

Dear Mr Coombes

On behalf of the Pylon the Pressure Group, I welcome the opportunity to comment on responses to the Examination Authority's first written questions.

SP Manweb remain firm in their view that "the benefits to landscape and visual amenity of additional underground cable do not *clearly outweigh* the extra economic, social and environmental impacts." (response to ExA Q1.4, paragraph 29).

As set out in the Pylon the Pressure Group's response to ExA's First Written Questions (<http://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN020014/Events/Deadline%201%20-%201%20September%202015/Pylon%20the%20Pressure%20Group.pdf>) the benefits of underground cabling (compared with overhead lines) has been valued conservatively by households within 5km of the route at between £24.4m (based on willingness to pay) and £69.0m (based on willingness to accept compensation).

SP Manweb estimate that the incremental cost of undergrounding the whole route to range between £24.1m and £40.4m, depending on the assets' lifetime and cost per km of undergrounding.

SP Manweb has provided some further information in response to Examination Authority's questions which confirm that their estimates are incorrect, and significantly overestimate the cost of undergrounding. The comments listed below relate to the evidence SP Manweb has provided in relation to the costs of underground cabling versus the cost of overhead lines. Specifically, we have corrected errors in SP Manweb's calculations, and revised some parameters estimates with more realistic figures. With these corrections, the incremental lifetime cost of underground cabling is significantly less (at £12m to £13m) than the value placed on maintaining a pylon-free landscape. **A wholly undergrounded approach to the NWWFC clearly meets the EN-5 criterion that the benefits to landscape and visual amenity of additional underground cable *clearly outweigh* the extra economic, social and environmental impacts.**

1. SP Manweb claims that the benefits that would be derived from undergrounding the cable as a means of reducing visual effects are likely to be outweighed by the effects of underground cables on habitats, ground cover, land management and unknown archaeology. However, in its response to the Examination Authority's questions (paragraph 1.18c), SP Manweb state that a wholly undergrounded route would follow existing highways where possible, necessitating an increase in its length to approximately 24km. By routing the cabling on existing highways there cannot be any impacts on habitats, ground cover or land management. Undergrounding has the potential to disturb unrecorded archaeology, but adverse effects would be unlikely due to the already disturbed nature of the ground. Where sections would pass through undisturbed ground (e.g. verges), the narrow footprint together with standard mitigation techniques would generally limit the possibility of disturbing archaeological remains; and besides there is no evidence that archaeological remains would be encountered.
2. The cost of supply and installation of the 132kV cable along the 11.2km land connection from the RWE Gwynt y Môr development was £15m (September 2010) (<http://s258888288.websitehome.co.uk/RWE%20Project.pdf>). This consisted of:
  - Manufacture of 134.4km of 132kV cable including all joints and terminations.

- Excavation and construction of transition pit (where onshore and offshore cable networks are safely connected) near Pensarn, North Wales
- Excavation of an 11.2km cable corridor from Pensarn/Belgrano to a new substation at St Asaph consisting of four trenches each containing three power ducts and auxiliary ducts.
- Directional drilling beneath, roads, major waterways and the railway line
- Installation of four power circuits (three cables in each circuit)
- All high voltage jointing, terminating and testing.
- Reinstatement of the entire cable route.

This is equivalent to £1.34m per km, which might superficially appear to be comparable with the £1.1m to £1.6m per km cited by SP Manweb. However this figure includes *four* trenches each containing three power ducts and auxiliary ducts. The requirements for the North Wales Wind Farms Connection project would be for a *single* trench carrying three power ducts, thereby reducing the cabling costs (in relation to the Gwynt y Môr project) to a quarter, and excavation and installation costs by a significant amount. Given that the costs of cables are about 9 times the cost of installation (per km) (Table 11 of: <https://www.ofgem.gov.uk/ofgem-publications/85339/annex2tneisreportonthebeaulymossfordstage2swwprojectassessment.pdf>), SP Manweb's figures of £1.1m to £1.6m per km are highly inflated.

