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EXECUTIVE SUMMARY

SHE Transmission's proposal

Ofgem requires consultancy input to inform its assessment of the proposed Beauly Mossford project proposed by Scottish Hydro Electric Transmission PLC (SHE Transmission). Ofgem have assessed and published determinations on the overall Needs Case and Project Assessment for stage 1 of this project (under the Transmission Investment Incentives, TII, arrangements). This consultancy support involves reviewing the TO Project Assessment submission for stage 2 (of 2) of the project, and making recommendations on certain areas relevant to Ofgem's assessment under the SWW process.

The project consists of two stages; a new substation and replacement and reinforcement of the existing 132kV overhead line (OHL), of which the substation has already been assessed by Ofgem and thus this scope of work is limited to the assessment of the OHL stage only. The key output of this stage is the provision of increased capacity on the 132kV transmission infrastructure between the new substation and the existing Beauly substation. The capacity will increase by 252MW from 86MW to 338MW upon completion, with the increased capacity planned to be available in Q4 2015. The high level scope of this stage is to construct 94 new Overhead line (OHL) double circuit towers over a route length of approx 26km, dismantle 177 existing towers and install 3.5km of below ground cable.

TNEI's scope of assessment of the project submission

- A view on the techno-economic efficiency and robustness of the approach (in terms of sensitivity to design changes and potential supply chain constraints for example).

  This comprises a review of the technical solution being proposed and an assessment of whether the proposed electrical design of the scheme is an economical solution given the proposed SWW output identified as required in the needs case, the construction solution is reasonable and fit for purpose and to confirm the outputs that will be delivered by the scheme.

  In the context of the above and taking into account the findings from the assessment of the needs case we will examine the submission to seek evidence of consideration of a full range of options for reinforcement given and taking appropriate account of future uncertainty in generation development and supply chain constraints and the justification for the preferred/proposed project option taking into account future uncertainties.

- The appropriateness of the construction programme and progress made towards being ready to proceed in the proposed timescales.

  A review of the construction programme will be carried out to develop a view on whether it seems realistic and achievable in the proposed timescales, including consideration of project progress made to date. This will include consideration of the consenting and other pre-construction works to date. Areas to be investigated in detail will include critical path definition and consistency and interaction with key risks such as extreme weather, consenting, key milestones and treatment of task inter-dependencies by SHE Transmission.

  The construction programme should also be consistent with the timing requirements for additional network capacity as assessed in the needs case.

- The appropriateness of the proposed costs, taking into account the conclusions on the above and any additional detailed cost assessment including benchmarking of specific elements.

  Key project unit costs for items of plant, construction and installation will be compared with benchmark unit costs sourced from the consultant's own extensive data source. This will take project-specific factors into consideration and will also be benchmarked in a top-down cost assessment as appropriate.

We conducted an initial assessment based on SHE Transmission's submission. We then raised a number of questions to which SHE Transmission provided responses, and our review of which guided our final conclusions and recommendations. Our assessment of the three aspects of submission can be summarised as follows:

Table 1 – Overview of TNEI assessment

Factor	Techno-economic efficiency	Equipment Cost	Programme
Initial assessment			
Final assessment			

Summary of our assessment of the SHE Transmission submission.

In summary, our assessment of the Beauly Mossford Strategic Wider Works stage 2 project submission is described below:

- The technical solution proposed would appear to be a fit for purpose economical solution, with a robust construction solution in order to deliver the capacity increase identified as required in the needs case.
  - Though at the high capacity end for 132kV OHL and cable equipment, the solution proposed is based on standard components and thus significant supply issues and technical risks are not foreseen.
  - Demand for 132kV cable is likely to be higher than OHL due to its wide use in both the onshore and offshore wind markets but onshore cable at this voltage has a reasonably large supply chain.
  - Future upgrades however would be difficult as the high current capacity requirements being utilised would limit any future expansion without the need for additional parallel circuits and/or increased transmission voltage.
- The project costs appear reasonable overall and are largely determined by the construction costs which themselves are largely contained within two Engineering Procurement and Construction (EPC) contracts.
  - The proposed construction costs which account for around 72% of the total costs appear appropriate when taking into account the overall procurement strategy and benchmarking the major EPC components against internal and external sources.

- Both risk management at [redacted]% and project management at [redacted]% though relatively minor by comparison are, never the less, not insignificant. For the nature and duration of the project and with the team proposed by SHE Transmission to run and manage the construction phase, project management costs of [redacted]% are considered reasonable. Risk management is discussed elsewhere.

- The construction programme would appear to be well thought out and has, with the exception of a number of minor details, the agreement of the two main contractors.
  - Interdependencies and critical path items have been identified and slack included. Opportunities, risks and mitigation have been assessed and specific issues around winter working and bird nesting issues identified and considered.
  - Though slack has been included in non outage works this is not the case for outage dependent works. The latter has however been identified as low risk due to the nature of the work required during the outage and the high level of definition associated with this work.
- Based only on the scope of assessment undertaken by TNEI we would not recommend the need for any adjustments to be made to the Ex ante allowance requested by SHE Transmission.

