

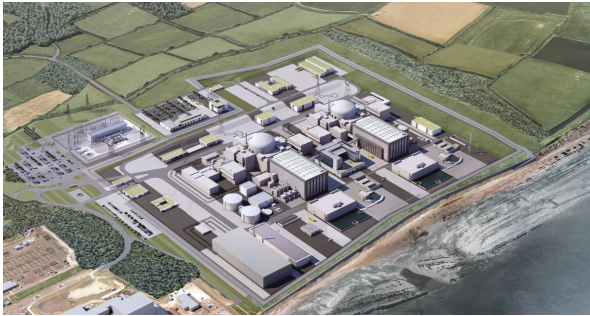
Consultation, Design Evolution and Approval of the Fish Recovery and Return Systems for New Nuclear Build in the UK

Hinkley Point C & Sizewell C New Nuclear Power Stations

Ross Pettigrew
Dr Stephen Roast

IFM First International Impingement Conference, Adelphi Hotel, Liverpool, UK
12th July 2023

Introduction



Near Bridgwater, Somerset, (Bristol Channel Coast)

Near Leiston, Suffolk (North Sea coast)

2 x UK EPR™ generating units

2 x UK EPR™ generating units

Direct Cooled (up to ~140 cumecs)

Direct Cooled (up to ~140 cumecs)

Electrical Output - 3.2 GW_e

Electrical Output - 3.2 GW_e

7% of UK energy demand (6 million homes)

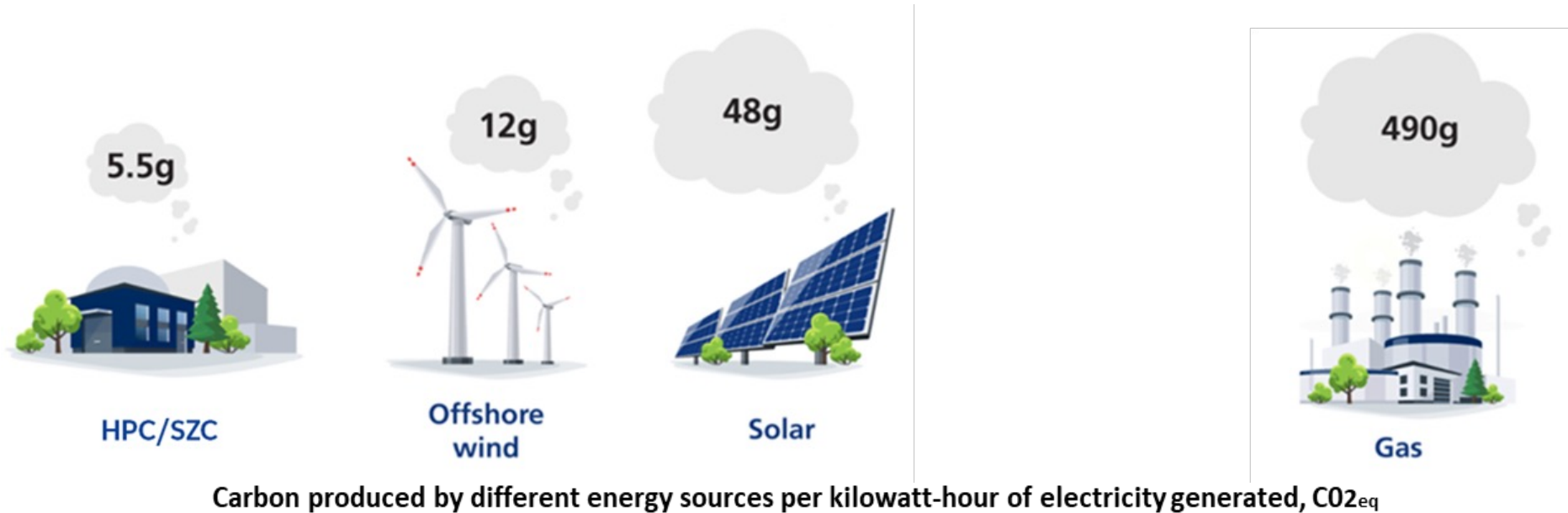
7% of UK energy demand (6 million homes)

Commercial Operation - 2027

Commercial Operation – 2034

UK Net Zero by 2050

Nuclear, wind, and solar all have critical roles to play in helping the UK meet its Net Zero targets by 2050.



HPC & SZC figures taken from lifecycle analysis reports prepared by Ricardo-AEA Technology and independently verified by WSP USA.

