Appeal ref: APP/EPR/573

IN THE MATTER OF A PUBLIC INQUIRY

Appeal by NNB Generation Company (HPC) Limited

Water discharge activity at Hinkley Point C, Somerset

Permit variation application relating to Acoustic Fish Deterrent system

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PROOF OF EVIDENCE OF MR STEVE COLCLOUGH ON BEHALF OF RULE 6 PARTY, THE SEVERN ESTUARY INTERESTS (SEI)

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1. QUALIFICATIONS AND EXPERIENCE

1.1. My name is Steve Colclough. I hold an Honours degree in Marine Biology from the University of Liverpool (1976). I am a Fellow of the Institute of Fisheries Management and a Chartered Environmentalist of the Society for the Environment.

1.2. I was a fisheries officer and scientist in the Environment Agency ("EA") and its predecessors for 35 years, starting in 1976. In 2002 I developed a multiple method fish survey programme in the Thames estuary. This was recognised as European Best Practice in its field (Hemingway and Elliott, 2002). By 2003 I had become a national technical advisor on estuarine fish ecology. I led the team that developed the WFD transitional waters fish sampling and classification component, based upon the Thames estuary survey programme. Our team led for the UK and Ireland in European developments of the process. Part of my role was to provide technical advice and support to Area EA colleagues who were working with marine infrastructural developments through the planning process. In the 1980/90s, I had contributed to advice on appropriate new fish protection measures for cooling water systems on new gas fired power stations. The EA had produced guidance on screening for intakes in 2005 (Turnpenny & O'Keefe, 2005) ("**EA 2005 Guidance**") (**CD 9.3**). That advice was not focused in particular on all aspects of the large cooling water volumes required for large new power stations, particularly New Nuclear Build (NNB).

1.3. In 2010, I sat as the technical Fisheries representative on the steering board for the development of new guidance by the EA, published as "*"Cooling Water Options for the New Generation of Nuclear Power Stations in the UK"* (Turnpenny et al, 2010)" ("**EA 2010 Guidance**") (CD 9.4). The EA 2010 Guidance was needed to establish best practice, given a 30-year gap in NNB and the advance of practice, policy, technology and science over the period.

1.4. British Energy commissioned Cefas in 2007 to provide technical support and data needed for the EIA process over NNB (the "**BEEMS project**"). Later that year, senior chemist, Andrew Wither and myself from the EA, were formally approached to sit on a new Expert Panel ("**EP**") which was being set up then by British Energy (later to become part of EDF) as part of the BEEMS project. The EP was set up as an independent non-executive group of experts to advise on best practice in the field. A prime source of reference here was what became the EA 2010 Guidance.

1.5. I left the EA in September 2011 and I then set up a specialist fisheries and aquatic consultancy (Colclough and Coates - SC2). I was asked to remain on the EP as a paid consultant. In practice, most of the work of the EP had been completed by 2011. The panel was finally disbanded by EDF in November 2017, with little activity after 2013.

1.6. Also, upon leaving the EA, I was invited by my Institute, the Institute of Fisheries Management to set up a new Estuarine and Marine Section, which I chair today.

1.7. As a consultant, between 2016 and 2019 I provided technical support to NRW over Wylfa NNB design and development in Anglesey. My role was simply to provide assurance to NRW that specific CW design elements did meet the EA 2010 Guidance, as stated by the developer. That work ceased when Wylfa NNB development was halted in 2019.

1.8. I am appearing before this inquiry in a private capacity, on behalf of the NGO sector, the Severn Estuary Interests group.

2. TECHNICAL BACKGROUND EXISTING PRIOR TO 2013

2.1. The *Screening for intake and outfalls: a best practice guide. Environment Agency. Science Report. SC030231* (Turnpenny, A.W.H and O'Keefe, N. 2005) ("**EA 2005 Guidance**") (CD 9.3), first brought the prime mitigation measures relevant to this Appeal into best practice guidance, including low velocity intakes, velocity cap, acoustic fish deterrence ("**AFD**") and fish recovery and return systems ("**FRR**").

2.2. Section 7.3 in the EA 2010 Guidance confirmed that CW for NNB could still be recognised as BAT in UK estuarine and coastal locations, given the advances that have been made in the past two decades concerning the developments in fields such as AFD, low velocity intakes and FRR.

