TRANSMISSION INVESTMENT

PROJECT APPRAISAL

REPORT

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EXECUTIVE SUMMARY

Each of the Transmission Owners (TOs) has nominated network reinforcement or development projects for consideration for funding under the Ofgem Transmission Access Review – Enhanced Transmission Investment incentives programme of work. This work was initiated by Ofgem in response to the proposal contained in the Transmission Access Review (TAR) Final Report to encourage the transmission companies to invest ahead of signalled need by anticipating future demand for connections to the network and investing efficiently to ensure timely delivery of capacity.

PB has been requested by Ofgem to critique each project in terms of:

- The adequacy of the technical design in view of the intended output;
- The appropriateness of the construction programme;
- The case for commencing construction before or during 2010/11;
- The forecast capital expenditure, and
- The measures that could be used in an *ex-post* assessment of the efficiency of the investment.

A separate tranche of work to comment on the need, objectives, optioneering and required completion date of each project was undertaken by KEMA

Following receipt of initial project information from the TOs in September 2009, a data request was issued seeking further detailed information on project programmes, progress of preliminary work, design and cost estimates. The level of detail provided in response to this request was very dependent on the amount of pre-construction work and design completed at that time. During the course of the work, we met with the TOs and Ofgem and sought additional information and clarification of information through email and telephone conversations. Research was also undertaken on up-to-date unit costs.

The projects assessed in this report are those identified by the TOs in their September 2009 submission. For the purposes of its detailed assessment PB has considered 36 projects individually. The correlation between the PB assessed projects and the TO groupings of projects which are intended to achieve a particular network objective is set out in the introduction to this report; however the number of projects grouped in schemes are as set out in the following table:

Scheme	Number of Projects
Anglo Scottish Incremental	2
Central Wales	2
East Anglia	4
Humber	2
London	2
North Wales	8
South West	2
Western HVDC	2

There are in addition a further 12 stand alone projects.

For review and analysis purposes the projects were classified by Ofgem as being Phase 1, Phase 2a or Phase 2b depending on construction cash flow timing. Projects incurring construction cash flow in financial year 2010/11 (or earlier) are classified as Phase 1 and those with construction cash flow in 2011/12 are classified as Phase 2a. Projects with later construction cash flows have been classified as Phase 2b.

Projects in each classification are at different stages of development. Some Phase 1 projects are well advanced whereas others still require significant preparatory work. Some NGET projects may be delivered using resources already in place such as the Electricity Alliances and at this stage there is little detailed information available for these. Where projects require design engineering by the contractor then again, only conceptual information or an outputs specification is available although some of this may be considered firm. Regardless of the stage of development, it is still possible to assess the Phase 1 and Phase 2a projects against benchmarked costs and to consider the timeframe for delivery.

The main uncertainty regarding deliverability is the length of time required to clear consents including planning approval. The report addresses this by noting whether consents are required and if so whether they are likely to be problematical. It is noted that the newly formed Infrastructure Planning Commission will adjudicate on some of the nominated NGET projects.

In each case reviewed, our views on deliverability, design and estimated costs are made against the current knowledge of the TO dependent on the status of the project as reflected in their submissions to Ofgem or in response to our queries. In many cases, as noted in the text and tables, TOs have indicated that they will update this information in due course.

Of the 36 projects nominated, 12 were classified as Phase 1 and these are estimated to cost £1858m in total. These projects are largely well defined and several are already cleared to construct and at the contract award stage or are expected to be cleared to construct without difficulty. These include:

- Deeside 400kV Substation Replacement
- Walpole Norwich Bramford 400kV OHL Reinforcement
- Bramford 400kV Substation Replacement
- Knocknagael Substation
- Beauly-Blackhillock-Kintore Reconductoring
- Dounreay Substation Reinforcement
- Beauly-Dounreay Reconductoring

Five of the 12 Phase 1 projects could become clear to construct in the near future but design decisions are required and/or consenting issues have to be addressed. These include:

- Western Isles link
- Lewis infrastructure
- Shetland link
- Hunterston-Kintyre Link
- Series Compensation of SPT-NGET Interconnection

Further updated information is to be provided for several SHETL Phase 1 projects listed above in 2010:

- Beauly Dounreay Reconductoring
- Western Isles Link
- Lewis Infrastructure
- Shetlands Link
- Hunterston- Kintyre Link

The Phase 1 projects are listed in the Table 1 below with headline summary assessment conclusions.

The report has taken into consideration information provided by the TOs following the issue of Ofgem's report, Transmission Access Review – Enhanced Transmission Investment Incentives: Initial Proposals, issued on 3 November 2009 and the Stakeholder event held on 7 December 2009 and particularly so in respect of the following Phase 1 projects:

- SPT-NGET Interconnection
- Shetland Link

The conclusions drawn in this report therefore supersede views expressed previously as information supplied by the TOs has been updated and considered on an ongoing basis.

Eight of the projects are classified as Phase 2a and these are estimated at £1755m total. Many of these projects have not been developed as far as some of the Phase 1 projects. The following Phase 2a projects may be progressed through detailed on-site investigation, materials ordering, resource allocation and outage planning.

- Reconductor Harker-Hutton-Quernmore Tee 400kV Circuits
- Series Compensation Harker to Hutton 400 kV Circuits
- Reconductor Trawsfynydd to Treuddyn Tee 400kV circuit
- Hackney to Waltham cross 400kV Upgrade

However some of these projects still have design issues to be resolved and costs may not be firm or, in some instances, we may not have accepted the cost projections as being sufficiently accurate at this point in time.

Other Phase 2a projects require further development with respect to design, programme and costs:

- Replace SPT (Manweb) 132kV Circuits
- Western HVDC link
- East Coast Upgrade
- East West 400kV Upgrade

The Phase 2a projects are listed in the Table 2 below with headline summary assessments.

Again the report has taken into consideration the most recently supplied information particularly in respect of:

- Reconductor Trawsfynydd Treuddyn Tee NW-R05
- Hackney Waltham Cross Upgrade LN-R01
- Western HVDC AS-R02

Sixteen projects have been categorised as Phase 2b amounting to £1919m and these are insufficiently developed to permit detailed assessment. Although some programme information is available, there is little information available neither on consents progress nor in many cases on design. However the pre-construction costs for these projects have been reviewed along with the other projects with outstanding pre-construction expenditure.

A more detailed summary of cost assessment is presented later in this executive summary.

The key to colour coding in the tables is as follows.

Deliverability	Design	Costs
Consents already obtained or are not required	Design firm	Cost estimates are considered be to be reasonable, reflecting content, quantities and market prices.
Consents required but are not expected to be problematical	Some design decisions required but may be addressed in the near future and the impact on cost may already be known	Cost estimate considered reasonable but may be updated in short term
Consents required and may cause a delay to the programme	Design decisions will be addressed over a period of time and may influence cost of project	Estimate not firm and may change with development

TABLE 1 – Phase 1 Project Summary Information

Project Title	Deliverability	Design	Costs
1 NGET - Deeside400kV Substation Replacement AS-R02	It should be possible to commence construction in early 2011.	Design and scope are considered appropriate	Cost estimates are considered be to be reasonable
2 NGET – Walpole Norwich Bramford 400kV OHL Reinforcement EC-R02 & 03	This work is deliverable within the planned time scale	The reconductoring proposals appear sound	Cost estimates are considered be to be reasonable
3 NGET – Bramford 400kV Substation Replacement EC-R04	Wayleaves are yet to be negotiated. The project should be clear to construct in early 2010.	The design of the substation is conventional with no addition to the minimum scope to meet objectives.	Cost estimates are considered be to be reasonable
4 SHETL - Knocknagael Substation	The work should be considered cleared to proceed to construction.	The substation is to be built to a 400kV specification to facilitate future upgrading.	Cost estimates are considered be to be reasonable
5 SHETL - Beauly-Blackhillock-Kintore Reconductoring	The work should be considered cleared to proceed to construction.	The conductor selection is appropriate.	Cost estimates are considered be to be reasonable

Project Title	Deliverability	Design	Costs
6 SHETL - Beauly-Dounreay Reconductoring	The work should be considered cleared to proceed to construction.	The conductor selection is appropriate subject to satisfactory completion of tests.	Cost estimates are considered be to be reasonable but these will be updated after tender evaluation.
7 SHETL - Dounreay Substation Reinforcement	Subject to planning approval and wayleaves being obtained in 2010, the construction programme looks achievable. Consents are not expected to be problematical.	It is noted that there is a large degree of asset replacement benefit from this scheme.	Cost estimates are considered be to be reasonable
8 SHETL – Western Isles link	Deliverability depends on a decision on the rating of the link and clearance of consents for Beauly substation works.	The design concept is considered sound but major decisions have to be taken before this can be progressed.	Cost estimates prepared are considered reasonable but subject to revision when design decisions have been taken. Additional information will be provided in Spring 2010
9 SHETL – Lewis infrastructure	Assuming consents are cleared in 2010, the construction of the circuits and substation works could take place between May 2011 and Jan 2013.	A decision on the type of circuit, overland or undersea, has yet to be taken.	Costs will depend on design decisions. We would consider the cost estimate for the land based option to be reasonable. A further submission in spring 2010 will update the estimated cost.

Project Title	Deliverability	Design	Costs
10 SHETL – Shetland link	Consents are still outstanding.	Decisions on Baseline (direct link from Shetland to mainland) or Incremental Project (link with an off-shore hub) are still required.	We find SHETL's estimated costs for the Baseline and Incremental Projects to be reasonable. We also note SHETL's intention to submit additional detailed information in January 2010.
11 SHETL/SPT Hunterston-Kintyre link	The consents process appears to be problematical and a new site for Cour substation is being sought.	The maximum available cable size currently available is being installed.	SHETL's estimated costs are reasonable but would caution that the subsea cable element (£79.6 million out of a total construction cost of £121.9 million) is based on an average cost and could subsequently vary. Additional information (including SHETL's technical report, cost-benefit analysis and an update to the project costs paper) will be submitted in early 2010.

Project Title	Deliverability	Design	Costs
12 NGET/SPT – Series Compensation of SPT-NGET Interconnection	Subject to clearing the necessary consents, the programme looks tight but feasible.	With the exception of Strathaven, only feasibility layout drawings or drawings issued for discussion are currently available.	We consider that SPT's estimated costs for the Eccles enabling works are reasonable. The main contract costs are reasonable at this stage but we would expect costs to vary as the design becomes more established.

TABLE 2 - Phase 2A Project Summary Information

Project Title	Deliverability	Design	Costs
13 NGET - Reconductor Harker-Hutton-Quernmore Tee 400kV Circuits AS-R01	There are no consents issues.	Re-conductoring with high temperature “GAP” type conductors appears reasonable in order to obtain a higher thermal rating.	Cost estimates are considered be to be reasonable.
14 NGET – Series Compensation Harker to Hutton 400 kV circuits AS-R03	The outline programme should be achievable subject to consents being received in time.	No information is currently available other than to “install 2 x 300MVAr series capacitor banks” and that some of this compensation might be variable thyristor controlled series compensation.	NGET’s estimated costs are higher than what we would expect from the limited information provided by NGET. However without further details on the capacity of such variable compensation, we are unable to comment further.
15 NGET/SPT - Replace SPT 132kV Circuits	Not assessable at present.	The concept is satisfactory but little detail is available	Costs are considered to be reasonable

Project Title	Deliverability	Design	Costs
16 NGET - Reconductor Trawsfynydd to Treuddyn Tee 400kV Circuit	A detailed programme will be prepared in April 2010.	The proposed reconductoring with GTZACSR 2 x 600mm^2 conductor is appropriate.	Cost estimates are considered be to be reasonable.
17 NGET - Hackney to Waltham cross 400kV Upgrade	With planning approval progressed by the IPC in 2012 and with materials ordering in 2013, this project should be deliverable by 2015/16.	Detailed engineering will commence in 2010	We are not able to account for all of the estimated capital expenditure. Furthermore as NGET develops its design the outturn costs are likely to vary, if not increase.
18 NGET/SPT - Western HVDC Link	The outline programme may be achievable but subject to many factors working in SPT/NGET favour.	Design is not yet firm.	Overall our estimated costs are higher than those of the TOs and we would expect these costs to increase as further design and exploratory work (including a survey of the seabed) proceeds.

Project Title	Deliverability	Design	Costs
19 SPT/SHETL – East Coast Upgrade	Obtaining consents may delay the programme.	Final substation sites have not yet been selected and it has not yet been established whether the condition of the conductor was sufficiently good to avoid re-conductoring the route.	Estimated costs are likely to increase
20 SPT - East West 400kV Upgrade	SPT consider that planning and consents for the works associated with Wishaw have the potential to delay the programme.	A general description of the work only has been provided. No data has been provided on the required increase in capacity.	We consider the forecast costs to be high

In due course it would be expected that as pre-construction work proceeds to completion, all projects will eventually be coded green in all categories.

Tables 3 and 4 below set out PB's Assessments of Cost for the Phase 1 and Phase 2 Projects respectively, compare the TOs' forecast costs with PB's estimates and present PB's view of the TOs' forecast costs.

Phase 1 Projects

For the Phase 1 projects we would consider the TOs' forecasts to be reasonable and so would recommend that these be accepted for consideration by Ofgem as the basis for funding with the following qualifications:

- We find SHETL's estimated costs for the Shetland Link Baseline and Incremental Projects to be reasonable. We also note SHETL's intention to submit additional detailed information in January 2010 with supporting justification for the inclusion of the offshore hub based on the grant award of €74.1million announced on 9th December by the European Commission under its European Energy Programme for Recovery (EEPR).
- Updated information is to be provided for several SHETL projects in 2010:
    - Beauly Dounreay Reconductoring
    - Western Isles Link
    - Lewis Infrastructure
    - Shetland Link
    - Hunterston Kintyre Link
- Although we find SPT's estimate for the Series Compensation of the SPT-NGET Interconnection to be higher than ours (by about 11 per cent), we consider that for present purposes this estimate should be accepted for the time being as the ratings, configurations and costs of series compensation are tenuous within this restricted (and for the British transmission system, novel) application. The enabling works at Eccles should be considered for funding now and funding for the main contract works should be considered later when the design and cost estimate has been developed further.

Phase 2a Projects

We would accept the TOs' estimates for the following projects without further qualification:

- NGET – Reconductor Harker to Hutton and Hutton to Quernmore Tee 400kV circuits, whilst noting that a decision has yet to be made on the conductor configuration
- NGET – replace SPT (Manweb) 132kV circuits.

We would accept the TOs' estimates for the following projects subject to qualification:

- NGET - although we find NGET's estimate for the Series Compensation of the Harker to Hutton 400kV circuits to be higher than ours (by about 14 per cent), we consider that for present purposes this estimate should be accepted as the ratings, configurations and costs of series compensation, particularly variable series compensation, are tenuous within this restricted (and for the British transmission system, novel) application

- NGET – Hackney to Waltham Cross 400kV Upgrade – although we consider NGET's costs to be low and liable to increase, for the purposes of the present exercise we would propose that NGET's forecast (lower than our estimate) be accepted for consideration
- NGET and SPT – Western HVDC Link (apart from SPT's Indicative Onshore Works) - although we consider NGET's and SPT's costs to be low and liable to increase, for the purposes of the present exercise we would propose that NGET's and SPT's forecast (lower than our estimate) be accepted; nevertheless we would expect our higher costs to be taken into account in the sensitivity case for the cost-benefit analysis and from a response from SPT this appears to have been the case in the ENSG Full Report and
- SHETL – East Coast Upgrade to 400kV - although we consider SHETL's costs to be low and liable to increase, for the purposes of the present exercise we would propose that SHETL's forecast (lower than our estimate) be accepted; we note that SHETL's planning is at an early stage.

In the case of SPT however for onshore works we find the forecast costs to be higher and also indicating that the corresponding unit costs may be higher than those of the other two TOs. Accordingly we propose that our estimates be the basis for consideration for the following projects:

- Indicative Onshore Works (Part of the Western HVDC Project) (£85.6 million instead of £125 million)
- East Coast Upgrade to 400kV (£101.5 million instead of £136.9 million) and
- East West 400kV Upgrade (£57.8 million instead of £82.6 million).

SPT's Phase 2a expenditure would therefore be reduced from £632.5 million to £532.9 million i.e. a reduction of £99.6 million. We would however point out that although we have received clarification from SPT on the asset types, locations and quantities comprising the schemes, these aspects could benefit from further clarification to avoid misinterpretation of the information provided thus far.

