ORJIP Ocean Energy

Information Note: Electromagnetic Field Emissions

Report to: Welsh Government

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Contents

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1 INTRODUCTION

This series of technical, topic specific Information Notes has been co-produced by the Welsh Consenting Strategic Advisory Group's Science and Evidence subgroup (SEAGP) in order to support the consenting of wave and tidal stream energy projects. The Information Notes have been developed to establish the current position of key stakeholders in Wales on the evidence available on interactions of wave and tidal energy technologies with the marine environment. They are designed to set out a starting point for applicants by providing an understanding of where consenting challenges might lie. The aim of the Information Notes is to support marine licence applications that are robust, proportionate and focused on assessing the key potential significant impacts and possible interactions between marine renewable energy (MRE) devices and the marine environment.

These Information Notes will support careful consideration of how, for a particular development, potential impacts that are considered low risk could be safely retired from further detailed consideration within Environmental Impact Assessments (EIA), where available evidence supports this approach. Ocean Energy Systems-Environmental (OES-Environmental) has set out a general process for risk retirement[1,2] but for developments in Welsh waters, risk retirement should always be discussed between developers and Natural Resources Wales (NRW) at the pre-application stage. In the context of these Information Notes, risk retirement implies that all potential impacts are included for consideration at the project scoping stage, and that following a review of the evidence some impacts may be 'scoped out' of any further detailed assessment to focus EIA on key significant impacts[3]. In all cases, potential impacts should be acknowledged in EIAs, with evidence-based justifications describing why particular impacts could be 'scoped out' for further detailed assessment.

Further information about this series of Information Notes, who these documents are for, how they were produced, and how they should be used can be found in the accompanying document *Information Notes: Background*

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[1] https://tethys.pnnl.gov/events/oes-environmental-webinar-risk-retirement
[2] https://tethys.pnnl.gov/publications/state-of-the-science-2020-chapter-13-risk-retirement
[3] It should be noted that The Wildlife Trusts expressed concerns about the use of the phrase 'risk retirement' being applied in this context, particularly considering the uncertainties in impact assessment that are likely to arise with increasing scale of MRE developments.

Information. The *Information Notes: Background Information* document also contains information about some of the terminology used in this Information Note.

1.1 ELECTROMAGNETIC FIELD EMISSIONS – GENERAL

Electrical cables in the marine environment produce a source of electromagnetic fields (EMFs). EMFs from electrical cables can combine with the Earth's natural geomagnetic fields to potentially change the behaviour of species who use EMF for migration, prey location, and orientation.

EMF emission in the marine environment is not regulated by specific legislation (Hutchison et al. 2020). However, EMF emissions are a consideration when assessing an application for a marine licence, if identified as a key impact pathway requiring assessment in EIA.

Most EMF research to date has focused on bony fish, invertebrates, cartilaginous fish, marine mammals, and sea turtles. To date, scientific evidence suggests that the ecological effects of EMF from power cables associated with wave and tidal energy developments on marine species are likely to be weak to moderate at the current scale of planned deployment (Gill et al. 2020). However, few studies have been carried out on power cables associated with wave and tidal energy developments, which means that data about impacts are limited, and that there are many remaining uncertainties about the effects of EMF. The large-scale deployment of offshore wind energy arrays around the UK's coasts could serve to provide useful insight into how EMF could be addressed in the consenting process and any required monitoring, although it should be noted that the present scale of power transmission from offshore wind energy developments is substantially greater than for any planned wave or tidal energy development.

OES-Environmental has developed a pathway for the retirement of environmental risks from marine renewable energy developments, and given the current evidence base, considers that risk from EMF for small numbers of devices[4] could be retired. Although OES-Environmental suggests that detailed studies of EMF at each new proposed project site may not be needed (OES-Environmental, 2021), the level to which such an approach is followed will depend on the perspectives of the decision-makers and the nature of the project involved.

[4] Currently the OES-Environmental Scaling Up Working Group proposes that 'small numbers' of devices is defined as 1-5 devices, although 'small numbers' will not have a formal definition in all cases and will depend on expert judgement.

