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

London, July 12, 2011

On behalf of Ofgem



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author : G.Sharp  
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reviewed : T.Leonard  
approved : M.Chitty

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**Authorisation Signature:**

**Martin Chitty**

**Consulting Director UK & Ireland**

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## EXECUTIVE SUMMARY

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

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

### Non-Load Related Expenditure

NLRE is driven by asset replacement and refurbishment requirements to ensure the transmission network continues to deliver the reliability, security and performance levels demanded. This review of SPTL's proposed NLRE for 2012/13 has determined that:

- SPTL investment requirements for NLRE continue to be determined by asset health with schemes prioritised by an assessment of risk driven by SPTL Asset Risk Management policies. It was confirmed during the cost visit that this approach had been adopted in the development of the Rollover year investment plan rather than a fully adopted NOM (Network Output Measures) methodology. This should be viewed as an interim measure as SPTL is continuing to develop the transition to the full NOM methodology to refine replacement priorities based on health index and criticality.
- In general, SPTL has collated asset condition information for the major asset categories based on generic or asset family type data but the condition of ancillary components is less well defined. SPTL has also acknowledged that the collection and

availability of site specific condition information requires enhancement and has already instigated a programme of work to enhance the collection of appropriate condition data.

- SPTL's switchgear replacement activities in TPCR 4 are due to greater awareness of condition issues, which has driven the increase in expenditure seen in 2009/10. Reasons proffered for the increase in expenditure include an increase in the scope of works due to poorer than expected asset condition and a greater than anticipated deterioration in supporting civil structures.
- The age of overhead line conductor is a great cause for concern with SPTL with approximately 80% of 275kV conductor at or approaching 50 years old. A controlled ramping replacement programme based on age profile has been proposed by SPTL to manage a potential future step change in expenditure. However, this age-based view of conductor degradation and life replacement modelling requirements does not fully consider conductor condition information. SPTL currently has condition assessment information for approximately 5% of 275kV overhead conductor and has acknowledged that recent reconductoring work of 275kV routes XB and XC determined the conductor to be in better condition than expected. It is suggested that further condition investigation be performed in parallel to initial refurbishment works to better inform the need and timing of the proposed major refurbishment programme.
- An examination of major asset unit costs revealed that SPTL transformer unit costs are higher than KEMA cost data but generally lower or in line with the TO Average. Switchgear costs appear to be significantly lower than both the TO Average and KEMA comparators and underground cable costs for 275kV cable appear to be exceptionally low.
- When all Capex is considered, particularly the Transmission Investment Incentive (TII) schemes, SPTL is facing a substantial increase in demands on its delivery capability from an expenditure of £117m in 2009/10 to £411m in 2012/13; a rise of 3.5 times.
- SPTL is well aware of the incumbent contractor capability to deliver the increasing workload and has expressed concern over limited competition and capacity constraints in the relatively small 275kV and 400kV overhead line contractor base in the UK. SPTL has, commendably, approached contractors traditionally working at lower voltage levels (132kV and 33kV) to advise them of the forthcoming workload and to encourage them to train resources appropriately.

2012/13 Rollover Year (£m)	SPTL F'cast	KEMA Estimate	Comment
<b>NON-LOAD RELATED EXPENDITURE</b>			
Assets - replacement and refurbishment			
Transformers	9.5	9.5	faulted units have driven volumes higher than
Reactors	0.0	0.0	no expenditure
Switchgear	19.0	15.0	justification to extend or accelerate replacement not always clear
Overhead Lines	41.1	28.0	requires improved condition data prior to
Underground Cables	3.4	3.4	few works forecast.
Protection & control	8.5	8.5	higher volumes driven by replacement
Sub-station other	2.1	2.1	
Other NLRE			
Other TO	3.7	3.7	driven by 132kV CT replacement
Quasi capex			
<b>TOTAL</b>	<b>87.2</b>	<b>70.2</b>	

Load-related expenditure comprises all spend in relation to reinforcement of the transmission system, excluding TII, to accommodate new generation and demand connections or changes to existing customer requirements.

This review of SPTL's proposed LRE for 2012/13 has determined that:

- SPTL's 2010 FBPQ submission has been based on the 'Gone Green' demand and generation scenarios appropriately updated to reflect the latest generation developments and the associated impacts on the investment and expenditure areas in 2012/13 in particular.
- There is a high demand for wind farm development in the south west area of Scotland with many proposed generation sites located in remote, unpopulated areas where there is little network infrastructure to support their connection.
- The majority of load related expenditure, approximately 84%, is driven by the connection requirements of approximately 900MW of new generation projects contracted to connect in 2013/14 with much of the associated infrastructure development to be undertaken in 2012/13.
- SPTL is planning to establish a series of collector stations to facilitate connection of this generation, of which the two major collector development schemes have been examined in detail. The two collector schemes are known as the South West Scotland (SWS) collector and the Moffat collector totalling approximately £52m in expenditure. There is a high degree of confidence in the requirement for the collector infrastructure development proposed by SPTL.

- [REDACTED]

From a detailed analysis of the largest elements of SPTL's load related Capex plan, the Infrastructure-entry triggered and Generation-sole use categories, and discussion of the main issues within this report KEMA has made an assessment of the appropriate expenditure for these categories in the Rollover year, 2012/13 as indicated below. The other LRE categories listed were not reviewed.



2012/13 Rollover Year (£m)	SPTL F'cast	KEMA Estimate	Comment
<b>LOAD RELATED EXPENDITURE</b>			
Generation connection - sole-use	20.1	13.4	
Demand connection - sole-use	0.0	0	no expenditure.
<b>Total LRE - sole-use</b>	<b>20.1</b>	<b>13.4</b>	
Infrastructure - entry triggered	91.1	73.2	
Infrastructure - general reactive (excl TIRG /TSS)	0.0	0	no expenditure.
Infrastructure - general non reactive (excl TIRG /TSS)	18.0	18.0	not assessed; lower % level than TPCR4 average.
Infrastructure - exit triggered	2.4	2.4	not assessed, aligns with TPCR4 average.
Infrastructure - TSS	0.0	0	no expenditure.
<b>Total LRE - Infrastructure</b>	<b>111.5</b>	<b>93.6</b>	
<b>TOTAL</b>	<b>131.7</b>	<b>107.0</b>	



## 1 INTRODUCTION

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

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

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

- a proportionate review of total forecast capital expenditure, drawing on historical information where appropriate;
- a proportionate assessment of non-load related capital expenditure (NLRE) for 2012/13 (including asset replacement expenditure); and
- a proportionate assessment of forecast load related capital expenditure (LRE) in 2012/13.

The result of the review and KEMA evaluation is a recommendation on the appropriate non-load related (NLR) and load related (LR) capital expenditure allowances for the Rollover year 2012/13. The report excludes consideration of operational expenditure and non-network capital expenditure.

## **2 APPROACH TO THIS ASSESSMENT**

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

KEMA reviewed the total LR and NLR capital expenditure for SPTL, comparing outturn against allowances and projecting forecasts forward through the Rollover year (2012/2013) to 2014/15. Further analysis was performed on the NLRE to obtain a clear understanding of the levels of investment and volumes of assets installed, replaced or refurbished by major asset category.

KEMA reviewed the Rollover FBPQ submissions and accompanying narratives paying particular attention to;

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

Responses to requests for clarification arising from the FBPQ review and issued by Ofgem on 30 November 2010 were submitted by SPTL and have been taken into full consideration in this review. In addition, visits to SPTL by Ofgem and KEMA on 17 and 18 January 2011 provided further clarification and understanding of the information submitted.