TABLE 3 – PB's Assessment of Phase 1 Project Costs

PB Ref	Description	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	TO's forecast Sub-totals	TO's forecast Total	PB's View of TO's Forecast Costs
		(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	
	Deeside 400kV Substation Replacement												
1	Pre-construction	0.6	0.7								1.3		
	Construction		20.4	22.4	24.3	22.7	13.9	1.9			105.7	107.0	Reasonable
	(Main TPCR Allowance @ 2009/10 prices)	-0.2	-4.5	-9.4	-9.4						-23.5		£20.4m @ 2004/5 prices already funded under TPCR4
		0.4	16.6	13.0	15.0	22.7	13.9	1.9			83.6	83.6	NGET forecast duly adjusted
	Walpole Norwich and Norwich - Bramford 400kV OHL Reinforcement												
2	Pre-construction	0.7	0.8								1.5		
	Construction		10.0	48.3	30.0	10.0					98.3	99.8	Reasonable
	Bramford 400kV Substation Replacement												
3	Pre-construction	1.8	2.0	1.2	1.0						6.0		
	Construction	2.0	25.0	25.0	23.0	15.0	12.0	9.0	9.0		120.0	126.0	Reasonable
	Knocknagael substation												
4	Pre-construction	0.0									0.0		
	Construction	5.9	24.9	10.0							40.7	40.8	Reasonable if 400kV busbars accepted
	Beauly-Blackhillock-Kintore												
5	Pre-construction	1.2	1.1								2.3		
	Construction	5.1	13.0	3.0	11.2	36.3	12.3				81.0	83.3	Reasonable
	Beauly-Dounreay Reconductoring												
6	Pre-construction	0.6									0.6		
	Construction		18.7	15.6	9.1						43.4	44.0	Reasonable
	Dounreay Substation Reinforcement												
7	Pre-construction	0.6									0.6		
	Construction		2.6	8.4	16.9						27.9	28.5	Reasonable
	Western Isles link												
8	Pre-construction	0.0									0.0		
	Construction	8.0	100.5	100.2	67.1	10.7					286.5	286.5	Reasonable
	Lewis infrastructure												
9	Pre-construction	0.3	0.0								0.4		
	Construction		1.4	5.9	8.1						15.4	15.7	Reasonable

	Shetland Link - Baseline Project												
10	Pre-construction	0.4	0.3								0.6		
	Construction		123.6	117.7	190.5	99.3	16.0				547.0	547.7	Reasonable
	Shetland Link with offshore hub (Incremental Project)												
10	Pre-construction	0.6	1.1								1.6		
	Construction	0.1	152.6	158.7	237.4	112.2	16.0				677.0	678.6	Reasonable
	Total project cost shown. Cost of the offshore hub is £130m, for which part funding has been applied for from the EC.												
	Hunterston - Kintyre Link												
11	Pre-construction	0.9	0.3	0.2							1.4		
	Construction		22.8	34.9	36.5	27.7					121.9	123.3	Reasonable
	Total project costs shown (including all of SPT costs; other documents exclude the cost of SPT's onshore works). Works in SPT's licensed area will be funded by SPT.												
	Series Compensation of SPT-NGET Interconnection												
12	Pre-construction	0.3	0.6	2.0	0	0	0	0	0		2.9		
	Construction	0	5	15	27	27	11	0	0		85.0	87.9	Reasonable; ratings and costs tenuous in this restricted application
						Excludes Deeside adjustment					NGET	332.9	
						Excludes Shetland Incremental Project					SHETL	1,169.7	
											SPTL	87.9	
											Total	1,590.5	

TABLE 4 – PB's Assessment of Phase 2a Project Costs

PB Ref	Description	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	TO's forecast Sub-totals	TO's forecast Total	PB's View of TO's Forecast Costs
		(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	(£m)	
	Reconductor Harker to Hutton and Hutton to Quernmore Tee 400 kV circuits												
13	Pre-construction	1.5	2.0	1.0							4.5		
	Construction			30.0	45.0	23.0					98.0	102.5	Reasonable
	Series Compensation Harker to Hutton 400 kV circuits												
14	Pre-construction	0.3	3.0	3.0	1.0						7.3		
	Construction			17.0	28.0	20.0	8.0				73.0	80.3	Reasonable; ratings and costs tenuous in this restricted application
	Replace SPT (Manweb) 132 kV circuits												
15	Pre-construction		1.0								1.0		
	Construction			5.0	6.0	5.0	2.0				18.0	19.0	Reasonable
	Reconductor Trawsfynydd to Treuddyn Tee 400 kV circuit												
16	Pre-construction	0.2	1.6								1.8		
	Construction			18.3	35.0	7.5					60.8	62.5	NGET's revised costs and route length are reasonable.
	Hackney to Waltham Cross 400 kV upgrade												
17	Pre-construction		3.0	2.0							5.0		
	Construction			4.0	52.3	69.9	43.0	9.4			178.6	183.6	Outturn costs are likely to vary, if not increase.
	Western HVDC Link												
18	Pre-construction	2.5	5.5	5.0							13.0		
	Construction			25.0	49.0	84.0	81.0	35.0			275.0	288.0	TOs' cable costs are low.
	Indicative Onshore Works				25.0	42.0	40.0	18.0			125.0	125.0	SPT's costs are high.
18	Pre-construction	3.1	5.8	4.4							13.3		
	Construction			25.0	49.0	84.0	81.0	35.0			274.0	287.3	TOs' cable costs are low.
	Deeside	0.4	16.6	13.0	15.0	22.7	13.9	1.9			83.6	83.6	Reasonable
											783.9	*783.9*	PB's estimate adopts NGET's Deeside costs.

	East Coast Upgrade to 400kV												
19	Pre-construction	0.2	0.4	1.3	0	0	0	0	0		1.9		
	Construction	0	0	7	24	43	42	19	0		135.0	136.9	SPT's costs are high, particularly switchgear.
	400kV east coast reinforcement												
19	Pre-construction	0.14	0.78	0.78							1.7		
	Construction					26.85	21.60	10.80			59.3	61.0	
19	**XT1/XT2 reconductoring and re-insulating other circuits**												
	Pre-construction				0.17	0.67	0.22				1.1		
	Construction							14.19	25.14	14.67	54.0	55.1	
											116.0	*116.0*	SHETL's costs are low and likely to increase.
	East-West 400kV Upgrades												
20	Pre-construction	0.2	0.5	1.9	0	0	0	0	0		2.6		
	Construction	0	0	8	14	24	24	10	0		80.0	82.6	SPT's costs are high, particularly switchgear and cable.
											NGET	818.8	
											SHETL	116.0	
											SPTL	632.5	
											Total	1,567.3	

In our review of pre-construction costs, we have confirmed that costs appear reasonable on a comparative basis for 19 of the 27 projects. We cannot confirm that costs are reasonable in 8 of the projects reviewed since there is either insufficient detail currently available to review them in a 'bottom up' approach or it is not possible to benchmark them in a 'top down' fashion against historic costs. In 7 of the 8 projects this is due to the influence of the new planning application legislation applicable in England and Wales, the introduction of the Planning Act 2008 and the Infrastructure Planning Commission (IPC). We would however confirm that evidence is now beginning to appear that the new planning legislation may be increasing NGET's pre-construction costs. There is insufficient detail currently available to review the Harker - Hutton project in a 'bottom up' approach.

A summary of the assessment is presented in Table 5 below.

Under the circumstances it would be appropriate for Ofgem to allow all pre-construction costs as presented by the TOs subject to a rigorous efficiency check against progress made at the end of the funding period.

indicates that costs appear reasonable on a comparative basis.

indicates that costs may be reasonable but that this cannot be confirmed at this stage.

TABLE 5 – Pre-construction Cost Assessment

Project	Assessment
Reconductor Harker - Hutton As-R01	
Replace SPT 132kV Ccts NW-R01	
Reconductor Trawsfynydd - Treuddyn Tee NW-R05	
Hackney Waltham Cross Upgrade LN-R01	
East Coast Upgrade	
East - West Upgrade	
Walpole Norwich - Bramford Reconductoring	
New 400 kV Overhead Line Circuit Bramford - Twinstead Tee	
New Central Wales - Ironbridge 400 kV Circuit	
Second Pentir - Trawsfynydd 400 kV Circuit	
New Wylfa - Pentir Circuit	
South West New Line and Reconductor	
Series Comp Harker - Hutton AS-R03	
Western HVDC Link AS-R02	

Eastern Anglo-Scottish HVDC Link	
HVDC Link Humber - Walpole	
Series Compensation Pentir - Deeside & Trawsfynydd - Treuddyn ccts	
Hunterston - Kintyre Link	
Quad Boosters in Walpole - Norwich line	
Substation Works at Humber and Walpole	
New Central Wales Substation	
Extension of Pentir 400 kV Substation	
Penisarwaun Substation	
South West New 400kV Substation	
Bramford Substation	
Deeside Substation	
New Wylfa 400kV substation	

INTRODUCTION

Background and Context

Each of the Transmission Owners (TOs) has nominated network reinforcement or development projects for consideration for funding under the Ofgem Transmission Access Review – Enhanced Transmission Investment incentives programme of work. This work was initiated by Ofgem in response to the proposal contained in the Transmission Access Review (TAR) Final Report to encourage the transmission companies to invest ahead of signalled need by anticipating future demand for connections to the network and investing efficiently to ensure timely delivery of capacity.

The projects identified by the TOs for consideration for funding followed a joint study, overseen by the ENSG, to identify the future reinforcements likely to be needed to accommodate the likely increase in renewable and conventional generation by 2020.

Ofgem has published 3 consultative documents relevant to this work:

> Initial Consultation on Enhanced Transmission Investment Incentives", Ofgem (175/08), 19 December 2008; and
>
> Access Review – Enhanced Transmission Investment Incentives: Update and Consultation on Further Measures", Ofgem (110/09), 08 September 2009
>
> Transmission Access Review – Enhanced Transmission Investment Incentives: Initial proposals, Ofgem (135/09), 3 November 2009.

Ofgem also held a stakeholder workshop on 7 December 2009.

The Ofgem Initial Proposals consultative document would have been influenced by the initial findings of the work described in this report and the views held on the work were discussed at the stakeholder workshop in December.

The work described in this report has been carried out over the period September to December 2009, i.e. prior to and post the Initial Proposals document and the stakeholder workshop, and hence the conclusions drawn in this report supersede views expressed previously as information supplied by the TOs has been updated and considered on an ongoing basis.

Terms of Reference

PB has been requested by Ofgem to critique each project in terms of:

- The adequacy of the technical design in view of the intended output;
- The appropriateness of the construction programme;
- The case for commencing construction before or during 2010/11 for Phase 1 projects and during 2011/12 for Phase 2a projects;
- The forecast capital expenditure, including:
    - Determination of the efficient costs for each of the projects through a unit cost analysis of individual cost components;

- Evaluation of the uncertainties surrounding the forecast capex including the ranges of variation of key parameters and assumptions underlying the licensees capex forecast; and

- The measures that could be used in an ex-post assessment of the efficiency of the investment.

A separate tranche of work to comment on the need, objectives, optioneering and required completion date of each project is being undertaken by KEMA.

Projects

The projects assessed in this report are those identified by the TOs in September 2009. For the purposes of its detailed assessment PB has considered 36 projects individually. The correlation between the PB assessed projects and the TO groupings of projects which are intended to achieve a particular network objective is set out in the tables below. Some projects, particularly SHETL and SPT projects were not presented in groupings and are listed as 'stand alone'.

For review and analysis purposes, the projects were classified by Ofgem as being Phase 1, Phase 2a or Phase 2b depending on construction cash flow timing. Projects incurring construction cash flow in financial year 2010/11 (or earlier) are classified as Phase 1 and those with construction cash flow in 2011/12 are classified as Phase 2a. Projects with later construction cash flows have been classified as Phase 2b.

In the tables below, the 'Phasing and Reference' refers to the phasing of the project and the section number of the project in this report.

TO Grouping Reference	TO Project Reference	Phasing and Section
Anglo Scottish Incremental	Reconductor Harker-Hutton-Quernmore Tee circuits	Phase 2a - 13
	Series Compensation Harker-Hutton circuits	Phase 2a - 14
Central Wales	New Central Wales - Ironbridge 400 kV circuit	Phase 2b - 7
	New Central Wales Substation	Phase 2b - 8
East Anglia	Reconductor Walpole-Norwich-Bramford	Phase 1 - 2
	Bramford 400kV substation	Phase 1 - 3
	New 400kV OHL circuit Bramford - Twinstead Tee	Phase 2b - 4
	Quad Boosters in Walpole-Norwich Line	Phase 2b - 5
Humber	HVDC Link Humber-Walpole	Phase 2b – 2
	Substation works at Humber and Walpole	Phase 2b - 3

TO Grouping Reference	TO Project Reference	Phasing and Section
London	Hackney to Waltham Cross 400kV upgrade	Phase 2a - 17
	Tilbury to Warley to Elstree 400kV upgrade	Phase 2b - 6
North Wales	Second Pentir to Trawsfynydd 400 kV circuit	Phase 2b - 9
	Extension of Pentir 400kV substation	Phase 2b - 10
	Penisarwaun substation	Phase 2b - 11
	Replace SPT (Manweb) 132 kV circuits	Phase 2a - 15
	New Wylfa-Pentir circuit	Phase 2b - 12
	New Wylfa 400kV substation	Phase 2b - 14
	SComp Pentir-Deeside &Trawsfynydd-Treuddyn circuits	Phase 2b - 13
	Reconductor Trawsfynydd-Treuddyn Tee 400kV circuit	Phase 2a - 16
South West	South West new line and reconductor	Phase 2b - 15
	South West new 400kV substation	Phase 2b - 16
Western HVDC Link	New Deeside 400kV substation	Phase 1 - 1
	Western Anglo-Scottish HVDC Link	Phase 2a - 18

Stand Alone Projects	Phasing and Section
East Coast upgrade	Phase 2a - 19
East-West upgrade	Phase 2a - 20
Hunterston-Kintyre Link	Phase 1 - 11
Knocknagael	Phase 1 - 4
Series Compensation of SPT-NGET Interconnection	Phase1 - 12
Beauly-Blackhillock-Kintore	Phase 1 - 5
Western Isles Link (including Lewis infrastructure)	Phase 1 - 8 & 9
Shetland Link	Phase 1 - 10
Beauly-Dounreay (Line & Substation)	Phase 1 - 6 & 7
Eastern HVDC Link	Phase 2b - 1

APPROACH TAKEN

An initial tranche of information on the nominated projects including cash flow profiles and in some cases general descriptions of the work and programme information was provided by the TOs in September 09.

Following an initial review of this information, a data request was issued identifying the information that would be required to enable consideration to be given to the projects. The data request was detailed and requested information in the following categories to be provided:

- Programmes
- Progress on preliminaries
- Scheme information and drawings
- Cost details

The assessment of the projects was then progressed through review of information and meetings with the TOs, Ofgem and KEMA, emails and telephone conversations to clarify information. Research was also undertaken to obtain up-to-date unit costs.

In the review of each project, the need for the project has been assumed. That is, it is assumed that network reinforcement is required and that the project as defined is the preferred option for achieving the project objectives.

We have not investigated whether a completely different project i.e. another option such as upgrading a circuit rather than a new circuit, would be preferred since this would require an understanding of the power flow studies, the network constraints and the degree of reinforcement required and this falls within the scope of the work undertaken by KEMA.

There are therefore 3 main issues to be critiqued for each project:

- The deliverability of the project;
- The adequacy and efficiency of the technical design; and
- The forecast capital expenditure.

Information Availability

The availability of information on projects is related to both the programme for execution of the work and how the project is to be delivered. With respect to Phase 1 projects, some are advanced to the point where contracts may be put in place immediately whereas considerable preparatory work is still required for others but it is envisaged that orders for plant may be placed during 2010/11 or contracts may be put in place later in the year and hence they are still treated as Phase 1 contracts. This latter group of projects may still be at the early conceptual design phase only at present.

The NGET projects which were reviewed in detail as far as was possible, 3 in Phase 1 and 5 in Phase 2a, may be delivered using Electricity Alliance resources[1] already in place and these would be very much 'business as usual' where consents may not be required and coordination of resources, materials and network outage windows (and funding) are all that is needed to let the work proceed. At this stage there is less information available on these projects than those being delivered by contractor.

Where projects will involve design engineering by the contractor[2] then again, only conceptual information or an outputs specification is available although this may be considered to be firm.

It will be clear from the above comments that there is little detailed information or indeed, in some instances, firm conceptual information currently available for some of the projects and that this will not be available for some time. Nevertheless it is still possible to assess the projects against benchmark costs and to consider the timeframe for delivery.

Other than some programme information and general descriptions, little detail on consents progress and detailed engineering is currently available for the Phase 2b projects and only the pre-construction funding requirement for these projects was reviewed.

[1] The use of Electricity Alliance resources is noted in the project reviews in the report.
[2] Generally SHETL projects, Series compensation and HVDC projects.

Deliverability

Although outline programme information has been projected for the majority of projects, the primary uncertainty is how long it will take to obtain consents including planning approval. The report addresses this by noting whether consents are required and if so whether they are likely to be problematical. In each case reviewed, our observations are made against the current knowledge of the TO depending on the status of the project and as described in their submissions to Ofgem and in response to our data requests and queries.

It is not possible to say whether or not a public enquiry will be required for some projects because it is not known what level objections will be raised. It is noted that the newly formed Infrastructure Planning Commission[3] will adjudicate on some of the nominated NGET projects. However this commission will not adjudicate on Scottish planning applications. It is also not possible to make allowance for a public enquiry in a project programme since the time period required and the outcome in terms of conditions are indeterminate.

A further observation is that some of these projects, particularly those with series compensation, introduce new technology to the network. It would not be surprising therefore if some of these projects slip until TOs become confident that they can design and operate the networks with the required degree of confidence and reliability.

In commenting on deliverability of a project, we have considered the detailed programme for the work where this was made available including pre-construction activities, procurement and site construction work. Where a detailed programme was not available, we have used key dates to determine time frames available.

Where it is known that work is to be carried out by contractors, we have reviewed the length of time allowed for tendering and contract award to see if it is reasonable. It is considered that a minimum of 3 months is required and in all cases the time allowed was greater than this. We have also looked to see that civil work on site was programmed sufficiently far in advance of plant deliveries.

We have examined whether the work spans the normal network access windows in the spring, summer and autumn. However, it was not considered appropriate to review network outage programmes since these are flexible and are updated on an ongoing basis in response to events and as projects are cleared to construct or are delayed.

In all cases, one of the main considerations is whether or not the project can be cleared to construct in accordance with the programme or key dates. We consider that a project is cleared to construct if consents have already been granted (or are not contentious and not expected to be a hurdle) and the conceptual design is firm in that sites are available, plant ratings, connectivity and plant arrangements have been decided. This should allow the project to move to the next stage of procurement and detailed design.

Design

The design of each project has been considered to determine whether:

[3] The new development consent regime for nationally significant infrastructure projects (NSIPS) and for the establishment of the Infrastructure Planning Commission (IPC) is expected to commence for the energy and transport sectors on 1 March 2010.

(a) project specific alternatives could be beneficial;

(b) the project could beneficially be implemented in stages;

(c) plant and circuit ratings, where specified, are suitable;

(d) the scope of the project has been extended beyond that necessary to meet the project objectives; and

(e) whether the project will deliver the project objectives.

Costs

PB's estimated costs have been derived from a consideration of:

- generic asset types;
- quantities of generic asset types; and
- asset unit costs.

The derivation of generic asset types and their unit costs follows the similar approach used by PB in the Main Transmission Price Control Review in 2006 for the modelling of asset replacement. Although in their submissions for the present review the TOs were required to compile a Table 2c – line item construction costs breakdown – the classification of assets and allocations of on-costs differed. Accordingly we adapted the asset classifications to derive a modified schedule of generic asset types suited to the purpose.

The quantities of asset are either as:

- stated by the TOs in narrative
- indicated on single line diagrams and layout drawings provided by the TOs or
- published (Seven Year Statement).

The unit costs have been derived from:

- unit costs obtained by PB during the Main Transmission Price Control Review (TPCR4), duly inflated using indices published by the electrical trade;
- unit costs advised by PB to Ofgem for Distribution Price Control Review 5;
- cost data held internally by PB including information from suppliers;
- price levels on current work being engineered by PB for clients worldwide;
- published announcements of award of contracts ;
- connection charges published by TOs; and
- sources including Cigré.

Any assumptions that have been made either by the TOs in their forecasts or by PB in its critique have been noted.

In some instances we have noted that some consideration was given to specific projects during the TPCR4 analysis and in one instance, we have noted that a project may be progressed as a substitute for another project that may be delayed, i.e. the project may be progressed at this stage to take

advantage of a network outage rather than due to a requirement to commence construction now to ensure completion for when needed.

PROJECT OUTPUTS

After review, it has been accepted that if each project is completed in accordance with the conceptual design outlined (or more detailed design where available), it should be considered 'fit for purpose' and meet the project objectives. In some instances, this was self evident, e.g. Deeside or Knocknagael substation construction, while in others it was necessary to consider equipment and circuit ratings and configuration e.g. Bramford Substation, Western Isles Link, Hunterston Kintyre Link.

The discussion on outputs against each project therefore comments on progress anticipated by the end of the current regulatory period and then by March 2013 should the price review period be extended by a year. Where detailed programmes were available, it was possible to quantify how construction should have progressed by the above dates. Otherwise anticipated progress has been determined by the TOs against the cash flow profile provided.