1.2 EVIDENCE SOURCES CONSIDERED BY SEAGP

SEAGP members were asked to apply their expertise and were encouraged to read the OES-Environmental Short Science Summary document[5] on EMF in advance of providing a response to the EMF Information Note questionnaire. Respondents were also encouraged to consult the full chapter on EMF within the OES-Environmental 2020 State of the Science Report[6]. Additional key references are listed at the end of this document.

2 VIEWS OF NATURAL RESOURCES WALES ON EMF

The information presented in this section was gathered in consultation with NRW benthic, fish, ornithology and marine mammal specialists.

2.1 GENERAL PERSPECTIVES ON EMF

The general level of environmental risk that NRW perceive to be associated with EMF is low or very low. However, NRW's perception of risk increases with the scale of development (Table 1).

NRW also considers that the level of risk varies according to the development location and receptor in question and that risks could be greater for fish.

Table 1: NRW perspectives on the general level of environmental risk associated with EMF for generic development scenarios.

Deployment scale	Very low	Low	Intermediate	High	Very high
Single device	✓				
Small array		✓			
Large array		✓			

**Note that risks are, by their nature very site specific. This table should be treated as a general indication of risk.*

2.1.1 Factors influencing environmental effects from EMF

The location of developments has substantial influence on the importance of EMF, and NRW suggests EMF would be dealt with on a case-by-case basis. For example, the level of importance of EMF effects would be higher if the

5 https://tethys.pnnl.gov/summaries/short-science-summary-electromagnetic-fields-2020
6 https://tethys.pnnl.gov/publications/state-of-the-science-2020-chapter-5-electromagnetic-fields

development crossed migratory routes for diadromous fish or spawning grounds for other species.

The importance of EMF is considered to be low for different types of devices (tidal energy, wave energy, floating tidal energy, etc.). However, device-specific characteristics, such as whether cables are suspended in the water column and device-specific EMF emittance levels, will be considered.

2.1.2 Status of the evidence base and requirements for data collection

Although the evidence base for EMF has improved in recent years, a strong evidence base is still not felt to be in place for this topic. Specifically, there is an evidence gap around the impacts associated with EMF emissions from large-scale deployment of marine renewables, as well as on the cumulative impact of EMF from multiple devices and associated cabling infrastructure. The evidence gaps will become more important as offshore cabling infrastructure becomes larger and more diverse with increasing developments in the marine environment (e.g., offshore wind, in addition to wave and tidal stream technologies).

Generally, NRW will expect developers to consider EMF as a potential pathway for effect on receptor groups in their applications and would review the evidence before being able to rule it out as a significant concern. For single devices, NRW consider that a proportionate approach would be to implement a desk-based review that includes case-specific information on planned cables and transmission systems. This approach could also be appropriate for small arrays, while large arrays may need a more detailed assessment.

The need to monitor developments for environmental effects from EMF will vary depending on the receptors present and the scale of the development. NRW did not identify any best practice for collecting project-specific information on EMF.

2.1.3 Mitigation strategies

Several strategies could be used to mitigate the effects from EMF, and these should be considered early in the development process or in the design phase of projects. For example, shielding, burial, and bundling for out-of-phase cables (where the voltage and current peaks are out of phase) are recommended for all scales of project. Depending on the receptors of concern, DC export cables (to remove iE fields) or AC cables (to reduce magnetic fields) would be recommended. For large arrays, cable micro-siting, use of the minimum current or amperage possible and bundling cables (particularly for floating arrays) would also reduce magnetic fields. However, different mitigation measures may be more appropriate at different sites, depending on seabed conditions, device and/or array design, and the presence of sensitive receptor groups. The OES-

Environmental Tethys Management Measures Tool provides a useful resource for mitigation and management of EMF effects[7].

2.2 SEABED HABITATS AND INVERTEBRATES

NRW considers that the importance of effects from EMF on seabed habitats, sessile invertebrates, and mobile invertebrates is likely to be low when compared to other potential impact pathways resulting from marine renewable energy developments, such as direct loss of habitat (Table 2).