Using all available information KEMA has made an assessment of:

- appropriate non-load related expenditure for the Rollover year 2012/13; and
- appropriate load-related expenditure for the Rollover year 2012/13.

### 3 NON-LOAD RELATED EXPENDITURE

#### 3.1 TPCR4 Expenditure to Date

NLRE investment levels exceeded allowances in the first two years of TPCR4 and fell back significantly in 2009/10 to outturn at £191.2m against allowances of £203.1m. The underspend relative to allowance assumptions at the start of TPCR4 is largely attributable to reduced investment in the overhead line asset category. SPTL is anticipating a recovery of NLRE during the final two years of the current price review with total NLRE for the price control period forecast to outturn slightly below (0.7%) allowance assumptions.

SPTL also noted that capital expenditure was reduced during 2009/10 as a prudent approach to the increased cost of borrowing as a result of the global financial crisis.

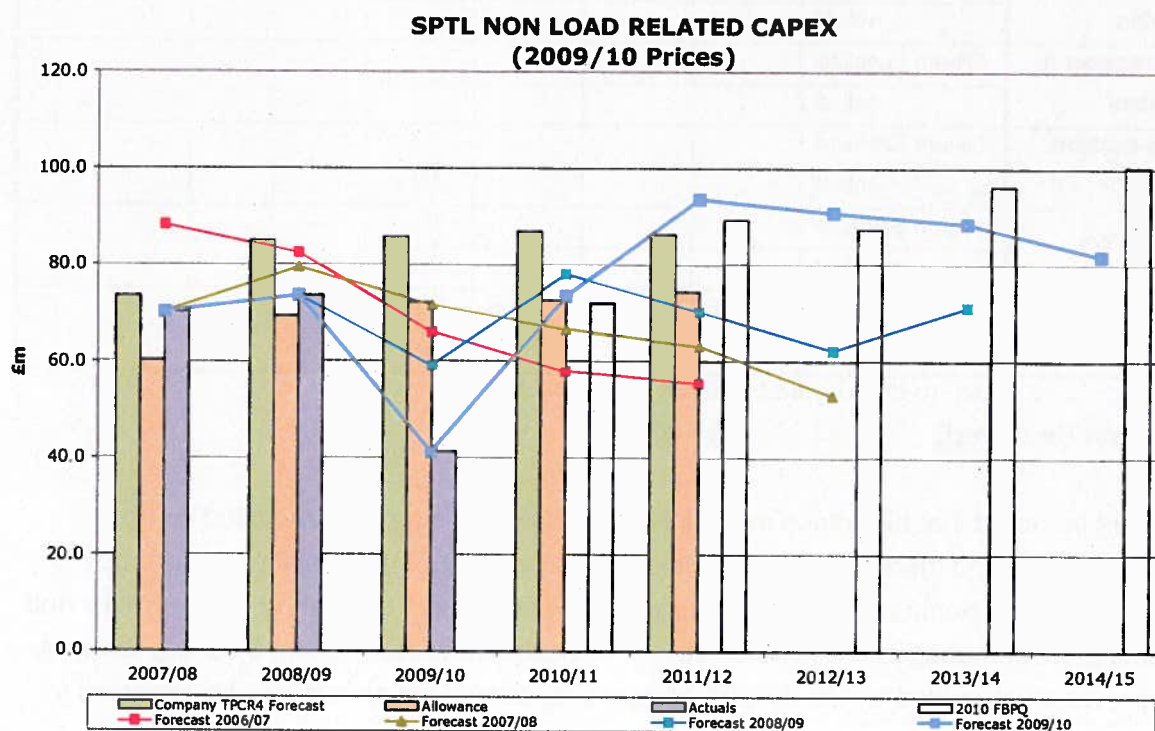


Figure 1: SPTL Non-Load Related capital expenditure.

### 3.1.1 Comparison of actual expenditure and allowances

Analysis of NLRE to date by major asset category (as reported in the FBPQ) is shown in Table 1 and indicates an underspend against TPCR4 allowance assumptions in all asset categories with the exception of the transformer category which exhibits expenditure significantly beyond allowance assumptions.

Asset Replacement	Expenditure £m	2007/08	2008/09	2009/10	Total	Act. minus B'line £m	Act. minus B'line %
Transformers	Ofgem Baseline						
	Actual						
Switchgear	Ofgem Baseline						
	Actual						
Overhead Line	Ofgem Baseline						
	Actual						
Underground cables	Ofgem Baseline						
	Actual						
Protection & control	Ofgem Baseline						
	Actual						
Sub-station other	Ofgem Baseline						
	Actual						
Other TO	Ofgem Baseline						
	Actual						
Total	Ofgem Baseline	60.8	70.4	71.8	203.1		
	Actual	76.3	73.6	41.2	191.2		

**Table 1: NLRE to date by major asset categories.**  
(NB Data Removed)

It should be noted that allowance assumptions by asset category are provided on an indicative basis and therefore not fixed. It is recognised that SPTL has significant scope to reprioritise investments across asset categories in response to changing circumstances and emerging asset management considerations. Consequently, expenditure by asset category (not previously provided for the TPCR4 allowances) should not necessarily be expected to align with TPCR4 allowance assumptions. However, correlations between allowance assumptions (per asset category) and expenditure should be apparent.

### **Transformers**

Transformer expenditure during the first two years has been more than double the assumed allowances and has driven the £19m overspend in this category to date.

SPTL has stated that the delivery of transformer replacements is in alignment with their programme and has explained the increase in expenditure by:

- The condition of site civil structures is significantly worse than anticipated, requiring additional scope of works for rectification and driving up cost;
- Late completion of the Chapelcross transformer replacement drove expenditure from TPCR3 into TPCR4;
- The unplanned replacement of three faulted transformers; and
- Cost increases above RPI.

### **Switchgear**

Switchgear expenditure levels have been lower than TPCR4 allowance assumptions to date resulting in a cumulative underspend of 25%.

There is no clear reason for the low level of expenditure during the first two years of TPCR4 but SPTL is now focusing on increased switchgear replacement due to greater awareness of condition issues, which has driven the increase in expenditure seen in 2009/10.

### **Overhead Lines**

NLRE peaked in 2007/08 at £28m and has subsequently fallen year on year to £7.9m in 2009/10. Cumulative expenditure to date is approximately 12% lower than the assumed allowance.

Several reasons were provided by SPTL for the reduction in overhead line expenditure:

- The increased capital requirements for substation works;
- Scheme deferrals due to significant wayleave and consent issues;
- Changes to scheme requirements from major refurbishment to minor refurbishment activities; and

- Deferral, or change in scope, of works due to uncertainty over the conductor capacity required for the refurbishment of MITS (Main Interconnected Transmission System) overhead line circuits.

However, the low expenditure in 2009/10 does not appear to correlate with the reported volume of conductor additions of [REDACTED] for that year but may be better aligned to the proposed 2010/11 volumes. These asset addition quantities are significantly higher than any other reported actual or forecast over the TPCR4 and Rollover periods.

### **Underground Cables**

Cable expenditure is slightly lower than the level of assumed allowance and all programmed work has been delivered to date. SPTL states that it has been able to realise efficiency savings by employing innovative engineering solutions.

### **Protection & Control**

After expenditure in the first two years of TPCR4 in line with assumed allowance, protection and control investment fell considerably below allowance assumptions in 2009/10 with a cumulative underspend to date of approximately 24%.