[HPC Life Cycle Analysis - 2021](#)

[SZC Lifecycle Analysis - 2021](#)

UK (English) Regulatory Regime

A complex picture



Various Local Authorities



HPC Only



SZC Only



With a complex set of permissions

Justification
Decision

Nuclear Site
Licence

Development
Consent Order

GDA DAC & SODA

Construction
Environmental
Permits




Operational
Environmental
Permits

Marine Licences

Land Drainage
Consents

TCPA Planning
Permissions

Primary Planning Legislation



Planning Act 2008

CHAPTER 29

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PART 1

THE INFRASTRUCTURE PLANNING COMMISSION

- 1 The Infrastructure Planning Commission
- 2 Code of conduct
- 3 Register of Commissioners' interests
- 4 Fees

PART 2

NATIONAL POLICY STATEMENTS


- 5 National policy statements
- 6 Review
- 7 Consultation and publicity
- 8 Consultation on publicity requirements
- 9 Parliamentary requirements
- 10 Sustainable development
- 11 Suspension pending review
- 12 Pre-commencement statements of policy, consultation etc.
- 13 Legal challenges relating to national policy statements

PART 3

NATIONALLY SIGNIFICANT INFRASTRUCTURE PROJECTS

General

- 14 Nationally significant infrastructure projects: general



Marine and Coastal Access Act 2009

CHAPTER 23

CONTENTS

PART 1

THE MARINE MANAGEMENT ORGANISATION

CHAPTER 1

ESTABLISHMENT

- 1 The Marine Management Organisation
- 2 General objective
- 3 Performance

CHAPTER 2

TRANSFER OF FUNCTIONS TO THE MMO

Sea Fish (Conservation) Act 1967

- 4 Licensing of fishing boats
- 5 Restrictions on time spent at sea: appeals
- 6 Trans-shipment licences for vessels
- 7 Regulations supplementary to sections 4 and 4A
- 8 Exemptions for operations for scientific and other purposes

Nature conservation

- 9 Licences to kill or take seals
- 10 Wildlife and Countryside Act 1981
- 11 Sea Fisheries (Wildlife Conservation) Act 1992

Generating and renewable energy installations

- 12 Certain consents under section 36 of the Electricity Act 1989

Primary Environmental Legislation

STATUTORY INSTRUMENTS	
2017 No. 1012	
WILDLIFE	
COUNTRYSIDE	
The Conservation of Habitats and Species Regulations 2017	
Made	30th October 2017
Laid before Parliament	31st October 2017
Laid before the National Assembly for Wales	31st October 2017
Coming into force	30th November 2017
CONTENTS	
PART 1	
Introductory and General Provisions	
1.	Citation and commencement
2.	Extent
3.	Interpretation
4.	Plans or projects relating to offshore marine area or offshore marine installations
5.	Nature conservation bodies
6.	Relevant authorities in relation to marine areas and European marine sites
7.	Competent authorities
8.	European sites and European marine sites
9.	Duties relating to compliance with the Directives
10.	Duties in relation to wild bird habitat
11.	Review by appropriate nature conservation body
PART 2	
Conservation of Natural Habitats and Habitats of Species	
12.	Selection of sites eligible for identification as of Community importance
13.	Designation of special areas of conservation
14.	Consultation as to inclusion of site omitted from the list
15.	Classification of sites as special protection areas
16.	Notification of a proposal to classify a special protection area
17.	Register of European sites
18.	Notification of changes to the register

STATUTORY INSTRUMENTS	
2016 No. 1154	
ENVIRONMENTAL PROTECTION, ENGLAND AND WALES	
The Environmental Permitting (England and Wales) Regulations 2016	
Made	11th December 2016
Coming into force in accordance with regulation 1(1)	
CONTENTS	
PART 1	
General	
1.	Citation, commencement, extent and application
2.	Interpretation: general
3.	Interpretation: Directives
4.	Exempt facilities and the application of section 33(1)(a) of the 1990 Act
5.	Interpretation: exempt facilities
6.	Interpretation: local authority
7.	Interpretation: operates a regulated facility and operator
8.	Interpretation: regulated facility and class of regulated facility
9.	Interpretation: relevant function
10.	Giving notices, notifications and directions, and the submission of forms
PART 2	
Environmental permits	
CHAPTER 1	
Application to the Crown and requirement for an environmental permit	
11.	Application to the Crown
12.	Requirement for an environmental permit
CHAPTER 2	
Grant of an environmental permit	
13.	Grant of an environmental permit
14.	Content and form of an environmental permit
15.	Conditions in relation to certain land
16.	Mobile plant operating on the site of another regulated facility: conflict of permit conditions
17.	Single site permits etc.

STATUTORY INSTRUMENTS	
2017 No. 407	
WATER RESOURCES, ENGLAND AND WALES	
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017	
Made	15th March 2017
Laid before Parliament	16th March 2017
Laid before the National Assembly for Wales	16th March 2017
Coming into force	10th April 2017
CONTENTS	
PART 1	
Introduction	
1.	Citation, commencement, extent and application
2.	Interpretation
3.	Duties on ministers and regulators
PART 2	
River basin districts and water bodies	
4.	Map of river basin districts
5.	Characterisation of river basin districts
6.	Classification of water bodies
7.	Economic analysis of water use in river basin districts
PART 3	
Protected areas	
8.	Bodies of water used for the abstraction of drinking water
9.	Designation of shellfish waters
10.	Register of protected areas
PART 4	
Monitoring	
11.	Monitoring programmes

