1. *"Please give quantitative data on species number and, if available, biomass of fish, crustaceans and other marine life impinged and entrained by the Sizewell B seawater cooling system in the past twelve months as well as for each of the previous five years. Please ensure to list includes all species of fish and crustaceans thus affected. Please confirm that these values are for a 10 mm screen and explain how these data can be used to estimate impingement on a 5 or 6 mm screen of the type planned for Hinkley C and, we believe, for a notional Sizewell C."*

Cefas do this on behalf of SZC Co; Sizewell B is not required to monitor fish impingement or entrainment. These data are for the 10 mm mesh used by Sizewell B; it is proposed that Sizewell C will also have a 10mm mesh. Data collected by Cefas on behalf of Sizewell C are presented in Table 1 (see end of document). The data are those collected during numerous 24h sampling sessions, multiplied up to pro rata annual values. EAV stands for "Equivalent Adult Value" and is a means to account for the fact that many fish do not survive to maturity in the natural environment anyway due to predation, disease, competition etc. Table 1 is taken from the SZC Co DCO submission:
SZC_Bk6_ES_V2_Ch22_Marine_Ecology_Appx22I_Impingement_Prediction_2009074_1

2. *"Please supply information on the survival rate of fish and other marine life after entrainment. We would like available data on the proportion of key fish and crustacean species that survive entrainment through the cooling water system. We would like to receive the reports from the entrainment survival rig study run by CEFAS at Lowestoft. We would be grateful if your response would address the role of chlorination in influencing entrainment survival."*

Cefas do this on behalf of Sizewell C; Sizewell B is not required to monitor fish impingement or entrainment. Survival data generated and/or used by Cefas on behalf of Sizewell C are presented in Table 2 (see end of document). Table 2 is taken from the SZC Co DCO submission:
SZC_Bk6_ES_V2_Ch22_Marine_Ecology_Appx22G_Predictions_of_Entrain_2009065_1

3. *"Please confirm that EdF is aware that the area of sea from which cooling seawater is drawn is a fertile nursery ground for fish fry and pipefish."*

This is not correct. The Sizewell B intake is not in a fertile nursery ground.

4. *"Please give your quantitative assessment of the cumulative losses caused by impingement and entrainment at Sizewell A and B over the years of their respective operation on fish and other biota. In addition to a quantification of the magnitude of the losses we would also like any information on the possible impact on local stocks in the Sizewell Bay area in terms of the proportion of the population lost."*

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Please refer to Table 1 for SIZEWELL B data; a thorough assessment is provided in the Cefas document that accompanied the SZC DCO submission. SZC_Bk6_ES_V2_Ch22_Marine_Ecology_Appx22I_Impingement_Prediction_2009074_1)

5. "Please advise if any special measures have been taken to prevent entrainment and impingement of any protected species and species of conservation concern such as alice and twaite shad, eel, lamprey and bass by the Sizewell B seawater cooling system. Have the Environment Agency and Cefas been advised by EdF or were they otherwise made aware of the quantities of protected species entrained and impinged?"

Sizewell B is fitted with a capped intake head such that it draws in water (abstracts) from a horizontal direction and not a vertical direction, as we know fish are better able to evade horizontal abstraction. The design flow velocity at the intake was also optimised to minimise its effect on fish impingement while providing the cooling water flows required.

When Sizewell B Power Station was designed and constructed, the majority of coastal power stations were still employing trash collection systems, whereby all of the fish impinging on the drum screens would be diverted to trash baskets for disposal. This was the original design intent for the Sizewell B system. However, the system was redesigned as a rudimentary fish recovery and return (FRR) system. Subsequently, the design, operation and performance of the FRR has been improved, to improve the survivability of impinged fish.

A number of fish survivorship studies preceded the current Comprehensive Impingement Monitoring Programme reported in Tables 1 and 2, below. Additionally, shortly into the operational phase of Sizewell B, the Environment Agency did shore surveys to ascertain whether large quantities of dead fish were washing ashore (and thereby causing a potential nuisance) but did not find any fish at all.