### **Sub-station other**

This expenditure category encompasses three main work streams; environment (oil, containment, noise abatement), faults (replacement of damaged assets) and minor projects (GSP metering, civil refurbishment). Expenditure has been consistently below assumed TPCR4 allowance to date resulting in a cumulative expenditure level of 63% of allowance.

### **Other TO**

Other TO capex costs covers elements of expenditure on system assets not addressed by the major construction projects e.g. servitudes, operational site security, non-rechargeable diversions, strategic spares etc. This expenditure does not have an assumed TPCR4 allowance.

### **3.2 Forecast Expenditure for 2012/13**

In the 2010 FBPQ submission SPTL has provided expenditure forecasts for the period 2010/11 to 2017/18 generally indicating a year on year increase to an annual expenditure peak of £107m in 2016/17. The forecasts and accompanying detailed narrative have been considered in the assessment of:

- Updated forecast of the NLRE to the end of the current TPCR4 period;
- Forecast of the NLRE in the 2012/13 Rollover year; and
- Longer-term consideration of non-load related expenditure plans.

#### **3.2.1 Application of Network Output Measures**

SPTL provided a brief overview of the Network Output Measures (NOM) methodology agreed between the three TOs and Ofgem. In the FBPQ detailed narrative it is stated that due to the early stage of development, and following this initial application of the processes, further development of the processes and data is anticipated over the coming months and years.

SPTL investment requirements for NLRE continue to be determined by asset health with schemes prioritised by an assessment of risk driven by SPTL Asset Risk Management policies. It was confirmed during the cost visit that this approach had been adopted in the development of the Rollover year investment plan. This should be viewed as an interim measure as SPTL is continuing to develop the transition to the full NOM methodology to refine replacement priorities based on health index and criticality.

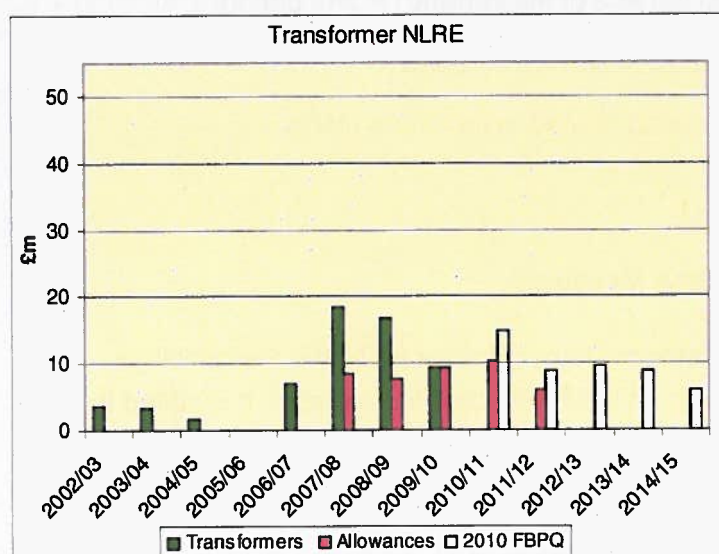
Table 4.28A of the FBPQ does demonstrate that SPTL has applied the NOM methodology in determining remaining useful life and replacement priority for each asset category by voltage level to specific sites on a generic basis but it is not clear that condition assessment has been driven down to site level.



### 3.2.2 Trends in expenditure

#### Transformers

The chart in Figure 2 shows actual and forecast transformer expenditure and assumed TPCR4 allowances.



**Figure 2: Actual and forecast transformer expenditure with assumed TPCR4 allowances.**

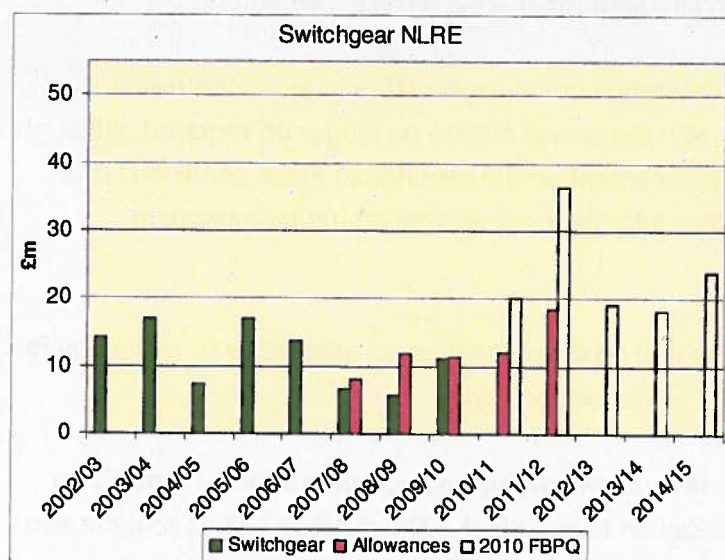
Expenditure to date is running approximately 75% above assumed allowances and is forecast to remain above allowances for the remainder of the TPCR4 period. The forecast expenditure is anticipated to peak at £14.9m in 2010/11 with a subsequent reduction and levelling into the Rollover year with an anticipated expenditure of £9.5m, lower than most of the TPCR4 years.

During the TPCR4 period to date, three transformers have failed, two with winding faults and one suffering catastrophic bushing failure. A replacement for the paired transformer, also exhibiting bushing deterioration, of the unit suffering bushing failure has been ordered for installation within TPCR4. Replacement of the four faulted transformers in addition to increased scope of works to the planned replacement programme has contributed significantly to the increased expenditure. The increase has been partially offset by the deferral of two transformer replacement schemes where further condition monitoring has determined that dissolved gas measurements have stabilised to acceptable levels

Assuming a one to two year lead time between expenditure and assets being recorded as additions to the network, there is a good correlation between transformer volumes and expenditure between 2010/11 and 2012/13. There is also a high degree of correlation between asset condition and Investment Priorities and no expenditure adjustment is proposed.

### Switchgear

The chart in Figure 3 shows actual and forecast switchgear expenditure and assumed TPCR4 allowances.



**Figure 3: Actual and forecast switchgear expenditure with assumed TPCR4 allowances.**

Switchgear expenditure has been reduced in the early TPCR4 years and is forecast to almost double in 2010/11 to £20m and then increase significantly to £36.4m in 2011/12, an unprecedented level of expenditure, prior to reducing to £19m in the Rollover year.

SPTL has explained the increase in expenditure over the last two years of TPCR4 due to:

- An increase in scope of work at Clydes Mill 275kV substation from [REDACTED]. This additional work has been brought forward from the RIIO-T1 period due to the poor condition of the assets.
- The acceleration of switchgear replacement at Dalmarnock substation from RIIO-T1 to TPCR4 to coordinate with the development of the Commonwealth Games site.

- The acceleration of Bonnybridge 132kV switchgear replacement to avoid outage conflicts with the delayed construction of the Beauly to Denny overhead line.
- The acceleration/extension of Devol Moor 132kV switchgear replacement completion.

The increase in expenditure has been partially offset by the deferral of Strathaven 275kV switchgear replacement.

SPTL has also identified the poor condition of civil structures as a significant factor to increasing scope of work and expenditure at some sites. SPTL switchgear replacement policy is evolving to full bay, rather than circuit breaker only, asset replacement.

At Inverkip 400kV substation, SPTL is deferring capital expenditure to avoid the risk of stranded assets should the connection with the power station no longer be required, although a good case could be made for asset replacement on the grounds of asset condition. This deferral is to be commended whilst further information is sought on future substation requirements and configuration.

SPTL also stated that it considers switchgear refurbishment as an alternative to replacement on a site-by-site basis to assess the most advantageous solution.