STATUTORY INSTRUMENTS	
2009 No. 3344	
FISHERIES, ENGLAND AND WALES	
RIVER, ENGLAND AND WALES	
The Eels (England and Wales) Regulations 2009	
Made	14th December 2009
Laid before Parliament	21st December 2009
Laid before the National Assembly for Wales	21st December 2009
Coming into force	15th January 2010
CONTENTS	
PART 1	
General	
1.	Title, commencement and application
2.	Interpretation
PART 2	
Records and restocking	
3.	Eel catch returns
4.	Records
5.	Imports
6.	Exports
7.	Duties on consignees
8.	Restocking
9.	Interpretation
PART 3	
Eel Licences	
10.	Close season
11.	Reduction of fishing effort
PART 4	
Passage of eels	
12.	Construction, alteration etc of obstruction

Hinkley Point C

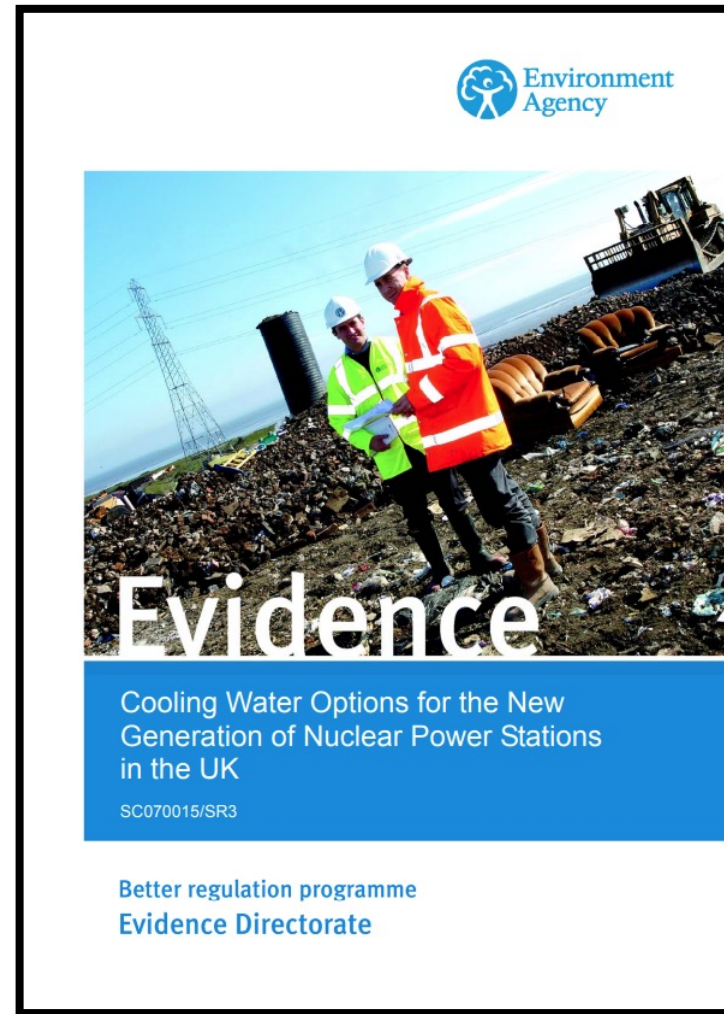
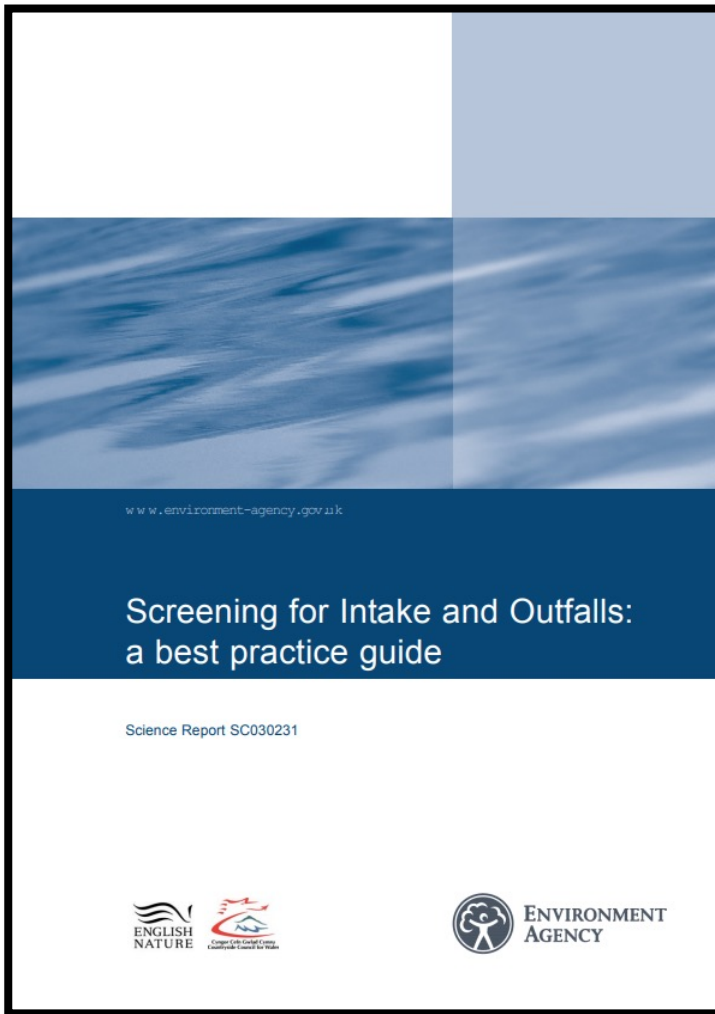
- Development Consent Order March 2013
- Water Discharge Activity permit March 2013
- Marine Licence July 2013
- Construction October 2016
- Commissioning 2026
- Operation 2027

