costs (£m)			SO costs (£m)		
	02/03	**03/04**	**04/05**	**02/03**	**03/04**	**04/05**
Network Strategy	10.2	8.5	7.5	0.0	0.1	0.1
Engineering Services	26.5	29.9	29.4	0.0	0.0	0.0
Operations &Trading	0.0	0.0	0.0	10.0	9.3	10.0
Commercial	1.4	1.4	1.7	1.8	1.5	1.2
Transmission Finance	0.2	0.4	0.4	0.4	0.3	0.5
Total	**38.3**	**40.2**	**39**	**12.2**	**11.2**	**11.8**

NB O&T and Network Strategy figure contain small differences (or the order of 0.5m) to National Grid's presentation figures. National Grid has been asked to reconcile these differences and have not provided further information, but have stated that the figures from their presentation material represent their baseline position. Costs at 04/05 prices

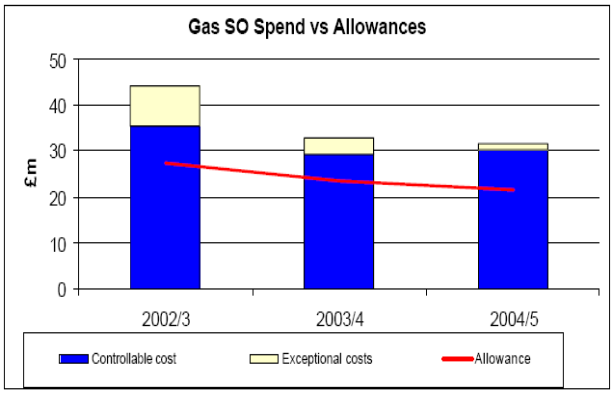
National Grid has submitted in its HBPQ that it has underspent the TO allowances and overspent the SO Allowances during the period of the current price review, with the variances largely as a result of the manner in which the costs were split between transmission and distribution at the time the allowances were set. The variances are shown in the following charts.

National Grid presentation of TO Underspend against Allowances

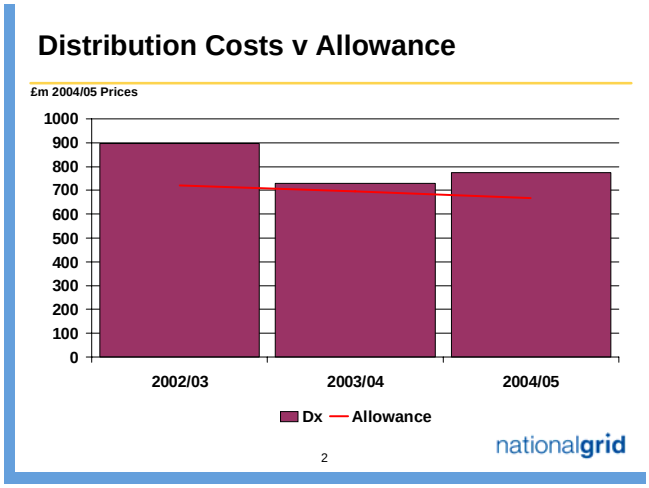


Source: National Grid HBPQ Submission, Executive Summary, Fig 21

National Grids Presentation of SO Overspend against allowances



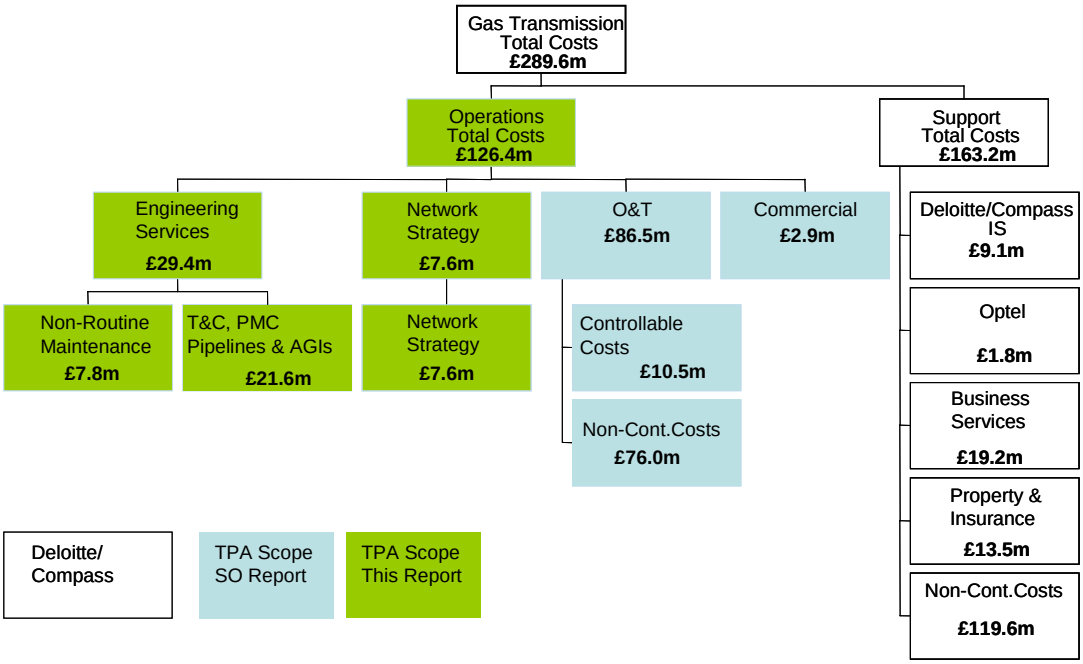
Source: National Grid HBPQ Submission, Executive Summary, Fig 23



Source: National Grid response to Question TP4108

Whether there was an original misallocation of costs is outside the scope of TPA's review. Ofgem has not asked TPA Solutions to reconcile the opex performance of the main operational departments to their performance under regulatory forms of control for the Gas TO and Gas SO. Total costs under the TO and SO form of control contain allocations from other parts of the business such as IS and HR, and other consultants are reviewing those costs. TPA has focused on assessing the controllable costs of the three main departments, and the non-controllable costs associated with Shrinkage.

National Grid's Gas Transmission Organisation



Source: National Grid Presentation 20.12.05

The costs shown are actual opex figures for the year 04/05. The diagram shows the elements of the National Grid Transmission Organisation as they relate to gas transmission. It should be noted that, with the exception of the gas-only Engineering Services, these departments are also undertaking activities in relation to electricity transmission. The costs shown here are for gas activity only.

The scope of TPA Solutions' study is illustrated above by the boxes shaded green and blue, and the scope of other consultants' work, as we understand it, is shown unshaded.

TPA Solutions study has focused on the material costs associated with the three main departments, Engineering Services (£29.4m), Network Strategy (£7.6m) and Operations & Trading (£10.5m controllable and £76m non-controllable (mostly shrinkage) costs). We have not examined allocations to or from other parts of the business. Our analysis of SO Costs (i.e. boxes shaded in blue) will be provided in a separate report.

TPA Solutions has approached the review of opex with the overall aim of establishing that the operating activities within the scope of our study being undertaken by National Grid are:

- appropriate,
- effective, and
- that costs are economically incurred

Network Strategy has a key role in the organisation, as it sets the strategy and hence the level of activity required to be delivered by the other parts of the business, particularly Engineering Services. Network Strategy is therefore reviewed first, in section 4.2, and the policies and procedures which govern the levels of activity of the other parts of the business have been comprehensively reviewed. This is central to determining whether or not the

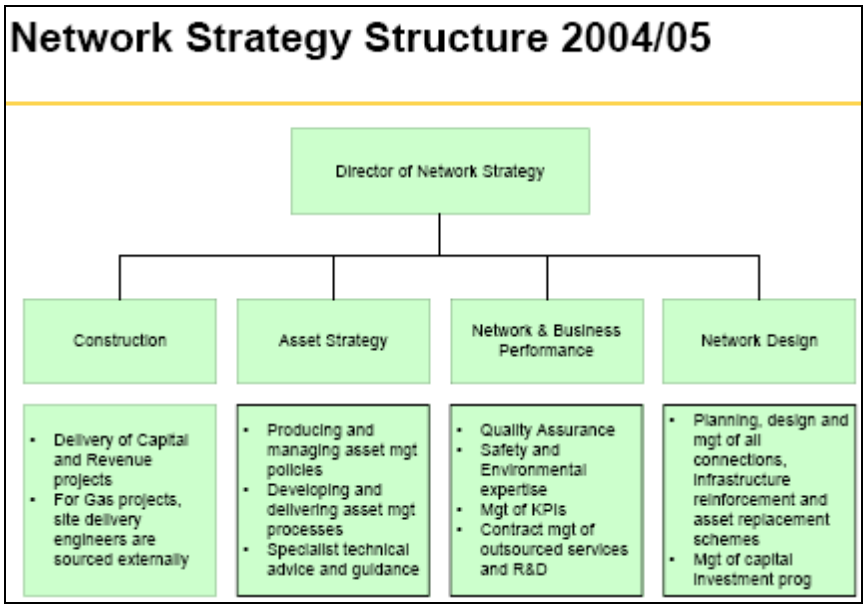
activities undertaken by the whole business are appropriate. Whether Network Strategy has incurred costs efficiently and economically within the boundaries of its own department is also included in this part of our review.

Our review of Engineering Services follows, in section 4.3 and within this section there is a corresponding emphasis as to whether costs have been efficiently and economically incurred, and whether or not there is further scope for efficiency.

4.2 NETWORK STRATEGY

Introduction

National Grid is responsible for the complete range of asset management functions for the England and Wales electricity transmission system and the UK high-pressure gas pipeline system. These activities are carried on pursuant to the electricity transmission licence of National Grid Company plc and the Gas Transporter licence of Transco. The HBPQ identifies that during 2004/05 Network Strategy was structured into 4 sections (Asset Strategy, Construction, Network and Business Performance and Network Design) and employs 359 permanent and 18 agency staff who undertake roles in the management of the electricity and gas transmission assets. The current structure is illustrated below.



Source: National Grid Presentation

Network Strategy is a key department who determine:-

- what assets are required to support the license obligation, including the 1 in 20 year peak requirement,
- when assets are required to be available for use,
- how the assets should be inspected, maintained and repaired and
- when an asset should be replaced.

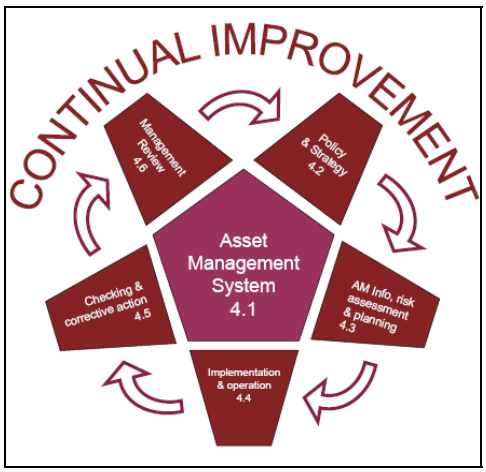
Recommendations made by Network Strategy therefore have a high impact on the gas asset regulatory value, Capex and Opex.

In order to form a view of the relevance of the outputs from the asset management process TPA have looked at the environment in which National Grid operates and considered whether the technical policies, procedures and standards that National Grid have developed

and used are appropriate and reflective of good practice and whether the work generated by these plans is appropriate and relevant to meet licence, statutory and commercial requirements.

Finally TPA have reviewed the organisational structure and the costs incurred (within both Network Strategy and by service providers such as Engineering Services and Shared Services) to form a view as to whether Network Strategy has conducted its asset management role in a way that is economic and efficient. TPA commentary on specific aspects of the asset management process and areas where efficiencies might have been made concludes this section.

4.2.1 Asset Management Processes



The processes adopted by Network Strategy are one of the indicators of the effectiveness of the organisation in delivering its responsibilities as comparisons can be made against the process used by other asset management organisations. National Grid has adopted PASS 55: 'Specification for optimized management of physical infrastructure assets' as a model for their asset management process.

PASS 55 is recommended by the Institute of Asset Management for assisting in structured and objective reviews of corporate governance, investment strategy and critical infrastructure management and is being increasingly adopted by organisations as a benchmark for best practice holistic asset management. Ofgem has welcomed the introduction of PASS 55 and the potential it offers for demonstrating effective asset management to the Regulator2.

It is not the intention of this report to fully examine National Grid compliance with PASS 55 however within each of the 6 elements of PASS 55 there are requirements with a significant technical content. TPA has reviewed key technical areas to determine the quality of decision making that generates opex and capex plans. The areas that have been reviewed are shown in the table below in relation to their requirements under the PASS 55 scheme. TPA summary of this review is contained in the main narrative [redacted]. Key findings are described and discussed in the main narrative of this report.

[2] John Scott Technical Director Ofgem, PAS 55 Launch 11 May 2004.

Specific Requirements of PASS 55

PASS 55 Requirements		Efficiency Study Reference and Heading	
Management system	• The organisation shall establish, document, implement and maintain an asset management system and shall continually improve its effectiveness. • Control of outsourced processes.	Main narrative Section 4.2.10	Introduction Outsourced Activities
Policy and strategy	• Framework for developing strategy, objectives, targets & plans. • Optimized for asset life cycles.	Section 4.2.2 [redacted] Section 4.2.12 [redacted] [redacted]	Asset Management Policy Developing the Capital plan Technical Asset Lives
Information, risk assessment and planning	• Legal, regulatory & statutory requirement monitoring • Information systems for; adequacy, accessibility and consistency. • Risk management; identification, assessment & control.	[redacted] Section 4.2.3 [redacted] Section 4.2.4 [redacted] Section 4.2.3 [redacted]	Gas Technical Policy, Safety and Compliance Information Tools Asset Health Reviews
Implementation and operation	• Structure, authority & responsibilities. • Training, awareness of & competent and qualified staff. • Emergency preparedness & response.	Section 4.2.7	Asset Management Capability
Checking and corrective action	• Recording & analysis • Calibration & compliance • Failures & non-conformance investigation • Risk-based strategies • Record-keeping; compliance, retention, auditing.	Section 4.2.6 [redacted]	Performance Management
Management review	• Monitoring opportunities new technology, tools and practices, • Evaluation of potential cost/benefits.	Section 4.2.11	R&D

Source: PASS 55 Documentation

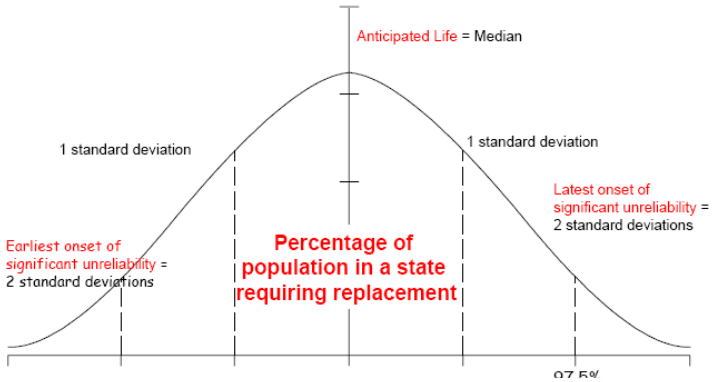
Commentary

The processes used by Network Strategy show strong alignment to PASS 55 and there is evidence that there is appropriate support for the processes from with the Network Strategy organisational structure of Asset Strategy, Network Design, Construction and Network & Business Performance, from internal service providers such as Engineering Services and Advantica and from external (outsourced) companies with specialist capabilities.

4.2.2 Asset Management Policy

National Grid has frameworks for developing strategy, objectives, targets and plans as required by PASS 55. The framework for developing load related strategies and plans, which are largely driven by existing and forward gas supply scenarios and license conditions for peak day demand are discussed in the sections on Capex.

For existing assets National Grid has a strategy which they have defined as being the use of condition assessment and diagnostic techniques, to identify and replace assets in a timely manner, before in service failure occurs. The strategy has a number of elements, which applied in part or in total according to the asset type:-



- reactive based actions, typically to repair or replace assets on failure,
- interval based maintenance and interval based replacement typically planned preventative maintenance driven by statutory requirement, original equipment manufacturers recommendations and industry best practice,
- condition based repair or replacement, and
- risk and critically based maintenance or replacement
- the determination of technical asset life

Commentary

Underpinning the asset policy are 4 strategies which are typical of similar asset based industries.

The predominant strategy is the application of interval based inspection and maintenance ‘planned preventative maintenance‘, to maintain and assess the reliability and condition of the asset. Inspection and maintenance intervals are largely driven and constrained by statutory requirement, original equipment manufacturers recommendations and industry best practice and TPA observation is that there is little scope for Network Strategy to extend intervals and remain within the constraints.

Some assets, notably components of gas generators, are replaced at intervals specified by the OEM, when major overhauls typically at 25,000 hours can return the unit to ‘zero rating’.

Reactive based repair or replacement actions may also be taken based on condition.

Increasingly Network Strategy is taking a proactive approach to the repair or replacement of assets as the assets approach the end of their original design life.

Examples of proactive repair or replacement in the period 2002/03 to 20054/05 have been reviewed and the processes and outcomes are substantially robust.

The proactive approach to asset repair or replacement rests heavily of the view taken of the technical (rather than design or commercial) asset life, safety considerations, the expected utilisation and the criticality of the asset.

The concept of the technical asset life is based on the expected wear out rate of the asset which can itself be mitigated or extended by appropriate maintenance and minor repairs. On some asset groups the previous maintenance practices have been ineffective with the result that the condition of the asset to deteriorate to the point where replacement is required. An example of this historical legacy is the condition of line valve body and vent lines and actuators/controls.

There is a risk that the determination of a technical asset life is arbitrary and subjective and Network Strategy have sought to mitigate this risk by apply a consistent definition of technical life and a structured and consistent approach to collecting, collating and assessing condition data. Where consistent data has not been available then condition assessment surveys have been initiated.

Technical asset lives are subject to ongoing review and challenge.

The determination of technical asset life is not an exact science and TPA accept Network Strategy's view that the determination of the technical asset live is only one facet of a repair or replacement programme which must take into account other risks and issues.

4.2.3 Information

Inherent in the development and refinement of maintenance and replacement strategies is availability of relevant information. It is evident that a number of information sources are available to Network Strategy to assist in the assessment of the condition of the asset base and a number of these information sources are described and discussed [redacted]

Commentary

TPA has reviewed a number of the sources of technical, performance and financial information available in Network Strategy. Information, for example on compressor reliability and key performance indicators is comprehensive and regular and provides a fair basis for the review and development of asset performance and strategies.

There is no integrated work and asset management system and in place of this information is drawn from a number of databases and spreadsheets. TPA accept that Network Strategy have investigated this area but are unable to develop a clear business case to justify an integrated system

4.2.4 Tools

For large asset groups having significant national importance risk, management & control is a complex process and requires a balance to be made of a number of complex variables when developing load related and non load related capital projects. Significant tools used in the development of capital projects are Graphical Falcon, the Capacity Risk Model (CapRi) and the Gas Asset Decision Support Tool.

[redacted].

Commentary

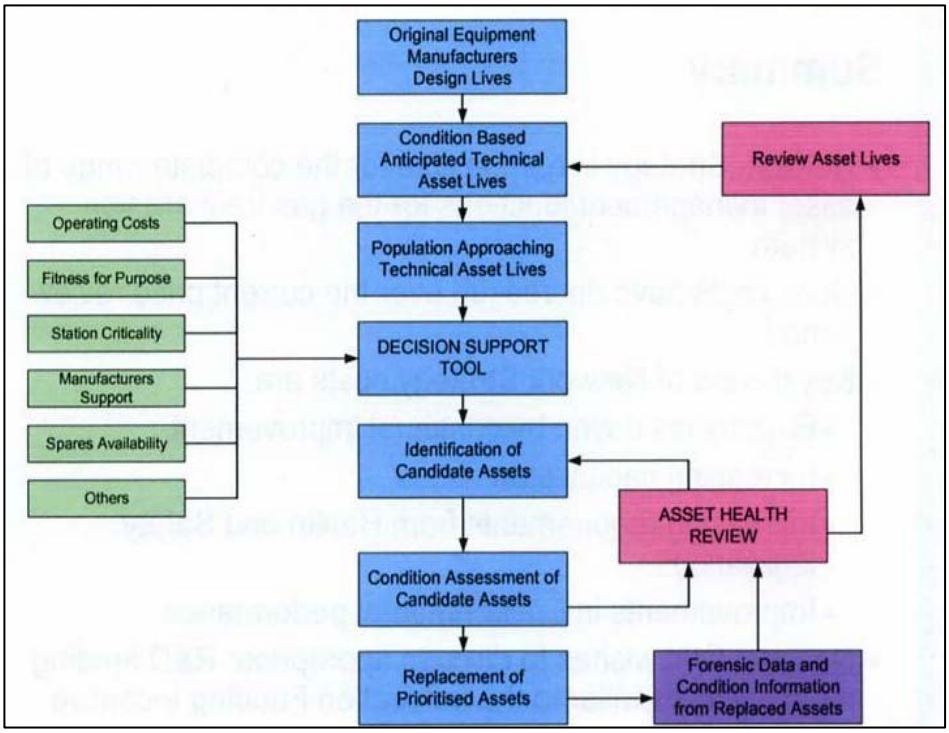
Risk management & control is a complex process and requires a balance to be made of a number of complex variables when assessing safety or when developing load related and non load related capital projects. Network Strategy has access to a range of well developed tools which are available 'in house' or from Advantica. Examples being pipeline risk assessment models, HAZOP / HAZID assessment techniques, the Gas Asset Decision Support Tool and the network planning and capacity risk assessment tools Graphical Falcon and Capri.

Network planning tools are routinely validated against actual supply, demand days to determine the levels of uncertainty on the models.

4.2.5 Asset Health Reviews

The Asset Health Review is undertaken by specialists drawn from Network Strategy, Engineering Services and Finance who draw together all the supporting information and analyses to form a collective view as to what corrective actions are necessary on the asset(s) under consideration. During the asset health review, recommendations are made to undertake programs of work, deferred work or to mitigate risk by taking alternative actions.

Diagram: The role of the Asset Health Review Process within the Asset Replacement Process



Source: National Grid

Recent examples of the Asset Heath Review process have been recommendations on:-

- Compressor unit air intake and exhaust stack replacement
- Valve / actuator replacement
- Gas generator overhauls
- Compressor station Protection & control system replacement pilot s
- Emissions reduction
- Security enhancements
- Entry point gas/liquid quality monitoring systems

Recommendations from the Asset Heath Review are then developed into expenditure proposals, supported by financial analysis, outage plans and an assessment of market capability, for consideration by the Transmission Project Sanctioning Committee.

Note. [redacted].

Commentary

The Asset Health Review seeks to determine a balanced view on the actions/investment needed to repair or replace assets. The review fits within a logical process and is heavily dependant on the quality of condition data provided by internal service providers, OEM or other potential vendor condition assessments and on supply and demand forecasts, which will determine the forward utilisation of the asset.

TPA has reviewed the asset review processes for compressor unit air intake and exhaust stacks and the Network Review which has determined the investments required to improve for compressor environmental performance. TPA has considered the use and quality of information, the assessment process to determine priorities (ranking), risks evaluations, review and challenge and programme adjustments to fit with other work programmes. TPA considers the processes to be logical and largely effective and there is evidence of efficiency in that initial proposals are deferred for further evaluation where uncertainty exists.

4.2.6 Performance Management

Within Network Strategy performance management activities are provided by Asset Strategy, Network and Business Development and Transmission Finance.

Note. [redacted]

Commentary

TPA has reviewed some of the key performance indicators and considers them to be comprehensive and subject to periodic review/amendment/change.

There is evidence that Network Strategy have sought to compare their relative (and strong) performance, with other European gas transmission operators.

The specific performance of some assets for example compressor units have also been compared with that of the Reliability Information Exchange (Reinex) member companies. With respect to 'start probability' The National Grid fleet compares well (above) with the Reinex mean.

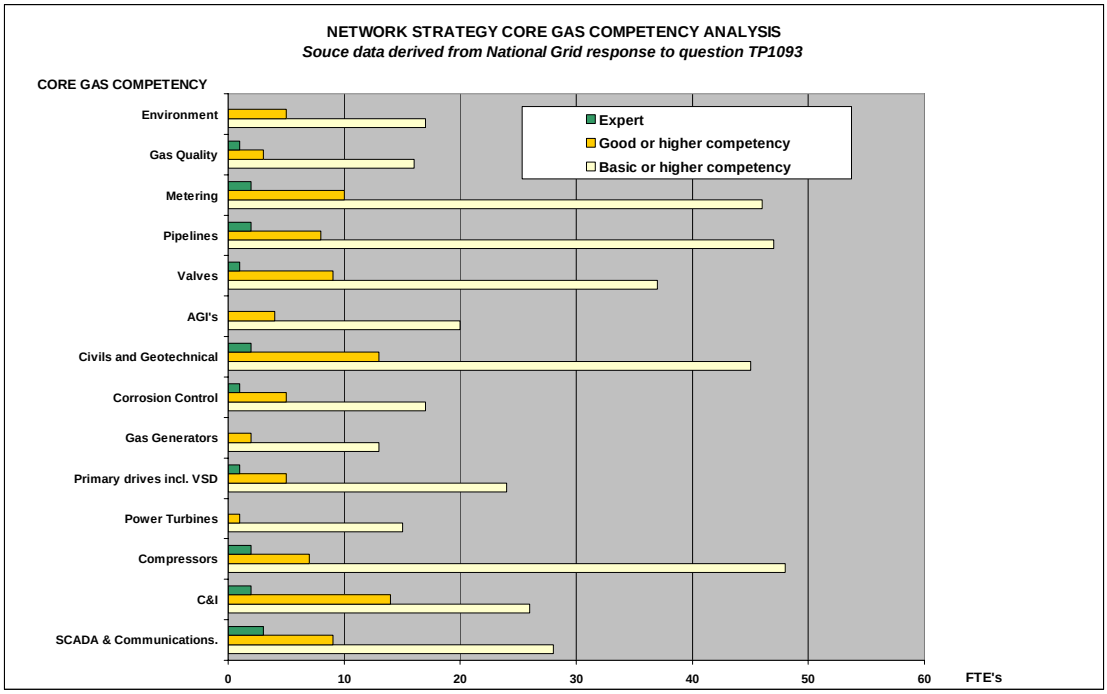
Against the metric 'mean time between failures' (MTBF) the fleet is improving and since 2004 is at the Reinex mean. However MTBF across the National Grid fleet show marked contrast between Kirriemuir and other gas generator and electric drive stations. Whilst the running regime is more constant at Kirriemuir and this will help to achieve a good MTBF performance, TPA observes that the disparity across the fleet in MTBF performance raises the question as to whether best practice has been applied consistently across compressor stations. It is not possible to evaluate this further without a more detailed study.

4.2.7 Asset Management Capability

Asset Strategy provides the principal informed buyer/expert user role within Network Strategy. The competence of persons staff employed to undertake asset management activities and the availability/capability of competent staff either from within Network Strategy, National Grid SHE or through outsourced arrangements is a prerequisite to achieving quality and informed decisions, actions and work programs.

Network Strategy has in place processes for assessing the competence and capability of staff employed on gas activities. The criteria that Network strategy apply to the level of capability is a minimum of 1 individual assessed as competent or expert and, to ensure succession planning, at least a total of 4 individuals assessed as either good, competent or expert. An analysis of the core gas competent and capability, based on information provided by National Grid, is shown in the table below.

Competency Analysis



Source: National Grid

Commentary

Network Strategy, using their own criteria, has 'expert' staff directly available to support most of the key asset types and functions. Where there are exceptions then alternative support is available for example; environmental activities are supported by National Grid SHE, gas generator asset management is supported by outsourced arrangements with Rolls Wood and other rotating equipment experts.

The capability/succession criteria appear to be satisfied for most asset types and functions or otherwise supported by outsourced arrangements.

There is evidence that Network Strategy are proactive in managing the competence capability in their recruitment of staff with competence in SCADA/telemetry, compression, power turbines and pipeline integrity and the intended external recruitment of a person with competence in process engineering and internal recruitment of addition skills in gas quality and metering.

There is also evidence of planning to enhance the boarder base of basic skills for example the training of staff on gas quality measurement devices using external courses provided by OEM's and suppliers and to provided internal training on GS(M)R requirements to staff with an electrical background.

For the major pipelines and compressor assets the team leader has 'expert' skills, which should ensure that the team is appropriately directed.

There is a 3 strong team of 'experts' for control and SCADA activities and given the intended expenditure in the next price control period for the replacement of protection and control systems on compressor stations this seems appropriate.

On balance TPA view is that the competency capability within Asset Strategy is appropriate for the size, complexity and significance of the gas transmission assets.

4.2.8 Asset Management Activities

The high level asset management activities undertaken by Network Strategy and the corresponding resources deployed (FTE'S) and the costs of the activities in 2004/05 are shown in the table below. The table also provides an indication of the scale and value of the gas asset base that Network Strategy is responsible for managing.

The decisions and work programmes (outputs) that are initiated by Network Strategy are highly significant in terms of both opex and capex expenditure, effecting not only Network Strategy itself but also those departments that provide services to the asset manager. Such services will include but not be limited to those provided by Engineering Services (£29.4m in 2004/05) and UK Business Services - IS (part of £103.5m in 2004/05). The table therefore includes summary information on the opex incurred by Engineering Services and the value of the capital plan for 2002/03 to 2006.

Summary of Network Strategy Activities, Asset base and associated Engineering Services Costs.

Network Strategy Opex Activities Functions				Asset Summary		Engineering Services Opex Activities		
	FTEs	£m					FTEs	£m
Asset Strategy	*20*	£1.1		Terminals 7 Terminals		Terminal site staff operations and maintenance	49	£13.7
Safety and Compliance	*6.3*	£0.8		Compressors 25 compressor stations		Compressor site staff operations and maintenance Note.8 FTEs support pipeline activities	(94-8) = 86	
Environmental Issues	*6.8*	£1.2				National Support Team – Terminals and compressors (estimated) Breakdowns Exhausts/air intakes Power turbines Civils and cabs Electrical and I&C inspections Valve and actuator refurbishment Stock provision	8 .	£0.64 £4.5 £0.3 £0.4 £0.1 £0.05 £0.05 £0.6
Technical Drawings, Data and Systems	*2.4*	£0.5				Terminal and compressor total	143	£20.1
Outsourced Engineering	*1.4*	£1.5		Pipelines		Pipeline field staff operations and	31+8 = 39	£3.8

Network Strategy Opex Activities Functions			Asset Summary	Engineering Services Opex Activities		
			6877 km of pipeline	maintenance		
Asset Management Review	*5.2*	£0.4		National Support Team – Pipelines (estimated)	2	
			112 Distribution off takes			
			30 off takes with preheating and metering	Civils and cabs		£0.16
				Electrical and I&C inspection		£0.10
			20 minimum connection off takes	Valve and actuator refurbishment.		£0.05
				Stock provision		£0.05
				Other		£0.2
						£0.4
R&D	*1.3*	£0.8	72 multi-junctions	Planning	4 (est)	£2.4 claims £0.3 staff
			251 block valve sites	Pipeline Maintenance Centre	88	£1.8
				Pipelines total	45/133	£9.26m
Total for management of existing asset	*43*	£6.3	Regulatory Asset Value (RAV) for Terminals, Compressors and Pipelines £2,361.7m	Total for Engineering Services Activities	274	£29.4m
Network Strategy Capex Activities			New and Replacement Assets			
Cost of developing Capital Plan	*24*	£1.0	Capex 2002/03 to 2006/07 £746m			
Reconciliation/rounding		*0.2*				
Total Network Strategy OPEX	*67*	£7.5				

Source: National Grid HBPQ submission and presentations with Network Strategy FTE data provided in response to TPA questionTP4147.

Several of the high level Network Strategy activities listed in the preceding table have been considered in the section covering Asset Management Processes.

The activity 'Safety and compliance' is explored separately below and in [redacted] because of the proportionally high opex associated with work undertaken by Engineering Services on behalf of Network Strategy at terminals and compressor stations (Engineering Services opex is £20.1m for terminals and compressors compared with £9.26m for pipelines

Commentary

TPA have reviewed the activities undertaken by Asset Strategy, Network Design and Network & Business Performance and the contribution that they make to the safety of employees, the public and the environment, the security of the gas supply and the management and development of the National Transportation System.

TPA view is that the activities are both necessary and relevant given the technical framework of legislation, licences and industry best practice within which National Grid is constrained to operate.

There is strong evidence of both technical (GSEC) and business governance (TEC), regular review of key performance indicators, of initiation of corrective actions and follow up.

There is evidence of both reactive (failure and incident investigations) and proactive (asset replacement and improvement programs) management of then asset and of working with external stakeholders (environmental improvements) to enhance value through efficient investment and operation.

TPA considers that the requirements that Network Strategy for the inspection and maintenance of the asset are relevant and reasonable of a prudent operator.

TPA consider that the level of direct staff employed on opex activities is in keeping with the range activities undertaken and the scale and distribution of the asset and recognise that some efficiency have been made over the period 2002/03 to 2004/05 in relation to staff costs.

4.2.9 TECHNICAL POLICY, SAFETY AND COMPLIANCE

As the gas transmission operator, National Grid conducts its activities with a highly structured technical environment which places statutory and licence and commercial duties on the company which include those determined by:-

- The Gas Transporters License, in particular standard condition 16.
- UK Legislation, Acts and Regulations.
- National or International standards.
- The original equipment manufacturer (OEM) or supplier.
- Company or industry best practice.

The technical policies and engineering documents that National Grid have in place to safely and effectively manage the transmission of high pressure gas and ensure compliance with European and UK legislation produce cost drivers within Network Strategy - who review and update the policies and within Engineering Services who undertake work to comply with the policies.

Note. [redacted]

Commentary

The Gas Requirement Manual and the engineering policies, procedures and standards that are used in the design, inspection and maintenance of the gas transmission asset take into account the relevant statutory duties and industry best practice. There is little scope little scope to reduce inspection and maintenance levels. Where activities are discretionary, such as site upkeep, the work specified is reasonable of a prudent operator.

TPA note the contribution made from the Safety Health and Environment Directorate to the governance process and that costs of developing and maintaining the GRM are shared with National Grid Gas Distribution.

TPA also note that where appropriate Network Strategy contributes, with other participants, to the development of gas industry standards which then become benchmark documents, which are recognised by the HSE and a means of demonstrating compliance with statutory duties.

4.2.10 Outsourced Activities

Network Strategy outsources a number of specialist services to support the asset management processes. A description of the brought in services is provided in the HBPQ Appendix 3, paragraph 313. The range of services outsourced and the value of the services brought in over the period 2002/03 to 2004/05 is shown below together with a brief explanation on the variances over the period. The outsourced services provided include:-

- Boroscope Inspections, part of the inspection requirements for gas generators and power recovery turbines.
- Technical Consultancy Services including Specialist Support for the inspections of pipelines and compressor stations, software and data capture related to the MIMS pipeline asset and work management database, risk assessments of pipelines and compressors and Rotating Machinery Improvements studies

- COAS hardware and software maintenance relating to compressor online performance and to emissions monitoring.
- TD1 Surveys
- Aerial, ground surveys, crossings (rail, river, ditch, etc), and population density surveys to support the monitoring of the integrity of pipelines.
- Underwater crossing surveys of the Humber, Thames and Exe rivers, and the Firths of Forth and Tay.
- Pipe Bridge Surveys.

Summary of Outsourced Services

All Outsourced service	**2002/03**		**2003/04**		**2004/05**	
£000 (04/05 prices)	**Budget**	**Outturn**	**Budget**	**Outturn**	**Budget**	**Outturn**
Boroscope Inspections		n/a[1]		n/a[1]		43
Technical Consultancy Services[2]		688		417		498
Rotating Machinery[2]		416		260		247
COAS Maintenance[3]		213		116		333
TD1 Surveys[4]		126		95		258
Underwater Crossing Surveys[5]		2		30		127
Pipe Bridge Surveys		0		0		10
Other outsourced gas services		55		53		12
Total outsourced services		**1,500**		**971**	**1,533**	**1,528**

Source: National Grid presentation, 19.1.06 and National Grid response to TPA question TP1008.

1 Boroscope inspection costs are included in 'other' for 2002/03 and 2003/04.

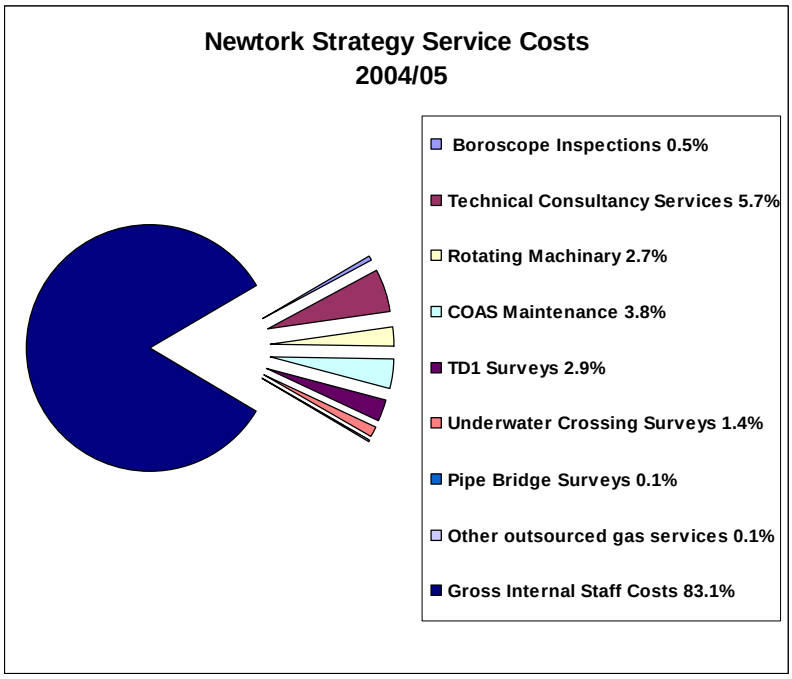
2 Costs for Technical Consultancy Services and Rotating Machinery decreased in 2003/04 due to significant changes in the contract format and the introduction of a new pricing regime based on a call of basis.

3 The current COAS Maintenance contract was awarded in November 2003. Costs for April-October 2003 are included in the Technical Consultancy Services costs.

4 TD1 Surveys are carried out according to an agreed plan of work, divided into phases. Expenditure varies year-on-year, depending on the stage of the contract.

5 The frequency of Underwater Crossing Surveys for each river is based on the results of an independent study. As different rivers are surveyed at different intervals, costs vary year-on-year, according to the combination of rivers being surveyed that year.

