Report into Underground Cable Costs

Brechfa Forest Connection Project

June 2013

CYSWLLT COEDWIG Brechfa FOREST CONNECTION

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Document Details

Document prepared by Balfour Beatty Utility Solutions Ltd on behalf of Western Power Distribution.

Contents

1 Background

1.1.1 Balfour Beatty Utility Solutions Ltd (BBUSL) were asked by Western Power Distribution (WPD) to provide indicative costings for a 132,000 volt (kv) underground cable route from three proposed wind farms located in and around Brechfa Forest north of Carmarthen to connect with an existing overhead line near Llandyfaelog south of Carmarthen.

1.1.2 To assist BBUSL in this, documents were provided by WPD's environmental consultants, RSK Environment Ltd, outlining a number of indicative options for cable routes based upon an analysis of environmental constraints. These were identified as red, green and blue routes. Elements of all three routes can be incorporated to provide the required connection.

1.1.3 It should be noted that these indicative underground routes have been identified purely for the purpose of providing a cost comparison to an overhead line connection. The identification of indicative alignments does not imply that WPD will chose to select a wholly underground route between the proposed wind farms and the connection point near Llandyfaelog. A final alignment (either overhead, underground or a combination of the two) will only be selected following Stage 2 of consultation process and following further environmental assessment.

1.2 Technical Expertise

1.2.1 BBUSL have considerable experience in the UK and overseas for the design and installation of cable systems up to 550kV. They have expertise in the installation and maintenance of oil, XLPE, EPR and gas filled cables and have our own jointing resource and engineering capability. They are Achilles registered and Lloyds accredited for the scope of services they provide.

2 Methodology

2.1.1 To evaluate potential cable routes from the information provided by RSK, a desktop study was carried out along with site visits. The site visits were undertaken by an experienced supertension engineer and manger to evaluate the routes taking account of topography, ease of access, traffic constraints and areas which may present engineering difficulties.

2.1.2 Not all areas of the proposed route were accessible during the site visits and local data and use of satellite mapping together with experience of similar types of installation formed the basis of their calculation.

2.1.3 It was found that the cable routes went through a range of diverse ground types comprising roadside verge, forestry, metalled roads including A roads and a number of major traffic junctions.

2.1.4 Factors taken into account when assessing the cable routes were trench dimensions, open cut options, ducted options, trefoil or flat cable formations, choice of cable bed materials, consideration of the water table and the location of watercourses.

2.2 Engineering Factors

2.2.1 The basis upon which costings were assessed consisted of an outline scheme based around a ducted single circuit. Using a ducted scheme meets the requirements of the Highway Authority and ensures that disruption to landowners and the general public is kept to a minimum. Using this method also enhances security and civil installation works can proceed whilst the cable is being manufactured to assist in meeting programme deadlines.

2.2.2 To ensure that the requirements of C55/4[1] are met and the potential for additional

[1] C55/4 is an Engineering Recommendation published by the Electricity Council of earthing requirements for HV cables.

costs associated with specialised earthing requirements are minimised, the scheme is based on a special cross bonded design with associated sectionalised joints and buried link boxes with the provision of sheath voltage limiters as required.

2.2.3 Allowance has been made for a 125mm duct to run alongside the main power cable ducts to accommodate fibre optic cables for signalling and circuit protection with IP65[2] rated enclosures at the terminal positions.

2.2.4 A fibre optic cable has also been allowed to accommodate any required DTS (distributed temperature sensing system) scheme which may be required.

2.2.5 Other engineering factors taken into account were potential customer requirements for cable specification and accessories, potential earth fault values, optimum section lengths, theoretical cable installation tensions in association with ground topography, the possible effect of section lengths on cable earthing schemes and standing voltage values.

2.2.6 Further considerations were the possible requirement for auxiliary cable ducts and the potential to de- rate power cable capabilities. The use of sectionalised and non-sectionalised joints to achieve required earthing requirements, pollution level performance for proposed sealing ends and the capability of HVAC testing over extended cable lengths.

2.2.7 The costing figures allow for all costs connected with the supply of the detailed 132kV cable materials and associated jointing, testing and civil installation works. They do not allow for the costs of any specialist provision that may be required for contaminated materials or other environmental considerations.

2.2.8 Costs have been assessed on the basis of using 630mm copper cable from outline design specifications. At the time of evaluation the required cable rating date was not available to allow a more detailed cable design analysis to be made.

[2] IP65 is a waterproof enclosure.