2.3. Section 19.8.26 in the Appellant's document *Hinkley Point C Development Site Environmental Statement – Volume 2 (October 2011) Chapter 19 – Marine Ecology* ("**ES 2011 Chapter 19**") (CD Ref SEI 19) describes the five main mitigation features recommended in the EA 2010 Guidance in order to meet BAT. These are –

- Location of the cooling water intake away from fish spawning grounds.
- Maintenance of low velocities (target _0.3m.s-1) at all tidal states via low velocity side entry ("**LVSE**") intake design.
- A cap ('velocity cap') across the top of the intake to prevent vertical intake currents, which fish find it difficult to avoid.
- Fish deterrent system fitted to the cooling water intake structure to provide avoidance cues.
- Fish Recovery and Return (FRR) system to intercept and return any fish not repelled by the intake fish deterrent system (e.g. hearing-insensitive species).

2.4. Later sections in the same report describe how these measures will all be built in to the HPC design process. Later sections concur with both the EA 2005 & 2010 Guidance that the AFD, LVSE and FRR are designed to work together. They provide complimentary mitigations. Hearing specialist fish species will take avoiding action at the range at which the AFD is effective. Non-specialist species may be able to swim away from the LVSE design given the low intake velocity design and velocity cap. Those more robust species that are impinged can be returned to the estuary via the FFR with as little damage as possible.

2.5. The options appraisal conducted under the BEEMS project for the siting of the cooling water intakes for HPC is summarised by the Appellant in section 2.4 in Document B. 4 NNB-308-REP-000710 (CD 1.5). The location is based on the balance of a range of considerations including geology, operational efficiency, health and safety, avoiding bed sediment transport, limiting the entrainment of fish (including larval and egg life stages) and other aquatic fauna and avoidance of thermal recirculation by proximity to the outfall. The location should also be close enough to the station to reduce the pumping capacity required by the cooling water system. Extensive coastal modifications would be required to secure a cross-shore intake with sufficient depth of water at all times. Due to the significant environmental impacts of such a structure, an inshore intake location was rejected. Two locations were assessed for a suitable offshore location. A final location some 3.3km offshore was selected on the balance of the considerations outlined above.

2.6. There is an assumption made by the Appellant in ES 2011 Chapter 19 (**CD Ref SEI 19**) and other documents that an offshore intake will entrain less fish simply because of its location, since fish densities will be lower at depth. I disagree with this statement and support comments made by Devon & Severn IFCA in their response (**CD 15.5**) that there is growing evidence that produces a much more complex picture. Estuaries are highly dynamic environments and we still know little of the complex ecology associated with these waters. There is significant uncertainty in this assumption by the Appellant. It was recognised at the time of the intake site selection that this is a novel application globally, highlighting further uncertainty over performance of the system. As a wider background, two information papers (Colclough, 2013 (**CD Ref SEI 20**); Colclough, 2018 (**CD Ref SEI 21**)) which describe the complex ecology of fish species in estuaries and associated habitats such as saltmarshes are appended to this Statement.

2.7. Section 2.5 in Document B. 4 NNB-308-REP-000710 (**CD 1.5**) describes the LVSE intake. The document notes that the intake was designed using principles described in the EA 2005 Guidance. The LVSE design evolved from past experience at other nuclear power stations and to this point had not been implemented anywhere, this was an experimental design, a logical evolution of past experience certainly, but as yet untested in the field. This is recognised in section 19.8.29 of the 2011 ES Chapter 19. The report noted "Numerical hydraulic modelling demonstrated that the LVSE design adopted for HPC and shown to offer more uniform low-velocity profiles and therefore perform better than the LVSE reference design". Nevertheless, this is a novel field application and introduces another area of uncertainty over performance of the CW system.

2.8. Section 2.3.3 in Document B. 4 NNB-308-REP-000710 (**CD 1.5**) states that the location of the intakes was established prior to the selection of the AFD technology.

2.9. Sections 19.2.239-325 of the 2011 ES deals with impingement of fish. A detailed description is provided of how offshore and inshore fish surveys demonstrate that the fish community found close to the proposed new intake is similar to that found near shore close to by HPB intake. On that basis, a decision was made to base estimation of the unmitigated impingement at the proposed HPC intake on that seen in the CIMP surveys at HPB. Given that such an offshore intake is novel, there is further uncertainty embedded in the process here, as described above.

2.10. Sections 19.10.26-27 of the 2011 ES describes a fish impingement/ entrainment monitoring programme that will be developed and implemented using available best practice guidance. This is recommended in both the 2005 & 2010 EA Guidance as good practice, one way to address uncertainty and to improve future more sustainable design.