Analysis of Outsourcing Costs



Source: TPA using National Grid data.

Commentary

In house skills are supported by specialist service providers who provide expertise, tools and equipment that would otherwise be wholly borne by National Grid. The outsourced services are relevant as they provide information either for safety and compliance or to assist in the formulation of asset strategies.

The degree of outsourcings is typically 17% by cost of all Network Strategy resources and with the exception of some of the Technical Consultancy Services provided by Advantica, the services are procured at the market rate in accordance with National Grid Procurement and Logistics procedures. Services are charged on a work execution basis with the exception of COAS services where an annual support fee is also payable.

Given the role of Network Strategy the percentage of resources that are outsourced is not unreasonable and any further outsourcing of asset management capability would cut deeply into Network Strategy's core competencies. However it is also the case that there is limited opportunity to reduce the level of services provided by the outscored providers as much of their activity is determined by the inspection and maintained procedures discussed elsewhere the corollary being that a forward reduction in Network Strategy opex would impact NS core competencies.

4.2.11 R&D

The level of expenditure on R&D has reduced from £1.4m to £0.8m over the period 202/03 to 2004/05. The reduction in expenditure is cited as being indicative of a more rigorous approach to the management of R&D as a result of the adoption the of NGET model for merit based assessment of projects proposals across both gas and electricity businesses and the development of project proposals by UKT rather than the major R&D provider Advantica and a merit. There is also evidence of R&D leverage through the membership of Pipeline Research Committee International.

The stated objectives of the R&D programme are to improve the performance of the system, manage risks to the system through innovation and application of new technology, and provide support in relation to health, safety and environmental matters and to maintain National Grid as a technically aware organisation.

Areas of R&D activity have been;

- improving Health Safety & Environmental issues,
- understanding the impact of emerging technologies,
- maximising economic and effective utilisation of assets & network and supporting decision making.

Examples of successful R&D projects cited in the HBPQ are:-

- The ongoing investigations into P11 pipeline repairs (£80k) and high strength Steels (£40k) which are claimed to have supported the continued use of X80 against the use of X65 (a more expensive option) on the Bacton to Kings Lynn uprating undertaken in 2002 at a capital cost of £102,000.
- The development of the Gas Asset Decision Support Tool which is used to establish replacement programs.

Commentary

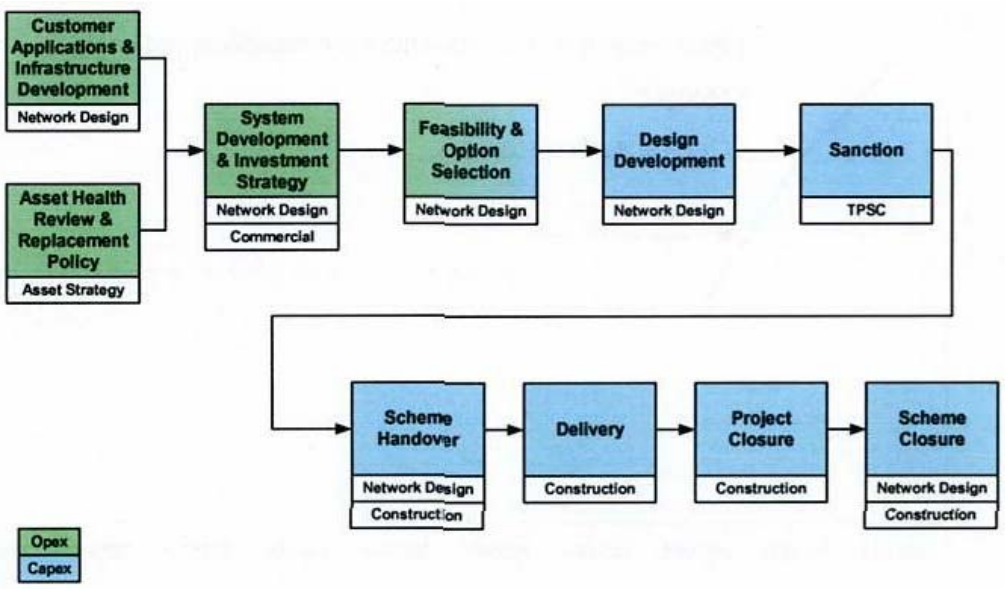
TPA notes the reduction in the level of R&D expenditure 2002/03 to 2004/05. Arising from the adoption the of NGET model for merit based assessment of projects proposals and the sharing of R&D expenditure through collaborative research through the Pipeline Research Committee International.

Recent R&D projects with Advantica to develop P11 criterion for the assessment of damage to high strength (X80) pipelines and the development of the gas asset decision support tool have identifiable benefits and provide value in the current price control period.

4.2.12 Development of the Capital Plan for New and Replacement Assets.

Typically National Grid sanctions 30 gas capital projects a year and these arise from gas shipper or end user entry and exit connection enquiries with the potential for load related capacity increases or from non load related issues arising from environmental or safety improvements or from the requirement to replace asset whose condition has deteriorated or are no longer economic to maintain.

Capital Planning Process, showing degree of capitalisation of the activities



Source: National Grid presentation, 19.1.06

The development of the capital plan, from project initiation through to feasibility study and option studies and selection, is charged to opex and Network Strategy deploy typically 19 FTE's to this activity at a cost of around £1.0m

Load related capital projects are considered in the section 5 Gas Capex. This section of the report looks at the approach taken and the project solutions to non load related capital projects begin progressed by National Grid within the price control period 2002/03 to 2006/07. Non load related projects are largely driven by the condition of the asset or the need to address external factors or requirements and the major projects in the period are:-

Condition driven projects

The condition driven projects undertaken in the current price control period are:-

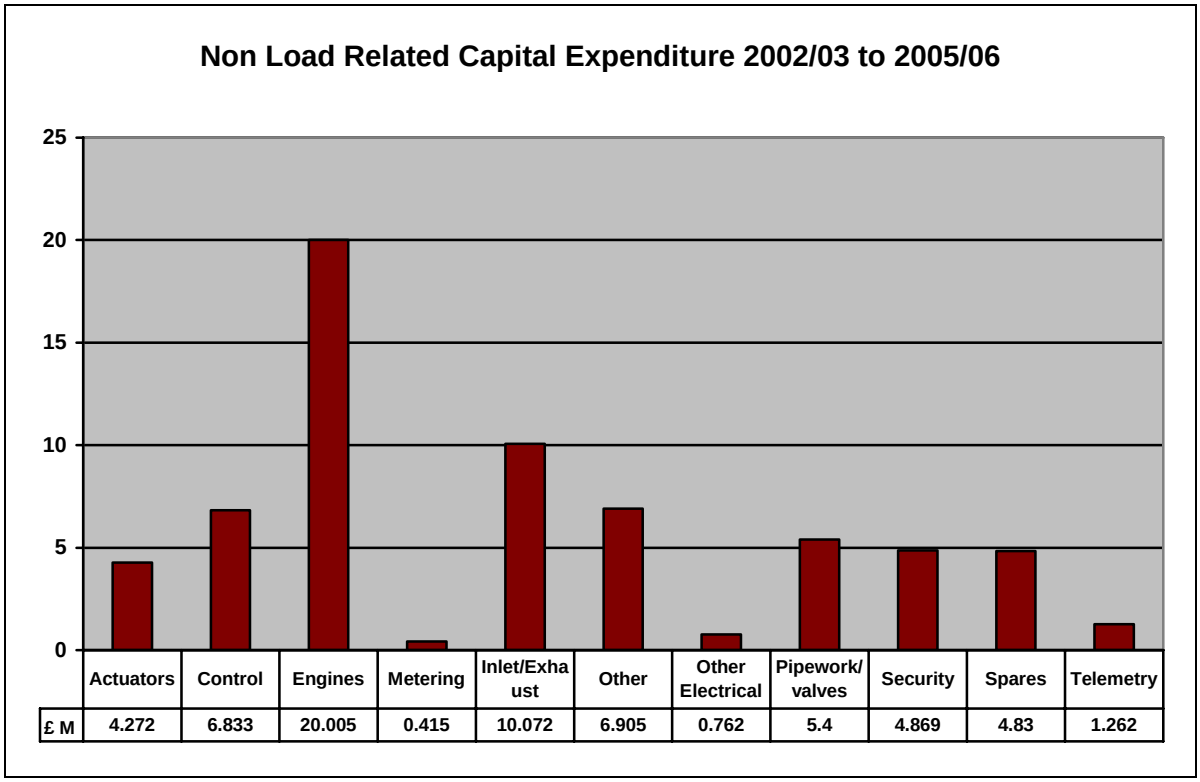
- Valve and actuator replacements estimated at £9.6m with further expenditure proposed in the next price control period.
- Compressor station and unit protection and control system replacement. A £3.7m pilot project at Wormington compressor station is ongoing in the current price control period and there is the potential for further capital expenditure of £32m in the next price control period.
- Gas generator zero rating overhauls estimated at £20m in the current price control period with a potential for further capital expenditure in the next price control period.
- Compressor unit air intake filter housing and exhaust stack replacements. £8.5m has been spent in the period 2002/03 to 2004/05, with additional capex forecast at £3.4m for 2005/06 to 2006/2007 and a estimated at £3.3m for the next price control period

Externally driven projects

The externally driven projects undertaken in the current price control period are:-

- Compressor unit emission reductions, estimated at £52m in the current price control period with a potential capital expenditure of £150m in the next price control period.
- Site security fencing improvements at Government determined network critical key points, estimated at £2.2m in the current price control period with a further capital expenditure in the next price control period.
- Improved gas quality and liquid monitoring systems at network entry points estimated at £8.6m in the years 2005 to 2007 of current price control period.

The expenditure in the period 2002/03 to 2005/06 is shown in the figure below.



	Actuators	Control	Engines	Metering	Inlet/Exhaust	Other	Other Electrical	Pipework/ valves	Security	Spares	Telemetry
£ M	4.272	6.833	20.005	0.415	10.072	6.905	0.762	5.4	4.869	4.83	1.262

Source: TPA Breakdown of National Grid HBPQ Information

The asset management processes used to evaluate the need for a project and the solution to a project have already been considered above and in this section some of the higher cost non load related projects are examined below [redacted] determine whether the outputs from the asset management process has been or will be relevant and result in efficient and economic expenditure. The execution of non load related capex is covered in Section 5 Capex.

4.2.12.1. Gas Generator and Power Turbine Overhauls

In the period 2002/03 to 2005/06 £20m was incurred on repair and major overhauls of generators and power turbines. The effect of an OEM major overhaul is to zero rate effectively "turning the clock back", and enabling the equipment to operate for a further 25000 life hours. Zero Rating meets the FRS15 definition of subsequent expenditure i.e. 'a major inspection or overhaul restoring economic benefits previously recognised through depreciation' and major overhauls are therefore charged to capex.

In addition £4.5m opex has been incurred, by Engineering Services, on breakdowns partly attributed to emerging defects on compressor units, e.g. Avon burner cans. A further £0.4m opex was incurred on power turbine inspections & refurbishment.

Note. [redacted]

Commentary

National Grid have little real alternative to complying with OEM recommendations on the frequency of overhauls. OEMs have a vastly more data on their units and generally operate in a competitive environment and have little to gain from shortening intervals between overhauls. There are also statutory requirements under the site environmental licence to "maintain and keep in good repair all plant and equipment used in carrying on the process and shall carry out maintenance of that plant and equipment … in accordance with the manufacturers' recommendations…."

Boroscope inspections do not fully identify damage that may have occurred in a unit and subsequent inspection at the OEM authorised repair facility may lead to additional work and expenditure. Unit conversions and or (power) upgrades may also be undertaken as part of a major overhaul. Ref TPSC-543 06 January 2005.

MTBF benefits from the proactive approach inspection, evaluation, repair and overhaul will be limited as the MTBF is a function of all trip conditions associated the compressor unit and its operating parameters.

For the established fleet of Avon and RB211 gas generators, capex associated with major overhauls will be driven, predominantly, by utilisation which is itself a function of gas supply and demand and the System Operators actions in managing security of supply. Capex drivers arising from contamination of the fuel gas supply with natural gas liquids, glycols and seal oil could be mitigated by fuel gas pre-treatment (filtering and separation) subject to a business case evaluation.

It is reasonable to expect this area of serviceability capex to reduce as IPPC environmental improvement projects to install electric variable speed drives are completed.

4.2.12.2 Air Intake and Exhaust Stack replacement

During the current price control period, £10m has been spent on condition based refurbishment and replacement of air intakes and exhaust stacks. A further £1.9m is forecast to be spent by 2006/07.

Air intake deterioration arises largely from corrosion caused by moisture in the air and degradation of the sound absorption packing material due to vibration and age.

Exhaust deterioration arises largely from heat (cracking) and corrosion effects from moisture and acidic gases in the exhaust and from degradation of the sound absorption packing material and sheeting due to vibration, age and heat.

Depending on the condition of the equipment minor repair works, refurbishment or replacement options are available to extent or restore the asset life. It is apparent from data provided by Network Strategy, which is summarised in the table below, that the range of remedial solutions has been used.

Remedial Solutions

	2002	2003	2004	2005	All
Air Intake Refurbishment	9	9	10	2	29
Exhaust Stack Minor works	4	9	11	7	31
Exhaust Stack Refurbishment	-	-	3	-	3
Exhaust Stack Replacement	3	3	3	-	9

As a consequence of the work the age profile of intakes and exhaust stacks has changed leaving a 'tail' of older intakes and stacks in the population. TPA note National grids intention to undertake additional refurbishment and replacement work, estimated at £4.5m, in the next price control period.

Note. [redacted]

Commentary
The process followed seems to be robust with risks of partiality from a potential OEM (Cullum Detuners) mitigated by audit inspections, the peer review and competitive EPIC contracting strategy.

TPA understand that new condition surveys will be undertaken on the 7 candidate sites for work proposed work in the next price control period.

4.2.12.3 Emission Reduction Project (Externally driven)

In the submission for the current price control period National Grid sought funding of £195m for new single lead, gas Turbine units at 11 compressor sites on the justification of environmental compliance, age and maintenance. However Ofgem argued, taking into account advice from their consultants Mazars Neville Russell that the retrofit of DLE technology to the existing RB211/Avon 1533 fleet was cost effective, deliverable and would be compliant under IPPC, that there was insufficient pressure to justify the 'urgent' status attached to the investments by National Grid and allowed £48m capital to replace single gas generators at 4 sites within the 2002-2007 PCR period.

National Grid concerns about the conclusions drawn by Ofgem centred on whether the retrofitting approach would be compliant with EA and SEPA guidance H1/H2 and H3 and future legislative impacts from the Large Combustion Plant Directive (LCPD) and European Union Emissions Trading Directive (EUETS). National Grid also had concerns regarding the feasibility and cost of retrofitting DLE technology. National Grid were also concerned that the allowable funding would not satisfy the expectations of the Licensing Authorities, EA and SEPA, with the likely cost of compliance being £25m for each of the 20 non-compliant sites, nor would it be possible to meet the construction programme necessary to deliver compliance by 2007.The resolution of compliance and funding issues has been a necessary activity and background to the issue and the steps taken by Network Strategy to move towards compliance by 2007 are described and discussed [redacted].

Note. [redacted]

Commentary

The steps taken by National Grid to fundamentally review their strategy for emissions improvements appears to have been robust and with respect to reaching agreement in principle with EA/SEPA, successful to date although this will only be known when National Grid submitted their IPPC applications in March 2006.

There is clear evidence of process, stakeholder engagement at a high level and of internal review and challenge within the Network Review process. The agreement with EA/SEPA to make investment of the forward (2008) operational plan rather than on historic and current operating patterns has resulted in a markedly different implementation strategy and route (compared with 2003) with clear environmental and expenditure benefits. The analysis has taken into account the forward gas supply scenarios to the year 2012 and confirmed that the sites identified for initial (Phase 1) environmental improvements are priority sites in all the three scenarios. There is also evidence that other factors are taken into account and that investment proposal at some sites are held back for further analysis e.g. Carnforth.

The review has also had (and has the potential to have) benefits with respect to capital investment. Under this price control investment has been deferred until late in the period with Phase 1 projects at St Fergus, Kirriemuir, Hatton and Peterborough sanctioned to commence in 2005/06 for delivery in 2008 at a cost of £52m although this is slight higher than the allowed capital (£48m) for the period.

Whilst the Phase 2 work commencing in the 2007-2012 is subject to the review of forward capex (estimated at £150m with expenditure likely at Carnforth, Moffat, Warrington and Aylesbury) the expected outcomes of the environmental improvements are, compared with the 2003 base case, are a reduction of greater than 95% NOx and 70% reduction in CO2 emissions with a significant increase in the overall fleet compressor train efficiency.

TPA has reviewed the development of some of the non load related capital investment associated with asset serviceability and emission reductions and considers that the approach to the projects has been effective and should result in efficient investment taking into account the expected supply and demand scenarios until 2012.

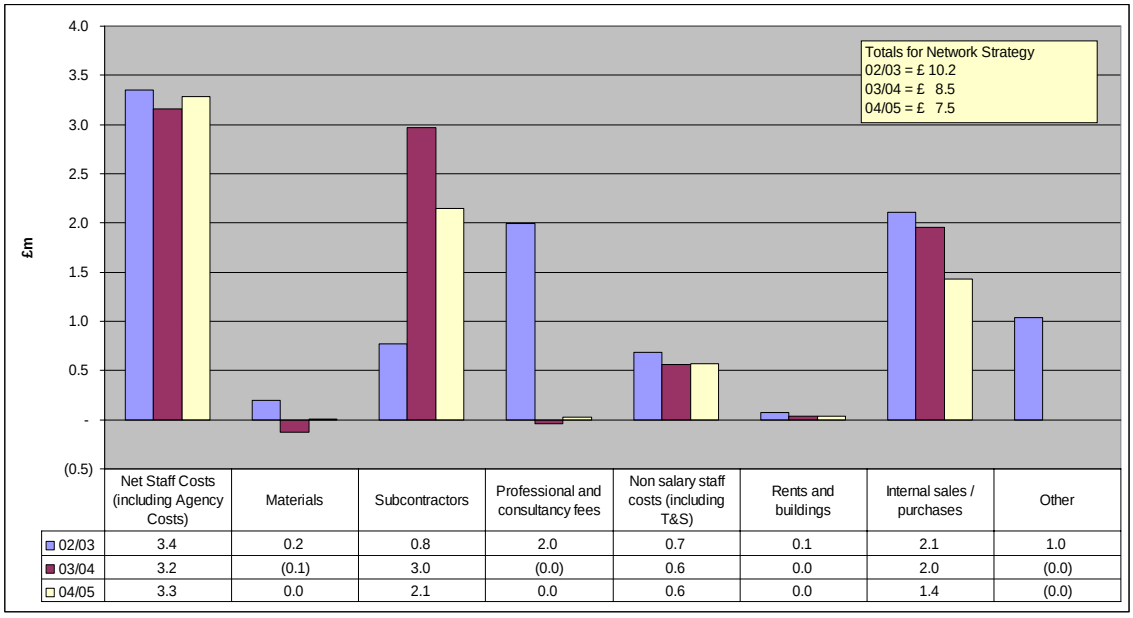
The compressor unit serviceability projects have used the asset health review process to identify which asset are priority candidates for investment on the basis of consistent asset information and an assessment of the current and forward criticality of the units and how the proposed work can be integrated with other competitively tendered EPIC contracts.

The Emission Reduction Project is an outcome of the Network Review which made a fundamentally review of options and strategies to reduce strategy for emissions from gas generators. The process has been robust and subject to scrutiny by EA/SEPA. Agreement in principle has been reached to make investment of the forward (2008) operational plan rather than on historic and current operating patterns and has resulted in a markedly different implementation strategy and route (compared with 2003) with the clear environmental expected to bring about a 95% reduction in NOx and a 70% reduction in CO2 emissions with a significant increase in the overall fleet compressor train efficiency. The cost first phase of the programme, due for delivery in 2008, will be £52m broadly in line with the allowed capital (£48m) for the period.

4.2.13 Network Strategy Opex Performance

Network Strategy operates as an integrated gas and electricity department but for financial transparency and accounting purposes staff time is book against the gas or electricity activities using the Oracle iTime system and non staff costs are booked against the relevant activity codes. From these systems the high levels costs for Network Strategy over the periods 2002/03, 2003/04, 2004/05 have been provided in the HPBQ data and is reproduced below.

High Level Network Strategy Costs



	Net Staff Costs (including Agency Costs)	Materials	Subcontractors	Professional and consultancy fees	Non salary staff costs (including T&S)	Rents and buildings	Internal sales / purchases	Other
02/03	3.4	0.2	0.8	2.0	0.7	0.1	2.1	1.0
03/04	3.2	(0.1)	3.0	(0.0)	0.6	0.0	2.0	(0.0)
04/05	3.3	0.0	2.1	0.0	0.6	0.0	1.4	(0.0)

Source: TPA Analysis of National Grid HBPQ Data

To assist in the analysis of the allocated costs TPA have mapped activity costs for the year 2004/05 onto the functional activities undertaken within Network Strategy and using an FTE unit cost (£50,000) by Transmission finance TPA have made an estimate of the FTE's allocated to these activities. TPA estimates, which have taken into account external costs, are also included in the table below.

Network Strategy FTEs and Cost Analysis 2004/05

Asset Management Strategy Development			Asset Management Delivery			Asset Management Review		
Activity	Est. FTEs	Activity Cost	Activity	Est. FTEs	Activity Cost	Activity	Est. FTEs	Activity Cost
Asset strategy	20	£1.1m	Non Capital scheme development			Bench-marking	1.3	£0.4m
Safety and Compliance	6.3	£0.8m	Outsourced Engineering	1.4	£1.5m	Quality Management System	3.9	
Environmental	6.8	£1.2m	Developing capital plan	24	£1.0m	R&D	1.3	£0.8m
Technical drawing	2.4	£0.5m						
Sub total	35.5	£3.6m		25.4	£2.5m		6.5	£1.2m
Rounding		£0.2m						
Directorate	1							
All	67	£7.5m						

Source: National Grid HBPQ and response to TPA question TP 4147

Commentary

Operational expenditure for Network Strategy over the period 2002/03 to 2004/05 has reduced from £10.2 m to £7.5m.

Within the period net staff costs (inclusive of employers National Insurance and pension contributions) has fallen slightly from £3.4m to £3.3m over the period 2002/03 to 2004/05 when net staff costs equated to 67 full time National Grid staff and some agency staff (~5).

TPA note that 31 full time National Grid staff and some agency staff costs where capitalised to projects in 2004/05 bringing the total number of gas FTEs including agency within Network Strategy to around 105 in 2004/05.

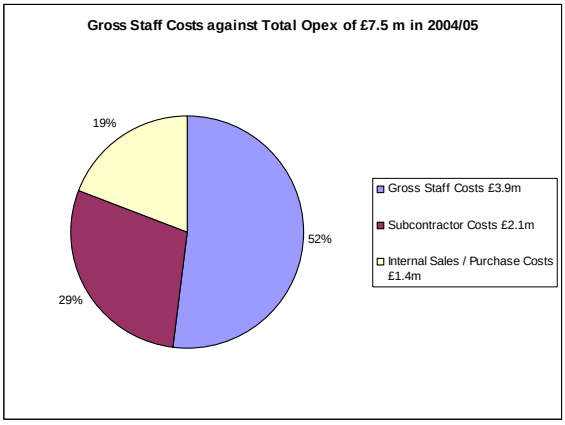
Sub contactor costs increased over the period from £0.8m to £2.1m in 2004/05 and represent an increase in workload driven outsourced engineering and drawing/record updating services.

In 2002/03 the Ryther to Scunthorpe pipeline project was cancelled resulting is a one-off write-down of design costs of £2.0m, which was charged against to professional fees.

Non salary staff costs relating to training, relocation, travel and subsistence showed a slight reduction in line with the reduction in staff costs.

There has been a significant reduction in "other cost" from £5.7 m to £1.8m in 2004/05.

There has been significant change management with the gas business arising from the Blackwater project cumulating in the sale of four Distribution Networks in October 2005. Network Strategy costs associated with the Network sales process has been allocated to The Blackwater Project (Ref: question TP1128).



It is evident that the majority of the opex incurred is associated with direct and agency staff costs (52%). It is therefore necessary to consider whether the number of FTE's allocated to the asset management activities described in the table Network Strategy Activity, Cost and FTE Analysis above are appropriate.

TPA's overall view is that the FTE allocation within Network Strategy is appropriate given the size of the asset base and the requirement to comply with gas transporter licence conditions and statutory duties, together with the necessary demonstrations of compliance through the safety case, safety reports, major accident prevention documents, environmental licenses and the associated supporting records and management information. TPA have also taken into consideration that state of the gas organisation following merger and the steps taken to rationalise and achieve a consistent approach to gas and electricity asset management.

TPA also notes the impact of the Blackwater Project and the need to resource the preparation and development of commercial and technical arrangements between UK gas transmission and Distribution Network Operators. Within these constraints TPA note that there has been a reduction in net staff and that internal resources appear appropriately supported and supplemented by outsourced services procured from the market.

TPA considers that the asset management functions undertaken by Network Strategy have been conducted in an economic and efficient manner and TPA view has also taken into account the costs associated with Network Strategy activities, the value of the regulatory asset base, the capital program and cost of operating, inspecting and maintaining the gas transmission asset.

TPA notes that:-

- The cost of asset management activities for the existing asset is typically 0.27% p.a. of the Regulatory Asset Value for terminals, compressors and pipelines £2,361.7m.
- The cost of developing the capital program is typically 0.7% pa of capital expenditure £746 m for the years 2002/03 to 2006/7.
- The cost to the asset manager of Engineering Services is £29.4m p.a.

A further indicator of financial performance and overall efficiency has been provided from international benchmarking exercise in which National Grid has co-operated with 4 other European Gas Transmission operators to compare performance. It is accepted that gas transmission benchmarking is embryonic and that there are a limited number of consistent participants and that the metrics are under development. However the comparative results show National Grid to be in the forefront of European practice.

HBPQ National Grid Benchmarking Results

Benchmark	Relative Performance			
	National Grid	Low	Average	High
Transmission System Spend excluding fuel and losses / (Gas Transported x Mean Transportation Distance)	2,048		8,374	
Number of Transmission System Staff per BCM of gas transported.	3.25		18.87	
Operations & Maintenance (O&M) Spending per BCM.	0.454	0.454	1.591	2.613
Compressor O&M Spend / Power Installed.	32,306	32,306	57,783	11,4551
Compressor O&M Spend/ Hours of Operation.	254	110	343	695
Working Days Lost due to Illness, Injuries and Strike.	3.66		3.48	

Source: File reference 2.1 Ofgem Supp Info req QA2_1 ITOMS-GTBI.pdf

Commentary

TPA considers that the asset management functions undertaken by Network Strategy have been conducted in an economic and efficient manner and has also taken into account the costs associated with Network Strategy activities, the value of the regulatory asset base, the capital program and cost of operating, inspecting and maintaining the gas transmission asset.

TPA note that some efficiencies have been made in the area of staff costs and would expect to see some continuing downward trend on staff costs as the asset management process matures and as major environmental compliance improvements are agreed with EA/SEPA and implemented but TPA do not foresee that substantial reductions in gas direct staff can be reasonably achieved.

4.2.14 Overall Conclusions and Commentaries Summary

TPA have reviewed the overall Network Strategy asset management process, policy objectives, the activities that are undertaken and the underlying capability of the organisation, in terms of human resources, information, systems and tools, to support the process.

TPA have also looked at the environment in which National Grid operates and considered whether the technical policies, procedures and standards used are comparable with best practice and appropriate and relevant to meeting licence, statutory and commercial requirements.

Finally TPA has reviewed organisational structure and the costs incurred to form a view as to whether Network Strategy has conducted its asset management role in a way that is economic and efficient.

TPA's overall view is that the processes and activities undertaken by Network Strategy, and the contribution that they make to the safety of employees, the public and the environment, the security of the gas supply and the management and development of the National Transportation System are largely efficient, relevant and consistent with best practice. TPA have not identified where there is scope for to extend inspection and maintenance intervals to significantly reduce operational expenditure and remain within the constraints imposed by legislation and best practice.

TPA consider that the asset management functions have been undertaken with lean resources in an economic and efficient manner taking into account the scale and distribution of the asset. Although some reduction in costs have been achieved, over the period to date, it is unlikely that significant reductions can be made for the remainder of the period given the level of capital expenditure and asset commissioning.

TPA commentaries on each area of Network Strategy process and activities that have been reviewed in this section are consolidated in the table below.

Reference	Title	Description	Commentary
4.2.1	Asset Management Process	*Network Strategy has adopted PASS 55 'Specification for optimized management of physical infrastructure assets' as their model for asset management.*	The processes used by Network Strategy shows strong alignment to PASS 55 and there is evidence that there is flexibility and appropriate support for the processes from with the Network Strategy organisational structure of Asset Strategy, Network Design, Construction and Network & Business Performance and from internal service providers such as Engineering Services and Advantica and from external (outsourced) companies with specialist capabilities.
4.2.2	Asset Management Policy	*Network Strategy has a policy to identify and replace assets in a timely manner, before in service failure occurs.*	Under pinning the asset policy are 4 strategies which typical of the most asset based industries. The predominant strategy is the application of interval based inspection and maintenance - planned preventative maintenance- to maintain and assess the reliability and condition of the asset. Inspection and maintenance intervals are largely driven and constrained by statutory requirement, original equipment manufacturers recommendations and industry best practice and TPA observation is that there is little scope for Network strategy to extend intervals and remain within the constraints. Some asset , notably components of gas generators are replaced at intervals specified by the OEM, when major overhauls Typically at 25,000 hours can return the unit to ' 'zero rating'. Reactive based repair or replacement actions may also be taken based on condition. Increasingly Network Strategy is taking a proactive approach to the repair or replacement of assets as the assets approach the end of their original design life.

Reference	Title	Description	Commentary
			Examples or proactive repair or replacement in the period 2002/03 to 20054/05 have been reviewed and the processes and outcomes are substantially robust. The proactive approach to asset repair or replacement rests heavily of the view taken of the technical (rather than design or commercial) asset life, safety considerations, the expected utilisation and the criticality of the asset. The concept of the technical asset life is based on the expected wear out rate of the asset which can itself be mitigated or extended by appropriate maintenance and minor repairs. On some asset groups the previous maintenance practices have been ineffective with the result that the condition of the asset to deteriorate to the point where replacement is required. An example of this historical legacy is the condition of line valve body and vent lines and actuators/controls. There is a risk that the determination of a technical asset life is arbitrary and subjective and Network Strategy have sought to mitigated this risk by apply a consistent definition of technical life and structured and consistent approach to collecting, collating and assessing condition data. Where consistent data has not been available then condition assessment surveys have been initiated. Technical asset lives are subject to ongoing review and challenge. The determination of technical asset life is not an exact science and TPA accept Network Strategy's view that the determination of the technical asset live is only one facet of a repair or replacement programme which must take into account other risks and issues.
4.2.3	Information	*Network Strategy has access to historic records and forecast data to support their asset management processes.*	TPA has reviewed a number of the sources of technical, performance and financial information available in Network Strategy. Information, for example on compressor reliability and key performance indicators is comprehensive and regular and provides a fair basis for the review and development of asset performance and strategies. Whilst there is no integrate work and asset management system , with information being drawn from a number of databases and spreadsheets TPA accept that Network Strategy have investigate this area but are unable to develop a clear business case to justify an integrated system.
4.2.4	Tools	*Network Strategy*	Risk management & control is a complex process

Reference	Title	Description	Commentary
		have developed tools for network modelling, capacity risk evaluation , the prioritisation of assets for repair or replacement and for scheduling and recording inspection and maintenance work.	and requires a balance to be made of a number of complex variables when assessing safety or when developing load related and non load related capital projects. Network Strategy has assessed to a range of well developed tools available in house or from Advantica. Examples being pipeline risk assessment models, HAZOP / HAZID assessment techniques, The Gas Asset Decision Support Tool and network planning and capacity risk assessment tools Graphical Falcon and Capri. Network planning tools are routinely validated against actual supply, demand days to determine the levels of uncertainty on the models.
4.2.5	Asset Health Review	*The Asset Health Review is undertaken to draw together all supporting information and analyses and form a collective view as to what corrective actions are necessary on the asset(s) under consideration.*	The Asset Health Review seeks to determine a balanced view on the actions/investment needed to repair or replace assets. The review fits within a logical process and is heavily dependant on the quality of condition data provided by internal and OEM/potential vendor assessments and on supply and demand forecasts which will determine the utilisation of the asset. TPA has reviewed the asset review processes for compressor unit air intake and exhaust stacks and the Network Review which has determined the investments required to improve compressor environmental performance. TPA has considered the use and quality of information, the assessment process to determine priorities (ranking), risks evaluations, review and challenge and programme adjustments to fit with other work programmes. TPA consider the processes to be logical and largely effective and there is evidence of efficiency in that initial proposals are deferred for further evaluation where uncertainty exists
4.2.6	Performance Management	*Network Strategy routinely reviews the performance of its assets, work programmes, staff and finances using key performance indicators.*	TPA has reviewed some of the key performance indicators and considers them to be comprehensive and subject to periodic review/amendment/change. There is evidence that Network Strategy have sought to compare their relative (and strong) performance, with other European gas transmission operators. The specific performance of some assets for example compressor units have also been compared with that of the Reliability Information Exchange (Reinex) member companies. With respect to 'start probability' The National Grid fleet compares well (above) with the Reinex mean. Against the metric 'mean time between failures' (MTBF) the fleet is improving and since 2004 is at the Reinex mean. However MTBF across the National Grid fleet show marked contrast between

Reference	Title	Description	Commentary
			Kirriemuir and other gas generator and electric drive stations. Whilst the running regime is more constant at Kirriemuir and this will help to achieve a good MTBF performance, TPA observes that the disparity across the fleet in MTBF performance raises the question as to whether best practice has been applied consistently across compressor stations. It is not possible to evaluate this further without a more detailed study.
4.2.7	Asset Management Capability	*Network Strategy's key competencies and resource levels are continuously reviewed to ensure that appropriate informed buyer capability is maintained.*	Network Strategy, using their own criteria, has 'expert' staff directly available to support most of the key asset types and functions. Where there are exceptions then alternative support is available for example; environmental activities are supported by National Grid SHE, gas generator asset management is supported by outsourced arrangements with Rolls Wood and other rotating equipment experts. The capability/succession criteria appear to be satisfied for most asset types and functions or otherwise supported by outsourced arrangements. There is evidence that Network Strategy are proactive in managing the competence capability in their recruitment of staff with competence in SCADA/telemetry, compression, power turbines and pipeline integrity and the intended external recruitment of a person with competence in process engineering and internal recruitment of addition skills in gas quality and metering. There is also evidence of planning to enhance the boarder base of basic skills for example the training of staff on gas quality measurement devices using external courses provided by OEM's and suppliers and to provided internal training on GS(M)R requirements to staff with an electrical background. For the major pipelines and compressor assets the team leader has 'expert' skills, which should ensure that the team is appropriately directed. There is strong team of 'experts' (3) for control and SCADA activities and given the intended expenditure in the next price control period for the replacement of protection and control systems on compressor stations this seems appropriate. On balance TPA view is that the competency capability within Asset Strategy is appropriate for the size, complexity and significance of the gas transmission assets.
4.2.8	Asset	*Network Strategy*	TPA have reviewed the activities undertaken by

Reference	Title	Description	Commentary
	Management Activities	*activities a high impact on safety, network capacity and availability, the gas regulatory asset value, Opex and Capex.*	Asset Strategy, Network Design and Network & Business Performance and the contribution that they make to the safety of employees, the public and the environment, the security of the gas supply and the management and development of the National Transportation System. TPA view is that the activities are both necessary and relevant given the technical framework of legislation, licences and industry best practice within which National grid is constrained to operate. There is strong evidence of both technical (GSEC) and business governance (TEC), regular review of key performance indicators, of initiation of corrective actions and follow up. There is evidence of both reactive (failure and incident investigations) and proactive (asset replacement and improvement programs) management of then asset and of working with external stakeholders (environmental improvements) to enhance value through efficient investment and operation. TPA consider that the requirements that Network Strategy for the inspection and maintenance of the asset are relevant and reasonable or a prudent operator. TPA consider that the level of direct staff employed on opex activities is in keeping with the range activities undertaken and the scale and distribution of the asset and recognise that some efficiency have been made over the period 2002/03 to 2004/05 in relation to staff costs.
4.2.9	Gas Technical Policy, Safety and Compliance	*Network Strategy have developed The Gas Requirements Manual for the governance and specification of gas assets and associated work activities for their UK gas business*	The Gas Requirement Manual and the engineering policies, procedures and standards that are used in the design, inspection and maintenance of the gas transmission asset take into account the relevant statutory duties and industry best practice. There is little scope little scope to reduce inspection and maintenance levels. Where activities are discretionary, such as site upkeep, the work specified is reasonable of a prudent operator. TPA note the contribution made from the Safety Health and Environment Directorate to the governance process and that costs of developing and maintaining the GRM are shared with National Grid Gas Distribution. TPA also note that where appropriated Network Strategy contributes, with other participants, on the development of gas industry standards which then become bench mark documents, which are recognised by the HSE and a means of demonstrating compliance with statutory duties.