Table 2: NRW perspective on the importance of EMF as an effect on seabed habitats and invertebrates and on the status of the current evidence base

Deployment scale	Importance*	Available evidence base**
Single device	Very low	Poor
Small array	Low	Poor
Large array	Low	Poor

**the scale for importance is 'negligible, very low, low, intermediate, high, very high'*
***the scale for evidence base is 'very poor, poor, adequate, good, very good'*

2.2.1 Status of the evidence base and requirements for data collection

For seabed habitats and invertebrates, the available evidence supporting decision-making is noted to be very poor.

Scientific studies to date have focused on EMF effects on single species and mainly on crustacea. The limited evidence available suggest species-specific behavioural changes occur in response to EMF in some crustacean taxa (Ernst and Lohmann, 2018; Hutchison et al., 2018; Scott et al., 2018). NRW suggest that although developers currently assign a low level of risk to impacts from EMF on benthic species and habitats, without further evidence it is difficult to establish whether this reflects the real risk.

NRW suggests that further evidence on whether EMF effects on benthic habitats and species differ between device types would be required to support decision-making. It is recognised that this is a growing area of research, therefore NRW would expect developers to assess potential impacts of EMF on benthic receptor groups on a case-by-case basis and using the most up to date evidence, particularly in relation to Section 7 Environment (Wales) Act 2016 habitats and species or those protected under the Conservation of Habitats and Species Regulations 2017.

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[7] https://tethys.pnnl.gov/management-measures

2.3 FISH

EMF would always be considered a pathway for impacts on fish, although depending on the specific project and following a review of the appropriate evidence, it may be determined not to be a significant concern. EMF would become relatively more important for fish receptor groups if the development spanned migratory routes for diadromous fish, or spawning grounds for other species (Table 3).

Table 3: NRW perspective on the importance of EMF as an effect on fish and on the status of the current evidence base

Deployment scale	Importance*	Available evidence base**
Single device	Very low	Adequate
Small array	Low	Adequate
Large array	Intermediate	Poor

**the scale for importance is 'negligible, very low, low, intermediate, high, very high'*
***the scale for evidence base is 'very poor, poor, adequate, good, very good'*

2.3.1 Status of the evidence base and requirements for data collection

NRW would expect to see project-specific data for fish receptor groups for large array projects. NRW suggests that at present there are adequate research outcomes and information to inform decision-making around EMF for fish receptors (demersal, pelagic, and diadromous) provided that developers include relevant information in their applications. This might include information about cabling design and predicted EMF emissions.

2.4 SEABIRDS

Although some birds are known to use the Earth's magnetic fields for navigational purposes, impacts from EMF on this ability are thought to be very low (Table 4), although the evidence base for this effect is very limited.

Table 4: NRW perspective on the importance of EMF as an effect on seabirds and on the status of the current evidence base

Deployment scale	Importance*	Available evidence base**
Single device	Very low	Poor
Small array	Low	Poor
Large array	Uncertain - would require assessment	Poor

**the scale for importance is 'negligible, very low, low, intermediate, high, very high'*
***the scale for evidence base is 'very poor, poor, adequate, good, very good'*

NRW considers that any impacts of EMF on birds would be more likely to occur because of EMF impacts on prey species, which would have knock-on effects on seabirds' foraging success. This impact pathway is also likely to be relevant for marine mammals and predatory fish.

2.4.1 Status of the evidence base and requirements for data collection

For seabirds, the available evidence supporting decision-making was noted to be poor or very poor. NRW highlight that for seabirds there is greater uncertainty around how the existing evidence base would apply to different technology types (e.g., tidal, wave, floating offshore wind). Section 2.1 identifies that deployment location has a substantial effect on the importance of EMF as an impact pathway. This is relevant for seabirds as the requirement to assess the likely significant effect of a development on populations will depend on the proximity of developments to marine protected areas (MPAs).

For small arrays, NRW would expect to see case-specific data and information provided to address EMF in some cases for seabird receptor groups. The effect of EMF on seabirds would require assessment for large arrays.

2.5 MARINE MAMMALS

Impacts from EMF on marine mammals are thought to be very low, although it was noted that the evidence base for this impact pathway is limited (Table 5). If EMF effects were to affect marine mammals, it would be very difficult to identify effective mitigation strategies. At present, impact pathways other than EMF were identified to be of greater concern for marine mammals. Any impacts of EMF on marine mammals would more likely occur because of impacts on prey species, with knock-on effects on foraging success.

