

**Electricity Act 1989 (Sections 36, 37, 62(3) & Schedule 8) Town and
Country Planning Act 1990 (Section 90) and the Electricity Generating
Stations and Overhead Lines (Inquiries Procedure)(England and Wales)
Rules 2007**

**Application by SP Manweb PLC, dated 2 December 2009 for consent
under Section 37 of the Electricity Act 1989 to install and keep installed a
132kV overhead electric line connection from the proposed Llandinam
Wind Farm to Welshpool Substation (the “Application”)**

Summary Proof of Evidence

Of

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On

Engineering Project Design

SPM/ENGINEERING/POE/PAALMAN/003B

1. **SCOPE OF EVIDENCE**

- 1.1 In December 2009, SP Manweb plc ("SP Manweb") applied for consent pursuant to section 37 of the Electricity Act 1989 (CD/COM/023) to construct a 132kV overhead electric line connection from the proposed Llandinam Wind Farm substation to Welshpool Grid substation (the "Llandinam Scheme").
- 1.2 I describe how the engineering design of the Llandinam Scheme takes account of the technical requirements of the electricity distribution system, customer requirements and the costs of the connection.

2. **THE PROPOSED LLANDINAM SCHEME**

Introduction

- 2.1 The proposed design of the Llandinam Scheme ensures that the electrical design requirements are met for a 132kV circuit between Welshpool Grid and the Llandinam Repowering Wind Farm substation. It also ensures that SP Manweb's responsibilities to offer a connection and its duty to maintain an economical system of electricity distribution are met.
- 2.2 The circuit has to be capable of carrying 90MVA at 132kV between the Llandinam Repowering Wind Farm substation and Welshpool Grid substation. To minimise the environmental effects of overhead lines, consideration is given to the type of support to be used, the overhead line route, balancing technical requirements with SP Manweb's licence obligations and other aspects of the design of an overhead line.
- 2.3 In my proof of evidence I have carefully considered the use of two wood pole overhead line designs - Trident and Heavy Duty Wood Pole (HDWP).

Engineering specification of the overhead line

- 2.4 The Llandinam Scheme primarily comprises the installation of a 132kV single circuit overhead line between Welshpool Grid substation and the

proposed Llandinam Repowering Wind Farm substation. The connection comprises (for the majority of its length) an overhead line on wood pole supports with a short cable section at the termination at Welshpool Grid substation.

2.5 The wood pole overhead line support structures have to carry a single circuit containing three phase conductors (commonly known as the "wires" on an overhead line). Depending upon the ground conditions at the Llandinam Repowering Wind Farm substation, an additional aerial earth wire may be needed.

2.6 The three phase conductors are made of an aluminium alloy whilst the earth conductor is made of aluminium alloy with steel reinforcement in the centre.

2.7 The wood pole structures are designed to support bare overhead metallic conductors. A 200mm² conductor is proposed, providing a summer rating of 124MVA which is sufficient to meet the design connection requirement of 90MVA.

2.8 At the Welshpool Grid substation, the overhead line terminates onto a cable supporting structure (cable sealing ends) from where a 50m section of cable provides the connection to the existing 132kV network.

3. **UNDERGROUNDING**

3.1 SP Manweb's approach to undergrounding complies with the policy set down in the National Policy Statement for Electricity Networks Infrastructure (EN-5) ("NPS EN-5") (CD/COM/003). SP Manweb has a licence obligation to develop an efficient, coordinated and economical system. An overhead line solution typically facilitates compliance with these obligations. Overhead line solutions are more economical than cable alternatives to develop, as well as providing shorter return to service times under fault conditions.

3.2 One section of the Llandinam Scheme, the A483 near Old Neuadd Bank to Cae-betin Wood, has been noted as triggering "serious

concerns" under NPS EN-5 in respect of potential adverse landscape and visual effects. As such, SP Manweb has assessed undergrounding this section. My input into this assessment is that the net additional capital cost of this route would be approximately £8.2M (excluding the lifetime maintenance costs). SP Manweb's view is that these costs are not justified. For the reasons given in the Appraisal of the Llandinam Scheme against National Policy Statement for Electricity Networks Infrastructure (NPS EN-5) (the "NPS EN-5 Paper") (Appendix 05a to the Updated ES (Volume 3a) (CD/SPM/ES/01)), SP Manweb's view is that undergrounding in the context of the Llandinam Scheme is not justified.

4. SELECTION OF WOOD POLE DESIGN (CONSIDERATION OF TRIDENT AND HDWP TECHNOLOGY)

4.1 Two wood pole options have been considered according to the following designs: ENA technical specification 43-50 issue 1 & 2 132kV Single Circuit Overhead Lines on Wood Poles (Appendix 2) referred to as Trident and OHL-03-132 issue 2 Technical Guidance for the Design and Analysis of SP 132kV Single Cct, 4-Wire Heavy Duty Wood Pole OHL (c/w underslung OPGW Earthwire) (Appendix 3) referred to as HDWP.