Should pre-construction funding not be made available for projects at this point in time, then the projects could be put on hold although not without consequences, particularly for the Phase 1 projects, as set out below. Where pre-construction activities have already commenced for Phase 2a (6 off) and 2b projects (9 off), the same consequences would apply to a lesser degree since work has not progressed very far on some of the projects:

- In several cases there would be a loss of pre-construction effort and momentum and when funding was made available, there would be inefficiency and delay due to the need to ramp up activities possibly involving a learning curve for new staff involved depending on the time interval;
- Depending on how far pre-construction activities had progressed, it may be necessary to revisit consents, particularly for non-completed wayleaves and easements and for land access permission; and
- Projects which are still in the pre-construction phase could not progress to the construction phase.

Should construction funding not be made available for projects at this point in time, then:

- For the SHETL Phase 1 projects particularly, some tendering effort would be wasted and retendering may be required in due course. For the Knocknagael project, where transformers have already been ordered and construction is already under way, storage costs would be incurred and cancellation charges may apply to contracts;
- For NGET projects being delivered by Electricity Alliance resources, resources would have to be rescheduled, possibly inefficiently depending on the state of development of alternative projects, and materials already on order would have to be stored or allocated to alternative projects.
- Finally, again for Phase 1 projects particularly, network outage opportunities would be missed and the projects would slip until network outages could be rescheduled.

EX-POST ASSESSMENT OF EFFICIENCY OF INVESTMENT

A post investment appraisal would normally review the assumptions that were made in planning the investment, the outturn costs compared to the forecast and the time taken to complete the work. Such exercises are normally undertaken as a learning opportunity and as an assessment of the planning and project management efficacy of the investing organisation.

For the purposes of informing an ex-post assessment of the efficiency of the investments by Ofgem (from a project delivery viewpoint only), the information provided in this report can be used to capture the pre-investment assumptions represented in:

- the forecasts of cash flow profile;
- project programmes where available;
- key dates where available; and otherwise
- in the project outputs expressed as deliverables by March 2012 and March 2013.

Each of these aspects should therefore be made as firm as possible and agreed at the time project funding is made available.

ASSESSMENTS

Each of the Phase1 and Phase 2a projects is reviewed in sections 1 to 20 that follow.

The report takes into consideration information received following the issue of Ofgem's report, Transmission Access Review – Enhanced Transmission Investment Incentives: Initial Proposals, issued on 3 November 2009 and the Stakeholder event held on 7 December 2009 and particularly in respect of the following projects:

SPT-NGET Interconnection

Reconductor Trawsfynydd Treuddyn Tee NW-R05

Hackney Waltham Cross Upgrade LN-R01

Western HVDC AS-R02

Shetland Link

In the summary tables that conclude each section, the colour coding is described in the table below.

The review of Pre-construction costs for all projects where pre-construction work is still outstanding is presented in section 21.

Deliverability	Design	Costs
Consents already obtained or are not required	Design firm	Cost estimates are considered be to be reasonable reflecting content, quantities and market prices.
Consents required but are not expected to be problematical	Some design decisions required but may be addressed in the near future and the impact on cost may already be known	Cost estimate considered reasonable but may be updated in short term
Consents required and may cause a delay to the programme	Design decisions will be addressed over a period of time and may influence cost of project	Estimate not firm and may change with development

PHASE 1 PROJECTS

1 DEESIDE 400KV SUBSTATION REPLACEMENT AS-R02 (NGET – WESTERN HVDC LINK)

1.1 Project Objective

This substation replacement project is a preparatory and integral part of the Western HVDC Link project assessed in section 18.

The existing Deeside 400kV substation is a 19 bay 400kV double busbar substation and the rating of the busbar and the arrangement of the transmission circuits connected to the substation are not suitable to accommodate connection of a 2GW HVDC link and increased north to south power flows. It will be necessary to transpose circuits across the substation and increase the rating of the busbars to accommodate these power flows

The project is therefore to replace the existing Deeside substation with a new 5000A 400kV substation and arranged to accommodate increased north to south power transfers with transfer of all circuits from the existing substation to the new substation by 2015.

1.2 Consents Application Status

NGET considers that the works will fall under permitted development rights but this has to be confirmed with the local authority with which discussions have yet to be undertaken.

All sites and routes are located on NGET owned land.

1.3 Delivery Strategy

NGET alliance partners have confirmed that they have sufficient resources available to undertake and complete the works at Deeside to the required programme and are progressing the project for delivery to the required timescales.

Orders for plant are to be placed in July 2010 and the scheme should be cleared to construct in September 2010. Construction is planned to commence with civil works in April 2011.

1.4 Anticipated cash flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total Costs
Pre-construction	0.6	0.7						1.3
Construction		20.4	22.4	24.3	22.7	13.9	1.9	105.6

1.5 Project Assessment

1.5.1 Deliverability

Work on a detailed programme is to commence January 2010.

It should be possible to commence construction in early 2011 provided there are no delays arising in obtaining consents if these are necessary. If consents are required, these are unlikely to be problematical.

Normally a 2 to 2.5 year period of site works is sufficient to construct a major substation and in this case the programme has been extended to allow circuits to be connected. Circuit outages to enable transfer to the new substation should commence in March 2013 with sufficient circuits transferred to accept HVDC by April 2015.

We consider the programme for the construction of the substation to be reasonable as discussed above and the extended time to transfer circuits justified.

1.5.2 Design

NGET originally had intended to construct an Air Insulated Switchgear (AIS) substation but decided on a Gas Insulated Switchgear (GIS) arrangement in mid 2009 on reduced risk associated with 5000amp GIS circuit breakers rather than initial cost. The principal driver to replace the existing substation is to connect the proposed Western Link HVDC converter station for which 5,000A switchgear would be required instead of 4,000A at present. Limited availability of land dictates the replacement of AIS with GIS. The converter station is then to be built on the site of the existing substation. If the converter station is not required in 2015 as programmed by NGET, then NGET would expect that the Deeside 400kV substation would require replacement on asset health grounds around 2018.

We queried whether it was necessary to replace the two system grid transformers but we accept NGET's explanation that the transformers will be 39 and 43 years old by the time they would be relocated and this would give rise to a high probability of failure.

1.5.3 Costs

The construction quantities and costs appear reasonable,, assuming the inclusion of three switch bays for unlicensed generator connections in the quantities and costs.

We would also consider the pre-construction cost estimates to be reasonable.

There is already an allowance for substation replacement at Deeside in the Main Transmission Price Control in 2006. Table 9.9 of the FBPQ, as submitted by NGET in 2006 includes Scheme ID 8985x, DEES 400 INFRA REPLACEMENT, with some £20.5 million of expenditure forecast for the years 2008/9 to 2011, with a final completion date of 2011 and project status unsanctioned (UNS). NGET has confirmed that this was a minor asset replacement scheme (replacement of disconnnectors, current and voltage transformers.

On the basis that this expenditure has already been allowed we would propose that it be deducted from the allowance for the replacement of the 400kV substation. The Main TPCR Allowance (TPCR4) has been inflated to 2009/10 price level using the RPI 02 all items index and shifted forwards by a year to line up with NGET's proposed transmission investment costs.

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total Costs
Pre-construction	0.6	0.7						1.3
Construction		20.4	22.4	24.3	22.7	13.9	1.9	105.6
(Main TPCR Allowance @ 2009/10 prices)	-0.2	-4.5	-9.4	-9.4				-23.5
	0.4	16.6	13.0	15.0	22.7	13.9	1.9	83.6

1.5.4 Outputs

The preconstruction engineering is to be completed by end 2010/11.

NGET anticipate that by end March 2012, the project will be 40% complete with main plant ordered, detail design completed and civil work on site underway.

By end March 2013, the project should be 60% complete (on an expenditure basis) including construction site established.

It should be possible to update and refine these outputs in January 2010 when a detailed programme for the project is available.

1.5.5 Assumptions/Uncertainties

NGET have assumed that:

- the Deeside works will be permitted development; and
- design and manufacturing resources will be available and that system access will also be available for circuit transfer.

These assumptions are considered reasonable at this stage.

There is also an implicit assumption that the Western HVDC project will receive funding to proceed in accordance with the current outline project and that any conditions pertaining to the planning approval of the Western HVDC project will not impact on the decision to proceed with Deeside in the short term.

1.6 Summary of Assessment

Deliverability	Design	Costs
It should be possible to commence construction in early 2011. If consents are required, these are unlikely to be problematical.	Design and scope are considered appropriate.	Cost estimates are considered to be are reasonable.

2 WALPOLE NORWICH BRAMFORD 400KV OHL REINFORCEMENT EC-R02 & R03 (NGET – EAST ANGLIA)

2.1 Project Objective

The project is to reconductor the Walpole- Norwich Bramford 400kV overhead line to increase the thermal capacity to accommodate increased generation volumes (including offshore Wind, Nuclear and CCGT).

The existing conductor, 2 x 400mm^2 ACSR, is to be replaced with 3 x 700mm^2 AAAC conductor and strung for an increased post fault operating temperature of 75˚C.

Other parts of the East Anglia scheme are addressed in the following sections of this report:

Bramford 400kV substation	Phase 1 - 3
New 400kV OHL circuit Bramford - Twinstead Tee	Phase 2b - 4
Quad Boosters in Walpole-Norwich Line	Phase 2b - 5

2.2 Consents Application Status

Additional consents are not required although access arrangements will have to be negotiated.

2.3 Delivery Strategy

It is assumed that delivery will be by Electricity Alliance resources.

2.4 Anticipated cash flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total Costs
Pre-construction	0.7	0.8						1.5
Construction		10	48.3	30	10			98.3

2.5 Project Assessment

2.5.1 Deliverability

The work for the Walpole Norwich section of line is programmed for outage windows between May 2011 and Nov 2011.

The Norwich Bramford section should be cleared to construct in 2012 with first site access planned for 2013.

Subject to ordering materials on time and Electricity Alliance resources being available, this work should be deliverable within the planned time scale.

2.5.2 Design

NGET policy for the reconductoring of overhead lines is discussed in Appendix B. The reconductoring proposals for this line appear sound.

2.5.3 Costs

The average unit cost of about £356,000 per circuit-kilometre (Walpole – Norwich route length 79.2km, Norwich – Bramford 61.1km) appears reasonable being similar to that allowed at the Main Transmission Price Control Review in 2006 after allowing for inflation.

2.5.4 Outputs

The expenditure will result in a circuit with an enhanced Pre-Fault winter rating of 2580MVA, Post–Fault Winter rating of 3070MVA.

The projected cash flows above indicate that preconstruction engineering is to be completed by end 2010/11 and by the end of 2011/12, construction should also be complete on the Walpole Norwich section of line. At this stage 20% of the Norwich Bramford section is expected to be complete (on a cash flow basis) and by March 2013 this should have increased to 80%.

2.5.5 Assumptions/uncertainties

NGET assumptions are that resources will be available to carry out this work.

2.6 Summary of Assessment

Deliverability	Design	Costs
Subject to ordering materials on time and Electricity Alliance resources being available, this work is deliverable within the planned time scale. No additional consents are required.	The reconductoring proposals appear sound.	The average unit cost for reconductoring appears reasonable.

3 BRAMFORD 400KV SUBSTATION REPLACEMENT EC-R04 (NGET – EAST ANGLIA)

3.1 Project Objective

Bramford 400kV substation is to be extended to accommodate the turn in of Pelham – Sizewell circuits and to provide 2 new bays for a new 400kV overhead line route to Twinstead Tee together with associated protection and control changes at remote ends.

Other parts of the East Anglia scheme are addressed in the following sections of this report:

Reconductor Walpole-Norwich-Bramford	Phase 1 - 2
New 400kV OHL circuit Bramford - Twinstead Tee	Phase 2b - 4
Quad Boosters in Walpole-Norwich Line	Phase 2b - 5

3.2 Consents application status

A planning application is not required for the current proposal since permission has already been granted for the original Bramford substation AIS extension in 2007. This has been confirmed by the local planning authority.

Additional land for the scheme has been acquired. Revised wayleaves will be negotiated with landowners once the scheme details have been confirmed.

3.3 Delivery Strategy

Substation civil works are to commence in 2010. These will address enabling works prior to the main contract. The enabling works include:-

- Diversion of a bridleway
- Clearance of existing structures
- Relocation of services
- Overhead line / cable circuit diversions

The operational land is to be extended to facilitate construction of the new support structures for the circuits which are to be transferred to the new substation. In parallel, it is intended to construct the GIS building and the double bus bar. This will be followed by installation of further circuit breakers and the transfer of the remainder of the circuits to the new substation. The final stage will involve the connection of the new 400kV OHL between Bramford and Twinstead Tee.

3.4 Anticipated cash flow

NGET initially advised the following cash flow projection:

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	1.41	1.97	1.63	0.99					5.99
Construction		5.91	20.04	27.15	29.16	16.19	12.47	9.48	120.40

NGET has subsequently confirmed that due to reprogramming, a revised cash flow is anticipated as shown below:

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	1.8	2	1.2	1					6
Construction	2	25	25	23	15	12	9	9	120

PB have accepted that NGET need to establish the double busbar earlier to allow existing circuits to be diverted into the substation.

3.5 Project Assessment

3.5.1 Deliverability

Additional land has been acquired and additional consents are not required. Subject to some minor considerations and provided compulsory wayleaves are not required, the project should be clear to construct in early 2010.

The programme for the work is complex and the programme is extended by the time required in the early stages of the project to establish the double bus-bar arrangement to divert existing circuits into the substation prior to the transfer of existing circuits and the connection of the new circuits.

3.5.2 Design

The number of feeders appears in order; the proposed substation would have 22 bays.

NGET had originally intended to use an AIS substation design and received planning approval accordingly. A review in July 2009 concluded that a GIS substation was the preferred option.

3.5.3 Costs

In the Main Transmission Price Control in 2006, £11.4 million (FBPQ Table 9.9) was included in the forecast expenditure (infrastructure – exit triggered) for a 5th SGT under project 15117I for the years 2005/6 to 2008/9. The project status was unsanctioned. Although NGET still envisage that this transformer will be required, the cost has not been included in the funding request.

We consider the construction costs to be reasonable.

3.5.4 Outputs

By the end of the current regulatory period, preconstruction work should be 80% complete including environmental assessments and planning consents. Main plant will have been ordered.

By March 2013, pre-construction work should be complete. A review of the programme shows that the construction site should also have been established and the GIS building should be complete.

NGET programmes:

Annex 1 Q4 Bramford SS (Critical Path 6 October 2009) v1 14 October.pdf

Annex 2 Q4 Bramford SS (Size 05 At – 01 SEESA Full Plan WBS 15 Sept 09) v1 14 October.pdf

3.5.5 Assumptions/uncertainties

It is assumed that Electricity Alliance resources will be available to undertake the work.

Summary of Assessment

Deliverability	Design	Costs
Additional land has been acquired and additional consents are not required although wayleaves are yet to be negotiated. The project should be clear to construct in early 2010.	The design of the substation is conventional with no addition to the minimum scope to meet objectives.	Cost estimates are considered to be reasonable.

4 KNOCKNAGAEL SUBSTATION (SHETL)

4.1 Project Objective

The substation will provide a new supply to Inverness city. This will help to balance the flows on the 275kV network between Beauly and Blackhillock and will increase the transmission system capacity available for the export of renewable generation from north-west Scotland.

The project involves the construction of the new 275/132kV Knocknagael substation along with associated 275kV overhead line modifications and new 132kV cable circuits. The substation is to be built to a 400kV specification to allow for future upgrading.

4.2 Consents Application Status

The project was developed in 2008 leading to submission of applications for consent in August 2008. Consent was granted for the construction of the substation at the Highland Council planning meeting in December 2008 but the associated application for overhead line modifications was rejected.

A revised application was submitted in January 2009 for an alternative overhead line proposal and this received consents in April 2009.

4.3 Delivery Strategy

A multi-contract approach is being adopted with main contracts covering electrical, civil, transformers, overhead line, and underground cable works. Facilitation works will be completed by SHETL, the largest single element of which involves improvements to the public road leading to the new substation (approx 1.5km).

Overhead line wayleaves have been agreed and underground cable wayleaves or easements will be completed in January 2010 when the cable route has been agreed with the cabling contractor.

Main land purchase has been completed and completion of purchase of an additional smaller area of land is in hand.

Survey works commenced during November 2009 and road improvement works are expected to commence in December 2009. Transformers have been ordered and are due to be delivered during May 2010. Electrical works are scheduled during 2010 and 2011 with commissioning of the substation expected in late 2011.

The civil works are on the critical path for the project and detailed site investigation works were therefore carried out in advance of the tendering process to minimising risk during the construction period. The civil design also included up front design works for the required road upgrades for construction of the new substation.

4.4 Anticipated cash flow

£m	2009/10	2010/11	2011/12	Total
Pre-construction	0			0
Construction	5.9	24.9	10	40.8

4.5 Project Assessment

4.5.1 Deliverability

This project is essentially cleared to proceed and work is under way. There would appear to be sufficient time available to complete on time provided funding approval is given in the near future and network outages are available.

4.5.2 Design

We note that SHETL is proposing that the 275kV busbars be built to a 400kV specification allowing for a future re-build of the Beauly – Blackhillock double circuit line to 400kV. SHETL's justification for installing 400kV equipment at Knocknagael is that the volume of renewable generation applications to the north of SHETL's North West boundary (B1) is driving major reinforcement of the boundary including a rebuild of a Beauly – Keith line to 400kV standards. There are three existing lines between Beauly and Keith, two at 132kV and one at 275kV (the 275kV line which presently connects Beauly, Dallas and Blackhillock i.e. part of the Beauly-Blackhillock-Kintore (BBK) project). Of these three existing lines SHETL considers that the 275kV line would be the most likely candidate for rebuild.

We would comment that the justification to build Knocknagael to 400kV standards is, to a certain extent, at odds with the proposal to reconductor the BBK line; if such reconductoring proceeds it might have a limited life before a 400kV rebuild becomes necessary. However, the proposal to future proof Knocknagael at relatively low cost seems sensible whereas the high cost of upgrading the BBK line would have to be justified against firmer load transfer projections and confirmation that the BBK line is the preferred line to upgrade.

4.5.3 Costs

We would consider SHETL's estimate of construction costs of £40.7 million to be reasonable. If 275kV switchgear was to be allowed for, the costs would be reduced by about £2.5 million. However, we consider this premium to be warranted for future proofing the substation. No pre-construction costs have been requested. The construction costs include £5.9 million in 2009/10 which presumably covers mainly the costs of the two transformers for which an order has already been placed.

4.5.4 Outputs

On completion, a new 275/132kV substation will have been established to provide a supply to Inverness city and releasing 275kV system capacity for the export of renewable generation in the north-west.

This project should be 100% complete within the current price control with final commissioning of the substation in November 2011.

SHETL programme:

Microsoft Office Project – Programme 2009 09 24.pdf

4.5.5 Assumptions/uncertainties

It is assumed that cable routes will clear in time to suit construction requirements. This assumption is reasonable.

4.6 Summary of Assessment

Deliverability	Design	Costs
This project is cleared to proceed, procurement is in hand and survey work has been initiated on site.	The substation is to be built to a 400kV specification to facilitate future upgrading.	Cost estimates are considered to be reasonable.