Table 5: NRW perspective on the importance of EMF as an effect on marine mammals and on the status of the current evidence base

Deployment scale	Importance*	Available evidence base**
Single device	Very low	Very poor
Small array	Low	Very poor
Large array	Uncertain - would require assessment	Very poor

**the scale for importance is 'negligible, very low, low, intermediate, high, very high'*
***the scale for evidence base is 'very poor, poor, adequate, good, very good'*

2.5.1 Status of the evidence base and requirements for data collection

For marine mammals, the evidence base available to support decision-making is considered to be very poor. EMF effects would need to be dealt with on a case-by-case basis, depending on the specifics of each project.

For small arrays, NRW would expect to see project-specific data and information provided to address EMF in some cases for marine mammal receptor groups. The effect of EMF on marine mammals would require assessment for large arrays. Furthermore, deployment locations in the vicinity of MPAs would require further consideration in the context of the size of the infrastructure compared to the size of the MPA, animal density, the size and health of the population in question and its level of sensitivity to EMF.

3 PERSPECTIVES FROM ENVIRONMENTAL ORGANISATIONS

The information presented in this section was gathered in consultation with The Wildlife Trusts (TWT). Although fully engaged in SEAGP, the Royal Society for the Protection of Birds (RSPB) did not provide input into this Information Note as EMF emission is not an area of focus or expertise for the organisation.

While the evidence base for EMF emissions has improved in recent years, TWT suggests that a strong evidence base was not yet in place, and stress that they do not support the large-scale development of marine renewable energy in Wales in the absence of an acceptable evidence base. In particular, there is an evidence gap around large-scale deployment of renewable energy infrastructure and the associated impacts of EMF emissions. TWT understands that if cabling and offshore grids are to become more coordinated in the future (in association with the Department of Business, Energy, and Industrial Strategy's Offshore Transmission Network Review[8]), cabling infrastructure is likely to be larger and much more diverse. The potential impacts of the evolution of the offshore grid, in terms of EMF, is uncertain.

TWT indicate that all developments must abide by the mitigation hierarchy and precautionary principle by first avoiding locating developments in areas of high biodiversity, such as MPAs and important spawning, foraging, or nursery areas for sensitive receptors such as elasmobranchs. As the scale of offshore infrastructure increases, increasing uncertainty around potential impacts could push TWT to become more precautionary in their position on marine renewable energy and other offshore infrastructure. It is suggested that it may be useful for SEAGP to identify where the evidence gaps related to EMF are for Wales, as well as specific mechanisms for addressing those gaps.

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8 https://www.gov.uk/government/groups/offshore-transmission-network-review

4 PERSPECTIVES FROM INDUSTRY

Industry perceives that the importance of EMF as an effect on receptor groups, relative to other potential effects, is either negligible, or very low. However, the relative importance of EMF would be highly dependent on the presence of highly sensitive receptors (e.g. elasmobranchs), or species such as Atlantic salmon, European eel and twaite shad. Industry agrees that the importance of EMF is also location-dependent and in some locations a more detailed risk assessment would be required, for example where developments overlap with diadromous fish migration pathways.

Like NRW, industry members suggest that the importance of EMF would increase in a small array scenario for receptors that may be sensitive to EMF such as diadromous fish and elasmobranchs. For all other receptors the importance of EMF relative to other potential effects would remain 'negligible' or 'very low' for small arrays. For large arrays, industry members would expect the importance of effects from EMF to increase with the number of cables associated with the development and particularly if there are receptors in the development area that may be sensitive to EMF effects.

The physical characteristics of the environment at some locations may limit the types of MRE devices that can be installed (e.g. gravity based, floating). Each type of device will have different configurations of inter-array and export cabling. EMF from export cables and devices located at different points in the water column will interact with different species. The effect of cables suspended in the water column represents an important evidence gap. However, it is suggested that developers could consider bundling cables to minimise spatial coverage in the water column.

4.1 STATUS OF THE EVIDENCE BASE FOR EMF

From the perspective of industry members, the level of information and research outcomes available to support decision-making around EMF is thought to be adequate to very good for single devices and adequate for small arrays. Industry members noted that the level of evidence available to support an application depends on the likelihood of receptors which may be sensitive to EMF being present and the amount of available information about local species and its populations. It was suggested that regional locational guidelines and strategic assessments would help to guide decision-making for different locations.