6. "Please advise what professional advice EdF received from Cefas or the Environment Agency regarding the avoidance of impinging or entraining protected species and species of conservation concern and what action EdF took as a result of this advice."

Please see the response to question 5.

7. "Please advise the times of year that chlorine is used in the cooling water system of Sizewell B to stop fouling of screens and pipes and the quantity used for each of the last ten years."

Sizewell B requires hypochlorite dosing throughout the year. The Environmental Permit (PRECS/3962C) limits the concentration of total residual oxidant (TRO) discharged to sea, not the total quantity of hypochlorite used and consequently the data that you have requested are not available.

8. "Please confirm that EdF is aware that the use of chlorine in cooling water will harm and potentially kill the fish EdF hopes to return to sea alive."

There is a small potential for TRO to harm the fish impinging on the drum screens as they are carried through the FRR. However, the minimum quantity of hypochlorite is dosed into the system to prevent biofouling of the condenser tubes while meeting the strict limits on TRO expressed in the environmental permit. Consequently, the harm to fish in the FRR is minimised.

9. "Please confirm or deny that EdF has sought to buy a new electro-chlorination plant in the last year due to the inoperable condition of the one currently in place."

The electro-chlorination plant at Sizewell B has been replaced in the last year as part of our expected plant lifetime management regime.

10. "Please confirm that biofouling (say, with mussels or sea squirts and microorganisms such as bacterial slimes) of the intake pipes and condenser cooling pipework presents a safety issue, as such fouling could reduce the water flow and impair heat exchange."

Reducing cooling water flow would reduce turbine efficiency and power output. In the extreme, it could require one or both turbines to be shut down. The seawater also provides cooling to nuclear safety-related heat exchangers. This is precisely why the system is chlorinated to prevent any significant biofouling. However, in the event that cooling to these systems lost, the air-cooled system called the Reserve Ultimate Heat Sink would provide equivalent alternative cooling.

11. "Please advise what adverse environmental impact arises when static seawater in a fouled pipe, which quickly turns anoxic when fouling organisms in the pipe together with trapped fish and crustaceans die and rot, is pumped to sea."

The condenser water boxes are drained when the cooling water system is shut down for any significant period. The small volume of water retained in the system, when discharged to sea, is quickly mixed with a very high volume of within the system and in the sea, so there is negligible environmental impact.

12. "Please advise of the records maintained to record the impact of Sizewell B's cooling water outlet pipe in the area of seabed 500 metres (or such distances for which records are maintained) from the end of the outlet pipe (to include thermal plumes, heavy metals, chemicals and dead/dying/rotting biota)."

A full description of the physico-chemical components of the receiving water are presented in the SZC Co DCO application as this is the baseline for the Sizewell C assessments. The Sizewell C DCO also provides information on the thermal and chemical plumes discharged form Sizewell B.
See SZC_Bk6_ES_V2_Ch21_Marine_Water_Quality_and_Sediments.

13. "Please advise how cooling water being returned to the sea is monitored for contaminants and how the quality of the North Sea water in proximity to the Sizewell plants is monitored."

The Environmental Permit (PRECS/3962C) lists several substances that are assessed by a combination of sampling source vessels within the power station and samples taken from the surge chamber, near the cooling water outfall. There is no requirement for EDF Energy to measure water quality in the marine environment.

Table 1
Annually raised mean Sizewell B estimates of impingement for 24 key species. Total losses have been converted to adult equivalent (EAV) numbers and weights (t) and calculated as a percentage of either the mean Spawning Stock Biomass (SSB) (t) or mean international landings (t).

Note: numbers in red font are either estimates of the population numbers (e.g. sand goby) or reported catch numbers (salmon and sea trout).

