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Submitted electronically

5 August 2016

Dear Mr Hendry,

Hendry Review of Tidal Lagoons: Call for Evidence - ICE, RAEng and IMechE joint response

The Institution of Civil Engineers (ICE), the Royal Academy of Engineering (RAEng) and the Institution of Mechanical Engineers (IMechE) would like to thank the Hendry Review for the chance to take part in this call for evidence on tidal lagoons.

ICE is a UK-based international organisation with over 90,000 members ranging from professional civil engineers to students. It is an educational and qualifying body and has charitable status under UK law. Founded in 1818, the ICE has become recognised worldwide for its excellence as a centre of learning, as a qualifying body and as a public voice for the profession.

RAEng brings together the most successful and talented engineers from across the engineering sectors for a shared purpose: to advance and promote excellence in engineering. RAEng takes a lead on engineering education, invests in the UK's world-class research base to underpin innovation and works to improve public awareness and understanding of engineering.

IMechE has over 113,000 members in 140 countries and is the largest network of mechanical engineering knowledge, skill and opportunity in the world. IMechE develops and maintains key partnerships with leading multi-national employers to ensure their technical workforces are trained to the highest standard.

We hope that you find our joint response to the Review useful and would welcome any opportunity to provide further insight at subsequent stages.

Yours sincerely,

Gavin Miller
Policy Manager, ICE

Hendry Review of Tidal Lagoons - ICE, RAEng and IMechE joint response

Summary

- At present, the only detailed proposals and information available for tidal lagoons in the UK relate to Tidal Lagoon Power's (TLP's) Swansea facility. Therefore, while this response is on tidal lagoons in general, in practice the majority of the specific comments relate to Swansea in particular

- TLP's proposals for Swansea tidal lagoon are for a relatively small site (320 MW) to be the "scalable blueprint for a programme...to develop, construct and operate a fleet of tidal lagoons to meet up " of tidal lagoons"[1]

- The development of Swansea tidal lagoon is planned to be financed privately. There will be no central government funding until the facility begins generating, meaning the risk to the taxpayer and consumer is minimal

- The Contract for Difference (CfD) funding for Swansea is estimated at around £25 - £60m per year, depending on the contract agreed and future wholesale electricity price, which is relatively little in the context the Levy Control Framework

- The individual technologies (turbines, sluices, bunds etc.) are tried and tested. However, their development as a whole would be first of a kind, therefore uncertainties around hydrology, environmental impacts and generation output remain

- It is critical any assessment of cost effectiveness is carried out both in the context of the specific lagoon being implemented and its integration with the whole UK energy system

- Tidal lagoons could play an important role as part of the UK's low-carbon electricity generation mix. To ensure that lessons learnt can be incorporated effectively, the first tidal lagoon should be working for at least one full annual cycle before the next site is developed.

Question 1: An assessment of whether, and in what circumstances, tidal lagoons could play a cost effective role as part of the UK energy mix

1.1 Background

Aside from Swansea, which has received planning consent, there are only two tidal lagoon projects in planning – Cardiff and Newport, both are on the River Severn and are being brought forward by TLP[2].

Other tidal lagoons are limited in number and advancement:

- LongBay SeaPower suggested a 1,080 MWh tidal lagoon at Minehead. Plans for the £2.4bn project appears to be in early stages with plans not expected to be submitted until 2018[3]

[1] TLP (2016) 'Introduction'
[2] Tidal Lagoon Power (2016) 'Projects'

- Stepping Stones at Aberthaw on the Severn coast dates from 2012. Its scoping document estimated 600MW / 1,200,000 MWh per year[4]. The proposals do not seem to have been developed.

- In March 2016, the wind power developer Ecotricity, announced plans for tidal lagoons, which the company says will be cheaper than TLP's[5]. However, to date no details have emerged.

1.2 Cost effectiveness

While costs and financing for tidal lagoons are site specific, at present the only detailed information available is from TLP's Swansea proposals. As such, assessment of cost effectiveness is difficult to extrapolate beyond specific circumstances and must be treated as indicative only.

For Swansea, all up-front capital finance is planned to come from the private sector and a CfD around electricity generation is in negotiation between TLP and the Government. TLP's Cardiff and Newport projects are currently expected to be financed and funded in a similar way, which - together - could set a precedent in investor's minds for the approach to financial support of tidal lagoons. As such, from a Government and consumer perspective, the CfD is likely to be the primary determinant of cost effectiveness of tidal lagoons, however system wide impacts and benefits should also be considered (see section 1.3).