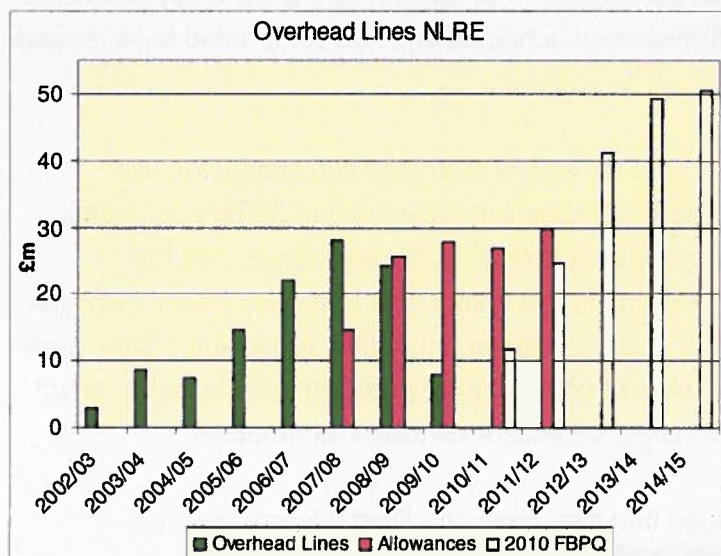
SPTL is advancing the replacement of several switchgear replacement schemes, many for valid and justifiable reasons, but the validation to include the Devol Moor 133kV scheme into the TPCR4 Rollover period from RIIO-T1 does not appear to be entirely clear, requiring clarification.

SPTL has expressed concerns with delivery and supply chain constraints and with the unprecedented levels of switchgear replacement activity and expenditure at the end of the TPCR4 period and into the Rollover year there is some concern over delivery capability.

It is suggested that the sum of £4m be deducted from the SPTL forecast for 2012/13 to account for fewer schemes being subject to acceleration. This equates to a £1.5m removal for Devol Moor; and a reduced spend of £2.5m on the £8m schemes spend at Clydes Mill, Dalmarnock, and Bonnybridge - that represents a 30% reduction consistent with an average of TPCR4 allowances of £12.3m compared to a Rollover figure of £17.5m (excluding Devol Moor).

### Overhead Lines

The chart in Figure 4 shows actual and forecast overhead line expenditure and assumed TPCR4 allowances.



**Figure 4: Actual and forecast overhead line expenditure with assumed TPCR4 allowances.**

Subsequent to severely depressed overhead line expenditure in 2009/10 of £7.9m, SPTL is forecasting a significant and rapid escalation of expenditure at the end of TPCR4 to £24.5m followed by a £16.5m increase in the Rollover year to £41m, an unprecedented level of expenditure. A further increase to a level of approximately £50m is then forecast to be sustained for the next three years to 2015/16 and peaking through another increase to £56m in 2016/17.

These forecast increases in expenditure are against a background of consistently lower actual and forecast spend compared to the assumed allowance range of approximately £25m to £30m during TPCR4.

SPTL's expenditure forecast is primarily driven by major refurbishment of 275kV and 132kV circuits in particular;

- several 132kV circuits at end of life where, through network reconfiguration and selective undergrounding, sections of the overhead line circuits are removed;
- 132kV circuits, at end of life, which require major refurbishment; and

- several 275kV / 400kV circuits at or near end of life, which require major refurbishment.

SPTL has also reported that condition assessment of tower foundations has resulted in the replacement of a large number of these foundations. This requirement is generally additional to the original scope of work for the refurbishment schemes and has contributed to increased refurbishment costs.

One of the major issues identified by SPTL is the age of overhead line conductor, with approximately [REDACTED] conductor at or approaching 50 years old. SPTL's concerns over conductor age are based on an industry view (from CIGRE and others) that the accepted technical asset life of ACSR (Aluminium Conductor with Steel Reinforcement) type conductor, predominantly installed at SPTL, is 53 years and that they are facing a 'bow wave' of investment. However, this age-based view of conductor degradation and life replacement modelling requirements does not fully consider conductor condition information.

During the cost visits SPTL acknowledged that they have condition information on approximately [REDACTED] and has already embarked on a programme to assess the condition of additional circuits. Assuming that conductor condition has also been assessed, this is a small sample on which to base a major programme of conductor replacement. This is reflected in the moderate to good assessment of the correlation between asset condition and Investment Priority provided in 3.2.3.

Recent refurbishment of the [REDACTED] by SPTL provided an opportunity to forensically examine the condition of the conductor removed. The conductor examined was determined to be in better condition than expected.

As there appears to be limited understanding of the condition and rate of deterioration of the ACSR type conductor as it reaches the end of its technical asset life, it is suggested that further investigation be performed in parallel to initial refurbishment works to better inform the need and timing of the proposed major refurbishment programme.

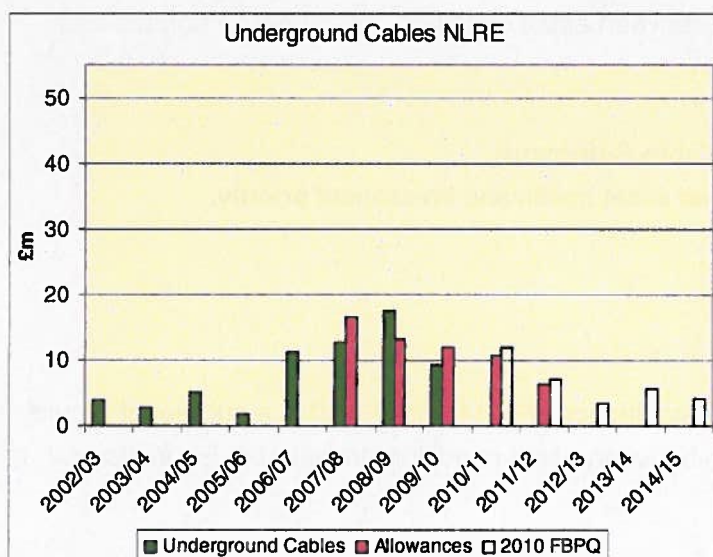
With an anticipated three fold increase in total overhead line expenditure in 2012/13 from 2009/10 levels there is also concern over the deliverability of this programme given the recognised supply chain constraints. [REDACTED]  
[REDACTED]  
[REDACTED].



It is therefore suggested that forecast expenditure be reduced by £13m to a level reflective of proven NLRE delivery capability, being the £28m expenditure delivered in 2007/08.

### Underground Cables

The chart in Figure 5 shows actual and forecast underground cable expenditure and assumed TPCR4 allowances.



**Figure 5: Actual and forecast underground cable expenditure with assumed TPCR4 allowances.**

Cable expenditure is forecast to decline during the remainder of TPCR4 with the completion of the replacement programme for gas compression cables. Expenditure in the Rollover year is forecast to be £3.4m.

### 3.2.3 Scheme condition and priority assessment

SPTL has provided evidence of the correlation between Asset Health Index and Investment Priority when prioritising scheme selection for the Rollover year, 2012/13. An assessment of the relationship between these factors is considered by major asset category.

In general SPTL has asset condition information for the major asset categories based on generic or asset family type data but the condition of ancillary components is less well

defined. SPTL has also acknowledged that the collection and availability of site specific condition information requires enhancement and has already instigated a programme of work to do so.

SPTL continues to improve the quality and quantity of asset condition information but has not revised any asset lives during TPCR4.