3. Another example of contracted cabling work (as opposed to assumed estimates), is the £30m contract to design, supply, install and test a twin circuit onshore 132kV cable system over a distance of 47km from landfall near Weybourne, Norfolk to Necton, Norfolk (<http://www.carillionplc.com/news-media/news/2014/carillion-signs-%C2%A330m-contract-to-design-and-build-uk%E2%80%99s-longest-onshore-hv-connection-for-an-offshore-windfarm.aspx#.VffPZU1RGpo>). The contract involves the design, supply and installation of 288km of 132kV cable and associated jointing accessories. At £0.64m per km, this is half of SP Manweb's estimate of £1.1m to £1.6m per km, while carrying not one but two circuits.
4. The Brechfa development (<http://www.westernpower.co.uk/docs/About-us/Our-business/Our-network/Current-WPD-Planning/Stage-2-library/Detailed-reports/Lifetime-Costs-Report.aspx>) estimated the cost of underground cabling at £986k per km.
5. The Llandinam Scheme which was to include 35km of 132kV overhead line plus associated substation and protection, and pre-engineering works, was estimated to cost £21m to £24m ([http://spllandinamconnection.info/?wpfb\\_dl=371](http://spllandinamconnection.info/?wpfb_dl=371)). This SP Manweb development has many similarities with the North Wales Wind Farm Connection project, with a single circuit 132 kV overhead line on Heavy Duty Wood Pole structures; but with the main differences of distance (being 18km longer) and cost (being £8m to £11m cheaper).
6. In the Technical Appendix of the Planning Statement (Document reference 7.5), dated March 2015, SP Manweb state that capital costs these have been determined to be approximately £1.1m (installed in roadside verges) to £1.6m per km (in the case of made ground such as roads) plus the costs of associated cabling equipment such as termination structures. Six-months earlier, an SP Manweb spokesman reported the costs as "£1.1m per km for underground cables in arable or unmade ground rising to £1.3m per km in the case of made ground, for example, within a roadway." (<http://www.dailypost.co.uk/news/north-wales-news/overhead-cables-banned-amid-concerns-7988741>). It is inconsistent for the lower estimate to have remained unchanged but for the higher estimate to have increased by more than 23% in such a short period of time. This undermines the credibility of the figures provided by the Applicant.

7. In paragraph 1.17(f) of their response to the Examination Authority's questions, SP Manweb explain that their estimate of £340k per km for overhead lines is based on an average figure based on their experience of wood pole constructions in various locations across the country. In relation to SP Manweb's application for the Llandinam development, they state: "For an HDWP overhead line, the base estimate used by SP Manweb in September 2013 prices is £340,000 per km erected. This value takes into account the installation of several overhead angle support structures and assumes an almost straight overhead line route." ([http://spllandinamconnection.info/?wpfb\\_dl=427](http://spllandinamconnection.info/?wpfb_dl=427)). Given that the cost of undergrounding has seemingly increased by 23% over the last 6 months, would it not be unreasonable to assume that the cost of overhead lines may have increased by at least as much over 2 years? Moreover, £340k per km was cited when SP Manweb said that pylons were to be spaced 100m apart. We now know that pylons are to be spaced 79m apart (on average), meaning that there will be 27% more pylons. Their construction appears to be at no additional cost. Overall, the impression (if not reality) is that SP Manweb has inflated the costs of undergrounding while suppressing the costs of overhead lines, thereby exaggerating the difference in the cost of underground cabling versus overhead lines.
8. In their response to the Examination Authority's questions, SP Manweb has provided further details of the costs of overhead lines and underground cables. The costs presented provide no reassurance of their accuracy. For instance, the figures relating to the "Capital cost per km of transmission route" are given as £1.638m per km (overhead line) and £2.008m to £2.483m per km (underground cable), which are entirely different from their figures of £340k per km, and £1.1m to £1.6m (or £1.3m) per km. Moreover, in section 1.18(a), SP Manweb provide (slightly) different figures again: £1,633,693 and £2,004,330, for overhead and underground transmission, respectively. These figures (and/or their labelling) are misleading and cannot be trusted. They appear to represent the total cost (£32.0m in the case of overhead lines, £48.2m to £59.6m for underground cabling) divided by the length of the route (taking into consideration, where appropriate, the short 2.6km section of undergrounding). This total capital cost includes the cost for the installation and procurement of all necessary plant and equipment required to achieve the 132kV circuit and associated controlling/transforming substation to connect the Proposed Development to the existing Electricity Distribution Network. The cost also includes costs associated with pre and post consenting works, and the £1.7m SP Manweb estimates to be the cost of payments for rights acquisition, including option and easement payments, disturbance, injurious affection and related professional fees. (paragraph 2.4.4 of <http://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/projects/EN020014/2.%20Post-Submission/Application%20Documents/Compulsory%20Purchase%20Information/4.2%20Funding%20Statement.pdf>). The inclusion of substation costs is misleading as, in the case of the Clocaenog forest substation, application for planning permission was rejected by Denbighshire Council. SP Manweb's global estimate of cost is unhelpful, and the cost per km, misleading.
9. In order to separate the fixed costs from the known marginal cost of each additional km of installed transmission, we made calculations based on SP Manweb's own figures:
- 6.1 Based on the overhead line:
- Total costs = Fixed costs + marginal costs
  - Fixed costs = Total costs minus {(17km at £0.34m per km) plus (2.6km at £1.6m per km)}
  - Fixed costs = £32.02m - £5.78m - £4.16m = £22,080,383