1. TNEI'S ASSESSMENT OF THE SUBMISSION

Our assessment of the stage 2 submission for SHE Transmission's proposed Beauly Mossford 132kV Transmission line replacement as detailed below is based on the SHE Transmission Costs and Outputs Submission document of 13 May 2013 supplemented by a series of Q&A responses.

2. TECHNO-ECONOMIC EFFICIENCY

2.1 Overview

The project consists of two stages; a new substation and replacement and reinforcement of the existing 132kV overhead line, of which the substation has already been assessed by Ofgem and thus this scope of work is limited to the assessment of the OHL stage only.

The forecast stage 2 construction costs for the replacement and reinforcement of the existing 132kV overhead line (OHL) between Mossford and Beauly are £54,648,083.

The key output is the provision of increased capacity on the 132kV transmission infrastructure from 86MW to 338MW, an increase of 252MW. The Increased capacity is expected to be available from the 4th Quarter 2015.

The detailed scope includes:

- Replacement of the existing 132kV OHL from Dunmore to Corriemoillie Substation.
    - Dismantling of 177 existing 132kV OHL towers and conductor.
    - Construction of 94 new 132kV OHL (double circuit rated to 338MW summer pre-fault rating) towers and conductors over a route length of approximately 26km.
    - Enabling works to accommodate the new line including forestry clearance and network rail crossings.
    - Public Road Improvements to accommodate the dismantling of the existing OHL and construction of the new OHL.
    - Alteration works on existing distribution network to accommodate the new OHL.
- Construction of a new Sealing End Compound at Dunmore and installation of a new 132kV double circuit cable route to Beauly Substation. The following works are included as part of the scope:
    - 3.5km underground cable circuit (2 circuits rated at 391MW continuous summer rating) from Dunmore to Beauly substation.
    - Construction of a new Sealing End Compound at Dunmore.
    - Electrical installation at the new Sealing End and circuit modifications at Beauly substation, including required control & protection provisions.

2.2 132kV OHL contract

The construction costs for the OHL contract are the output from a competitive tendering process that commenced in 2011 and was concluded in Quarter 1 of 2012. This was undertaken in accordance with the SSE procurement manual. The construction costs in relation to this item have subsequently been updated based on the change to the construction programme since Quarter 1 of 2012.

The procurement process commenced with a two stage pre-qualification assessment of prospective contractors. Firstly the Achilles database was used to identify those contractors that met the defined criteria. At this stage, fourteen contractors were identified, with six subsequently expressing an interest in bidding for the work. The second stage of the pre- qualification process involved the completion of pre-qualification questionnaires. Five of the six selected contractors achieved the required score to progress to the next stage.

Three compliant tender submissions were received in August 2011. Following the tender interviews, on the balanced scorecard evaluations Balfour Beatty Utility Solutions Limited (BBUSL) achieved the best score against the tender evaluation criteria.

On completion of the internal SHE Transmission contract award approval process and following expiry of a two week stand still period and final contract negotiation the OHL contract was awarded in June 2012.

2.3 HVAC cable contract

The construction costs for the underground contract are the output from a competitive tendering process that commenced in 2011 and was concluded in Quarter 1 of 2012. This was undertaken in accordance with the SSE procurement manual. The construction costs in relation to this item have subsequently been updated based on the change to the construction programme since Quarter 1 of 2012.

The procurement process commenced with a two stage pre-qualification assessment of prospective contractors. Firstly the UVDB Achilles database was used to identify those contractors that met the SSE defined criteria. At this stage twenty eight contractors were identified, with ten expressing an interest in bidding for the work. The second stage of the pre-qualification process involved the completion of pre-qualification questionnaires. Of the ten contractors that expressed an interest two did not complete the questionnaire. Five of the eight that returned questionnaires achieved the required score to progress to the next stage.

Four compliant tender submissions were received in August 2011. Following tender interviews the balanced scorecard evaluations of the remaining four contractors were finalised. J Murphy & Son Ltd were evaluated as the best score against the tender evaluation criteria.

The absence of ground and site investigation works and SHE Transmission experience on similar recent projects has identified the need for a number of provisional sum items.

2.4 Design

2.4.1 OHL

The OHL contract scope for the Stage 2 works was developed utilising a pre-design study produced by an external OHL consultant. The pre-design study and subsequent scope of work were developed prior to site and ground investigation work being undertaken.

The existing circuits are predominantly single circuit, with sections of double circuit. The single circuit specifications are 175mm^2 ACSR Lynx conductors and 70mm^2 ACSR Horse earthwire on L7C towers.

A new double circuit design, comprising single Araucaria conductors at 90ºC, of approximately 26.2km is proposed to replace the two single circuit designs comprising 175mm^2 ACSR Lynx conductors and 70mm^2 ACSR Horse earthwire. This is the maximum 132kV conductor size that can be accommodated on the existing structures.