5 BEAULY-BLACKHILLOCK-KINTORE RECONDUCTORING (SHETL)

5.1 Project Objective

The objective of the Beauly to Blackhillock to Kintore (BBK) 275 kV reconductoring project is to increase the north – west power transfer capacity of the existing transmission network. The existing conductor will be replaced with a more modern Gap type conductor that has similar physical characteristics but has a greater current capacity while running at higher temperatures.

It is proposed to complete part of the Beauly-Blackhillock reconductoring in advance of the outages required for Beauly-Denny so that the BBK project can be completed a year earlier than would otherwise be possible.

5.2 Consents application status

Due to the nature of the project no new consent is necessary as these works can be completed under the original Section 37 consent. Discussions continue with Scottish Natural Heritage and The Highland Council in order to obtain consent to work within designated protected areas taking due consideration of European Protected Species and Habitats.

5.3 Delivery Strategy

The overhead line contract will initially be awarded for the Phase 1 works defined in the table below. This work is due to commence in April 2010 and to be complete by the end of November 2010. Conductor and long lead materials will need to be placed on order by 2 November 2009 to achieve this.

The other phases will be tendered under a separate tendering process nearer the time of construction. These are also shown in the table below.

Tower Numbers	Phasing	Year for Outage	Approx Route length km	Estimated Costs
Beauly to Blackhillock				
1 to 104	Phase 1	2010	33	£17.6m
104 to 229	Phase 2	2013	39	£20.8m
229 to 328	Phase 3	2014	33	£17m
Blackhillock to Kintore				
1 to 148	Phase 4	2013	52	£25.4

The process of identifying a conductor to replace the existing Lynx conductor was carried out and requirements forwarded to potential overhead transmission line conductor manufacturers.

Hitachi/J-Power specification for the development of a new GTACSR 208mm² GAP Conductor was identified as the best option. Development and testing of the GTACSR 208mm² is presently underway and has progressed in a satisfactory manner.

SHETL has also evaluated the tender for the Design and Build contract for Phase 1 of the project and are in a position to let this contract subject to funding approval.

5.4 Anticipated cash flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	Total
Pre-construction	1.2	1.1					2.3
Construction	5.1	13	3	11.2	36.3	12.3	80.9

5.5 Project Assessment

5.5.1 Deliverability

This project should be clear to construct and looks feasible in the timescales indicated.

5.5.2 Design

Please refer to Appendix B in which we provide a commentary on the policies for uprating of overhead lines. The uprating proposals look sound.

5.5.3 Costs

The unit costs are higher than those for reconductoring the Beauly Dounreay circuit.

Beauly Dounreay reconductoring project comprises a single circuit with a single conductor (i.e. 1 conductor per phase) whereas the BBK reconductoring project comprises two circuits with a twin conductor configuration (i.e. 2 conductors per phase). The process for installing Gap Type conductor is also more time consuming.

We would also comment further that the existing BBK line is of L3 construction supporting bundles of twin 175mm^2 ACSR Lynx conductors per phase. The L3 construction is a light construction line and in general has a limited capability to support a heavier conductor arrangement.

We would consider the level of pre-construction costs to be reasonable.

5.5.4 Outputs

The circuit rating post reconductoring will be increased to 1500 amperes summer pre-fault. This corresponds to around 900MVA as a post fault winter rating.

All preconstruction work should be complete by the end of 2010/11.

A review of the programme shows that by the end of the current period, the work on towers 1 to 104 of the Beauly to Blackhillock section will be complete and 13% of the Blackhillock to Kintore Section.

By 2012/13 the Blackhillock to Kintore section should be complete and 10% of the tower 104 to tower 229 section of the Beauly to Blackhillock section leaving the remaining 90% of this section and 100% of the tower 229 to 328 section still to be completed.

SHETL programme refers:

B-Bhk + Kint Programme.pdf

5.5.5 Assumptions/Uncertainties

It is assumed that tests on the new conductor tests, which have progressed satisfactorily to date, will be completed satisfactorily.

5.6 Summary of Assessment

Deliverability	Design	Costs
This work is clear to proceed to contract award and construction.	The decision to replace with a GAP type conductor is sound.	Cost estimates are considered to be reasonable.

6 BEAULY-DOUNREAY RECONDUCTORING (SHETL)

6.1 Project Objective

The project objective is to utilise the east side of the existing 275kV tower line to install a second 275kV circuit between Beauly and Dounreay.

6.2 Consents Application Status

No new consent is necessary for this work as these works can be completed under the original Section 37 consent.

Discussions are required with Scottish Natural Heritage and Highland Council in order to agree procedures for work within designated protected areas taking due consideration of European Protected Species.

6.3 Delivery Strategy

A tender document has been prepared for a design and build contract and invitations will be sent out in November. The conductor has been specially developed for the circuit in order to avoid vertical clearance issues while at the same time giving the required circuit electrical rating. The conductor will be procured by the successful tender from the nominated supplier. The programme for the overhead line works shows the contract being awarded in May 2010.

A separate contract will be issued for public road improvement works prior to the main contract starting.

The power export from Caithness and Sutherland depends on the parallel operation of the 275kV and 132kV circuits. To control power flows and balance the two networks, quadrature booster transformers will be installed on the 132kV circuits at Beauly substation as part of the works under this project.

It is proposed to commence with tower strengthening and foundation upgrade works in 2010, and erect the conductor on the east circuit in the 2011 and 2012 outage seasons. Following a competitive tendering process, the overhead line contract will include the design and installation of the necessary tower and foundation strengthening and site accommodation works to complete the reconductoring between tower 1 at Dounreay substation and tower 474 at Beauly (153 km route).

6.4 Anticipated cash flow

£m	2009/10	2010/11	2011/12	2012/13	Total
Pre-construction	0.6				0.6
Construction		18.7	15.6	9.1	43.4

6.5 Project Assessment

6.5.1 Deliverability

A detailed programme for the work is available. Due account has been taken of the fact that access windows will not be available between November and March.

The work should be considered cleared to proceed to construction subject to suitable tenders being received.

6.5.2 Design

The circuit is to be reconductored with 625mm^2 AAAC trapezoidal conductor which has been developed to give the required rating while minimising vertical clearance issues.

6.5.3 Costs

SHETL plans to re-conductor some 238 circuit-km of line (conductor the second circuit and re-conductor some 169km of the existing circuit with 69km of the existing circuit remaining in situ) at an average cost of £138,000 per circuit-km which we would consider to be reasonable.

The estimated costs should be updated after tender evaluation.

6.5.4 Outputs

SHETL advise that the circuit rating post reconductoring will be 1057Amperes summer pre-fault and that this corresponds to around 700MVA as a post fault winter rating.

All pre-construction engineering will be completed in 2009/10.

A review of the programme shows that by the end of TPCR4, all tower steelwork modifications will be complete and conductor stringing should be 17.5% complete. By end March 2012/13, this should have progressed to 66% complete.

SHETL programme refers:

090929 Bly Dounreay.pdf

6.5.5 Assumptions/uncertainties

The work should be considered cleared to proceed to construction subject to suitable tenders being received.

6.6 Summary of Assessment

Deliverability	Design	Costs
The work should be considered cleared to proceed to construction subject to suitable tenders being received.	The conductor selection is appropriate subject to satisfactory completion of tests.	Cost estimates are considered be to be reasonable but these will be updated after tender evaluation.

7 DOUNREAY SUBSTATION REINFORCEMENT (SHETL)

7.1 Project Objective

Dounreay Substation is to be reinforced to cater for the known and future capacity from wind farms being developed in the Highlands of Scotland and marine energy generation which is likely to be developed in the Pentland Firth.

Currently a single 275kV circuit is connected to Beauly Substation but a second overhead line circuit on the existing towers between Dounreay and Beauly is to be constructed. Dounreay Substation will also cater for this new 275kV connection.

It is proposed to construct a new indoor substation housing 275kV GIS and 132kV GIS switchgear; it will also have space for two future 132/33kV transformers and two future 33/11kV transformers. Both sets of GIS switchgear will have space for future circuits to be added on at the end of each suite. Two 240MVA supergrid transformers complete with 60MVAr shunt reactors will be installed within the building which can be accommodated within the existing substation boundaries.

The existing substation will be demolished after the new substation is put into service. This will free up space for further expansion including the two future 275/132kV supergrid transformers for the Pentland Firth marine energy.

7.2 Consents Application Status

It is intended that the consent applications will be made by the end of 2009.

It is proposed that 275kV towers in the immediate area of the substation boundary will be relocated to facilitate the additional line entries.

The existing substation is located adjacent to the nuclear reactor site at Dounreay owned by UKAEA. Also the 275kV terminal tower is located in adjacent ground belonging to HMS Vulcan. Arrangements are being made to hold interface meetings with UKAEA and HMS Vulcan during October 2009.

The outcome of meetings with The Highland Council, UKAEA and HMS Vulcan will determine the extent of the consents application. Specialist waste disposal may be required for all materials and equipment that have to be removed from site. A full assessment will be made.

7.3 Delivery Strategy

The project will be delivered via a number of discrete contracts covering:

- Gas Insulated Switchgear
- Transformers and Fire Protection
- Substation extension civil, demolition and electrical works
- Underground HV cabling works

An invitation to tender will be issued in early 2010 as a turnkey project to construct the entire works. Transformers and additional ancillary equipment will be supplied by SHETL as free issue.

7.4 Anticipated cash flow

£m	2009/10	2010/11	2011/12	2012/13	Total
Pre-construction	0.6				0.6
Construction		2.6	8.4	16.9	27.9

7.5 Project Assessment

7.5.1 Deliverability

The programme for the substation works shows consents being cleared in February 2010 and contract award in June 2010. Site works are expected to commence in April 2011 with commissioning in Dec 2012.

Subject to planning approval and wayleaves being obtained in 2010, the construction programme looks achievable.

Consents are not expected to be problematical.

7.5.2 Design

The proposed development is conventional with appropriate consideration being given to future development. It is noted that there is a large degree of asset replacement benefit from this scheme.

7.5.3 Costs

Cost estimates are considered to be reasonable.

7.5.4 Outputs

The existing substation will have been replaced with a new indoor substation which has space for future expansion when required.

A review of the programme shows that by end 2011/12, all civil works will be complete. All plant and equipment will be on site and installation of equipment approximately 20% complete.

By March 2013, all work should be complete.

SHETL programme refers:

Dounreay Substation Rev 3 28.9.9.mpp

7.5.5 Assumptions/uncertainties

SHETL advise the following information:

- Future development of SVC and MSCDN circuits will require additional land purchase and have not been considered.
- Future connections to marine power in the Pentland Firth have not been considered
- Costs for special waste disposal as a result of the proximity to the nuclear establishment, has not been allowed in the budget.
- SHETL does not expect that there would be any significant objections to the proposals. However, SHETL may have to comply with UKAEA and HMS Vulcan site procedures.

These decisions and assumptions are considered reasonable at this stage.

7.6 Summary of Assessment

Deliverability	Design	Costs
Subject to planning approval and wayleaves being obtained in 2010, the construction programme achievable. Consents are not expected to be problematical.	It is noted that there is a large degree of asset replacement benefit from this scheme.	Cost estimates are considered to be reasonable.

8 WESTERN ISLES LINK (SHETL)

8.1 Project Objective

The objective of the Western Isles Connection project is to construct a new transmission connection from the Isle of Lewis to the Main Interconnected Transmission System at Beauly Substation in Inverness-shire. The connection is proposed as a High Voltage Direct Current (HVDC) transmission circuit operating over underground and subsea cables and employing voltage source converter (VSC) technology. The transmission capacity is 450 MW at an operating voltage of +/- 150kV.

The project involves the construction of new substations/Converter Stations at Grabhair on Lewis and adjacent to the existing Beauly Substation.

8.2 Consents Application Status

The project has been developed over a number of years, leading to the submission of all applications for consent on 24 October 2008. As at the end of April 2009, consent has been granted for the subsea cable, the converter station on the Isle of Lewis, all ancillary works to facilitate the subsea cable and most of the underground cable route. Consent for the converter station at Beauly was refused by The Highland Council on 14 April 2009 and is now the subject of an appeal. Discussions continue with Scottish Natural Heritage in order to obtain consent to lay the underground cable through two Special Areas of Conservation.

At present the Local Authority (The Highland Council) has refused planning consent for the proposed site for the terminal at Beauly and SHETL has lodged an appeal with the Scottish Government. Additionally compulsory wayleaves may be required for the land purchase for the Beauly converter station. This work is likely to be taken forward following the imminent announcement by the Scottish Government on its decision relating to the Beauly – Denny overhead line.

8.3 Delivery Strategy

SHETL intends that the bulk of the project would be delivered under a single contract with an HVDC manufacturer. The HVDC contract would include the supply, delivery, installation, commissioning and initial operation of a complete HVDC link between Grabhair and Beauly.

A competitive tender process in 2005, led to the selection of ABB Power Technologies of Sweden as a preferred contractor. A design contract was awarded to ABB. Following the successful completion of the design works, ABB revised their tender based on the approved design. Negotiation with ABB reached a conclusion in May 2009 with SHETL able to recommend the award of a contract to ABB to deliver the Western Isles Connection.

Various facilitation works would be completed by SHETL. The largest single element of these works involves the necessary improvements to the public road network and the construction of Beauly 400kV substation.

Beauly 400kV Substation would be established under the Beauly-Denny project but the 400kV double busbar arrangement would be established under the Western Isles Connection. This package of work would be separately tendered.

SHETL had concerns over the rating of the link and the user commitment and undertook sensitivity analysis (described below) to inform a decision.

In order to achieve project completion in late 2012, and provide connection for the consented projects, SHETL will need to place major contracts early in 2010. SHETL propose to work with the affected parties such that at 31 January 2010 they are able to identify and progress the transmission reinforcement that best meets the requirements of those users that are able to commit to the investment in the network. This might mean the construction of a link of lower capacity than that developed to date, or an alternative solution.

SHETL will bring forward detailed proposals to the Authority shortly afterwards.

8.4 Anticipated Cash Flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	Total
Pre-construction	0					0
Construction	8	100.5	100.2	67.1	10.7	286.5

The cash flow in 2009/10 would arise in the first quarter of 2010 following contract award.

8.5 Project Assessment

8.5.1 Deliverability

Deliverability depends on final decisions being taken on the design and rating of the connection and on the ability to obtain consents. At present the Local Authority has refused planning consent for the proposed site for the terminal at Beauly and SHETL has lodged an appeal with the Scottish Government.

Time is also required to progress compulsory wayleaves and a successful decision on the appeal that has been made against the converter terminal at Beauly is also required.

8.5.2 Design

SHETL have carried out various economic assessments of the Western Isles connections with the following conclusions:

- The cost of the 450MW HVDC link is met by carbon savings from anything upwards of 146MW of installed wind on the Isle of Lewis.
- A 150kV HDC link is the most economic transmission technology for the power transfer range under consideration, 150MW to 450 MW
- The capitalised cost of lost energy from the 56MW consented generation is sufficient to justify the cost of the transmission developments to connect it.
- It is fundamentally more economic to build the 450MW link on day one (provided there is at least 150 MW of generation) instead of a two stage build, and remains so for at least eight years, even if the remaining contracted capacity does not materialise and no other use is made of the link in that time.

We would also comment that we would expect the HVDC converter to be a voltage sourced converter (VSC) as that type of converter has an inherent “black start” capability and avoids the requirement to provide an ac system of sufficiently high fault level (typically about 2.5 times converter rating) at the sending end. Furthermore a VSC converter also inherently meets the Grid Code requirements in terms of reactive power capability at the receiving end and does not require separate reactive compensation as would be required by a conventional line commutated converter (LCC). Two disadvantages of a VSC converter are however higher losses and a restriction on maximum operating voltage than compared with a line commutated converter. With respect to losses, the load factor of the Western Isles Link is expected to be relatively low reflecting the availability of wind generation.

The operating voltage of +/-150kV is lower than the maximum voltage available for a VSC (+/-200kV) and is not therefore a restriction in this instance. HVDC transmission using VSC technology is becoming the preferred arrangement for long distance transmission of offshore wind power as is illustrated by the recent placing of a construction contract for the 400MW NordE.ON1 offshore wind farm connection to an onshore substation in Germany.

We have considered alternative ac options of equivalent rating but these were found to be considerably more expensive both in terms of capital and whole-life costs.

We have concluded that we are in agreement with SHETL that a single 450 MW HVDC link is the most economically efficient for a contracted generation capacity of 432 MW and SHETL’s capital cost of £290 million appears reasonable.

We have considered the possibility of implementing the project in stages. Consented generation on Lewis presently stands at 70 MW and SHETL consider that this could rise to 254 MW by 31st January 2010. SHETL have estimated a capital cost of £150 million for an HVDC link to provide sufficient capacity for the currently consented generation on Lewis. (The scheme they propose would provide up to 150 MW of capacity.) We estimate higher capital costs of £170-235 million for comparative ac schemes.

We have also considered options for a higher rated connection. Options for providing increased capacity to accommodate wind generation beyond 450 MW include the following;

Option 1: 1 x 600 MW HVDC (+/-200 kV VSC) link

Option 2: 2 x 450 MW HVDC (+/-150 kV VSC) link

The incremental cost of Option 1 has been estimated by SHETL at £45 million, while the incremental cost of Option 2 (if both links were constructed together) is £150 million. The second underground cable circuit across the environmentally sensitive Scottish mainland associated with Option 2 could however be provided at an incremental cost of £25 million. This would allow for future uprating of the link from 450 – 900 MW without major environmental objection. SHETL intend to revise their funding request to include this £25 million.

The level of user commitment (in terms of consented generation capacity) however currently stands at just 70 MW which does not appear to justify construction of a 450 MW link. A reduced capacity link could be built at a cost of approximately £150 million to serve the presently consented generation and up to a total 150 MW. HVDC is also the most economically efficient means of providing 59 -150 MW of capacity. A second stage link to provide the remaining 300 MW of capacity could be built later at a

cost of approximately £230 million. The capital cost of building the 450 MW link in two stages is therefore around £90 million more than the single stage link.

The relative economics of the single stage vs. two stage approach will depend on the number of years between building the two stages and the extent to which the link is used in the interim period.

SHETL believe that the potential exists for more than 450 MW of generation capacity on Lewis and that they should make provision at this stage for a second 450 MW link. This could be achieved by laying a second cable circuit across the environmentally sensitive Scottish mainland at an incremental cost of £25 million. The remainder of the second link would then be built when required. SHETL intend to revise their funding request to include this £25 million.

A decision will be required on the rating of the link based on the level of consented generation at the end of January 2010.

8.5.3 Costs

The HVDC contract costs are broken down into the three main elements of the work: converter stations, subsea cable and underground cable. All costs are based on the tender submission prices as at the end of March 2009. An allowance for weather downtime is included based on statistical data of likely periods of adverse weather conditions. The risk of additional weather downtime is included in the risk allowance.