Reference	Title	Description	Commentary
4.2.10	Outsourcing	*Network Strategy have outscore arrangements in place to support and supplement their own capability*	Network Strategy outsources some services to specialist service providers who provide expertise, tools and equipment that would otherwise be wholly borne by Network Strategy. The outsourced services are relevant for example the surveys of pipelines by helicopter as they provide information for safety or to assist in the formulation of asset strategies. The degree of outsourcings is typically 17% of the cost of all Network Strategy resources and with the exception of some of the Technical Consultancy Services provided by Advantica, the services are procured at the market rate in accordance with National Grid Procurement and Logistics procedures. Services are charged on a work execution basis, largely driven by inspection and maintenance intervals, with the exception of COAS services where an annual support fee is also payable. Given the role of Network Strategy the percentage of the resource that is outsourced is not unreasonable and any further outsourcing of asset management capability would undermine Network Strategy's core competencies. There may have been over reliance on outsourced services for rotating equipment specialist that could impact on improving compressor reliability and the development and cost of capital projects. Note: towards the end of the period, as part of the competency review, National Grid has increased its capability in the area of rotating machinery see section 4.2.7. There is also a high dependency on Advantica for the provision of the 'Competent Person' under PSSR which may present a forward risk if alternative arrangements are made either By UKT or UKD for the provision of this service.
4.2.11	R&D	*The objectives of the R&D programme are to improve performance and manage risks through innovation and the application of new technology and to provide support on health, safety and environmental matters.*	TPA notes the reduction in the level of R&D expenditure 2002/03 to 2004/05. Arising from the adoption the of NGET model for merit based assessment of projects proposals and the sharing of R&D expenditure through collaborative research through the Pipeline Research Committee International. Recent R&D projects with Advantica to develop P11 criterion for the assessment of damage to high strength (X80) pipelines and the development of the gas asset decision support tool have identifiable benefits and provide value in the current price control period.
4.2.12	Developing	*Capital plans are*	TPA have reviewed the development of some of

Reference	Title	Description	Commentary
	Capital Plans	*developed to meet National Grid's licence and statutory and obligations, to minimise the risk of supply interruption and to enhance and restore asset life.*	the non load related capital investment associated with asset serviceability and emission reductions and consider that the approach to the projects has been effective and should result in efficient investment taking into account the expected supply and demand scenarios until 2012. The compressor unit serviceability projects have used the asset health review process to identify which asset are priority candidates for investment on the basis of consistent asset information and an assessment of the current and forward criticality of the units and how the proposed work can be integrated with other competitively tendered EPIC contracts. The Emission Reduction Project is an outcome of the Network Review which made a fundamentally review of options and strategies to reduce strategy for emissions from gas generators. The process has been robust and subject to scrutiny by EA/SEPA. Agreement in principle has been reached to make investment of the forward (2008) operational plan rather than on historic and current operating patterns and has resulted in a markedly different implementation strategy and route (compared with 2003) with the clear environmental expected to bring about a 95% reduction in NOx and a 70% reduction in CO2 emissions with a significant increase in the overall fleet compressor train efficiency. The cost first phase of the programme, due for delivery in 2008, will be £52m broadly in line with the allowed capital (£48m) for the period.
4.2.13	Financial Performance	*National Grid must conduct its undertaking in a manner that is economic and efficient.*	TPA consider that the asset management functions undertaken by Network Strategy have been conducted in an economic and efficient manner and view has also taken into account the costs associated with Network Strategy activities, the valve of the regulatory asset base, the capital program and cost of the operating, inspection and maintaining the gas transmission asset. TPA note that some efficiencies have been made in the area of staff costs and would expect to see some continuing downward trend on staff costs as the asset management process matures and as major environmental compliance improvements are agreed with EA/SEPA and implemented but TPA do not foresee that substantial reductions in gas direct staff can be reasonably achieved.

4.2.15 Range Analysis

TPA provides the following analysis on possible upper and lower boundaries for the base year 2004/05.

TPA has already commented that the asset management functions undertaken by Network Strategy have been conducted in an economic and efficient manner and our views of the efficiencies that might be applied to the base year reflect this.

The primary area where TPA considers that efficiency might be applied arise from the Network Sales process. In the year 2004/05 National Grid incurred set up and activity costs associated with the development of in house maintenance expertise. Of the £594k incurred £176k was allocated to opex (Ref question TP1128). Whilst the opex cost associated with the Network Sale could be seem as a single event and a full efficiency argued, TPA accept the requirement for maintenance expertise in the following years and the range of efficiencies reflect this.

The other area where marginal efficiencies might have been made is in the area of environmental improvements where a high level of resources has been utilised.

The following table indicates the range of adjustments that might be realised in the base year and includes

- The range of adjustments, high, medium and low for the two areas where TPA have
- identified possible efficiencies. (£M)
- The total efficient adjustments high, medium and low (£M)
- The actual base year expenditure by activity (£M)
- The TPA efficiency adjustment by activity high, medium and low (£M)
- The Adjustment expressed as a % of the actual base year opex
- The likely impact on the number of FTE's high, medium and low if the efficiencies where realised

Negative valves are shown in red.

Efficiency Analysis for Base Year		**2004/2005**		
		High	Medium	Low
Adjustment Detail				
Asset Strategy: Impact of Network Sales/GRM	**£m**	-0.15	-0.1	-0.05
Environmental Issues: Smaller environmental policy team	**£m**	-0.1	-0.05	-0.05
Total Efficiency Adjustment for Year	**£m**	-0.25	-0.15	-0.10
Activity Cost Analysis	**ACTUAL SPEND**	**TPA RE-ASSESSMENT BASE YEAR**		
		High	Medium	Low
Asset Strategy	1.10	0.95	1.00	1.05
Safety and Compliance	0.80	0.80	0.80	0.80
Environmental Issues	1.20	1.10	1.15	1.15
Technical Drawings, Data and Systems	0.50	0.50	0.50	0.50
Outsourced Engineering	1.50	1.50	1.50	1.50
Asset Management Review	0.40	0.40	0.40	0.40
R+D	0.80	0.80	0.80	0.80
Cost of Developing Capital Plan	1.00	1.00	1.00	1.00
Rounding	0.20	0.20	0.20	0.20
Total **£m**	**7.50**	**7.25**	**7.35**	**7.40**
Efficiency Adjustment % of Total Network Strategy Budget for Year		-3.45%	-2.04%	-1.35%
Equivalent FTE reduction		-5	-3	-2

Source: TPA Analysis

4.3 ENGINEERING SERVICES

Introduction

Engineering Services (ES) role is to plan and deliver work in a safe, efficient and timely manner in accordance with a framework of policies and legislation ensuring the optimal availability of the electricity and gas transmission systems at all times. It provides and supports field-based maintenance; response to faults and project services and also provides front line management of activities within these areas. For completeness and to illustrate the total scope of ES it comprises the following six main groups:

- **Planning** which is responsible for ensuring all aspects of planning (outages and resources) are in place on a national basis to enable the substation and overhead line teams to their services effectively. It also includes land acquisition & management of grantors (including easement management and crop loss and mineral rights compensation) and fault response.
- **Substations** that consist of a number of multi-skilled geographical teams who carry out all of the routine maintenance and fault repair work on substations and cables on the HV Electrical system in England and Wales, deliver occupier duties, and provide emergency cover.
- **Gas Transportation Services (GTS)** who manage and maintain National Grid's Gas Transmission Assets which includes Compressor Stations, National Transmission System (NTS) pipelines and AGI's, Terminals and LNG sites.
- **Overhead Lines (OHL) and Pipeline Maintenance Centre (PMC)** who manage and maintain National Grid's overhead line assets, including emergency fault response, condition assessment defect repair including equipment modification instructions and live line working.
- **Operational Performance Group (OPG)** which provides a focus on driving performance and productivity within Engineering Services. OPG provides Business Systems management and support services, Field Delivery Support services, Audit and Investigation services as well as performance and productivity monitoring
- **Electricity Services (UKES)** which carries out unlicensed business. UKES manages customer contracts, work requirements and invoicing plus reporting to unlicensed customers. The planning and delivery of work is carried out by Planning and Substations staff with apportioned transfer of costs to the unlicensed activity.

Engineering Services supports the 5 key areas of National Grid's Transmission Strategy. These key objectives are: -

- Look after all Engineering Services staff in a clean secure injury free environment
- Staff development through focused training at all levels
- Take care of all the systems ensuring a fierce focus on transmission reliability
- Continued drive on efficiency in all activities undertaken
- Demonstrate that all actions undertaken are necessary and efficient

The scope of this technical efficiency assessment is limited to controllable historic opex incurred in Gas TO within Engineering Services which comprises predominantly the maintenance of the gas National Transmission System assets and is carried out within **Gas Transportation Services** ('GTS') and in **PMC** as defined above.

4.3.1 Engineering Services Opex Performance

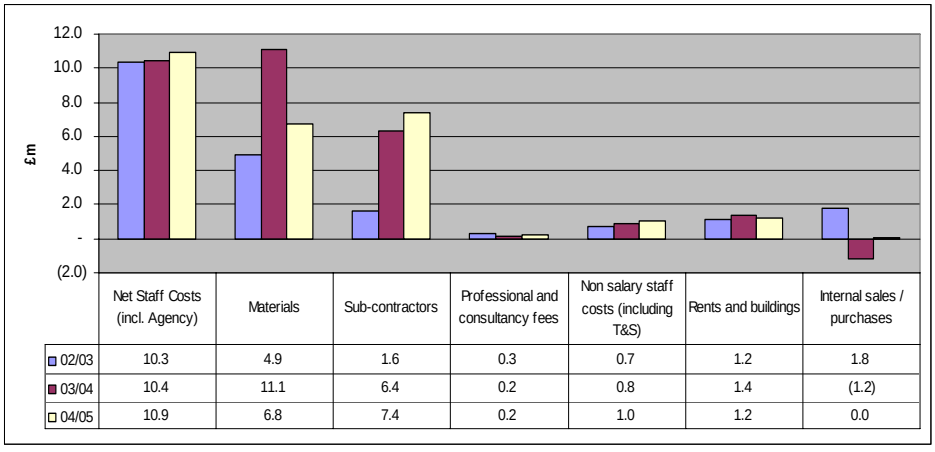
The following table presents a summary of the opex historical cost performance for this maintenance work is as follows. No Gas TO costs are available for year 2001/02 as being prior to merger of NG and Lattice Group. These figures are extracted from the data tables in National Grid's HBPQ response.

Engineering Services Gas Controllable Costs

	£m 2002/03	£m 2003/04	£m 2004/05
Net Staff Costs (including Agency Costs)	-10.35	-10.40	-10.92
Materials	-4.89	-11.12	-6.75
Subcontractors	-1.62	-6.35	-7.43
Professional and consultancy fees	-0.34	-0.18	-0.22
Non salary staff costs (including T&S)	-0.73	-0.85	-1.05
Insurance	0.00	0.00	-0.01
Rents and buildings	-1.15	-1.37	-1.22
Profit / loss on sale of fixed assets	0.00	0.00	0.00
Internal sales / purchases	-1.76	1.20	0.03
Other	-5.71	-0.85	-1.79
Total Accounting Controllable Costs:	**-26.54**	**-29.92**	**-29.37**

Source: National Grid HBPQ Submission

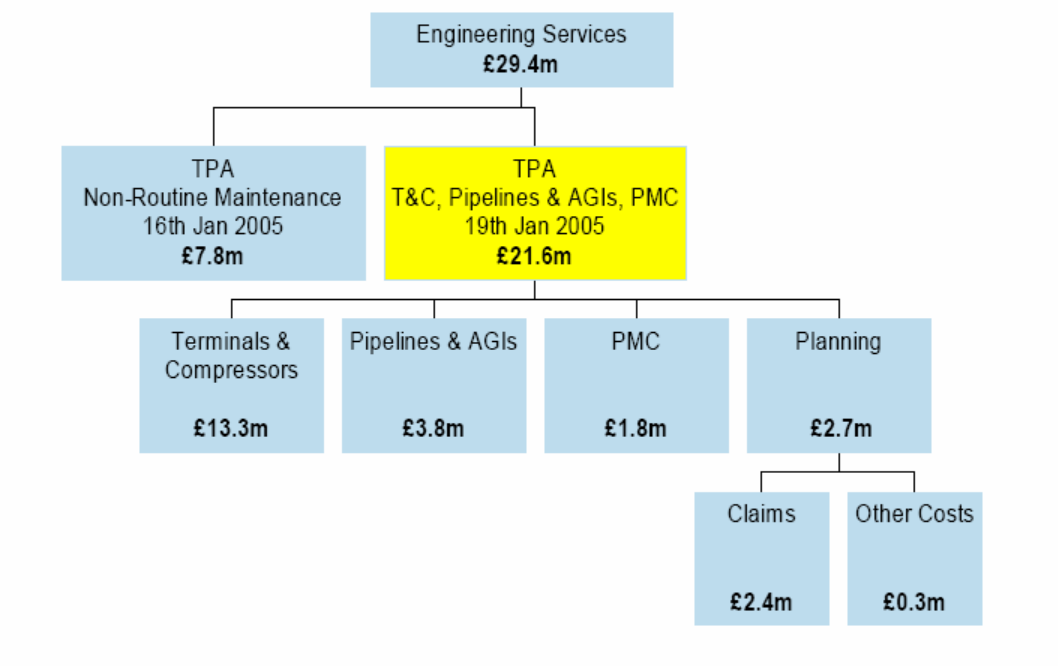
Chart to illustrate scale of costs



Source: TPA Solutions, using data from National Grid HBPQ Submission

The following diagram shows how National Grid allocates gas opex TO costs across activities for 2004/05 is as follows:

Allocation of Opex in Engineering Services



Source: National Grid Presentation

FTE data has not been specifically available at the Gas TO level, however from workshops and presentations, and some of National Grid's responses to questions, TPA has deduced that the above structure is populated with staff numbers as follows:

Headcount Figures

Activity	FTE's
Compressors	94
Terminals	49
PMC	88
Planning	20
NRM	12
Pipelines/AGI's	31

Source: TPA Estimates

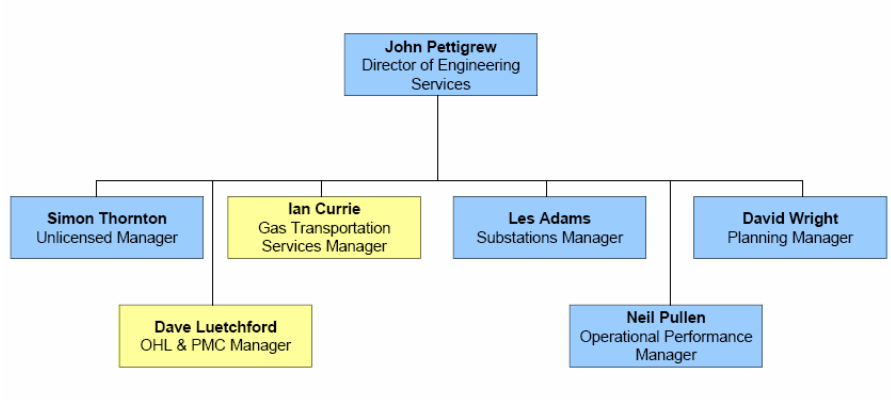
4.3.2 Opex movements and trends

Significant increases in both Materials and Subcontractor charges are evident in 2003/04 and 2004/05 when compared to 2002/03. National Grid state this is due to emerging defects and consequent non-routine maintenance of for example £7.8m in 2004/05 predominantly on gas turbine machines. Such work is carried out either by the OEM or an approved vendor and National Grid advise this is carried out through a competitive process. In view of a possible increasing trend, National Grid has initiated a programme of boroscope inspections to assess machinery condition. This is discussed in Network Strategy and is further considered in our discussion of the proposals for forecast opex.

4.3.3 Organisation and staffing

The management structure indicating where GTS and PMC reside within Engineering Services is as below:

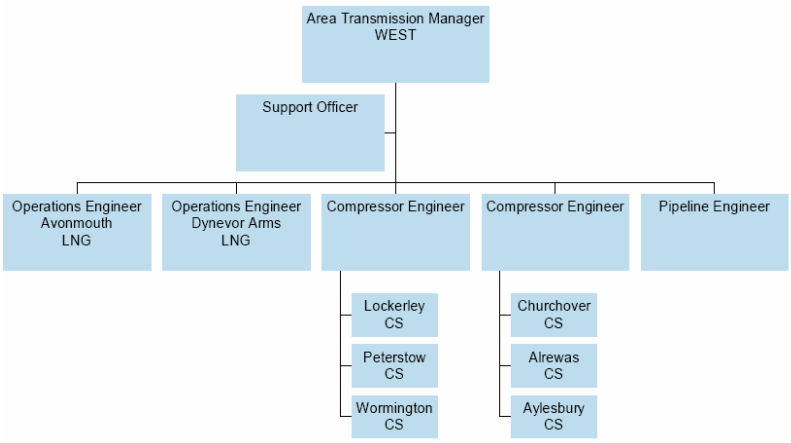
Management Structure within Engineering Services

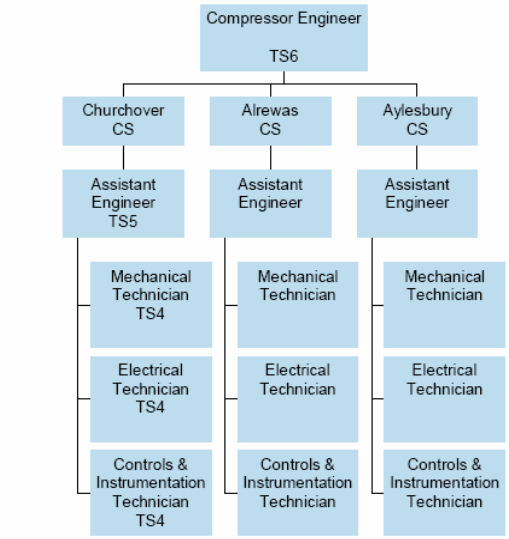


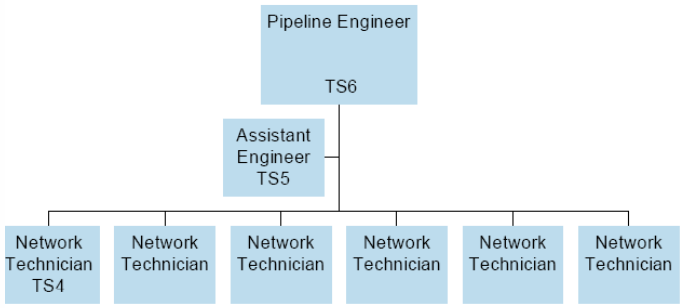
GTS is then organised into 4 Areas each covering where appropriate Compressors, Terminals, Pipelines/AGI's and for information LNG sites although those are not part of this opex study.

Transmission West Area is illustrated overleaf, by way of example:

Management Structure within Transmission West Area







The activity of each of these groups is described and discussed below:

4.3.3.1 Compressor Stations

Of the Compressor stations, 25 are gas turbine driven and 2 are variable speed electric drives.

Each of 4 Areas includes Compressor Engineers and each station three technicians (mechanical, electrical, instrument disciplines) plus an Assistant Engineer. They are specifically responsible for the maintenance of the Compressor Station; however other work of a similar nature and skill-set in the vicinity of a compressor station is also carried out to ensure better utilisation of resources. Staff also participate in a standby rota for emergency call out and National Grid advise that a degree of peripatetic work is carried out with technicians being seen as a pool of labour across their respective Area rather than specifically allocated to a station. There is no 24 hour manning, presence on site being normally during standard working hours.

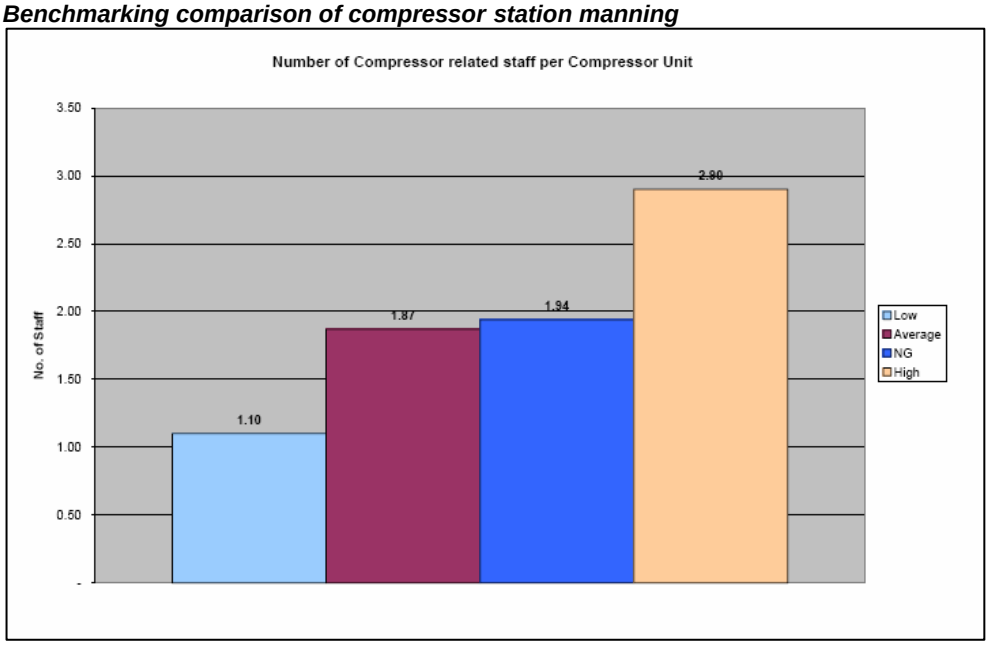
Activities carried out:

- Repair and maintenance of plant and buildings including outsourcing specialist services e.g. standby generators
- Management of other outsourced facilities services such as grass cutting, cleaning etc
- Utility costs – predominantly for the usage of electricity to run pumps, vent fans, heaters and other ancillary equipment
- Provision of security services at high criticality sites
- Calibration and maintenance of new enhanced gas quality monitoring equipment

Commentary

It has been questioned as to why every compressor station has three technicians resident when considering the wide variation in running hours across the fleet and geographical proximity of some installations. While there has to be an effective standby and callout arrangement in place to meet GS(M)R and Safety Case obligations which will to a degree dictate practical staffing levels, potential may exist for future efficiencies while considering future compressor station usage and forecast running hours forecast under planning scenarios. This is explored further with the proposals for forecast opex and in conjunction with the NG proposed expansion of electric drive compressors across the fleet in compliance with IPPC. National Grid provide benchmark data from a comparator sector of relevant gas transmission companies that indicates they are slightly above average in manning per unit as indicated below.

Benchmarking comparison of compressor station manning



Source: GTBI Benchmarking Report, provided by National Grid

4.3.3.2 Terminals

There are 2 manned and 5 unmanned Terminals. The two terminals at St Fergus and Bacton are manned 24 hours with shift work rota's covering control rooms and day time maintenance technicians.

Activities carried out:

- Similar physical activities as for compressor stations with the addition that they are more strategically significant, i.e.,
- Activities more onerous than compressor sites
- Sites classed as Super Economic Key points
- More complex control & safety systems
- Higher level of monitoring and control

Commentary

The 2 manned terminals are considered to be both economic and as secure economic key points on the gas supply system with consequent higher levels of manning plus 24 hour operation, it is not considered realistic to reduce manning on these sites.

4.3.3.3 PMC

PMC staff is geographically based at 7 depots (Ambergate, Glasgow, Hitchin, Birmingham, St Helens, Featherstone and Cardiff) to provide a distributed operational service. PMC is a service provider and provides an operational service to National Grid on the National Transmission System and also to both retained and independent DN's for which an income is received. Opportunities for income are also explored in other market sectors (e.g. 3rd party pipelines) where this may be of value, while ensuring no conflict with their core duties. Services provided include helicopter surveillance of pipelines, flow stop, pigging and inspection, support to Online Inspection carried out by PII and its core service the 24 hour CEME emergency callout scheme.

National Grid advise that synergies have been explored with OHL in electricity transmission but that practically little cross-flexibility working can be carried out due to different skill sets and operational needs, e.g., common helicopter usage for survey was considered but discounted due to conflicting duty/use and CAA requirements.

Activities carried out:

- Pipeline intervention / sealing / bypass / repair on high, medium and intermediate pressure and large diameter low pressure mains
- Mobile recompression
- On-line inspection (OLI) support
- Aerial survey management
- Spares / specialist equipment
- Transmission records management

Commentary

The core service for PMC is CEME which is predominantly based at Ambergate. The other depots provide a support service and planned work capability to DN's. It is noted that PMC operationally support PII who have a 5 year contract for OLI1 inspection during on-line inspection. The contract is in year 4 so negotiations will we assume be in progress for new tenders to be issued. To enable true market testing and potential benefits there remains an issue of ownership of raw data on pipeline surveys which must be resolved but is currently subject to contract negotiation.

4.3.3.4 Pipelines and AGI's

There are 251 block valve sites, 27 pig trap sites and 6877 km pipeline on the NTS.

At the point of DN sales, NG considered that the former LDZ practice related to devolved maintenance of NTS pipelines and AGI's would no longer be practical in view of legal separation of the iDN's as new businesses and NG concluded it would be more economic if 31 of the 39 DN staff carrying out this work for NTS would be brought into GTS. The resource imbalance would be supplemented by compressor station technicians. There comprises therefore a Pipeline Engineer at each Area plus Network Technicians to manage the workload.

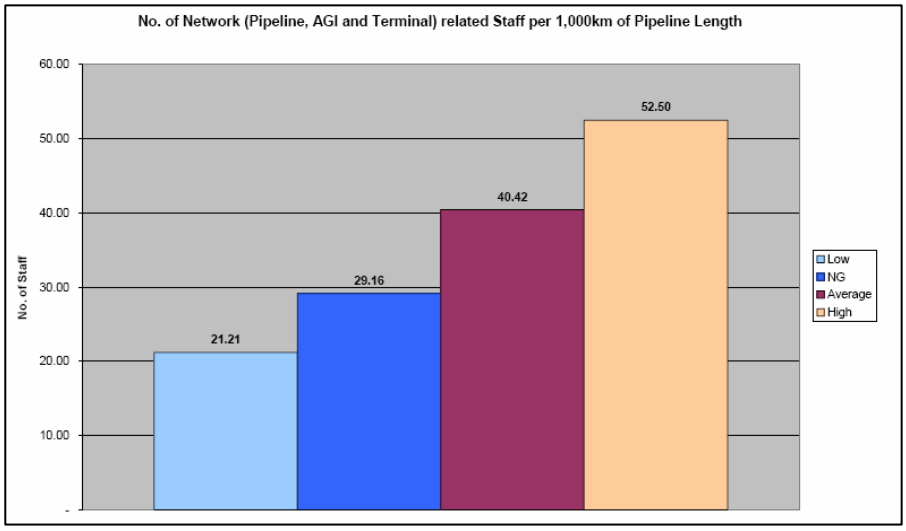
Activities carried out:

- Vantage Point Surveys
- Encroachment Management
- Marker Post Maintenance
- On-Line Inspections
- Pig Trap Maintenance
- Annual Valve Maintenance
- Corrosion Control / CP Monitoring
- Electrical and Instrumentation
- Direct Offtake Maintenance

Commentary

Annual maintenance opex for the entire NTS pipeline system was only £3.8m in 2004/05 of which staff costs are approximately 50%. There are developing issues regarding emerging defects which will be explored further with the proposals for forecast opex; however it is considered that there is little scope for immediate savings in this area. Furthermore, NG benchmarking data indicates staffing levels significantly below the comparator sector average which TPA would accept:

Benchmarking comparison of Staff employed on Pipeline and AGI Maintenance



Source: GTBI Benchmarking Report, provided by National Grid

4.3.3.5 Planning

Staff costs are small in Planning, typically £0.8m per annum. The principal opex costs are those incurred as a result of Crop Loss and drainage compensation and Quarry mineral rights compensation, amounting to £2.4m pa in 2004/05. Both activities are on-going costs where the outcome depends on negotiation. In Crop Loss and drainage, liabilities exist and remain towards landowners, particularly farmers where loss of crop yield and/or damage to land drains results from prior pipeline laying work. Legacy and latent issues remain where regular claims are made and assessment agreed through independent agents. In newer cases full and final settlement is attempted but often resisted by landowners. Loss of mineral extraction rights where quarries are located either adjacent to or beneath pipelines are also dealt with by negotiation. Latterly this has also become an issue with respect to the additional loss of landfill opportunity which may result in significant future costs. This will be discussed further with the proposals for forecast opex.

Commentary

Significant improvement has been made in more recent years in land management during construction, compared to earlier years of developing the pipeline system. This results in lower liabilities for crop loss and drainage, however there will continue to be legacy and on-going claims to manage in an effective way. Provisions are available in the NFU/CLA and Scottish land Agreements to mitigate crop loss claims through full and final settlement but TPA accepts there will continue to be ongoing costs to manage. The developing issue with respect to loss of landfill rights is of concern and will be reviewed with the proposals for forecast opex.

4.3.4 HBPQ – Reported Opex cost savings/additions

The following sections describe and discuss the opex savings and additional costs which National Grid has reported in their response to the HBPQ.

4.3.4.1 2002/03 to 2003/04

Breakdown and repair costs associated with Gas Transmission assets increased by £3.8m. These costs have generally increased over time as around half the assets are at or beyond their original design lives. Changes in supply patterns and the consequential need to deliver Transmission Capacity have triggered wider variation in utilization of compressors.

Significant cost variations occur year on year depending on the nature of breakdowns and the mix of operating cost rectification of breakdowns and capital replacement.

The introduction of a robust programme of proactive "boroscope" inspections of gas turbine units has also contributed to this increase as the onset of failure has been identified earlier leading to remedial works.

Loss of development claims fell by £1m in 2003/4. These costs are dependant upon the timing, and merits, of claims made by private land owners who hold a "Deed of Grant of Easement" from the time of installation. Claims are defended rigorously but remain unpredictable and this cost line is volatile when analyzed year on year.

4.3.4.2 2003/04 to 2004/05

Pipeline Maintenance Centre charges to Distribution Networks increased by £1.2m. This reflected the review of charges to ensure cost reflectivity. Other costs were managed down by £0.3m as the mix of project work, maintenance activity and provision for claim settlements remained broadly in line with 2003/4.

Discussion

Increased incident of emerging defects is being experienced and is raised by NG as part of initial FBPQ submissions. Such costs will be seen in historic trends under non-routine maintenance (see below) and are explored further with the proposals for forecast opex.

4.3.5 Non Routine Maintenance

Regular on-going maintenance is carried out as described earlier however in the event of significant non routine work arising, this is managed through the National Support Manager on a project delivery basis. Where appropriate, costs are capitalised.

Activities carried out are:

- Management of breakdowns
- Remedial site civil works
- Air intake and exhaust stack repairs
- Valve and actuator repairs
- PSSR inspection program and remedial works
- Non-return valve inspection program
- Co-ordination of support for field staff

National Support and Non Routine Maintenance activities comprised £7.8m in 2004/05 of which the most significant items were gas turbine related, the composition of this figure is shown in the table below:

Composition of Non Routine Maintenance Costs

National Support and NRM team	£0.8m	
Breakdowns	£4.5m	Emerging defects e.g. Avon burner cans
Other works		
◆ Exhausts/Air Intakes	£0.3m	Defect repairs
◆ Corrosion control	£0.2m	Defect repairs
◆ Power Turbine inspection & refurb	£0.4m	Low given historical equipment failures
◆ Civil works, building and cab repairs	£0.2m	
◆ Electrical / I&C inspections	£0.1m	
◆ Valve & Actuator refurb	£0.1m	Emerging corrosion issues e.g. sealant lines.
◆ Other	£0.4m	
Stock Provision	£0.8m	Rationalisation of GTS stores holdings.
TOTAL	**£7.8m**	

Source: National Grid Presentation on Non Routine Maintenance

Commentary

TPA believes this approach to project-related non routine activities gives a focussed delivery and ensures performance of assets is fed back into the investment process in Network Strategy. Where significant works such as gas turbine refurbishment resulting in zero rating and hence effectively asset renewal is carried out, these are subsequently capitalised in accordance with financial accounting standards. The trend in expenditure is seen in the following table where the dominant activity influence is clearly non-routine repairs and maintenance. This is to be explored further with the proposals for forecast opex, in relation to the National Grid “emerging defects” plan.

GTS Total Costs

£m	2002/03	2003/04	2004/05
Engineering Services Total	26.5	29.9	29.4
T&C, Pipelines, AGIs, PMC	22.7	23.6	21.6
Non Routine Maintenance	3.8	6.4	7.8

4.3.6 Summary of TPA Commentary

Reference	Title	Description	Commentary
4.3.3.1	**Compressor Stations**		It has been questioned as to why every compressor station has three technicians resident when considering the wide variation in running hours across the fleet and geographical proximity of some installations. While there has to be an effective standby and callout arrangement in place to meet GS(M)R and Safety Case obligations which will to a degree dictate practical staffing levels, potential may exist for future efficiencies while considering future compressor station usage and forecast running hours forecast under planning scenarios. This is explored further with the proposals for forecast opex and in conjunction with the NG proposed expansion of electric drive compressors across the fleet in compliance with IPPC. NG provide benchmark data from a comparator sector of relevant gas transmission companies that indicates they are slightly above average in manning per unit as above.
4.3.3.2	**Terminals**		The 2 manned terminals are considered to be both economic and as secure economic key points on the gas supply system with consequent higher levels of manning plus 24 hour operation, it is not considered realistic to reduce manning on these sites.
4.3.3.3	**PMC**		The core service for PMC is CEME which is predominantly based at Ambergate. The other depots provide a support service and planned work capability to DN's. It is noted that PMC operationally support PII who have a 5 year contract for OLI1 inspection during on-line inspection. The contract is in year 4 so negotiations will we assume be in progress for new tenders to be issued. To enable true market testing and potential benefits there remains an issue of ownership of raw data on pipeline surveys which must be resolved but is currently subject to contract negotiation. There is however no evidence of alternative business strategies to manage such a risk and any potential loss would therefore it is assumed be managed within current opex constraints
4.3.3.4	**Pipeline and AGI Maintenance**		Annual maintenance opex for the entire NTS pipeline system was only £3.8m in 2004/05 of which staff costs are approximately 50%. There are developing issues regarding emerging defects which will be explored further with the proposals for forecast opex; however it is considered that there is little scope for immediate savings in this area. Furthermore, NG benchmarking data

Reference	Title	Description	Commentary
			indicates staffing levels significantly below the comparator sector average which TPA would accept
4.3.3.5	**Planning**		Significant improvement has been made in more recent years in land management during construction, compared to earlier years of developing the pipeline system. This results in lower liabilities for crop loss and drainage, however there will continue to be legacy and on-going claims to manage in an effective way. Provisions are available in the NFU/CLA and Scottish land Agreements to mitigate crop loss claims through full and final settlement however TPA accepts there will continue to be ongoing costs to manage. The developing issue with respect to loss of landfill rights associated with quarries is of concern and is reviewed with the proposals for forecast opex.
4.3.5	**Non Routine Maintenance**		TPA believes this approach to project-related non routine activities gives a focussed delivery and ensures performance of assets is fed back into the investment process in Network Strategy. Where significant works such as gas turbine refurbishment resulting in zero rating and hence effectively asset renewal is carried out, these are subsequently capitalised in accordance with financial accounting standards. The trend in expenditure is seen in the following table where the dominant activity influence is clearly non-routine repairs and maintenance. This is to be explored further with the proposals for forecast opex, in relation to the National Grid “emerging defects” plan

4.3.7 Range Analysis

The following table shows TPA's assessment of the base year, reflecting the findings above in relation to marker posts and corrosion control and coating.

Efficiency Analysis for Base Year		**2004/2005**		
		High	Medium	Low
Adjustment Detail				
Pipeline and AGI maintenance: marker posts	**£m**	-0.3	-0.15	0
Pipeline and AGI maintenance: corrosion control and coating	**£m**	-0.2	-0.1	0
Total Efficiency Adjustment for Year	**£m**	-0.5	-0.25	0
Activity Cost Analysis	**ACTUAL SPEND**	**TPA RE-ASSESSMENT BASE YEAR**		
		High	Medium	Low
Terminals and Compressors	13.7	13.7	13.7	13.7
Pipelines and AGI's	3.8	3.3	3.55	3.8
PMC	1.8	1.8	1.8	1.8
Planning	2.7	2.7	2.7	2.7
Non-Routine Maintenance	7.8	7.8	7.8	7.8
Total £m	**29.8**	**29.3**	**29.55**	**29.8**
Efficiency Adjustment % of Total Engineering Services Budget for Year		1.68%	0.84%	0

Source: TPA Analysis

SECTION 5. CAPEX BUSINESS CASE REVIEW

5.1 Introduction: Objectives and process

The objectives of this section of the report are:

- To establish and review the Business Case for all capital investment in 2002-2005 ("Business Case Review")
- To review the efficiency of delivery of the capital investment programme ("Capex Delivery Review")
- To provide a commentary to Ofgem in relation to business case and efficiency that can be considered as part of the 2006 TPCR review

The TPA Business Case Review is in Section 5 and the Capex Delivery Review in Section 6 with commentaries after each of these. [3]

5.1.1 Review Methodology

TPA reviewed the responses to the Historic Base Plan Questionnaire and submitted further requests for information including requesting copies of all Governance Papers for capex projects with a value greater than £5M. As a result of a review of this information, a number of projects were identified for detailed analysis, based on the following criteria agreed with Ofgem:

Business Case

- The projects selected should have a range of drivers

Project Type

- Projects to include both pipelines and compressor assets and as such provide a reasonable proxy for future capex, the majority of which (>90%) is in these same categories.

Materiality

- Projects should have a capex >£10M as these were thought to be a good test of National Grid processes and any findings were likely to be material.

2002 – 2005 Projects

- Majority of Capex should be incurred within the period 1 April 2002 – 31 March 2005

Based on the above criteria, the following projects were selected:

[3] *Figures are as submitted by National Grid in the HBPQ in Q4 2005, with clarifications in Q1 2006 (notably TP1135 which updated the capex forecast figures for the 5 year period). National Grid have subsequently provided updated capex actuals figures for 2005/06, and these are shown where appropriate. However, TPA has not received any further update to the forecast for the 5 year period, hence the aggregate 5 year forecast figures do not take account of the updated 05/06 data. Project specific totals are also taken from the project approval papers*

Projects selected for Review

Project	Reason for review	Key questions for the review
St Fergus – Aberdeen	Capex overspend (£50M budget, £80M outturn) and difficulties in obtaining landowner consent	• Why was this project so much more expensive than expected? • Why does it appear to take longer to build pipelines than in previous years? • Is there an efficient Pipeline Project delivery process? • What lessons were learned and are they being applied to future pipelines?
Avonbridge Compressor station	Business Case and capex overspend (£50M budget, £63M outturn)	• Why was this compressor station built? • Was the sizing appropriate? • What about a pipeline alternative or an electrically driven machine? • Was delivery efficient?
Aberdeen – Lochside	Business Case and project delivery efficiency	• Why was this project built? • Should it have been cancelled when circumstances changed? • Lessons learned for the future?
Cambridge, Kings Lynn and Nether Kellett compressor stations	Project delivery efficiency including project slippage	• Is there an efficient Compressor Station project delivery process? • Why was there significant slippage on these projects? • What lessons were learned and are they being applied to future compressor related works?
Bacton – Kings Lynn	National Grid believe this was a significant success	• Lessons from this project • Unit Costs

The above projects had the following characteristics making them appropriate for review:

Business Case

- TPA satisfied itself from an initial review and interviews that the Bacton related capacity projects had a sound Business Case
- However, TPA believed that there was less confidence in relation to some of the St Fergus projects and these therefore merited detailed reviews.