### **Transformers**

The transformer replacement schemes selected for TPCR4 and 2012/13, a sub-set of Figure 6, indicate a high degree of correlation between asset condition, Investment Priorities and Investment Plan timing.

**(Table Removed)**

**Figure 6: SPTL assessment of transformer asset health and investment priority.**

### **Switchgear**

The switchgear replacement schemes selected for TPCR4 and 2012/13, a sub-set of Figure 7, indicate a good degree of correlation between asset condition, Investment Priorities and Investment Plan timing.

**(Table Removed)**

**Figure 7: SPTL assessment of switchgear asset health and investment priority.**

### **Overhead lines**

The overhead line conductor replacement and minor refurbishment schemes selected for TPCR4 and 2012/13, a sub-set of Figure 8, indicate a moderate degree of correlation between criticality, asset condition, Investment Priorities and Investment Plan timing.

**(Table Removed)**

**Figure 8: SPTL assessment of overhead line conductor asset health and investment priority.**

SPTL has demonstrated a moderate to good degree of correlation between asset health, Investment Priority and Investment Plan and is developing its approach to asset condition assessment to a site specific, rather than asset family oriented, level to further refine the risk



and criticality approach to asset replacement planning. No alteration to expenditure is proposed on the grounds of scheme selection and priority as SPTL has made best use of available information and continues to improve their priority assessment process.

### 3.2.4 Comparison of unit costs

The unit costs provided by SPTL in Table 4.27.3 of the FBPQ quoted purchase costs and not installed costs, with the exception of underground cable. Installed costs were subsequently sought from SPTL for the transformer, switchgear and overhead line asset categories.

Installed unit costs have been provided by all TOs and averaged to provide a basis for comparison. Further comparison against KEMA unit cost data has also been performed. Table 2 summarises these comparisons by asset category.

**(Table Removed)**

**Table 2: Comparison of SPTL unit costs**

#### **Transformers**

SPTL noted that the costs provided did not include the cost of protection or civil works.

[REDACTED]. The lower voltage transformer costs are a little higher than the KEMA comparator and significantly lower than the TO Average and are likely to re-align with the TO average costs when protection and civil works are considered.

#### **Switchgear**

In response to FBPQ query F27, SPTL has stated that switchgear costs include all associated civil construction and ancillary equipment and are based on whole bay costs. The costs provided by SPTL compare favourably to both the TO Average and KEMA comparators, being considerably lower. A reason for the difference has not been apparent.

#### **Overhead lines**

It is not evident that the TO costs submitted have been done so on the same basis and any direct comparison with the TO Average is not considered valid. Overhead line costs for the Scottish TOs are generally significantly lower than those of NGET, primarily due to the extent of the 132kV network.

#### **Underground cables**

Costs provided by SPTL for 132kV XLPE cable are closely correlated to both the TO Average and KEMA comparators. [REDACTED]  
[REDACTED]

It should be noted that cable installation costs can vary significantly from scheme to scheme and are sensitive to local topology and obstacles that may require more specialist installation techniques.

[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

#### **3.2.5 Assessment of replacement volumes**

The asset addition volumes provided in Table 3 are sourced from the 2010 FBPQ Table 4.15.

**(Table Removed)**

**Table 3: Major asset category replacement volumes**

It can be observed that:

- There is a significant increase in transformer replacements at the end of TPCR4, largely driven by the replacement of potentially type faulted units. [REDACTED]  
[REDACTED]  
[REDACTED]

- Proposed switchgear [REDACTED]  
[REDACTED]
  - Proposed overhead conductor (full refurbishment) additions in the rollover year are 1.7 times the average annual addition and are predominantly based on replacement of 275kV conductor perceived to be at the end of its technical asset life;
  - As the addition volumes forecast for overhead fittings is the same as for overhead conductor for the years 2010/11 to 2012/13, it has been assumed that they represent full refurbishment schemes and that no minor refurbishment schemes are forecast; and
- [REDACTED]  
[REDACTED]  
[REDACTED]

### 3.2.6 Programme delivery

NLRE expenditure is forecast to increase significantly from 2009/10 to [REDACTED] in 2012/13 that may place some strain on supply chain delivery. However, this increase [REDACTED] is modest in comparison to the total forecast capital expenditure in the Rollover year [REDACTED] and SPTL's approach to meeting this challenge is discussed in Section 5 of this report.

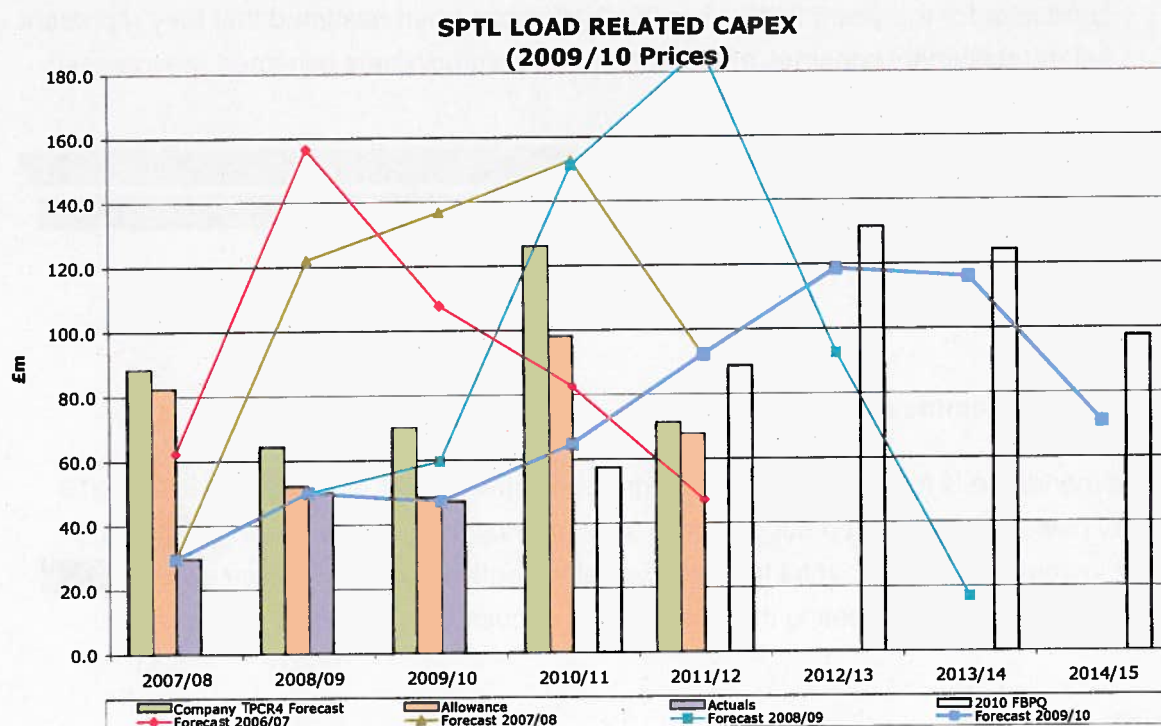
## 4 LOAD RELATED EXPENDITURE

SPTL's 2010 FBPQ submission has been based on the 'Gone Green' demand and generation scenarios that have been appropriately updated to reflect the latest generation developments and the associated impacts on the investment and expenditure areas in 2012/13 in particular.

For the avoidance of doubt, expenditure associated with TIRG and TII related projects is not included in this LRE assessment.

#### 4.1 TPCR4 Expenditure to Date

There has been a reasonably steady two year period of load related expenditure of approximately £48m/yr following a rise from the first year of TPCR4 as illustrated in Figure 9. Expenditure to date is currently £126m (31%) under the allowances assumed at the start of TPCR4.