Regulator Expectations

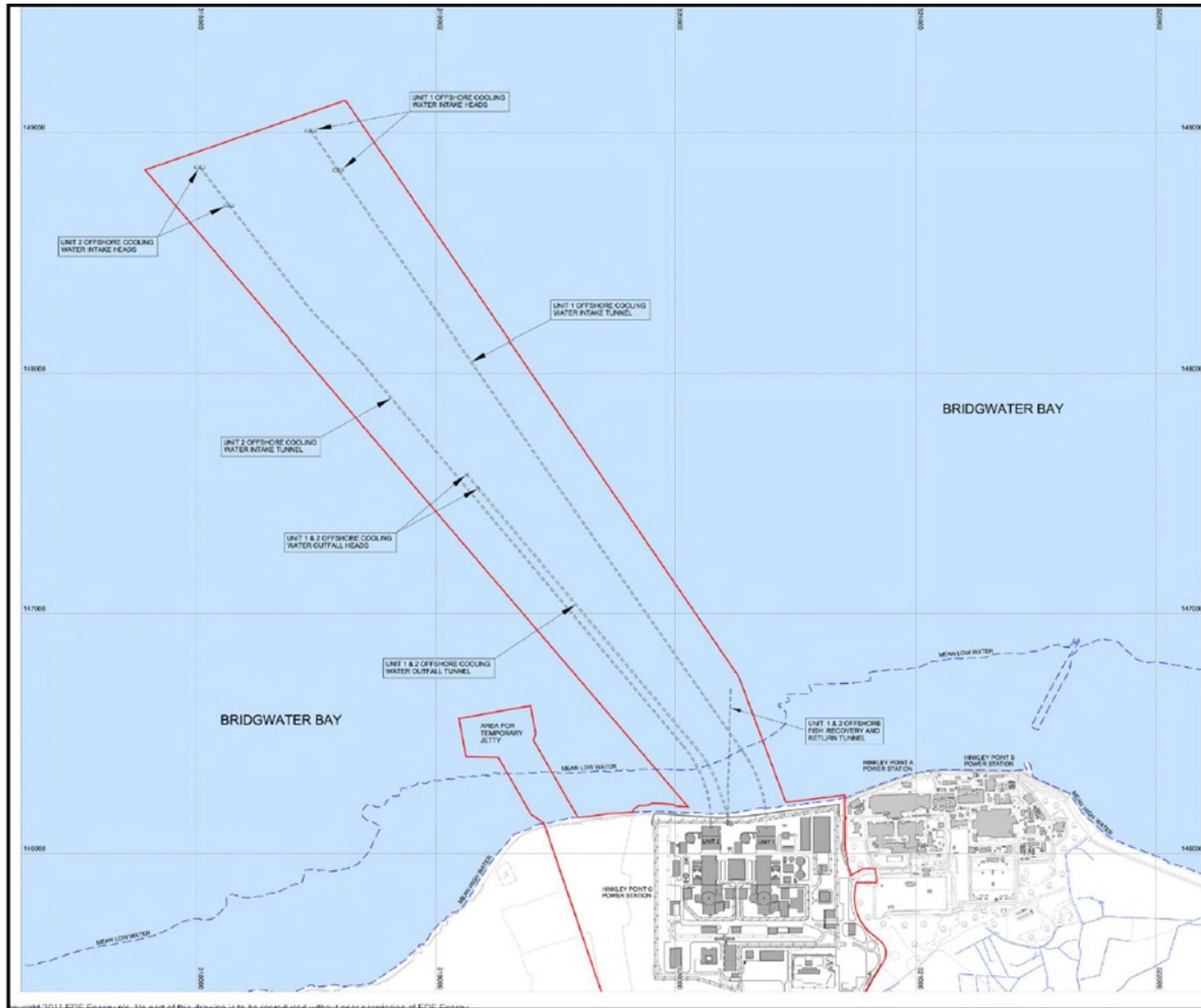
Key DCO Requirement - CW1(1)

<i>(1)</i> <i>Reference No.</i>	<i>(2)</i> <i>Requirements</i>
CW1	<p>Cooling water infrastructure design</p> <p>(1) No development shall commence until details of Work Nos. 2A to 2H have, following consultation with the Countryside Council for Wales, Natural England, English Heritage and the Environment Agency, been submitted to and approved by the Marine Management Organisation. The details shall include—</p> <ul style="list-style-type: none"> <li>(a) the location and design (size and shape) of the off-shore intake and outfall heads; <li>(b) the alignment (horizontal and vertical) of the cooling water intake and outfall tunnels; and <li>(c) the location and design of the fish recovery and return system and the low velocity side entry intakes, which shall be in accordance with the Environment Agency guidance referenced in the Environmental Statement (Volume 2, chapter 2, paragraph 2.6.21).