Project Type

- These projects cover all the range of National Grid capex
- As such, the review would provide understanding of business processes and data that can inform the review of forward capex.

Materiality

- In terms of Capex materiality, the above projects represented around 47% of the £426.4M Capex incurred in the period 2002 – 2005 (£200M)

2002 – 2005 Projects

- Majority of Capex was incurred within the period 1 April 2002 – 31 March 2005
- The St Fergus – Aberdeen pipeline was forecast for completion in 2001 but was delayed. Given that the original approval amount for this project was £50M and the final amount was £80M, Ofgem requested TPA to review this project

Review of other >£5M Projects

In addition to the above, TPA carried out a high level review of all other projects with capex >£5M in order to establish the Business Case and benchmark costs against other similar projects delivered by National Grid in the past and, if possible, against similar projects identified elsewhere. The projects were also reviewed to identify if and how National Grid applies lessons from one project to later projects to ensure continuous improvement.

5.1.2 Process and Information Exchange

National Grid provided a large amount of information in response to the HBPQ issued by Ofgem and answers to 138 further questions from TPA. [redacted]

In addition to the formal question and answer process, TPA held a number of focused workshops and meetings which allowed TPA to review and challenge National Grid staff both in relation to general processes and strategy and to specific capital projects. The following table summarises the workshop and meeting sessions specifically related to the Capex part of our study. All the meetings and workshops were helpful and TPA received a good level of co-operation from National Grid during this process.

Table of Capex Meetings

Date	Purpose	Project Reviews
20 December 2006	Preliminary meeting to establish requirement for further workshops and meetings	
13 January 2006	CAPEX: 1. St Fergus expansion related projects 2. General capex review (2002-2005)	St Fergus – Aberdeen Aberdeen – Lochside Avonbridge Compressor
16 January 2006	CAPEX/OPEX: 1. Compressor serviceability 2. Opex/capex split re. compressor maintenance and component replacement	
18 January 2006	CAPEX: • Project Delivery Strategy (Pipelines and Compressor Stations)	St Fergus – Aberdeen Aberdeen – Lochside Avonbridge Compressor Station Kings Lynn – Bacton Compressor Stations
6 February	CAPEX: Compressor Serviceability Project Delivery	Air Intake and Exhaust Stacks

Date	Purpose	Project Reviews
16 March	Kings Lynn and Peterborough compressor station visit	
23 March	Avonbridge compressor station visit	

5.2 Capex (2002-2005)

As a starting point for the review, National Grid provided a table of actual capex for the period 2002-2005 with their latest forecast for the full 5 year period: The figures in this table are taken from National Grid's HBPQ Submission, Executive Summary, figure 13, and from the HBPQ data tables, tab 11, as modified in TP1135.

National Grid Historic Capex Figures

		Capex £M						
		Actual to 2004/05	**Forecast For 05/06 and 06//07**	**Actual to 2005/06**	**Forecast Total to 2006/07**	**Allowed to 2006/07**	**Diff(+/-) to 2006/07**	**National Grid's Main Reason for Difference**
Load Related	Entry - Capacity	161	175.6	311.4	337	101	-236	Easington related capex for Ormen Lange *
	Entry - Summer Flexibility	78.7	3.6	79.9	82.3	415	332.7	No customer demand for higher summer capacity
	Exit - Power Stations	0.5	27.4	0.5	27.9	39	11.1	Lower CCGT growth
	Exit - Demand	61.6	4.3	60.1	65.8	134	68.2	Lower gas demand
Non-load related	Compressor Emissions	0	68.5	0.0	68.5	53	-15.5	Broadly in line
	Compressor Serviceability	46.9	25.4	55.4	72.3	76	3.7	Broadly in line
	Other (inc PMC and IS)	9.7	39.3	32.7	49	42	-7	Broadly in line
	Sub- Total	**358.4**	**344.1**	**540.1**	**702.8**	860	157.2	
	Incremental SO Entry Capacity	5.7		5.7	366.8	0		*Milford Haven
	SO Capex	72.2	27.4	85.1	99.6	27	-72.6	Original costs under-estimated
	Total Capex	436.3	371.5	625.2	1174.7	887		

Source: HBPQ Exec Summary fig 13, as modified by TP1135, and updated by TP1139 for 05/06 Actuals

Notes :

i) Capex associated with Milford Haven is 'Incremental SO Entry Capacity' and not TO Entry Capacity. These projects will be reviewed in the forward capex report.

ii) SO Capex will be reviewed in a separate report.

iii) Prior to 2002, Transco (then part of Lattice Group) had a different method for categorising projects, referring to '1 in 20 demand' for certain load related investments. All capex approved in this category has been re-allocated by National Grid into the above categories to ensure a consistent approach from 2002 to 2012.

A number of categories of capex show material differences between those allowed in the 2001 PCR and the latest forecast for the 5 year period. National Grid has indicated why the forecast outturn will be different, with the main reason shown in the right hand column in the above table. An objective for TPA is to review the reasons for these differences.

5.2.1 National Grid Organisation and Capex Governance

National Grid has provided details of its capex approval processes (Quality Control Plan NSBP003 and Contract management and Reporting Procedure NSBP133) and these were discussed at the 20th December 2005 meeting with Jon Carlton, Network Strategy Director of National Grid's Transmission business.

The Network Strategy Department is responsible for the Business Case for all capex projects; please refer to Section 4.2 for details of this department. Project Delivery is the responsibility of the Construction Directorate which was formed in 2005 to be responsible for delivery of all capex projects, in gas transmission, gas distribution and electricity transmission.

In relation to gas, there are 17 Contract Managers in Construction Directorate who deliver the capital programme, with all elements of the work programme outsourced and only a minor amount of Engineering Service labour (£200k) capitalised as part of this programme.

Whilst procedures have changed as a result of the October 2002 merger of National Grid plc and Lattice Group plc, and the Construction Directorate has been established, National Grid has said that there have been no fundamental changes in relation to NTS capex strategy, both in relation to planning and delivery, though TPA noted that a number process improvements have been made.

Planning is discussed in section 5.2.3 below as part of the Capex Business Case review, delivery strategy and execution is discussed in Section 6 below as part of the Capex Delivery Review.

5.2.2 Project Approval Governance

For each capital investment project, National Grid has a well defined governance process that has been in place since 2001. For each project the key elements of the governance process are as follows:

A capacity expansion scheme is identified within Network Strategy at the end of an annual consultation process with the industry, during which National Grid revises its supply and demand forecasts and produces a supply/demand match, with any necessary reinforcement identified.

Before a scheme is sanctioned a feasibility study will be carried out to determine if it can be constructed and made available in the timeframe proposed. For larger schemes a risk workshop is carried out to determine the cost range for sanction.

All schemes involving expenditure of greater than £100,000 follow the principles and guidelines laid out in the Investment Scheme Procedure (ISP). The ISP outlines the stages that each scheme must follow from inception to closure. It specifies the structure and contents of scheme documentation, and assigns responsibility for the control, implementation and completion of the investment schemes to relevant personnel.

The ISP also summarises the minimum authority levels for transmission scheme approvals. For all schemes where the total cost is over £1m, approval is sought from the Transmission Project Sanctioning Committee (TPSC), a sub-committee of the Transmission Executive Committee. For schemes where the total cost is over £30m, approval is sought from the National Grid Executive.

The ISP identifies the scheme sponsor and project manager roles as being key to the development and delivery of schemes. Scheme sponsors are responsible for coordinating

and leading cross-functional scheme teams to develop schemes and prepare scheme papers. Project managers are responsible for the delivery of schemes following approval.

All approved transmission schemes are monitored and reported. For schemes where the total cost is over £1m, an exceptions report is prepared and presented to the TPSC on a quarterly basis, chaired by the CEO of National Grid Gas. This identifies schemes where the expected costs have moved outside the approved cost range and schemes where the expected completion date is beyond the approved completion date.

Within the project life-cycle, the key Governance Papers are as follows:

Project Approval Paper which goes to National Grid Gas Transmission Management Team and to National Grid Executive and Board for higher value projects, with re-submission in the event of higher capex or schedule impact

Project Review and Close-out Report prepared by the National Grid Contract Manager who is responsible for project delivery

Final Completion Report prepared by the National Grid Project sponsor and reviewed within National Grid to capture lessons learned.

National Grid says that a number of process improvements have been made since the merger with Lattice Group in 2002, including:

- All processes have ISO 9001 which includes regular validation by an external agency
- A more robust option selection process has been introduced
- A Project Sponsor from Network Strategy department maintains involvement from initial feasibility through to commissioning.
- Establishment of a Construction Directorate for delivery

More details of the entire 'planning, through delivery, to operations' process are given in the Opex review, Section 3 (i.e. review of the Network Strategy asset management function)

5.2.3 Network Planning Process

TPA has reviewed the processes and procedures used by National Grid in its network planning function, as set out in Section 17 of its Safety Case for its Gas Transmission Business (Section 17). TPA is satisfied that the process is generally sound.

However, given that network flow simulations provide the bedrock for the majority of investment by National Grid, in the light of major industry change, TPA believes that it is now appropriate to review the level of the Flow Margin applied within the Falcon flow simulation model.

The following section describes the Flow Margin, taken from Section 17 of the Safety Case.

"In the process of Network Analysis an allowance needs to be made for variances in gas flow from the assumptions made in the base case design. This is referred to as the "flow margin" and exists to provide a margin of cover for a list of effects or events wherein the actual flows and pressures on the NTS will differ from those in the base case design. This margin takes the form of a percentage increase in flows used for network analysis and there are two elements:

Transient Component

This element encompasses compressor trips, forecasting errors, suppliers' alerts, producer variation and operational state changes. These are outlined as follows:

- *Compressor trips - when a compressor trips downstream pressures fall and time is needed to bring on LNG (Operating Margins) to maintain supplies.*
- *Forecasting errors - there is a time delay between distribution systems taking increased rates from the NTS and additional supplies being provided from beach or storage.*
- *Suppliers' alerts - when there is an offshore alert, additional time is needed to bring on LNG.*
- *Producer variation - the rates at which producers deliver gas, can vary from the assumed steady 24-hour flat rate.*
- *Operational state - as demand changes from day to day the configurations used within the network need to change to meet the new flow pattern.*

All of the above refer to a time element, which results in a need for linepack to provide the flexibility to respond to the changes. The margin used to cover these transient elements is 2.5%.

Transmission Capacity Component

Typically on the NTS it takes three years from the launch of a project to its commissioning. Therefore, the project will be based on predictions of supply and demand three years ahead. In the interim period the actual pattern of supplies and demands will develop and will differ from the assumptions made at the project launch. An analysis has been carried out on the costs of failure on the NTS against costs of installing additional transmission capacity such that the NTS would fail in just 25% of 1 in 50 winters. The value for the corresponding flow margin is 2.5%.

The overall flow margin is obtained by adding the transient and transmission capacity component together to arrive at a figure of 5%."

Source: Safety Case, section 17

In the case of a St Fergus flow of 156 MCMD the calculations of pressure loss on the network model would be done on a flow of 156 x 1.05 MCMD (163.8 MCMD) and the pressures would be based on the higher flow although the reported flow would be lower

TPA believes that the Flow Margin was derived at a time when flows were increasing in most places on the system so capacity was tight, demonstrated in the south in 1987 when there was an exceptionally cold spell of weather and the last 1 in 20 day occurred (13th January 1987). TPA believes that the Transmission Capacity Component may no longer be appropriate and that the Transient Component should be reviewed to take into account changed circumstances in 2006 including:

- Flows in decline at St Fergus
- Additional summer flexibility investment made at St Fergus and Bacton provides additional peak linepack and capacity as a by-product
- Additional capacity as a result of the installation of electrically driven compression
- Higher CV's in the future due to LNG
- Independent storage operators who can provide gas and CCGT's who have demonstrated that they can release capacity (40MCMD in winter 2005/6) at peak times
- Interaction with Operating Margins which have a similar purpose
- Improved information available to System Control as a result of the Ulysses System Control Project

Specifically, TPA believes that a 5% margin may lead to over investment in capacity to the South West which is proposed in the FBPQ and possibly in relation to the new entry terminals.

5.3 Business Case Review

The following projects were reviewed in detail:

- St Fergus to Aberdeen pipeline
- Avonbridge compressor station
- Aberdeen to Lochside pipeline
- Bacton to Kings Lynn pipeline
- Kings Lynn, Nether Kellett and Cambridge Compressor projects

For each project, the key metrics and National Grid driver is given in a summary table, followed by further supporting details and discussion. For each Project, TPA comments on the Business Case with any recommendations for consideration by National Grid and Ofgem.

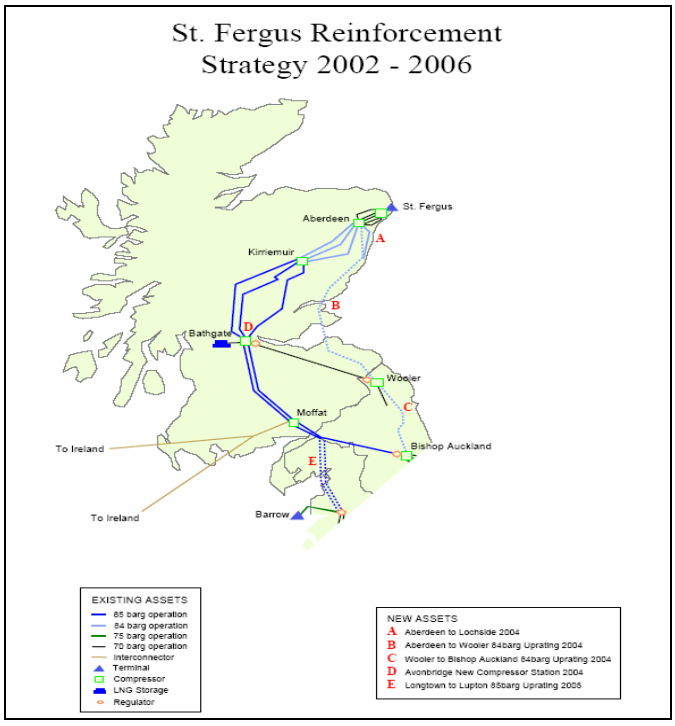
The other capacity related investment incurred during this period was at Bacton and this was also reviewed at a high level.

The first three projects have been reviewed together as they all increase St Fergus entry capacity, both in relation to the peak day and at times of lower demand when effective pipeline capacity is lower.

5.3.1 St Fergus Capacity Expansion Project Summary

Project	Scope	Approval and Completion	Business Case	Capex
St Fergus to Aberdeen Pipeline	72km, 1200 mm diameter	Approved in 1999, completed in 2002	Additional peak entry capacity	Approval capex was 50.2M, outturn 80M
Avonbridge compressor station	2 x 30 MW and 2 x 15 MW compressors	Approved in 2001, completed in 2005	Additional peak entry capacity but also related to serviceability and IPPC	Approval capex was 52.5M, outturn 63.4M
Aberdeen to Lochside Pipeline	50km, 1200 mm diameter	Approved in 2002, completed in 2004	Additional summer entry capacity	Approval capex was 50.2M, outturn 58.1M

These projects, together with associated uprating projects, are shown in the drawing below:



5.3.2 Strategy to Increase Entry Capacity at St Fergus

In addition to the above three projects, National Grid has also uprated the operating pressure of all its Northern NTS pipelines as a means to provide additional capacity. The following table shows the projects that have increased St Fergus peak capacity from 130MCMD to 156 MCMD at a total cost of £204M

Projects to increase St Fergus Capacity

Project	Scope	Month/Year approved	Year completed	Driver	Capex £M	Summer capacity MCMD	Peak capacity MCMD
Prior to this investment						***102***	***130***
Investment forecast to be completed prior to 2002							
St Fergus – Aberdeen	72km x 1220 mm dia	06/99	2002	Entry	80*	112	140
Investment post 1 April 2002							
Avonbridge compressor station	2 x 30 MW + 2 x 15 MW	05/01	2005	Entry / Service-ability	63.4	116	148
Longtown - Lupton uprating	70 to 85 bar	05/01	2003	Entry	6.5		
Aberdeen - Lochside	50km x 1220 mm	12/02	2004	Entry - Summer	58.1	122	156
Wooler - Bishop Auckland uprating	70 to 85 bar	12/02	2004	Entry - Summer	4.6		
Total					**206.9**	**122**	**156**

5.3.3 Capacity Efficiency

In order to assess the relative efficiency of incremental capacity addition, TPA has estimated the cost of increasing capacity as follows:

TPA Estimate of Cost of Incremental Capacity Addition

Capacity	Project	Estimated MCMD increment	Estimated CAPEX £M	Capex/MCMD £M	Comments
Pipelines	St Fergus – Aberdeen	10	80	8	
	Aberdeen – Lochside	6	58.1	9	
Uprating	Longtown – Lupton	2	6.5	3.3	
	Wooler – Bishop Auckland	2	4.6	2.3	
Compression	Avonbridge	6	100	16.6	Higher capex to take into account opex including fuel gas
Compression	Avonbridge	6	50	8.3	Reduction in estimated capex to take into account replacement of existing 45MW station.

Whilst there has been some simplification in this analysis, it does illustrate the ranking of these three approaches as alternative means to increase capacity, with uprating the most efficient. Whether additional compression or pipelines are selected depends on the individual circumstances of the capacity requirement, timing, environmental issues, fuel gas cost, future growth and utilisation.

TPA believes that the uprating of the Northern parts of the NTS from 70 to 85 bar operation has been efficient and has provided benefits to customers.

5.4 St Fergus – Aberdeen Pipeline Business Case

5.4.1 Background

At the time of approval in 1999, National Grid identified three potential levels of St Fergus peak capacity from the base level of 126 MCMD:

a) Increase to 130 MCMD (option rejected on the basis of strong evidence for higher flows)

b) Increase to 140 MCMD

c) Increase to 154 MCMD

National Grid selected Option b), and identified a new pipeline from St Fergus to Aberdeen as the most efficient way to achieve this. A higher capacity expansion to 154 MCMD was considered, but, *'on balance it was decided not to increase capacity to this level, though feasibility studies on the pipelines necessary would be carried out'.*

5.4.2 Commentary

TPA believes that there was a sound Business Case for this project based on the information available to National Grid at that time.

However, TPA believes that there may have been a deficiency in the planning process at the time of approval of this paper in 1999 in that there is no evidence that National Grid took a strategic approach in relation to increasing capacity from St Fergus, looking at the different means of increasing capacity from 126 MCMD to over 150 MCMD and taking into account such issues as future utilisation, IPPC requirements and the development of the entry capacity regime. TPA would have expected to see a paper setting out a comprehensive strategic approach from the outset of this expansion programme (in line with National Grid's thinking prior to the current PCR), with subsequent projects approved as part of the strategy.

National Grid argues that the Strategic Business Plan submitted to Ofgem in 2000 set out the strategy but TPA believes it should have been set out in a single paper that provided context to all the proposed St Fergus investment and that the existence of such a strategic paper may have reduced the level of investment actually made, as it would have set out the capacity and utilisation at St Fergus, identifying key risks such as Ormen Lange landing at Easington.

TPA notes that National Grid have done such a paper in relation to IPPC investment and recommends that in future National Grid sets out a strategic approach ahead of proposed major investments that are part of a longer term scheme, e.g. in relation to all the SW related investment for Langage and DN growth.

5.5 Avonbridge Compressor Station Business Case

5.5.1 Background

In November 2001, a paper was approved setting out the NTS Investment Strategy for 2003, with a capex of £159M. The discussion in this paper focused on Bacton capacity (Chalgrove - East Ilsey and Bacton – Kings Lynn, see Section 5.9 below). However, the paper also approved projects to increase St Fergus capacity:

- Avonbridge compressor station - £52.5M (new compressor station on National Grid land, adjacent to the existing Bathgate station)
- Aberdeen to Wooler uprating - £8.7M
- Longtown to Lupton uprating - £5.7M

The paper gave the reason for the Avonbridge investment as providing "Baseline Capacity" and that "the Baseline investment is consistent with Transco's GT licence obligations and will therefore be recovered through revenues allowed in the price control formulae". There was no link to Shipper demand.

There was an existing compressor station at Bathgate which was based on three Avon driven units, with a total output of 45MW. A fourth machine had been taken out years before when new compression was installed at Kirriemuir. The new Avonbridge station has two identical sub-stations, each with one 30MW compressor and one 15 MW compressor, giving a total capacity of 90MW. A maximum of 45MW is designed to be used at any one time with 45MW standby, with the different power ratings allowing more efficient operation at different flowrates. The existing Bathgate station had three Avon's, each of 15MW, with normally 2 running and one on standby.

National Grid accepts that the Project Approval Paper did not provide an appropriate level of review in relation to the Avonbridge project, and TPA acknowledges that papers since 2003 are improved in relation to option selection with a National Grid electricity process now adopted in gas (Procedure TP146, Strategic Options Paper).

National Grid maintains, however, that the selection of a new 90 MW station at Avonbridge was appropriate based on the following:

- The existing station (dating from 1977) required significant capex and there was not a straightforward option of adding additional machines due to the layout of the site
- Additional entry capacity (both peak and summer was required)
- IPPC regulations meant that it was possible/likely that the existing Avon gas generators would need significant investment (NOX related).

TPA has reviewed the papers associated with this project, National Grid's responses to specific questions and the 10 Year Statement at that time and accepts the following:

- There would be an ongoing requirement for a compressor station at Bathgate and the existing station was in need of significant investment due to age, condition, criticality and IPPC
- The view of IPPC regulations at that time was that compressor stations using Avon gas generators would require significant investment by 2007 in order to reduce NOX emissions
- There was also a Business Case for additional capacity at St Fergus as a result of pressure on entry capacity

- There were difficulties in expanding the existing station
- The future utilisation of the existing station was sufficient to justify replacement investment

5.5.2 Commentary

TPA believes that there was a reasonable Business Case to build a new compressor station at Bathgate. However, TPA does have a number of comments in relation to the selection of 90 MW for the new station and the process related to the approval of this project, as follows:

- There was no evidence of an overall St Fergus strategy (as explained above) and no link to the previously approved St Fergus to Aberdeen project that had increased both peak and summer capacity and was the start of a 5th St Fergus feeder.
- Other than by reference to investment needed to comply with GT licence obligations, there was no discussion in the approval paper as to why capacity at St Fergus was being increased and to what level and no consideration that assets may be under-utilised in future as the UKCS declined (as described in 3.3)

TPA believes that the Project Approval paper should have explained separately why a replacement compressor station at Bathgate was required (rather than a refurbishment) and then why it was proposed to also double capacity to 90 MW, with an increase in standby to 100% from 50% and an increase in power from 30MW to 45MW.

National Grid identified a new 95km pipeline, 1200mm diameter, from Wooler to Longtown as the alternative to Avonbridge, at an estimated capex of £85M. No comparison was made in NPV terms which may have indicated that the pipeline was more appropriate. The winning Avonbridge tender had a net present cost of around £99M at the time of contract award, which is likely to have risen to around £110M due to the capex overspend (ignoring the impact of higher gas prices). Given the unit costs for 1200 mm pipelines in Scotland it may be that the cost of the pipeline was similar to the cost of the new 90MW compressor station.

TPA believes that the pipeline alternative should have been considered, but that the most efficient outcome was for only 45MW of additional capacity with the existing 45MW of compression used as back-up in the same way that has happened at Kings Lynn. If this approach had been adopted, a further 45MW could have been phased later if required. Of the total 63.4M outturn, after allowance for land related and Bathgate costs, TPA estimates that around 30% of the remaining capex would have been saved if this approach had been adopted. To that end, TPA believes that the business case for £17.3M of capex on Avonbridge should only be classed as ‘reasonable’. National Grid says that this option was considered but rejected because the belief at the time was that the EA would not have accepted this and that, in addition, major capex would have been required to maintain the Bathgate machines as efficient standby plant

In addition, the IPPC submission for Avonbridge argues that an electrically driven compressor (which is the strategy now adopted, maintain the gas compressors for security, add electrically driven machines for bulk transportation with corresponding NOX reduction) was worse in NPV terms and in overall CO2 terms. TPA believes that it may be that 45MW of electrical capacity with the Avon’s remaining as standby was also a more efficient solution than the one implemented.

The current position (Q1 2006) is that the old Bathgate compressor station is still operational pending completion of repairs to some of the new compressors. The future

running hours for Avonbridge are dependent on gas flows from St Fergus. The load factor of Avonbridge will be reviewed as part of the review of forward capex, including in relation to both compressor serviceability and IPPC. The new station is acceptable in relation to IPPC and as such, offers some benefit going forward, though it is unlikely that there will be any requirement for the additional capacity installed over the Bathgate level, due to the decline in St Fergus flows.

5.6 Aberdeen to Lochside Business Case

5.6.1 Background

This project was approved in December 2002 by Transco plc Board, [redacted].

Quotes from the Executive Summary of the Project Approval Paper are as follows:

'This paper seeks approval for NTS investments totalling £57.7 million, required for the 2004/05 gas supply year. The investments identified, the construction of Aberdeen to Lochside pipeline (50km, 1200mm) and Wooler to Bishop Auckland 85 barg pipeline uprating, [redacted]

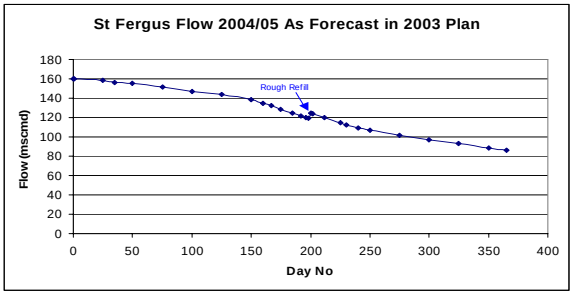
'The investment proposal will enable Transco to meet Baseline entry capacity at St. Fergus in the summer of 2005 by providing additional capacity flexibility to allow for any necessary major plant outage. [redacted]

Source: National Grid Approval Paper

The Aberdeen to Lochside investment and Wooler to Bishop Auckland uprating are the only summer flexibility investments for St Fergus and were approved on 3rd December 2002 for completion for the winter of 2004/5.

National Grid says in this paper that the forecast for supply growth at St Fergus at the time of approval suggested that the investment would be required to provide (peak) entry capacity by 2006/7 [redacted]. The decision to bring forward the project to 2004/5 was justified on the basis of providing summer flexibility capacity to enable continuing high gas flows from St Fergus towards the Bacton Interconnector during summer maintenance periods i.e. capacity to allow for any necessary plant outage, as most maintenance on the system is carried out in the summer.

The St Fergus entry flow forecast at the time of approval is shown below**:**



Source: National Grid 2003 Plan

Summer capacity (e.g. from demand day 150 onwards) is lower from St Fergus because gas demand in Scotland is lower. It is this demand that allows additional gas volumes to be transported from St Fergus in winter.

National Grid says (in response to a TPA question) that:

- In 2002 it had been experiencing higher summer capacity requirements from St Fergus terminal as Shippers exported gas to Europe through the Interconnector. There had been growing pressure from the shipping community (and consequently Ofgem) to make the levels of capacity available at entry terminals during the summer months similar to that available during the winter months.
- Whilst the traditional balance sheet process did not forecast high summer flows for St Fergus, National Grid Gas was required to sell baseline entry capacity on a flat (top-down) basis in a series of auctions for blocks of monthly entry capacity. On a longer-term basis, baselines had also been set by Ofgem as part of the SO incentives, although the first long-term auction was not held until January 2003. The licence arrangements also required that when the volumes are unsold in auctions (long and short term) they still have to be offered for sale on the day leaving the company exposed to buy-backs if the baseline capacity is physically unavailable and requested.

What this means is that if capacity on a July day is reduced to 120 MCMD, say, but shippers nominate 122 MCMD, [redacted] National Grid has demonstrated to TPA that there was and remains very little liquidity in this market and hence prices can be very high.

[redacted].

4 INVESTMENT OPTIONS

4.1 Recommended Option: Reinforcement of the NTS (P(50) forecast £57.7m)

The required reinforcements for the provision of summer flexibility at St. Fergus for Summer 2005 are a new 1200mm pipeline from Aberdeen to Lochside (50 km) and 85 bar_g uprating of the existing Wooler to Bishop Auckland pipeline system. The reinforcement identified through network analysis has been examined over a 10-year period, taking account the increases in both winter and summer capacities.

Without this investment, latent capacity at St. Fergus assuming no plant outage would be 1652 Gwh. With the investment, latent capacity of 1732 GWh can be realised. [redacted]

4.2 [redacted]

4.3 Proceed with projects on a pre-Form A basis until latest possible date

The Main Works Contract for the pipeline project must be let in January 2003 at the latest in order to meet a commissioning deadline of Oct 2004 with an 80% confidence. No further market or regulatory information will be obtained before January 2003 therefore the assessment of this investment proposal will not change by this date. The option has been discounted on this basis.

Source National Grids Paper Aberdeen to Lochside Business Case Dec 2002

The impact of Ormen Lange not landing at St Fergus was not considered to be a material risk given that [redacted]

7 RISKS

7.1 [redacted]

[redacted]

7.2 Project delivery risk

There are risks associated with the failure to deliver projects on time, therefore approval is being sought now to achieve the initial October 2004 commissioning requirement. Significantly, Contract Award needs to take place in January to maintain this deadline to a confidence level of 80%. All the project risks have been examined through a risk-workshop, and appropriate mitigating actions will be taken in-line with usual project management techniques.

7.3 Norwegian Imports

The current forecasts for St. Fergus include some assumed Norwegian imports from the Vesterled pipeline. There is a small risk of <10% that these imports do not materialise at St. Fergus. The proposals for importation of Ormen Lange gas are not forecast to start until 2006/07 and therefore do not affect this proposal.

Source National Grid's Paper Aberdeen to Lochside Business Case Dec 2002

Subsequently in the first long-term auction in January 2003 an additional 29 GWh of non obligated entry capacity was offered for sale and bought by Shippers. The revenue from the sale was £13.4M in 2004/5 winter and £4.4M in 2005/6 winter (these revenues are subject to 50% sharing factors)

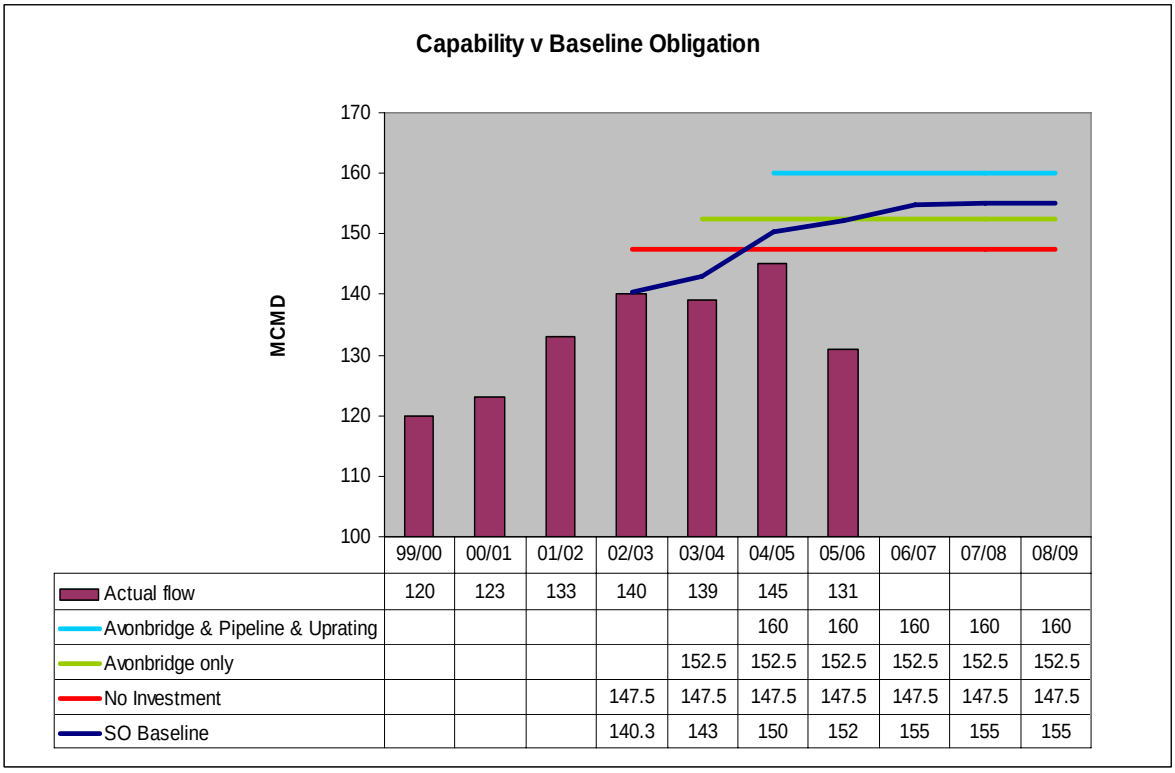
[redacted]

[redacted]

Formula Year			
	Summer	Winter	Total
	£m	£m	£m
2000	[redacted]	[redacted]	[redacted]
2001	[redacted]	[redacted]	[redacted]
2002	[redacted]	[redacted]	[redacted]
2003	[redacted]	[redacted]	[redacted]
2004	[redacted]	[redacted]	[redacted]
2005	[redacted]	[redacted]	[redacted]

Source: National Grid Answer to TPA 1056

St Fergus Baseline and Actual Flows



	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09
Actual flow	120	123	133	140	139	145	131			
Avonbridge & Pipeline & Uprating						160	160	160	160	160
Avonbridge only					152.5	152.5	152.5	152.5	152.5	152.5
No Investment				147.5	147.5	147.5	147.5	147.5	147.5	147.5
SO Baseline				140.3	143	150	152	155	155	155

Source: National Grid

The above graph shows the rising Baseline that was built into National Grid's Licence in 2002 and was the reason given by National Grid for having confidence that this investment would not be stranded in a financial sense.

5.6.2 Commentary

TPA Solutions agrees that a continuation of the St Fergus to Aberdeen 85 bar pipeline, 48" diameter, to Lochside is the most efficient way to increase capacity from St Fergus, both in relation to summer capacity (the driver for bringing forward this project) and peak capacity.

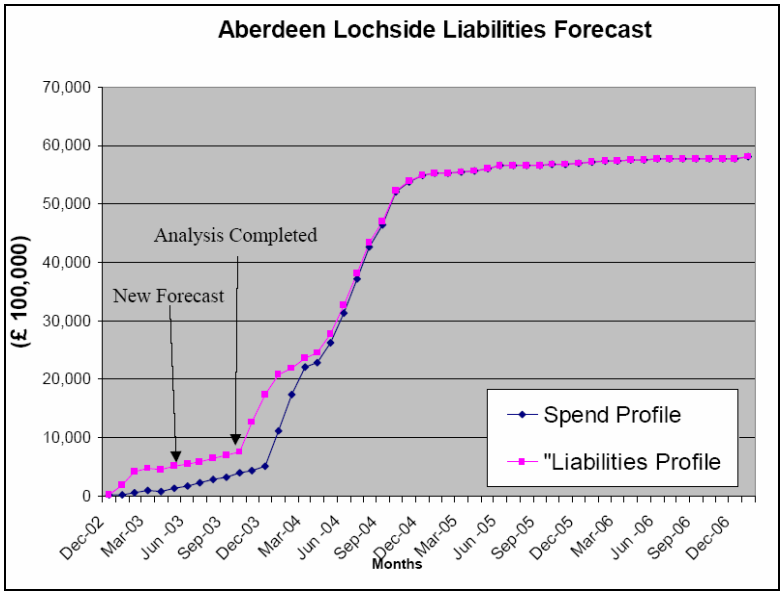
The fact that actual flows are significantly lower even that the 2002 Baseline, prior to completion of St Fergus – Aberdeen, Aberdeen – Lochside, Avonbridge Compressor station and uprating (total investment of £215M) does not mean that the decision was wrong at the time (December 2002). Note: of the £63M capex for Avonbridge, TPA estimates that £45.7M was related to replacement of Bathgate with £17.3M to provide additional capacity.

The issue that TPA believes is important is not whether it was right to approve the project in December 2002, but whether National Grid should have considered the cancellation of the project as a result of 2 developments in Q1 2003, within 2 months of Project Approval:

- First LTSEC auctions in January 2003 indicating no customer demand for increased summer capacity from summer 2005
- Decision of Ormen Lange to land their gas at Easington rather than St Fergus (National Grid informed in January 2003)

National Grid have produced a graph (below) that shows the cost of cancelling this project in 2003 and have said that this was considered in June 2003 with the decision to continue made. There is no evidence that National Grid and Ofgem held any discussions at any time in relation to the possible cancellation of this project nor that National Grid Executive (who approved the project) were informed of these developments and the impact on this project.

Costs of Cancelling Aberdeen to Lochside



Source: National Grid Answer to TP 1046

National Grid says that the fact that Ormen Lange was forecast to land at St Fergus by 2007/8 meant that it was not a significant factor given the project was based on the summer flexibility business case only.

TPA does not agree with this. The giant Ormen Lange field, discovered in 1997, is one of the largest gas fields ever discovered in the Norwegian or British sectors of the North Sea and can produce at up to 70 MCMD, supplying 20% of the UK's gas needs for up to 40 years. Without Ormen Lange, the St Fergus capacity expansion scenario (See Section 3) could not have existed in 2000/2001 at the start of the current PCR because there would have been insufficient gas to make it credible.

TPA believes that in December 2002 it was reasonable to approve this project based on the summer flexibility case, but only with a high degree of confidence of Ormen Lange landing at St Fergus at a later date. There was no discussion in the paper in relation to the Ormen Lange project at a time when the Operator, Hydro, was signalling that a new

pipeline to a southern UK landfall was a strong option and that any use of existing UKCS pipelines was likely to include SEAL (to Bacton) and CATS (to Teesside) as well as Miller (to St Fergus). Further, in the 17th July 2001 paper for Kings Lynn Compressor Station, a risk had been identified as follows:

> *'Competitive Offshore Infrastructure Development: In responses to the recent Transco "Transporting Britain's Energy" consultation document, several key producers including Norwegian companies, strongly indicated that they are considering the development of the offshore infrastructure delivering to Bacton. Whilst these projects represent 'competition' to future investment downstream of St. Fergus, they would fully mitigate the risk of stranding of these proposed reinforcements downstream of Bacton.'*

Source: National Grid Paper for Kings Lynn Compressor Station, July 2001

There was no discussion of this in the December 2002 Project Approval Paper for Aberdeen-Lochside. TPA believes that this was a significant omission as the Ormen Lange UK landing point was a highly material point in relation to increasing further the peak St Fergus entry capacity.