Species	Mean SZB estimate	EAV number	EAV weight (t)	Mean SSB	% of SSB	Mean landings (t)	% of landings
Sprat	2,782,934	2,090,690	21.96	220,757	**0.01**	151,322	0.01
Herring	998,201	713,932	134.69	2,198,449	**0.01**	400,244	0.03
Whiting	728,597	259,437	74.15	151,881	**0.05**	17,570	0.42
Bass	224,719	50,329	77.04	14,897	**0.52**	3,051	2.53
Sand goby	149,045	149,045	0.28	205,882,353	**0.07**	NA	NA
Sole	97,665	20,791	4.45	43,770	**0.01**	12,800	0.03
Dab	58,163	25,860	1.06	NA	NA	6,135	**0.02**
Anchovy	28,849	28,102	0.58	NA	NA	1,625	**0.04**
Thin-lipped grey mullet	26,435	2,204	1.15	NA	NA	120	**0.96**
Flounder	14,912	6,886	0.56	NA	NA	2,309	**0.02**
Plaice	9,877	3,411	0.84	690,912	**0.00**	80,367	0.00
Smelt	9,320	7,096	0.12	105,733,825	**0.01**	8	1.39
Cod	6,579	2,363	6.15	103,025	**0.01**	34,701	0.02
Thornback ray	4,219	813	2.60	NA	NA	1,573	**0.17**
River lamprey	2,624	2,624	0.21	62	**0.34**	1	18.61
Eel	1,764	1,764	0.58	79	**0.74**	14	4.18
Twaite shad	1,407	1,407	0.44	7,519,986	**0.02**	1	**33.04**
Horse mackerel	1,592	1,592	0.22	NA	NA	20,798	**0.00**
Mackerel	245	245	0.08	3,888,854	**0.00**	1,026,828	0.00
Tope	25	25	0.17	NA	NA	498	**0.03**
Sea trout	4	4	0.01	NA	NA	39,795	**0.01**
Allis shad	2	2	0.00	27,397	**0.01**	0	**0.70**
Sea lamprey	2	2	0.00	NA	NA	NA	NA
Salmon	0	0	0.00	NA	NA	38,456	**0.00**

Ref:
SZC_Bk6_ES_V2_Ch22_Marine_Ecology_Appx22I_Impingement_Prediction_2009074_1

Table 2
Predictions of entrainment mortality obtained from EMU experiments

Taxon	Estimated entrainment survival	Source	Notes
Sole eggs	20 % at ≥23°C	Bamber and Seaby, 1993	
Bass eggs	40 - 46 % at 11°C change in temperature, 62 % at 11.6°C change in temperature	Bamber and Seaby, 1995; BEEMS Technical Report TR261	
Glass eel	100 % up to 21.9°C, 37 % at 31.8°C	BEEMS Technical Report TR395	Laboratory experiments, not EMU experiments. SZC Temperature and chlorination profile only, not pressure.
Glass eel	80 % at HPC standard operating conditions for maximum discharge temperature of up to 28.8°C. 5mm mesh	BEEMS Technical Report TR273	HPC profile. Peak pressure change 4bar, chlorination applied, delta T 11.6°C. Intake lengths approx. 3km, 5mm mesh. This quoted survival rate is considered the more precautionary set of results for glass eel but SZC with a 10mm screen mesh is considered likely to produce greater survival.
Plaice yolk sac larvae	6.5 % at 11.6°C change in temperature, worst case experimental result	BEEMS Technical Report TR297 BEEMS Technical Report TR396	
Mysids (*Schistomysis sp.)*	70 % at 25°C, 0 % at >29°C	BEEMS Technical Report TR394	Present all year at Sizewell but with peaks in May and September - November
Copepod (*A. tonsa*)	80 % no temperature change 70 % at 11.6°C change in temperature	Bamber and Seaby, 2004; BEEMS Technical Report TR408	
Decapods (*C. crangon* first zoea larvae)	70 % (26 - 27°C), 2 % (29 - 31°C)	Bamber and Seaby, 2004; BEEMS Technical Report TR370	

Ref:
SZC_Bk6_ES_V2_Ch22_Marine_Ecology_Appx22G_Predictions_of_Entrain_2009065_1