4.2 MITIGATION STRATEGIES

Industry members identified several actions as helpful in mitigating effects from EMF, but that these mitigation measures would depend for example on the differences in seabed conditions and device or array design. Like NRW, industry members identified the use of low voltage systems, adequate cable armouring, and the use of delta-connected systems as appropriate mitigation strategies, as well as cable micro-siting and protection for large arrays. It is also considered that any required monitoring and mitigation must be proportionate, particularly in reference to the comparatively large scale of offshore wind energy developments and electrical grid interconnectors. Evidence from these larger infrastructure developments could be used to inform decision-making for wave and tidal energy developments.

5 SUMMARY AND RECOMMENDATIONS

At present there is an evidence gap around large-scale deployment of marine renewable energy infrastructure and the associated impacts of EMF emissions.

Much of the scientific evidence currently available to support EMF impact assessments for marine renewable energy developments is focused on a small number of individual species, mainly fish, elasmobranchs and benthic crustaceans. Further evidence is therefore needed to better understand the effects of EMF on fish and benthic communities. Although a direct impact pathway for EMF has not been identified for marine mammal or seabird receptor groups, it is important to consider that any impacts to fish from EMF may also have an indirect effect on predators that rely on them for food. Consideration of such potential effects could become more important for future development of large arrays and could be included in a targeted strategic research programme.

In the future, it could be useful to set a threshold below which assessment of EMF in an application would be minimised. If an applicant was able to demonstrate that their project sat below this threshold, NRW may be able to conclude that negative effects would be unlikely, although at present there is not sufficient evidence to support a particular EMF emission threshold level. TWT also suggest that the evidence base for EMF must improve substantially before the precautionary principle could be discounted in favour of this approach. The development of thresholds for EMF could be incorporated into a strategic research programme.

For deployments of single devices, a proportionate approach would be to implement a desk-based review that includes information on planned cables and transmission systems. For small arrays, further project-specific data would be expected, particularly for marine mammal, seabird, and benthic receptor groups. For large arrays, a more detailed project-specific assessment would likely be required. Regional locational guidance and strategic assessments would help to guide both applications and decision-making for specific locations.

An important challenge is the lack of standardisation or best practice for gathering project-specific data to support assessment of EMF. This has likely led to challenges in understanding the nature of EMF effects on the marine environment and has limited the overall evidence base. Regularly updated guidance on quantifying EMF effects for marine renewable energy assessments would help to gather evidence in a structured way, which could help to improve our understanding and inform future strategic environmental assessments and project EIAs.

In the absence of large-scale wave and tidal energy developments, evidence and good practice from offshore wind energy developments and grid interconnectors could be used to support decision-making, although it will be important to review and assess the applicability of this evidence to marine renewable energy developments before doing so. There are also opportunities for the marine renewable energy sector to work together to develop good practice mitigation standards for cable installation, shielding, and/or burial to minimise EMF emissions.

5.1 RECOMMENDATIONS

- Development of best practice for collection of project-specific data on EMF emissions and quantifying effects on marine life would provide consistency across developments in all sectors (MRE, offshore wind, etc), and, if data is made available, it would help to develop an evidence base for future decision-making.
- Consider a strategic approach to delivering an evidence base that would support decision-making about the effects of EMF for large-scale arrays. This might include identifying good practice and applying evidence from other offshore industries such as offshore wind energy.
- In the absence of a sufficient evidence base for EMF, regulators could consider engaging with counterparts in other jurisdictions to understand how EMF effects are approached, the requirements for assessments, and how the existing evidence base is applied and interpreted, to inform assessments in Wales. This would help to provide consistency and reduce project risk for developers pursuing projects in different geographies.
- Identify the evidence requirements and actionable steps in research and monitoring that would enable the development of a threshold, below which assessment of EMF could be minimised.
- The above recommendations could be incorporated into a collaborative, strategic environmental programme for MRE development in Wales and across the UK.

