The North Wales Wind Farms Connection Project

SP Manweb's Response to Deadline 2 representation from Robin Barlow

Application Reference: EN020014

Deadline 4 Submission
November 2015

Document reference: SPM NWWFC D2RB

SP Manweb's Response to Deadline 2 representation from Robin Barlow

Author	SP Manweb
Date	2nd November 2015
Version	V1
Planning Inspectorate Reference No.	EN020014
Document reference	SPM NWWFC D2RB

SP Manweb plc, Registered Office: 3 Prenton Way Prenton CH43 3ET. Registered in England No. 02366937

SP Manweb's comments on Robin Barlow's response ("RB Response") to SP Manweb's Response to RR15 ("SPM RR Document", REP1-055)

1. The RB Response concerns paragraph 8.4 of the SPM RR Document, which contains SP Manweb's response to Robin Barlow's RR (RR15). Paragraph 8.4 provides that:

   "8.4 Rationale for choosing a double wood pole design

   8.4.1 The double wood pole design is required not only to carry the earth conductor, but also to carry the 300sqmm UPAS conductors. The Design and Construction Report (DCO document reference 7.1) paragraph 2.2.21 relates to the need to support the 300sqmm UPAS conductors. It states:

   "*The proposed design can support a conductor with a nominal cross sectional area of up to 300mm2. In this instance a 300mm2 conductor (referred to as "Upas") providing a summer rating of 176MVA is necessary to meet the generation capacity of the four wind farms."*

   8.4.2 For clarity, the 300 mm2 conductor is still required with the new contracted capacity of 148MW.

   8.4.3 The double wood pole design is required to support the 300mm2 conductor and carry the earth wire as the weight and tension of all the conductors is such to require double poles. Accordingly, it is not just the earth wire that necessitates the double wood poles, but the UPAS conductors.

   8.4.4 It would be possible to implement a single pole design but this would require a considerably reduced span length (less than 60m) to accommodate the higher weight and tension of the conductors. This would result in a significant increase in the number of pole positions, which would have consequential detrimental impacts on landowners and the public. For these reasons the single wood pole design has not been used".

Extracts from the RB Response	SP Manweb's Comments
In my original WR I pointed out that SP Manweb had been economical with the truth, and pointed out that a counterpoised connection, in which only the ground connector was undergrounded would lead to a lighter load on the pylons and a possible use of a Trident like structure instead of the HDWP. This representing a second best option to undergrounding. SPM's response to this was: "...The double wood pole design is required to support the 300mm2 conductor **and** carry the earth wire as the weight and tension of the conductor is such to require double poles. Accordingly, it is not just the earth wire that necessitates the double wood poles, but the conductors." Of course they do not answer the counterpoising proposal as that would have reduced the weight and load by around 25%. It is worth noting that the HDWP incorporates both heavy duty wood poles (2) and a massive steel superstructure. A Trident solution has a minimal steel superstructure and usually 1 pole".	The double wood pole design (or lattice tower) is required due to the need for an earth wire for this project. The only design approved by SP Manweb for this type of project is an overhead earth conductor. An underground earth conductor is not approved for use on SP Manweb's network for a project of this type. The following should also be noted about a counterpoise earth conductor: **1) Safety:** An underground earth (counterpoise) conductor must maintain the earth system at a low value to restrict the Rise of Earth Potential at the substation site. This is a critical safety feature required to protect people, livestock and equipment. Third party interference may lead to damage or separation of the earth conductor in which case the earth conductor cannot fulfil its function. **2) Integrity:** Due to its location below ground level, it is technically difficult to monitor the integrity of a separate undergrounded earth conductor. The initial detection of a fault condition on the underground earth and the subsequent work to find the location of any faulted conductor section would involve extensive excavation. Significant time and resources would need to be expended to carry out such excavation, during which the critical earth system would not be available, therefore resulting in considerable safety risk. In contrast the integrity of an overhead earth conductor can be observed without the need to excavate, resulting in faster, safer and less resource intensive repairs and operation. **3) Cost**: The cost of installing a separate earth conductor in the ground would entail significant additional capital costs for excavation, installation and reinstatement. In addition, there would be on-going maintenance costs associated with such a proposal that, in combination with the capital costs of excavation, would result in an economically less efficient outcome compared with the cost of an above ground earth connection.