It is clear now and was clear from January 2003 that St Fergus capacity was likely to be far in excess of that required by 2006/7 as a result of the Ormen Lange – Easington decision. In addition, the Norwegians have also indicated since 2003 that the gas that currently lands at St Fergus, via the Vesterled pipeline, will be switched to Easington from October 2006.

National Grid argues that, at short notice, Norwegian gas can be switched back into St Fergus in the event that capacity was not available, thereby making National Grid pay uncapped capacity buy-back charges. TPA has been unable to confirm if this scenario is physically possible (to the extent that is material given the significant apparent excess capacity at St Fergus and the accelerated decline of UKCS production landing at St Fergus) but believes that this is something that should be considered by Ofgem as part of the review of Baselines. In addition, if this was the primary concern National Grid could have discussed possibility of UNC Modification limiting future offers of unsold capacity as they have done at Milford Haven.

National Grid argues that shippers continue to book St Fergus entry capacity at around the baseline level (TP1056). TPA accepts this but believes it is a reflection of the fact that entry capacity charges may be immaterial when compared to current gas and oil prices and hence there is no incentive for any trading to take place. The true measure is one of actual utilisation of capacity and the latest figures indicate that the St Fergus entry capacity is not being utilised because the gas is no longer there, irrespective of price. In addition [redacted].

The following table is taken from National Grid's Winter 2006/07 Consultation Document and shows the decline of the UKCS maximum at St Fergus.

Table 6 – Preliminary 2006/07 UKCS Maximum Forecast by Terminal

Peak (mcm/d)	2005/06		2006/07	Comments
	Forecast	Highest	Forecast	
Bacton	83	78	76	
Barrow	29	30	26	
Easington	17	20	16	
Point of Ayr	2	5	2	Difference accounted for by local power station
St Fergus[4]	110	98[5]	92	Noticeable decline in UKCS fields observed
Teesside	28	34	28	Difference accounted for by local power station
Theddlethorpe	23	30	26	
Total	**292**[6]	**295**	**266**	

Source : National Grid's Winter 2006/07 Consultation Document

Adding Norwegian imports of around 30 MCMD which are now forecast to land at Easington still leaves St Fergus at levels last seen in 1998.

TPA believes that more consideration should have been given to the cancellation of this project in Q1 2003. It could have been cancelled in Q1 2003 at a cost of around £4M. As a result of its construction, an asset of £58.1M has been created. TPA believes that National Grid and Ofgem should have discussed the issues associated with Ormen Lange and summer capacity/buy-back in February 2003 and that the project probably should have been cancelled at that time. At the very least, National Grid should have engaged with Ofgem. TPA recommends that as a matter of principle, National Grid should be allowed to fully recover the cost, in the event of a prudent cancellation.

Whilst there have been incremental sales of non obligated entry capacity at St Fergus, these have not been sufficient to justify the project. There may be benefits from this asset in relation to IPPC (reduced emissions) and lower opex at other stations, including the new Avonbridge compressor station, but these are unlikely to outweigh the financing costs of this pipeline. TPA believes that National Grid should have cancelled this project and taken a write-off to the P&L of around £4M (depending on timing) or, at the very least, informed Ofgem of the position whereby a £58.1M investment was being made solely to avoid possible buy-backs in summer 2005 only, with no requirement in future summers or winters.

TPA accepts that it was too late in Q1 2003 to also reduce the size of Avonbridge compressor station, though the incremental capacity at Avonbridge is also not likely to be required.

National Grid and Ofgem should consider an arrangement whereby National Grid is not penalised by making a decision to cancel a project when circumstances change (e.g. allowing costs incurred to remain in RAV provided National Grid has acted reasonably) and that Baselines can be modified from time to time to reflect supply/demand fundamentals and are not maintained at artificially high levels without good reason.

5.6.3 St Fergus Capacity - Asset Management Response

There are 2 developments that, taken together, mean there is likely to be significant under utilisation of NTS assets associated with transporting gas from St Fergus:

- St Fergus capacity has been increased from 126 MCMD to 156 MCMD and will further increase due to the additional capacity provided as a by-product of the IPPC driven projects at St Fergus and Kirriemuir.
- The decline of major UKCS oil/associated gas production, the landing of Ormen Lange at Easington and the capacity available in the CATS and SEAL pipelines means there is no longer any realistic prospect of St Fergus gas flows getting back to 2004/05 levels and even the 1998 level of 126 MCMD looks high. Whilst new sources of gas could slow the decline, there is no realistic prospect of an increase due to the maturity of the northern and central north sea basins.

[redacted]

TPA believes that there is also unlikely to be any requirement to run Aberdeen given that since it was installed in 1998 there has been around £150M of pipeline related capex to the north and south of Aberdeen.

Given the changing utilisation, TPA recommends that National Grid develop and implement an appropriate asset management response, aiming to reduce future capex and opex from the changing capacity position, as follows:

[redacted]

Other benefits from surplus capacity:

- The additional linepack in the Northern NTS as a result of the pipeline uprating projects and the St Fergus – Aberdeen – Lochside pipeline should reduce the need for both Operating and Flow Margins.

[redacted]

All options should be explored in order to ensure that National Grid is able to focus on those compressor assets that are required for Licence and Safety Case drivers.

At the same time, TPA believes that the St Fergus Baseline should be reduced, first to 125 MCMD from 2007/8 and then a second reduction to around 100 MCMD by 2010/11. This is to ensure that National Grid is not exposed to imports from Norway that are designed to exploit the capacity regime. Doing this in a phased manner will also maintain sufficient flexibility for market players who value excess capacity.

TPA believes that it is necessary for Ofgem and National Grid to agree an appropriate regulatory treatment in relation to assets that are no longer required as a result of the decline of UKCS production.

5.7 TPA Commentary on the Business Case for 2002-2005 St Fergus related Capex

No.	Title	Description	TPA Commentary
1	Flow Margin	In the process of Network Analysis a 5% capacity allowance is made for variances in gas flow from the assumptions made in the base case design. This is referred to as the "flow margin" and exists to provide a margin of cover for a list of effects or events wherein the actual flows and pressures on the NTS will differ from those in the base case design.	TPA believes that the Transmission Capacity Component may no longer be appropriate and that the Transient Component should also be reviewed to take into account changed circumstances.
2	St Fergus capacity expansion strategy	For the £215M investment in increasing St Fergus capacity from 130MCMD to 156 MCMD, there was no overall strategy set out and limited links drawn between the schemes approved in 1999, 2001 and 2002.	National Grid should ensure that a strategic approach is taken to capacity expansion, e.g. in relation to future Capex related to the SW/Langage.
3	St Fergus Capacity	Capacity at St Fergus is greater than it needs to be under all reasonably foreseeable scenarios as a result of developments at Easington, Milford Haven, Bacton and Isle of Grain. The rising Baseline that was built into National Grid's Licence in 2002 was the reason given by National Grid for having confidence that this investment would not be stranded in a financial sense. The actual flows have been and are likely to be significantly lower which means that up to £169M has been invested (based on 60 year lives) with limited prospect of full utilisation and possibly no requirement at all.	National Grid should review future utilisation of compressors and pipelines to reduce opex and reduce future IPPC and Serviceability capex on the northern parts of the NTS
4	St Fergus - Aberdeen	New pipeline to increase peak (and summer) capacity at St Fergus from 130 to 140 MCMD	Business Case was acceptable
5	Avonbridge (90MW)	Project Approval paper was poor with no justification offered for larger compressor station, for more standby capacity, for not refurbishing Bathgate, in relation to introducing electric drives, for not choosing other alternatives, and with £17.3M capex associated with capacity expansion having a weaker case. (Project execution strategy is discussed below). TPA believes a 45MW station may have been more appropriate and the best option, additional electrically driven machines, was missed.	National Grid has introduced a much more robust process since this project was approved. TPA believes there was a reasonable case for this project but not necessarily for the full 90MW that has been installed.
6	Aberdeen – Lochside and SO Incentive Impact	The SO Incentive should have encouraged National Grid to reduce the one-off high peak in 2004/05 by commercial means rather than make all the £215M investment. On the contrary, the rising Baseline in the Licence together with the buy-back regime and imperfect capacity market (lack of liquidity) incentivised National Grid to make additional investment earlier that it probably would have done otherwise.	Ofgem and National Grid should review the SO regime to ensure that this situation does not happen again There needs to be a mechanism to adjust baselines and/or mitigate buy back exposure in changing circumstances and where assets may only have minimal utilisation.

7	Cancellation of Aberdeen - Lochside	TPA believes that more consideration should have been given to project cancellation in Q1 2003 when it was clear Ormen Lange was to land at Easington and there was limited shipper demand for summer capacity. TPA believes that National Grid and Ofgem should have discussed the issues [redacted] in February 2003 and that the project probably should have been cancelled at that time. At the very least, National Grid should have engaged with Ofgem.	National Grid and Ofgem should consider an arrangement in future whereby National Grid is not unfairly penalised by making a decision to cancel a project when circumstances change.
8	Asset Management response to declining St Fergus flows	As a result of increased capacity to transport gas in the NTS from St Fergus at the same time as declining supplies, there is forecast to be a large number of compressor assets that are no longer required.	TPA recommends that as a matter of urgency given the IPPC programme, National Grid develops an appropriate asset management response to reduced future gas supplies at St Fergus, considering sale and relocation of assets, providing benefits in relation to Flow and Operating Margins and lower NTS opex and capex (this is explored in a note at the end of Section 5.6 and set out more fully in the forward capex report)

5.8 Other Load Related Capex

In the period 2002-2005, substantially all the Entry-related investment was incurred in the St Fergus and Bacton areas. There is a significant capex programme underway to increase Easington capacity (Ormen Lange related) and another in relation to Milford Haven LNG. However, capex prior to 1 April 2005 on these projects was relatively small and the efficiency of these projects is reviewed in the future capex report (to follow).

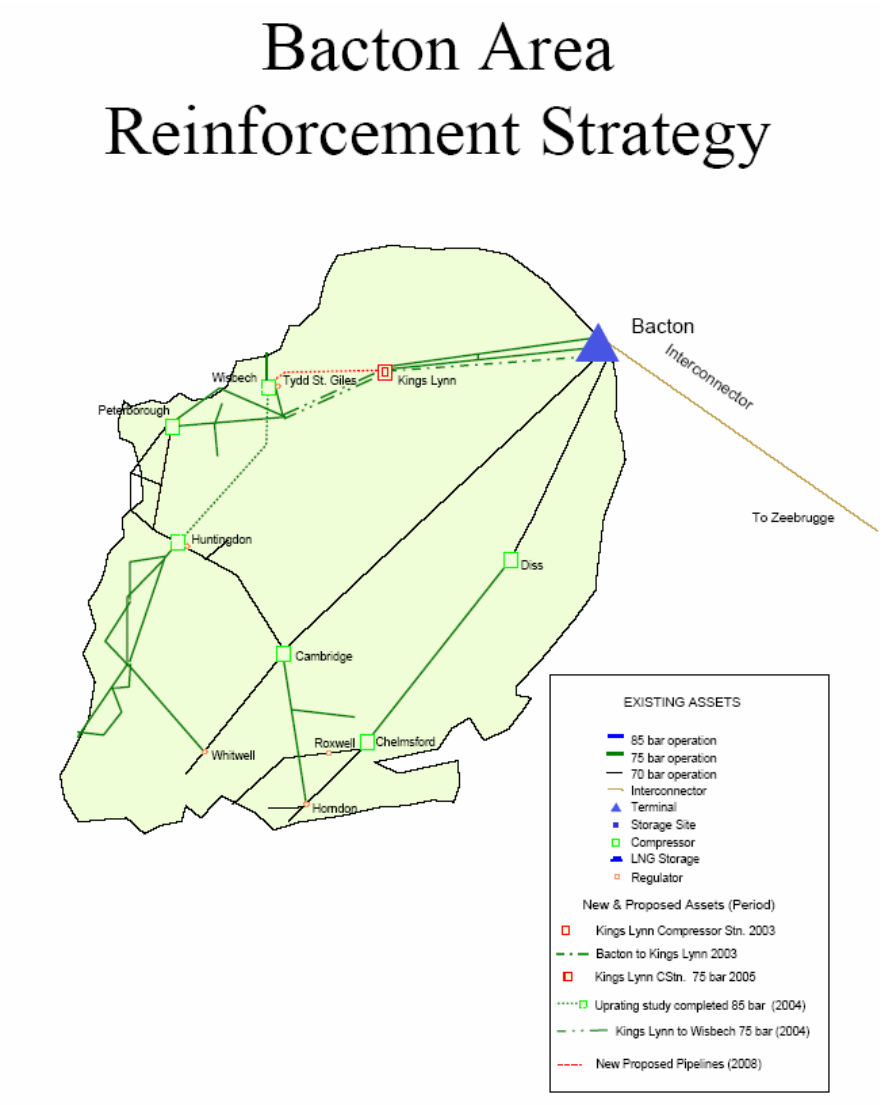
The majority of the Exit Demand-related capex was also incurred in the Bacton area and this is reviewed with the Bacton entry capex.

5.9 Bacton

5.9.1 Background

Bacton Related Projects

Project	Scope	Year completed	Driver	Total Capex £M
A. Willington - Steppingley	21km x 900 mm	2002	Exit demand (SW LDZ)	16.2
Cambridge – 3rd compressor	15 MW	2002	Exit demand (SE LDZ)	15.6
B. Cambridge - Matching Green	46km x 1200 mm	2002	Exit demand (SE LDZ)	32.9
C. Kings Lynn Compressor		2003	Entry	19.8
F. Bacton - Kings Lynn	65km x 1200 mm	2003	2/3 Entry/1/3 summer	52
K. Wisbech - Huntingdon uprating		Not implemented	Entry	3.4
Total				139.9



All future models for supply and demand include high flows in the South East quadrant with possible importation via the UK-Continent Interconnector, the BBL pipeline and the Isle of Grain LNG installation and possible exports through the Interconnector.

In order to accommodate the LNG from Milford Haven, National Grid is developing NTS reinforcement projects from South Wales to the Peterborough area. This is because National Grid network planners have to be able to link new supplies to sources of demand. Given the opportunity to supply the South East and the Interconnector, Peterborough is used as the node to which gas must be capable of being delivered. TPA Solutions supports this approach.

5.9.2 Commentary

Given the supply/demand backdrop at Bacton, with Interconnector exports in summer and imports in winter and with considerable uncertainty going forward in relation to the level and direction of Interconnector flows, together with the proposed BBL interconnector, TPA believes there was a good business case for National Grid to increase capacity in the Bacton – Kings Lynn area and the mix of projects to provide capacity and flexibility was appropriate.

In relation to the new pipeline projects to provide additional capacity for demand growth, TPA also believes that there was a good business case and the options selected were efficient.

5.10 Wisbech to Huntingdon uprating

5.10.1 Background

National Grid has completed a significant amount of feasibility work in relation to the uprating of the pipeline between Wisbech and Huntingdon. The current forecast of spend on this scheme is £3.4M.

5.10.2 Commentary

TPA believes there was a reasonable case to uprate this pipeline but that it is possible that this project will not now proceed and hence there will be no capacity benefit from the £3.4M invested to date. National Grid accounting policies would mean that National Grid should normally take a write-off to the P&L account after 5 years in the event that the project does not go ahead.

TPA believes that where economic and efficient opex is incurred in relation to the development of projects, Ofgem should consider providing some financial relief to National Grid in the event that the project does not proceed to construction.

National Grid is saying that this project is now scheduled for around 2010.

5.11 Non-load related Capex: £ 45.5 Million for Compressor Serviceability

5.11.1 Background

The table below summarises serviceability expenditure over the project period, categorised by project type. The drivers behind these projects are discussed below.

All in £M (outturn prices)	2002/3	2003/4	2004/5
Pipework and Valves			
Stabbings	1.1	1.2	0.4
Peterborough pipework and mods	1.8	0.0	0.0
Protection and Control Systems			
Bacton Remote Operations	2.2	0.0	0.0
Control System Replacement	0.1	0.1	0.8
Air Intake & Exhaust Systems			
Air Intake/Exhaust Stack major refurb & replacement	2.6	2.9	3.4
Exhaust stack sample points	0.0	0.3	0.2
Actuators			
St. Fergus	0.0	0.0	0.5
Moffat, Kirriemuir & Scunthorpe	0.0	0.0	1.9
Bacton	0.0	0.3	0.34
Other Items			
Spares (2 engines + 1 power turbine)	2.4	2.6	0.2
Zero Rates/Overhauls	3.7	3.5	4.6
Site security fences	0.0	0.0	1.5
Misc.	2.5	2.1	2.4
Serviceability	**16.4**	**13.0**	**16.2**

5.11.2 Pipework and Valves

Up until the end of March 2005, National Grid Gas invested £4.5M on pipework and valve major enhancement and replacement. The bulk of this investment was targeted towards the modification and/or replacement of compressor bridle pipework and casing connections (stabbings) installed on compressor stations (£2.7M). The remainder was invested at Peterborough Compressor Station (£1.8M) to undertake mandatory modifications to the discharge pipework, vent stack replacement and cab ventilation.

The principal driver for the investment on stabbings was safety.

The principal driver for the investment at Peterborough Compressor Station was to ensure the company's conformance to its licence obligations whilst also ensuring compliance with the safety and environmental legislation.

5.11.3 Protection and Control Systems

During the period up to 31st March 2005, £3.2M was invested on protection and control system replacement at Compressor Stations and Terminals. The majority of this spend was at Bacton Terminal (£2.2M) and Wormington Compressor Station (£0.8M).

Protection and Control system replacement at Bacton Terminal was sanctioned to enable remote operation of the terminal, whilst the work at Wormington Compressor Station is a trial installation ahead of wider planned asset replacement. Wormington Compressor Station is deemed to be the least 'network critical' of those stations requiring this type of asset replacement and therefore provides the opportunity to develop specifications and procedures on a site with less onerous consequences should project delivery be delayed. These procedures will then be applied to more strategically vital compressor stations.

Condition Assessment had identified that an increasing number of Protection and Control systems were becoming obsolete and unsupportable. As the installed asset base continues to age, if a replacement programme was not devised there would be an increasing risk that:

(i) Safety protection systems may fail on demand, resulting in damage to plant, an environmental incident or in the worst case expose personnel to unnecessary safety risks.

(ii) Multiple compressor stations or terminals may have to be declared unavailable.

5.11.4 Air Intake/Exhaust Systems

Up until the end of March 2005, National Grid Gas invested £9.4M on the refurbishment and replacement of Compressor Station air intake and exhaust systems. The bulk of this investment was targeted towards air intakes and exhaust stack major refurbishment and replacements (£8.9M) with the remainder on exhaust stack sample point installations (£0.52M).

During 2001, independent condition assessments were conducted by Cullum Detuners Ltd at all the air intake and exhaust stack units, which helped Asset Strategy (following challenge and review) develop a prioritised programme of works that targeted all relevant compressor sites up to 2007. Phase 1 of this replacement/refurbishment programme of works has been scheduled and carried out from 2002 to 2007. Phase 2 programme of works is scheduled to start from 2008/9 onwards.

The principal driver for this investment was to prevent a safety hazard, by carrying out work to stop structures becoming unstable as a result of increasing deterioration. Failure to carry out this work could have lead to consequential damage to the compressor machinery. In addition, another driver for this investment was to comply with Integrated Pollution Prevention Control (IPPC) legislation.

5.11.5 Actuators

Up until the end of March 2005, National Grid Gas invested £3M on valve actuator major refurbishment and replacement. The bulk of this investment was targeted towards actuators installed at Kirriemuir, Moffat, Scunthorpe Compressor Stations and St Fergus Terminal (£2.35M) with the remainder at Bacton Terminal (£0.65M).

The principal driver for this investment was to maintain system reliability in line with historic levels of performance, and major refurbishment was required as a result of poor condition, reliability and obsolescence of actuator parts. The work entailed the complete replacement of actuators at Bacton Terminal and major refurbishment of the actuators at the other four sites along with the replacement of their associated outdoor actuator control cabinets.

5.11.6 Other Major Items

£5.2M of investment was made in spares holdings to ensure sufficient cover for non-availability of gas generators or power turbines. Additionally, £11.8M was invested to overhaul and 're-life' gas generators to recommended OEM (Original Equipment Manufacturer) schedules. The driver for these investments is to maintain the integrity, reliability and operational efficiency of the National Grid fleet. Finally, £1.5m was invested in security fence enhancement/replacement at 4 operational sites.

The remaining expenditure is a wide variety of smaller investments under £500k. Examples include mobile gantries and vent systems upgrades.

5.11.7 Commentary

The Business Case for this investment is discussed in the Opex Section of this report Section 3. The efficiency of delivery of these projects, following the Business Case and funding approval, is reviewed in the capex delivery review section

5.12 Other capex - Emissions and Security Enhancement

5.12.1 Background

There was minimal investment in 2002-2005 in relation to 2 areas that have significant forecast capex for the period 2005 - 2012:

- IPPC – no capex
- Security – minimal security capex

5.12.2 Commentary

In relation to IPPC, the Business Case for this investment is discussed in the Opex Section of this report. National Grid has demonstrated that it was able to comply with the IPPC regulations without making any investment in this period.

The efficiency of delivery of these projects, following the Business Case and funding approval, is reviewed in the capex delivery review section. [redacted]

5.13 TPA Commentary on Business Case for 2002-2005 Capex – Summary

No.	Title	Description	TPA Commentary
1	Flow Margin	In the process of Network Analysis an allowance needs to be made for variances in gas flow from the assumptions made in the base case design. This is referred to as the "flow margin" and exists to provide a margin of cover for a list of effects or events wherein the actual flows and pressures on the NTS will differ from those in the base case design.	TPA believes that the Transmission Capacity Component may no longer be appropriate and that the Transient Component should also be reviewed to take into account changed circumstances.
2	St Fergus capacity expansion strategy	For the £215M investment in increasing St Fergus capacity from 130MCMD to 156 MCMD, there was no overall strategy set out and limited links drawn between the schemes approved in 1999, 2001 and 2002.	National Grid should ensure that a strategic approach is taken to capacity expansion, e.g. in relation to future Capex related to the SW/Langage.
3	St Fergus Capacity	Capacity at St Fergus is greater than it needs to be under all reasonably foreseeable scenarios as a result of developments at Easington, Milford Haven, Bacton and Isle of Grain. The rising Baseline that was built into National Grid's Licence in 2002 and was the reason given by National Grid for having confidence that this investment would not be stranded in a financial sense. The actual flows have been and are likely to be significantly lower which means that up to £169M has been invested (based on 60 year lives) with limited prospect of full utilisation and possibly no requirement at all.	National Grid should review future utilisation of compressors and pipelines to reduce opex and reduce future IPPC and Serviceability capex on the northern parts of the NTS.
4	St Fergus - Aberdeen	New pipeline to increase peak (and summer) capacity at St Fergus from 130 to 140 MCMD	Business Case was acceptable (project efficiency discussed in Section 6.3.3 below)
5	Avonbridge (90MW)	Project Approval paper was poor with no justification offered for larger compressor station, for more standby capacity, for not refurbishing Bathgate, in relation to introducing electric drives, for not choosing other alternatives, and with £17.3M capex associated with capacity expansion having a weaker case. (Project execution strategy is discussed below). TPA believes a 45MW station may have been more appropriate and the best option, additional electrically driven machines, was missed.	National Grid has introduced a much more robust process since this project was approved. TPA believes there was a reasonable case for this project but it may not have been approved today based on the more robust approach that has been adopted.
6	Aberdeen – Lochside and SO Incentive Impact	The SO Incentive should have worked to cause National Grid to reduce commercially the one-off high peak in 2004/05 rather than make all the £215M investment with a combination of a lower level of investment and commercial means. On the contrary, the rising Baseline in the Licence together with the buy-back regime and market (lack of liquidity) incentivised National Grid to make additional investment earlier that it probably would have done otherwise.	Ofgem and National Grid should review the SO regime to ensure that this situation does not happen again.
7	Cancellation of Aberdeen - Lochside	TPA believes that more consideration should have been given to its cancellation in Q1 2003 when it was clear Ormen Lange was to land at Easington and there was limited shipper demand for summer capacity. TPA believes that National Grid and Ofgem should have discussed the issues	National Grid and Ofgem should consider an arrangement whereby National Grid is not penalised by making a decision to cancel a project when

No.	Title	Description	TPA Commentary
		associated with Ormen Lange summer capacity [redacted] in February 2003 and that the project should have been cancelled at that time. At the very least, National Grid should have engaged with Ofgem.	circumstances change.
8	Asset Management response to declining St Fergus flows	As a result of increased capacity to transport gas in the NTS from St Fergus at the same time as declining supplies, there is forecast to be a large number of compressor assets that are no longer required.	TPA recommends that as a matter of urgency given the IPPC programme, National Grid develops an appropriate asset management response to reduced future gas supplies at St Fergus, considering sale and relocation of assets, providing benefits in relation to Flow and Operating Margins and lower NTS opex and capex (this is explored in a note at the end of Section 5.6 and set out more fully in the forward capex report)
9	Bacton Area Capacity Expansion	£142M of reinforcement to provide additional capacity had a sound Business Case, providing increased capacity to move gas to and from Bacton on peak and off peak days.	£3.4 M associated with the Wisbech-Huntingdon uprating has not resulted in any capacity. National Grid and Ofgem should discuss future treatment of abortive costs (links to 6 above). Note National Grid now indicate that the project will be completed in 2010.
10	Air Intake and Exhaust Stacks	Replacement of air intake and exhaust stacks on a number of compressor stations.	There is a reasonable case for this investment
11	Compressor Serviceability	Various other categories of replacement on compressor assets	The National Grid process for prioritising replacement is generally sound. The key issue relates to funding – should the replacement be done over 5 or 15 years, especially given future forecasts of lower compressor use.

5.14 Review of Expenditure by Business Case

Based on the above table, TPA's summary review of the Business Case on expenditure for 2002-05 is as follows based on 4 categories:

- Good – TPA believes that National Grid has demonstrated a good Business Case
- Reasonable – TPA believes National Grid has demonstrated a reasonable Business Case
- Weak – TPA believes that National Grid has demonstrated a weak Business Case
- None – TPA believes that National Grid has not demonstrated a Business Case

Review of Expenditure by Business Case

		Business Case				
		Capex from 2002/3 to 2004/5	**Good Case**	**Reasonable**	**Weak**	**None**
Load Related	Entry - Capacity	161.0	143.7	17.3 (25-30% of Avonbridge)	*	
	Entry - Summer Flexibility	78.7	27.4	8.85 (Aberdeen – Lochside)	45.25 (Aberdeen - Lochside)	
	Exit - Power Stations	0.5	0.5			
	Exit - Demand	61.6	61.6			
Non-load related	Compressor Emissions	0.0	0			
	Compressor Serviceability	46.9	46.9			
	Other (inc PMC and IS)	9.7	9.7			
	Sub- Total	**358.4**	287	26.15	45.25	

- There was a good case to replace Bathgate due to age, condition, criticality and IPPC. There was a reasonable case to increase the capacity to 90 MW from 45 MW, TPA's estimate of the split between good and reasonable. However, an electrical base-load option would have been the best solution with the existing station as a standby. TPA estimates that around 25 – 30% of capex related to Avonbridge was associated with increased capacity, the case for which is not as good as for the capex associated with replacing Bathgate

- Aberdeen – Lochside - £4M allowance made for costs prior to cancellation. In addition, total non obligated sales of entry capacity of £17.7M in 2004/5 and 2005/6 were achieved. Given that 50% of this benefit goes to shippers and 50% to National Grid, TPA believes that the 50% shipper element can be considered as a credit to this project and therefore £8.85M has been moved into the reasonable category. TPA does not believe there will be any future significant income from this capacity once the market is aware of the St Fergus capacity position

SECTION 6: CAPEX DELIVERY REVIEW – PIPELINES AND COMPRESSORS

6.1 TPA Methodology

Section 5 of this report reviews the business case for all capex projects carried out in the period 2002-2005. This section 6 reviews the efficiency of the delivery of the Transmission Operator (TO) pipeline and compressor projects using the following approach:

- Section 6.2 sets out the National Grid delivery strategy
- Section 6.3 reviews a number of pipeline and compressor projects in detail and others at high level
- Section 6.4 sets out the unit costs for compressor and pipeline projects
- Section 6.5 sets out TPA's overall findings in relation to pipeline and compressor project delivery
- Section 6.6 sets out TPA's key conclusions in respect to the efficiency of delivery of the 2002-2005 capital programme for pipelines and compressors

6.2 Capex Delivery Strategy

National Grid has adopted a strategy of a small number 17 of Contract Managers supported by procurement staff, to deliver all capex projects (pipelines, compressors, other). The fundamental strategy is that all works are outsourced to competent service providers:

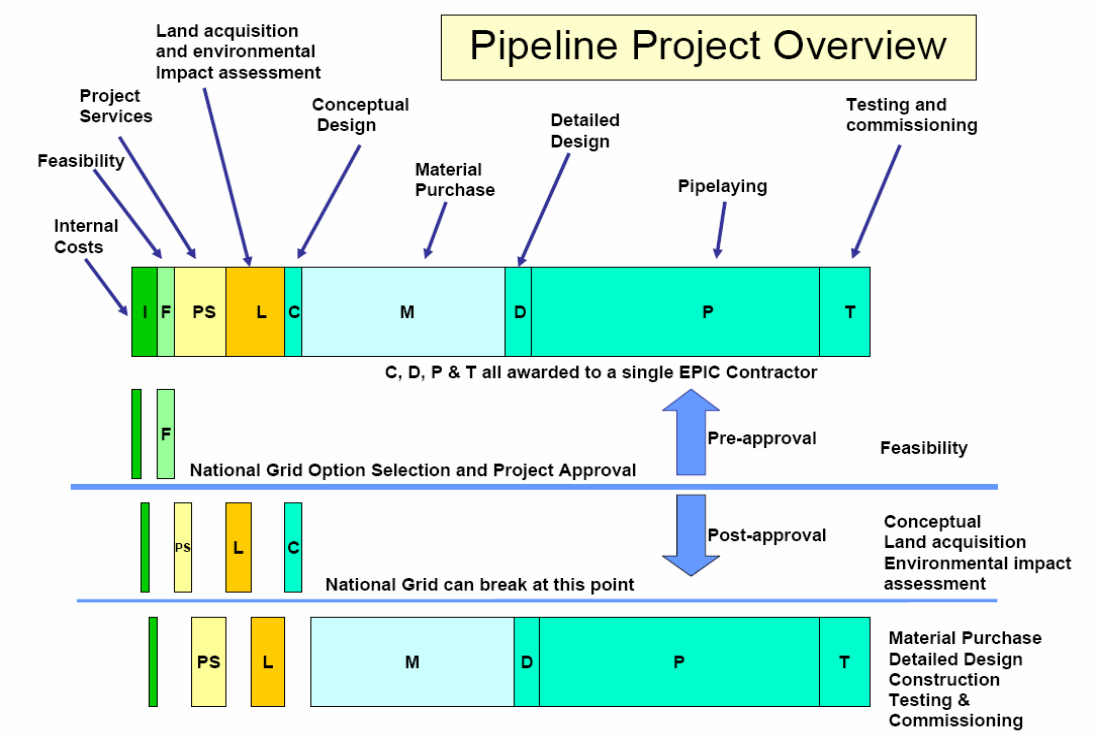
The National Grid Contract Managers and Procurement Staff appoint a Project Services Company (from an approved list, with agreed rates).

For Pipelines, the Project Services Company then tenders (on behalf of National Grid) to an EPIC (engineer, procure, install, commission) Contractor who will have responsibility for delivering the project from feasibility onwards. National Grid awards separate contracts for Land Acquisition (LA) and for Quality Assurance (QA).

For Compressor stations, the Project Services Company tenders (on behalf of National Grid) to an EPIC Contractor who has responsibility for delivering the project from feasibility onwards. National Grid awards separate contracts for LA and for QA but adopts a 'Proof of Concept' approach by paying the EPIC contract tenderers to carry out a Conceptual Design against a functional specification (start date, number of machines, design pressures, throughput, driver (gas or electricity)). The winner offers the best solution against combined technical/commercial criteria (including taking into account whole life maintenance and fuel costs).

The schematic below sets out the elements involved in a pipeline project (compressor related capex is similar). The proportion of work carried out by internal National Grid Gas staff capitalised to projects is small, around 0.1%. The remainder is competitively tendered to qualified suppliers, either on a Target Cost basis or using a Framework Agreement with agreed rates.

Elements of a Pipeline Project



Source: National Grid Presentation, 19.1.06

6.2.1 Feasibility to Commissioning Process

More details of the individual elements of the feasibility to commissioning process are given below.

6.2.1.1 Feasibility Study

For all projects, the requirement is identified in Network Strategy (see Section 3 above). A Feasibility Study, typically taking 16 - 24 weeks and costing 0.1% of the total pipeline capex (TP1121) or 0.4 - 2% of the total capex in respect to new compressor stations. Whilst some National Grid resources work on these Feasibility Studies, the majority of the work is sourced from pipeline design consultants.

(Note - The Feasibility Study is funded by National Grid unless it is specifically required as a result of a new large load or new system entry point as was the case in relation to Milford Haven and Isle of Grain)

6.2.1.2 Project Approval

At this stage funding is approved which releases monies to appoint the Project Services Company and a Land Agent. The Project Services Company issues an invitation to tender to the EPIC contractors on the framework agreement, covering the majority of activities at all stages of the project from the Feasibility Study onwards

6.2.1.3 EPIC Contract Strategy

The Contract strategy is a staged award process:

- Stage I involving the Conceptual Design, at the end of which National Grid can opt out of the project (e.g. if the requirement is no longer there or if costs are too high for that particular option). The cost of the Conceptual Design is relatively low, around 2 - 4% of the estimated total cost at Project Approval stage. The Environmental Impact Assessment is prepared by the EPIC Contractor as part of the Conceptual Design.
- Stage 2 moves onto more detailed design and construction, with a payment structure based on an incentivised (target) cost mechanism.

6.2.1.4 EPIC Contractor

National Grid outsources the day-to-day management of its gas capital program to pre-qualified service providers (4) under a new Framework arrangement developed in 2005. National Grid combines Conceptual and Detailed Design, Procurement of materials (apart from line pipe) and Construction into a single EPIC contract under the Institution of Civil Engineers Engineering and Construction Conditions of Contract 2nd Edition. For the latest pipeline projects which are approved after Feasibility, Option C is used, which is a target cost mechanism.

6.2.1.5 Materials

Materials - line pipe is purchased by National Grid Gas and free-issued to the contractor. All other materials, including valves, are purchased by the EPIC contractor

6.2.1.6 Project Services

The management process is contained within a suite of Business Procedures, underpinned by a suite of technical support procedures and it is the role of the Project Services Company to ensure that these are followed. The Business Procedures are outlined below:

(a) NSBP002 Change Control – How change is to be managed.
(b) NSBP003 Quality Control Plan – Timescales and dependency of activities on each other.
(c) NSBP181 Project Risk Management.
(d) NSBP136 Safety, Health and Environmental (SHE) Auditing/ Inspection
(e) NSBP007 Project Handover – certification and documentation.
(f) NSBP133 Contract Management and Reporting
(g) NSBP134 Project Delivery and Execution
(h) NSBP012 Quality Audits.
(i) NSBP013 Design and Design Appraisal.

The Project Services contractor is remunerated based on a schedule of rates for different resource, with timesheets signed off by the National Grid Contract Manager

6.2.1.8 Land Acquisition

National Grid uses specialist Land Agents to negotiate access arrangements with landowners, managed by the Project Services Company.

The Land Agent is remunerated based on a schedule of rates for different resource, with timesheets signed off by the Project Services contractor and the National Grid Contract Manager

6.2.1.9 Quality Control

This is the responsibility of the EPIC contractor but subject to an independent review process managed by National Grid, including on site inspection during the construction process.

The Quality Control contractor is remunerated based on a schedule of rates for different resource, with timesheets signed off by the Project Services contractor and the National Grid Contract Manager.

6.2.1.10 Health Safety and Environmental Performance

Day to day management of Health Safety and Environmental performance is the responsibility of the EPIC contractor but subject to an independent review process managed by National Grid throughout the life of the project.

6.3 Specific Project Review

A number of projects, below, were identified for detailed review (See Section 5). The key questions for TPA in this review were:

- Was delivery efficient?
- What lessons can be learned for future projects

TPA has restricted its comments in this report to areas that it believes are material.

Projects for Detailed Review

Project	Scope	Approval and Completion	Business Case	Capex
St Fergus to Aberdeen Pipeline	72km, 1200 mm diameter	Approved in 1999, completed in 2002	Additional peak entry capacity	Approval capex was 50.2M, outturn 80M
Avonbridge compressor station	2 x 30 MW and 2 x 15 MW compressors	Approved in 2001, completed in 2005	Additional peak entry capacity but also related to serviceability and IPPC	Approval capex was 52.5M, outturn 63.4M
Aberdeen to Lochside Pipeline	50km, 1200 mm diameter	Approved in 2002, completed in 2004	Additional summer entry capacity	Approval capex was 50.2M, outturn 55.4M
Bacton to Kings Lynn Pipeline	65km x 1200 mm diameter	Approved in 2001, completed in 2003	Additional peak entry capacity	Approval capex was 19.8M, outturn 19.2M

6.3.1 St. Fergus to Aberdeen Pipeline

6.3.1.1 Summary

The original estimated total cost of £51.8M, approved on the 25th June 1999, was based on the Transco database of historical costs together with an identified schedule of project specific risks. Re-approval was sought for the sum of £76.5M, an increase of 48%, approved on the 22nd November 2001, due to two principal issues driving the increase in project costs:

- Delays to the commencement of the 2001 construction programme, due to the national Foot and Mouth outbreak, £7.04m (14% increase)
- Significant delays in obtaining way leaves and failure to obtain access to 9km of the pipeline route, due to delays to the Compulsory Purchase Orders (CPO) process in Scotland, £12.61m (23% increase).

The final outturn costs are expected to be £80.5M

6.3.1.2 TPA Commentary

TPA has reviewed the project documentation and interviewed National Grid staff and comments as follows, with key findings identified in bold:

Foot and Mouth Disease:

Foot and Mouth disease has been a rare occurrence during the construction of the national grid network (two outbreaks, one in the 1960's and this recent one). TPA believes in the event of an outbreak it is difficult for National Grid to predict which projects might be affected. As such it is impossible build in contingencies for such an event occurring at project approval stage. The effects of Foot and Mouth on final project costs can be significant which can be seen on this project, where Contractor delays resulted in an additional £7M. Whilst it may be difficult to predict outbreaks of Foot and Mouth, TPA believes that once confirmed, as in this case, it may have been possible to have reduced this cost by instructing the EPIC to shut down operations sooner. However, TPA believes that National Grid acted reasonably in the circumstances, given the St Fergus entry capacity pressure it was under at that time.