A decision on Swansea's CfD strike price is pending. TLP's initial suggestion was for £168/MWh on a 35 year contract[6], which was followed by a second proposal of £95.60/MWh for 90 years[7].

With CfDs, the Government pays a generator the difference between the agreed strike price and the reference price (based on the day-ahead wholesale price). Therefore, if a generator agreed a strike price of £168/MWh and £44.70/MWh is taken - for argument - as the reference price[8], the generator will receive a 'top-up' of £123.30/MWh from consumers. If the strike price was £95.60/MWh the 'top-up' would be £50.90/MWh.

Using these scenarios, Swansea, with an estimated net annual power output of 495 GWh[9] at £123.30/MWh 'top-up', would be expected to cost £61m a year in CfDs or a total of £2.1bn over 35 years[10]. A 'top-up' of £50.90/MWh over 90 years is similar - a projected CfD cost of £25.2m a year, or £2.3bn over 90 years[11]. In reality, the CfD cost is likely to be less as there is a forecast increase in wholesale electricity prices[12] to 2035 across all scenarios[13].

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[3] OffshoreWind.biz (2015) 'LongBay SeaPower Submits West Somerset Lagoon Details'; LongBay SeaPower (2016) 'The West Somerset Lagoon'
[4] Parsons Brinckerhoff (2012) 'Stepping Stones Tidal Lagoon'
[5] Infrastructure Intelligence (2016) 'Cost of tidal power can be halved says Ecotricity'
[6] House of Commons Library (2016: 1) 'Debate pack: Potential economic effects of Swansea Tidal Lagoon'
[7] The Telegraph (2016) 'Meet the man who wants to be Britain's first tycoon of tides'
[8] The average wholesale price in Q2 2015
[9] Poyry (2014: 10) 'Levelised Costs of Power from Tidal Lagoons'
[10] Estimated figures based on: 495,000 MWh x £123.30 = £61,033,500. £61,033,500 x 35 [years] = £2,136,172,500
[11] Estimated figures based on: 495,000 MWh x £50.90 = £25,195,500. £25,195,500 x 90 [years] = £2,267,595,000
[12] Less difference between the reference price and the strike price will mean lower CfD payments.
[13] DECC (2015) 'Energy and Emissions Projections'

By way of indicative comparison, Government expenditure on the Renewables Obligation for 2014-15 was £3.1bn[14], the total CfD Pot 2 auction for less established technologies is set at £260m per year until 2020-21[15] and the Levy Control Framework as a whole is £9.1bn for the year 2020-21[16].
CfD strike prices for TLP's further planned sites are expected by the company to be lower than for Swansea. It is reasonable to assume that as the technologies involved in lagoons are already separately tried and tested, the reduction in levelised costs in developing further lagoons is driven primarily by moving to bigger sites with higher tidal range rather than technology learning[17]. Cardiff and Newport should each be between 1,800 MW and 2,800 MW (4,000 GWh and 6,000 GWh per year)[18]. However, the later sites with their large capital costs[19] cannot be guaranteed to follow on.

1.3 Assessment of cost effectiveness

With CfD contracts, payments only begin when the facility starts to generate: there is minimal risk to the taxpayer/consumer should a scheme not proceed. Similarly, as the CfDs are per MWh, if a generator exports less power, then predicted payments will decrease correspondingly.

Following a first set of negotiated CfD contracts in 2014[20], most CfDs in the UK are set through competitive auction. Since then, the only other prominent example of CfD outside the generic framework is for Hinkley Point C, which has been agreed at £92.50/MWh over 35 years[21].

The approach of using bilateral CfD negotiations for both Hinkley and Swansea have led to their strike prices being equated by some commentators[22]. However, due to their differing 'types' of power and generation lifespan, comparison between the two on strike price alone can be misleading. Tidal lagoons offer the possibility of intermittent but predictable power over an anticipated lifetime of up to 120 years[23]. Hinkley is designed primarily for base load generation with an expected lifespan of around 60 years[24]. As such, they are effectively different asset classes and their strike prices should be assessed on their own individual merits.

The other Government support available for the two developments is more informative. For Hinkley, the Government has agreed a £2bn loan guarantee via HM Treasury[25]. In addition, a Secretary of State Investor Agreement has been put in place, which means the Government will compensate investors if the plant is shut for "political reasons", or due to certain changes in law[26]. Swansea has received a £1.25m loan from the Welsh Government[27] but there are no plans to use Government money up-front or underwriting.