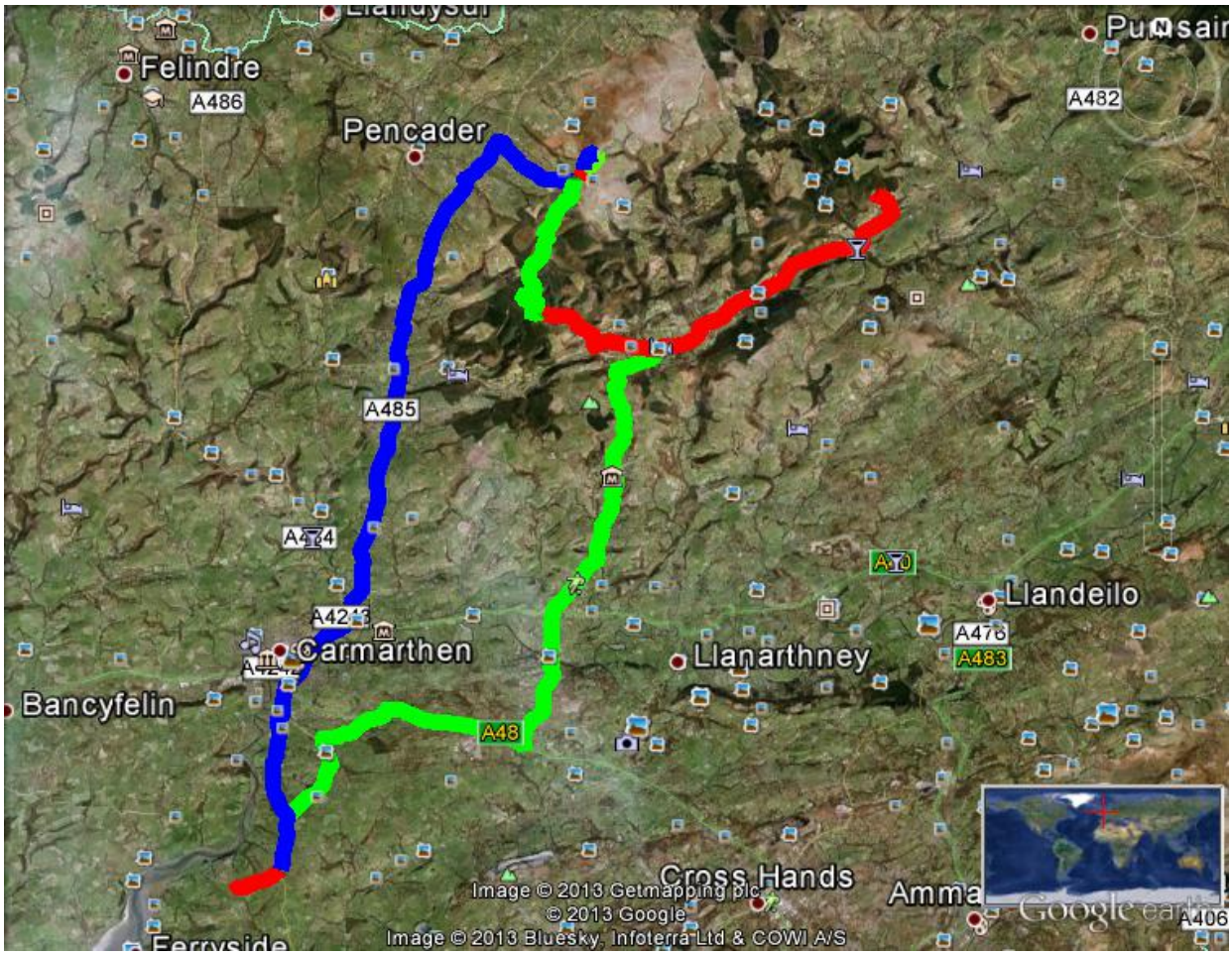
3 Costs

3.1.1 Using the methodology set out above, and taking into account the stated engineering factors, costs have been calculated for each of the three options which are shown on the figure overleaf. These costs are set out as a cost per kilometre thereby enabling better comparison between the three options.

- Green Route – Total route length of 32.44km with a cost of £950,340 per km.
- Red Route – Total length of 14.81km with a cost of £1,003,023.00 per km.
- Blue Route – Total length of 30.21km with a cost of £1,003,230 per km.