CPO Process:

National Grid has maintained that assurances given before the formation of the Scottish Parliament were not honoured which had a dramatically adverse affect in gaining consents through the CPO process. This is reflected in additional project costs of £17M which arose because the EPIC contractor could not access the land to lay the pipeline and all the costs associated with this fell to National Grid. **TPA accepts that the formation of the new Scottish Parliament and change in interpretation did contribute to project overspend as a result of the contract strategy which had been adopted.**

However, TPA believes that this problem would have been avoided had National Grid carried out the conceptual design and land acquisition process earlier, which was reasonable given its belief since 1998 that St Fergus was likely to be the source of new gas supplies to the UK. Had this been done, there would have been no need to commence construction of this project before all land owner consents had been secured. Whilst TPA is not saying the strategy was unreasonable, it was not as efficient as it could have been had National Grid been prepared to release funding for this project at an earlier stage.

c) Original Cost Estimate

TPA believes that the original cost estimate was also too low, based on the Aberdeen to Lochside pipeline completed in 2004, and because of the difficult terrain in Scotland (see unit cost review in section 6.4.1 below)

6.3.2 Avonbridge compressor station

6.3.2.1 Summary

The project was approved in November 2001 at a cost of £52.5M with the target for operation December 2003. Equipment failure and other issues delayed completion to May 2005 and the station is now operational, though TPA notes that there are continuing problems with performance which have caused National Grid to delay the decommissioning of the Bathgate compressor station until 2008. The final cost of building the new Avonbridge compresor station was £63M.

6.3.2.2 Commentary

TPA has reviewed the project documentation, interviewed National Grid staff and visited this compressor station. There are generally reasonable reasons for the 20% capex over-run that was incurred on this project, reflecting the strategy of minimal work prior to award of the EPIC contract.

In Section 3 of this report, TPA reviews the efficiency of National Grid's compressor station asset management approach and finds it to generally represent best practice. However, TPA had some concerns that the 'Proof of Concept' approach may have a number of deficiencies related to the transfer of knowledge and experience from National Grid to the EPIC contractor and makes a number of observations in relation to this project:

- National Grid did not make available copy of its compressor station feasibility study to tenderers which may cause valuable National Grid operational experience to be lost. TPA believes that National Grid has very good experience of operating and maintaining gas compressor stations, whereas the tenderers had very limited experience of this. National Grid argues that it reviewed the bids against its experience and has in place processes to ensure that its own asset management knowledge and experience is passed to the contractors.
- National Grid clearly defined the compressor station design and performance specification TP/PL/COMP/1 but this was not defined in the contract. Extract from National Grid's closure report "The winner bidder should verify the performance of the plant. Performance criteria should be given at design stage for this verification. This should have contractual definition".
- It is not clear that operational and maintenance costs are given appropriate weighting in selecting the winning tenderer. For example, in the whole life NPV calculation of the winning bidder, there was only £30k per annum for compressor station maintenance (gas generator/power turbine and compressors and all associated plant and equipment) and no accounting for spares which may have significant costs due to two of the Avonbridge machines not being used elsewhere in National Grid.
- Very high project services costs were incurred for this project which indicated that there may be insufficient informed buyer and specialist compressor capability within National Grid. National Grid says that additional resources have been recruited in key areas.

6.3.3 Aberdeen – Lochside

6.3.3.1 Summary

This project was originally approved by Transco on 13 November 2002 at £50.15M and completed in November 2004. The final outturn costs are expected to be £58.1M

National Grid has explained that the main reasons for the outturn cost being higher than the project approval amount related to a more expensive river crossing (£2.1M) due to environmental issues, adverse weather (£1.8M) and unforeseen ground conditions (£0.4M) .

6.3.3.2 Commentary

TPA is satisfied that this pipeline was delivered in a generally competent manner and that the outturn costs are reasonable and efficient.

6.3.4 Bacton - Kings

6.3.4.1 Summary

The original project was approved as two schemes Bacton to Brisley and Brisley to Kings Lynn on 28 January 2001 at £63.5M. The project was re-sanctioned on 2 September 2003 at £52.1M and the outturn cost is expected to be £52.3M

National Grid says that the reduction from the January 2001 estimate was because of 2 main reasons:

- Awarding conceptual design and environmental impact assessment to the main works contractor leading to savings of £7.4M;
- Reduction in the number of Above Ground Installations required as the result of a new, risk based assessment process, saving £4.0M. This approach will be utilized for all future schemes.

6.3.4.2 Commentary

National Grid's decision to incorporate a new contract strategy which allows the EPIC contractor to control all project elements from design through to final completion coupled with the reduction in AGI's appears to offer considerable cost savings. These factors coupled with the incorporation of best practice shared from similar projects e.g. Ozzy Padder, Automatic Welding and Ultrasonic Testing appear to have led to improved, efficiency and safety and a reduction in the number of adverse environmental issues.

TPA notes that this project used the Option A fixed price schedule rather than the target cost Option C that is now favoured in National Grid. It is not clear what the impact would have been had Option C been used on this project.

National Grid also acknowledged the importance of planning lead times and the need to involve the EPIC early in this process. It is difficult to reconcile why the introduction of this new contract strategy should lead to such a significant saving, especially as we assume that prior to this project National Grid would have been utilising their own experience and experienced pipeline design companies for conceptual design to ensure they were delivering cost effective projects.

In summary, TPA believes that National Grid managed this project in a competent manner.

6.3.5 Other Pipeline Projects

TPA also carried out a high level review of the other major pipelines built during this period:

a) Cambridge - Matching Green

The original project was approved by Transco on 14 December 2000 at £40.7m. The final outturn costs are expected to be £32.9m.

TPA believes that this project was executed efficiently and National Grid Gas should incorporate this good practice in their future projects.

b) Willington – Steppingley

The original project was approved by Transco Investment Committee (TIC) on 14 December 2000 at £19.2m. The project was re-sanctioned in June 2002 at £15.8M and the outturn cost is expected to be £16.2M.

TPA believes that National Grid's decision to award conceptual and environmental design as part of the EPIC as part of new contract strategy may have resulted in lower than originally budgeted costs and there is evidence that good practice from other projects was incorporated. The decision to award this project to the same MWC as Cambridge to Matching Green will have also lead to lower mobilisation costs and helped ensure an overall efficient outcome

c) Chalgrove to East Ilsley

The original project was approved by National Grid on 28 January 2002 at £17.45M, and the outturn costs are expected to be £17.9M.

TPA believes that this project was efficiently executed, benefiting from longer planning lead times.

6.3.6 Other Compressor Station Projects

General Comments

Compressor station plant and equipment and its design, operation and maintenance are an integral and crucial part of the operation of the National Transmission System. Since the development of the NTS, Transco and its previous organizations have been responsible for the design and installation of 24 gas transmission compressor stations with some 66 operating units. It should, therefore, be taken as a given, that the organisation has developed leading edge competencies in this vital area of its business. It is with this in mind that TPA reviewed the following compressor station projects completed in 2002-2005.

Cambridge Compressor Station

- Project approved in July 2000, target date 1 October 2001
- 1 new compressor, gas powered, 15 MW
- Operational acceptance in May 2004, final acceptance in September 2005
- Original approval amount was £15.6M
- The final scheme cost is estimated to be £17.2M.

The major reasons for the delay were due to a catastrophic failure of the compressor in April 2003 and delays due to re-wheeling of the existing compressors at Cambridge.

Nether Kellet Compressor Station

- Project approved in June 2000, target date 1 October 2003
- 2 new compressors, gas powered, 12MW each
- New units commissioned in September 2004
- Original approval amount was £19.9M
- The final scheme cost is estimated to be £22.9M.

The main reason for the delay was the fact that the original machinery supplied to site did not meet the contractual power rating

Kings Lynn Compressor Station

- Project approved in July 2001, target date 1 October 2003
- Proof of concept tender
- 2 new compressors, gas powered, 13.5 MW each
- New units commissioned in October 2003
- Original approval amount was £20.5M

The final scheme cost is estimated to be £19.8M.

Compressor Serviceability – Air Intakes and Exhaust Stacks

- The delivery strategy for these projects, bundling together a number of individual projects, was reasonable and efficient

Commentary

For the Kings Lynn project, there was a 'Lessons Learnt' exercise which represented good practice but also identified that National Grid needed a single department to have overall responsibility for ensuring that the whole process is joined up from start to finish. TPA believes that the current Network Strategy organisation is satisfactory in this regard.

- Examination of the personnel employed in the execution of these projects shows that National Grid did not have sufficient in-house expertise to control and manage compressor station projects as the majority of key personnel were provided by agencies or contract organisations. This could result in continuous poor performance in this key area of the business together with higher costs. TPA notes that in 2005 National Grid strengthened its resources in relation to machinery expertise and this is welcomed.
- There were no adverse consequences to National Grid in relation to capacity provision/buy-back as a result of the delays.

6.4 Unit Cost Review

6.4.1 Pipelines

[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]

6.4.1.1 TPA Analysis

	1200 mm dia		900 mm dia
No of Projects	2 in St Fergus area,	2 Bacton area	2 Bacton area
Unit Costs/km	£1,140,000	£750,000	£730,000
Option A versus Option C		Option A slightly lower	Option A slightly lower
EPIC costs/km	£710,000	£420,000	£445,000
Steel cost inflation	Analysis of 4 projects undertaken appears to indicate that material costs/km increased 17% between 2003 and 2004		Analysis of 2 projects undertaken appear to indicate that material costs increased 13% between 2002 and 2003
Pipe material costs/km	£250,000	£220,000	£160,000
Land costs/km	£75,000	£50,000	£40,000
Project Services outturn costs compared to approved	Outturn costs 100% above the original approved sum (Aberdeen-Lochside only as increase was higher for St Fergus – Aberdeen)	Outturn costs same as approved sum	Outturn costs 69% above the original approved sum
Project Services costs/km	£102,000	£50,000	£60,000

6.4.1.2 Commentary

- There is no strong evidence that Option C is better than Option A or vice versa
- Pipeline steel costs have risen reflecting the world market
- The 2 pipeline projects in the St Fergus area were significantly more expensive in all areas (apart from steel), reflecting both the terrain and the legal framework.
- There have been significant increases in Project Services costs even for the Bacton area projects.
- 1200mm dia pipelines appear to represent good value in capacity/km costs with efficiency in welding/inspection offsetting additional trenching and material costs
- TPA has compared the 900mm project unit costs with projects in National Grid in the 1995 – 2000 period and finds that these costs were generally at the lower end of the range.

6.4.2 Compressors

National Grid could not provide the same breakdown as for pipelines, but provided the following:

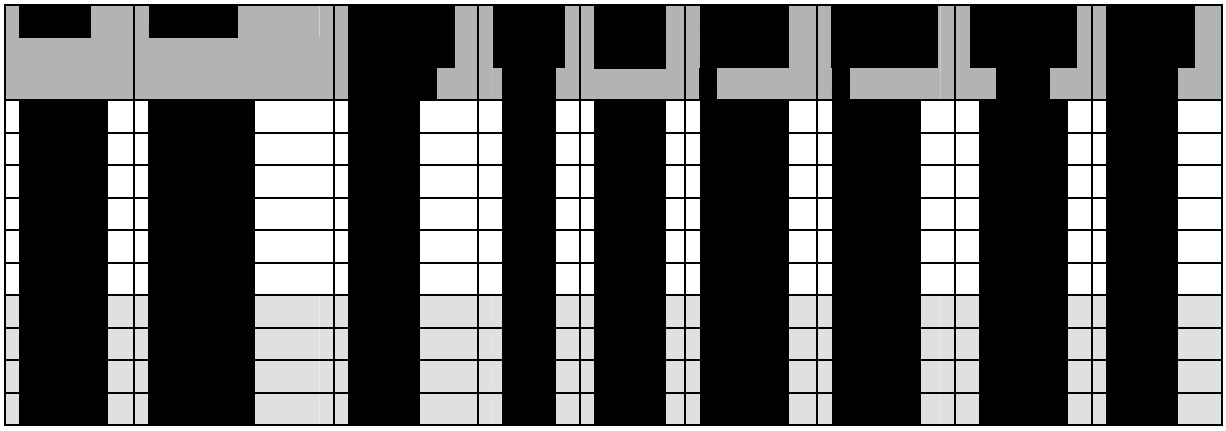
[redacted]

[redacted]							
[redacted]							
[redacted]							
[redacted]							
[redacted]							

Note: the EPIC Contract includes the capital cost of the machinery

** In addition, National Grid provided the unit costs for all compressor stations built since 1996, with costs inflated using an EC Harris index.*

[redacted]



[redacted]

6.4.2.1 Commentary

- The unit costs for Cambridge are high but include significant capex spent on refurbishing the existing compressor station (control system and other plant)
- The unit costs for Kings Lynn, Nether Kellett and Avonbridge are in line with historic numbers

6.5 TPA's Overall Findings in Relation to Efficient Project Delivery Review

6.5.1 TPA Commentary

TPA has reviewed National Grid's organisation, policies and procedures in relation to the delivery of the capital programme and has held a number of review sessions with National Grid staff. TPA has also reviewed Project Manager Closure Reports for a number of focus projects and summary Closure Reports for all other projects with capex >5M and has reviewed the unit costs for projects completed in 2002-2005.

Since these projects were completed, National Grid has made changes in the way it delivers similar projects. TPA comments below on the key factors related to project execution and sets out what it believes National Grid's latest position is.

Factor	TPA commentary	Latest position
National Grid Gas acts as **Informed Buyer**, with all work outsourced	TPA agrees that the principle is efficient but had some concerns regarding Informed Buyer Capability in respect to new compressor assets. This is further discussed in a) below	National Grid has recruited new staff in this area, in particular related to machinery.
National Grid Gas **only carries out a Feasibility Study** prior to National Grid Gas Project Approval Contract Award to the EPIC Contractor	For all the projects carried out in 2002-2005, National Grid was entirely in charge of the process from feasibility through to commissioning. Given that this was a period of stagnant growth in gas demand with no new system entry points and no major new offshore fields developed, it is disappointing that so many projects appear to have been under severe time pressure. TPA believes this may be, in part, due to starting projects later than was historically the case. This is further discussed in b) below	No change
The **EPIC Contractor carries out a Conceptual Design and then full Design and Build, with** National Grid Gas able to stop the project at the end of Conceptual Design if the need for the project has gone.	Adopting this approach to project enables the EPIC contractor to have earlier involvement in the planning/routeing process. In theory this should reduce the likelihood of future disputes and delays resulting in additional costs. Will high gas prices and reduced demand growth lead to cancellation of the Wormington to Sapperton project after Conceptual Design? TPA believes that there may be schedule advantages in National Grid carrying out the Conceptual Design as a stand-alone contract and bidding the project after that. If there is a risk of written off costs then this should be addressed by National Grid and Ofgem. This is further discussed in c) below	
Contracting basis is the **New Engineering Contract Option C** (target cost approach)	TPA 's evaluation of the EPIC contract costs for 6 major pipeline projects undertaken during this PCR indicates that Option A may give lower costs This is further discussed in c) below	Option C used for all
Steel pipeline is procured in-house and free-issued to the EPIC contractor	TPA believes that this is efficient given long lead times for steel pipelines and no obvious financial benefit from having a different approach.	
National Grid Gas prefers to build 48" dia pipelines, using X80 grade (high strength) steel, and utilising automatic welding techniques with ultrasonic examination of welds (e.g. build 20 km of 48" rather than 24 km of 42" to get the same capacity)	TPA believes that this is generally efficient and this is supported by the unit cost assessment.	
National Grid Gas believes that the **average time to obtain landowners permission has**	TPA accepts that it may take longer to obtain consent than in the past, but believes that this has also become a problem because of	

Factor	TPA commentary	Latest position
increased by 4 months	National Grid decision to do less work up front in preparation for the project which compresses the time compared to in the past (i.e. approving their project after feasibility study only rather than conceptual design).	
National Grid Gas believes that the need for an **Environmental Impact Assessment and the process involving the DTI and statutory Consultees** have also increased project timetables	TPA believes that there is evidence from other projects that this is the case.	
Design factors such as design and frequency of block valve installations.	TPA believes that policies and procedures are generally acceptable (though will be reviewed for Milford Haven projects)	
National Grid adopts a **'Proof of Concept'** approach in relation to new compressor stations, with a functional specification, in effect paying the 3 /4 tenderers to carry out their own Conceptual Design, all of which re capitalised.	TPA believes there is merit in this approach, but has concerns that National Grid expertise and learning may not be fully applied by the Contractors and also that ongoing reliability and operating costs may not be properly captured in the evaluation of the bids This is further discussed in d) below	
EPIC contractor workload and competitive pressures.	TPA believes that National Grid is focused on this issue but has not been successful to date in delaying projects.	
Project Services costs	There appears to have been a significant increase in these costs which are not subject to any target costing methodology. Given a continuing high workload, National Grid may be able to reduce these costs in the next 5 years.	

6.5.2 Further Discussion

a) Informed Buyer Capability

Actual Capex Compared to Project Approval Date Capex

National Grid Gas says it approves all capex projects based upon a P50 approach which means that a project has a statistically equal chance of being over and under budget. TPA believes that cost estimating capability can be a measure of how well the informed buyers know the market and the efficiency of the feasibility study and is a relevant factor in option selection, given the early approval of projects by National Grid Gas (after a low cost Feasibility Study)

In order to make a valid assessment of this, TPA selected all projects with total Capex > £10M that were completed in the Period 2002 – 2005 (including ones started in 1999, 2000 and 2001 but still ongoing after 1 April 2002). The following table lists all such projects and identifies the original capex approval amount when the project was first approved together with the final amount for each project. The third column has a reduced capex figure taking into account National Grid Gas's assessment of unavoidable costs as a result of the Foot and Mouth Outbreak in 2001. Pipelines, Compressors and IS/Telemetry are identified separately.

Original and Outturn Costs for all Capex Projects >£10m

Project	Original Approval Capex £M	Outturn Capex £M	Outturn Capex Adjusted for Foot and Mouth £M	Outturn (adjusted) compared to Approval +/- %
Willington – Steppingley *	19.2	16.2	16.2	-15
Cambridge - Matching Green *	40.7	32.9	32.9	-19
*St Fergus – Aberdeen *	*51.8*	*80*	*73*	*+41*
Mawdesley to Warrington *	51.4	59.5	58.4	+14
Birch Heath to Mickle Trafford *	11.5	14.2	14.2	+23
Chalgrove to East Ilsley	17.5	17.9	17.9	0
Bacton - Kings Lynn	54	54	54	0
Aberdeen - Lochside	***50.2***	*58.1*	*58.1*	*+16*
Total Pipelines	**296.3**	**332,8**	**324.7**	**+9.5**
Cambridge – 3rd compressor *	15.6	17.2	17.2	**+10**
Nether Kellet *	19.9	22.9	22.9	**+15**
Kings Lynn Compressor	20.5	19.8	19.8	**-3**
Avonbridge Compressor	*52.5*	*63.4*	*63.4*	***+20***
Total Compressors	**108.5**	**123.3**	**123.3**	**+13**

* indicates that the projects that were mostly built prior to 1 April 2002

Italics indicates that a detailed project review was carried out

Note - all capex amounts are on a like for like basis compared to the original project but all monies are not in consistent 2004/5 amounts

TPA's observations are as follows:

- The accuracy of estimates for pipeline projects and compressor stations are mixed with most projects within the +/- 10 – 25% band.
- TPA believes that a significant issues relate to the timing of Project Approval and the work done up to that date, together with the impact on project selection.
  - Prior to 1995, Transco used to complete all pipeline design work in house, with an established route tendered to a contractor. Project approval was then received after the costs were known and, as a result, very rarely did outturn costs exceed project approval costs. From 1996, Conceptual and Detailed design became bought-in packages but with the EPIC Contractor bidding based on a Conceptual Design, with known route.
  - The above Schematic in section 6.2 indicates the key activities required to build a pipeline or compressor station and shows that by only carrying out a Feasibility study at Project Approval stage, it is very difficult to be accurate as to the final project costs and it is this factor that leads to the 10 – 25% difference. As Project Approval uses an estimated route and estimated contractor costs, it is always likely that the actual route and actual contractor costs are likely to give rise to higher variances.
  - Sensitivity of option selection is therefore a factor. If a compression option, for example, is only 10 – 25% cheaper (in NPV terms) than a pipeline option, it is likely that both are estimated at only a +/- 25% accuracy. This means that the wrong option will be chosen on a significant number of occasions. To mitigate this requires higher up front feasibility/route costings. This may have been the case in respect to Avonbridge where a pipeline alternative may have had a lower whole life cost.
  - The fact that a project cost more than the budgeted amount is not necessarily an issue. Assuming acceptable Health, Safety and Environmental performance, the objective is for the necessary capacity to be delivered at least cost and it is against this that performance primarily should be measured (see unit cost above)

National Grid says that building pipelines and compressor stations is a core skill and they are world class. TPA had a concern that in relation to these compressor station projects National Grid employed an Agency 'Machinery Engineer' rather than employing in-house resource. TPA has been informed that the internal resource has since been strengthened.

b) Impact of Project Approval after Feasibility Study

There are a number of consequences of approving projects after the 'low cost' Feasibility Study:

- If the Conceptual Study identifies show-stoppers, valuable time has been lost
- The Conceptual Study may indicate that the wrong option was selected at Project Approval stage, but it is to late to change (Avonbridge may have been in this category)
- National Grid rarely has to write-off costs of abortive Feasibility Work. TPA does not believe this is necessarily efficient as it is reasonable for a regulated utility to need to do additional work to develop a number of options, given the fact that the assets will be depreciated over a 60 year period
- Network Strategy department annual Opex is around £7M and hence writing of even a relatively small amount of 'capex', say, £500K is material in relation to the Network Strategy budget.

c) EPIC Contractor and Conceptual Design and use of Option C

National Grid argues that by giving the Conceptual Design to the EPIC Contractor, dramatic cost savings result and illustrates this by reference to the Bacton projects:

Bacton Projects Cost Estimates and Outturns

Project	Original Approval Capex £M	Outturn Capex £M	Outturn Capex Adjusted for Foot and Mouth £M	Outturn (adjusted) compared to Approval +/- %
Willington – Steppingley *	19.2	16.2	16.2	-15
Cambridge - Matching Green *	40.7	32.9	32.9	-19

National Grid says that by introducing 'constructability' at an earlier stage, problems in detailed design and construction are avoided and there is also no extended period of discussions between the EPIC contractor and National Grid in relation to the Conceptual Design. However, it is not clear how much of the benefit was related to this, how much to the contract strategy (Option A, fixed price) and how much to the location of this pipelines.

TPA can appreciate benefits in giving the Conceptual Design to the EPIC contractor and the strategy of giving it to the EPIC contractor is a reasonable option. However, a good outsourced Conceptual Design would include contributions from pipe-laying experts who are qualified to advise on constructability. TPA believes that the projects in 2002-2005 may have had less schedule issues had this approach been adopted. Giving the project to the EPIC contractor early has advantages but these have to be weighed against the benefits of approving the major capex at a later stage and tendering based on Option A, fixed price.

As discussed above, TPA believes that National Grid should be incentivised to cancel projects when circumstances change and not be exposed to writing off significant sums to the P&L.

d) Proof of Concept Approach for Compressor Stations

National Grid adopts a **'Proof of Concept'** approach in relation to new compressor stations, with a functional specification, in effect paying the 4 tenderers to carry out their own Conceptual Design. National Grid does carry out a Feasibility Study prior to the tender, but does not present the findings of this study to the tenderers.

TPA believes there is merit in this approach, but has concerns that National Grid expertise and learning may be missed by the Contractors and also that ongoing reliability and operating costs may not be properly captured in the evaluation of the bids.

Investment in the asset management process (Section 4.) means that National Grid has far more experience of operations and maintenance of gas compression related plant than the contractors who bid for this work but may not have the volume of work to be competent, relying on former Transco engineers. TPA is not suggesting bringing back the detailed design and construction of compressor stations, however, it does want National Grid to ensure that the knowledge and experience it has of compressor asset management, which should far exceed that of any UK based contractor, is properly utilised.

TPA has reviewed the tender evaluation for Avonbridge in order to understand how operating costs are taken into account. TPA has a concern that the tenderers had an incentive to under-estimate the maintenance costs and fuel gas consumption given that they were not responsible contractually for this.

6.6 Commentary on Project Delivery Efficiency for 2002-2005 Capex – Key Findings

No.	Title	Description	TPA Commentary
1	Overall project delivery strategy	National Grid out sources its capital programme with a small internal 'informed buyer' resource, TPA has concerns that there was insufficient in-house 'informed buyer' capability in relation to compressors.	TPA believes this is efficient but has some concerns related to compression competence which may have been addressed
2	Conceptual Design and Option C Strategy	National Grid awards the Conceptual Design to the EPIC Contractor after Project Approval in order to capture 'constructability efficiency' in pipeline routing. Projects are awarded based on an Option target cost approach.	TPA believes it may be appropriate on occasions to carry out the Conceptual Design prior to Project Approval in order to retain flexibility and tender on the basis of Option A fixed price.
3	Proof of Concept	National Grid now builds new compressor assets (such as Avonbridge) based on the Proof of Concept model.	TPA believes is it important that this approach should transfer National Grid's asset management experience (operating and maintaining compression plant) to the contractors
4	Pipelines built in 2002-2005	National Grid built 235km of 1200mm dia pipelines and 47km of 900 mm dia pipeline.	Taking the programme as a whole, TPA believes these were generally executed in an efficient way, though
5	Compressors installed in 2002-2005	National Grid installed 9 new compressors at 4 stations, total of 125MW.	TPA has a concern that, taking the programme as a whole there were more significant over-runs of time that would have been expected, though the unit costs are generally reasonable. This supports TPA comments in relation to in-house compression competence
6	Avonbridge-Bathgate	National Grid proposes to decommission the Bathgate compressor station in 2008	TPA believes this should be done earlier
7	Project Services	National Grid buys in all project management and related services from Project Services companies	TPA believes that the needs to be management focus on the level of these costs and it should be possible to reduce them in £/M terms for projects going forward.

SECTION 7. FORECAST OPEX

7.1 FORECAST OPEX INTRODUCTION

7.1.1 Approach to TPA's review of Forecast Opex

The previous sections of this report have reviewed Historic Opex and Capex. The next section of this report addresses the forecast opex plans presented by National Grid. TPA Solutions has produced a separate report on supply/demand forecasting and forecast capex plans.

By way of context, the way in which National Grid has presented its' Opex Forecast is briefly outlined in the following section. How this relates to the gas element of the transmission business is then discussed.

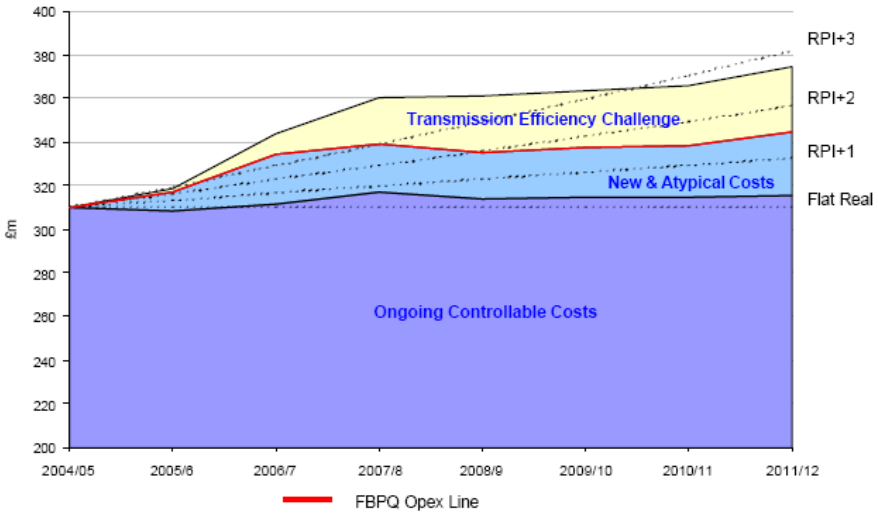
7.1.2 Overall Opex Forecast

In its FBPQ submission, National Grid state that, in combination with its Electricity Transmission business, its overall Opex target for the forthcoming period is to restrict cumulative real increase in controllable operating cost to 1.5%.

National Grid notes that this corresponds to a price increase for gas transmission customers of 23%, which amounts to £2.20 to the average customer (given that transmission forms only 3-4% of customers total costs)

National Grid has presented its Total Forward Opex requirement in the following manner:

Profile of Total (Gas and Electricity) Operating Costs over the next 5 years



Source: National Grid FBPQ Executive Summary, Para 101

In response to Ofgem's FBPQ, National Grid has specified its ongoing controllable costs, and separately identified new controllable costs and atypical costs.

The chart above shows the total level of controllable costs (gas and electricity) at £375m in 2011/12 (i.e.: the **top** line). National Grid state in their executive summary that this represents a **combination** of an **£85m pa increase** and a **£20m decrease** by 2011/12 in costs.

National Grid has provided the following information in response to TPA's request for a gas-only version of this cost profile.

Gas-Only Costs under the FBPQ (TO and SO Combined)

£m	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12
Impact of The Transmission Efficiency Challenge								
Gross FBPQ	**89.3**	**94.4**	**99.8**	**105.9**	**105.7**	**106.4**	**108.3**	**109.6**
LESS: Transmission Efficiency Challenge	0.0	0.0	2.8	7.1	7.7	7.9	8.2	8.0
Net FBPQ (Submitted to Ofgem)	**89.3**	**94.4**	**97.0**	**98.8**	**98.0**	**98.5**	**100.1**	**101.6**
Analysis of the NET FBPQ (Submitted to Ofgem)								
Ongoing Controllable Costs	89.3	93.9	93.7	96.5	94.5	96.4	97.5	98.6
New Controllable Costs & Atypical Costs	0.0	0.5	3.3	2.3	3.5	2.1	2.6	3.0
Net FBPQ (Submitted to Ofgem)	**89.3**	**94.4**	**97.0**	**98.8**	**98.0**	**98.5**	**100.1**	**101.6**

Source: National Grid, response to TP4112

7.1.2.1 Upward Cost pressures identified by National Grid

In its FBPQ National Grid identifies the following upward cost pressures on gas opex:-

- workload drivers such as network growth and installation of additional electricity driven compression
- compliance with legislation (IPPC, COMAH, DSEAR)
- 2% real pay growth
- increased insurance costs
- additional costs related to network security
- increases in input costs

TPA has not reviewed overhead or allocated costs, and has also not reviewed any of the issues associated with pay, pensions, insurance and the increased need for security. TPA believes the pay issue, in particular, is one which would benefit from thorough assessment by HR professionals. The requirement for increased security is being developed in conjunction with the Government and Ofgem and it has been agreed with Ofgem that TPA will not review the opex and capex associated with this

7.1.2.2 Opex Reductions Identified by National Grid

National Grid identify potential savings in the following areas

- reduction in opex due to asset replacement
- reduction in opex associated with maintaining the gas turbine driven compression fleet
- reduction in telecoms costs
- benefits in relation to shared services

National Grid has also indicated that the introduction of electrically driven compressors will reduce opex by £1.5M per annum.

National Grid claim that the net impact of these measures is an accumulating 1% per annum abatement to costs in these areas and this is already included in their submitted cost line. TPA's analysis therefore builds on top of these savings.

The net effect of upward cost pressure and planned savings is represented by the **top** line on National Grids chart above. The FBPQ line submitted (in red on the chart above) shows the planned costs, assuming successful delivery of the Transmission Efficiency Challenge.

The Gas-Only costs in the table above shows the assumed cost profile after upward cost pressure and planned savings as the gross FBPQ figure. The table also indicates that National Grid is assuming a gas-only saving of £8m in 11/12 can be delivered through the Transmission Efficiency Challenge. This is discussed further in the next section.

7.1.2.3 Additional Opex Reductions targeted by National Grid – the 'Transmission Efficiency Challenge'

National Grid has set itself a further 'Efficiency challenge', which is to reduce overall operating costs by £30m by 2011/12, and the impact of this challenge is represented by the red line in the chart above. It is this set of costs for which National Grid is seeking funding through the next formula period. £8m of this £30M is identified as to be delivered by the gas business.

The management action to reduce opex costs has 3 main elements:

- Business process re-engineering
- Reduction in real pay growth
- Supply chain/Procurement improvements

In effect, the opex reduction in the 'Efficiency Challenge' is a proxy for reductions that generally take place in a mature business. Whilst there are 3 areas identified as focus areas for the challenge it could be that additional savings in areas 7.1.2.2 above (greater than the assumed 1%) are delivered in practice and the 7.1.2.3 savings are less.

National Grid have already commenced the Transmission Business Process Review and recently announced the planned merger of Network Strategy and Engineering Services, and also that some parts of Regulation activity (currently within Business Services) would be merged with the existing Commercial Department. National Grid believes the overall effect of the Transmission Efficiency Challenge would be to:-

- Constrain regulatory controllable costs (for gas) to 98.6m by 2011/12
- Hold ongoing controllable costs comparatively flat in real terms
- Manage down the increase in controllable costs to around RPI+1.5 from a starting point approaching RPI + 3

7.1.3 Costs within Gas Transmission

Appendix 2 of the FBPQ submission contained summary forecast costs for the Gas TO and SO form of control. Within these, the forecast cost for each of the main departments was presented, and each department attracted an element of additional new or atypical costs. The summary information is set out in the following tables for TO and SO:

Gas TO Costs including New and Atypical Costs £m

	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12
Engineering Services	29.8	39.9	31.4	37.3	37.0	37.8	36.0	35.6
Network Strategy	7.4	15.3	8.2	9.1	9.0	9.0	9.1	9.0
Operations & Trading	0.1	0.3	1.2	1.3	1.1	1.0	1.0	1.2
Commercial	1.8	2.2	2.1	2.0	2.1	2.1	2.1	2.1
Transmission Finance	0.8	0.9	0.9	0.8	0.8	0.8	0.8	0.8
Total Controllable Costs of Operational Departments	***39.9***	***58.6***	***43.8***	***50.4***	***49.9***	***50.6***	***49.0***	***48.7***
Total Operating Costs for TO	176.1	221.3	220.6	677.0	293.1	301.3	304.2	305.6

Source: Data from Appendix 2, FBPQ Tables

Notes:
1. *04/05 is the base year*
2. *Engineering Services includes a line of new controllable costs, and separately identified Quarry and Loss of Development costs.*
3. *Network Strategy includes Research and Development costs, and*
4. *Operations & Trading TO costs include a £0.3m charge for the Scottish Independent Undertakings Price Differential.*

Gas SO Costs including New and Atypical Costs £m

	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12
Operations & Trading	10.5	17.1	17.4	17.7	17.0	17.0	17.0	18.0
Commercial	1.4	2.4	2.6	2.6	2.5	2.6	2.4	2.4
Network Strategy	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Transmission Finance	0.5	0.5	0.5	0.6	0.4	0.4	0.4	0.4
Total Controllable Costs of Operational Departments	***12.6***	***19.7***	***20.4***	***20.6***	***19.8***	***19.8***	***19.7***	***20.7***
Total Operating Costs for SO	46.2	56.9	49.5	48.6	43.3	45.0	46.0	46.0

Source: Data from Appendix 2, FBPQ Tables

Notes:
1. *04/05 is the base year*
2. *NB: No Engineering Services costs in SO*

TPA believes that the costs shown in these tables represent the controllable direct gas costs for the main departments, and form a component part of the red line in National Grid's overall chart, i.e. they include an element of **both** cost pressure and planned savings, and the impact of the Efficiency challenge. It is these direct costs which TPA has reviewed, along with the individual forward business plans of each of the main departments.

7.1.3.1 Potential Opex Reductions identified by TPA

As a result of the historic opex review and the forecast future operating context which has between 6 and 12 compressors not utilised, TPA has identified a number of areas for potential opex reductions, some, but not all of which have been identified by National Grid:

Network Strategy

- Increasing proficiency in asset condition assessment using established methods and tools and access to support from the increased competency/ capability within Asset Strategy and support from Engineering Services (7.2.2.1 c and d and 7.2.2.6)
- OMGS/consultancy costs for Safety and Compliance appear high compared with equivalent operators. (7.2.2.2)
- Increasing proficiency in environmental monitoring and reporting, integration of compliance activities between NS, ES and SO. (7.2.2.3)
- The provision of new asset records by the main works contractor in electronic format for migration to the proposed asset database should provide efficiencies in data acquisition and on going management. (7.2.2.4)
- Efficiency in forecasting and capital planning arising from Exit Reforms and the reducing level of capex through the period. (7.2.2.8)

Engineering Services

- Potential Reduction in manning due to significant reduction in future gas compressor fleet utilization (7.3.2.2)
- Efficiencies in costs for marker posts, corrosion control and painting (7.3.2.1)
- TPA believes that the savings by merging the 2 Directorates are around 500 - 700k per annum based on reduction of 1 Director and 5 Direct Reports and associated support. Further savings may be possible at lower levels, though the extent of these may be limited by the requirement to keep separation between work specification and work delivery. (7.3.2.6)

Merger of Network Strategy and Engineering Services

- Potential saving of 500-700k as a result of a reduction of 1 Director and 5 Level Staff and associated support, as described above.
- A saving associated with merging Engineering Services with Network Strategy of 2 FTEs within Non-routine maintenance (National Support).

7.1.3.2 Potential Opex Increases identified by TPA

TPA has identified the following possible upward drivers in Opex:-

Engineering Services

- Risk of increased PMC related charges if PMC loses 3rd party business (including DN's)
- Requirement for increased maintenance painting (and interaction with capex for replacement) as a result of not having a policy of maintenance painting

7.1.4 TPA Review of Forecast Opex Methodology

The elements of TPA's methodology are as follows:

1. Establish an understanding of the key opex functions and drivers as a result of the historic opex review. This was developed in Section 4 of this report.

2. Review of Departmental Business Plans, including:

- Review of the Opex Increases identified by National Grid (7.1.2.1 above)
- Review of the 'basic opex reduction initiatives' identified by National Grid (7.1.2.2)
- Review of the Additional Opex Reductions targeted by National Grid through the Efficiency Challenge (7.1.2.3)

3. Formulation of TPA's Assessment

- Review the Opex associated with TPA's identified factors (7.1.3.1 and 7.1.3.2)
- Develop Ranges for the Opex Forecasts by department.