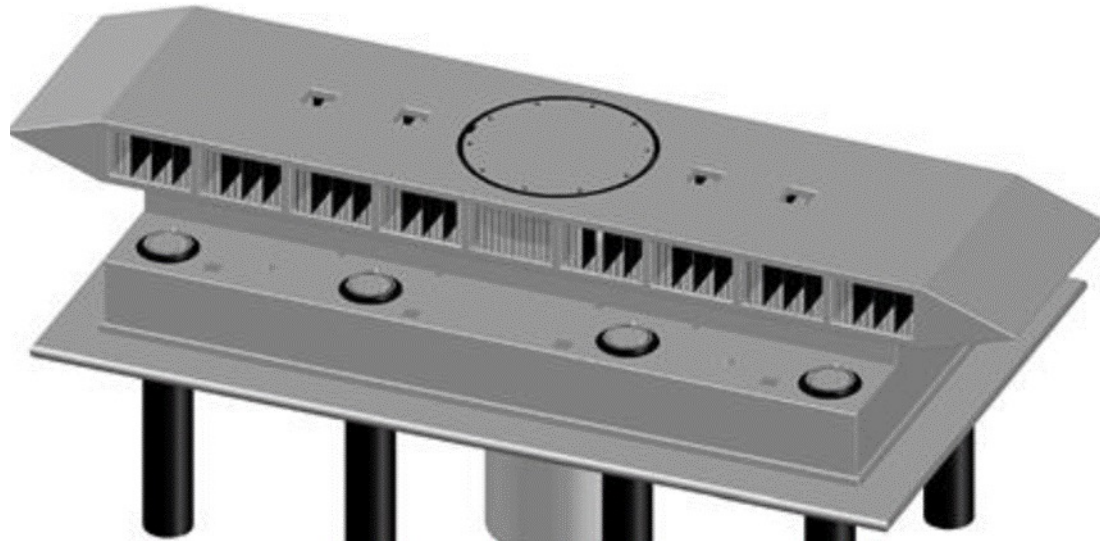
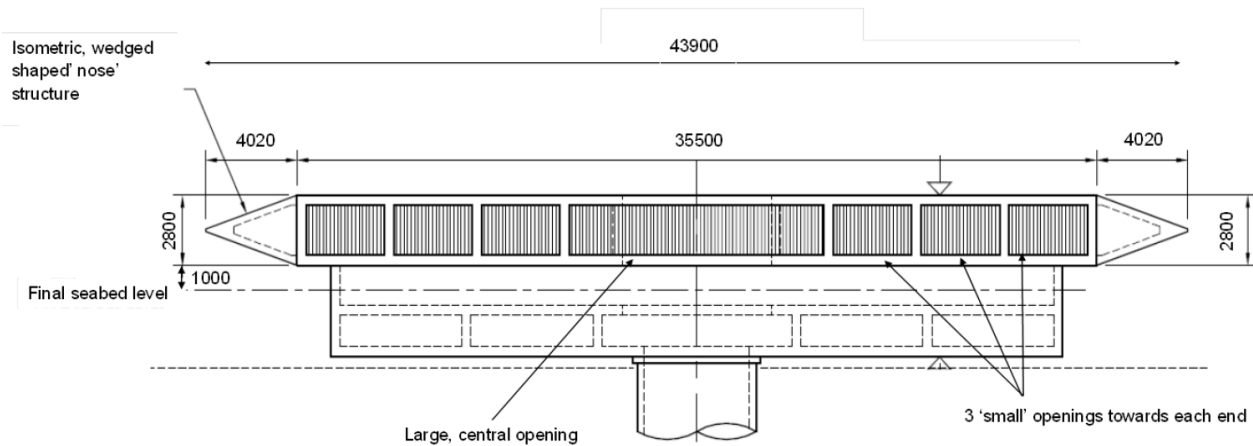
Guidance and Science/Evidence Reports



Cooling water system design at submission



Cooling water system design at submission



Information for Requirement - CW1(1)

Cooling water infrastructure design

(1) No development shall commence until details of Work Nos. 2A to 2H have, following consultation with the Countryside Council for Wales, Natural England, English Heritage and the Environment Agency, been submitted to and approved by the Marine Management Organisation. The details shall include—

- (a) the location and design (size and shape) of the off-shore intake and outfall heads;
- (b) the alignment (horizontal and vertical) of the cooling water intake and outfall tunnels; and



- (c) the location and design of the fish recovery and return system and the low velocity side entry intakes, which shall be in accordance with the Environment Agency guidance referenced in the Environmental Statement (Volume 2, chapter 2, paragraph 2.6.21).