**Figure 9: SPTL Load related capital expenditure**

Total LRE for the TPCR4 period is forecast to outturn at £272m, approximately £76m (22%), less than the total assumed allowance of £348m. It is also evident that forecast outturn is significantly less, approximately 35%, than the original TPCR4 forecast of £419m anticipated by SPTL.

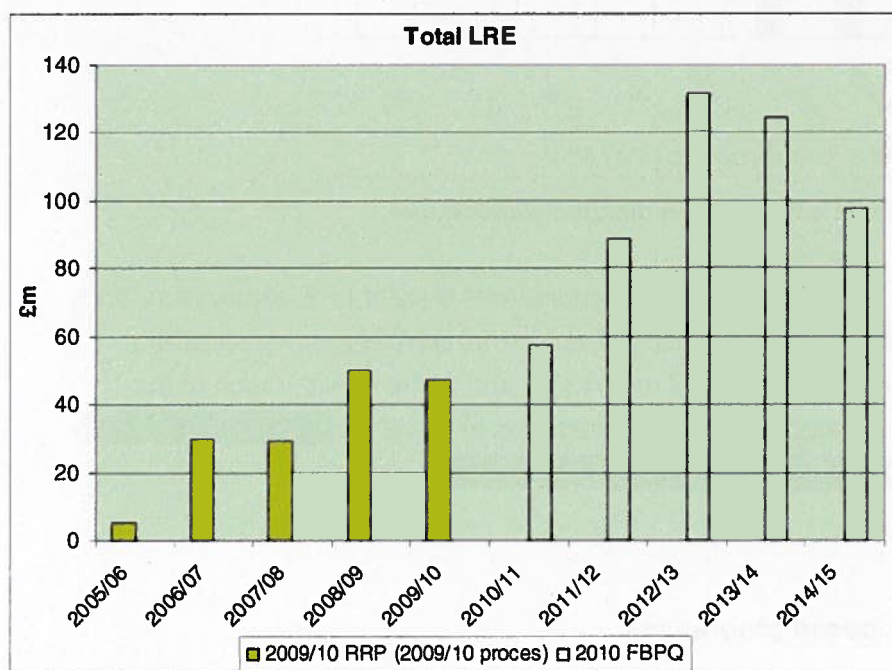
A high degree of variation between SPTL forecasts submitted with each annual Regulatory Reporting Pack (RRP) is also evident and indicates the volatility and uncertainty associated with renewable generation connections in central and southern Scotland.

## 4.2 Forecast Expenditure for 2012/13

In the 2010 FBPQ submission SPTL has provided expenditure forecasts for the period 2010/11 to 2017/18. The forecasts and accompanying detailed narrative have been considered in the assessment of:

- Updated forecast of the LRE to the end of the current TPCR4 period;
- Forecast of the LRE in the 2012/13 Rollover year; and
- Longer-term consideration of all load related expenditure plans, including TIRG and TII.

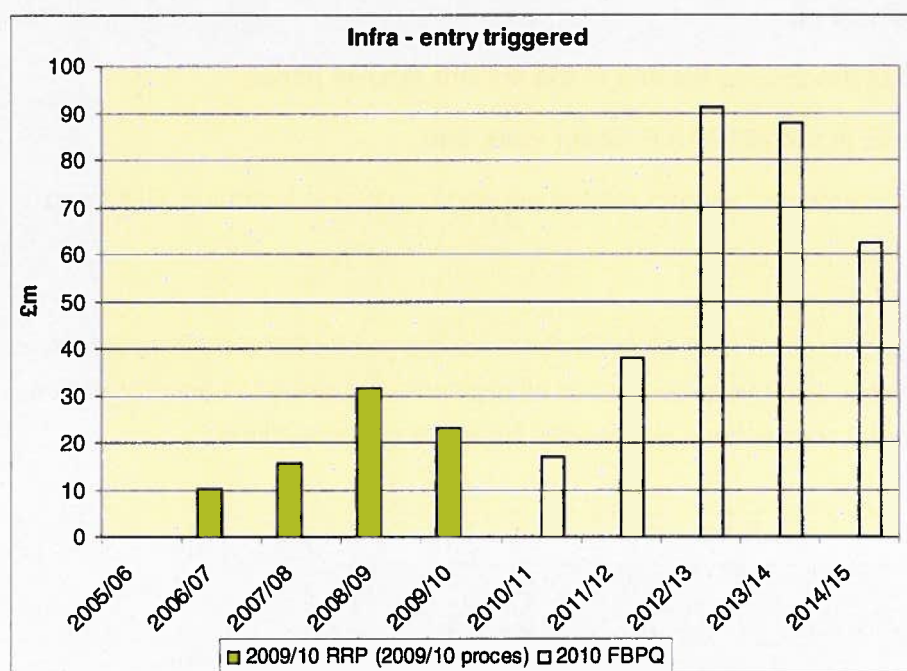
Actual LRE to 2009/10, and forecast LRE from 2010/11, for the period 2005-2015 is shown in Figure 10. The expenditure in each year comprises all expenditure needed to accommodate new generation and demand connections or changes for existing connections



**Figure 10: Actual and forecast load related expenditure**

The forecast LRE increases significantly year on year from 2009/10 to a peak of £132m in the Rollover year, followed by a decrease in subsequent years. The peak Rollover year expenditure is forecast to be almost 3 times the current level of expenditure.

The most significant element of the increased expenditure in 2012/13 is the 'Infrastructure – entry triggered' category indicated in Figure 11.



**Figure 11: Actual and forecast entry-triggered capital expenditure**

The forecast expenditure of £91.1m in 2012/13 represents 69% of LRE expenditure and appears to be associated with the connection of approx 901MW of new renewable generation currently contracted to connect in 2013/14 and 2014/15 with much of the associated infrastructure development to be undertaken in 2012/13.

#### 4.2.1 Review of proposed programme

SPTL has 25 renewable generation schemes contracted or under offer for connection beyond the end of TPCR4 in 2012. Eleven of these schemes are located in the south west of Scotland and SPTL is planning to establish a series of collector stations in two development schemes to facilitate connection of this generation. The two collector schemes are known as the South West Scotland (SWS) collector and Moffat collector.



These collector schemes were envisaged at the TPCR4 review but the amount of proposed new generation has grown significantly over the intervening period, from 309MW to 492MW for the SWS collector and 220MW to 409MW for Moffat, requiring a redesign of the network and collector configurations. The current status of these high expenditure collector schemes and their associated generation schemes has been reviewed as part of the Rollover price review.

### **South West Scotland collector scheme**

The total cost of this scheme is estimated to be £76.3m with a forecast expenditure of £30.0m in the Rollover year. There are six SPTL collector elements, listed in Figure 12, associated with the scheme and eight developer renewable generation projects.

The SPTL collector projects all have their Environmental Impact Assessments (EIA) and detailed designs complete and planning applications have been submitted to the relevant three authorities for consent. To date, two authorities have granted consent but one authority is still to provide consent and may take the matter to a public enquiry. However, SPTL is confident that all consents will be in place during 2011 and has based its plans on that assumption. Tender specifications and final project authorisations will progress once the planning consents are awarded.

**(Table Removed)**

**Figure 12: SPTL SWS collector schemes status.**

SPTL is anticipating that additional demands for renewable generation connections will be forthcoming over the next few years and has designed the SWS collector infrastructure with the capacity to absorb a further 368MW of generation.