6.2 Based on underground cables (low cost range):

- Fixed costs = Total costs minus (24km at £1.1m per km)
- Fixed costs = £48.10m - £38.4m = £21,703,915

6.3 Based on underground cables (high cost range):

- Fixed costs = Total costs minus (24km at £1.6m per km)
- Fixed costs = £59.60m - £38.4m = £21,200,000

6.4 This confirms that fixed costs associated with overhead lines (£22.1m) are higher than those associated with underground cables (£21.2m to £21.7m). This contrasts with SP Manweb's assertion that it would be higher because of costs not included in the marginal costs: i.e. those associated cabling equipment such as termination structures, control and protection equipment and the requirement for trial holes along an underground cable route (E-mail from Mrs Claire Duffy at 10:50 on 16 September 2014).

10. Notwithstanding these differences in fixed costs, the majority of the differences in the *capital costs* of overhead lines and underground cabling are captured within the marginal cost per km of line/cable installed. SP Manweb's low cost estimate (24km at £1.1m per km = £26.4m) assumes installation in roadside verges. The Applicant has not presented the cost of installation in arable or unmade ground which would offer a more direct route (17km at £1.1m per km plus 2.6km at £1.6m = £22.9m + fixed costs of £21.7m = total cost of £44.7m). Compared with the total cost of overhead lines (£32.0m), the incremental cost of capital is just £12.7m.

11. SP Manweb's large difference in *lifetime costs* derives from the cost of operation and maintenance. These are presented as £3,078 per km per year for overhead lines, and £17,739 per km per year for underground cables (£426k per year for the 24km route). The latter figure is stated to be based on SP Manweb's historical on-going maintenance and repair cost (paragraph 4.3.17 Document reference 7.5). However, there have been no additional details provided in their response to the Examination Authority's questions regarding costs, and so the basis of this figure is unclear. SP Manweb's RIIO T1 Business Plan presented their operating costs for high voltage assets.

([http://www.spenergynetworks.co.uk/userfiles/file/2011\\_SPTL\\_Narrative\\_6%20Operating%20Costs.pdf](http://www.spenergynetworks.co.uk/userfiles/file/2011_SPTL_Narrative_6%20Operating%20Costs.pdf)). This suggests that SP Manweb's total direct costs of fault repair, inspections and maintenance, tower painting, vegetation management totalled £7.1m in 2014. This included all the following assets relating to high voltage transmission:

- 157 Substation sites
- 2 HV/DC convertor stations
- 4074km of overhead line
- 475 circuit breakers
- 294 transformers
- 789km of cables