Information for Requirement - CW1(1)

For FRR needed:

- Screen mesh size
- Screen rotation speeds
- Bucket design
- Gutter diameters
- Gutter composition / finish
- Bend radii
- Vertical drop heights
- Flow rates
- Archimedes screw design
- Outfall head design

Also needed:

- LVSE intake head design and hydraulics
- Tunnel finish
- Forebay hydraulics

Marine Technical Forum (MTF)

Established post-consent to facilitate communal consultation with relevant regulators and stakeholders:

- Environment Agency
- Marine Management Organisation
- Natural England
- Natural Resources Wales (CCW)
- Devon and Severn Inshore Fisheries Conservation Authority

AND

- Independent Chair
- Invited Guests

Marine Technical Forum (MTF)

BUT, needed better representation from all sides:

EDF:

Fisheries /Ecology

Hydraulics engineers;

Safety Case engineers;

Operational engineers;

Numerical modellers;

Technical consultants;

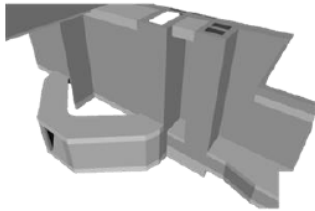
Regulators:

Fisheries /Ecology

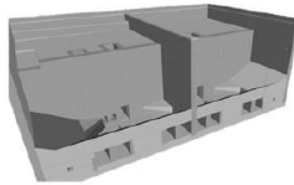
Numerical modellers

Technical consultants

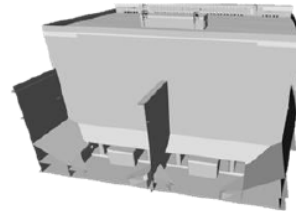
3 Dimensional Model



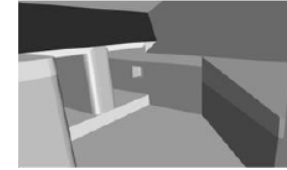
1) Intake tunnel terminates splitting flow into two halves.



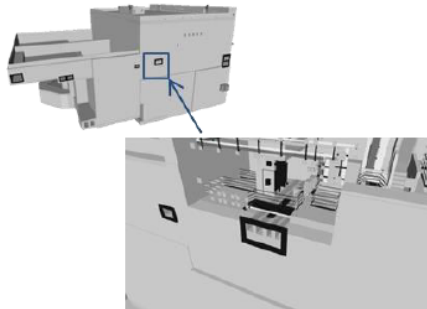
2) Two halves of forebay (looking back to tunnel exit).



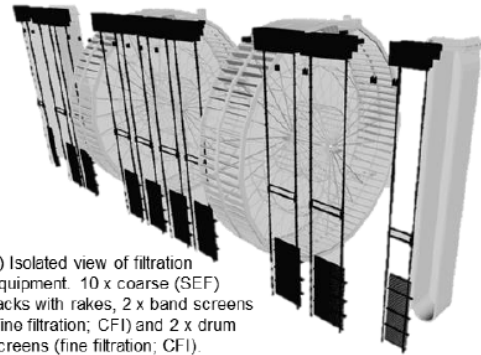
3) Two halves of forebay (looking back to tunnel exit).



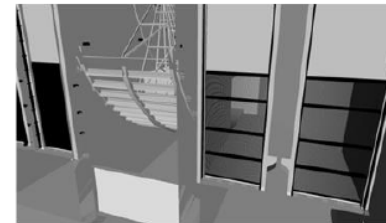
4) Detail of exit from forebay to pumping station.



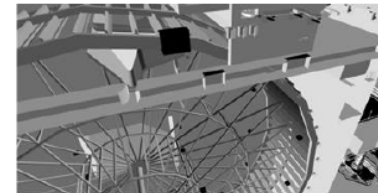
9) Detail of exit to debris recovery building. 4 channels: 1 x coarse and 1 fine filtration feed from both drum screens and one band screen; and 1 x coarse and 1 x fine filtration feed from the remaining band screen.



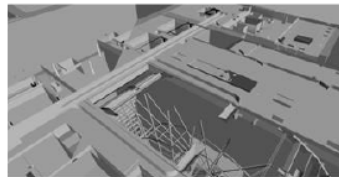
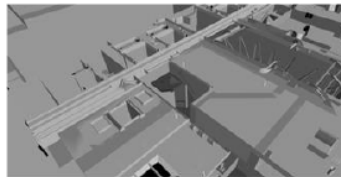
6) Isolated view of filtration equipment: 10 x coarse (SEF) racks with rakes, 2 x band screens (fine filtration; CFI) and 2 x drum screens (fine filtration; CFI).