The new design had a pre fault summer continuous conductor rating per circuit of 338MW which is a high rating for a 132kV route, and beyond the capacity of standard AAAC conductor arrangements for which the L7C tower is designed, even one previously reassessed to AAAC 500mm^2 Rubus conductor. The solution is a single AAAC Araucaria (700mm^2) conductor rated at 90ºC, and single high strength Keziah equivalent earthwire, with limited span lengths and tower strengthening to enable utilisation of standard L7C towers with the addition of 300kN tension insulator strings. The tension insulator strings require modification of the standard conductor landing arrangement.

2.4.2 Cable

The cable contract scope for the stage 2 works was developed by the SHE Transmission project team with support from external technical consultants using desktop studies and was developed prior to site and ground investigation work being undertaken.

The electrical design of the cable is the responsibility of the cable contractor under the terms of the design and build contract and is designed with a continuous summer rating of 391MW to exceed the capacity of the OHL.

The proposed solution comprises 2 x 1600mm^2 cables per phase x two circuits = 12 cables.

2.5 Our view of Techno-economic efficiency

Though at the high capacity end for 132kV OHL and cable equipment, the solution proposed is based on standard components and thus significant supply issues and technical risks are not foreseen.

Demand for 132kV cable is likely to be higher than OHL due to its wide use in both the onshore and offshore wind markets. Onshore cable at this voltage though has a reasonable large supply chain; significantly larger than, for instance, EHV subsea cables.

Future upgrades however would be difficult as the high current capacity requirements being utilised would limit any future expansion without the need for additional parallel circuits and/or increased transmission voltage.

Our view is that the technical design for reinforcement of the existing overhead line route meets the design requirements whilst providing an economic solution.

3. COST ASSESSMENT

3.1 Overview of approach

The key project unit costs for items of plant, construction and installation (i.e. HVAC cables and OHLs, civil works such as overhead line stringing and cable laying etc.) are compared with benchmark unit costs.

TNEI have, over time, developed an extensive in house cost library used for tendering, benchmarking and estimating purposes. This library includes data from multiple projects for public bodies and private companies across a wide range of industries, including transmission and distribution and onshore and offshore wind, in the UK and worldwide. This is further supplemented by publically available information. The primary data sources used for benchmarking of this project are:

- TNEI's internal database;
- RIIO-T1 asset cost data; and
- the IET/PB Power Cost Study 2012.

Benchmarking is undertaken for major equipment and activities only. Even where projects appear technically similar, costs can vary due to a range of issues such as location, supply and demand, contract strategy, material costs, exchange rates and inflation and thus, when benchmarking, a range of values are utilised rather than a single cost (please note that the range is typical and for guidance only as each project must be considered in its own right). Also, technical solutions may differ across projects with similar outputs and projects may not utilise a consistent approach to cost allocation. For example, two seemingly identical cost items may not consist of the same component build up i.e. allocation of design, commissioning and project management costs may be spread across all components or lumped into a single cost or split between manufacture and installation or not.

Our approach is to benchmark substation costs (equipment and works) in £m/MW, and cable and OHL costs (equipment and works), in £m/MW/km based on a top-down cost assessment as appropriate. Costs are then compared with reference to the design details and efficiency and comparison with similar projects in GB, Ireland and internationally. The influence of SHE Transmission's approach to procurement and selection, and risk on proposed project costs is not specifically considered.

3.2 Project costs

3.2.1 Overview

The construction costs for stage 2 of the Beauly Mossford project have been developed in accordance with SSE's Major Projects Governance Framework Manual (MPGFM). The total construction costs for stage 2 are estimated to be £54,648,083 by SHE Transmission. The estimate has been generated using a combination of:

- Tendered prices from the market for the works.
- Estimates based on historical data generated from previously delivered projects.
- Estimates based on tendered estimates for similar works, with adjustments.
- Estimates developed by the project team and utilising recent and transferable experience of live projects.
- Estimates based on framework agreements and call-off rates; using current industry rates.
- Estimates to derive provisional sums for expected change events based on current knowledge and experience.

The construction costs include all anticipated costs associated with the construction works, except for the specified exclusions, and also includes a quantified risk allowance.

An overview and distribution of SHE Transmission costs are shown in table 2 and figure 1 respectively.