The following sections therefore set out stages 2 and 3 of TPA's methodology, by department.

7.2 NETWORK STRATEGY

7.2.1 FBPQ Opex Profile and Cost Movement

The Chart and table below provide an overview of the Opex expenditure and FTE's over the period 2005/06 to 2012/13 as forecast by National Grid in the FBPQ submission presentations and in response to formal questions.

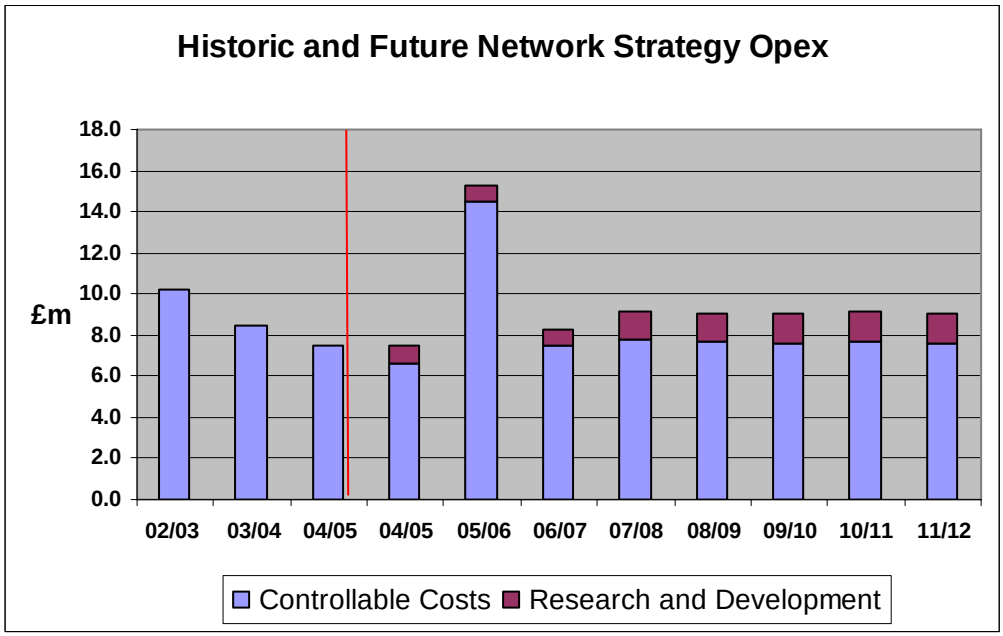


Figure 7.2.1.1 Source: Data from FBPQ Appendix 2. Chart prepared by TPA Solutions

	2002/ 03	2003/ 04	2004/ 05	2005/ 06	2006/ 07	2007/ 08	2008/ 09	2009/ 10	2010/ 11	2011/ 12
Controllable Costs	10.2	8.5	6.6	14.5	7.5	7.8	7.6	7.6	7.7	7.6
Research and Development	-	-	0.8	0.8	0.8	1.3	1.4	1.4	1.4	1.4
Total Network Strategy Costs	***10.2***	***8.5***	***7.4***	***15.3***	***8.2***	***9.1***	***9***	***9***	***9.1***	***9***
Increase / (decrease) in Ongoing Controllable Costs				7.83	-7	0.87	-0.1	0.03	0.06	-0.1
Year on Year Cost Increase				105%	-46%	11%	-1%	0%	1%	-1%
Controllable FTE's			67	80	80	80	80	80	80	80
R & D FTE's			1.3	2.1	2.5	2.6	2.7	2.8	2.8	2.7
Total FTE's			**68.3**	**82.1**	**82.5**	**82.6**	**82.7**	**82.8**	**82.8**	**82.7**
Year on Year FTE Increase										

Figure 7.2.1.2 Source Data from National Grid HBPQ, FBPQ submissions and National Grid response to question TP4147. Table prepared by TPA Solutions.

The data in Figure 7.2.1.2 shows a marked increase of £7.9 m in Opex in the year 2005/06 compared with the previous year. National Grid attribute £6.2m of the increase to a diversion scheme at Wicken Quarry to enable the extraction of minerals from an area

close to the pipeline and the replacement of a pipeline bridge over the River Ouse with a horizontal directional drilling (HDD) crossing for feeders 2 and 4. The remaining increase is attributed to higher safety, compliance and environmental costs compared to previous years, in National Grid's response to TPA question TP 4061.

For the years 2006/07 to 2012/13 the Opex profile is relatively flat at around £9.0 m each year and slightly higher than the average of the years 2002/03 to 2004/05.

As in the previous period the majority of Network Strategy costs (typically 83%) are associated with the employment of direct and some indirect (agency) staff. It is evident that National Grid are intending to maintain the number of FTE's allocated to gas transmission activities, including R&D, at ~82 which is an increase of ~16 compared with the period 2002/03 to 2004/05.

The organisational structure and the activities undertaken by Network Strategy have been described in detail in section 4.2. The FBPQ assumes that the organisational structure will remain broadly the same (although this may be amended following the Transmission Challenge).

The FBPQ also assumes that Network Strategy will continue to operate the PAS 55 model of asset management and an application for accreditation for the Gas Transmission Operator is planned for 2006/07.The Electricity Transmission Operator achieved PAS 55 accreditation in November 2005.

Given the intended organisational structure and asset management model the following table and sections consider the relative changes in the activity costs through the period and provides a commentary on the associated cost driver and the position taken by National Grid. The movements are analysed by asset management activity and relevant data is provided in the associated tables to show;

- the cost of direct and indirect staff (£ FTEs),
- the cost of outsourced materials, goods and services (OMGS),
- the equivalent number of staff allocated to activity or role (FTE).

Fig 7.2.1.3 Breakdown of Network Strategy activities by Cost and FTE's

		TPA HBPQ Analysis	NG presentation 21 March 2006 and response to questions TP4146 and TP4147								Report Section
		2004/05	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	
Asset Strategy	£FTE		£0.8	£1.6	£1.6	£1.6	£1.6	£1.6	£1.6	£1.6	7.2.2.1
	£OMGS		£0.3	£0.7	£0.7	£0.7	£0.7	£0.7	£0.7	£0.7	
	£all	£1.1	£1.1	£2.3	£2.1	£2.2	£2.2	£2.2	£2.3	£2.3	
	FTE's	16	20.0	27.0	25.9	25.9	25.9	25.9	25.9	25.9	
Safety and Compliance	£FTE		£0.3	£0.4	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	7.2.2.2
	£OMGS		£0.5	£0.7	£0.9	£0.9	£0.9	£0.9	£0.9	£0.9	
	£all	£0.8	£0.8	£1.3	£1.4	£1.4	£1.3	£1.3	£1.3	£1.3	
	FTE's	6	6.3	8.4	8.2	8.2	8.2	8.2	8.2	8.2	
Environmental issues	£FTE		£0.4	£0.3	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	7.2.2.3
	£OMGS		£0.8	£1.2	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	
	£all	£1.2	£1.2	£1.5	£0.9	£0.8	£0.8	£0.8	£0.8	£0.8	
	FTE's	12	6.8	6.9	6.9	6.9	6.9	6.9	6.9	6.9	

Technical Drawing, Data and Systems	£FTE		£0.2	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	7.2.2.4
	£OMGS		£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	
	£all	£0.5	£0.5	£0.7	£0.8	£0.8	£0.8	£0.8	£0.8	£0.8	
	FTE's	2	2.4	9.8	9.8	9.8	9.8	9.8	9.8	9.8	
Outsourced Engineering	£FTE										7.2.2.5
	£OMGS										
	£all	£1.5	£1.5	£1.3	£1.5	£1.4	£1.4	£1.4	£1.4	£1.4	
	FTE's	2	1.4	2.1	1.9	1.9	1.9	1.9	1.9	1.9	
Asset Management Review	£FTE										7.2.2.6
	£OMGS										
	£all	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	
	FTE's	8	5.2	6.6	6.8	6.8	6.8	6.8	6.8	6.8	
Directorate	£FTE										7.2.2.7
	£OMGS										
	£all										
	FTE's	0	1	2.8	2.8	2.8	2.8	2.8	2.8	2.8	
R&D management	£FTE										7.2.2.8
	£OMGS										
	£all	£0.8	£0.8	£0.8	£0.8	£1.3	£1.4	£1.4	£1.4	£1.4	
	FTE's	1	1.3	2.1	2.5	2.6	2.7	2.8	2.8	2.7	
Cost of Developing Capital plan	£FTE		£1.0	£0.7	£0.8	£0.8	£0.8	£0.8	£0.8	£0.8	7.2.2.9
	£OMGS		£0.0	£0.0	£0.0	£0.0	£0.0	£0.0	£0.0	£0.0	
	£all	£1.0	£1.0	£0.7	£0.8	£0.8	£0.8	£0.8	£0.8	£0.9	
	FTE's	19	24	16	18	18	18	18	18	18	
Reconciliation/ rounding	£m	£0.1	£0.1	£6.3	-£0.5	£0.0	-£0.1	-£0.1	-£0.1	-£0.3	
All Controllable Costs		**£6.6**	**£6.6**	**£14.5**	**£7.4**	**£7.8**	**£7.6**	**£7.6**	**£7.7**	**£7.6**	
Total NS incl R&D		**£7.4**	**£7.4**	**£15.3**	**£8.2**	**£9.1**	**£9.0**	**£9.0**	**£9.1**	**£9.0**	-
£ increase yr. on yr.		-	-	£7.9	-£7.1	£0.9	-£0.1	£0.0	£0.1	-£0.1	
£% increase yr. on yr.		-	-	107 %	-46%	11%	-1%	0%	1%	-1%	
		-	-	-	-	-	-	-	-	-	-
All FTEs		**66.0**	**68.4**	**81.7**	**82.8**	**82.9**	**83.0**	**83.1**	**83.1**	**83.0**	-
Increase yr. on yr.		-	-	13	1	0	0	0	0	0	
% Increase yr. on yr.		-	-	19%	1%	0%	0%	0%	0%	0%	

Note 1: *The source data for the analysis tables is derived from the National Grid FBPQ submissions Appendix 2 and the presentation "Network Strategy Gas opex Costs FBPQ" dated 21 March 2006.*

Note 2: *FTE's allocations have been provided by National Grid in response to question TP 4147*

7.2.2 Analysis of Cost Movements

7.2.2.1 Asset Strategy

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
£ FTE	£0.8	£1.6	£1.6	£1.6	£1.6	£1.6	£1.6	£1.6
£ OMGS	£0.3	£0.7	£0.7	£0.7	£0.7	£0.7	£0.7	£0.7
£ all	£1.1	£2.3	£2.1	£2.2	£2.2	£2.2	£2.3	£2.3
FTE's	16	27	25.9	25.9	25.9	25.9	25.9	25.9

Figure 7.2.2.1. Source: Data from National Grid HBPQ and FBPQ submissions, National Grid Network Strategy Gas Opex Costs presentations dated 21/03/2006 and response to question TP4147.

There is a significant increase in the number of FTE's in the year 2005/06 and through the forward period when compared to the base year. National Grid attribute the increase in costs and FTE's to better cost capture, the realignment of activities and budgets and an increase the number of technical competent persons.

Upward cost drivers identified by National Grid are:-

- Additional Asset Strategy responsibilities for compressor station performance testing.
- Increasing responsibilities for the development of new build specifications for pipelines, valves and plant.
- A higher level of activity in determining and assessing the condition of the ageing asset and the remaining asset life.
- Additional condition assessments of transmission assets previously maintained by Distribution Networks where it is considered that insufficient maintenance/assessment has been carried out.
- Strengthened competency and capability, compared with the period 2002/03 to 2004/05, in the areas of SCADA/telemetry, compression, power turbines, pipeline integrity, process engineering and gas quality and metering.

Commentary

TPA makes the following comments on the cost drivers identified by National Grid.

- A transfer of activity and budget for compressor performance testing (2 FTE's) has been made to Asset Strategy from Network Design and is therefore neutral in terms of impact on the Network Strategy opex. (Ref: question TP4145). See also 7.2.2.8
- A transfer of activity and budget (~£100,000) for the development of "new build" specifications has been made to Asset Strategy from Network and Business performance and is therefore neutral in terms of impact on the Network Strategy opex. (Ref: question TP4145).
- National Grid argue, based on their experience of electricity transmission, that as the asset ages there will need to be more activity in determining and assessing the condition of the asset and the remaining asset life. TPA agrees (sections 4.2.6 and 4.2.13.1) that there are indicators for asset deterioration and TPA support the view that this can only be expected to increase as the asset ages.
- However National Grid has already developed a rational approach to determining asset condition assessment and replacement priorities (sections 4.2.5 and 4.2.6).

The issue is therefore one of refreshing the data used in the review processes as TPA do not foresee, nor have National Grid positively identified any additional asset groups where, any previously unidentified, deterioration is expected to arise in the forward period. (Ref: question TP4075).

Where an extension to existing asset assessment criteria is applied, for example critical valve seat leakage tests, TPA would expect the FTE costs to be incurred in Engineering Services.

TPA considers that, given the established process and experience within Network Strategy, the maintenance and refreshing of asset data could be achieved with the level of resources similar to those utilised in the period 2002/03 to 2004/05.

TPA appreciates that in the next price control period the size of the asset base will increase as a result of both load and non Load related Capex. Pipeline lengths are expected to increase from 6877 km by 1375 km to 8258 km and the number of compressor units from 68 to 74. It is therefore reasonable to expect some increase in asset stewardship activity but consider this to be within the scope of 'Technical Drawing, Data and Systems' (section 7.2.2.4).

- The transmission assets previously maintained, on behalf of Gas Transmission by Distribution Networks, will be those associated with above ground (pipeline) installations. TPA would expect the FTE costs associated with any asset data collection, remedial and maintenance work to be incurred in Engineering Services. The establish asset review process for valves has already been established and TPA consider that any updating of the Gas Asset Decision Support Tool condition data is not likely to warrant additional resources in Asset Strategy.
- Asset Strategy capability has been or will be strengthened by the recruitment of additional competent staff with skills in SCADA/telemetry, compression, power turbines, pipeline integrity, process engineering and gas quality and metering (section 4.2.8). TPA recognises the requirement to provide competent staff in these key areas and consider the increase (TPA estimate 5 FTE's) to be appropriate.

Whilst National Grid make sound arguments for increased activity in some areas TPA consider that the merits of the proposed increase in opex is not wholly warranted in and that an efficiency adjustment in the forecast years can be applied to the asset review process, as indicated in section 7.2.5 and Figure 7.2.5.1.

7.2.2.2 Safety and Compliance

	2004/ 05	2005/ 06	2006/ 07	2007/ 08	2008/ 09	2009/ 10	2010/ 11	2011/ 12
£ FTE	£0.3	£0.4	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5
£ OMGS	£0.5	£0.7	£0.9	£0.9	£0.9	£0.9	£0.9	£0.9
£ all	£0.8	£1.3	£1.4	£1.4	£1.3	£1.3	£1.3	£1.3
FTE's	6	8.4	8.2	8.2	8.2	8.2	8.2	8.2

Figure 7.2.2.2. Source: Data from National Grid HBPQ and FBPQ submissions, National Grid Network Strategy Gas Opex Costs presentations dated 21/03/2006 and response to question TP4147.

There is an increase of 2 FTE's in the year 2005/06 and through the forward period when compared to the base year and an increase in outsourced costs. National Grid attribute the increase in FTE's and costs in part to an increasing requirement to demonstrate compliance with safety legislation to the HSE in particular compliance with the requirements of Control of Major Accident Hazard Regulations (COMAH), Pipeline Safety Regulations (PSR) and Dangerous Substances Explosive Atmosphere Regulations (DSEAR). (Ref: FBPQ Submission file B -Network Strategy OUBP-FBPQ and question TP 4061 and 4070).

As evidence for a higher level of demonstration National Grid cites HSE requirements for:-

- Safety Integrity Level (SIL) assessments and human factors assessments of safety critical procedures at the top tier COMAH sites at St Fergus and Bacton and at other gas transmission sites.
- Increased liaison with Local Authorities on land use planning and emergency plan testing and hazard analysis reviews of the transmission system to quantify societal risk within the context of the Pipeline Safety Regulations.
- Increased compressor cab ventilation studies/improvements arising under the Dangerous substances and explosive atmosphere regulations (DSEAR) and the application of HSE Guidance Note PM 84 'Control of safety risks at gas turbines used for power generation'

Commentary

Recent incidents on a high pressure pipelines (Fluxys, Belgium, 30/07/2005) and COMAH sites (Buncefield fuel depot, Hemel Hempstead, 11/12/2005) have heightened awareness of the consequences of a major accident hazard event and shifted the safety criteria from societal risk to worst case fatality assessment. Demonstrations of risk and consequence require complex and intensive analysis. It is reasonable that this change of emphasis will require the use of additional internal and outsourced specialist resources.

Given the program, agreed with the regulator authorities, the increase in 2 FTE's in the early part of the forward period seems appropriate as external resources for compliance in the areas identified are limited and the work assessment and demonstration activities need to be closely coupled to the asset management, records systems and regulatory authorities. The anticipated increase is the size of the asset base in the forward period also supports the increase in direct FTE's.

By way of an external comparison TPA has had discussions with an independent gas facility operator who has confirmed that they are also being required by the HSE to review their COMAH safety cases and to undertake Safety and Integrity Level (SIL)

assessments and SIL verifications against IEC 61508. The work is being undertaken on a major gas reception terminal with 2 process streams and 4 above ground installations and includes layer of protection analysis on instrumented protection systems designated SIL 2. The exercise will take around 15 man days per month for 18 months, equivalent to an expenditure rate of £100k p.a. TPA view is that the scale of work forecast by National Grid on two COMAH sites in the years 2005/06 to 2007/08 at £400k is budgeted at a higher rate which indicates the an efficiency adjustment could be made.

In relation to compressor stations and multi-junctions, in the later years of the forward period, National Grid's figure of £50k p.a. seems to be a reasonable forecast.

Given the prevailing trend of Safety Legislation and interpretation it is difficult to argue an efficiency adjustment in FTE's. However TPA's view is that an efficiency adjustment could be made to OMGS costs for COMAH compliance activities as indicated in section 7.2.5 and Figure 7.2.5.1.

7.2.2.3 Environmental Issues

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
£ FTE	£0.4	£0.3	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4
£ OMGS	£0.8	£1.2	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5
£ all	£1.2	£1.5	£0.9	£0.8	£0.8	£0.8	£0.8	£0.8
FTE's	12	6.8	6.9	6.9	6.9	6.9	6.9	6.9

Figure 7.2.2.3. Source: Data from National Grid HBPQ and FBPQ submissions, National Grid Network Strategy Gas Opex Costs presentations dated 21/03/2006 and response to question TP4147.

There is a decrease in the number of FTE's in the year 2005/06 and through the forward period, when compared to the base year, and a decrease in outsourced costs from the year 2006/07, following the peak year 2005/06, which is sustained through the remaining period.

National Grid cite the preparation and submission of new applications for emission permits at the 22 compressor sites as required by the Pollution, Prevention and Control Regulations (PPC), as the reason for the level of Opex between 2004 and 2006. (Ref: question TP 4061).

Beyond 2006 National Grid cite the need to respond to EA/SEPA questions, the periodic updating of the Network Review, the monitoring and compliance with PPC and EU Emissions Trading Scheme (EUETS) permits as the reason for the level of Opex in the remaining forward period. (Ref: FBPQ section 4.2 and question TP 4130)

Commentary

The impact of the European Directive (EC/96/61) on integrated pollution prevention and control, on the Capex program to reduce NOx and CO_2 emissions from gas generators has been previously considered (section 4.2.13.2) and it is clear that, as a result of developing more efficient working practices for compliance strategies and permit applications, National Grid have reduced the level of resource allocated to environmental issues compared with the period 2002/03 to 2004/05.

TPA have reviewed the level of resources proposed for the forward period under two main headings; the informed operator/buyer capability and compliance management.

The informed operate/buyer capability is required to keep abreast of environmental issues, monitoring, contribute to the development of UK and European environmental legislation, monitoring and evaluation appropriate technologies and approaches to mitigate the discharge to air, land and water. The informed buyer should also maintain a dialogue with and develop constructive working relationships with EA and SEPA. TPA has discussed with independent organisations, providing environmental services, the level of resources that would be needed to provide this function. Their view, which TPA share, is that no more than 3 FTE's would be required to manage these activities using as required supplementary resources from external specialists.

Compliance management is required to collate, analyse, calculate and validate environmental data to support the monitoring, reporting and auditing of compliance with ongoing PPC and EUETS permits. TPA note National Grid points regarding the high level of demonstration of compliance required under PCC and EUETS regulations and the potentially high financial penalties that could be applied if National Grid were found to be non compliant (Ref: question TP4130). There is a reasonable argument in the implementation and early operation under the EUETS for proposed level of resources, 4 FTE's. However TPA would expect National Grid to gain experience and expertise and to develop a systematic approach to data management and compliance reporting within the forward period.

Given the support available from Engineering Services for the maintenance and calibration of measurements systems and the role of the Gas System Operator for data collection, online performance monitoring, alarm handling and alarm response management TPA view is that an efficiency adjustment could be made to level of FTE's allocated to this activity from 2008/09 as indicated in section 7.2.5 and Figure 7.2.5.1.

7.2.2.4 Technical Drawing, Data and Systems

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
£ FTE	£0.2	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4
£ OMGS	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3
£ all	£0.5	£0.7	£0.8	£0.8	£0.8	£0.8	£0.8	£0.8
FTE's	2	2.4	9.8	9.8	9.8	9.8	9.8	9.8

Figure 7.2.2.1. Source: Data from National Grid HBPQ and FBPQ submissions, National Grid Network Strategy Gas Opex Costs presentations dated 21/03/2006 and response to question TP4147.

There is an increase of 5 FTE's in the year 2005/06 and through the forward period when compared to the base year and an increase in outsourced costs. National Grid attribute the increase in costs and FTE's to:-

- An increase in the size of the asset base and the assimilation of new asset data through the period,
- The introduction and management of new data systems which support the capital plan,
- Preparatory work to migrate drawings and data held on legacy systems to the Livelink web based server

Commentary

TPA makes the following comments on the cost drivers identified by National Grid.

- It is accepted that the continued use of legacy systems is undesirable and works against the implementation of an integrated and effective work and asset management system.
- TPA appreciates that in the next price control period the size of the asset base will increase as a result of both load and non Load related Capex. Pipeline lengths are expected to increase from 6877 km by 1375 km to 8258 km and the number of compressor units from 68 to 74. It is therefore reasonable to expect some increase in asset stewardship activity. [National Grid response to TP4088 and FBPQ Appendix 2 Tables, Sheet 11]
- However TPA view is that for new capital projects asset construction data acquisition could be predominantly in digital format and the provision of new asset and construction records in an acceptable/consistent digital format should be a contractual requirement for all new and replacement capital projects. This approach when integrated with the proposed IDMS Livelink systems should introduce efficiencies in the asset record management activity offsetting to some extent the anticipated workload.

TPA view is that the proposed increase in direct FTE's may not be wholly warranted and that an efficiency adjustment in the forecast years can be applied, as indicated in section 7.2.5 and Figure 7.2.5.1.

7.2.2.5 Outsourced Engineering

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
£ FTE								
£ OMGS								
£ all	£1.5	£1.3	£1.5	£1.4	£1.4	£1.4	£1.4	£1.4
FTE's	2	1.4	2.1	1.9	1.9	1.9	1.9	1.9

Figure 7.2.2.5. Source: Data from National Grid HBPQ and FBPQ submissions and National Grid Network Strategy Gas Opex Costs presentations dated 21/03/2006.

The costs and FTE's remain constant through the period and are consistent with the HBPQ costs reviewed in section 4.2.11.

Commentary

There are no planned changes to the range of services that are outsourced in the forward period. The primary services procured are for boroscope inspections, technical consultancy, rotating machinery, COAS support and pipeline inspections for TD1 infringements, underwater and above ground crossings. National Grid have indicated that there will be at least one contract renewal in to forward period indicating that competitive tendering/market testing will continue to be applied to the outsourcing process. (Ref: questions TP 4148 & TP4149)

7.2.2.6 Asset Management Review

	2004/ 05	2005/ 06	2006/ 07	2007/ 08	2008/ 09	2009/ 10	2010/ 11	2011/ 12
£ FTE								
£ OMGS								
£ all	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	£0.4	£0.5
FTE's	8	5.2	6.6	6.8	6.8	6.8	6.8	6.8

Figure 7.2.2.6. Source: Data from National Grid HBPQ and FBPQ submissions, National Grid Network Strategy Gas Opex Costs presentations dated 21/03/2006 and response to question TP4147.

Note; Asset Management Review includes QMS, assurance and benchmarking activities

The costs and FTE's remain constant through the period and are consistent with the HBPQ costs reviewed in section 4.2.6. National Grid attribute the level of ongoing costs to the increasing age profile of the asset base and the need to anticipate wear out and likely failure before the event and to put in place remedial or replacement programmes.

Commentary

TPA accepts the general point that as assets age there is a greater likelihood of condition based fault or failure. There is also an inherent obsolescence problem with older equipment that will require the development of mitigation or replacement strategies.

However the asset health review process is now established and there is experience within Network Strategy of operating the process and no identification of other asset groups where deterioration is anticipated. (Ref: question TP4075). There is also the potential to utilise the increased capability /competency within Asset Strategy and resources from Engineering Services to support the review process.

These factors indicate that some efficiency could be achieved when updating the asset condition and risk models and that an efficiency adjustment in the forecast years can be applied, as indicated in section 7.2.5 and Figure 7.2.5.1.

Other Comments

There is evidence [4] that in some areas, for example valve actuators, vent and sealant lines, that maintenance has been inadequate or Opex has been avoided and that the proposed remedy is to replace and rebase the asset life (non-load related Capex). National Grid notes this and intends to redress maintenance policies and practices to ensure that assets will meet their anticipated life.

With respect to compression plant the consequences of failure and the requirement to ensure that the 1 in 20 year capability is available have been a major driver for non-load related Capex. With the addition of new electric variable speed compression plant

[4] National Grid response to TP 4076: "Recent inspections have identified increasing (valve) vent and seal line corrosion issues. As a result future inspections will collect additional information to inform future maintenance activities to the peripheral equipment ensuring that the total valve assembly will meet the anticipated asset life".

at key points in the network and the expected changing pattern of gas delivery to the NTS, TPA would anticipate that at least the risk criteria would be reviewed and would also anticipate a slower rate of expenditure on non load related/ serviceability Capex on compression plant.

7.2.2.7 R&D

a) R&D Management

	2004/ 05	2005/ 06	2006/ 07	2007/ 08	2008/ 09	2009/ 10	2010/ 11	2011/ 12
£ FTE								
£ OMGS								
£ all	£0.8	£0.8	£0.8	£1.3	£1.4	£1.4	£1.4	£1.4
FTE's	1.3	2.1	2.5	2.6	2.7	2.8	2.8	2.7

Figure 7.2.2.7.a. Source: Data from National Grid HBPQ and FBPQ submissions, National Grid Network Strategy Gas Opex Costs presentations dated 21/03/2006 and response to questions TP4146 and TP4147.

The costs and FTE's remain constant through the period and are consistent with the HBPQ costs reviewed in section 4.2.12.

b) R&D Program

	2004/ 05	2005/ 06	2006/ 07	2007/ 08	2008/ 09	2009/ 10	2010/ 11	2011/ 12
£	0.8	0.8	0.8	1.3	1.4	1.4	1.4	1.4

Figure 7.2.2.7.b. Source: Data from National Grid HBPQ and FBPQ submissions and National Grid Network Strategy Gas Opex Costs presentations dated 21/03/2006.

The proposed R&D program is at a higher level than the base year and has two main drivers; controlling maintenance costs and determining asset life replacement. Specific work areas will include;

- Distributed strain sensing for gas pipelines subject to ground movement
- Modelling mechanical damage of gas pipelines and damage assessment for X80 material
- Vibration failure prediction using gas flow modelling
- Improved techniques for the inspection of piggable and un-piggable pipeline
- Risk based inspection methodologies for AGI's,
- Alternative methods for pipeline route surveillance

(Ref: question TP4151)

Commentary

The focus of the proposed program is appropriate and aimed at addressing areas of future opex and capex.

National Grid collaboration with other organisations provides access to external research programs and best practice.

TPA note National Grid proposal to discuss with Ofgem on how R&D projects should be funded.

7.2.2.8 Developing the Capital Plan

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
£ FTE	£1.0	£0.7	£0.8	£0.8	£0.8	£0.8	£0.8	£0.8
£ OMGS	£0.0	£0.0	£0.0	£0.0	£0.0	£0.0	£0.0	£0.0
£ all	£1.0	£0.7	£0.8	£0.8	£0.8	£0.8	£0.8	£0.8
FTE's	24	16	18	18	18	18	18	18

Figure 7.2.2.8. Source: Data from National Grid HBPQ and FBPQ submissions and National Grid Network Strategy Gas Opex Costs presentations dated 21/03/2006.

There is a decrease of 6 FTE's in the year 2005/06 and through the forward period when compared to the base year.

Commentary

National Grid attributes the expected containment and reduction in costs to further integration of their gas and electricity planning activities and efficiencies in the co-ordination of investment strategy. However part of the reduction (2 FTE's) appears rather to be due to the transfer of compressor performance testing to Asset Strategy. (Ref: question TP4145)

TPA view is that there are additional factors that should be considered by National Grid when determining the level of resources needed to develop the capital plan. i.e. the impact of exit reforms, when Distribution Network Operators become responsible for demand forecasting and the level of capex through the period.

The figure below indicates the likely level of capex in the forward period. The capex is high to the start of the period but falls significantly towards the end of the period.

FBPQ Load Related Capex (£m)									
Category	**2005/06 to 2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**		**Total 2007/08 to 2011/12**	**Total for Period 2005/06 to 2011/12**
Entry-Capacity	175.6	322.0	139.4	21.8	5.6	0.4		489.2	664.8
Entry-Summer Flexibility	3.6	0.0	0.0	0.0	0.0	0.0		0.0	3.6
Exit Power Generation	27.4	48.6	78.0	57.7	29.3	36.7		250.3	277.7
Exit Load Growth	4.3	15.3	28.4	27.5	38.3	30.0		139.6	143.8
EC Harris Unit Costs	0.0	0.8	5.2	12.0	11.6	11.8		41.4	41.4
Sub Total	**210.9**	**386.7**	**251.0**	**119.0**	**84.8**	**78.9**		**920.4**	**1131.3**

Figure 7.2.2.8. Source: Data from National Grid HBPQ (and TP1135) and FBPQ submissions

TPA view is that further reductions in the number of FTE's may be possible from 2008/09 given the FBPQ Capex proposals. TPA view is that there should also be a lower capex allowance for exit load growth and power generation projects in the forward period. These two factors suggest that an efficiency adjustment in the forecast years could be applied, as indicated in section 7.2.5 and Figure 7.2.5.1.

7.2.3 General Overview and Consolidated Commentary

As discussed in Section 4.2 Network Strategy makes a significant contribution to the management of the gas transmission asset base and largely determines the work load of and therefore the costs of Engineering Services. In TPA review of the FBPQ submission, covering Network Strategy an analysis has been made of the areas of activity where National grid have identified cost s movements compared with the base year. The cost drivers upwards, neutral or downwards are summarised below.

7.2.3.1 Upward cost drivers

- The requirements to continue to develop and manage serviceability programmes to achieve and/or extend the technical asset life of plant and equipment and the provision of technical support during the commissioning and early operation of new compressor units and compressor station protection and control systems, which will arise from the proposed capex programme
- The review of COMAH, Pipeline Safety Regulation and DSEAR compliance issues arising from HSE requirements for higher level demonstrations of compliance.
- The implementation of and the ongoing monitoring and reporting of PPC and EUETS.
- The assimilation of new asset data and the provision of additional technical capability/support during the commissioning and early operation of new compressor units and compressor station protection and control systems, which will arise from the proposed and significant capex programme.
- Real pay growth.
-

7.2.3.2 Neutral costs

- There appear to be no new "activity drivers" for the period to 2012/13, for example, pending legislation that would require Network Strategy to develop any new compliance strategies.
- There is no indication new serviceability issues will surface.
- National Grid has already developed asset health review methodologies for air intakes, stacks, valves and vent lines.
- The Asset Health Reviews, carried out on the current period, have not identified a requirement to change the form or frequency of the inspection and a maintenance regime, which would drive upwards the associated opex costs for valves, compressor air intakes and compressor exhaust stacks. (Ref: question TP4076).
- National Grid do not envisaged any changes to the inspection and maintenance regimes for pipelines and pressure systems over the forthcoming price review period. (Ref: question TP4077)

7.2.3.3 Downward cost drivers

- The agreement in principle by EA and SEPA to National Grid environmental improvements program and the submission of applications for PPC permits and the move to the implementation and compliance phases.
- The ongoing asset review processes are achieving marginal maintenance cost reductions in some areas such as the functional testing of critical valves. (Ref question TP4076).

7.2.3.4 General Summary

The opex profile for Network Strategy controllable costs, at least in the first 3 years, are reasonable given the upward pressure on activities and salaries. TPA view is that from the mid to end years of the period some efficiencies should be possible as the asset management process matures. TPA has identified some areas where these efficiencies or efficiency adjustments could be made/applied as indicated below. These areas which may also be the areas where National Grid would seek reduce costs under the Transmission Efficiency Challenge.

- Increasing proficiency in asset condition assessment using established methods and tools and access to support from the increased competency/ capability within Asset Strategy and support from Engineering Services (7.2.2.1 c and d and 7.2.2.6)
- OMGS/consultancy costs for Safety and Compliance appear high compared with equivalent operators. (7.2.2.2)
- Increasing proficiency in environmental monitoring and reporting, integration of compliance activities between NS, ES and SO. (7.2.2.3)
- The provision of new asset records by the main works contractor in electronic format for migration to the proposed asset database should provide efficiencies in data acquisition and on going management. (7.2.2.4)
- Efficiency in forecasting and capital planning arising from Exit Reforms and the reducing level of capex through the period. (7.2.2.8)

The following table collates TPA key points and comments.

Reference	Title	Description	Commentary
7.2.2.1	Asset Strategy	Increased direct and indirect staff costs as a result of increasing asset base and asset life issues.	Whilst National Grid make sound arguments for increased activity in some areas, TPA consider that the merits of the proposed increase in opex is not wholly warranted. National Grid have already developed a rational approach to determining asset condition assessment and replacement priorities and the forward issue is one of refreshing the data used in the review processes. TPA view is that the asset health process could be managed with the level of resources similar to those utilised in

Reference	Title	Description	Commentary
			the period 2002/03 to 2004/05 supplemented with FTE support from Engineering Services.
7.2.2.2	Safety and Compliance	Increased direct and outsourced costs as a result of HSE requirements for demonstrations of safety compliance.	Given the prevailing trend of Safety Legislation and interpretation it is difficult to argue an efficiency adjustment in FTE's. TPA view is that the scale of work forecast by National Grid on two COMAH sites in the years 2005/06 to 2007/08 at £400k is high, compared with similar work undertaken by other gas facility operators, and that an efficiency adjustment could be made to OMGS costs for COMAH compliance activities.
7.2.2.3	Environmental Issues	The ongoing costs of compliance with PPC Regulations should be reviewed.	There is a reasonable argument for the level of resources in the early period of the price control and the operations of the PCC Regulations and EU Emissions Trading Scheme for the level of resources proposed. However TPA would expect National Grid to gain experience and expertise and to develop a systematic approach to data management and compliance reporting within the forward period and given the support available from Engineering Services and the role of the Gas System Operator TPA view is that an efficiency adjustment could be made to level of FTE's allocated to this activity from 2008/09.
7.2.2.4	Technical Drawing, Data and Systems	Increased direct and outsourced costs as a result of an increase in the size of the asset base and the migration of data from legacy systems onto a new web based server platform which offers the potential for an integrated Work and Asset Management System.	It is accepted that the continued use of legacy systems is undesirable and works against the implementation of an integrated and effective work and asset management system. TPA accepts that in the next price control period the size of the asset base will increase and there will be an increase in asset stewardship activity. However TPA view is that the acquisition of new asset data in digital format which when integrated with the proposed IDMS Livelink systems should introduce efficiencies in the asset record management activity offsetting to some extent the anticipated workload.
7.2.2.5	Outsourced Engineering		There are no planned changes to the range of services that are outsourced in the forward period. The primary services procured are for boroscope

Reference	Title	Description	Commentary
			inspections, technical consultancy, rotating machinery, COAS support and pipeline inspections for TD1 infringements, underwater and above ground crossings. National Grid have indicated that there will be at least one contract renewal in to forward period indicating that competitive tendering/market testing will continue to be applied to the outsourcing process. (Ref: questions TP 4148 & TP4149)
7.2.2.6	Asset Management Review	The increasing age of the asset base increase the likelihood of failure.	TPA accepts the general point that as assets age there is a greater likelihood of condition based fault or failure. However the asset health review process is now established and there is experience within Network Strategy of operating the process and no additional asset groups have been identified where deterioration is anticipated. (Ref: question TP4075). There is the potential to utilise the increased capability /competency within Asset Strategy and to use resources from Engineering Services to support the review process.
7.2.2.7	R&D Program	An increase in the number of FTEs is needed to run and implement the increased future volume of work under the R&D programme.	The focus of the proposed program is appropriate and aimed at addressing areas of future opex and capex. National Grid collaboration with other organisations provides access to external research programs and best practice. TPA note National Grid proposal to discuss with Ofgem on how R&D projects should be funded.
7.2.2.8	Developing the Capital Plan	Further integration of gas and electricity planning activities and efficiencies in the co-ordination of investment strategy are expected to reduce costs.	There is a decrease in the number of 2 FTE's from the years 2005/06 onwards compared with the year 2004/05. The reduction is in part due to the transfer of compressor performance testing to Asset Strategy rather than a net reduction in Network Strategy costs. However additional factors should be considered when determining the resources required for the forward period; the impact of exit reforms, when Distribution Network Operators become responsible for demand forecasting and the reducing level of capex through the period. TPA view is that further reductions in the number

Reference	Title	Description	Commentary
			of FTE's could be made from 2008/09 and that an efficiency adjustment in the forecast years could be applied.

7.2.4 Network Strategy and Engineering Services Synergies

See Section 7.3

7.2.5 Range Analysis

TPA provides the following analysis on possible upper and lower boundaries for opex in the period 2006/07 to 2012/13 based on the assumptions and commentary made above.