6 REFERENCES

NOTE THAT SOME REFERENCES ARE PROVIDED IN THIS SECTION FOR THE READER'S REFERENCE, AND ARE NOT CITED IN THIS INFORMATION NOTE

Clarke D.R.K., C.J. Allen, C. Artero, L. Wilkie, K. Whelan, D. Roberts. 2021a. Acoustic tracking in Wales – designing a programme to evaluate Marine Renewable Energy impacts on diadromous fish. NRW Evidence Reports No: 553, 64 pp, National Resources Wales, Bangor

Clarke D.R.K., C.J. Allen, C. Artero, L. Wilkie, K. Whelan, D. Roberts. 2021b. Acoustic tracking in Wales – designing a programme to evaluate Marine Renewable Energy impacts on diadromous fish. NRW Evidence Reports No: 553, 64 pp, National Resources Wales, Bangor

Dannheim, J., Bergström, L., Birchenough, S. N., Brzana, R., Boon, A. R., Coolen, J. W., ... & Degraer, S. 2020. Benthic effects of offshore renewables: identification of knowledge gaps and urgently needed research. ICES Journal of Marine Science, 77(3), 1092-1108.

Ernst, D. A., & Lohmann, K. J. 2018. Size-dependent avoidance of a strong magnetic anomaly in Caribbean spiny lobsters. Journal of Experimental Biology, 221(5), jeb172205.

Gill, A.B. and M. Desender. 2020. Risk to Animals from Electro-magnetic Fields Emitted by Electric Cables and Marine Renewable Energy Devices. In A.E. Copping and L.G. Hemery (Eds.), OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World. Report for Ocean Energy Systems (OES). (pp. 86-10). DOI: 10.2172/1633088.

Hutchison, Z. L., Gill, A. B., Sigray, P., He, H., & King, J. W. 2020a. Anthropogenic electromagnetic fields (EMF) influence the behaviour of bottom-dwelling marine species. *Scientific reports*, *10*(1), 1-15.

Hutchison, Z. L., Secor, D. H., & Gill, A. B. 2020b. The interaction between resource species and electromagnetic fields associated with electricity production by offshore wind farms. *Oceanography*, *33*(4), 96-107.

Hutchison, Z. L., Gill, A. B., Sigray, P., He, H., & King, J. W. 2021. A modelling evaluation of electromagnetic fields emitted by buried subsea power cables and encountered by marine animals: Considerations for marine renewable energy development. *Renewable Energy*, *177*, 72-81.

OES-Environmental 2021. Stressor-specific Guidance Document: Electromagnetic Fields. Available Online:

https://tethys.pnnl.gov/publications/stressor-specific-guidance-document-electromagnetic-fields. Accessed 14/10/2021.

Scott, K., Harsanyi, P., & Lyndon, A. R. 2018. Understanding the effects of electromagnetic field emissions from Marine Renewable Energy Devices (MREDs) on the commercially important edible crab, Cancer pagurus (L.). *Marine pollution bulletin*, *131*, 580-588.

Scott, K., Harsanyi, P., Easton, B. A. A., Piper, A. J. R., Rochas, C. M. V., & Lyndon, A. R. 2021. Exposure to Electromagnetic Fields (EMF) from Submarine Power Cables Can Trigger Strength-Dependent Behavioural and Physiological Responses in Edible Crab, Cancer pagurus (L.). *Journal of Marine Science and Engineering*, *9*(7), 776. MDPI AG. Retrieved from http://dx.doi.org/10.3390/jmse9070776

Taormina, B., Bald, J., Want, A., Thouzeau, G., Lejart, M., Desroy, N., & Carlier, A. 2018. A review of potential impacts of submarine power cables on the marine environment: Knowledge gaps, recommendations and future directions. *Renewable and Sustainable Energy Reviews*, *96*, 380-391.