Table 2 – Overview of project costs

Work Element	Costs
Project Management	£[redacted]
Regulatory & Consent	£[redacted]
Engineering	£[redacted]
Construction	£[redacted]
Commissioning	£[redacted]
Operations	£[redacted]
Risk	£[redacted]
Total	**£54,648,083**

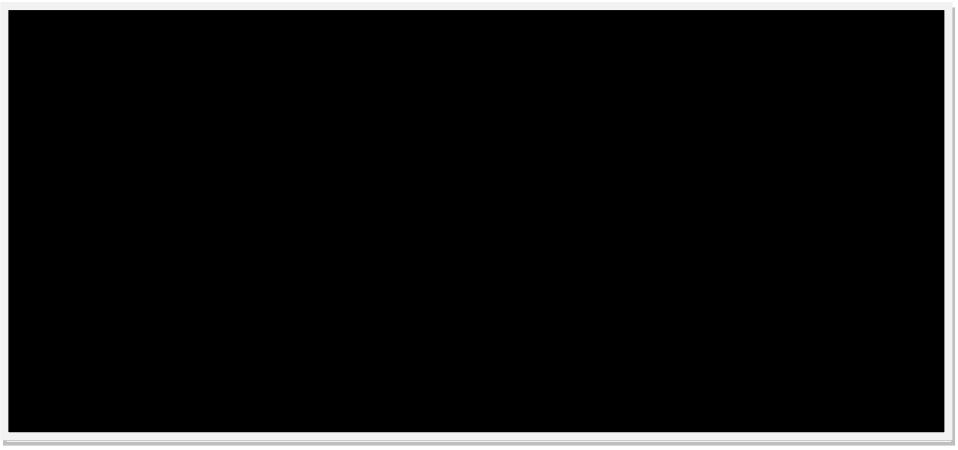

Figure 1 - Distribution of project costs

It can be clearly seen that the majority of the cost is associated with construction ([redacted]%) with project management ([redacted]%) risk and regulatory consent (circa [redacted]%) and the next two largest areas.

Construction costs have increased by £[redacted] since the SHE Transmission July 2010 cost estimate based on the 2012/2013 cost. SHE Transmission explained that this is due to significant increases in project management and regulatory and consent costs due to lessons learnt from previous projects of this nature, results of competitive tendering (OHL costs have gone up though HVAC cable costs have come down) and identification of necessary enabling works.

3.2.2 Construction overview

Of the construction costs, the two EPC packages; OHL works and cable works account for 81% with OHL works the largest cost component. The remaining 19% is a SHE Transmission direct cost largely covering enabling/facilitation works, and public road improvements. This is summarised below in Table 3.

Table 3 – Overview of construction costs

Work package	Cost
Enabling Works/Forestry Clearance/Site Prep	£[redacted]
Public Road Improvements	£[redacted]
Alteration Works (includes Diversions)	£[redacted]
OHL (EPC)	£[redacted]
Underground Cables (EPC)	£[redacted]
Substations	£[redacted]
Total	**£39,141,233**

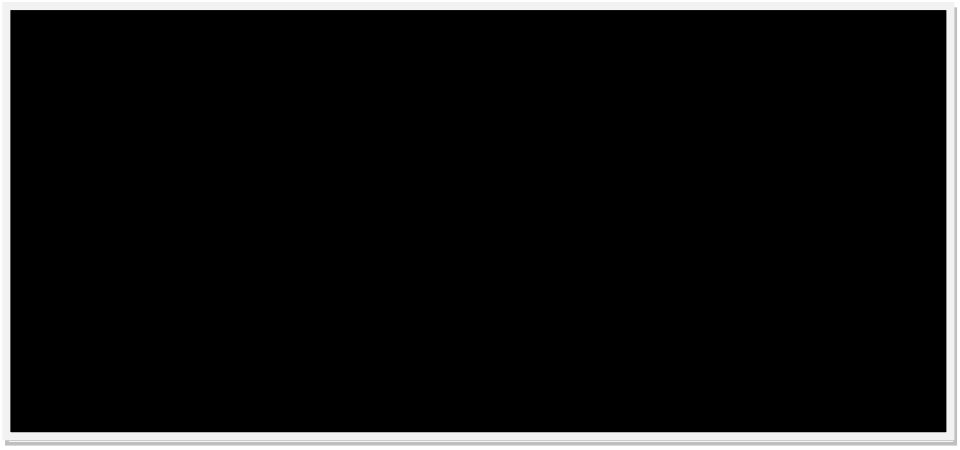

Figure 2 - Distribution of construction costs

The EPC package costs include the contract cost (current BAFO including any outstanding equalisation items still to be negotiated) and provisional sums allocated by SHE Transmission. In the case of the cable cost, a Balblair Wirescape allowance is also included. This allowance transfers funding from the Beauly Denny to the Beauly Mossford project where funding for this item has already been allocated.

Table 4 and 5 provide details of the OHL and cable EPC provisional sums in comparison to the total EPC costs.

Table 4 – OHL EPC Costs

Work package	Cost
OHL (Contract)	£
OHL provisional sums	£
OHL (Total)	**£**

Table 5 – Cable EPC Costs

Work package	Cost
Underground Cables (Contract)	£
Underground Cables (Balblair Wirescape Allowance)	-£
Underground Cables provisional sums	£
Underground Cables (Total)	**£**

Separating the cost of non contract items from the estimated construction costs gives both a truer reflection of the cost of these items when comparing against benchmark values and the relative proportion of the cost to the overall project. The outcome of removing the non contract specific items is that the EPC element of the project reduces to % (£ M) of the total construction costs with the remaining % (£ M) with SHE Transmission. The EPC element remains the largest part of the construction element and is still the single largest element, at % of the total project costs.