Of the eight developer generation schemes, listed in Figure 13, associated with the SWS collector, two have full planning consent, two have aviation radar issues to resolve due to their proximity to Prestwick airport and the remainder have completed EIAs and have submitted the appropriate planning applications.

Several assessment factors have been studied to examine the relationship between:

- SPTL schemes and their planning status;
- SPTL scheme consent status;



- SPTL forecast construction authorisation date;
- Developer project status (construction, planning consents) associated with each SPTL scheme; and
- Developer project contracted connection dates.

A scheme by scheme assessment of the degree of certainty that each one is likely to incur expenditure in the Rollover year has been made based on the assessment factors above. Results of the scheme assessments have been graded High (H), Medium (M) and Low (L) in relation to the certainty of expenditure in 2012/13. For instance;

- H has been awarded where there is a high degree of correlation between all the factors above and therefore the need and timing of the scheme is clear;
- M has been awarded where there is a moderate degree of correlation (e.g. there may be uncertainty in the consent process in relation to the contracted connection date) but there remains reasonable certainty of the need and timing of the scheme; and
- L has been awarded where there is a lower degree of correlation between the assessment factors (e.g. developer schemes may be in the scoping phase or have long history of delay) and therefore the need and timing of scheme expenditure in the Rollover year is not clear.

**(Table Removed)**

**Figure 13: Developer generation projects associated with the SPTL SWS collector scheme.**

In addition to the generation projects listed above three new renewable generation schemes totalling 195MW capacity have recently applied for connection to the SWS collector infrastructure: Sanquhar and Lorg schemes are under offer and Hare Hill has recently submitted an application.

In keeping with the proportionality approach adopted by Ofgem for the Rollover price review, a high level analysis has been performed on these entry-triggered infrastructure schemes forecast to incur expenditure in the Rollover year.

From the high level scheme analysis performed it can be concluded that:

- There is a high demand for wind farm development in this area of Scotland;
- As many of these sites are located in remote, unpopulated areas, there is little network infrastructure to support their connection;
- The TIRG funded infrastructure investment is a pre-requisite for the establishment of the collector schemes and the ability to connect the proposed generation. SPTL has revised the proposed network configuration for the TIRG and SWS collector schemes to minimise the environmental impact and has applied for planning consents for all works in a single package. Two of the three local authorities involved have already provided consents for this package and SPTL is confident the third will also agree;
- There is a medium to high likelihood of most of the proposed generation projects progressing as planned and therefore a high level of confidence in the requirement for the collector infrastructure investment; and



#### **Moffat collector scheme**

The total cost of this scheme is estimated to be £43.8m with a forecast expenditure of £22.4m in the Rollover year. There are three SPTL collector elements associated with the scheme and three developer renewable generation projects.

**(Table Removed)**

**Figure 14: SPTL Moffat collector schemes status.**

The three SPTL collector schemes are fully consented, authorised and construction has commenced at Moffat 400kV & 132kV substations.

**(Table Removed)**

**Figure 15: Developer generation projects associated with the SPTL Moffat collector scheme.**

Of the three developer projects, outlined in Figure 15, associated with the Moffat collectors, Harestanes is fully consented and progress on the remaining two is determinate on consent being granted for the Earlishaugh scheme. An assessment of a medium to high likelihood of expenditure in 2012/13 has been made for these projects and it is suggested the expenditure allowance for the Moffat collectors is unchanged.

### **Generation scheme connections**

In addition to the entry triggered collector scheme expenditure, SPTL will incur expenditure for all contracted generation connections of generation schemes associated with the collectors plus ten other schemes. The forecast 2012/13 expenditure is shared across the category of 'Infrastructure-entry triggered' and 'Generation connection-sole use' and is shown in Table 4.

Infrastructure-entry triggered expenditure is forecast to be £30.9m and Generation-sole use at £20.1m

**(Table Removed)**

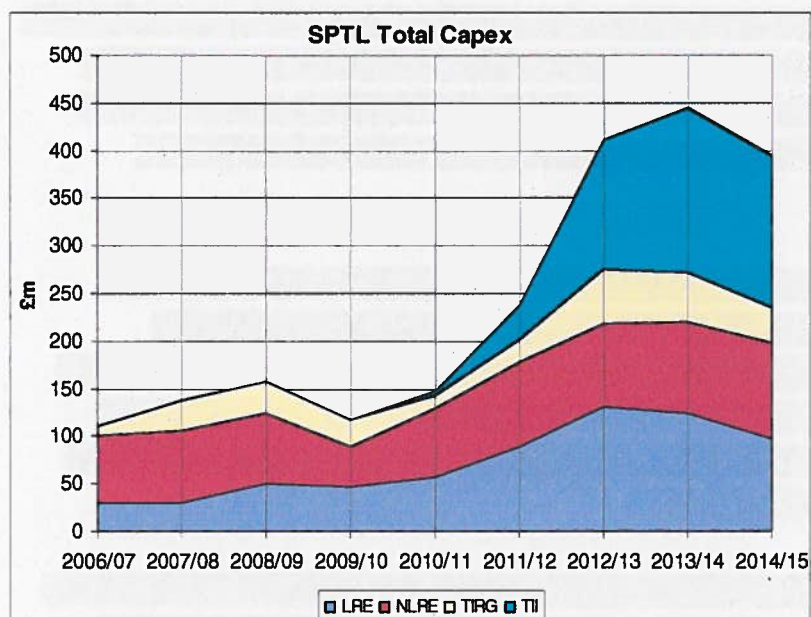
**Table 4: Total SPTL generation scheme expenditure and consent status.**

Similarly to the collector schemes, all generation schemes have been assessed with a High, Medium or Low certainty of incurring expenditure during the Rollover year based on the contracted connection date and the current status of planning applications and consents etc.



## **5 TOTAL CAPEX PROGRAMME DELIVERY**

The total Capex forecast by SPTL in the four main categories of Load Related, Non-Load Related, TIRG and TII is presented in Figure 16.



**Figure 16: Total SPTL Capex forecast**

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

<sup>1</sup> TII overhead line contribution estimated from Table 4.23 of 2010 FBPQ.

<sup>2</sup> TII substation related works estimated from Table 4.23 of 2010 FBPQ.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

## 6 SCHEME ASSESSMENTS

KEMA identified 3 schemes from the FBPQ for detailed investigation and requested the appropriate scheme information from SPTL. These schemes consisted of:-

- 1 Load related, 2 Non-load related;
  - 2 overhead line schemes; and
  - 1 switchgear scheme.

Table 5 summarises the schemes, their status and details of the associated expenditure.

**(Table Removed)**

**Table 5: SPTL schemes selected for detailed analysis.**

General conclusions and a scheme assessment summary are outlined in this section with full scheme assessments provided in Appendix A. General findings are:

- The Harestanes windfarm connects to the SPTL network at Moffat substation where SPTL has installed a 400 kV double busbar design when a cheaper mesh design may have been adequate;
- In the scheme examples examined there did not appear to be any inflated costs: indeed, at Inverkip SPTL is deferring capital expenditure to avoid the risk of stranded assets, although a good case could be made for asset replacement on the grounds of asset condition; and
- SPTL's overhead line reconductoring costs align with expectation.

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

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

and for each issue a bullet “colour-coding” scheme has been used, where:-

- Green indicates concurrence;
- Amber indicates that there are uncertainties regarding aspects of the scheme; and
- Red indicates there are unjustified aspects of the scheme.