Of note the report states "*This will include tests of the AFD system, such as those described above, to define the benefits of both the AFD system itself and the LVSE intake design and location against the HPB base, should HPB still be operating. This will inform enhanced operation of the AFD and FRR systems as necessary as well as informing sustainable decision making at other sites*". Furthermore, "*The comprehensive impingement monitoring programme (CIMP), utilised to estimate likely impingement catches of HPC for this ES, will be re-established for a single annual period at HPC in order to confirm these previous estimates*".

3. CURRENT ENVIRONMENTAL PERMIT APPEAL

Criticism of impingement data

3.1. My colleague Dr P.Henderson, a well-respected international expert in the field of impingement and entrainment of fish at power station cooling water intakes has produced a detailed review of the impingement data (**CD 10.3**) in the new work undertaken by the appellant in document TR456 (**CD 1.11**). He has identified serious flaws in the processes and logic used to assess impingement for HPC. Dr Henderson deals with five key issues in detail. He concludes that overall, there has been a significant under-estimation of impingement at HPC. I wholeheartedly agree with every statement made by Dr Henderson in his review document (**CD 10.3**).

3.2. A summary of the five key issues raised by him appear below -

(i) Estimates are based on the use of the incorrect filter screen mesh size. Estimates are made for a 10 mm mesh, but the proposed C station will use a 5 mm mesh. This results in a great underestimate of impingement. Cefas has not used data available from entrainment studies at Hinkley B to estimate the number of fish which presently penetrate the 10 mm mesh.

(ii) The sampling undertaken on the B station is claimed to be heavily biased because samples are collected on the ebb tide. I will show that this bias does not exist and data on fish deterrent trials was incorrectly used to claim this reduction.

(iii) C station impingement is claimed to be lower because it will be a capped design not used on the Hinkley B intake. This is erroneous for a number of reasons. First, the structure of the B station intake is incorrectly characterised, it does in fact function like a semi-capped intake and second, capped intakes do not reduce impingement of all clupeid species. The argument for the utility of a cap is based on Sizewell A & B intake comparisons these data have been incorrectly used. For example, this comparison showed no reduction for herring.

(iv) An argument is made for a reduction in C station impingement linked to the orientation of the screens in relation to tidal streams. Data from the B station and other power stations shows no scientific basis for this reduction.

(v) It is assumed that a linear relationship exists between water flow and number of fish impinged. Double the flow and the fish capture is doubled. This is incorrect, impingement has a power relationship to flow. The result is that the potential impingement on the exceeding large C station intake is greatly under-estimated.

3.3. Another international expert, and colleague in the field, Dr Andy Turnpenny, has produced a further detailed critique (**CD 10.2**) of the work developed by the appellant in TR456 and related matters. I agree with his review completely. That review is also appended to SEI's Statement of case. (**CD10.2**)

3.4. I will add one further potentially large flaw in the logic set out to upscale the HPB impingements to the unmitigated HPC estimates. This is dictated by a combination of the physical locations of the HPB & HPC intakes and our limited current understanding of fish movements in truly dynamic environments such as estuaries (Elliott, M. 2002). Seasonal movements of non - migratory estuarine and marine fish species in estuaries have been well described, as has the use of selective tidal stream transport to effect migrations through the estuary by some estuarine and marine species. (Colclough et al, 2000 (**CD Ref SEI 22**) & Colclough et al, 2002) (**CD Ref SEI 23**); (Elliott et al, 2002). Section 19.4.98 of the 2011 ES (**CD Ref SEI 19**) describes how flounder and plaice move shorewards on rising tides to feed, utilising selective tidal stream transport. Laffaille et al (2000) (**CD Ref SEI 24**) and Colclough et al (2005) (**CD Ref SEI 25**) have described how both benthic and pelagic species move actively into the intertidal zone to feed in productive shallow warm water refugia away from predators, often arriving near the surface, only to withdraw on the ebbing tide in the deeper channels. This opportunistic behaviour provides competitive survival advantages. The importance to juvenile fish of the intertidal zone is noted in Section 19.4.130 of the 2011 ES (**CD Ref SEI 19**) in relation to the intertidal fish surveys undertaken. What is less well understood is that most of the more stenohaline estuarine and marine species, both pelagic and benthic, do not remain static but are continually passively moving with the tidal stream twice a day, both up and down the tidal channel and/or up and down the shoreline. In part this a feeding strategy but also in part to maintain stasis. Salinity is one of the great drivers of fish distribution in estuaries and also one of the main environmental stressors (Costa. M.J et al, 2002). Passive movement with the tidal stream to maintain stasis is energetically preferable in terms of osmotic pressures (Able, 2005) (**CD Ref SEI 26**); (Becker et al, 2016) (**CD Ref SEI 27**). HPB is sited 640m offshore with a minimum water depth above the intake at extreme low tide of 3m. HPC is 3.3km offshore with a minimum depth of 7-8m.