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[14] Ofgem (2015: 7) 'Renewables Obligation Annual Report 2014-2015'
[15] DECC (2015) 'Electricity Market Reform: Contracts for Difference'
[16] In 2011-12 prices: DECC (2015) 'Levy Control Framework cost controls'
[17] Poyry (2014: 2-3) 'Levelised Costs of Power from Tidal Lagoons'
[18] Tidal Lagoon Power (2016) 'Welcome to Tidal Lagoon Cardiff's website' and Tidal Lagoon Power (2016) 'Tidal Lagoon Newport – Harnessing the power of the Severn Estuary'
[19] Poyry (2014: 10) 'Levelised Costs of Power from Tidal Lagoons'
[20] In 2014, eight bilateral CfDs were negotiated for offshore wind and biomass, with strike prices of between £103 and £154/MWh: National Audit Office (2016: 23) 'Nuclear Power in the UK' .
[21] DECC (2013) 'Initial agreement reached on new nuclear power station at Hinkley'
[22] See, for example, Citizens Advice (2015: 6) 'Call for Evidence: Swansea Bay Tidal Lagoon: potential support for the project through the CFD mechanism Response from Citizen's Advice'; BBC (2015) 'Budget 2015: Swansea tidal lagoon negotiations 'opening'' and The Guardian (2015) 'Swansea tidal lagoon project faces delays'
[23] Landscape Institute (2016) 'Swansea Bay Tidal Lagoon'
[24] DECC (2015) 'Hinkley Point C to power six million UK homes'
[25] HMP Treasury (2015) '£2 billion support for Hinkley Point'
[26] National Audit Office (2016: 30) 'Nuclear Power in the UK'
[27] BBC News (2014) '£1bn tidal lagoon: Swansea Bay deadline looms'

Based on TLP's information, tidal lagoons have the potential to be competitive, play a cost effective role and add value to the UK's low-carbon electricity generation portfolio. However, any assessment of cost effectiveness - whether the
generators are tidal lagoons, nuclear plants or gas with carbon capture and storage - should be considered both in the context of the specific lagoon and its integration with the GB energy system[28].

With no other support the proposed, a bilateral CfD for Swansea seems a sensible structure to use for a first of a kind development[29]. Around £2.2bn across the lifetime of the scheme is relatively little in comparison to the annual Renewable Obligation spend and Levy Control Framework cap. Later, bigger tidal lagoons should prove to be cheaper per MWh[30] but these should be decided on their own merits when more information is available.

Question 2: The potential scale of opportunity in the UK and internationally, including supply chain opportunities

The Crown Estate estimates the UK's tidal lagoon power resource to be 25,000 GWh/year mostly in the Severn Estuary, Solway Firth and the Wash[31]. However, this is a theoretical maximum and, in reality, the output will always be much lower. To put this in context, total electricity generation in the UK in 2014 was 339,000 GWh with 64,700 GWh generated from renewables[32].

Tidal Lagoon Power's three main planned projects should provide a net total of around 8,480GWh/year[33]. The Severn has the second greatest tidal range in the world so would be expected to be exploited both first and to the greatest extent. However, as the sites are located close together they would generate power at roughly the same time. If tidal lagoons are to have maximum effectiveness it is important to also consider sites in West Cumbria and Colwyn Bay where tides are around four to six hours different in cycle from the Severn.

One way of increasing the scale of opportunity presented by tidal lagoons is to couple facilities with onshore electricity storage such as batteries or liquid air. Such an approach would not increase the deliverable power (indeed, it would decrease due to parasitic load) but would improve flexibility, allowing delivery on demand and therefore participation in short-term supply markets and - potentially - accessing a secondary CfD market[34].

Question 3: A range of possible structures for financing tidal lagoons

Due to the limited number of locations available for tidal lagoons, their site specific nature and high capital costs (but relatively low running costs); bespoke, bilateral CfDs are likely to be the only currently available option for government financial support. For example, tidal lagoons are unlikely to be able to compete in the current CfD auctions framework. Even in Pot 2 for less established technologies, as it is a descending price

[28] Energy Technologies Institute (2015) 'Options Choices Actions – UK scenarios for a low carbon energy system'
[29] The use of bilateral CfD negotiation for Swansea was supported by 85% of respondents to DECC's consultation: DECC (2015: 7) 'Swansea Bay Tidal Lagoon: potential support for the project through the CFD mechanism'
[30] Poyry (2014: 10) 'Levelised Costs of Power from Tidal Lagoons'
[31] The Crown Estate (2012) 'UK Wave and Tidal Key Resource Areas Project Summary Report'
[32] DECC (2015:113 and 157) 'DUKES'
[33] Poyry (2014: 10) 'Levelised Costs of Power from Tidal Lagoons'
[34] DECC (2016) 'Consultation on changes to the CFD contract and CFD regulations'

auction, more established alternatives such as offshore wind and biomass projects are more likely to be presented and priced at levels, which would take priority for available contracts.