Table 6 – Construction Cost Breakdown

Work package	Cost
Enabling Works/Forestry Clearance/Site Prep	£[redacted]
Public Road Improvements	£[redacted]
Alteration Works (includes Diversions)	£[redacted]
OHL (EPC)	£[redacted]
Underground Cables	£[redacted]
Substations	£[redacted]
Provisional sums	£[redacted]
Balblair Wirescape Allowance	-£[redacted]
Total	**£39,141,233**

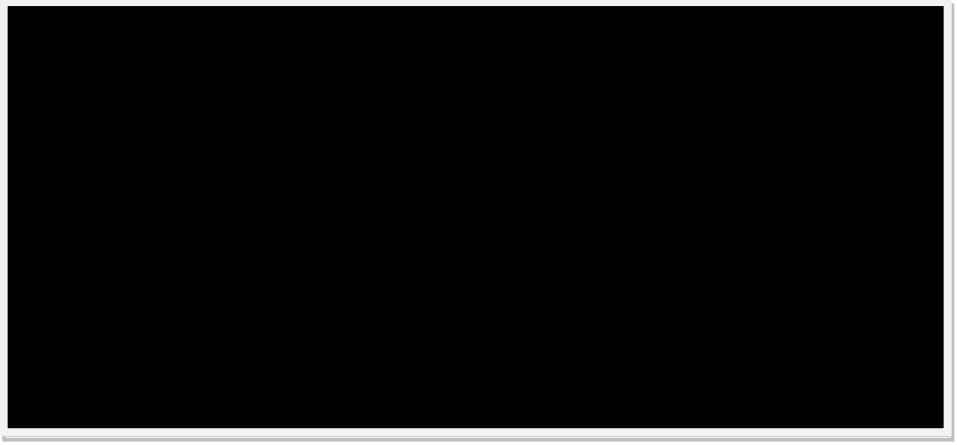

Figure 3 – Distribution of construction costs

3.2.3 Project Management Costs

Project Management costs for the project amount to £[redacted] including a [redacted]% cost uplift for remote site working. The costs which include project management, project controls, administration and support services for the duration of the project account for [redacted]% of the total project costs. Though these are considered reasonable for a project of this size, type and duration, they have increased considerably since the original submission. SHE Transmission advised that this cost increase is based on lessons learned and feedback from similar projects.

The project team comprises a core mixture of SHE Transmission staff supplemented by external specialists with the capacity to draw further resource from the wider company as required.

3.2.4 EPC Costs

A discrepancy currently exists between the costs submitted by SHE Transmission on their costs and outputs submission and the stage 2 EPC value provided for both the cable contract and the OHL contract.

The contract value of the stage 2 OHL works is £[redacted] and comprises the signed OHL contract value (with BBUSL) amounting to £[redacted] adjusted to exclude stage 1 works, a saving of £[redacted], but including a 2015/16 inflation allowance of £[redacted]. The contract value submitted on the costs and outputs submission is £[redacted] a difference in cost of £[redacted] in favour of [redacted].

The contract value of the stage 2 cable works is £[redacted] and comprises the signed cable contract value (with J Murphy and Son Ltd) amounting to £[redacted] adjusted to include changes to the spares philosophy, commodity costs and a 2015/16 inflation allowance. The contract value submitted on the costs and outputs submission is £[redacted], a difference in cost of £[redacted] in favour of [redacted].

In accordance with both contracts, the contractor is entitled to an adjustment based on commodity price and inflation between tendering and contract award which is reflected in the signed contract value. The discrepancy between contract value and the cost and outputs submission is that the latter does not reflect these latest changes but instead will be adjusted to reflect London Metals Exchange (LME) changes one month prior to Ofgem determination.

A breakdown of the EPC costs for both the OHL and the cable contracts are shown in Tables 7 and 8.

Table 7 –OHL Works Contract Value

Description	Total
Preliminary Works	£ [redacted]
Towers	£ [redacted]
Foundations	£ [redacted]
Conductors, Earthwire and Fittings	£ [redacted]
Tower Earthing	£ [redacted]
Dismantling and Reinstating	£ [redacted]
Sub-Station tie in structures	£ [redacted]
Tie ins - Conductors, Earthwire and Fittings	£ [redacted]
Tower Earthing on Ties ins	£ [redacted]
Foundations on Tie ins	£ [redacted]
Access	£ [redacted]
Misc Items	£ [redacted]
[redacted]	-£ [redacted]
Pre-Construction Work	£ [redacted]
Extended Contract Period Supervision - Additional 17 weeks	£ [redacted]
CE's	£ [redacted]
Total	**£** [redacted]

