Briefing Note: Cooling Water – Why all the Fuss?

All thermoelectric plant use very large amounts of cooling water to condense the steam which spins the turbine to generate electricity. The heat used can come from the burning of any fuel eg, coal, gas or oil, or by using uranium. A typical cooling water circuit is shown in Figure 1, and I have indicated the position of screens etc where fish can be Impinged and Entrapped.

Unfortunately, both the Government (through their Energy Policy – 'Overarching National Policy Statement for Energy (EN-1) and National Policy for Nuclear Power Generation (EN-6) and the Environment Agency with their report 'Cooling Water Options for the New Generation of Nuclear Power Stations' advocate 'Once Through' or 'Direct Cooling' as the 'Best Available Technique' (BAT). Until this policy is changed (as it has been in the United States) we will continue to see hundreds of thousands or millions of fish, fish eggs, larvae, crustaceans, shrimps etc killed each year: This is **What the Fuss is about!**

Environmental and Social Aspects of Cooling.

In the World Nuclear Association – Cooling Power Plants (updated February 2018) it states. "Each of the different methods of cooling create their own local environmental and social impacts. In the case of direct (once-through) cooling, adverse impacts include the amount of water withdrawn (my insert – in the case of Hinkley Point C this is **2.5 Billion Gallons Per Day from the Severn Estuary)** and effects upon organisms in the aquatic environment, particularly fish and crustaceans. This latter includes both fish kills due to Impingement (trapping of larger fish on screens) and Entrapment (drawing in of smaller fish, eggs and larvae through the cooling system) and change in ecosystem conditions brought about by the increase in temperature and possible chemicals introduced to control biofouling (Sodium Hypochlorite or Electrochlorination)"

You may be aware of the amount of fish killed at the current Hinkley Point B station – **some 2.05 tonnes per day-equivalent to ¾ the total capacity of Wimbleball Reservoir every day!.** HPC is likely to kill far more than this I have estimated **at least 4 times** this based on the increased flow. Please note that the daily figure quoted above is not something I have 'plucked out of thin air'! It comes from personal knowledge and some 20 years of monitoring fish trapped by Pisces Conservation ltd (Dr P.A Henderson, Managing Director and Professor of Zoology at Oxford University). Further, in a paper entitled 'Are Coastal Power Stations affecting Northern European Inshore Fisheries' He outlines the numbers of fish etc killed by the 45 Coastal and Estuarine Power stations in the UK, and the numbers are staggering EG for eggs, 9.66 X 10 to power 7 and fish 1.08 X 10 to power 8.!! Of course, added to this are other large users of cooling water such as petrochemical plant. He adds, "the fate of animals sucked in with the water depends on their size. Fish less than 30millimetre in length are caught by the screen of 2.5 – 10 mm mesh. These impinged fish are killed, even if a return system is installed. Those which pass through the screens travel via the condenser circuits to be discharged to sea. Few survive passage as they suffer mechanical, temperature, biocides and pressure damage"

It must be said that the 'modern' approach is to provide mitigation to reduce the problem such as Low Velocity intakes, Acoustic Barriers, Screening and Strobe lighting. (In a Guide to Best Practice for Intake Screening –Turnpenny and O'Keefe- recommend that the following

measures should be implemented to REDUCE impingement: 1) Intakes should be designed to reduce the face velocities to a target flow rate of 0.3metres per second. 2) A suitable fish deterrent should be fitted at the intakes that will work synergistically with the Low Velocity intakes,(LVI) and 3) that a fish recovery and return system should be fitted to IMPROVE the survival rates of those fish that are impinged. Unfortunately, in my experience, these are not effective – certainly not for all species. The LVI is equivalent to 1 foot per second, and whilst many large fish can possibly escape this speed, small fish, larvae and fish eggs certainly will not.(see Henderson above). In the Environment Agency document 'UK RD33 'Cooling Water options' the author states that at Hinkley B the acoustic barriers installed only achieved an INCREASE in entrapment, especially of Sprat!

I have previously indicated that there are viable alternatives for new stations, however the only way in which the fish problem can be avoided is by the use of Air Cooling, again, this has been ruled out by the UK Government on the basis of cost and the energy required for operating the cooling system, and the Summer temperatures!!(Air Cooling is installed at a CCGT station in Kent). Cooling Towers are a suitable compromise, and these can be 'Natural Draught' or Low Profile Hybrid Towers see Fig 2 for examples. Whilst the Low Profile Hybrid Cooling Towers that I am recommending still require a vast amount of water to 'fill' the closed system, this is basically a 'one-off' operation. After this only very limited volumes of water are required to compensate for 'evaporative losses' etc. Again, energy is required to drive the fans required for the 'forced draught'. The 'natural draught' towers require no energy, but, as can be seen they suffer from the disadvantage of being very high – between 122 to 200metres (396ft to 650ft).

I have brought all of these matters to the attention of Central Government, the Chairman of the Environment Agency, EDF – both the CEO in Paris and the MD of HPC-, Horizon Nuclear, Hitachi in Japan and others. Whilst not relevant to D&SIFCA I am Registered as an 'interested Party' to the current Wylfa Nuclear Power Station in Anglesey, and the Natural Resources Wales (NRW) to try and persuade the Infrastructure Planning Inspectorate to give permission for Cooling Towers Only and for NRW to only issue a Permit for water from a cooling tower(s).

In my view, the D&SIFCA (and others in the UK) should unite in its Opposition to the UK Government and the Environment Agency on the issue of Direct Cooling, if for no other reason than its deleterious effect upon fish, and to prevent further mortality. I hold the opinion that the fish mortality problem caused by direct cooling far outweighs any other source!

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