5) Detail of coarse filtration (SEF) racks leading to drum screen well.



7) Detail of drum screen hopper and gutter interface. Note – two hoppers per drum screen (one each side).



8) Detail of pumping station gutters. Right hand image is eastern end (Trains 1-5) and left hand image is western end (Trains 6-10) exiting to debris recovery (HCB) building.

Criteria and checks for compliance

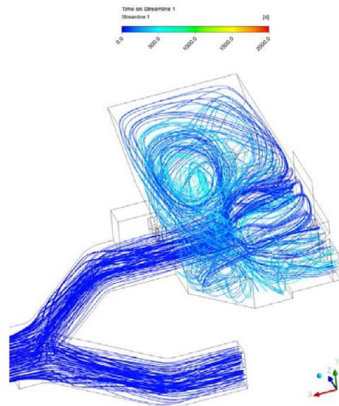


Table 8: Drop heights from the individual collection gutters from the band and drum screens into the common collection gutter.

Intersection	Invert level of main gutter (m OD)	Draft of water in main gutter (m)	Water level in main gutter (m OD)	Invert level of DS/BS gutter into main gutter (m OD)	Vertical drop from DS/BS gutter to main gutter (m)
BS1 – C	9.57	0.10 – 0.13	9.67 – 9.70	9.62	Interface to be defined by equipment contractor, Ovivo
DS1: B – D	9.49	0.10 – 0.13	9.59 – 9.62		0.03 – nil
DS1: B – E	9.45	0.18 – 0.23	9.63 – 9.68		nil – nil
DS2 : B – F	9.34	0.26 – 0.31	9.60 – 9.65		0.02 – nil
DS2 : B – G	9.30	0.32 – 0.38	9.62 – 9.68		nil – nil
H – Exit from HP	9.20	0.38 – 0.45	9.58 – 9.65	N/A	N/A
BS2 – I	9.24	0.10 – 0.13	9.34 – 9.37	Interface to be defined by equipment contractor, Ovivo	
J – Exit from HP	9.20	0.10 – 0.13	9.30 – 9.33	N/A	N/A



NOT PROTECTIVELY MARKED

NNB-209-REP- 0001030

V2.0

Table 27: Summary of the compliance of separate Hinkley Point C Fish Recovery and Return (FRR) system with the Environment Agency criteria (Ref [2] [3]).

Component	Criterion	Compliance	Section	Justification
Intake head	Location	Yes	4.2	-
	Low velocity, side entry design	Yes	4.3	-
	Intake velocity	No		11.2
Intake Shaft	N/A	Yes	4.4	12.1.2
Intake Tunnel	N/A	Yes	4.5	12.1.2
Forebay	N/A	Yes	5	13.1.4
				13.1.11
Cooling water pump house				
Coarse filtration	Undefined	-	6.1	14.1
Band screens	Continuous	Yes	6.2	
	Speed	No	6.2	14.2
	Mesh size	Yes	6.2	-
	Low pressure sprays	Yes	6.2	-
	No biocide	Yes	6.2	-
Drum screens	Geometry	Yes	6.2	-
	Continuous	Yes	6.3	-
	Speed	Yes	6.3	-
	Mesh size	Yes	6.3	-
	Low pressure sprays	Yes	6.3	-
Gutters	No biocide	Yes	6.3	-
	Geometry	Yes	6.3	-
	Drops minimised	Yes	6.4	-
	Smooth	Yes	6.4	-
	Diameter (>300mm)	Yes	6.4	-
	Bends (swept, >1.5x radius for 400 mm radius)	Yes	6.4	-

Table 25: Environment Agency criteria (Ref [2] [3]) and assessment of Hinkley Point and Return (FRR) system.

Description	Hinkley Point C Design
1 The power dissipation (turbulence) must be $\leq 100W m^{-3}$	All drops are $100 W m^{-3}$ or less.
2 Sprays used for washing fish from the screens must operate at ≤ 1 bar pressure.	All sprays used for fish removal (bar) and High (6.5 bar) pressure debris
3 Wash-water flow must be continuous.	Wash-water flow is continuous a to improve flushing along hopper
4 High-pressure backwashing should discharge to the fish return hoppers (or, at least, have the ability to be re-directed to the fish return launders when required).	ALL material washed from the tri drum is transferred to the HCB b (FRR)
5 All fish handling gullies must have a smooth finish, including the joints, so that there are no rough edges	All fish handling gutters will smor polyethylene (HDPE) will be used to line gutters. HDPE is very smooth, with a Strickler coefficient of $100 m^{1/3} s^{-1}$.
6 Gullies should be covered, but accessible. Areas where fish may collect should be protected from bird predations.	The fish return gutters will be covered with access chambers for maintenance.
7 All fish handling gullies must be at least 0.3 m diameter, in section; the return tunnel must be at least 0.5 m diameter, in section.	All gutters in the cooling water pump house are 0.4 m diameter; Fish return gutters (pipes) are 0.65 m



Figure 42: Smooth finish of a typical moulded tunnel lining segment.