Other mechanisms such as the capacity market or Short Term Operating Reserve demand an element of despatchability that tidal lagoons cannot guarantee. Although they can pump, that ability is normally used to maximise generation around high or low tide. In theory, they could store water between one tide and another – but that would affect the next cycle of generation and, importantly, the tidal habitat enclosed by the sea wall, which, if it is to mimic natural tides, has to empty regularly. Without linkage to electricity storage, tidal lagoons have limited flexibility in generation so may be constrained in accessing ancillary markets.

Question 4: Different sizes of projects as the first of a kind

In their 2013 report on proposals for a Severn Barrage, the Energy and Climate Change Committee recommended an incremental approach using technologies such as tidal lagoons. They went on state any such development should demonstrate "…robust evidence about the costs, environmental and socio-economic impacts…" and suggested "…consideration is given to first developing a smaller scale tidal project, in order to build a stronger evidence base…"[35].

The proposals for Swansea are seen by TLP as establishing a scalable blueprint for a programme to develop a fleet of tidal lagoons[36]. The main components proposed such as turbines, sluices and breakwaters are well-tested and understood. TLP's approach is for future tidal lagoons to capitalise on the supply chain of these technologies developed for Swansea.

As the development as a whole would be a first of a kind[37] uncertainties remain. The current proposals from TLP are for work on the Cardiff site to commence before the Swansea is completed. Under this approach there is a risk of unforeseen consequences arising from the first scheme - for example around changes in the flood risk, hydrodynamics of the estuary and silting in the lagoon[38] [39] - that might not be able to be corrected in later schemes.

Several environmental organisations such as Greenpeace, Friends of the Earth and WWF Cymru support the application. However, others such as the RSPB[40] [41], the Wildlife Trusts[42] and Wetland and Wildlife Trust[43] are supportive with the caveat that there is a need for testing and lesson learning with Swansea from future developments.

The new UK standard PAS 2080 on Carbon Management in Infrastructure[44] could be used to ensure carbon is consistently and transparently quantified and reduced at key points in delivery, enabling data to be shared transparently along the supply chain. In addition, if later schemes are to be financed and funded on the same model as Swansea, then it should be used to provide information to help set future tidal lagoon CfDs.

[35] HoC Energy and Climate Change Committee (2013: 54) 'A Severn Barrage?'
[36] TLP (2016) 'Introduction'
[37] DECC (2015: 6) 'Swansea Bay Tidal Lagoon: potential support for the project through the CFD mechanism'
[38] Falconer et al (2016) 'Tidal Energy from the Severn Estuary: Opportunities and Challenges'
[39] Natural Resources Wales (2014) 'Relevant representation from the natural resources body for Wales'
[40] RSPB Cymru (2015) 'What are we doing about tidal lagoons?'
[41] RSPB (2014) 'Representation to Planning Inspectorate'
[42] Wildlife Trusts (2015) 'Statement on Swansea Bay Tidal Lagoon'
[43] Wildfowl and Wetlands Trust (2014) 'Representation to Planning Inspectorate'
[44] BSI (2016) 'PAS 2080 Carbon Management in Infrastructure'

A smaller (e.g. 50 MW) demonstration project to address any uncertainties has been suggested as an option [45]. However, the apparent current lack of developer and likely higher cost per MWh it would make such a project difficult to pursue. Nevertheless, it is vital tidal lagoon developers work closely with regulators to ensure all coastal and environmental assessments and risks are properly managed preventing additional costs. To ensure that lessons can be incorporated, the first tidal lagoon should be fully operational for at least one full annual cycle before the next site is developed.

Question 5: Whether a competitive framework could be put in place for the delivery of tidal lagoon projects.

No comment.

ENDS

[45] Sustainable Development Commission (2007: 6-7) 'Turning the Tide: Tidal Power in the UK' and HoC Energy and Climate Change Committee (2013: 54) 'A Severn Barrage'