3.5. In TR456 (**CD 1.11**), the Appellant contends that fish densities will be lower at the HPC intake because of the deeper water. This is an assumption, with no evidence provided (see Section 2.6 above). We have little knowledge of the dynamic movements of fish at depth in estuaries. In a worst case scenario, shoals of pelagic species moving at depth will be swept passively past the HPC intake up to four times a day, on both the flood and ebb tides, unsighted in turbid conditions. In this scenario, an AFD would have provided some protection through avoidance at reaction distance.

The AFD mitigation measure

3.6. The rationale for not applying the AFD mitigation measure, as specified in the DCO and permitting in 2013, is set out in document NNB-308-REP-000710 (**CD1.5**). Section 3.1.2 confirms that the location of the cooling water intakes was made prior to the DCO decision in 2013 and that the DCO process validated that location. The Appellant had agreed to implement the full suite of mitigation measures as part of the DCO decision. Section 3.3.1 provides a timeline for consideration of the AFD design. A pre-optioneering phase took place between December 2015 and April 2016, an optioneering phase between April and October 2016 and finally a consolidation/ design development phase between November 2016 and December 2017. Section 4.2 describes the site-specific constraints pertaining to implementation of AFDs at HPC. On 15 February 2019 the Appellant submitted to the Environment Agency an application to vary the Hinkley Point C Water Discharge Activity Environmental Permit (EPR/HP3228XT) (**CD 1.2**), seeking the removal of the condition to install an AFD.

3.7. This offshore intake including both the AFD (established technology) and an LVSE (novel in itself) was accepted by all in advance as a novel intake arrangement, with no precedent. Given the embedded uncertainty, the precautionary principle would insist that if an item like an AFD was to be considered critical to comply with BAT, in a novel circumstance, critically in close functioning with a yet to be designed LVSE (also critical to BAT), in a site with multiple conservation designations, then either full and robust testing of some analogue would have to be conducted prior to the consenting process and/or or some consideration of contingency action post-commissioning had been considered in advance.

3.8. To the lay reader the appellant's case to remove the AFD in NNB-308-REP-000710 (**CD1.5**) appears to provide a comprehensive and very full analysis. Some expert opinion would not agree. The FGS Appeal letter, document reference -1384R0403 (**CD 10.4**) finds significant flaws in the Appellant's case. FGS point to a fundamental misunderstanding of the purpose of AFD technology. They note that the three elements of mitigation, low velocity intake, AFD and FRR are designed to work together, as described in both the 2005 & 2010 EA Guidance. Without the AFD, the FRR will result in the mass mortality of the delicate pelagic species that enter the cooling system. Document TR493, HPC-DEV024-XX-000-RET-100122 (**CD 1.15**) notes that "*delicate species such as sprat are expected to have 100% mortality within the FRR system*". Yet elsewhere in the same report the statement is made that during peak periods sprat can account for 76% of the total fish impingement at HPB. What is not included in HPC-DEV024-XX-000-RET-100122 (**CD 1.15**) is a statement that as a hearing specialist, the AFD will be very effective at deterrence of sprats at range, permitting avoidance in turbid conditions when the fish are unsighted. The complex food webs associated with estuaries are still poorly understood. Henderson and Henderson (2017) (**CD Ref SEI 28**) in a long-term study of the factors regulating growth, condition and survival in sprat in the Bristol Channel demonstrated clear evidence of some local functioning in the population. There is no knowledge available on what impact significant losses of sprat might have elsewhere in the food chain locally, for example on species which predate on sprat.

