Together Against Sizewell C

TASC IP No. 20026424

Comments on proposal to construct a desalination plant Sizewell C

Author Dr P A Henderson

Prepared Monday, 04 October 2021

I am a marine biologist with extensive experience working on wedge wire screens for the protection of water intakes in both the USA and the UK. I also have an in-depth knowledge of the ecological issues linked to power generation having worked in the field for over 40 years. I lecture and hold the position of Senior Research Associate in the Department of Zoology, University of Oxford, UK. I am an ecological consultant and research scientist with 40 years' experience combining theoretical, applied, and field research, with extensive experience of the management of major ecological assessment projects including preparation and presentation of material for public enquires and liaising with conservation bodies and engineers. Projects undertaken include conservation planning for large tropical nature reserves, ecological effects studies of nuclear power station intakes, conservation studies of rare freshwater life and effects of climate change and drought. I have written 7 books including the standard textbook Ecological Methods.

I itemise below a series of points relating to marine impacts of the proposed desalination plant.

1. The efficiency of wedge wire screens.

Wedge wire screens are only protective to marine life if they are not fouled. This is because fouling creates velocity hot spots and small organisms and young fish will be killed if they are drawn against the screen in these hot spots. We are told that they will use air burst anti fouling. However, there are no details of how this will be operated and maintained. Fouling will occur without good anti fouling procedures; far more information is required. I suspect they will have difficulty maintaining air burst cleaning away from the shore and it may be at best only partially effective for the reasons I describe below.

Wedge-wire screens have a proven ability to reduce both impingement and entrainment mortality at low volume intakes (to 2.5 m^3s^{-1}). Their effectiveness is related to (1) the slot width, (2) through-slot velocity, (3) existence and strength of ambient cross flow to carry organisms away from the screen, (4) the amount of biofouling and (5) the amount of ambient debris. As will be discussed below, the effectiveness of wedge-wire screens is linked to water velocity across the screen.

Wedge-wire screens with slot widths of 5 to 10 mm have been used to effectively eliminate impingement at freshwater cooling water intakes. They have rarely been used at marine or estuarine facilities, probably because of fears that biofouling and screen blockage would lead to operational problems. Small-scale trials of Johnson wedge-wire screens at Fawley in the 1980s showed that standard steel wedge-wire screens developed a fouling community (Bamber and Turnpenny, 1986). Even a Johnson 715 alloy (70% Cu: 30% Ni) screen that leached copper and thus poisoned organisms that had settled experienced some fouling.

It is clear that the reductions in impingement and entrainment possible using wedge-wire screens will be determined primarily by the slot width, the water velocity across the screen and the mix of species present at the particular locality. In marine locations the problem is that 2 mm slot widths which will greatly reduce entrainment losses of early fish life-stages when clean, are highly vulnerable to fouling. Trials in the USA show that for good protection, across screen velocities of 0.25 feet per second (fps) which is about 0.3 ms^{-1} are required. These are quickly exceeded when fouling occurs. This risk is clearly noted in the Design Criteria for Fish Screens in Virginia Gowan & Garman (1999) where on page 32 it states: "*Screens partially clogged with debris have hot spots where through-screen velocity exceeds approach velocity criteria."*

Reduction of the filtering area could occur if (1) there were high levels of debris in the water, e.g. seaweed, blocking the screens that were not efficiently removed by airburst cleaning, or if (2) biofouling occurred. Biofouling is the process by which a community of organisms gradually grow on the surface of the screen leading to the blocking of the mesh. Either possibility would lead to an increased in through-screen velocities. This is because as the biofouling blocks the slots the water must pass across a reduced cross-sectional area. If the volume of water pumped is to remain constant, the velocity must inevitably increase. I consider the possibility for increased through-screen velocity as a result of biofouling to be a very significant concern.

Biofouling is a constant threat to the functioning of screens and must always be considered. To quote from the EPRI (1999) report on Fish Protection at Cooling Water Intakes TR-114013:

"*From an engineering viewpoint, a primary concern with coarse or fine-mesh cylindrical wedge-wire screens at many projects is the ability to prevent or control biofouling. Biofouling of interior surfaces by organisms such as mussels, barnacles, bryozoans and zebra mussels is particularly problematic since these surfaces are not easily accessible for manual cleaning by divers.*"

All waters hold potential fouling organisms. For many filter feeding species, filter screens, with their steady gentle flow, are an ideal habitat. Occasional airbursts to clean the screens is unlikely to be effective against biofouling, however, because these organisms, unlike dead material such as leaves, are adapted to attach very firmly to the material. Further, the young stages can settle and grow inside the intake screens and air-burst is designed to remove material from the outer surface of the screen. It has also been found that airburst will not clean all the surfaces of a wedge wire screen. For example, the Evaluation of Delta Wetlands Proposed Fish Screens, Siphons and Pumping Stations report, produced for Dept. Water Resources, California, December 2001 states that:

"*The periodic burst of air can lift debris if there is a strong sweeping flow to carry away debris, but it does not replace periodic manual brush cleanings by divers. The advantage of this type of screen is that the screens are quite durable, if protected from heavy river debris, and do not have moving parts. The disadvantage is that the air cleaning is only marginally effective at cleaning the debris from the underside of the screens."*

Biofouling can be reduced if the screens are constructed from copper-containing alloys rather than stainless steel. In the Great Lakes, for example, where zebra mussels are a problem, a cupro-nickel alloy has been used. There is nothing in documentation to suggest whether the screens would be made of an alloy effective for repelling organisms. Moreover, in the event that a copper-nickel alloy were used, this would inevitably result in the leaching of small amounts of copper into the environment. The possible impacts of heavy metal leaching from such screens would be another impact to consider.

For wedge wire screens to be effective, there must be a sweep velocity greater than the through-screen velocity along the surface in order to carry debris and animals past the screen. The need for a sufficiently high sweep velocity is made clear in the EPRI (1999) report on Fish Protection at Cooling Water Intakes TR-114013:

"*Another factor that may limit application of wedge-wire screens in some environments is the lack of ambient currents to sweep organisms past the screen and carry backwashed debris away. This is an important requirement of this technology. Therefore, it may not be practicable to consider in water bodies without at least a low velocity cross-current.*"

I have not read of a tidal velocity analysis undertaken to allow the view that the sweep velocity will be sufficiently high to allow the wedge wire screens to function as required.

2. Chlorination

The intake pipe would inevitably foul without anti fouling procedures. The normal method on intakes is continuous low-level chlorination. This is not proposed. Periodic shock chlorination, as proposed, will use a far higher and highly toxic dose of chlorine to kill organisms living along the pipe work. What will happen to this chlorinated water? Will it be discharged to the sea? If so, what impact will it have on sea life?

3. The impact of brine discharge

Desalination produces a brine solution which they propose to discharge to sea. The problem is that high salinity water is denser than sea water and will flow along the seabed killing the benthic flora and fauna. They claim that by rapid mixing with the receiving waters they reduce the impact. However, it is very difficult to fully mix waters of differing density and we are given no details of the design or efficiency of these diffusers. The normal approach is to look at various designs and then undertake modelling to show the distribution of high salinity water. They have not done this work, or have not reported upon it. The proposal is quite unacceptable without a full study. There are specialist software programmes that do this modelling.

The ability to mix waters also depends on the temperature differential between the discharge and the receiving water. We are told the discharge will be at ambient temperature so no problem. But, is this air or sea ambient? On the East coast there can be a huge difference as anyone who swims regularly can testify. There is a hint in the text that they also do not believe the brine discharge will mix well. They state that the intake and outfalls would be… "*sufficient distance for the intake to minimise re-entrainment of the brine water*."

A final point of clarification is required. They describe the passive wedge wire screen as having a "2 mm mesh size". I think they mean a 2 mm slot width as wedge wire screens are made with strips of metal and not a square 2mm mesh.

Prepared Wednesday, 06 October 2021

At the ISH regarding the proposal for a temporary desalination plant on 5th October 2021, I asked the following questions setting out matters that appear to be absent from the Applicant's documentation but need to be clarified to enable an informed opinion to be made on these proposals:-

1. Noting that a 2 mm wedge wire screen will only be protective for marine life if it does not become fouled and develop velocity hot spots, how will the air burst system to clear passive debris off the screen surface be activated?

2. Air-burst creates noise- has the impact on marine life been assessed?

3. Because air burst cleaning cannot remove living organisms such as mussels and barnacles, biofouling organisms will be removed by shock chlorination. This is short-term chlorination at a high concentration which quickly kills marine life. (A) What chlorine concentration will be used? (B) What will happen to the toxic chlorinated water? (C) What is the chlorine source? I note that there is no mention of the installation of an electro-chlorination plant? (D) If chlorine is to be transported to site has the movement of a dangerous chemical by road been assessed?

4. The brine discharge is stated as being at ambient temperature. Is this air ambient or water ambient? At some times of the year these temperatures can be quite different. This is important because the CORMIX modelling was undertaken assuming no temperature differential eg water ambient. Water of different temperatures are difficult to mix so temperature differentials are important when considering whether the diffusers will successfully mix the brine with the receiving water.

5. 2 mm wedge wire screens are rarely deployed as a mitigation measure in fully marine environments because they are so vulnerable to fouling and becoming blocked. Council for EFD incorrectly asserted that the cylindrical wedge wire

screen was a standard fitting and not a mitigation device to reduce impingement and entrainment of marine life. If it is standard fitting can EDF point to any deployment of a 2mm screen in a fully marine environment or from personal experience describe their use as a standard fitting on a water intake in a fully marine environment? Their use in fresh waters is more common as they are less subject to biofouling and are more accessible for cleaning.