The analysis is presented as a challenge and the high efficiency adjustment is aggressive. The impact of the high adjustment would have to be carefully assessed and quantified as there is a risk that the core technical capability embedded within Network Strategy, whose role is to design and development of the National Transmission System, would be adversely effected.

The potential areas for efficiencies identified by TPA may also be the areas subject to review by National Grid under the Transmission Efficient Challenge.

In either case the significance of any changes in resources and organisational structure to such as merger of Network Strategy and Engineering Services will need to be determined and any significant change would have to be submitted to HSE for Safety Case assessment.

The areas where TPA has identified possible efficiency adjustments as the asset management process mature are:-

- Increasing proficiency in asset condition assessment using established methods and tools and access to support from the increased competency/ capability within Asset Strategy and support from Engineering Services (7.2.2.1 c and d and 7.2.2.6)
- OMGS/consultancy costs for Safety and Compliance appear high compared with equivalent operators. (7.2.2.2)
- Increasing proficiency in environmental monitoring and reporting, integration of compliance activities between NS, ES and SO. (7.2.2.3)
- The provision of new asset records by the main works contractor in electronic format for migration to the proposed asset database should provide efficiencies in data acquisition and on going management. (7.2.2.4)
- Efficiency in forecasting and capital planning arising from Exit Reforms and the reducing level of capex through the period. (7.2.2.8)

The table below indicates the range of adjustments that might be realised at the start of the forward period and by the end of the period and shows:-

- The range of adjustments, high, medium and low for each area where TPA has identified possible efficiencies. (£M)
- The total Network Strategy opex
- An exceptional adjustments
- The underlying Network Strategy opex

- Total adjustments, high, medium and low for each area where TPA has identified possible efficiencies. (£M)
- The Adjustment expressed as a % of total Network Strategy opex
- The likely impact on the number of FTE's

Negative valves are shown in red type.

Adjustment Details	2005/06			2011/12		
Efficiency Adjustment to Forecast Years (£M)	High	Med.	Low	High	Med.	Low
Asset Strategy: Increasing proficiency in asset condition assessment using established methods and tools (7.2.2.1 c and d)	-0.05	0.00	0.00	-0.05	-0.05	0.00
Safety & Compliance: OMGS/consultancy costs for Safety and Compliance appear high compared with equivalent operators. (7.2.2.2)	-0.1	-0.05	-0.05	-0.10	-0.05	0.00
Environmental issues: Increasing proficiency in environmental monitoring and reporting, integration of compliance activities between NS, ES and SO. (7.2.2.3)	0	0.00	0.00	-0.10	-0.05	-0.05
Technical Drawings: The provision of new asset records by the main works contractor in electronic format for migration to the proposed asset database should provide efficiencies in data acquisition and on going management. (7.2.2.4)	-0.05	0.00	0.00	-0.10	-0.05	-0.05
Asset Review: Increasing proficiency in asset condition assessment using established methods and tools and access to support from the increased competency/ capability within Asset Strategy and support from Engineering Services (7.2.2.6)	-0.1	-0.05	0.00	-0.10	-0.05	0.00
Capital Plan: Efficiency in forecasting and capital planning arising from Exit Reforms and the reducing level of capex through the period. (7.2.2.8)	0	0.00	0.00	-0.30	-0.20	-0.10
Total Efficiency Adjustment for Year (£M)	**-0.30**	**-0.10**	**-0.05**	**-0.75**	**-0.45**	**-0.20**
	High	Med.	Low	High	Med.	Low

Figure 7.2.5.1. Source: TPA Solutions

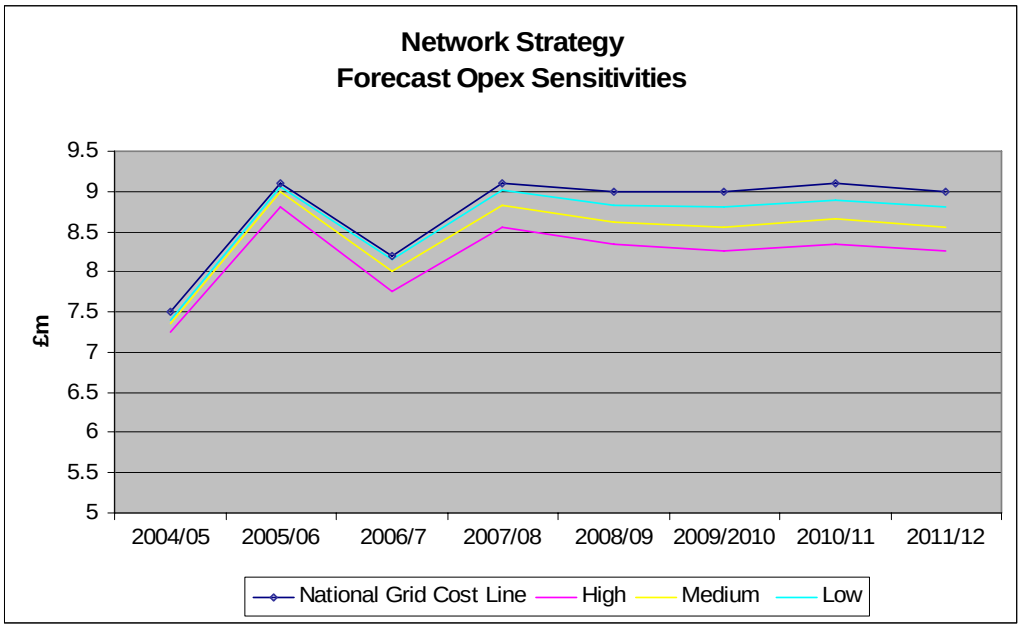
Adjustment Summary	2005/06			2011/12		
Total Network Strategy Budget for Year (£M)	15.30			9.00		
Exceptional items: Diversion Schemes see 8.2.1 (£M)	-6.20			0		
Underlying Network Strategy Budget for Year (£M)	9.10			9.00		
Total Efficiency Adjustment for Year (£M)	-0.30	-0.10	-0.05	-0.75	-0.45	-0.20
Efficiency Adjustment % of Total Network Strategy Budget for Year	**-3.30%**	**-1.10%**	**-0.55%**	**-8.33%**	**-5.00%**	**-2.22%**
Associated FTE reduction	-4	-1	0	-13	-8	-4
	High	Med.	Low	High	Med.	Low

Figure 7.2.5.2. Source: TPA Solutions

[redacted]

The following chart illustrates TPA's Range Analysis for Network Strategy

Illustration of TPA Range Analysis

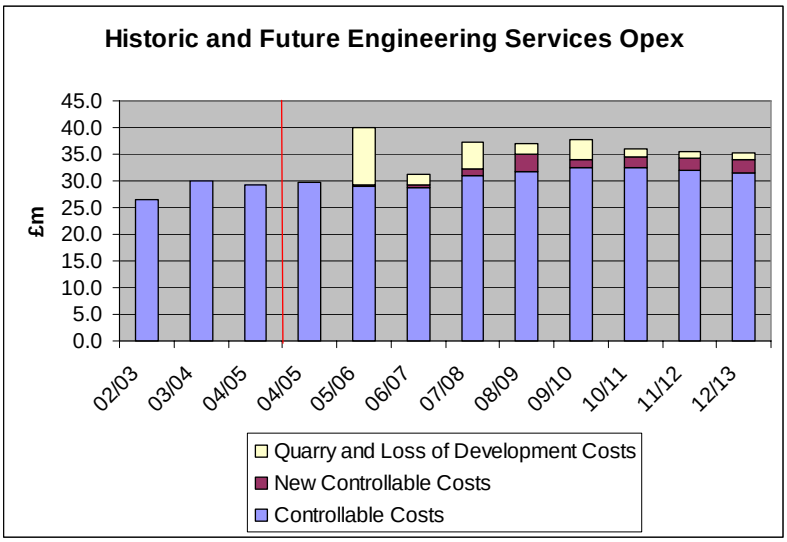


NB: High = Most Efficient, Low = Least Efficient

7.3 ENGINEERING SERVICES

7.3.1 FBPQ Opex Profile and Cost Movement

The Chart and table below provide an overview of the Opex expenditure over the period 2005/06 to 2012/13 as forecast by National Grid in the FBPQ submission and additional material provided in presentations and in response to formal questions.



Source: Data from FBPQ Appendix 2. Chart prepared by TPA Solutions

Opex Controllable Cost Movement £m	2004/05	2011/12
Pipelines and AGI's	3.8	6.6
Terminals and Compression	13.7	16.3
National Support and NRM	7.8	6.7
PMC	1.8	1.8
Land and Development	2.7	2.6
General Efficiencies (1% abatement)	0	-2.1
TOTAL	29.8	31.9
New Controllable Costs		
Security	0	1.9
Exhaust And Intakes	0	0.4
TOTAL	29.8	34.2

Source: Presentation Data from March 22nd 2006

7.3.2 Analysis of Cost Movements

7.3.2.1 Pipelines and AGI's

The forward capex plan indicates a significant investment in pipelines over the price control period to 2011/12 in the order of £1.3bn. Increase in asset base will result in increased maintenance requirement for OLI, inspection, aerial surveillance and PSSR. The proposed additional pipeline length to 2011/12 is a direct cost driver and is illustrated as follows:

Asset Growth	2004	2011
Pipeline km	6877	7931

Source: National Grid FBPQ

This represents a 15% increase in asset base over 2004 equating to an additional maintenance cost of £0.6m pa at 2011/12

Three new offtakes in South Wales are forecast at a cost of £150k pa for 3 years

It is proposed to increase gas quality monitoring at entry points from the current 45 minute sampling period to a maximum 15 minutes due to increased excursions from quality standards and the need to be able to respond quickly to DFO actions to ensure compliance with GSMR. Further evidence is awaited from National Grid as to the number and frequency of occasions to be able to validate the assumption (TP4153) although the principle of frequency is accepted.

Additional opex costs of gas quality monitoring are forecast to be as follows:

- Increased maintenance liability new equipment = £1.5m pa at 2011/12
- Increased maintenance liability current equipment = £0.2m pa at 2011/12

Following two pipeline incidents, a review of management procedures was carried out in August 2005 and concluded a standard approach to marker posts should be implemented which historically had varied across the network. A 4 year programme is therefore proposed in the business plan up to 2011/12 at £300k pa for survey, assessment and replacement of pipeline marker posts.

As well as the survey and prioritised replacement of markers the review recommended the risk assessment and introduction of additional markers in situations where 3rd party encroachment could result from their absence:

- Suburban and rural areas
- Locations of high 3rd party activity
- Critical pipelines
- River & estuary crossings
- Direction changes
- Support for improved aerial surveys

Total additional maintenance opex costs are therefore identified at £2.8m pa at 2011/12 indicating that underlying pipeline and AGI maintenance cost remains at the 2004 level of £3.8m.

Commentary

- It is accepted that increased maintenance costs will accrue as a result of increased asset base and the proposal as related to capex investment appears reasonable.
- NG must ensure they monitor the quality of gas at entry points and take appropriate action where unacceptable deviations from quality standards occur to protect both customers and the integrity of the network and the proposal is supported
- Integrity of marker posts, consistent application and their effective positioning, while possibly at odds with security considerations, has been an ongoing matter for many years. It would be expected that this is a part of normally funded pipeline maintenance and the proposal therefore suggests an absence of historical maintenance. An identifiable programme of remedial work is technically supported by TPA, to ensure the integrity of the pipeline system. A 4 year programme is proposed in the business plan up to 2011/12 at £300k pa for survey, assessment and replacement of pipeline marker posts. It may be argued that adequate historical maintenance should have ensured the integrity of pipeline marker posts, albeit to varying geographical based standards. It is accepted that standardisation will contribute to improved pipeline surveillance and in the longer term reduced maintenance, however costs of marker post maintenance should already be part of budgets so a sensitivity is proposed based on no allowance as a high case to full allowance as a low case sensitivity. The cost involved is however small at £300k pa for the 4 years to 2011/12
- The business plan also includes for a programme of corrosion control (painting and protective coatings) for AGI's following a condition assessment of assets. Such assets comprise 251 block valves, 27 pig-trap sites and 72 multi-junctions. Maintenance opex of £200k pa for corrosion control (painting and costing) is included from 2005/06 to 2011/12. As above, it may be argued that such work should already have been in budgets and poor historical maintenance has led to neglect. A high sensitivity of no allowance may be considered.
- Cost per km of pipeline and AGI maintenance increases from £552 per km in 2004/05 to £830 per km in 2011/12 however this is largely as a consequence of investment in gas quality monitoring and in marker post remediation, the underlying maintenance cost per km remaining level and is considered reasonable

7.3.2.2 Terminals and Compressors

The forward capex plan indicates investment in new and replacement compression plant providing a driver for increased maintenance costs. New compressor stations will increase opex maintenance and the Engineering Services plan includes for the additional recruitment of 18 FTE (in 2005/06 and 2006/07) due to current vacancies at St Fergus terminal and current compressors stations and 4 FTE (in 2009/10) at new compressor stations

[redacted]. This we assume represents the 60 gas sites [redacted] and generates an additional total direct annual opex cost of £1.9m. This is included in the separately identified schedule [redacted]; see below, £1.9m in 2011/12.

Additional compressor site costs are identified in South Wales at £100k pa for 3 years from 2009 to 2011.

Commentary

- Increase in opex of £13.7m in 2004/05 to £16.3min 2011/12 is a 19% increase represented directly by the increase in FTE, i.e., 22 new FTE compared to the current 143 FTE (94 compressors + 49 terminals) on terminals and compressors. We have questioned the manning strategy going forward as it appears from the 2005 plan cycle that 6 compressor stations are forecast to have zero running from 2009 to 2013. In that event we would expect to see some novel proposals regarding management of those sites it being unacceptable to maintain wholly under-utilised staffing. The capital plan and forecast compressor fleet utilisation analysis (TP4097) indicates that 6 compressor stations will exhibit zero running hours from 2007 onwards. There may therefore be scope for saving 24 FTE (4 staff per station) by decommissioning redundant stations. National Grid philosophy is to assess operational usage for two years in addition to the two years planning analysis indicating zero forecasts running. As earlier planning analysis also indicated zero running for 2006 it is considered that the 2 year planning horizon is satisfied as at 2007. In the event that operational usage from 2007 confirms zero running, then 6 compressor stations may potentially be considered redundant from 2009. Potential maximum staff and maintenance costs saving may be in the order of £97k pa per FTE (based on 2004/05 T&C opex of £13.7m and 141 FTE) suggesting a high-end sensitivity of £2.3m pa from 2009/10. Set against this direct saving would however be consequential additional costs of redeployment, retraining or redundancy costs. There would also be decommissioning costs which are currently exampled by Bathgate at a one-off £2.0m and issues of how the regulatory regime will treat redundant assets and their value in the RAV. TPA therefore suggest regulatory treatment of redundant assets is considered and developed to incentivise opex savings based on redundant plant
- We have reviewed the philosophy of manning at Compressor Stations and TPA accept the principle of distinct and discrete skills sets in mechanical, electrical and instrumentation disciplines and the consequent qualifications required. It is unrealistic to combine these skills due to their diverse technical nature and it is an intrinsic consequence of the equipment and plant on site that these skills are required. Some off site work is carried out where possible however, geographical constraints and physical location of compressor stations limit the potential for greater utilisation of the resource. In particular it is noted that the appropriate level of electrical certification is for work on electrical systems at up to 11kv which would limit further work on the national electrical grid should that be a possible work opportunity. The manning levels also support an economic and appropriate standby and emergency callout rota in support of safety case obligations. The future change in operating scenario where it is planned to install electrical VSD prime movers in addition to retaining gas turbines is considered to continue to require similar skill sets on site.
- TPA accepts the need for additional staff in relation to Felindre compressor station and also in relation to the possible Panel compressor station,should that be required as a result of Easington auction signals in 2006.
- It was noted with some disappointment during recent site visits to Peterborough, Kings Lynn, Bathgate and Avonbridge Compressor Stations the apparently neglected state of site pipework. These are manned during the day stations and we

would expect to see more care and attention to corrosion and unprotected pipework.

- National Grid considers the direct opex security costs to be controllable as they have the ability to influence the routine maintenance cost by competitive tender of maintenance and repair agreements. We would support this approach.

7.3.2.3 National Support and Non-Routine Maintenance

The FBPQ plan forecasts an opex reduction of £1.1m (14%) at the end of period due to expected reduced breakdowns mainly as a result of proactive boroscoping to identify potential defects.

Upward opex drivers are the Bathgate decommissioning costs of £0.2m in 2007/08 and £1.8m in 2008/09 and revised 2005/06 experiences in additional compressor breakdowns in total +£1.5m.

A replacement programme is in place for protection and control systems commencing at Wormington in 2007 with two systems per annum thereafter. This results in an annual opex maintenance cost of £0.85m by 2011/12 for the associated Post Delivery Support Agreements (PDSAs)

The FBPQ capex plan includes for significant investment in electric VSDs at compressor station to comply with IPPC. New support agreements are therefore required as the specialist skills do not reside in-house. National Grid forecast an annual opex maintenance cost increasing to £0.7m pa at 2011/12.

The business plan includes for a programme of corrosion control (painting and protective coatings) for AGI's following a condition assessment of assets. Such assets comprise 251 block valves, 27 pig-trap sites and 72 multi-junctions. Maintenance opex of £200k pa for corrosion control (painting) is included from 2005/06 to 2011/12.

Commentary

- The business plan reflects a reduction in opex from £7.8m in 2004/05 to £6.7m in 2011/12, however underlying ongoing opex excluding the above additions of £1.8m pa at 2011/12 equates to £4.9m (63%) representing the continuing major overhaul and breakdown costs
- Investment in electric VSDs and PDSAs will influence the manning strategy at compressor stations. We would expect this to be a factor included in the strategy for manning of compressor stations.
- A programme of corrosion control painting and coating has been assessed and recognised for AGI's. No similar programme is evident for compressor stations and in view of experiences during site visits we would expect a similar assessment.

7.3.2.4 Pipeline Maintenance Centre

PMC operates from 7 geographically dispersed depots with 88 staff and provides a 24 hour CEME capability together with high pressure planned work capability. It operates as a profit centre deriving income from Distribution and iDNs. Within the business plan there is an assumption of status quo regarding income which may or may not be realistic.

Evaluation of the risk suggests a potential upwards opex pressure due to loss of planned work contracts of £0.9m pa and £1.8m pa for loss of CEME contract for two iDNs at 2011/12. In the event that chargeable work is lost and the capability becomes solely an emergency service at an NTS level there is an upwards opex pressure of potentially £10.2m. However, since 4 of the DNs supported are National Grid owned it is unlikely that total loss of income may occur in which case a 50% sensitivity is considered realistic, i.e., potential loss of income of £5.1m. National Grid state that this risk will be managed with existing constraints and that no allowance or mitigation is included in FBPQ for this risk

It is noted that total PMC income from Distribution, CEME, OLI, Aerial Surveillance and Planned Work was £10.2m in 2004/05 (PMC accounts submitted in response to TP1018). The corresponding annual PMC cost is £12.0m.

Commentary

- There is no evidence of alternative business strategies to manage risk of loss of income and any potential loss would therefore be managed within current opex constraints. The risk of loss is therefore illustrated as a sensitivity, however we would expect National Grid to have mitigation plans in place to either replace potential loss of contracts with alternative external income or reorganise the PMC capability. Of the 7 depots, the major high pressure capability is based at Ambergate the other depots predominantly managing up to 7 bar networks and it in considered in the worst case scenario that NTS support could be managed through 2 depots, i.e., Ambergate and another in the North.
- We recognise the strategic importance of the CEME capability to the security of the network and support its continuation

7.3.2.5 Land and Development

FBPQ includes opex compensation liability for crop loss and drainage remedial work as a result of pipeline construction. There are ongoing legacy issues and new costs included going forward for compensation as a consequence on new capex pipeline programme.

Full and final settlement is negotiated where possible though landowners and agents are well aware of their rights and will largely persist with maintaining their ongoing settlements. A flat opex profile of £2.7m in 2004/05 to £2.6m in 2011/12 is maintained based on historical experience and assumes that improved land management during pipeline construction in latter years will contain the level of compensation.

Excluded from FBPQ controllable opex are uninsured losses as a result of quarry mineral rights compensation and consequential loss of development primarily landfill opportunities. A significant settlement is pending at £10.7m through arbitration relating to a quarry site owned by Lafarge Roxwell and which is currently subject to appeal. Known possible claims that may follow as a result of this case are included in uncontrollable opex at this stage. This forecast opex profile based on known sites is as follows:

Forecast Profile of Costs (£m) based on Known Sites

	05/06	06/07	07/08	08/09	09/10	10/11	11/12
Quarry and Loss of Development Costs	10.7	2.1	5.1	2.1	3.8	1.4	1.4

Source: National Grid FBPQ

National Grid has stated they wish to approach Ofgem to review and discuss regulatory treatment of such claims.

Commentary

Legitimate claims will arise due to sterilisation of land opportunities and each case will depend on its relative merits. Negotiation with claimants and using specialist consultants is carried out and where it is justified alternative pipeline routing may be an option and should be considered.

7.3.2.6 General Efficiencies

National Grid includes an assumed but as yet unallocated general efficiency of £2.1m in the Engineering Services GTS Business Plan. Additionally, the recently announced Transmission Efficiency Challenge and merger of Engineering Services and Network Strategy will generate cost benefits which are as yet unclear

The UK Transmission Efficiency Challenge is intended to generate savings of £30m by 2011/12. National Grid currently envisages that these savings will derive from:

- UK Transmission BPR, including bringing Network Strategy and Engineering Services together and other as yet unspecified initiatives
- Pay Growth Reduction
- Procurement Savings

Such planned savings are currently unallocated, although National Grid has stated in presentations that they broadly see each of these three items would contribute roughly £10m in savings.

Commentary

TPA believes that the savings by merging the 2 Directorates are around 500 - 700k per annum based on reduction of 1 Director and 5 Direct Reports and associated support. Further savings may be possible at lower levels, for example 2 FTE within technical expertise in NR&M, though the extent of these may be limited by the requirement to keep separation between work specification and work delivery. National Grid proposed dates for this are as yet unknown.

7.3.3 New Controllable Costs

7.3.3.1 Security

Security issues are restricted to discussion and agreement between National Grid, DTi and Ofgem. We are advised that agreement has been reached on the measures and costs required to be included in FBPQ. [redacted]

Commentary

[redacted], no further comment is added regarding security considerations

7.3.3.2 Exhaust Stacks and Air Intakes

50% of the population of these assets is nearing the 20 year asset life and a programme of inspection through independent assessment has indicated a remedial programme is required. This is mainly capex and is covered in FBPQ Capex but there is an element of minor repairs required which is assessed at £0.4m pa over the period by 2011/12 in accordance with the following plan:

Repairs Requirement

2007/08		2008/09		2009/10		2010/11		2011/12	
Air Intake	Exhaust	Air Intake	Exhaust	Air Intake	Exhaust	Air Intake	Exhaust	Air Intake	Exhaust
0	3	0	0	5	7	3	3	3	3

Source: National Grid FBPQ

Commentary

- Engineering Services business includes for an opex increase for this activity of £0.2m pa above 2004/05 level by 2011/12
- We do not see why this is taken as an additional new controllable opex item and what may distinguish this one from other new items in Non Routine Maintenance. Therefore we suggest it is included in National Support and Non Routine Maintenance
- We would recognise the technical merit of condition based refurbishment

7.3.4 Summary of Opex movements

The following table shows the opening and closing FBPQ Capex for the period. Opex additions which are attributed to additional workload above the 2004/05 base are illustrated based on the assumptions and commentary above. Subtracting the Opex additions from the closing position reveals the underlying level of opex.

Summary to show the underlying opex level

Opex Controllable Cost Movement £m	**2004/05**	**2011/12**	**Opex additions**	**Underlying opex**
Pipelines and AGI's	3.8	6.6	2.8	3.8
Terminals and Compression	13.7	16.3	2.7	13.6
National Support and NRM	7.8	6.7	1.8	4.9
PMC	1.8	1.8	0	1.8
Land and Development	2.7	2.6	0	2.6
General Efficiencies	0	-2.1	-2.1	-2.1
TOTAL	29.8	31.9	5.2	24.6
New Controllable Costs				
Security	0	1.9	1.9	1.9
Exhaust And Intakes	0	0.4	0.4	0.2
TOTAL	29.8	34.2	7.5	26.7

Source: TPA Solutions

Commentary

- Taking the new business plan additions out of the 2011/12 forecast indicates an underlying ongoing opex level some 11% below 2004/05 outturn
- Upwards opex pressure of £5.1m will impact PMC should no mitigation plans be in place in the event of loss of CEME and Services contracts with DNs
- Included in 2011/12 forecasts is a real pay increase of 2%. Assessment of the impact of this in Engineering Services is outside the scope of TPA remit but may amount to in the order of £0.3m pa based on October 2005 Engineering Services GTS management accounts salaries costs. TPA would suggest appropriate consultants review the National Grid performance and reward strategy.
- We assume that the UK Transmission Efficiency Challenge will influence the above particularly with respect to the proposed merger of Network Strategy and Engineering Services. No further information is available on the initiative at his stage and stage and the detailed implications of such merger and its impact are outside the scope of this report.

7.3.5 Summary of TPA Commentary

Reference	Title	Description	Commentary
7.3.2.1	**Pipelines and AGI's**		It is accepted that increased maintenance costs will accrue as a result of increased asset base and the proposal as related to capex investment appears reasonable. National Grid must ensure they monitor the quality of gas at entry points and take appropriate action where unacceptable deviations from quality standards occur to protect both customers and the integrity of the network. Further evidence is awaited to support the investment (TP4153) Integrity of marker posts and their effective positioning, while possibly at odds with security considerations, has been an ongoing matter for many years, It would be expected that this is a part of normally funded pipeline maintenance and the proposal therefore suggests an absence of historical maintenance. An identifiable programme of remedial work is technically supported to ensure the integrity of the pipeline system. Cost per km of pipeline and AGI maintenance increases from £552 per km in 2004/05 to £830 per km in 2011/12 however this is largely as a consequence of investment in gas quality monitoring and in marker post remediation, the underlying maintenance cost per km remaining level.

Reference	Title	Description	Commentary
7.3.2.2	**Terminals and Compressors**		Increase in opex of £13.7m in 2004/05 to £16.3min 2011/12 is a 19% increase represented directly by the increase in FTE, i.e., 22 new FTE compared to the current 143 staff on terminals and compressors. We have questioned the manning strategy going forward as it appears from the 2005 plan cycle that 6 compressor stations are forecast to have zero running from 2009 to 2013. In that event we would expect to see some novel proposals regarding management of those sites it being unacceptable to maintain wholly under-utilised staffing. TPA proposes that Ofgem consider regulatory treatment of redundant assets. TPA accepts the technician manning philosophy at compressor stations. It was noted with some disappointment during recent site visits to Peterborough, Kings Lynn, Bathgate and Avonbridge Compressor Stations the apparently neglected state of site pipework. These are manned during the day stations and we would expect to see more care and attention to corrosion and unprotected pipework. National Grid considers the direct opex security costs to be controllable as they have the ability to influence the routine maintenance cost by competitive tender of maintenance and repair agreements. We would support this approach.
7.3.2.3	**National Support and Non-Routine Maintenance**		The business plan reflects a reduction in opex from £7.8m in 2004/05 to £6.7m in 2011/12, however underlying ongoing opex excluding the above additions of £1.8m pa at 2011/12 equates to £4.9m (63%) representing the continuing major overhaul and breakdown costs Investment in electric VSDs and PDSAs will influence the manning strategy at compressor stations. We would expect this to be a factor included in the strategy for manning of compressor stations. A programme of corrosion control painting and coating has been assessed and recognised for AGI's. No similar programme is evident for compressor stations and in view of experiences during site visits we would expect a similar assessment. Potential saving of 2 FTE with NS/ES merger and sharing of technical skills
7.3.2.4	**Pipeline Maintenance Centre**		There is no evidence of alternative business strategies to manage such a risk and any potential loss would therefore it is assumed be managed within current opex constraints. The risk of loss is therefore illustrated as a

Reference	Title	Description	Commentary
			sensitivity, however we would expect NG to have mitigation plans in place to either replace potential loss of contracts with alternative external income or reorganise the PMC capability. We recognise however the importance of the CEME capability to the security of the network and support its continuation
7.3.2.5	**Land and Development**		Legitimate claims will arise due to sterilisation of land opportunities and each case will depend on its relative merits. Negotiation with claimants and using specialist consultants is carried out and where it is justified alternative pipeline routing may be an option and should be considered.
7.3.2.6	**General Efficiencies and UK Transmission Efficiency Challenge**		General Efficiencies of 1% are included in FBPQ submission TPA believes that the savings by merging the 2 Directorates are around 500 - 700k per annum based on reduction of 1 Director and 5 Direct Reports and associated support. Further savings may be possible at lower levels, for example 2 FTE within technical expertise in NR&M, though the extent of these may be limited by the requirement to keep separation between work specification and work delivery. National Grid proposed dates for this are as yet unknown. We assume the proposed Network Strategy/Engineering Services merger is subject to HSE Safety Case approval for the gas activities and would comment that this may affect savings expected.
7.3.3.1	**Security**		In view of the sensitive issues no further comment is added regarding security considerations
7.3.3.2	**Exhaust Stacks and Air Intakes**		We do not see why this is taken as an additional new controllable opex item and what may distinguish this one from other new items in Non Routine Maintenance. Therefore suggest it is included in National Support and Non Routine Maintenance We would recognise the technical merit of condition based refurbishment
7.3.3.4	**Summary Analysis**		Taking the new business plan additions out of the 2011/12 forecast indicates an underlying ongoing opex level some 11% below 2004/05 outturn Upwards opex pressure of £5.1m will impact PMC should no mitigation plans be in place in the event of loss of CEME and Services contracts with DNs

Reference	Title	Description	Commentary
			Included in 2011/12 forecasts is a real pay increase of 2%. Assessment of this is outside the scope of TPA remit but may amount to in the order of £0.3m pa based on October 2005 Engineering Services GTS management accounts salaries costs. We would suggest appropriate consultants review the National Grid performance and reward strategy We believe the UK Transmission Efficiency Challenge will influence the above particularly with respect to the proposed merger of Network Strategy and Engineering Services. No further information is available on the initiative at his stage.

7.3.6 Range Analysis

TPA provides the following analysis on possible upper and lower boundaries for opex in the period 2006/07 to 2012/13 based on the assumptions and commentary made above.

The analysis is gives two alternative scenarios, the second of which includes the possibility of the significant upwards costs drivers identified above occurring.

In either case the significance of any changes in resources and organisational structure to such as merger of Network Strategy and Engineering Services needs to take into account all factors including the Safety Case.

The areas where TPA has identified possible efficiency adjustments in Engineering Services are:

- Compressor Station Manning
- Pipelines and AGI's Marker Posts
- Pipelines and AGI's Corrosion Control and Painting
- Savings of 2 FTEs from Non-routine Maintenance (National Support) through the merger between Engineering Services and Network Strategy.
- In addition, by merging Directorates there could be a rationalization in Level 3 Managers and associated support, together giving a saving of around £700k per annum which would be available by the start of the price control period.

The 1% improvement in general efficiencies which National Grid has identified is included within their submitted costs and so TPA's analysis builds on top of these savings.

However, these potential savings must also be considered in the light of upwards costs drivers, particularly

- PMC Risk of Loss of Business
- Land and Loss of Development Claims

Negative values are highlighted in red type

Adjustment Details	**2005/06**			**2011/12**		
Efficiency Adjustment to Forecast Years (£M)	**High**	**Med.**	**Low**	**High**	**Med.**	**Low**
Compressor Station manning in considering future running hours scenarios (7.3.2.2)	0	0	0	-2.3	-1.1	0
Pipeline and AGI maintenance and marker posts (7.3.2.1)	0	0	0	-0.3	-0.15	0
Pipeline and AGI maintenance and corrosion control and painting (7.3.2.1)	0	0	0	-0.2	-0.1	0
Potential manpower savings in NRM from merger of ES and NS (7.3.2.6)	0	0	0	-0.1	0	0
Potential management level manpower saving due to merger of NS and ES (7.3.2.6)	0	0	0	-0.7	-0.6	-0.5
PMC risk of losing income from DN's for planned maintenance and CEME services (7.3.2.4) but not included in FBPQ submission but noted for information	0	2.5	5.1	0	2.5	5.1
Land & Development quarry compensation and loss of development rights (7.3.2.5) claims not included in FBPQ submission but noted for information	0	0	10.7	0	0	1.4
Total Efficiency Adjustment for Year (£M) (excluding PMC and Land)	**0**	**0**	**0**	**-3.6**	**-1.95**	**-0.5**
	High	Med.	Low	High	Med.	Low

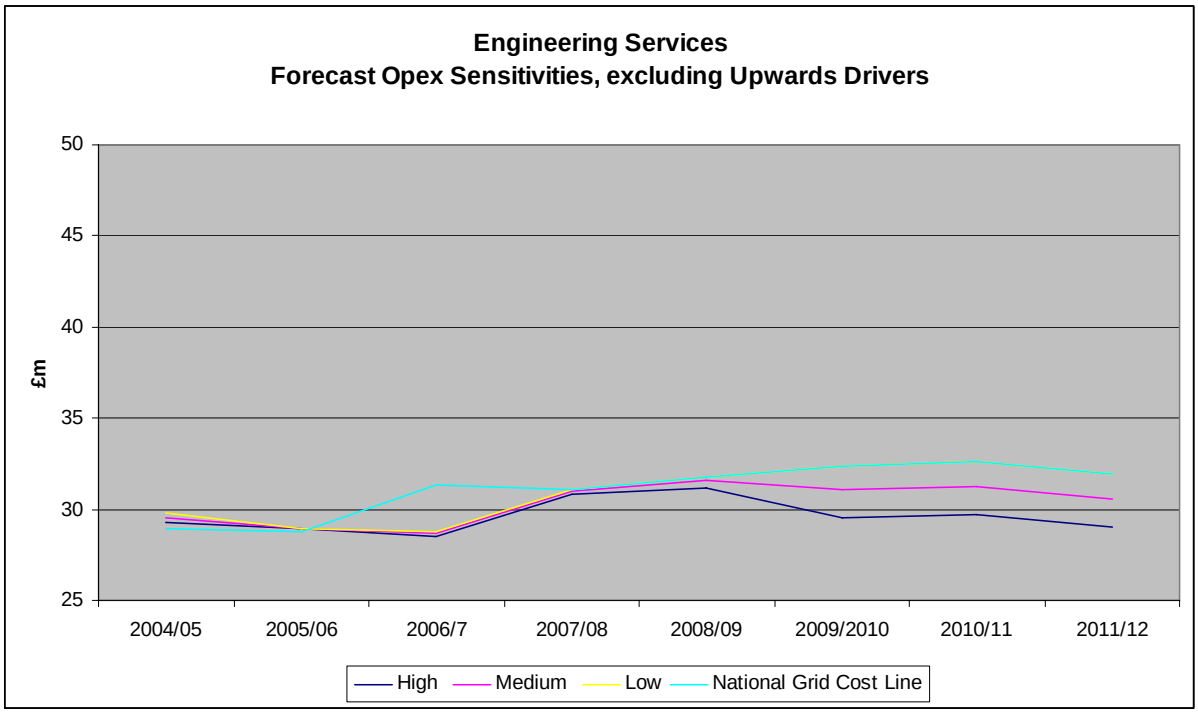
Source: TPA Analysis

Adjustment Summary	**2005/06**			**2011/12**		
Total ES GTS Budget for Year (£M)	28.9			31.9		
Total Efficiency Adjustment for Year (£M)	0	0	0	-3.6	-1.95	-0.5
Efficiency Adjustment % of Total ES GTS Budget for Year excluding PMC and Land & Development	0	0	0	11.29%	6.11%	1.57%
Underlying ES GTS Budget for Year (£M) excluding PMC and Land & Development	28.9	28.9	28.9	28.3	30.0	31.4
Associated FTE reduction	0	0	0	32	18	4
	High	Med.	Low	High	Med.	Low

Source: TPA Analysis

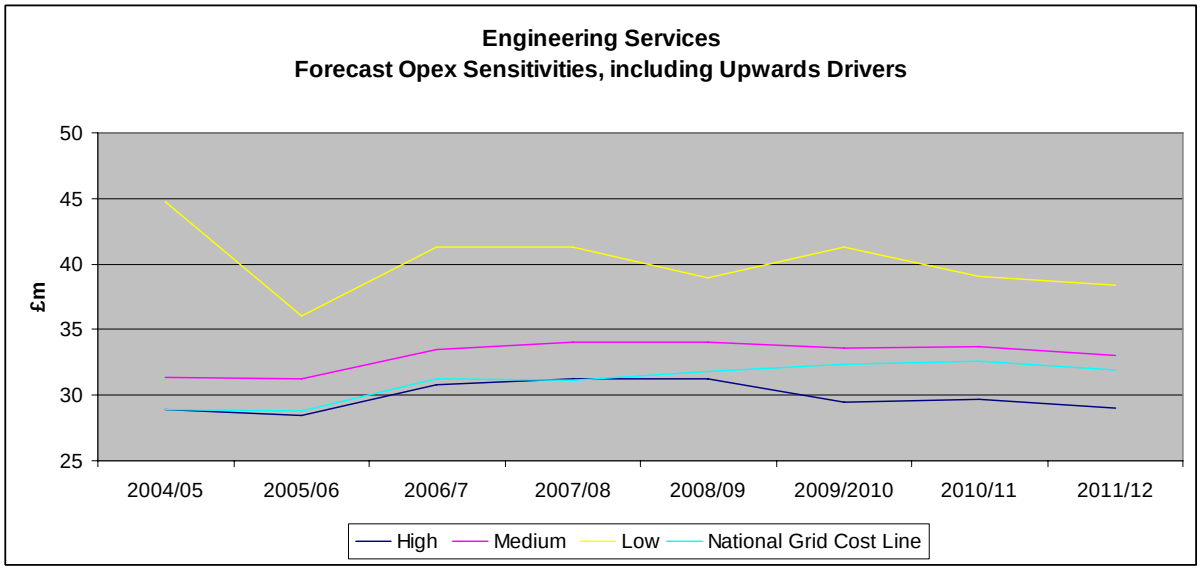
The following charts illustrate TPA's Range Analysis for Engineering Services.

Illustration 1 of TPA Range Analysis



NB: High = Most Efficient, Low = Least Efficient

Illustration 2 of TPA Range Analysis



NB: High = Most Efficient, Low = Least Efficient