Table 8 –Cable Works Contract Value

Description	Total	Total adjusted
Contractual Requirements	[redacted]	[redacted]
Compound and Accommodation for Design & Investigation Works	[redacted]	[redacted]
Compound and Accommodation for Construction Works	[redacted]	[redacted]
Design Works & Project Management	[redacted]	[redacted]
Key Material Supply	[redacted]	[redacted]
Delivery & Installation	[redacted]	[redacted]
Commissioning Works	[redacted]	[redacted]
Site Management	[redacted]	[redacted]
Spares	[redacted]	[redacted]
Adjustments	[redacted]	[redacted]
LME Risk Allowance	[redacted]	[redacted]
Total	**£**[redacted]	**£**[redacted]

3.3 Cost Benchmarking

3.3.1 OHL

The OHL works costs dismantling the existing OHL, as they stand in the cost and submission schedule, total £[redacted] and comprise the cable contract value and provisional sums.

Construction of 26km of new 132kV double circuit overhead line for the Beauly-Mossford project is forecast to cost £[redacted]m, a unit cost of [redacted]£m/km.

National Grid 2010 Offshore Development Information Statement (ODIS) Appendices estimates a 132kV double circuit costs 0.7 - 0.9 £m/km installed. The IET Transmission Costing report estimates a comparable unit cost range of 0.75 - 1.2 £m/km for an AC overhead line. The SHE Transmission OHL costs appear reasonable and fall within the cost range even when considering the remote location of the OHL, which adds a cost premium to the work in terms of mobilisation and construction costs, and the project specific requirement to dismantle the existing overhead line.

Table 9 – Double circuit OHL cost benchmarking

Item	SHE Transmission Cost £m/km	Benchmark £m/km
OHL works	[redacted]	0.7 – 1.2

Using a bottom up approach to cost benchmarking gives the following results as shown in Table 10.

Table 10 – OHL costs

OHL Works	SHETL Cost	Benchmark Cost	
		Max	Min
Preliminary works	£[redacted]	£4,043,834.01	£2,022,567.59
Steel towers	£[redacted]	£5,830,744.78	£3,117,532.48
Tower foundations	£[redacted]	£9,288,311.60	£5,835,053.83
Conductors	£[redacted]	£5,166,239.05	£2,425,030.60
Dismantling	£[redacted]	£1,295,735.60	£567,972.90
Access	£[redacted]	£4,325,752.73	£2,844,284.26
Miscellaneous	£[redacted]	£3,213,486.53	£917,043.08

Figures 4 shows the distribution of OHL costs for the Beauly Mossford project and figure 5 a comparative distribution for a general (Benchmark) OHL for comparison.

Though the distribution of cost for the Beauly-Mossford 132kV OHL project appears to differ from a typical OHL project cost breakdown, this can partly be attributed to the subjective nature of cost allocation and breakdown. In general costs as a percentage would appear to be reasonable. For the major items:

- Beauly-Mossford 132kV OHL conductors at [redacted]% of the total cost equate to benchmarked conductors and insulator cost at [redacted]% of the total cost. The Beauly Mossford conductors are at the upper boundary of 132kV conductor sizes and thus would be expected to comprise a larger component of the overall cost and to have a higher cost.
- Beauly-Mossford 132kV OHL preliminary works comprise [redacted] % of total cost combined with access at [redacted] % to give the equivalent to access at [redacted] %. Preliminary work and access requirements are very much project, location and site specific and hence difficult to benchmark. The Beauly Mossford costs would appear to be within the range expected.
- SHE Transmission Tower foundations and steel work at [redacted] % equate to towers erection and foundations at [redacted] %.