	In relation to Mr Barlow's statement that a Trident solution usually has a single pole, SP Manweb considers that this is not correct and that a Trident solution utilises a combination of single, double and quadruple pole structures. For example, on the recently constructed Legacy to Oswestry Trident line some 20km in length 22% (38) of the structures were of double pole design, and there were two terminal structures requiring 4 poles each.
With this response SP Manweb imply that the power capacity to be delivered necessitates use of the 300mm2 UPAS connectors (an AAAC technology), and that the weight and associated tension from these require the HDWP solution. As a point of reference for a less intrusive 132KV solution we have SP Manweb's own Legacy to Oswestry Reinforcement project which (in its revised version following objections to its HDWP solution) is based on a single pole Trident structure carrying the 200mm2 Poplar connector (also an AAAC technology). In the revised version this line carried no earth as SP Manweb had realised that the 2 lines it was reinforcing already carried earths between the same endpoints. The Poplar is also lighter (at 680kg/km) than UPAS (998 kg/km) but carries less current.	The Trident solution for Legacy to Oswestry identified by Mr Barlow does not carry an earth wire as an earth wire is not required along the line. This solution would not therefore be acceptable for the Proposed Development which requires SP Manweb to provide an earthed solution to maintain a safe level of Rise of Earth potential. There are no alternative SP Manweb earth systems in the vicinity of Clocaenog substation that could be utilised. It is therefore not appropriate to compare the Legacy to Oswetry line to the Proposed Development in this regard. Mr Barlow's reference to the 200mm2 Poplar connector is not relevant in the context of the Proposed Development because SP Manweb could not use this connector as it does not meet the design criteria for the contracted capacity of the Proposed Development.
Question P1: following the withdrawal of Vattenfall would the 250mm2 Sycamore connector (also AAAC technology) not be sufficient, its lower weight (835 kg/km) enough to tip the scales to the "lighter" trident solution? As far as I can see the Sycamore can carry 10% less current than UPAS but Vattenfall's exit reduces the capacity need from 176 MW to 147MW ie more than 10%. Or is the Sycamore not stocked in SP Manwebs stores?	SP Manweb has developed and approved the HDWP design for two conductor sizes - 200mm2 Poplar and 300mm2 Upas only. SP Manweb does not use 250mm2 Sycamore conductor. In any event, the choice of conductor will not change the requirement to use the HDWP design for the Proposed Development as this is necessary to carry the earth wire which is required for safety reasons. The extent of the removal of the Vattenfall scheme on the line rating has been reviewed by SP Manweb and there is no change to the scheme specification required.
Question P2: could not SP Manweb apply the DTR (Dynamic Thermal Rating) technology that it has, with Ofgen support, so successfully trialled on its 132KV network (including St Asaph to Rhyl)? See https://www.ofgem.gov.uk/ofgem-publications/84214/finalclosedownreport09-10- 2 013.pdf and I quote "..Dynamic Thermal Rating of 132KV overhead circuit in North Wales demonstrated the ability to increase the circuit capacity and thus defer the need to construct further circuits....It was found that the average uplifts ranged from 1.24 to 1.55 times the static summer rating. ...This project has given SP Energy Networks confidence that there are significant rating uplifts achievable through RTTR and that such schemes could be utilised to facilitate the connection of onshore wind farms". Actually, the rating increase would allow them to use the Poplar connector as used on Trident. This was back in 2009-2013.	The use of Dynamic Thermal Rating (DTR) has only been partially trialled and is not a fully developed option at this time. Therefore, it is not a reasonable alternative available to SP Manweb. Even if it could be implemented, it would not change the need to use a HDWP design, as this is necessary to carry the earth wire. RTTR (Real time thermal rating) models may well provide benefits in the future but at this time they are innovation projects only and are subject to further assessment by SP Manweb and other utility companies before they can be rolled out as standard equipment on the networks. This technology is therefore not available for this project.
Question P3: could the award winning (wooden spoon) steel superstructure of the HDWP not be redesigned with higher specification materials and tolerances so that this morphs into a (near) single bar. I am sure that engineers can solve this. At a price of course, but at what price is our landscape valued. And certainly cheaper than undergrounding. Has this been investigated?	The HDWP is designed in accordance with BS EN 50341 (Overhead electrical lines exceeding AC 1 kV) to provide resilience under those conditions stipulated within the standard. These conditions include reliability levels for various factors including severe weather, and type of use of the overhead line. As such, the steelwork used on the cross-arms of the poles is inherent to the overall design and conforms to the basic requirements as set out in the Standard. Any redesigning and strengthening of the steel members into a slimmer version is likely not to meet these requirements. One of the most onerous resilience cases discussed in BS EN 50341 is the broken wire scenario where the line must limit the damage caused by a broken wire (the cascade effect). Whilst there are specific failure containment structures within the overall design to limit this effect, the steelwork on other structures affords some limited additional resilience, particularly with regard to pole twisting. Reducing the steelwork to a “single bar” would reduce