If we assume SP Manweb's estimate of £17,739 per km per year is a rough guide to maintaining their existing underground cables, their 789km of underground cables would cost them £14.0m to maintain annually. So their 4,074 km of overhead line would have to cost them -£1,693 per km to maintain! These figures simply do not add up. Figures cited for the Brechfa Forest Connection Project (<http://www.westernpower.co.uk/docs/About-us/Our-business/Our-network/Current-WPD-Planning/Stage-2-library/Detailed-reports/Lifetime-Costs-Report.aspx>), of £800 per km per year (overhead lines) and £1000 per km per year (underground) are closer to

those in the RIIO T1 Business Plan.  $\{£800 \times 4074\text{km} + £1000 \times 789\text{km}\} = £4.0\text{m}$  per year. If the ratio of 1.25 ( $£1000/£800$ ) is assumed to apply to SP Manweb's assets, the maintenance and operating costs required to yield a total of £7.1m are £1,333 per km per year for overhead lines and £1,666 per km per year for underground cabling  $\{£1,333 \times 4074\text{km} + £1,666 \times 789\text{km} = £7.1\text{m}\}$ . Applying these figures to SP Manweb's calculations reduces the lifetime cost difference between underground cabling and overhead lines (low estimate over 25 years) from £23.0m to £15.2m.

12. SP Manweb acknowledge that the use of underground cables incurs lower network losses, and has estimated "the losses in this case to be £100k less than the all overhead design" (paragraph 4.3.10, Document reference 7.5). However in its response to the Examination Authority's questions, SP Manweb has calculated the cost of losses over 25 years to be £2.3m (overhead line) versus £1.1m (underground) (paragraph 1.17(b) of SPM's responses to ExA questions). The difference of £1.2m over 25 years is equivalent to £48k per year, less than half of SP Manweb's claimed figure. Based on £100k per annum the difference in the cost of losses between overhead and underground is £2.5m over 25 years, not £1.2m.
13. In their calculation of total lifetime costs, SP Manweb has not discounted costs to net present value. According to the Treasury Green book: "The discount rate is used to convert all costs and benefits to 'present values', so that they can be compared. The recommended discount rate is 3.5% per annum. Calculating the present value of the differences between the streams of costs and benefits provides the net present value (NPV) of an option. The NPV is the *primary criterion* for deciding whether government action can be justified."
14. In relation to the funding of the connection, SP Manweb state (in paragraph 2.8) that "the termination of the connection agreement for Nant Bach would not change the position [of the development being developer funded], other than the costs will now be shared between the three remaining wind farm developers. There is no change in the position that the costs of funding delivery of the North Wales Wind Farms Connection remain the responsibility of the contracted developers." However, the Nant Bach development was terminated on the basis of it no longer being commercially viable "The market has moved on and left Nant Bach behind" (<http://corporate.vattenfall.co.uk/projects/wind-energy-projects/nant-bach-conwy/>). The other consented wind farm are to similar specifications, how can the Applicant, and for the matter those charged with consenting the application, be confident that the project is viable?

Costs based on SP Manweb figures for 25 years (all figures in £M):

	Overhead line versus:	
	Underground cable (low cost)	Underground cable (high cost)
SP Manweb estimate	$59.90 - 35.80 = 24.1$	$71.30 - 35.80 = 35.5$
Estimate corrected for cost of losses (overhead) being £100k per year more than underground	$59.90 - 37.13 = 22.7$	$71.30 - 37.13 = 34.2$
Also corrected for cost of operating and maintenance (£1,333 per km per year overhead; £1,666 per km per year underground)	$50.20 - 36.27 = 13.93$	$61.70 - 36.27 = 25.43$
Also corrected by discounting to NPV (3.5% per annum)	$49.95 - 35.76 = 14.19$	$61.45 - 35.76 = 25.69$

Costs based on SP Manweb figures for 40 years (all figures in £M):

	Overhead line versus:	
	Underground cable (low cost)	Underground cable (high cost)
SP Manweb estimate	$66.90 - 38.00 = 28.90$	$78.40 - 38.00 = 40.40$
Estimate corrected for cost of losses (overhead) being £100k per year more than underground	$66.90 - 40.19 = 26.70$	$78.40 - 40.19 = 38.20$
Also corrected for cost of operating and maintenance (£1,333 per km per year overhead; £1,666 per km per year underground)	$51.46 - 38.83 = 12.64$	$62.96 - 38.83 = 24.13$
Also corrected by discounting to NPV (3.5% per annum)	$51.06 - 35.76 = 13.05$	$62.56 - 35.76 = 24.54$

For full transparency, calculations underpinning these figures are provided in an Excel spreadsheet.