Summary of EA information providing guidance on fish protection aspects of cooling water systems for new nuclear stations, with Hinkley Point C progress against this guidance.






Guidance information is summarised from the following documents:

- *Cooling Water Options for the New Generation of Nuclear Power Stations in the UK* – labelled as ‘2010’ and black text.
- *Screening for Intakes and Outfalls: a best practice guide* – labelled as ‘2005’ and blue text.
- *Screening at intakes and outfalls: measures to protect eel* – labelled as The Eel Manual and green text.
- Any additional guidance is in purple text and source specified.

Hinkley Point C progress outlined here is relevant to Paragraph 1 of DCO Requirement CW1.

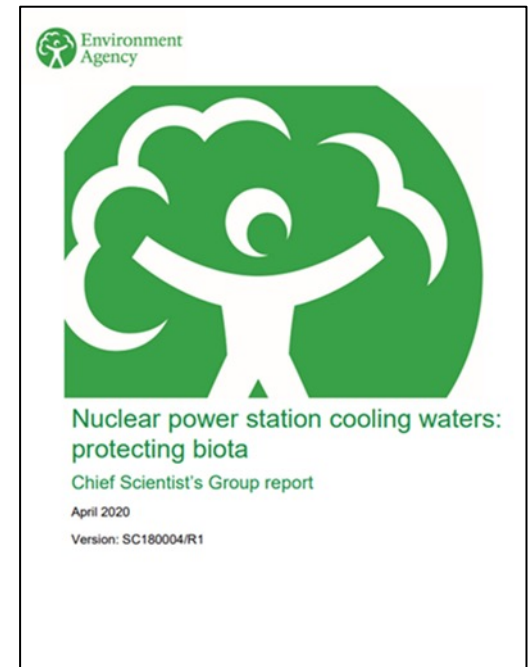
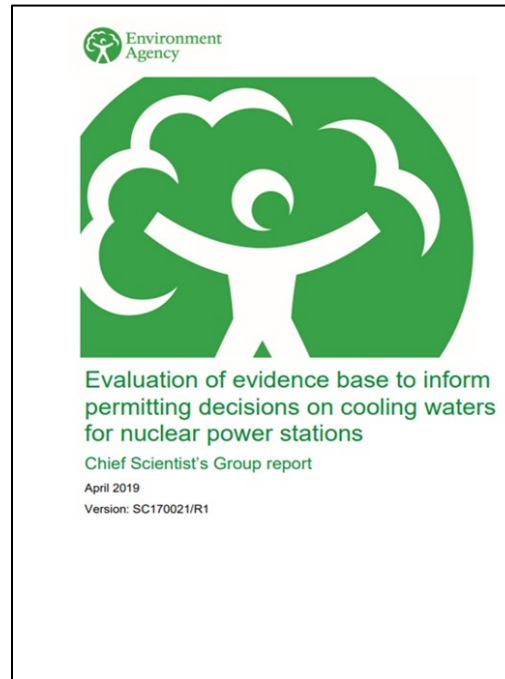
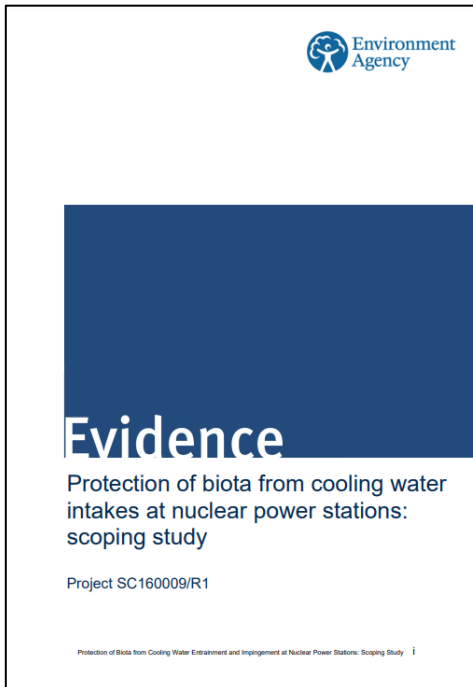
Version E2 (8 October 2015) incorporates:

- Previous comments of EA marine/fisheries specialists/consultant
- Ongoing updates from NNB documents, Level 4 meetings etc.
- Comments from EA Bristol/telecom meeting on 9 September 2015
- Discussions with EA Eels specialists on 17 September 2015
- Addition of all live issues from CW1 Issues Tracker
- Additional comments following EA circulation on 18 September 2015

State	Key
Aspect closed	
Aspect still to be addressed, but outside Paragraph 1 of DCO Requirement CW1	
No further issues at this time, confirmation required in NNB <u>GenCo Report to Inform discharge of CW1 Para 1</u>	
Aspect outstanding	
Aspect outstanding, with particular concern about technical issue*	

*This workstream is currently ‘amber’. We consider it will turn from amber to green when there are no red aspects on this table.

Learning and new Environment Agency reports



Thank You