3.9. In TR 493, HPC-DEV024-XX-000-RET-100122 (**CD 1.15**), the Appellant notes that there are currently no AFD systems and suppliers that can meet the requirements at HPC. In a detailed response, FGS contend that there is a misconception here of technical progress in the field. They assert that suitable AFD systems are available that will meet all of the published requirements. They acknowledge challenges associated with the HPC intake heads being 3 km offshore, but contend that there are suitable systems available and experience of installation at less accessible sites than HPC. They contend that the diver assessment is overly pessimistic and based upon overly conservative assumptions that do not allow for any improvements through diver familiarity with the system, nor any attempt of achieving efficiencies by managing tasks more effectively. Development in ROV offshore technology can be brought to bear. ROVs can be used to access the AFD. Finally, FGS contend that the issues raised by the Appellant can be addressed and the report does not constitute justification to remove the AFD requirement. A similar case about the availability of suitable AFD systems is made by Dr Andy Turnpenny (**CD10.2**). I would recommend that that there is such a dichotomy between the Appellant and noted experts in the field that this issue of the applicability or otherwise of the AFD should be thoroughly addressed and tested as an urgent matter, given the potential implications of permitting the removal of the AFD requirement.

Uncertainties

3.10. The DCO and permitting process were completed in 2013 on the evidence presented between 2008 and 2012. All of the fish data referred to in the variation order documentation from the Appellant refers to the period 2008-2012. It is accepted practice in infrastructural projects today that suitable environmental data should be no more than 5 years old. Given the statements made by both the Appellant, Environment Agency and other respondents in several reports concerning the implications of climate change on local fish communities. I would contend that it is questionable as to whether this historical data is still fit for purpose.

3.11. I have carefully read the revised impingement estimates presented by the appellant in TR456 (**CD 1.11**) and also all the EA documentation developed in the evolution of this Appeal process, including the AA and all of the Technical Briefs. Given that there are significant uncertainties in this process and that expert judgement has to be exercised with most of the content, I find myself very broadly in agreement with the statements and judgements made by the EA. I would agree with the statement by Natural England in the EA SoC (**CD 6.2**) that the documentation provided by the EA 'is the product of sound scientific judgement and takes into account the best and most recent science and evidence'. I find that on balance, I support all of the judgments about site integrity made by the EA in their SoC (**CD 6.2**).

3.12. No information on design or performance of the LVSE was available prior to the DCO. There is no clear evidence presented in TR456 (**CD 1.11**) to explain satisfactorily why the LVSE is now so efficient that there is no significant impact on the fish species assessed. Nor is there any examination of the case with an AFD plus LVSE (as originally specified), suggesting that the Appellant regards the AFD and its role as superfluous. Given that sprat forms 50% of the predicted impingement, as a hearing specialist, an AFD would reduce the impingement significantly as a behavioural cue.

3.13. I do not accept the concept that "*there is no such thing as a biological population at the estuary level*" as described in TR456 (**CD 1.11**). There is sufficient information put forward by both the EA and Devon and Severn IFCA to indicate that this is most certainly the case for a number of well researched species. I would reference two further papers in support of the evidence base for some local functioning within the fish communities associated with the Severn Estuary. As described above in Section 3.8, Henderson and Henderson (2017) (**CD Ref SEI 28**) demonstrated clear evidence of some local functioning in the population of sprat in the Bristol Channel. In a similar long-term study on whiting recruitment and population regulation in the Severn estuary, Henderson (2019) (**CD Ref SEI 29**) same to a similar conclusion for this species too.

3.14. I do not support the general use of ICES stock units as a suitable form of assessment in this instance. There is sufficient evidence put forward by both the EA (TB011) (**CD 8.10**) and Devon & Severn IFCA to clearly demonstrate that more discreet management units reflecting a modern understanding of fish ecology are far more appropriate here. Furthermore, the ICES stock unit system was designed to manage marine fish stocks which might be spread over significant distance, but assumed to be homogenous. The system was never designed for use in an estuarine environmental impact assessment or HRA process. The scale of the management until adopted obviously has a close bearing on the significance of the impact.

3.15. In the ES 2011 Chapter 19 (**CD Ref SEI 19**), the Appellant predicted that entrainment will have a minor adverse impact on ichthyoplankton on the basis of low sensitivity and magnitude. Devon and Severn IFCA correctly point out that the screening out by the Developer of fish entrainment as a significant factor in the Habitats Regulations Assessment (HRA) is an error because the effects of entrainment and impingement should be taken in combination to estimate total fish mortality due to CW abstraction. This is standard procedure, as set out in EA Guidance 2010 (**CD 9.4**) (p.102-104). Although entrainment rates will not be affected with or without AFD, the effects on total fish mortality cannot be assessed without following this process. The Appellant conducted a joint survey programme with the EA to assess glass eel in the vicinity of the HPC intake over a 2-year period in 2012-13. The study consisted of three separate campaigns during the peak migration period for glass eels in February to April. The surveys were undertaken over the full width of the estuary at Hinkley Point at up to three different depths and consisted of 323 fishing tows with gear optimised for sampling glass eels. The Appellant in SPP107 (**CD 7.10**) and the EA in TB004 (**CD 8.2**) have come up with different conclusions based upon the same data set. The two parties disagree about the depth distribution of the glass eel conclusions that can be drawn from the data. This dichotomy demonstrates yet more uncertainty in the process. Entrainment monitoring must be taken forwards as part of the suite of operational monitoring of the station.