Costs incorporating the corrections listed above under more realistic scenario (all figures in £M):

	Overhead line versus:	
	Underground cable (25 years)	Underground cable (40 years)
Underground cabling £986k per km ( <a href="http://www.westernpower.co.uk/docs/About-us/Our-business/Our-network/Current-WPD-Planning/Stage-2-library/Detailed-reports/Lifetime-Costs-Report.aspx">http://www.westernpower.co.uk/docs/About-us/Our-business/Our-network/Current-WPD-Planning/Stage-2-library/Detailed-reports/Lifetime-Costs-Report.aspx</a> )	$46.7 - 34.20 = 12.55$	$47.8 - 36.4 = 11.40$

**Replicating SP Manweb's figures**

	Overhead	Overhead	Underground	Underground	Underground	Underground
			Low	High	Low	High
High (£1.6m/km) or low (£1.1m/km) cost scenario for cables	-	-	Low	High	Low	High
Lifetime (years)	25	40	25	25	40	40
Length of route	19.6	19.6	24	24	24	24
Cost of installation	32020383	32020383	48103915	59600000	48103915	59600000
Cost of Losses	2300000	3600000	1100000	1100000	1700000	1700000
Cost of Operation & Maintenance	1508220	2413152	10643400	10643400	17029440	17029440
Lifetime costs	£ 35,828,603	£ 38,033,535	£ 59,847,315	£ 71,343,400	£ 66,833,355	£ 78,329,440

Differences		
	Underground (low)	Underground (high)
25 years	£ 24,018,712	£ 35,514,797
40 years	£ 28,799,820	£ 40,295,905

**Estimate corrected for cost of losses (overhead) being £100k per year more than underground**

	Overhead	Overhead	Underground	Underground	Underground	Underground
			Low	High	Low	High
High (£1.6m/km) or low (£1.1m/km) cost scenario for cables	-	-	Low	High	Low	High
Lifetime (years)	25	40	25	25	40	40
Length of route	19.6	19.6	24	24	24	24
Cost of installation	32020383	32020383	48103915	59600000	48103915	59600000
Cost of Losses	3600000	5760000	1100000	1100000	1760000	1760000
Cost of Operation & Maintenance	1508220	2413152	10643400	10643400	17029440	17029440
Lifetime costs	£ 37,128,603	£ 40,193,535	£ 59,847,315	£ 71,343,400	£ 66,893,355	£ 78,389,440

Differences		
	Underground (low)	Underground (high)
25 years	£ 22,718,712	£ 34,214,797
40 years	£ 26,699,820	£ 38,195,905

Underground - losses per km per year £1,833

Overhead - losses per km per year (based on £100k difference) £8,190

**Estimate corrected for cost of losses (overhead) being £100k per year more than underground and cost of operating and maintenance (£1,333 per km per year overhead; £1,666 per km per year underground)**

	Overhead	Overhead	Underground	Underground	Underground	Underground
			Low	High	Low	High
High (£1.6m/km) or low (£1.1m/km) cost scenario for cables	-	-	Low	High	Low	High
Lifetime (years)	25	40	25	25	40	40
Length of route	19.6	19.6	24	24	24	24
Cost of installation	32020383	32020383	48103915	59600000	48103915	59600000
Cost of Losses	3600000	5760000	1100000	1100000	1760000	1760000
Cost of Operation & Maintenance	653170	1045072	999600	999600	1599360	1599360
Lifetime costs	£ 36,273,553	£ 38,825,455	£ 50,203,515	£ 61,699,600	£ 51,463,275	£ 62,959,360

Differences		
	Underground (low)	Underground (high)
25 years	£ 13,929,962	£ 25,426,047
40 years	£ 12,637,820	£ 24,133,905