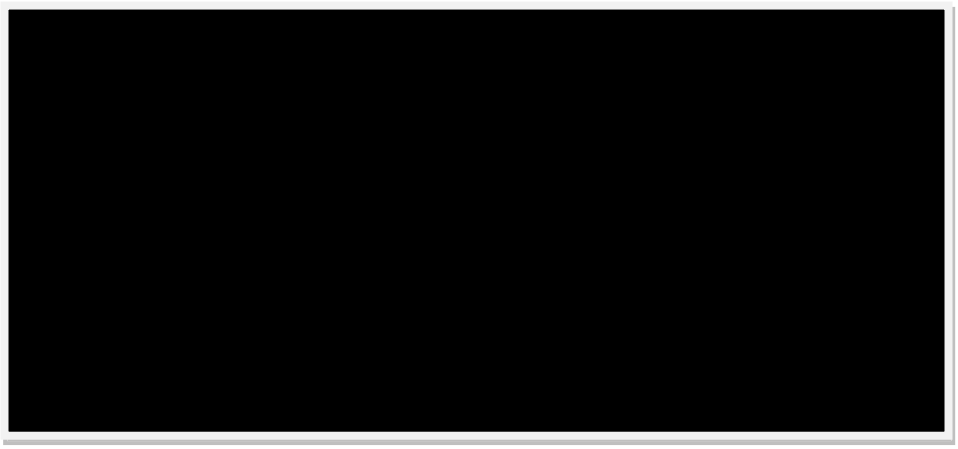

Figure 4 – Beauly Mossford 132kV OHL Cost Breakdown

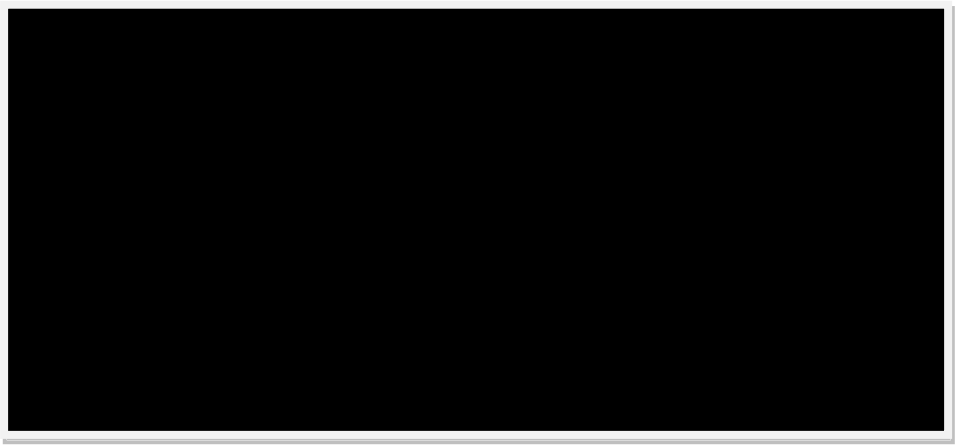

Figure 5 – General Benchmark OHL Cost Breakdown

3.3.2 Cable works

The total cable works costs, as they stand in the cost and submission schedule, total £ and comprise the cable contract value (£), provisional sums (£) and an allowance from the Beauly Denny project (£ Balblair Wirescape allowance).

The installed cable costs appear reasonable £ m/km when compared to the benchmark cost range of 1.5 – 2.6 £m/km. The cable supply costs are comparable but installation costs appear high. There are two possible explanations for this: Benchmark costs are on £m/km based on typical multiple kilometre cable lengths (installed in ducts or direct laid) and thus any fixed costs and local anomalies are absorbed over the whole length. The cable installation costs for this project relate to a total length of circa 3.5km and thus there is no opportunity to absorb the cost.

Table 11 – Cable costs

Item	SHE Transmission Unit Cost	Benchmark
Cable supply	[redacted] £m/km	1.35 - 2.35 £m/km
cable installation	[redacted] £m/km	0.15 - 0.25 £m/km
Total	[redacted] **£m/km**	**1.5 – 2.6 £m/km**

3.4 Our view of project costs

A comparison of the key benchmarked costs items (contract price excluding equalisation items) shown in Table 12 would indicate that the SHE Transmission costs are reasonable. The project costs are driven by a combination of the multi contract procurement strategy and the tender evaluation process leading to a competitive tender situation resulting in most economically advantageous solution. Whilst the cost may be at the top end of the benchmark range or even exceeding it in the case of the onshore cable costs the robust process would lead to the conclusion we have drawn. Costs are largely lead by current market forces and the nature of this project.

Cable: The Land Cable Works (3.5km) at £[redacted] million are deemed reasonable for the defined scope.

OHL: SHE Transmission unit costs for the overhead line (including foundations, earthing, conductors) is comparable to internal cost estimates and therefore reasonable.

Table 12 – Project cost comparison

Item	SHE Transmission Cost	Benchmark Cost
OHL	£[redacted]	£21,800,000 - £33,200,000
Cable	£[redacted]	£5,250,000 - £9,100,000
Total	**£**[redacted]	**£27,050,000 - £42,300,000**

Overall, our assessment is that costs appear reasonable.

4. ASSESSMENT OF CONSTRUCTION PROGRAMME

4.1 Overview of approach

A review of the construction programme was carried out to develop a view on whether it seems realistic and achievable in the proposed timescales, including consideration of project progress made to date such as consenting and other pre-construction works.

Critical path definition and consistency and interaction with key risks such as extreme weather, consenting, key milestones and treatment of task interdependencies by SHE Transmission were investigated in detail. Interdependencies with the procurement strategy were also assessed.

4.2 Project milestones

The initial SHE Transmission submission contains very limited programme information, a single page summary schedule has been included, and reference has been made to key project dates. It is not clear on the programme the critical path and hence it was not possible to identify and mitigate potential bottlenecks and assess the likely impact of delays.

SHE Transmission have subsequently provided a more comprehensive construction programme detailing the progress to date, interdependencies, critical path and available float. The programme has been provided in both Work breakdown Structure (WBS) format and on a section basis. The latter more clearly demonstrates the impact of and the criticality of the outage constraints due to the nature of the construction methodology and the need to maintain the existing line in operation until the new line is complete.