3.16. The Appellant makes the point in TR456 (**CD 1.11**) that the overall abstraction in the Severn estuary from power station intakes has been falling so far in recent decades that the establishment of HPC will not elevate that above past historic levels. Furthermore, they contend that the reduction in impingement associated with decommissioning of HPA could not be detected in the HPB monitoring dataset. I can only draw the conclusion here that the presumption being made is that there was no detectable impact from the HPA impingement.

In my view this is a rather simplistic argument. Our monitoring tools may not be sufficiently subtle yet to detect such changes in impact in the short term in these highly dynamic environments, but that does not mean that the long-term impacts are invisible or not relevant. Historical impingement through HPA and elsewhere in the Severn will have been a pressure on the system and a threat to site integrity alongside many other pressures. Favourable condition is much more certain in the abatement of these pressures, providing greater resilience to climate change.

3.17. The EA 2010 guidance was reviewed with a scoping report (Horsfield, 2018) (**CD Ref 9.1**), followed by further reviews (Scorey & Teague, 2019) (**CD Ref 9.2**) and (Seaby, 2020) (**CD Ref SEI 30**). Although these later documents pose more questions and recommend further studies, they confirm that little new robust evidence has arisen since 2010 and therefore on balance the 2010 Guidance with the need for the suite of measures specified including AFD is still considered BAT in specific circumstances. The 2020 review does express the urgent need for research into barotrauma. The BEEMS project commissioned a series of trials with an Entrainment Mimic Unit which is designed to faithfully reproduce the complex of environmental pressures that an entrained fish would experience in transit through a CW system. Table 19.31 in the ES 2011 Chapter 19 (**CD Ref SEI 19**) depicts survival estimates for the egg and/or larvae of sole, turbot, bass and eel based on some of the EMU trials. As far as I am aware much of this data has yet to reach the public domain. This issue will be particularly relevant in the light of this novel intake design based upon 3.3km tunnels. If no barotrauma data is available, a precautionary approach is needed and uncertainty should be recognised.

3.18. Both the Appellant and the EA have made statements about the impacts of climate change. It is imperative that the scale of the potential impacts here is fully considered, given the operational life of the new station and the subsequent decommissioning period. From an ichthyological standpoint, warming seas will see the replacement of some more Arctic-Boreal (coldwater species) with more Lusitanian (warmwater) species. That process has been evident in our seas and estuaries for the past 25 years. On this subject, I make reference to Item 6 in the Review conducted by Dr. Turnpenny as appended to SEI's statement of case which I fully support. Dr Turnpenny (**CD 10.2**) cites the twaite shad as one species that may well become much more common in the estuary in future years. This is another hearing specialist species that an AFD would provide effective protection for.

The sturgeon

3.19. I turn now to another warm water species that until now has not been considered in this application, simply because we did not have historical evidence in depth until very recently.

3.20. On behalf of Defra and as an EA employee of the EA, I represented the UK in a Bern Convention meeting about the common or sea sturgeon *Acipenser sturio* in Bordeaux in 2006. In response to the meeting, I developed a database of some 135 sturgeon reported from UK waters since 1800. French and German restoration programmes are now underway in the Gironde, Elbe and the Baltic. Sturgeon are anadromous, spending most of their life in shallow coastal and estuarine waters and running up rivers to spawn in the summer months. Unlike the salmon, 5-10% of sturgeon stray to spawn elsewhere. Adolescents spend up to 10 years in the estuary before migrating to sea. Some adolescents can travel great distances to spend the last part of that life phase in other estuaries. French and German expert opinion for the past few years has been that sturgeon originating from their works will start to appear in our coastal waters rivers and estuaries in due course, probably seeking out waters they were once present in. In practice this return started in 2016. Since then, we have had 6 individuals, all late adolescents at 1.5m plus. The most relevant here was a stranded corpse reported from the shore close to the mouth of the river Dyfi in South Wales in September 2019.