HDWP

4.2 HDWP wood poles carry a single circuit containing three phase conductors with an under slung aerial earth wire. The three phase conductors are made of an aluminium alloy; the earth conductor is aluminium with steel reinforcement and contains a fibre optic circuit.

Trident

4.3 Trident wood poles carry a single circuit containing three phase conductors. There is no earth wire with this design.

Need for an earth wire

- 4.4 SP Manweb has a duty to design and operate installations that that do not give rise to public safety issues. Accordingly, SP Manweb is required to minimise the Rise Of Earth Potential (ROEP) and hence eliminate dangerous touch and step potentials.
- 4.5 There are high ground impedance values around the proposed Llandinam Repowering Wind Farm substation. This means a greater ROEP. There are no practical solutions to significantly reduce the ground impedance values to reduce the ROEP to acceptable limits around the proposed substation. Nor would it be practical to establish and maintain an exclusion zone around the perimeter of the main substation. As a result and to limit the ROEP to manageable levels, the overhead line arrangement must be of an earthed design.
- 4.6 HDWP is an earthed design. The Trident design is not. Utilising the HDWP design ensures that SP Manweb adheres to its licence obligation to develop a safe, efficient, coordinated and economical system. By contrast, the Trident design would not ensure SP Manweb adheres to its licence obligations and its use for all or part of the route cannot be recommended on the grounds of safety.

5. TECHNICAL AND COST CHARACTERISTICS OF CONNECTION ALTERNATIVES.

- 5.1 The estimated cost of the Llandinam Scheme (the "LSC") is between £21m - £24 m. It is based on a new 35km 132kV overhead line plus associated substation works.

Estimate of cost for the Llandinam Scheme and combined with the Mid Wales scheme.

- 5.2 The combined estimated cost of the Llandinam Scheme and the relevant element of the SP Mid Wales Connections Project, ("LS/MWC") is between £48m to £52m.

5.3 The following alternatives have been considered by SP Manweb in developing the Llandinam Scheme:

5.3.1 Accommodate the connection on existing 33kV customer connection using current and new 33kV infrastructure – Newtown Grid;

5.3.2 Accommodate the connection on existing 132kV network – Newtown Grid;

5.3.3 Accommodate the connection on existing 132kV network – Carno Grid / Circuit;

5.3.4 Accommodate the connection on existing 132kV network – Welshpool Grid via an underground cable;

5.3.5 Accommodate the connection via the SP Mid Wales Connections Project (amended) through various sub-alternatives 4a to 4g (see the Review of Needs Case and Alternatives (Volume 5 of the Updated ES (CD/SPM/ES/01)) for an explanation of these options).

5.4 Comparative costs of the alternatives

Accommodate on existing network	£,000,000		
33kV			
Current and new 33kV infrastructure – Newtown Grid	30.5	Above	LSC
132kV			
Newtown Grid	9.8	Above	LSC
Carno Grid / Circuit	22.4	Above	LSC
Welshpool Grid via an underground cable	38.8	Above	LSC
Alternative network 400kV infeeds – Mid Wales			
Alternative 4a	6	Above	LS/MWC
Alternative 4b	8.2	Above	LS/MWC
Alternative 4c	3.9	Above	LS/MWC
Alternative 4d	6.7	Above	LS/MWC
Alternative 4e	0.7	Above	LS/MWC
Alternative 4f	24	Below	LS/MWC
Alternative 4g	26	Below	LS/MWC

6. **CONCLUSIONS**

- 6.1 I have described how SP Manweb has approached the development of its proposal for a 132kV wood pole overhead line between the proposed Llandinam Repowering Wind Farm substation and Welshpool Grid.
- 6.2 I have explained the engineering requirements and variation in costs for the alternatives listed compared to the Llandinam Scheme and (where relevant) the combined costs of the Llandinam Scheme and the SP Mid Wales Connections Project.
- 6.3 I have highlighted that undergrounding small sections of overhead line could give rise to unwarranted adverse impacts both on operational performance and construction costs.
- 6.4 Following representations on the project, SP Manweb was asked to consider the use of a Trident design rather than the HDWP design to further mitigate environmental impacts. I have explained the technical reasoning behind the decision to maintain the HDWP design and in particular the need to maintain that design on the grounds of public safety.
- 6.5 From an engineering design and a costs perspective, the proposed connection utilising HDWP between Welshpool Grid and the proposed Llandinam Repowering Wind Farm is the preferred option.