From available information the Construction programme has been revised since 2012 as SHE Transmission were unable to commence the main construction works due to the need to discharge section 37 pre start consent conditions in particular the submission and approval of a construction and environmental management plan and the submission and approval of all public road improvement designs to the highland council.

These requirements were discharged in 2nd Quarter 2013 and the new revised programme is:

Early construction works commence	May 2013
Main construction works commence	September 2013
Complete Cable commissioning	3rd Quarter 2014
Complete sealing End commissioning	3rd Quarter 2014
Complete OHL commissioning	4th Quarter 2015
Complete all re-instatement works	2nd Quarter 2016

The OHL construction programme accounts for a nominal 2.5 years from approval to completion and takes into account both constraints associated with winter working in the area (snow, rain, ice, wind) and, though not explicitly shown, the Osprey breeding season. The later expressly requires winter working to be an integral part of the programme as forestry works in particular must be undertaken outside the bird breeding season.

SHE Transmission have confirmed that the overall programme reflects both the cable supplier and OHL supplier detailed programmes and though full agreement is still to be reached with the OHL contractor it is not expected to result in any major changes.

The new double overhead circuit follows the same route as the two single circuit overhead lines currently installed. The construction programme therefore allows for the progressive replacement of sections of the existing route with the new route. In order to do this outages must first be agreed with NGT to allow each section of single conductor line to be dismantled and replaced by a new section of double circuit OHL. Though these outages are agreed for 2013 the process is such that later outages are still to be confirmed. This is largely a procedural issue and is not expected to cause any delay. However the requirement for outages means that work is restricted to the outage season (nominally April-October).

The upside of the project is that the construction work is largely carried out offline and hence delays won't significantly impact the current system operation.

4.3 Progress to Date

SHE Transmission have discharged their section 37 pre start consent conditions in particular the submission and approval of a construction and environmental management plan and the submission and approval of all public road improvement designs to the highland council and a new revised programme is in place.

Though the project is awaiting funding approval and Ofgem Determination both the OHL contract (BBSUL) and cable contract (Murphys) have been awarded and design activities started (first part of a two part contract of which the second predominant part comprises the construction phase).

Enabling works associated with public road improvements, forestry, and system alterations have been undertaken or are underway with some foundation and access tracks being installed.

4.4 Our view of construction programme

SHE Transmission has provided a comprehensive construction programme detailing the progress to date, interdependencies, critical path and available float.

Though no slack has been included during the outage works, the risk is small as these areas are the best defined with the least unknown elements.

Ultimately the programme would appear robust and though yet to be fully agreed by the OHL contractor no significant changes are expected.

5. SUMMARY OF ASSESSMENT FINDINGS

Our assessment of the three key aspects of the submission can be summarised as follows:

Table 13 – Overview of TNEI assessment

Factor	Techno-economic efficiency	Equipment Cost	Programme
Initial assessment			
Final assessment			

In summary, our assessment of the Beauly Mossford Strategic Wider Works stage 2 project submission is described below:

- The technical solution proposed would appear to be a fit for purpose economical solution, with a robust construction solution in order to deliver the capacity increase identified as required in the needs case.
  - Though at the high capacity end for 132kV OHL and cable equipment, the solution proposed is based on standard components and thus significant supply issues and technical risks are not foreseen.
  - Demand for 132kV cable is likely to be higher than OHL due to its wide use in both the onshore and offshore wind markets but onshore cable at this voltage has a reasonably large supply chain.
  - Future upgrades however would be difficult as the high current capacity requirements being utilised would limit any future expansion without the need for additional parallel circuits and/or increased transmission voltage.
- The project costs appear reasonable overall and are largely determined by the construction costs which themselves are largely contained within two Engineering Procurement and Construction (EPC) contracts.
  - The proposed construction costs which account for around 72% of the total costs appear appropriate when taking into account the overall procurement strategy and benchmarking the major EPC components against internal and external sources.
  - Both risk management at [redacted]% and project management at [redacted] % though relatively minor by comparison are, never the less, not insignificant. For the nature and duration of the project and with the team proposed by SHE Transmission to run and manage the construction phase, project management costs of [redacted] % are considered reasonable. Risk management is discussed elsewhere.

- The construction programme would appear to be well thought out and has, with the exception of a number of minor details, the agreement of the two main contractors.
  - Interdependencies and critical path items have been identified and slack included. Opportunities, risks and mitigation have been assessed and specific issues around winter working and bird nesting issues identified and considered.
  - Though slack has been included in non outage works this is not the case for outage dependent works. The latter has however been identified as low risk due to the nature of the work required during the outage and the high level of definition associated with this work.
- Based only on the scope of assessment undertaken by TNEI we would not recommend the need for any adjustments to be made to the Ex ante allowance requested by SHE Transmission.

5.1 Recommended adjustment to annual ex-ante funding allowances

Based only on the scope of assessment undertaken by TNEI we would not recommend the need for any adjustments to be made to the Ex ante allowance requested by SHE Transmission