**(Table Removed)**

**Table 6: Summary of SPTL scheme assessments.**

## **7 CONCLUSIONS**

KEMA has reviewed the total NLR and LR capital expenditure for SPTL, comparing outturn against allowances and projecting forecasts forward through the Rollover year (2012/2013) to 2014/15. Further analysis was performed on the NLRE to obtain a clear understanding of the levels of investment and volumes of assets installed, replaced or refurbished by major asset category.

In conclusion:

- Transformers; SPTL has experienced three transformer failures to date in TPCR4 that has required increased expenditure and re-prioritised transformer replacements. This has resulted in replacement volumes in the Rollover year above the TPCR4 annual average but there appears to be high correlation between asset condition and the Investment Priorities. There also appears to be an incipient fault with certain Bruce Peebles transformers and SPTL has prudently increased condition monitoring on these units. Where practicable SPTL is reducing the load on affected transformers to control the level of gassing and extend asset life.



- Switchgear; Switchgear expenditure has been significantly suppressed during the initial years of TPCR4 and is forecast to rise to unprecedented levels at the end of the period. SPTL has stated that reasons for the rise in expenditure are; increase in scope of works due to poor condition of civil structures, extended scheme switchgear replacement due to poor condition, the evolution to a full bay replacement policy and the acceleration of schemes into the TPCR4/Rollover year period. At present SPTL's asset condition assessment is based on generic asset families and is in the process of being driven down to more specific scheme and site assessments. The justification to extend or accelerate switchgear replacement schemes is not always clear and it is suggested that 2012/13 expenditure be reduced by £4m to account for potential deferral. [REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

- Overhead lines; Refurbishment expenditure in 2009/10 was significantly suppressed, however, proposed replacement volumes and expenditure increase significantly year on year to 2012/13 and beyond. This increase is predominantly driven by concerns over the age of overhead line conductor with approximately [REDACTED] conductor at or approaching 50 years old. However, this age-based view of conductor degradation and life replacement modelling requirements does not fully consider conductor condition information. SPTL currently has condition assessment information for approximately [REDACTED] overhead conductor and acknowledged that recent reconductoring work [REDACTED] determined the conductor to be in better condition than expected. It is suggested that further condition investigation be performed in parallel to initial refurbishment works to better inform the need and timing of the proposed major refurbishment programme. [REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

- Underground cables; With completion of the gas compression cable replacement at the end of TPCR4, expenditure is forecast to reduce significantly in the Rollover year. SPTL was able to realise efficiency savings in the cable replacement programme by pro-actively pursuing innovative engineering solutions.

Protection and control; A type based asset risk method is being used to consistently quantify the health of protection relay types and this approach is used to quantify the asset health of the entire protection population. A programme of work has been scoped to replace all end of life protection on the system by 2018.

- Substation other; This expenditure category encompasses three main work streams; environment (oil, containment, noise abatement), faults (replacement of damaged assets) and minor projects (GSP metering, civil refurbishment). Expenditure has been consistently below assumed TPCR4 allowance to date and is forecast to reduce further to £2.1m in 2012/13.
- Other TO; Other TO capex costs covers elements of expenditure on system assets not addressed by the major construction projects e.g. servitudes, operational site security, non-rechargeable diversions, strategic spares etc. Expenditure in 2012/13 is higher than the TPCR4 annual average to date, driven by the replacement of CT's with a risk of catastrophic failure.
- Scheme assessments; Three schemes were examined in detail (2 NLR and 1LR) and assessed by project need, design and cost. In general the need and design of the schemes examined is considered to be valid but in one case the costs of overhead line reconductoring are deemed to be high.

Adopting the proportionate approach encouraged by Ofgem for this review, KEMA has made an assessment of appropriate expenditure for each NLRE asset category in the Rollover year, 2012/13. This assessment is presented below.

2012/13 Rollover Year (£m)	SPTL F'cast	KEMA Estimate	Comment
<b>NON-LOAD RELATED EXPENDITURE</b>			
Assets - replacement and refurbishment			
Transformers	9.5	9.5	faulted units have driven volumes higher than
Reactors	0.0	0.0	no expenditure
Switchgear	19.0	15.0	justification to extend or accelerate replacement not always clear
Overhead Lines	41.1	28.0	requires improved condition data prior to
Underground Cables	3.4	3.4	few works forecast.
Protection & control	8.5	8.5	higher volumes driven by replacement
Sub-station other	2.1	2.1	
Other NLRE			
Other TO	3.7	3.7	driven by 132kV CT replacement
Quasi capex			
<b>TOTAL</b>	<b>87.2</b>	<b>70.2</b>	

A proportionate approach to the 2012/13 LRE category analysis has also been adopted by reviewing the two largest expenditure categories, encompassing approximately 84% of total load related expenditure, of 'Infrastructure-entry triggered' (£91m) and 'Generation connection-sole use' (£20m).

In conclusion:

- There is a high demand for wind farm development in the south west area of Scotland with many proposed generation sites located in remote, unpopulated areas where there is little network infrastructure to support their connection.
- SPTL is planning to establish a series of collector stations to facilitate connection of this generation, of which the two major collector development schemes have been examined in detail. The two collector schemes are known as the South West Scotland (SWS) collector (£30m) and the Moffat collector (£22.4m). These collector schemes were envisaged at the TPCR4 review but the demand for generation connections has grown significantly over the intervening period, from 309MW to 492MW for the SWS

collector and 220MW to 409MW for Moffat, requiring a redesign of the network and collector configurations. There is therefore a high degree of confidence in the requirement for the collector infrastructure development proposed by SPTL.

- A TIRG funded infrastructure investment is a pre-requisite for the establishment of the SWS collector scheme and SPTL has revised the proposed network configuration to minimise the environmental impact. SPTL has applied for planning consents for all TIRG and SWS works in a single package and to date two of the three local authorities involved have granted consent for this package and SPTL is confident the third will also agree. Consents for the Moffat scheme have already been secured and the project has commenced construction.
- In addition to the collector scheme expenditure, SPTL will incur expenditure for all contracted generation schemes associated with the collectors plus ten other schemes contracted to connect at other points in the network. The forecast 2012/13 expenditure for the connection schemes is shared across the category of 'Infrastructure-entry triggered' (£30.9m) and 'Generation connection-sole use' (£20.1m).

[REDACTED]

From a detailed analysis of the largest elements of SPTL's load related Capex plan, the Infrastructure-entry triggered and Generation-sole use categories, and discussion of the main issues within this report KEMA has made an assessment of the appropriate expenditure for these categories in the Rollover year, 2012/13 as indicated below. The other LRE categories listed were not reviewed.

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2012/13 Rollover Year (£m)	SPTL F'cast	KEMA Estimate	Comment
<b>LOAD RELATED EXPENDITURE</b>			
Generation connection - sole-use	20.1	13.4	
Demand connection - sole-use	0.0	0	no expenditure.
<b>Total LRE - sole-use</b>	<b>20.1</b>	<b>13.4</b>	
Infrastructure - entry triggered	91.1	73.2	
Infrastructure - general reactive (excl TIRG /TSS)	0.0	0	no expenditure.
Infrastructure - general non reactive (excl TIRG /TSS)	18.0	18.0	not assessed; lower % level than TPCR4 average.
Infrastructure - exit triggered	2.4	2.4	not assessed, aligns with TPCR4 average.
Infrastructure - TSS	0.0	0	no expenditure.
<b>Total LRE - Infrastructure</b>	<b>111.5</b>	<b>93.6</b>	
<b>TOTAL</b>	<b>131.7</b>	<b>107.0</b>	

## APPENDIX A - DETAILED SCHEME ASSESSMENTS

(Appendix Removed)