	this resilience.
Question P4: the UPAS connector dates back 25 years and has been a trusted bit of kit for a long time. But, time moves on and even Ofgem is now promoting the use of High Temperature Low Sag (HTLS) connections based on ACCC and ACCR technology - at least in refurbishment projects where the power must be increased and the old pylons reused. These connectors offer at least twice the current capacity for the same diameter and also sag less. Alternatively they offer the same current for less diameter and weight, and still sag less. For example the 150mm2 ACCC conductor weights in at 500kg/km (significantly less than Poplar) but is rated at over 600 amps (significantly more than UPAS). Has SP Manweb considered this option? What are the cost differences?	SP Manweb is currently trialling the use of HTLS and is working with National Grid and others in this field. There are several types and manufacturers of HTLS on the market, each with differing characteristics, technologies and installation techniques. SP Manweb is currently evaluating several and is currently installing its first trial installation on a tower line in Scotland. HTLS technology is not yet part of SP Manweb's standard apparatus. There are some significant challenges to manage before it could be adopted. For example, there may be design issues with the extra erection tensions that are associated with HTLS conductors particular in relation to wood pole lines (both Trident and HDWP) and their effect on the factors of safety required by the relevant standards. Therefore, HTLS conductors are not an option for the Proposed Development.
Question P5: Local people were shocked when the average span between the poles was reduced from the 100 meters value of the statutory consultations to the 79m of the final ES. Has SP Manweb considered and costed the use of HTLS connectors in order to reduce the number of poles? By what % could the number of poles be reduced?	SP Manweb does not have an approved HTLS conductor. Therefore, this has not been considered. As mentioned in the answer to P4 above, each HTLS conductor has different characteristics, technologies and installation techniques such that any study would require the presumption of particular conductor type which may then not achieve future type approval. The installation of the HDWP overhead line design, including the under-slung earth conductor, follows a detailed earthing study of the connection arrangement. An alternative 132kV overhead line route for this earth is not available from the area where the renewable generation will be installed. The earthing question is addressed below.
The problem of the earth connector. It certainly does not need to go by the same poles (as Legacy shows) or even be above ground.	Mr Barlow is correct that it not always necessary for the earth conductor or path to be catered for on the same poles or circuit as the current carrying conductors. However this is only the case where there is a suitable alternative parallel path, i.e. a second or third circuit between the same points, or where the ground conditions provide a low resistance earth return path preventing an unsafe Rise of Earth potential. In relation to the Proposed Development, a single circuit is proposed with no suitable alternative earth path.
Question E1: Counterpoising the earth connector ie laying it underground is a potential solution (as stated by me in my first response). What would it cost? Possibly <1/6 of the cost of the conductors but of course additional to the reduced OHL costs.	As stated in the opening paragraph, the only design approved by SP Manweb for this type of project is an overhead earth conductor. An underground earth conductor is not approved for use on SP Manweb's network for a project of this type. Third party interference may lead to damage or separation in which case the earth does not fulfil its critical function to lower the Rise of Earth Potential at the substation site. The earth conductor must remain continuous along its entire length in order for it to fulfil this function. SP Manweb, like most DNO's, use short lengths of buried earth cables close to lower voltage pole mounted transformers in rural and agricultural settings. In SP Manweb's experience, these buried earth cables are often damaged or broken by farm or other utility machinery. Repair time and costs are extensive for counterpoise earth conductors as the location of any damage may not be apparent and require extensive excavations to locate. During this period the critical safety of the system would be not be able to be maintained. This would necessitate the circuit being removed from service. Refer also to the response at the start of this table.
Question E2: Can the earth be carried on a Trident solution? If not why not or where are the limits (mechanical and electrical)? Actually the answer from SP Manweb is YES, it can be carried on Trident. SP Manweb has in several documents shown diagrams of a Trident carrying an earth connector, see for example	SP Manweb does not have an earthed Trident solution for 132kV overhead lines. ENA TS 43-50 Issue 1 specification for Trident is for an unearthed overhead line. SP Manweb specification OHL -03-099 is a specification for 11 & 33kV unearthed overhead lines and is therefore not applicable to