The primary protection of the subsea cable lies with armouring and burial in the sea bed. These costs are included in the HVDC contract price. However, it is known that burial to the required depth will not be achieved across the whole route. Rather than request ABB to price for an unknown quantity, SHETL have accepted all risks that full burial will not be achieved. This also allows SHETL, in its view, to take a pragmatic decision on the actual risk to the cable before deciding on the additional protection measures to be employed. From a provisional risk assessment based on the seabed survey, it is expected that rock dumping will be proposed in certain areas to protect the cable. The costs for this protection are included in the project costs. The risk of additional areas being identified is included in the risk analysis.

The cost of implementing the crossing of the British Telecomm cable in Little Loch Broom is included in this item.

An estimate for the costs of the two year operation and maintenance contract proposed as part of the works is also included in this item.

We find that SHETL's estimated capital costs of £290 million for a 450MW HVDC link are reasonable but would point out that these costs do not include any appreciable contingency for measures such as rock dumping to protect the cable which could increase the cost if found to be necessary.

SHETL's capital cost compares favourably with our estimates of ac-based options for a 450 MW link, which we expect to be in the range of £460-500 million.

We would expect the losses associated with the HVDC option to be slightly higher than the losses for the ac options; however consideration of the costs of losses indicates that the whole-life cost of the HVDC option is also considerably lower than that of the ac options.

8.5.4 Outputs

On completion, if constructed in accordance with the current conceptual design, a new 450 MW transmission connection from the Isle of Lewis to the Main Interconnected Transmission System will have been provided. This project also provides an alternative supply to Lewis which can be used to secure supplies to the distribution network and reduce the dependence on island based diesel generation as a standby supply (see section 9 below).

The current programme for a 450MW link shows that cable manufacture should be complete with excavation and cable installation lagging by approximately 3 months. Electrical installation of block 1 should be complete with electrical installation of block 2 not commencing until Dec 2012 and being approximately 70% complete by end March 2013.

Should funding not be available, the project could be shelved with resulting additional costs in retendering. It is assumed that funding would be made available before the expiry of the planning approval, once obtained.

SHETL programme refers:

Programme 2009 9 3.pdf

8.5.5 Assumptions/uncertainties

PB has noted that there are significant uncertainties associated with this project including:

- The user commitment and associated design/rating decision
- Dependence on Beauly/Denny
- Converter terminal site acquisition
- Planning approval for the converter station at Beauly.

8.6 Summary of Assessment

Deliverability	Design	Costs
Deliverability depends on a decision on the rating of the link and clearance of consents for Beauly substation works.	The design concept is considered sound but major decisions have to be taken before this can be progressed.	Cost estimates are considered reasonable but subject to revision when design decisions still to be taken.

9 LEWIS INFRASTRUCTURE (SHETL)

9.1 Project Objective

SHETL has advised that the Lewis network requires reinforcement to allow the export of the smaller scale generation on the island. This can be achieved by using the proposed converter station at Grabhair as an alternative source of supply and by providing a new 132kV connection to Stornoway Grid Substation independent of the existing 132kV circuit which feeds. The circuit could be land based or sub-sea. The final decision on the nature and route of the new circuit has yet to be taken.

The costs presented below were prepared on the basis of the predominantly land based option indicated in SHETL's Report on Consultations document published in July 2008. A further report will be submitted to Ofgem in spring 2010 which will provide the detailed rationale and quantification of benefits deriving from the Lewis infrastructure.

There are also considerable advantages from the project in addition to securing the supply to Stornoway by reducing the dependence on diesel generation currently used for peak-lopping and supply restoration following a fault.

9.2 Consents Application Status

It was intended to select the proposed route and apply for consent by the end of 2009 however this is now more likely to be in the first half of 2010 assuming that the Western Isles Link proceeds.

9.3 Delivery Strategy

The project will be delivered via a number of discrete contracts covering:

- Overhead line construction
- Subsea cable for loch crossings
- Underground cable sections
- Stornoway substation extension civil works
- Stornoway substation extension electrical works
- Transformers

9.4 Anticipated Cash Flow

The cash flow set out in the table below was projected in September 2009 and was based on the predominantly land based option

£m	2009/10	2010/11	2011/12	2012/13	Total
Pre-construction	0.3	0			0.3
Construction		1.4	5.9	8.1	15.4

More recent work has established an estimated cost of approximately £30m based for a subsea cable approach. Relative routing considerations have been assessed and this will form part of the funding pack submission planned by SHETL for Ofgem's consideration in spring 2010.

9.5 Project Assessment

9.5.1 Deliverability

Overhead line routes and wayleaves could take some time but assuming these are cleared in 2010, the construction of the circuits and substation works could take place between May 2011 and Jan 2013. A subsea route may also require a similar time to clear consents.

SHETL have also confirmed that the existing substation will have to be extended and that planning approval for this will also be required.

The completion date is linked to the completion of the first commissioning of the Western Isles Link converter terminal in December 2012.

9.5.2 Design

Conceptual design is straightforward but detail design (and cost) is dependent on route selection which is still outstanding.

9.5.3 Costs

We would consider the cost estimate for the land based option to be reasonable.

SSE have applied for costs of £2m (2012/13 & 2013/14) for 33kV reinforcement of the Lewis network in the DPCR5 submission.

9.5.4 Outputs

On completion a 132kV interconnection between the new converter station at Grabhair (Grabhair) and Stornoway Grid Substation will have been established which will facilitate the connection of additional small scale generation, secure supplies to Stornoway Grid and reduce dependence on diesel based generation with significant annual cost savings and potentially capital investment savings in the long run.

SHETL have not yet provided a detailed construction programme for the Lewis Infrastructure project and this will depend to a degree on design decisions. However the outline programme shows construction taking place between May 2011 and January 2013.

SHETL programme refers:

Western Isles Link Programme - Programme 3 9 3.pdf

9.5.5 Assumptions/uncertainties

Uncertainties include:

- Route/type of new 132kV circuit
- Cost estimate
- Planning approval
- Dependence on the Western Isles connection.

9.6 Summary of Assessment

Deliverability	Design	Costs
Assuming consents are cleared in 2010, the construction of the circuits and substation works could take place between May 2011 and Jan 2013.	A decision on the design of the circuit, overland or undersea has yet to be taken.	Costs will depend on design decisions. We would consider the cost estimate for the land based option to be reasonable. A further submission in spring 2010 will update the estimated cost.

10 SHETLAND LINK (SHETL)

10.1 Project Objective

The objective of the Shetland Connection project is to construct a new transmission connection from Shetland to the Main Interconnected Transmission System at Blackhillock Substation in Moray in order to transmit power from the projected Viking Energy Partnership (VEP) 550MW wind farm project on Shetland. The connection is proposed as a 600MW High Voltage Direct Current (HVDC) transmission circuit operating over underground and subsea cables. The project involves the construction of new converter stations at Kergord on Shetland and adjacent to the existing Blackhillock Substation.

10.2 Consents Application Status

The project has been developed over a number of years, leading to the submission of all applications for consent on 23 July 2009. No consents have been received yet.

No major objections to wayleaves have been identified.

10.3 Delivery Strategy

SHETL intends that the bulk of the project would be delivered under a single contract with an HVDC manufacturer. The HVDC contract would include the supply, delivery, installation, commissioning and initial operation of a complete HVDC link between Kergord and Blackhillock.

Various facilitation works would be completed by SHETL. The largest single element of these works involves the necessary improvements to the public road network, reconfiguring the Shetland distribution network and the construction / reconstruction of Blackhillock 400kV and 275kV substations.

A competitive tender process started in 2008, leading to the submission of detailed tenders for the design and construction of the HVDC link in June 2009.

Technical and commercial assessment is currently underway.

Subject to the progress of the consents applications, SHETL expect to submit additional information to Ofgem in January 2010 with the possibility of contract award in the first half of 2010. The January 2010 submission is likely to reflect tendered prices with an updated cost estimate and cash flow for the project.

SHETL are considering both a Baseline Project, i.e. the direct connection as described above, and an Incremental Project which includes the establishment of an off-shore hub which is currently the subject of an EEC grant application.

10.4 Anticipated cash flow

Without off-shore hub (Baseline Project)

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	Total
Pre-construction	0.4	0.3					0.7
Construction		123.6	117.7	190.5	99.3	16	547.1

With off-shore hub (Incremental Project)

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	Total
Pre-construction	0.6	1.1					1.7
Construction	0.1	152.6	158.7	237.4	112.2	16	677

In each case, the cost flow projections are for the complete project, i.e. without and with the off-shore hub.

10.5 Project Assessment

10.5.1 Deliverability

This will require detailed review depending on the actual date of planning approval, manufacturing periods, weather windows and outage constraints. SHETL expect to submit additional information to Ofgem in January 2010 with the possibility of contract award in the first half of 2010.

10.5.2 Design

Baseline Project

The “Baseline Project” is for a 600MW HVDC link between Kergord on Shetland and Blackhillock substation, the main elements of the project comprising;

1. HVDC converter site in the Kergord Valley on Shetland
2. 7 km HVDC underground cable between Kergord and the shoreline at Weisdale Voe
3. 330km HVDC subsea cable circuits between Weisdale and Portgordon on the Moray coast
4. 17km HVDC underground cable between Portgordon and Blackhillock, near Keith, and
5. HVDC converter substation adjacent to Blackhillock substation.

The converter stations would use voltage source converter (VSC) technology which is appropriate for this type of offshore installation.

Incremental Project

The “Incremental Project” is for:

1. the addition of an offshore HVDC node off the Caithness coast (i.e. an offshore platform) allowing the connection of a potential future HVDC terminal and link for Pentland Firth and

Orkney marine generation, this step being seen by SHETL as increasing the connection capacity north of Beauly by at least a further 500MW above that presently planned (by the Beauly – Dounreay reinforcement measures) and

2. uprating of the portion of the planned HVDC circuit and converter station at Blackhillock from 600MW to 1000MW.

The proposed connection of the Pentland Firth link would represent a novel multi-terminal connection arrangement using VSC technology. However, as SHETL acknowledges, no multi-terminal HVDC system is yet in commercial operation although manufacturers have indicated that this should be possible using VSC technology. Furthermore no HVDC circuit breaker is available despite development work some years ago. The connections at the platform would be through HVDC linkages, probably off-circuit disconnectors, but with space provision for HVDC circuit breakers (and transducers) should these become available. Any fault or switching operation on the proposed HVDC system is likely to require a total shutdown of that system, which may be acceptable given the intermittent nature of the generation sources.

SHETL considered the following options to (further) reinforce the transmission capacity from Caithness;

1. Rebuild the existing 132kV double circuit overhead lines for 275kV operation at an estimated cost of some £500 million but likely to be challenged on environmental grounds

2. Construction of a point to point HVDC link from Caithness to Moray at an estimated cost of £320 million

3. Install 132kV subsea cables from Caithness to Moray at a cost of £230 million but offering a limited reinforcement potential ; and

4. Construction of an additional terminal on the Shetland HVDC Connection, the expected cost of the incremental works being £130 million and the cost of the third converter station to be built in Caithness and the associated cable to the offshore node (around £200 million) – with a notional proportional share of the costs of the incremental works of the Shetland connection of £83 million, the total cost of this option would be £283 million.

SHETL has made an application to the European Commission Directorate –General for Energy and Transport (EC: DG TREN) for an Offshore Wind Energy Grant Application for half the estimated cost of the increment of the Incremental Project over the Baseline project, namely a request for €74.713 million (approximately £65 million at an exchange rate of €1 = £0.87). The cost of the Incremental Project excludes the cost of the third converter station to be built in Caithness and the associated cable to the offshore node (around £200 million).

In the application to the DG TREN, SHETL states that given the marginal economic advantage and technical risk, SHETL as a regulated business may not be able to make a strong case to the industry regulator, Ofgem, to allow the full incremental expenditure on the Shetland HVDC link on a stand alone basis. Furthermore SHETL's assessment of the reinforcement options studied showed that,

with EC Fund assistance, the economic efficiency of the proposed incremental investment could be demonstrated to Ofgem and would help secure the remaining 50% funding requirement.

Although SHETL intends that the link between the platform and the converter station at Blackhillock would have a capacity of 1000MW we consider that it is unlikely that this could be achieved using a single cable at present assuming a link at, say +/- 200kV. A major step increase in voltage level would be required, available with MIND cable but not yet with XLPE. Furthermore a single VSC converter of 1000MW capacity would also represent a major increase on the largest corresponding capacity presently available although manufacturers are expecting that this capacity could shortly become available.

We have therefore some remaining concerns as the Incremental Project breaks new ground (multi-terminal operation, higher capacity of VSC converter than is present available, seabed survey may reveal requirement for additional protective measures) and so outturn costs could vary but without further information from SHETL, promised for January 2010, we are unable to quantify these concerns further.

SHETL's subsequent receipt of grant award towards the Incremental Project

The European Commission under its European Energy Programme for Recovery (EEPR) announced on 9 December 2009 a grant award of €74.1 million towards the Incremental Project (we understand that this funding would be conditional on a similar amount being allowed by Ofgem).

SHETL has commented further that costs for inclusion of the offshore hub in the Shetland link would be driven amongst other things, by the responses from equipment suppliers to the task of developing their VSC HVDC technology to its design limits for rating, and to its first real offshore multi-terminal application. The actual costs would be dependent on technology development and architecture from competing suppliers. In its September submission SHETL indicated that in January 2010 it intended to submit detailed information for the Shetland link and hub on a comparable level to that provided for the Western Isles link.

SHETL expects that this will include the rationale for inclusion of the hub based on taking advantage of grant funding to include capacity in the Moray Firth at least two years earlier than would otherwise have been the case, providing options for Caithness and Orkney reinforcement or future offshore wind connections, and potentially on a lower cost basis than stand-alone solutions for Caithness reinforcement and/or offshore wind connection.

10.5.3 Costs

We find SHETL's estimated costs for the Baseline project to be reasonable.

Subsequent to the workshop on 7 December 2009, we have re-assessed our estimates for the Incremental Project on what might be achieved technically in the near future instead of what could be achieved now; the re-assessed costs were slightly lower than SHETL's estimate which in the circumstances we now consider to be reasonable.

10.5.4 Outputs

On completion, a 600MW link connecting Shetland to the Main Transmission Infrastructure Network will be available.

Assuming planning approval has been granted by March 2010, plant manufacture should be 50% complete and cable manufacture 75% complete by March 2012.

A review of the programme shows that by March 2013, electrical plant installation should be 70% complete, OHL and underground cable installation should be 50% complete and sub-sea cable installation should be 80% complete with all works programmed for completion by August 2013.

SHETL programme refers:

Microsoft Office Project – SHET Daft 05.pdf

10.5.5 Assumptions/Uncertainties

- Consents
- Design & Costs
- Construction programme
- Additional generation to justify the Incremental Project
- New HVDC technology developments, particularly multi-terminal operation and offshore switching hub.

There is a large degree of uncertainty associated with these factors and, as proposed by SHETL, some of these should be removed or minimised before a funding decision can be made.

10.6 Assessment Summary

Deliverability	Design	Costs
Consents are still outstanding. SHETL expect to submit additional information to Ofgem in January 2010 with the possibility of contract award in the first half of 2010.	The converter stations would use voltage source converter (VSC) technology which is appropriate for this type of offshore installation. Decisions on Baseline or Incremental project are still required.	We find SHETL's estimated costs for the Baseline and Incremental Projects to be reasonable. We also note SHETL's intention to submit additional detailed information in January 2010 with supporting justification for the inclusion of the offshore hub based on the grant award of 74.1million euro announced on 9th December by the European Commission under its European Energy Programme for Recovery (EEPR).

11 HUNTERSTON-KINTYRE LINK (SHETL/SPT)

11.1 Project Objective

The aim of the project is to facilitate the export of renewable generation from Kintyre to the Main Interconnected Transmission System (MITS). This will be realised by connecting the Scottish Hydro Electric Transmission Limited (SHETL) 132kV substation at Carradale on Kintyre with the SP Transmission Limited (SPTL) network at Hunterston via a firm 200MW connection.

This link shall consist of:

i. the replacement of the section of 132kV overhead line between the existing substation at Carradale and a new substation at Cour;

ii. two 132kV underground cables between Cour substation and Cour Bay landing point;

iii. two subsea cables between Cour Bay landing point and Ardneil Bay landing point

iv. two 132kV underground cables between Ardneil Bay landing point and Hunterston substation; and

v. two 132kV feeder bays will be required at the existing 132kV Hunterston substation to connect the cables;

The final decision on the route of the new circuits has yet to be taken. As such, these costs are prepared on the basis of the current preferred route. The route may change, subject to survey, environmental and landowner issues.

11.2 Consents Application Status

The project has been developed over a number of years, commencing in April 2006 only to be put on hold one year later. The project was resurrected in early 2009 with a target for consents being sought at the end of 09/beginning 2010. Planning consent for the substation has been delayed by issues with the landowner for the preferred site. Alternative sites are currently being reviewed.

In addition the new planning regulations add three months to the planning application process through a formal consultation process triggered by the size of the substation.

11.3 Delivery strategy

The project will be delivered via a number of discrete contracts covering:

- Overhead line construction
- Subsea cable between Kintyre and the Hunterston area
- Underground cable sections between the substations and the subsea cable
- Civil works for the new substation at Cour
- Electrical works for the new substation at Cour
- Quad Boosters
- SVC

- Road infrastructure improvements

Two 800mm^2 copper cables have been allowed for in the costs. This will limit the power transfer capability to approximately 180MVA. The Project Listing Document calls for a cable rating up to 240MVA per cable and should a larger cable become available the cost of the subsea cable will increase accordingly. The 800mm^2 cable size is indicative of the maximum 3 core submarine cable that is presently available.

Additional information (including SHETL's technical report, cost-benefit analysis and an update to the project costs paper) will be submitted in early 2010.

Construction should start on site during March 2011 to achieve Completion by end 2013. Dismantling of the existing 132kV overhead line and restoration of the ground is planned to be complete by September 2014.

11.4 Anticipated Cash Flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	Total
Pre-construction	0.9	0.3	0.2			1.4
Construction		22.8	34.9	36.5	27.7	121.9

11.5 Project Assessment

11.5.1 Deliverability

The consents process appears to be problematical and a new site for Cour substation is being sought. It is still possible that contracts could be awarded in early 2011 and cash flow would be incurred in the 2010/11 financial year.

11.5.2 Design

The design proposed is straightforward double circuit reinforcement but the 800mm^2 cable size will limit power transfer to 75% of the preferred capability under single circuit operation. Since the maximum available cable size currently available is being installed, this is considered reasonable under the circumstances.

11.5.3 Costs

We would consider SHETL's estimated costs to be reasonable but would caution that the subsea cable element (£79.6 million out of a total construction cost of £121.9 million) is based on an average cost and could subsequently vary, depending on the findings of a seabed survey and routing. The total construction cost has not yet been apportioned between SHETL and SPTL – £121.9 million is the total construction cost.

11.5.4 Outputs

On completion a new connection will be provided between Kintyre and the SP Transmission Limited (SPTL) network at Hunterston via a firm 200MW connection.

A review of the programme shows that by March 2012, civil works should be 85% complete and overhead line work 100%.

By March 2013, electrical work should be 70% complete with commissioning programmed for Sept/Oct 2013.