3.21. The advent of new digitised searchable databases of newspaper archives has produced a wealth of new information on past sturgeon records in the UK over the past 18 months. We now have records of some 5000 plus fish in UK waters since 1700. Of these, 1400 plus were reported in rivers and estuaries. There is significant evidence of seasonal migrations of singles and groups of fecund fish suggesting intent to spawn, although very little definitive evidence of actual reproduction has yet been found. On the basis of this UK data, German and French experts are now convinced that UK rivers, estuaries and coastal waters once formed part of the normal habitat range for the species. That conviction now appears in a new OSPAR Assessment of the status of the species in Europe. A UK Sturgeon Alliance has now been formed to promote the interests of sturgeon in the UK and to seek recognition of this as a UK native species, against the special background that this is probably a pan-European population. An evidence report (**CD Ref SEI 31**) will soon be presented to Defra JNCC, NE, NRW and other interested parties. Given that 20% of the records available come from the Severn catchment, this will be the initial focus of the Alliance, working with the Unlocking the Severn Project.

3.22. The UK government has responsibilities for this species in our waters as numbers increase, irrespective of native status, under several international conventions. Today it is one of the most threatened fish species in Europe, being in critical danger of extinction (IUCN Red List 2010). The species is now strictly protected under International and European legislation (e.g. OSPAR, CITES, Bern Convention, European Habitats Directive) as well as under national legislation in most countries of its historic range. In the UK the species has protection under the Wildlife and Countryside Act, 1981 and is listed as a priority species in the UK BAP.

Table 1:

A breakdown of sturgeon records in the Severn Catchment Area since 1718
River Severn from Diglis downstream to the Bristol Channel -**224** records from 1718-1989. (Only 50 fish after 1900) **River Wye** – **31** records between 1765-1902. **River Usk** - **13** records between 1749-1990 (only 2 after 1900, both 1990's) **River Parrett** - **16** records between 1829-1914 **Bridgwater Bay** (location specifically cited in record) **- 5** records between 1850 -1878 Of note, **3** fish have been reported from the stake net fishery operated by Messrs Sellick at Stotfold in 1873,1878 & 1937. **Bristol Channel** - **25** records between 1804-1984 <u>A total of some **313** fish.</u>
Looking further afield
River Tywi - **63** records between 1815-1990 (only 20 after 1900) **Cardigan Bay, Pembroke and Swansea Bay** - **92** records between 1806-1947
<u>Grand total of **473** records.</u>

3.23. This is the second largest concentration of records in Britain. The North Sea is the largest concentration of sturgeon reports in Britain, but some of the landings at East Coast ports may have been captured close to continental coasts. There are also now some 400 plus records of sturgeon in Irish waters over the same time period.

Technological advancements

3.24. One of the issues at play here is simply the passage of time against a background of rapidly improving technology, science and policy. Technology around AFD systems in particular is evolving rapidly as described by FGS, as is our understanding of fish in these dynamic environments.

3.25. To quote a statement made by a number of respondents to this Appeal, we are suffering two modern crises, which are necessarily linked, climate change and biodiversity. It is imperative that any new energy production system employs technologies that do not negatively impact on already threatened species and habitats.

3.26. On a wider front, the government has funded studies by a consortium including Rolls Royce to look at a future generation of small modular reactors (SMRs), learning from the defence sector. These can be assembled much more cheaply either singly or in multiples, are inherently safer, and even if using a CW system apparently use much less water. The cost to supply the electricity is likely to be more in line with renewables. A pilot plant is planned for the early 2030’s. I understand that the Welsh Government are investigating compulsory purchase of the Wylfa NNB site in Anglesey to promote development of a suite of SMRs. Over the past decade the economic case for combined cycle gas turbine power stations has been almost destroyed by the rapidly falling cost of constructing and supplying renewable energy.

4. COMPENSATORY MEASURES

4.1. If the scale of residual impacts proves to be greater than expected, what ameliorative actions can be taken at that point? As pointed out by Devon & Severn IFCA in their letter to the Appeal (**CD 15.5**), there is no adaptive management that can be undertaken in the management of the CW system at that stage.

4.2. This issue is dealt with briefly in the EA 2010 Guidance **(CD 9.4**) section 7.4 dealing with residual impact:

“*For a major project to proceed, impacts remaining after all mitigations have been applied must be deemed acceptable or compensated in some form. Recent years have seen much progress in the development of ecological compensation measures, both overseas and in the UK. The main requirements are that compensation should as far as possible be like-for-like and commensurate with, or an improvement upon, the level of impact. In practice this means exceeding the estimated loss, as replacement measures are often of lower quality than the original or may take time to develop. More recently, compensation habitat for UK port developments has been provided through managed coastal realignment projects.*”

Some of these compensatory measures have been conducted outwith the strict regulatory process of the Habitats Regulations. Some have been conducted in advance of completion of the development, rather than in response to any performance monitoring.