http://www.spenergynetworks.co.uk/userfiles/file/OHL-03-0 99_Issue1_ForInternet.pdf (albeit for 33 KV connections, but the weights and tensions must be similar). More recently (August 2015) and more importantly SP Energy Networks has published the Loch Urr Routeing Consultation Document for a 132KV connection for three wind farms (85,59 and 59 MW capacity) in Scotland. I quote from the section Overhead Line Design starting at R3.3.5 “The 'Trident' wood pole 132KV overhead line design utilises two standard pole types, as illustrated on Figure 3; a 'single' pole and an ‘H’ pole configuration....... . The spacing between the poles will vary but will generally be 100m .... The proposed wood pole will support three conductors (wires) in a horizontal flat formation as shown in Figure 3. In addition, there is an earth conductor suspended beneath the main conductors in order to provide lightning protection. This also includes fibre optic cores for communication purposes”. A single sometime double pole Trident with a single bar superstructure, and carrying an earth. See http://www.spenergynetworks.co.uk/userfiles/file/Loch_Urr_Phase_A_Routeing.pdf	132kV earthed overhead lines. The SP Manweb 33kV overhead line network is an unearthed construction. Mr Barlow’s reference to the specification 33kV OHL-03-099 is actually related to the replacement of Hardex (insulated pilot communication cable used on 33kV circuits) with an Horse equivalent OPGW conductor. The referenced section presupposes that the original line had reduced span lengths (or higher poles) to cater for a fourth conductor. The span distance and the height are identified as being the primary factors to ensure the minimum ground clearance for 33kV is achieved (which is 5.2m rather than the 6.7m required at 132kV). These factors are not related to 132kV overhead lines and are therefore not relevant. Mr Barlow's references to Trident lines comprising an earth wire suspended below the phase in the Loch Urr document is an error. SP Manweb has responded to this point specifically in ISH Day One Action 3 (examination library reference REP3-030). This response confirmed that Trident is not designed to carry an earth conductor and that Figure 3 does not show Trident structures with an earth wire. The only approved design to carry both the earth wire and conductor is the HDWP.
In summary it seems that there are a number of viable engineering solutions to significantly reducing the visual impact of the proposed 132KV overhead connection while carrying the required power. They need to be considered and costed.	For the above reasons, SP Manweb considers that the engineering solutions suggested by Mr Barlow are not appropriate in these circumstances.