SHETL programme refers:

KH Issue 05 (29.09.09).pdf

11.5.5 Assumptions/uncertainties

- The route of the new circuits and associated wayleaves and easements.
- Design/cable rating
- Site acquisition/Planning approval

The uncertainties are such that, as proposed by SHETL, some of these should be removed or minimised before a funding decision can be made.

11.6 Assessment Summary

Deliverability	Design	Costs
The consents process appears to be problematical and a new site for Cour substation is being sought.	The 800mm^2 cable size will limit power transfer to 75% of the preferred capability under single circuit operation. Since the maximum available cable size currently available is being installed, this is considered reasonable under the circumstances.	SHETL's estimated costs appear to be reasonable but we would caution that the subsea cable element (£79.6 million out of a total construction cost of £121.9 million) is based on an average cost and could subsequently vary. Updated costs are to be submitted in Spring 2010.

12 SERIES COMPENSATION OF SPT-NGET INTERCONNECTION (SPT)

12.1 Project Objective

The Scottish electricity transmission system is connected to the England and Wales system by two double AC circuits operating at 400kV. Power system analysis confirms that reducing the reactance of the circuits on the following overhead line routes by approximately 35% is sufficient to raise the transient stability limit towards 4400MW:

- Strathaven-Harker 400kV double circuit;
- Eccles-Stella West 400kV double circuit; and
- Harker-Hutton 400kV double circuit.

This project assumes the Strathaven-Wishaw-Kaimes-Smeaton 275kV circuits are uprated to 400kV. A parallel reinforcement project will be undertaken by NGET in the north of England.

Existing sites at Strathaven, Coalburn, Elvanfoot and Eccles, and at the new Moffat substation (to be completed by 2012) are considered suitable locations for series compensation equipment in SPT's area.

The scope of this project includes:

i. Install 1 x 100MVAr Series Capacitor on the Strathaven-Coalburn 1 400kV circuit at Strathaven

ii. Coalburn - Install 1 x 100MVAr Series Capacitor, creating Strathaven-Coalburn 2 and Coalburn - Elvanfoot 2 400kV circuits

iii. Install 1 x 255MVAr Series Capacitor on the Elvanfoot-Gretna 400kV circuit at Elvanfoot

iv. Install 1 x 255MVAr Series Capacitor on the Moffat-Harker 400kV circuit at Moffat and

v. Install 2 x 255MVAr Series Capacitor on the Eccles-Stella West/ Blyth 400kV circuits at Eccles.

12.2 Consents Application Status

A planning strategy is currently being developed to identify the necessary environmental information which will be prepared to support the necessary planning consent applications. An initial planning review has identified the need for planning consent to be obtained for the series compensation elements with any necessary overhead line deviations requiring Section 37 consent.

SPT note that this project will be subject to significant planning and environmental consent risks and that these have the potential to delay the programme.

12.3 Delivery Strategy

The latest programme for the work shows a single tender for all works being placed in April 2011 with work on site commencing in August 2011 and commissioning complete in November 2013.

Overhead line enabling works at Eccles are to commence in April 2010 to take advantage of a 2010 outage window.

12.4 Anticipated cash flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	Total
Pre-construction	0.3	0.6	2	0	0	0	2.9
Construction	0	5	15	27	27	11	85

12.5 Project Assessment

12.5.1 Deliverability

At 3 locations, Coalburn, Moffat and Eccles, it is expected that planning and landowner consents are likely to be granted voluntarily and are not expected to be contentious. SPT have advised that in 2 of the locations for the series capacitance, Elvanfoot and Strathaven, planning and landowner consents may also be granted voluntarily but may require a longer time to negotiate and an updated programme has been prepared allowing additional consenting time for these sites.

SPT advise that it is necessary to take advantage of planned outages in 2010/2011 to carry out enabling works including diversion of the Stella West line entry at an estimated cost of £5m. This work is cleared to proceed subject to landowner consent only.

The programme for the main contract is reasonably tight with manufacturing design time not shown and with installation of equipment following manufacture with little slack.

Commissioning for all 6 installations is planned over the period October 2012 to November 2013.

Subject to clearing the necessary consents, the programme looks feasible.

12.5.2 Design

With the exception of the Strathaven location, only layout feasibility drawings are currently available or drawings issued for discussion.

SPT consider that if any specific requirements are identified in the work being carried out be NGET on series compensation that there may be sufficient time to take these into consideration.

12.5.3 Costs

The series capacitor banks represent substantial additions to the substations concerned and common equipment such as overhead line diversions, (bypass) switchgear, secondary plant, buildings and civil works including the platforms would account for an appreciable portion of the total cost. We consider that SPT's estimated costs, including the £5m for the enabling works at Eccles, are reasonable at this stage and would expect costs to vary as the design becomes more established.

12.5.4 Outputs

By March 2012 all pre-construction work would be complete.

A review of the programme shows that by March 2012, the enabling works at Eccles 400kV Substation including the deviation of 400kV overhead line entry should be complete. The contract for the series compensation should have been placed and manufacture should be approximately 50% complete. Site civil works would also be nearing completion.

By March 2013, series compensation installation should be complete and initial commissioning works should be underway.

SPT advise that it is necessary to take advantage of planned outages in 2010/2011 to carry out enabling works including diversion of the Stella West line entry at an estimated cost of £5m. This work is cleared to proceed subject to landowner consent only.

SPT programme refers:

Series Compensation ver2b.pdf

12.5.5 Assumptions/uncertainties

SPT comments:

- It is assumed that both the TIRG and TPCR upgrades to the SPT-NGET Interconnection are complete. This includes works to achieve a maximum conductor operating temperature of 90deg.C on the Strathaven – Harker (ZV) overhead line route.
- It is also assumed that the Strathaven-Wishaw-Kaimes-Smeaton 275kV circuits are uprated to 400kV operation although this is not programmed for completion until Oct 2014, one year later than this project.

PB notes that the installation of series compensation on the Harker-Hutton 400kV double circuit line is also required but cash flow projections for this project do not commence until 2011/12 making it a Phase 2a project.

12.6 Assessment Summary

Deliverability	Design	Costs
The enabling works at Eccles can proceed subject to landowner consent which should be achievable. The programme has allowed for additional time to acquire consents at 2 locations. Otherwise, subject to clearing the necessary consents, the programme looks tight but feasible.	With the exception of the Strathaven location, only feasibility layout drawings or drawings issued for discussion are currently available.	We consider that SPT's estimated costs for the Eccles enabling works are reasonable. The main contract costs are reasonable at this stage but we would expect costs to vary as the design becomes more established. The main contract works could be considered a Phase 2a project with further consideration being given to both costs and programme in 2010.

PHASE 2A PROJECTS

13 RECONDUCTOR HARKER-HUTTON-QUERNMORE TEE 400KV CCTS AS-R01 (NGET – ANGLO SCOTTISH INCREMENTAL)

13.1 Project Objective

The project is to reconductor the Harker-Hutton-Quernmore Tee overhead line (2 x 116 km) with GZTACSR conductor to increase its thermal rating.

The circuit rating is to be increased from a post fault rating of 1390MVA to more than 2500MVA.

The series compensation project associated with the Harker-Hutton circuit is addressed in section 14 of this report.

13.2 Consents Application Status

Not required.

13.3 Delivery Strategy

It is assumed that this work will be carried out by Electricity Alliance resources.

13.4 Anticipated Cash Flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	Total
Pre-construction	0.5	2	1.5			4.5
Construction			30	45	23	98

13.5 Project Assessment

13.5.1 Deliverability

This work is not scheduled until 2013. However, an outage is scheduled to allow work to be carried out on the Spennymoor-Norton route in 2011 but not all planning consents for this work have been obtained. In the event that these are not cleared in time to allow the work to proceed then the outage and the resource schedule for this work will be made available to reconductor the Harker-Hutton-Quernmore circuits otherwise this work will be timed as originally intended and as required by network reinforcement objectives.

There are no consents issues and the scheme could proceed subject to material and resource availability and network access.

13.5.2 Design

The existing Harker – Penwortham overhead line is of L2 construction with twin 500mm^2 conductors (the Hutton tee is relatively short and is on L6 towers). As the towers would be unable to support a heavier conductor bundle, re-conductoring with high temperature “GAP” type conductors appears reasonable in order to obtain a higher thermal rating.

NGET have not yet chosen the replacement conductor.

13.5.3 Costs

GAP type conductors are appreciably more costly than either ACSR or AAAC conductors. Subject to further review our initial view is that the average cost per circuit-km would appear to be reasonable.

Although this project is being progressed as a substitute project there is no cost duplication with funding already provided under TPCR4.

13.5.4 Outputs

The circuit rating will have been increased to give a Pre-Fault winter rating of 2610MVA which equates to a Post–Fault Winter rating 3100MVA.

By March 2012, pre-construction work should be complete with 30% work completed on site. On a cash flow basis, this should have progressed to 75% by March 2013.

A detailed programme is not yet available from NGET

13.5.5 Assumptions/uncertainties

This project is being used as a substitute project in the event that another project is not cleared to proceed.

13.6 Assessment Summary

Deliverability	Design	Costs
There are no consents issues and the scheme could proceed subject to material and resource availability and network access.	Re-conductoring with high temperature “GAP” type conductors appears reasonable in order to obtain a higher thermal rating.	The average estimated unit cost per circuit-km would appear to be reasonable.

14 SERIES COMPENSATION HARKER TO HUTTON 400 KV CIRCUITS AS-R03 (NGET – ANGLO SCOTTISH INCREMENTAL)

14.1 Project Objective

The introduction of Series compensation into overhead line routes in the North of England is being developed to improve the stability limit between Scotland and England and thus increase the transfer capacity. The timing of the preparatory work is planned as follows:

2009 – 2010 identify design parameters

2010 physical arrangements, siting studies

2011 - 2013 planning permission, land purchase and easements/wayleaves

Equipment ordering, manufacturing, delivery and installation is scheduled over the period 2013-2016 since access to the network will limit the ability to commission installations simultaneously.

The reconductoring of the Harker-Hutton-Quernmore Tee circuit is discussed in section 13 of this report.

14.2 Consents Application Status

To be addressed between 2011 and 2013 as set out above.

14.3 Delivery strategy

This project would introduce new technology onto the grid and NGET considers that this requires a thorough examination of all the aspects of their operation, maintenance and construction to arrive at an installation that is safe to construct and operate, and provide an economic, efficient and co-ordinated solution. NGET intend to hold detailed discussions with major suppliers to ensure the features and operational aspects of their products are fully understood.

NGET advise that equipment ordering, manufacturing, delivery and installation are scheduled over the period 2013-2016. That being the case cash flow projections appear to be front ended without the close out costs that would be expected in 2016.

14.4 Anticipated Cash Flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	Total
Pre-construction	0.3	3	3	1			7.3
Construction			17	28	20	8	73

14.5 Project Assessment

14.5.1 Deliverability

The outline programme set out in 14.1 and 14.3 should be achievable subject to consents being received in time.

14.5.2 Design

Little information is currently available from NGET. What has been provided comprises:

- Table 1 “install 2 x 300MVAr series capacitor banks” ;
- it is presently assumed that some 50% of the series capacitors will incorporate thyristor control, but this will be confirmed as part of the detailed studies undertaken in the pre-construction engineering phase (NGET reply to PB dated 13 November 2009);
- in previous submissions to Ofgem we (NGET) have reflected our view, based on discussions with manufacturers, that series compensation costs less per MVAr than SVCs (approximately ½ the price for controlled and lees for fixed); and
- on the basis of the above analysis we (NGET) continue to believe that series compensation is the most economic reinforcement for the B6 boundary.

14.5.3 Costs

NGET’s estimated costs are higher than what we would expect from the above statements. However without further details on the capacity of such variable compensation, we are unable to comment further. (NGET has not provided a Table 2c giving a detailed breakdown of its estimates for this project.)

Considering that plant is not to be ordered until 2013, the projected cash flow appears to be front-ended. A review of the level of costs and the profile should therefore be carried out later in 2010 when design is firmer.

14.5.4 Outputs

Based purely on the projected cash flow, by March 2012, only some civil work may have been completed with all plant manufacturing and installation to follow.

By March 2013, some equipment will have been manufactured and possibly been delivered to site but installation would still be outstanding.

A detailed programme for the work is not yet been provided.

14.5.5 Assumptions/uncertainties

At this point in time this project is only outline defined and assumptions have been made both with respect to design (and hence estimated costs) and with respect to planning consents.

14.6 Assessment Summary

Deliverability	Design	Costs
The outline programme should be achievable subject to consents being received in time.	No information is currently available other than “install 2 x 300MVAr series capacitor banks” and that some of this compensation might be variable thyristor controlled series compensation.	NGET’s estimated costs are higher than what we would expect from the limited information provided by NGET. However without further details on the capacity of such variable compensation, we are unable to comment further.

15 REPLACE SPM (MANWEB) 132KV CIRCUITS NW-R01.4 (NGET – NORTH WALES)

15.1 Project Objective

The project objective is to rationalise the existing SP Manweb owned 132kV circuit, strung between Trawsfynydd and tower 4ZC70, for operation at 400kV by reconductoring the circuit using 2x700mm^2 conductor. This project results in the requirement for the Bryncir GSP[4] scheme which will be required to ensure continued supply of the Four Crosses demand following removal of the existing 132kV circuit on the 4ZC route. The Bryncir GSP scheme is part of the project entitled "Second Pentir to Trawsfynydd 400kV circuit", a Phase 2b project (Appendix B).

Other aspects of the North Wales Scheme are addressed in the following sections of this report:

Second Pentir to Trawsfynydd 400 kV circuit	Phase 2b - 9
Extension of Pentir 400kV substation	Phase 2b - 10
Penisarwaun substation	Phase 2b - 11
New Wylfa-Pentir circuit	Phase 2b - 12
New Wylfa 400kV substation	Phase 2b - 14
SComp Pentir-Deeside &Trawsfynydd-Treuddyn circuits	Phase 2b - 13
Reconductor Trawsfynydd-Treuddyn Tee 400kV circuit	Phase 2a - 16

15.2 Consents Application Status

No detailed work has been carried out to date.

15.3 Delivery Strategy

It is assumed that this work will be carried out by Electricity Alliance resources.

15.4 Anticipated Cash Flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	Total
Pre-construction	0.1	1					1.1
Construction			5	6	5	2	18

[4] Grid Supply Point

15.5 Project Assessment

15.5.1 Deliverability

Deliverability is not assessable at present since neither programme nor key date information is available.

15.5.2 Design

NGT advise that the overhead line element of the circuit would have a Pre-Fault winter rating 2120MVA and a Post–Fault Winter rating 2520MVA to match the rating of the adjacent overhead line circuit.

Where the route crosses the River Glaslynn the overhead line is replaced by a section of cable. The rating of the existing circuit is restricted by the rating of this cable section. The NGET approach has been to match the rating of the No.1 circuit cable by installing a cable comprised of a single core per phase initially with a design that would enable a second core per phase to be installed at a later date as the generation in the North Wales area develops and greater capacity is required.

15.5.3 Costs

We calculate that about 17 km of the existing circuit presently energised at 132kV would need to be restrung. In addition about 5.7 route-km of single core/phase 400kV cable would need to be laid. On this basis we would consider NGET's estimated construction costs to be reasonable.

15.5.4 Outputs

Based on cash flow profiles, pre-construction work will be 100% complete in 2010/11 with construction work 60% complete by March 2012. A year later, this will have increased to 80%.

15.5.5 Assumptions/uncertainties

Only high level information is currently available so assumptions have been made with respect to design, estimated costs and deliverability.

15.6 Assessment Summary

Deliverability	Design	Costs
Not assessable at present.	The concept is satisfactory but little detail is available	Costs are considered to be reasonable

16 RECONDUCTOR TRAWSFYNYDD TO TREUDDYN TEE 400KV CIRCUIT NW-R05 (NGET – NORTH WALES)

16.1 Project Objective

The objective of the project is to increase the network capability in North Wales to facilitate significant increase in volumes of generation in this area. The scheme comprises the reconductoring of the Trawsfynydd leg of the Deeside- Legacy-Trawsfynydd double circuit overhead line with GZTACSR (GAP) 2 x 620mm^2 high temperature conductors.

Other aspects of the North Wales Scheme are addressed in the following sections of this report:

Second Pentir to Trawsfynydd 400 kV circuit	Phase 2b - 9
Extension of Pentir 400kV substation	Phase 2b - 10
Penisarwaun substation	Phase 2b - 11
Replace SPT (Manweb) 132 kV circuits	Phase 2a - 15
New Wylfa-Pentir circuit	Phase 2b - 12
New Wylfa 400kV substation	Phase 2b - 14
SComp Pentir-Deeside &Trawsfynydd-Treuddyn circuits	Phase 2b - 13

16.2 Consents Application Status

Additional consents are not required.

16.3 Delivery Strategy

It is assumed that this work will be carried out by Electricity Alliance resources.

16.4 Anticipated Cash Flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	Total
Pre-construction	0.200	1.55				1.8
Construction			18.25	35.0	7.5	60.75

16.5 Project Assessment

16.5.1 Deliverability

A detailed programme will be prepared in April 2010 with material ordering following in June 2010. Construction is currently planned for the period April 2011 to October 2012.

16.5.2 Design

The Trawsfynydd to Treuddyn section is on L2 towers insulated for 400kV and with two 400mm^2 ACSR conductors/phase. The proposed re-conductoring with GZTACSR 2 x 620mm^2 conductors would increase the winter post fault rating to 2240A per conductor i.e. 3100MVA per circuit, reflecting a rated conductor temperature of 170^{0}C.

16.5.3 Costs

NGET has confirmed that the route length as 64.28km and not as stated previously. The route length agrees with other NGET records, notably Table B.2.1.c of the Seven Year Statement 2009.

NGET has revised its costs to total £62.5 million with which we would agree.

16.5.4 Outputs

The cash flow profile above shows completion of pre-construction work by March 2011 with 30% construction complete by March 2012 and 88% complete by March 2013.

16.5.5 Assumptions/uncertainties

Only high level information is currently available so assumptions have been made with respect to design, estimated costs and deliverability.

16.6 Assessment Summary

Deliverability	Design	Costs
A detailed programme will be prepared in April 2010.	The proposed reconductoring with GTZACSR 2 x 600mm^2 conductor is appropriate for the existing line supported by L2 towers; the post fault continuous rating will be 3,100 MVA.	NGET's stated route length is now correct and revised estimated costs are reasonable.

17 HACKNEY TO WALTHAM CROSS 400KV UPGRADE LN-R01 (NGET – LONDON)

17.1 Project Objective

The project is to uprate a 275kV overhead line from Waltham Cross to Hackney via Brimsdown and Tottenham to 400kV. This will involve substation works at Waltham Cross and Hackney, NGET identifying the principal measures as follows:

- a new 400kV GIS double busbar substation at Waltham Cross, and transfer of circuits from existing substation to new substation
- replacement of two 275/132kV transformers at Brimsdown (on ZBC route) to 2x400/132kV transformers
- replacement of 2x275/66kV transformers at Hackney by 2x400/66kV transformers
- reconductoring of the Waltham Cross – Hackney route with 2x620 GAP conductors as described below (text and diagram provided, the GAP conductors providing a winter post fault circuit rating of 3100MVA)
- and/or reconductor or 'Hot Wire' the Pelham – Rye House – Waltham Cross circuits

The London scheme also includes the Tilbury to Warley to Elstree 400kV upgrade, a Phase 2b project.