APPENDIX A : ADDRESSING EMF IN PREVIOUS MARINE ENERGY PROJECTS: LICENSING DOCUMENTS AND CONSENT CONDITIONS

Project Name	Location	Technology	Consenting Status	How addressed EMF	EIA / HRA / Other	Condition
Greenlink	Ireland - Wales	Interconnector	Consented – construction not started	Assessment of EMF within ES	EIA Licensing documentation	CML 1929: EIA Written Confirmation of the EIA Consent Decision 8.1 Features or measures to avoid, prevent, reduce, or offset likely significant effects 8.1.2.3 Submarine cables will be bundled together, which reduces the seabed footprint of installation activities and the electromagnetic field generated during operation, thus minimising any potential compass deviation effects

Project Name	Location	Technology	Consenting Status	How addressed EMF	EIA / HRA / Other	Condition
Moray Offshore Renewables (Moray East)	Scotland	Offshore Wind	Consented	EMF modelling technical appendix of ES	EIA Marine Licence Cable plan	Marine Licence: MS-00008919 Section 3.2.2.10: Cable Plan ("CaP") The Licensee must, no later than 6 months prior to the Commencement of the Works, submit CaP, in writing, to the Licensing Authority for their written approval. d) Technical specification of all cables, including a desk based assessment of attenuation of electromagnetic field strengths and shielding.
MeyGen	Scotland	Tidal Stream Array	Constructed	EMF Best Practice Report	Post-consent ML and s36 condition	The licensee must, no later than three months prior to the commencement of the works, provide the licensing authority for their written approval a report detailing current 'best practice' relating to the attenuation of field strengths of cables by shielding or burial designed to minimise effects on electro-sensitive and migratory fish species. Such 'best practice' guidance as is identified must be incorporated into the Construction Method Statement, in respect of which condition 9 of the section 36 consent relates.

Project Name	Location	Technology	Consenting Status	How addressed EMF	EIA / HRA / Other	Condition
Dounreay Tri	Scotland	Floating Offshore Wind	Consented	Discuss the potential for EMF impacts associated with cabling and grid connection infrastructure, including the risks that this could pose for fauna	EIA Environmental Statement Marine Licence	Marine Licence: MS-00009329 Section 3.2.9: Cable Plan ("CaP") The Licensee must, no later than 6 months prior to the Commencement of the Works, submit CaP, in writing, to the Licensing Authority for their written approval. c) Technical specification of all cables, including a desk based assessment of attenuation of electromagnetic field strengths and shielding.
Hywind Scotland	Scotland	Floating Offshore Wind	Consented	Effects of EMF and heat generated by active power cables on benthic invertebrates	EIA Environmental Statement Hywind Scotland Plan for Construction Activities	Marine Licence: 05515 Section 3.2.2.10: Cable Plan ("CaP") The Licensee must, no later than 6 months prior to the Commencement of the Works, submit CaP, in writing, to the Licensing Authority for their written approval. c) Technical specification of all cables, including a desk based assessment of attenuation of electromagnetic field strengths and shielding.

Project Name	Location	Technology	Consenting Status	How addressed EMF	EIA / HRA / Other	Condition
Kincardine	Scotland	Floating Offshore Wind	Consented	Impacts from EMF	EIA Cable Plan Environmental Statement S36 Variation Decision: Letter and Conditions	Section 36 consent Section 17: Cable Plan ("CaP") The Licensee must, no later than 6 months prior to the Commencement of the Works, submit CaP, in writing, to the Licensing Authority for their written approval. c) Technical specification of all cables, including a desk based assessment of attenuation of electromagnetic field strengths and shielding
META	Wales	Wave and Tidal Demo Zone	Consented	There is no marine communications cable within the project design envelope, and so no potential for production of EMF.	EIA Marine Licence Environmental Statement Chapter 8: Fish and Shellfish	No conditions associated with EMF

Project Name	Location	Technology	Consenting Status	How addressed EMF	EIA / HRA / Other	Condition
Nova Innovation Blue Mull Sound	Scotland	Tidal Stream Array	Consented	Not addressed in Environmental Assessment Report. Statutory EIA was not required for this project.	[Environmental Assessment Report]()	Marine Licence 06642/18/0. No specific conditions associated with EMF 3.2.1.1 The Licensee must, within three months of the issue date of this licence, unless otherwise agreed with the Licensing Authority, submit a Project Environmental Monitoring Programme ("PEMP"), in writing, to the Licensing Authority for their written approval. 3.2.2.4 The Licensee must, within three months of the issue date of this licence, submit a Cable Plan ("CaP") in writing, to the Licensing Authority for their written approval

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