3.1.2 Based upon the work undertaken and reported within this document, it can be concluded that undergrounding of 132kV cable through the study area would result in an approximate cost of £986,000 per kilometre.

3.1.3 The cable price quoted is based on the cost of copper @ £5,000 per tonne and lead @ £1,300 per tonne.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Appendix 1
Technical Specifications

Technical Specifications

1.1 The cable system is designed to comply with IEC60840

Design Voltage

Nominal Do/U 76kV/132kV

Maximum/Umax 145kV

Basic Impulse Level 650kVp

- Short-circuit current carrying capacity
- Three phase Symmetrical: not specified
- Single phase Asymmetrical: 10kA for 3 seconds

Season	**Max continuous Rating**
Summer Winter	150MVA/656A

1.2 We are not currently in receipt of any cyclic data. These figures do not take into account soil drying out conditions during abnormal or normal continuous operating conditions.

1.3 Cables installed in unfilled 160mm O/D uPVC ducts: Ambient temperature (°C)

Winter	Summer
10°C	15°C

1.4 Cable environment thermal resistivity

CBS/selected sand	Concrete	CBS/selected sand
1.05 Km/W	1.00Km/W	1.2 Km/W

1.5 General installation (carriageway)

Method of Laying	**Unfilled UPVC Ducts**
Duct Size	160mm O/D
Depth of Burial	900mm
Formation spacing	Trefoil touching
Duct Surround	Limestone dust

1.6 Carriageway crossing

Method of Laying	**Unfilled UPVC Ducts**
Duct size	160mm O/D
Burial formation	900mm
Spacing	Trefoil touching
Circuit surround	concrete

1.7 Forestry installation/open countryside

Method of Laying	**Unfilled UPVC Ducts**
Duct size	160mm O/D
Burial formation	1000mm
Spacing	Trefoil touching
Circuit surround	Limestone dust

1.8 Forestry track heavy vehicle crossing points

Method of Laying	Unfilled UPVC Ducts
Duct size	160mm O/D
Burial formation	1000mm
Spacing	Trefoil touching
Circuit surround	Limestone dust (encased within reinforced concrete)

1.9 Proposed 132kV power cable design

132kV, 630mm^2 stranded (Cu) Copper conductor (longitudinally water blocked), extruded semi-conducting conductor screen, extruded XLPE insulation, bonded extruded semi-conducting core screen, semi-conducting water-blocking layer, and lead sheath and polyethylene oversheath with extruded conductive coating manufactured to meet the requirements specified in IEC60840.

1.10 Fibre Optic cable (communications and control)

Non-metallic, water blocked, 48 fibre, optical fibre cable manufactured generally to IEC 60793 parts 1 and 2 as specified within the scope of works. Fibres shall also take into account the ITU-t recommendation G.651D or G.652-D fibre optic modes and buffer tube identification to EIA/TIA-598.

1.11 The proposed 132kV XLPE power cable design is suitable for the asymmetrical fault of 10kA/3secs. A bonding lead, having a cross sectional area of 240mm^2 is proposed as being suitable for carrying a fault level of 10kA/3 seconds. The cables will be installed as a cross bonded system complying with the requirements of 5.4. Engineering Recommendation C55/4 - The cable metallic sheath at the base of the outdoor terminations at of the route will be solidly earthed via an LBM2 single-way gantry mounted boxes. The connection between cable sheath, link box and earth mat will be made with 240mm^2 normal bonding lead.

1.12 Allowance has been made for one 125mm O/D unfilled UPVC duct to be installed with the upper 132kV communications. We have allowed for the fibre optic protection and control circuits to be terminated in IP65 rated enclosures at the 132kV termination structures at either end of the route. No allowance has been made for any further fibre optic cable to enable the circuits to be routed through either substation to the final point of connection.

1.13 Accessories

- 132KV Composite type outdoor terminations having a Class III heavy (25mm/kV) pollution rating which also including arcing horns and post insulators;
- 132KV Sheath sectionalised joints, suitable for burial in wet ground conditions;
- Single way gantry mounted link boxes IBM 2 Three way buried link boxes LBM 15 and IBM 18.

1.14 Testing and Commissioning

- 132kVHV Pressure test;
- Provision has been made in our offer for the circuit to be tested by means of AC test at 1.7Uo for a duration of one hour at a frequency between 0 and 300Hz;

1.15 Oversheath tests

- The 132kV cables shall be tested by application of 10kV DC for 1 minute;
- All test voltages and durations shall be agreed in advance.