17.2 Consents Application Status

An application is to be made to the Infrastructure Planning Commission submission in Quarter 1 of 2012 with anticipated approval a year later.

17.3 Delivery Strategy

It is assumed that this work will be carried out by Electricity Alliance resources.

Contract award/plant ordering date would be quarter 3 2013 with network access windows planned for 2014, 2015 and 2016

17.4 Anticipated cash flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total
Pre-construction	0.1	3	2					5.1
Construction			4	52.3	69.9	43	9.4	178.6

17.5 Project Assessment

17.5.1 Deliverability

With planning approval progressed by the IPC in 2012 and with materials ordering in 2013, this project should be deliverable by 2015/16.

17.5.2 Design

Detailed engineering will commence in 2010

17.5.3 Costs

Apart from the above statement and a single line diagram, no quantities (nor Table 2c) have been provided by NGET. Insofar as we are able to identify the quantities and items concerned we are unable to account for all of the estimated capital expenditure. Items over which there is uncertainty and which could account for the difference include the diversions of the existing ZBC overhead line at the new substations, switchgear requirements notably at Hackney and the proposed increase in rating of the Pelham – Rye House – Waltham Cross overhead line. Furthermore as NGET develops its design the outturn costs are likely to vary, if not increase.

The cash flow profile appears to be front ended with £52m being spent in 2012/13 presumably in large part on civil works. A review of the level of costs and the profile should therefore be carried out later in 2010 when design is firmer.

17.5.4 Outputs

Preconstruction work should be 100% complete by March 2012 and work should have commenced on site.

17.5.5 Assumptions/uncertainties

Only high level information is currently available so assumptions have been made with respect to design, estimated costs and deliverability.

17.6 Assessment Summary

Deliverability	Design	Costs
With planning approval progressed by the IPC in 2012 and with materials ordering in 2013, this project should be deliverable by 2015/16.	Detailed engineering will commence in 2010	We are unable to account for all of the estimated capital expenditure. Furthermore as NGET develops its design the outturn costs are likely to vary, if not increase.

18 WESTERN HVDC LINK AS-R02 (NGET/SPT)

18.1 Project Objective

This major reinforcement project will be a joint project SPT/NGET.

Planned to complete in 2015, the scope of this project covers:

a) SPT 400kV substation at or near Hunterston, together with

b) reconfiguration of the existing 400kV and 275kV system on the west coast, in part to deliver a Windyhill-Denny or Neilston-Strathaven 400kV link,

c) SPT HVDC Converter station at or near Hunterston

d) SPT-NGET Sub-Sea HVDC cable from at or near Hunterston to Deeside. This project element will be shared 50:50 with NGET.

e) NGET HVDC converter station at Deeside

f) NGET 400kV substation at Deeside

Other than the replacement of the 400kV substation Deeside substation, the replacement of which has been reviewed earlier in this report, no initial reinforcements are planned to the transmission system at the southern landing point.

18.2 Consents Application Status

An element of the initial work involves a consents regime review in order to identify all necessary planning consents required both on and off shore. This will allow the formation of the appropriate environmental studies and necessary information to be compiled to accompany applications to the various determining authorities for each the respective elements of the proposal.

For the offshore cabling, the detail of the consenting process associated with this project is complicated by the changes in the marine consenting regime in Scotland and in England and Wales. Marine Licensing in Scotland by Marine Scotland and in England and Wales under the Marine and Coastal Access Bill has yet to be tested. There is a possibility that the Infrastructure Planning Commission may determine that this project is of sufficient national significance that they should be involved in the determining body.

The route/site selection studies have commenced for the HVDC circuit. Deeside has been established as the southern converter station location. For the Scotland converter station consideration is being given to whether Hunterston is the most appropriate.

The initial findings of the siting appraisal will be complete in November 2009 and will be followed by desktop route studies to establish, in greater detail, viable onshore and offshore route options which will then be assessed to establish a preferred route corridor by April 2010. Route surveys will follow.

18.3 Delivery Strategy

SPT/NGET have had discussions with the suppliers with proven experience in delivering major HVDC converter and cable projects. Manufacturing lead times are based on the minimum periods indicated

by the suppliers. Subsea cable installation will take place over two periods (years) utilising suitable weather windows; SPT/NGET note however that there is reluctance by the specialist manufacturers to be clear in terms of delivery dates and prices. One objective of the project strategy will be to establish clearer timescales and prices of viable designs; these will then be developed and taken to a firmer priced position and will be achieved by engaging suppliers in design/development contracts.

The TOs intend to work with two or more suppliers to jointly develop the most effective HVDC design. This will seek to optimise the design of the HVDC converter station and HVDC cable system, and the associated control system to maximise power flow and onshore stability limits. Subject to satisfactory completion of suitable designs, the suppliers will be invited to tender a price against agreed design on a suitable commercial basis. This will ensure all design options are explored and verified whilst maintaining a suitable level of commercial tension amongst suppliers.

18.4 Anticipated Cash Flow[5]

18.4.1 SPT Costs

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total
Pre-construction	2.5	5.5	5.0					13
Construction			25	49	84	81	35	275
Indicative Onshore Works				25	42	40	18	125

18.4.2 NGET Costs

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total
Pre-construction	2.5	5.1	4.4					12.0
Construction			25	49	84	81	35	274
Deeside		20.4	22.4	24.3	22.7	13.9	1.9	105.6

The total of the above amounts is £805.9 million.

18.5 Project Assessment

18.5.1 Deliverability

SPT consider that planning and landowner consent for the converter terminal and sub-sea cable are likely to be granted voluntarily in accordance with programme.

It is noted that the project strategy should establish clearer timescales and a firmer price.

Nevertheless the outline programme looks feasible subject to many factors working in SPT/NGET favour including planning approvals, manufacturing capacity availability, cable laying resource availability and not least, weather windows and network outages.

[5] The breakdown of the Indicative Onshore Works costs has been presented by SPT in its Table 2(c) – d – West Coast HVDC: Indicative Onshore Works.

PB's appreciation

The TOs are proposing a single HVDC link of capacity 1.8GW which, assuming the link to be a bipole arrangement, would represent the upper limit of what could be constructed as a single link. (The existing Cross –Channel link comprises two 1GW bipole links which are arranged to be independent electrically.) As no technical details were provided initially for the proposed Western HVDC link, we carried out an appreciation in which we assessed the link as using conventional line commutated converters, voltage rating +/- 450kV (reflecting the maximum cable voltage presently available e.g. as on the BritNed and NorNed HVDC links). We would also consider that an achievable cable arrangement would comprise two cables per pole, of MIND insulation and with copper conductors, and two cables for the return path, the bipoles being earthed at their centre points and connected to the return path. In addition there would an optical fibre communications cable laid in one of the main cable bundles (each bundle otherwise comprising one cable core of each polarity). Allowance would have to be made for subsea obstacles, such as:

- Obtaining permits to cross existing cables, including the Moyle interconnector;
- Beaufort Dyke, off Portpatrick; and
- Munitions dumping areas off the Scottish coast.

TOs' clarification

NGET (on behalf of NGET and SPTL) however subsequently clarified that:

- its costs were based on one cable per pole operating at 500kV or potentially higher and that currently 500kV cables are in service
- MIND or PPL cable, c2,500mm^2
- no metallic return path is envisaged but this would be evaluated during the design works in terms of risk of damage, potential damage to a single cable in a bundle and cost benefit of redundancy
- no separate cable assumed for telecommunications; use of multiple onshore communications circuits assumed instead and
- no contingency was allowed (to be reviewed following sea bed survey).

Deeside converter station

Another aspect for consideration is that the East West Interconnector Project (EWIP) is already under construction with a 500MW HVDC voltage sourced converter (VSC) station being built at Deeside and scheduled to enter service in 2012. The Nordel Grid Code, for example, requires that adjacent HVDC converter stations should not interfere with one another and Cigré has proposed minimum fault level

requirements for systems with multiple DC infeed[6]. NGET has indicated that in view of the high fault level at Deeside, multiple infeed operation there should not present an undue problem.

We also note that no credit is given to any "loop flow capacity" that might become available via Ireland (Moyle Interconnector, the projected Meath - Cavan – Tyrone 400kV overhead line and the EWIP).

18.5.2 Costs

We find the TOs' cost estimates for converter stations to be in accordance with those indicated by Cigré[7] for LCC converters.

We have also compiled estimates of the cost of the cable arrangement on the following bases:

- +/-450kV HVDC link without metallic return path
- +/-450kV HVDC link with metallic return path and
- with a further contingency to cover as yet unknown cabling costs.

In each case we find our estimates for the cables to be higher than those of the TOs.

Conversely our estimate of the costs of the reinforcement of the western part of SPT's transmission system (the "Indicative Onshore Works") is lower than SPT's estimate. We would consider that this difference is in part due to our unit costs for switchgear being lower than SPT's and to large undefined items under "substation other" within SPT's Table 2(c) –d which, being unsupported by any other information, we are unable to identify.

Overall our estimated costs are higher than those of the TOs. We further note however that because of the broad general nature of the presentation of the TOs' estimates, as well as the assumptions within our own appreciation of the converter and cable arrangement, these estimates may change as detailed design progresses.

Following receipt of the TOs' clarification we have also reviewed our estimate of the cost of a single cable, 500kV, 2,500mm^2 copper conductor, MIND insulated, and find that based on published contract price information, there is little difference between the cost of a single 500kV 2,500mm^2 cable and our estimate for two 450kV cables of smaller size but same capacity. Another issue is the requirement or otherwise for a metallic return path – this may be avoided if the sea electrode(s) are not to be used in any redundant mode (loss of a pole for example). Environmental consents may influence the requirement for a metallic return path.

Furthermore although the TOs' cable cost may be about the basic cost that would be paid to a contractor to supply and lay the cable, from the overall costs that are being quoted for the current projects in Europe (EWIP, BritNed, NorNed etc.), no allowance or contingency appears to have been included by the TOs for seabed survey, permitting or additional measures, such as rock dumping, to protect the cable. Accordingly we would suggest that a contingency of about 50% on the basic cable unit cost could be appropriate, noting that there are subsea obstacles on the route from Hunterston to Deeside.

[6] Cigré: Technical Brochure 364, Systems with Multiple DC Infeed, December 2008
[7] Cigré: Technical Brochure 388; Impacts of HVDC Lines on the Economics of HVDC Projects, August 2009. Table 5.3 would indicate that the cost of a +/- 450 kV, 1.8GW converter station would be about £200 million (for both stations (rectifier/inverter).

Accordingly we would advise that we would expect the costs to increase as further design and exploratory work (including a survey of the seabed) proceeds.

18.5.3 Outputs

The cash flow profile indicates that by March 2012, pre-construction work should be complete.

The outline programme shows that construction contracts will have been placed and the contractor will be involved in detail design.

By March 2013, plant and cable manufacture will have been programmed but not commenced.

SPT/NGET program refers:

Section 4 Ofgem Information Requests Parsons B Final v2.pdf

18.5.4 Assumptions/uncertainties

At this point in time all aspects of design, cost estimation, planning approval and delivery are based on assumptions none of which have yet been tested or refined by the design and procurement process.

18.6 Assessment Summary

Deliverability	Design	Costs
The outline programme looks achievable subject to many factors working in SPT/NGET favour including planning approvals, manufacturing capacity availability, cable laying skills and resources availability and not least, weather windows and network outages.	Design is not yet firm.	Overall our estimated costs are higher than those of the TOs and we would expect these costs to increase as further design and exploratory work (including a survey of the seabed) proceeds.

19 EAST COAST UPGRADE (SPT/SHETL)

19.1 Project Objective

19.1.1 SPT

The existing overhead line route from Kintore in the SHETL area to Kincardine in the SPT area operates at 275kV. It is proposed to uprate this route to 400kV operation.

The reinforcement scope covers:

a) Creating three new 400kV substations, together with modifications, at Kincardine, Grangemouth and at a new site at Harburn.

b) Uprating the 275kV line from Kincardine to Harburn to 400kV operation. This will include two new OHL sections of around 1km to 2km to (i) complete the 400kV double circuits from Kincardine to Harburn and (ii) create two new 275kV double circuits from Harburn to Currie.

c) Uprating the 275kV double circuit line from Kincardine to the SHETL boundary (around 10km) to 400kV operation.

d) Uprating the 275kV Kincardine - Longannet double circuit to 400kV operation. Two 400kV/275kV auto transformers will be located at Longannet in order to retain the future option to create a 400kV double circuit line from Longannet to Lambhill while also avoiding the need to relocate the Longannet reactors to Kincardine.

e) Uprating the 275kV cable sections from Longannet on the Longannet - Westfield circuits.

The Harburn 400kV supergrid substation would split the upgraded 400kV Strathaven - Wishaw - Kaimes double circuit route to create two new double circuit 400kV routes from Strathaven - Wishaw - Harburn and from Harburn - Kaimes.

19.1.2 SHETL

SHETL would be responsible for the uprating of the bulk of the Kintore to Kincardine route to 400kV operation and this work will be included in their submission to Ofgem.

The SHETL portion of the East Coast upgrade, namely the re-insulation of the line route from Blackhillock to Kincardine and re-conductoring of the line route (XT1/XT2) between Kintore and Tealing, is identified in SHETL's Table 1.1b, Projects not nominated at this stage. In the additional information supplied on 30 September 2009; a comment is made that construction costs are expected to be included in TPCR5.

Further explanation was provided by SHETL on 14 October 2009 to the effect that while pre-construction work was already provided under TPCR4 for the re-insulation of the circuits between Blackhillock and Kincardine, the actual construction work and the re-conductoring of the XT1/XT2 275kV line was planned for TPCR5.

We note, from Figure 3 of the SHETL Technical Report "North West Transmission Boundary Reinforcement Need Case For Beauly-Blackhillock-Kintore Reconductoring", that the 275kV overhead line to be re-insulated between Blackhillock and Kintore is the VH/HK1/XK line (of L8 construction) via

Keith and the tee point, Rothienorman, on the Keith – Peterhead – Kintore line route. New 400/275kV switchyards will be required at Blackhillock, Rothienorman, Kintore and Alyth (near Tealing). Information provided by SHETL on 6 November 2009 states that the line between Kintore and Alyth to be re-insulated to 400kV working is in fact that carrying the XZ1 and XT3 circuits (and not the 275kV L3 construction line between Kintore and Tealing carrying circuits XT1 and XT2 as indicated initially). Between Alyth and Kincardine the circuits to be upgraded to 400kV working are the XZ1 and TZ2 circuits. The circuits identified for upgrading are supported on L8 towers which are suitable for re-insulating to 400kV working; the existing conductor size is twin bundled 400mm^2 ACSR.

SHETL has also confirmed that the 400kV East Coast project would include the provision of 275kV Quad Boosters (located at Tealing on the Kintore to Tealing circuits XT1/XT2) to control the power on the weaker 275kV parallel route to maximise the boundary transfer capability.)

SHETL has however qualified the information provided stating that it was in the pre-construction engineering phase of this project and had not yet selected final substation sites. Indeed, it had not yet been established whether the condition of the conductor was sufficiently good to avoid re-conductoring the route. Hence, the project was not yet sufficiently developed to issue a schedule of quantities and costs.

No formal technical report was available from SHETL.

19.2 Consents Application Status

A planning strategy is currently being developed to identify the necessary environmental information which will be prepared to support the necessary planning consent applications.

19.3 Delivery Strategy

Not known at present.

19.4 Anticipated Cash Flow SPTL

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total
Pre-construction	0.2	0.4	1.3					1.9
Construction	0	0	7	24	43	42	19	135

19.5 SHETL

400kV East Coast reinforcement								
£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014n/15	2015/16	Total
Pre-construction	0.14	0.78	0.78					1.7
Construction					26.85	21.6	10.8	59.25

XT1/XT2 reconductoring and re-insulating other circuits							
£m	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Total
Pre-construction	0.17	0.67	0.22				1.06
Construction				14.19	25.14	14.67	54

The total cost of the project amounts to £4.7m pre-construction costs and £248.25 construction costs.

19.6 Project Assessment

19.6.1 Deliverability

SPT note that although planning and consents may be obtained voluntarily, there is the potential in doing so to delay the programme. This applies to all aspects of the work with the exception of the uprating of the 275kV cable sections.

19.6.2 Design

SHETL states that it is only at the pre-construction engineering phase for this project and it has not yet been established whether the condition of the conductor is sufficiently good to avoid re-conductoring the route.

19.6.3 Costs

Although SHETL has not provided a Table 2c schedule of unit quantities and costs, we have compiled our own estimates which exceed SHETL's estimates, largely due to substation costs. In view of the tentative nature of SHETL's proposals we would consider that SHETL's estimated costs are likely to increase.

Conversely our estimates of SPTL's costs are appreciably lower than theirs. In particular we find SPTL's unit costs for 400kV air insulated switchgear to be high – higher than those used elsewhere for connection charges, for example[8].

The Kincardine – Currie overhead line routes (XD, XN, XK and XM) were constructed between 1962 and 1965. These routes are equipped with a twin 'Zebra' (400mm^2 ACSR) conductor system. It is assumed that significant investment will be required, due to condition, in the 2012 – 2017 price control period, including replacement of the conductor system. It is assumed that the replacement conductor system will provide a thermal rating not less than that of twin 'Totara' (425mm^2 AAAC). The cost associated with overhead line refurbishment is not included in the East Coast Upgrade.

19.6.4 Outputs

While pre-construction work should be complete in the current period, the programme shows that manufacture will be underway for Harburn 400kV upgrade and that civil work will have commenced on site.

By March 2013, installation of plant on site would be 50% complete and manufacture should be in hand for other locations.

19.6.5 Assumptions/uncertainties

SPT comments as follows:

> The environmental and engineering design associated with the proposed enhanced transmission system is currently at a very high level feasibility stage. Further significant work

[8] National Grid: The Statement of the Connection Charging Methodology, Effective from 1 April 2009, Appendix 1: Illustrative Connection Charges.

will be required to resolve the outstanding environmental and engineering issues to allow the overall scheme to be developed into a deliverable design.

System outages may prove to be a major constraint in the detailed design of this enhanced transmission system."

Assessment Summary

Deliverability	Design	Costs
Obtaining consents may delay the programme. This applies to all aspects of the work with the exception of the uprating of the 275kV cable sections.	Final substation sites have not yet been selected and it has not yet been established whether the condition of the conductor is sufficiently good to avoid re-conductoring the route.	Estimated costs are likely to increase.

20 EAST WEST 400KV UPGRADE (SPT)

20.1 Project Objective

The southern side of the Strathaven-Wishaw-Kaimes-Smeaton double circuit overhead line route presently operates at 400kV while the northern side operates at 275kV. To increase voltage and transient stability limits towards the 4420MVA winter thermal rating of the SPT-NGET boundary, it is proposed to uprate the northern side of this route to 400kV operation.