4.3. The EA 2010 Guidance includes a protocol termed habitat production foregone, also known as equivalent area of lost production EALP. This is a means of visualizing the habitat required to produce a given production of fish equivalent to that lost through impingement mortality. Fish production figures for intertidal habitats are available in the US where such studies have been underway for the past 50 years, but such figures are not yet available for UK locations.

4.4. I would argue that the uncertainty outlined in this development is sufficient to warrant some form of compensatory measures over and beyond adequate mitigation. This would be the case even if the Appeal was denied and the AFD incorporated. The scale of uncertainty would be greater without the AFD and this should be reflected in the compensation provided. There are a number of newer policy drivers in the UK now to encourage such action, which are raised in our SoC (**CD 6.4**). For example, the Government's 25 Year Plan adopts a more holistic approach and a move towards an Ecosystem approach to fisheries management. Estuaries are becoming better protected as they are recognised as areas of Essential Fish Habitat given the importance these dynamic and productive environments have for the early life stages of a range of conservation, commercial and recreational fish stocks.

4.5. Whatever the decision in this appeal it is vital that full impingement/entrainment monitoring of the performance of the CW system is conducted over an extended period given the novel elements in this design. That monitoring requirement should also extend to any compensation measures agreed.

4.6. I deal with the types of compensatory measures that might be applicable in this case in a separate note appended to this Witness Statement. (**CD Ref SEI 32**)

5. STATEMENT OF TRUTH

5.1. I confirm that I am able to give evidence in light of my relevant experience as summarised above. I can confirm that the opinions given in this proof of evidence are my true professional opinions.

Signed: S.R. Colclough

Dated: 6th May, 2021

SEI ADDITIONAL LIST OF DOCUMENTS:

Reference	Title
SEI 19	Hinkley Point C Development Site Environmental Statement – Volume 2 (October 2011) Chapter 19 – Marine Ecology
SEI 20	Colclough. S, 2013. Fish Ecology in Estuaries. An information paper for Defra.
SEI 21	Colclough, S. 2018. Saltmarsh and Fish - A UK Perspective. An Information paper for for Defra.
SEI 22	Colclough, S. R., Dutton, D., Cousins, T. & Martin, A. (2000). A Fish Population Survey of the Tidal Thames. Bristol: Environment Agency.
SEI 23	Colclough S.R., Gray G., Bark A. and Knights B., 2002. Fish and fisheries of the tidal Thames: management of the modern resource, research aims and future pressures. Journal of Fish Biology 61(Suppl. A), 64–73
SEI 24	Laffaille P., Feunteun E. and Lefeuvre J.-C., 2000. Composition of fish communities in a European macrotidal salt marsh (the Mont Saint-Michel Bay, France). Estuarine, Coastal and Shelf Science 51, 429–438.
SEI 25	Colclough S., Fonseca L., Astley T., Thomas K. and Watts. W., 2005. Fish utilisation of managed realignments. Journal of Fisheries Management and Ecology. 12, 351-360.
SEI 26	Able K.W. 2005. A re-examination of fish estuarine dependence: evidence for connectivity between estuarine and ocean habitats. Estuarine Coastal and Shelf Science 64: 5–17.
SEI 27	Becker, A., Holland, M., Smith, J.A. et al. Fish Movement Through an Estuary Mouth Is Related to Tidal Flow. Estuaries and Coasts 39, 1199–1207 (2016)
SEI 28	Henderson, P.A. and Henderson, R.C., 2017. Population regulation in a changing environment: Long-term changes in growth, condition and survival of sprat, Sprattus sprattus L. in the Bristol Channel, UK. Journal of Sea Research, 120, pp.24-34.
SEI 29	Henderson, P.A., 2019. A long-term study of whiting, Merlangius merlangus (L) recruitment and population regulation in the Severn Estuary, UK. Journal of Sea Research, 155, p.101825.
SEI 30	Seaby, R. Nuclear power station cooling waters: protecting biota. SC180004/R1 Environment Agency – April 2020
SEI 31	Colclough, S. 2021. The Common or European Sturgeon Acipenser sturio L, 1758). An evidence report of the history and status of the species in Great Britain (unpublished). UK Sturgeon Alliance.
SEI 32	Colclough (2021), *The case for compensatory measures at Hinkley HPC*