**Corrected as above, also discounted to NPV**

	Overhead	Overhead	Underground	Underground	Underground	Underground
			Low	High	Low	High
High (£1.6m/km) or low (£1.1m/km) cost scenario for cables	-	-	Low	High	Low	High
Lifetime (years)	25	40	25	25	40	40
Length of route	19.6	19.6	24	24	24	24
Cost of installation	32020383	32020383	48103915	59600000	48103915	59600000
Fixed costs	22080383	22080383	21703915	21200000	21703915	21200000
Cost of Losses (per annum)	144000	144000	44000	44000	44000	44000
Cost of Operation & Maintenance (per annum)	26126.8	26126.8	39984	39984	39984	39984
Lifetime costs	£ 35,759,065	£ 38,015,335	£ 49,949,535	£ 61,445,620	£ 51,063,355	£ 62,559,440

Differences		
	Underground (low)	Underground (high)
25 years	£ 14,190,470	£ 25,686,555
40 years	£ 13,048,020	£ 24,544,105

Discount rate 0.035

O&M per km Overhead 1333  
O&M per km Underground 1666

Year	32020383	32020383	48103915	59600000	48103915	59600000
1						
2	£163,709	£163,709	£80,816	£80,816	£80,816	£80,816
3	£162,069	£162,069	£80,006	£80,006	£80,006	£80,006
4	£160,808	£160,808	£79,384	£79,384	£79,384	£79,384
5	£159,786	£159,786	£78,879	£78,879	£78,879	£78,879
6	£158,926	£158,926	£78,455	£78,455	£78,455	£78,455
7	£158,185	£158,185	£78,089	£78,089	£78,089	£78,089
8	£157,534	£157,534	£77,767	£77,767	£77,767	£77,767
9	£156,954	£156,954	£77,481	£77,481	£77,481	£77,481
10	£156,431	£156,431	£77,223	£77,223	£77,223	£77,223
11	£155,956	£155,956	£76,988	£76,988	£76,988	£76,988
12	£155,519	£155,519	£76,773	£76,773	£76,773	£76,773
13	£155,117	£155,117	£76,574	£76,574	£76,574	£76,574
14	£154,742	£154,742	£76,389	£76,389	£76,389	£76,389
15	£154,393	£154,393	£76,217	£76,217	£76,217	£76,217
16	£154,066	£154,066	£76,056	£76,056	£76,056	£76,056
17	£153,758	£153,758	£75,904	£75,904	£75,904	£75,904
18	£153,467	£153,467	£75,760	£75,760	£75,760	£75,760
19	£153,192	£153,192	£75,624	£75,624	£75,624	£75,624
20	£152,931	£152,931	£75,495	£75,495	£75,495	£75,495
21	£152,682	£152,682	£75,372	£75,372	£75,372	£75,372
22	£152,445	£152,445	£75,255	£75,255	£75,255	£75,255
23	£152,218	£152,218	£75,143	£75,143	£75,143	£75,143
24	£152,000	£152,000	£75,036	£75,036	£75,036	£75,036
25	£151,792	£151,792	£74,933	£74,933	£74,933	£74,933
26	£151,592	£151,592	£74,834	£74,834	£74,834	£74,834
27	£151,399	£151,399	£74,739	£74,739	£74,739	£74,739
28	£151,213	£151,213	£74,647	£74,647	£74,647	£74,647
29	£151,034	£151,034	£74,559	£74,559	£74,559	£74,559
30	£150,860	£150,860	£74,473	£74,473	£74,473	£74,473
31	£150,693	£150,693	£74,390	£74,390	£74,390	£74,390
32	£150,531	£150,531	£74,310	£74,310	£74,310	£74,310
33	£150,373	£150,373	£74,233	£74,233	£74,233	£74,233
34	£150,221	£150,221	£74,157	£74,157	£74,157	£74,157
35	£150,073	£150,073	£74,084	£74,084	£74,084	£74,084
36	£149,929	£149,929	£74,013	£74,013	£74,013	£74,013
37	£149,789	£149,789	£73,944	£73,944	£73,944	£73,944
38	£149,653	£149,653	£73,877	£73,877	£73,877	£73,877
39	£149,520	£149,520	£73,812	£73,812	£73,812	£73,812
40	£149,391	£149,391	£73,748	£73,748	£73,748	£73,748