Reconfiguration will be required at a number of existing substation sites, including Strathaven, Kaimes and Smeaton. Initial engineering assessment indicates that physical constraints at Wishaw 275kV Substation prevent development of a 400kV substation at the site. To facilitate the uprating of the existing Strathaven-Wishaw-Kaimes 275kV connections and continue to support the Wishaw / Newarthill demand group, a new 400/275kV substation to the east of Wishaw is proposed (Overtown Substation).

The rating of the existing 2.2km cable sections on both Torness-Eccles 400kV circuits limits the thermal capability of the internal SPT system such that SPT-NGET transfers in excess of approximately 3400MW could not be supported. To allow the SPT system to accommodate transfers up to the 4420MVA winter thermal rating of the SPT-NGET boundary, it is proposed to install a second 400kV cable per phase on both of the Torness-Eccles 400kV circuits.

20.2 Consents Application Status

A planning strategy is currently being developed to identify the necessary environmental information which will be prepared to support the necessary planning consent applications

SPT note that the project will be subject to significant planning and environmental consent risks.

20.3 Delivery Strategy

Not known at present.

20.4 Anticipated Cash Flow

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total
Pre-construction	0.2	0.5	1.9					2.6
Construction			8	14	24	24	10	80

20.5 Project assessment

20.5.1 Deliverability

Obtaining consents may be difficult but this activity lies on the critical path for all sections of work associated with this project. However an extended period has been allowed for the Wishaw consents process. Nevertheless SPT still consider that planning and consents for the works associated with Wishaw have the potential to delay the programme.

There would also appear to be a concentration of commissioning work associated with this project into the 2014 outage window.

20.5.2 Design

A general description of the work only has been provided and only limited information has been provided by SPT to enable us to assess the design. For example no data has been provided on the required increase in capacity. The basis of the East West 400kV upgrade project is to re-insulate the northern side of the Strathaven – Wishaw – Kaimes – Smeaton overhead line (XH/XJ route) which is of L2 construction, strung with twin 'Zebra' (2 x 400mm^2) phase conductor system, presently operated at 275kV, and therefore suitable for upgrading to 400kV operation. The southern side of the circuit in question is already operated at 400kV. Both circuits would then be in accordance with the L2U specification (insulated for 400kV working).

20.5.3 Costs

The cost estimates for the East West 400kV Upgrade project comprise:

a) 400kV feeder bay and overhead line terminations at Strathaven substation

b) Overton 400/275kV substation, comprising five 400kV bays, two 500MVA 400/275kV transformers and eight 275kV bays

c) 400kV overhead line bypass connection at Kaimes substation

d) Overhead line connections at Smeaton substation and

e) Second cable/phase on the 2.2km cable sections of each of the Eccles – Torness 400kV circuits.

Wishaw 275kV Substation is equipped with twelve Reyrolle type OBR60 air-blast circuit breakers in a 'one and a half switch' configuration. These units are of 1965 vintage. It is assumed that Wishaw 275kV Substation will require significant investment due to condition in the 2012 – 2017 TPCR5 price control period. No asset replacement expenditure at Wishaw substation has however been included in the cost estimates for the East West 400kV Upgrade project. The overhead line upgrade costs cover re-insulation of the (northerly) Strathaven to Smeaton circuit only; no re-conductoring costs are included. It is not clear whether SPT expects to re-conductor the line under a separate and later project, for example under the 2012 to 2107 price control period.

Our estimates of SPTL's costs are appreciably lower than theirs. We find SPTL's estimated costs for 400kV air insulated switchgear and the provision of a second cable on the underground sections of the Eccles to Torness circuits also to be high.

20.5.4 Outputs

Cash flow profiles show pre-construction engineering complete by March 2012 with construction work barely underway. By March 2013, based on cash flow profiles, the project should approximately 27% complete.

20.5.5 Assumptions/uncertainties

At this point in time, all aspects of this work as defined are based on assumptions on deliverability and hence the project phasing and cash flows, design with respect to layouts, access arrangements,

environmental mitigation etc and associated and costs. Considering that pre-construction work has just commenced, these assumptions have to be made at this stage.

20.6 Assessment Summary

Deliverability	Design	Costs
SPT still consider that planning and consents for the works associated with Wishaw have the potential to delay the programme.	A general description of the work only has been provided and only limited information has been provided by SPT to enable us to assess the design.	We consider the forecast costs to be high

PRE CONSTRUCTION COSTS & PHASE 2 B PROJECTS

21 PRE-CONSTRUCTION COSTS - PHASE 2 B PROJECTS

21.1 Phase 2b Projects

Phase 2b projects are identified as those projects which do not have construction cash flow until 2012/13 or later.

Design is at the early conceptual stage for many of these projects and little or no information is available about consents requirements, design, costs or delivery strategy. Some programme information is however available.

Consideration has therefore been given to an assessment of the pre-construction costs only for these projects together with those for the Phase 1 & Phase 2a projects. Phase 1 projects that have already progressed beyond the pre-construction phase have not been included.

Appendix C attached lists the 16 Phase 2b projects together with the submitted pre-construction and construction cash flows.

21.2 Pre-construction Costs

The magnitude of pre-construction costs is related to the nature of the work and partially to the size of the project.

In order to facilitate comparisons, the projects have been allocated to one of the following groups:

i) Existing Overhead Line Projects

ii) New Overhead Line Projects

iii) Series Compensation/HVDC Projects

iv) Substation Projects

Where projects comprise of more than one of the above categories, the project has been allocated to the dominant characteristic.

In the review of pre-construction costs, where costs appeared high, queries were raised with the TOs and responses considered. NGET accepted that in some instances, estimated design costs may have been high but that in several instances, insufficient allowance had been made for the impact on costs of the new planning act and the IPC process. NGET therefore proposed increases in some of the pre-construction costs. We would suggest that where design costs have been increased, there should be a corresponding reduction in project construction costs, i.e. design is now being carried out as a pre-construction activity rather than a construction activity.

We find that where costs have been increased to take into account the impact of the new planning act and the IPC process, we cannot support the submissions on the basis of a top down assessment since historic costs are not yet available.

In the tables below, we have indicated where we consider that the pre-construction costs (updated by NGET in response to our query) can be considered reasonable by a green indicator. Pre-engineering costs for 6 of the 7 the projects on existing overhead lines and 2 of the 5 new overhead line projects can be considered reasonable at this stage. Pre-engineering costs for 7 of the 8 substation projects

and 4 of the 7 Series Compensation/HVDC projects can also be considered reasonable. Where we find that we cannot confirm that costs are reasonable at this stage, the project has a blue indicator.

Note that the assessment is based on TO cost estimates from 2009/10 onwards and therefore the numbers include some costs which are already funded and exclude any costs incurred before 2009/10.

We have the following detailed comments.

- At almost £1m, the cost for obtaining consents for the reconductoring of the Harker Hutton Quernmore Tee line look high. Although the pre-construction costs as a percentage of construction costs are not unreasonable and NGET consider that is it difficult to be precise about how the pre-construction costs break down into the 4 sub-categories, it is difficult to see how the figures for both route selection and consents for work on an existing line could be high. Nevertheless NGET may be able to provide a schedule of mandays against tasks which justify the estimate.
- The Hackney - Waltham Cross Upgrade project design costs also look high but the design aspect of the work in assessing upgrade requirements is intensive and as a percentage of the total projects costs, the pre-construction costs are low.
- There are 3 new line projects where we cannot confirm that the design costs are reasonable. These costs look high compared to the more expensive Central Wales to Ironbridge 400kV circuit pre-construction costs. In addition the estimated costs for route identification, environmental assessment and planning consent require breakdown and justification.
- There are 3 new Series Compensation/HVDC where we cannot confirm that the design costs are reasonable at this stage. We would need to see the breakdown of mandays against tasks and understand the dividing line between pre-construction and construction design.
- Finally the pre-construction expenditure for Extension of Pentir 400 kV Substation and Penisarwaun Substation look high expressed as a percentage but the projects costs are relatively low compared to the other substation projects.
- A breakdown of pre-construction costs for Wylfa has not been provided but they are higher than those for South West New 400kV Substation.

In summary, in 8 of the 27 projects reviewed, pre-engineering costs cannot be confirmed reasonable without further information. We would reiterate that where we have not confirmed that costs are reasonable, this is solely on the basis that there is insufficient information currently available to allow analysis from a ‘bottom up’ approach and it is not possible to benchmark them in a ‘top down’ fashion against historic costs. We would confirm that evidence is now beginning to appear that the new Planning Act, applicable in England and Wales, may be increasing NGET’s pre-construction costs.

Under the circumstances it would be appropriate for Ofgem to allow all pre-construction costs as presented by the TOs subject to a rigorous efficiency check against progress made at the end of the funding period.

Existing OHL Work	Reconductor Harker Hutton As-R01	Replace SPT 132kV Ccts NW-R01	Reconductor Trawsfynydd Treuddyn Tee NW-R05	Hackney Waltham Cross Upgrade LN-R01	East Coast Upgrade	East West Upgrade	Walpole Norwich Bramford Reconductoring
Project design	1.75	0.80	0.50	2.50	0.70	1.40	0.75
Route Identification	0.45	0.05	0.15	0.50	0.20	0.00	0.15
Env Assessment	0.81	0.06	0.60	0.90	0.50	1.00	0.27
Planning Consent	0.99	0.15	0.5	1.1	0.5	0.2	0.33
Total	**4.00**	**1.06**	**1.75**	**5.00**	**1.90**	**2.60**	**1.50**
Total as % of Constn costs	4.1%	5.9%	4.4%	2.8%	1.4%	3.3%	3.1%

New OHL Work	New 400 kV Overhead Line Circuit from Bramford to Twinstead Tee	New Central Wales to Ironbridge 400 kV Circuit	Second Pentir to Trawsfynydd 400 kV Circuit	New Wylfa to Pentir Circuit	South West New Line and Reconductor
Project design	3.00	1.50	0.60	3.00	4.00
Route Identification	1.00	1.00	0.50	1.00	1.50
Env Assessment	1.00	1.00	0.20	1.00	1.50
Planning Consent	1.50	1.00		1.50	1.50
Total	**6.50**	**4.50**	**1.30**	**6.50**	**8.50**
Total as % of Constn costs	7.6%	2.1%	1.6%	6.8%	4.3%

Series Comp/HVDC	Series Comp Harker Hutton AS-R03	Western HVDC As-R02	Eastern Anglo-Scottish HVDC Link	HVDC Link from Humber to Walpole	Series Compensation Pentir to Deeside & Trawsfynydd to Treuddyn ccts	Hunterston Kintyre Link[9]	Quad Boosters in Walpole Norwich OHL
Project design	4.20	8.98	3.06	9.00	1.32	-	-
Route Identification	0.00	1.18	0.40	1.50	0.00	-	-
Env Assessment	1.40	1.10	0.37	1.50	0.44	-	-
Planning Consent	1.4	0.75	0.25	1.00	0.44	-	-
Total	**7.00**	**12.00**	**4.09**	**13.00**	**2.20**	**1.4**	**1.1**
Total as % of Constn costs	9.6%	2.2%	1.2%	3.4%	4.6%	1.2%	2.2%

Substation Work	Substation Works at Humber and Walpole	New Central Wales Substation	Extension of Pentir 400 kV Substation	Penisarwaun Substation	South West New 400kV Substation	Bramford Substation	Deeside Substation	New Wylfa 400kV Substation
Project design	3.08	1.20	1.53	0.80	2.00	2.99	0.83	-
Route Identification	0.39	0.10	0.59	0.00	0.39	1.20	0.08	-
Env Assessment	0.77	0.10	0.53	0.20	0.77	1.08	0.19	-
Planning Consent	0.77	0.20	0.35	0.10	0.77	0.72	0.18	-
Total	**5.00**	**1.60**	**3.00**	**1.10**	**3.92**	**5.99**	**1.27**	**5**
Total as % of Constn costs	3.3%	4.6%	12.0%	9.2%	5.2%	4.4%	1.2%	6.7%

[9] This project may not lie naturally in any of the 4 main groupings but the level of pre-construction expenditure would be low regardless of what comparison was made. The pre-construction costs for this project were updated recently without a breakdown being provided.

APPENDIX A POLICY FOR THE UPRATING OF OVERHEAD LINES

APPENDIX A POLICY FOR THE UPRATING OF OVERHEAD LINES

NGET

NGET has for some years now adopted a policy of replacing existing conductor systems with either all aluminium alloy conductors (AAAC) or high temperature gap type conductors (typically GZTACSR 620mm^2 Matthew gap conductor), where such uprating is required by circuit load. As far as possible and depending on the condition of existing towers[10], the towers are retained thereby avoiding the need for obtaining new Section 37 consents. In general existing twin conductor systems, supported by either L2 or L8 towers, are replaced by new twin conductor systems, typically either twin Sorbus (570mm^2 AAAC) conductor or, where higher rating is required, twin Matthew gap conductor as these towers will not support heavier conductor arrangements. The heavier duty L6 towers, originally supporting either twin or quad 400mm^2 Zebra aluminium cored steel reinforced (ACSR) conductor are being re-conductored with either twin or triple 700mm^2 Araucaria AAAC conductor, depending on circuit loading requirements.

A key factor in the uprating process is the maximum conductor temperature for which a line may be sagged. The original 400kV lines with ACSR conductor and built some 40 to 50 years ago were sagged for a maximum conductor temperature of 50^{0}C and so had conservative capacities in order to maintain statutory clearances. (Another consideration was the melting point of grease inside the ACSR conductor.) Nowadays AAAC conductor lines are sagged for conductor temperatures of 75^{0}C to 90^{0}C and Matthew gap conductors may be sagged for a temperature of 170^{0}C.

By way of example the post-fault continuous winter ratings of typical uprated 400kV overhead line circuits at 75^{0}C are as follows:

- 2 x 570mm^2 Sorbus AAAC conductor, 2010MVA
- 3 x 700mm^2 Araucaria AAAC conductor, 3820MVA
- 2 x 620mm^2 Matthew Gap GZTASCR conductor, 3100MVA.

These ratings generally represent appreciable increases in rating in instances where the original conductor system was sagged for, say, 50^{0}C or where conventional conductor is to be replaced by gap conductor. At the same time gap conductor has markedly higher procurement and installation costs than conventional conductor and special installation techniques and procedures have been established.

SHETL

SHETL is similarly proposing uprating the capacity of one overhead line route by using high temperature conductors on the same towers.

SPTL

SPTL is not proposing the use of high temperature conductors to uprate overhead lines.

[10] Towers generally have an asset life of approximately twice that of conductor systems.

APPENDIX B PHASE 2B PROJECT LISTING

APPENDIX B - PHASE 2B PROJECT LISTING

1 Eastern Anglo-Scottish HVDC Link

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	£m	Total
Pre-construction	0.200	0.750	2.815	0.320					0.200	4.1
Construction					69.000	104.000	104.000	69.000		346.0
		£m								
Project design		3.056								
Route Identification		0.401								
Environmental Assessment		0.373								
Planning Consent		0.255								

2 HVDC Link from Humber to Walpole

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	1.0	1.0	3.0	5.0	5.0				15.0
Construction					15.0	125.0	125.0	120.0	385.0
		£m							
Project design		10.471							
Route Identification		1.371							
Environmental Assessment		1.283							
Planning Consent		0.875							

3 Substation works at Humber and Walpole

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction		0.50	0.50	2.00	2.00				5.00
Construction					30.00	50.00	50.00	20.00	150.00
		£m							
Project design		3.077							
Route Identification		0.385							
Environmental Assessment		0.769							
Planning Consent		0.769							

4 New 400 kV Overhead line circuit from Bramford to Twinstead Tee

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	0.4	2.1	2.0	2.0					6.5
Construction				5.0	25.0	30.0	25.0		85.0
		£m							
Project design		4.167							
Route Identification		0.278							
Environmental Assessment		0.208							
Planning Consent		0.347							

5 Quad Boosters in Norwich to Walpole Circuit

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	.1	1.0							1.1
Construction					5.0	20.0	20.0	5.0	50.0
		£m							
Project design		1.1							
Route Identification									
Environmental Assessment									
Planning Consent									

6 Tilbury to Warley to Elstree 400 kV upgrade

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction							2		2
Construction									
		£m							
Project design		1							
Route Identification		0.2							
Environmental Assessment		0.36							
Planning Consent		0.44							

7 New Central Wales to Ironbridge 400 kV circuit

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	0.5	1.0	1.0	1.0	1.0				4.5
Construction					65.0	86.0	65.0		216.0
		£m							
Project design		8							
Route Identification		0.12							
Environmental Assessment		0.218							
Planning Consent		0.15							

8 New Central Wales Substation

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction		0.20	0.80	1.00					2.00
Construction				15.00	15.00	5.00			35.00
		£m							
Project design		1.2							
Route Identification		0.1							
Environmental Assessment		0.1							
Planning Consent		0.2							

9 Second Pentir to Trawsfynydd 400 kV circuit

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	0.1	2.0	1.0	1.0					4.0
Construction				16.0	30.0	27.0	10.0		83.0
		£m							
Project design		0.6							
Route Identification		0.5							
Environmental Assessment		0.2							
Planning Consent									

10 Extension of Pentir 400 kV substation

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction		0.20	0.80	1.00	1.00				3.00
Construction					10.00	10.00	5.00		25.00
		£m							
Project design		1.529							
Route Identification		0.588							
Environmental Assessment		0.529							
Planning Consent		0.353							

11 Penisarwaun substation

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction		0.20	0.80	1.00					2.00
Construction				5.00	5.00	2.00			12.00
		£m							
Project design		0.8							
Route Identification		0							
Environmental Assessment		0.2							
Planning Consent		0.1							

12 New Wylfa to Pentir circuit

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	0.7	1.6	2.8	1.4					6.5
Construction				10.0	30.0	30.0	20.0	5.0	95.0
		£m							
Project design		3							
Route Identification		0.2							
Environmental Assessment		0.15							
Planning Consent		0.25							

13 Series Compensation Pentir to Deeside & Trawsfynydd to Treuddyn ccts

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	0.2	0.20	1.00	1.00					2.4
Construction				5.00	14.00	14.00	10.00	5.00	48.00
		£m							
Project design		1.32							
Route Identification		0							
Environmental Assessment		0.44							
Planning Consent		0.44							

14 New Wylfa 400 kV substation

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Totals
Pre-construction		0.200	0.800	2.000	2.000				5.000
Construction					15.000	25.000	25.000	10.000	75.000
		£m							
Project design									
Route Identification									
Environmental Assessment									
Planning Consent									

15 South West new line and reconductor

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction	0.7	2.7	2.1	2.0	1.0				8.5
Construction				8.0	70.0	85.0	30.0	5.0	198.0
		£m							
Project design		5.833							
Route Identification		0.389							
Environmental Assessment		0.292							
Planning Consent		0.486							

16 South West New 400kV substation

£m	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Total
Pre-construction				1.0	1.5	1.5			4.0
Construction					20.0	25.0	25.0	5.0	75.0
		£m							
Project design		3.077							
Route Identification		0.385							
Environmental Assessment		0.769							
Planning Consent		0.769							