MAINSTREAM RENEWABLE POWER

Neart na Gaoithe Offshore Wind Farm

Pre-Construction Ornithology Monitoring Proposal

March 2016

Pursuant to Neart na Gaoithe Section 36 Consent Condition 23

UK02-0504-0584-CEC-BIRD MONITORING PROPOSAL-RPT-A1

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1 Introduction

1 This document sets out the proposed approach for pre-construction ornithology monitoring for the Neart na Gaoithe Offshore Wind Farm (NnG). It has been prepared for discussion with the ornithology sub-group of the Forth and Tay Regional Advisory Group (FTRAG-O), as a precursor to the Project Environmental Monitoring Programme (PEMP). Agreement on proposals for pre-construction monitoring will enable a partial discharge of the relevant Section 36 consent condition.

2 As this document relates to pre-construction data collection, the focus is on monitoring displacement and barrier effects.

3 Neart na Gaoithe Offshore Wind Limited (NnGOWL) is committed to monitoring collision and/or avoidance, however as this does not require the collection of pre-construction data, it is not necessary to finalise methods at this stage. Indeed it is preferable to wait until closer to the operational phase of the wind farm when it is expected that technology will have improved. Collision/avoidance will therefore be the subject of a future proposal, prepared for discussion with FTRAG-O.

2 Consent Conditions

4 Table 2.1 identifies the Section 36 Consent conditions relevant to seabird monitoring.

Table 2.1 Relevant Section 36 Consent Conditions

Condition	Details
S36 Consent condition 23	The Company must, no later than 6 months prior to the Commencement of the Development, submit a Project Environmental Monitoring Programme ("PEMP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with SNH, the JNCC, RSPB Scotland, WDC, ASFB and any other ecological advisors or organisations as required at the discretion of the Scottish Ministers. The PEMP must be in accordance with the Application as it relates to environmental monitoring. The PEMP must cover, but not be limited to the following matters: a. Pre-construction, construction (if considered appropriate by the Scottish Ministers) and post-construction monitoring surveys as relevant in terms of the ES and any subsequent surveys for: 1. **Birds** The participation by the Company in a National Strategic Bird Monitoring Framework ("NSBMF") and surveys to be carried out in relation to regional and / or strategic bird monitoring including but not necessarily limited to: 1. The avoidance behaviour of breeding seabirds around turbines; 2. Flight height distributions of seabirds at wind farm sites; 3. Displacement of kittiwake, puffin and other auks from wind farm sites; and 4. Effects on survival and productivity at relevant breeding colonies.
S36 Consent condition 24	The Company must participate in any Forth and Tay Regional Advisory Group ("FTRAG") established by the Scottish Ministers for the purpose of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, **ornithology**. Should a Scottish Strategic Marine Environment Group ("SSMEG") be established (refer to condition 25), the responsibilities and obligations being delivered by the FTRAG will be subsumed by the SSMEG at a timescale to be determined by the Scottish Ministers.
S36 Consent condition 25	The Company must participate in any Scottish Strategic Marine Environment Group ("SSMEG") established by the Scottish Ministers for the purposes of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, **ornithology**.

3 Approach to Seabird Monitoring

5 Following the granting of Consents by the Scottish Ministers under Section 36 of the Electricity Act 1989 to construct and operate four offshore wind farms in the outer Forth and Tay, the Forth and Tay Regional Advisory Group (FTRAG) has been set up to meet the requirements of the Section 36 and associated Marine Licence conditions for the Forth and Tay developments.

6 As part of FTRAG, an ornithology subgroup (FTRAG-O) has been set up to discuss and agree appropriate bird monitoring for the Firth of Forth and Tay offshore wind farms. NnGOWL has appointed Cork Ecology and Pelagica to provide advice on bird monitoring options and to engage in FTRAG-O discussions.

7 NnGOWL has participated in several FTRAG-O meetings with developers, Marine Scotland, SNCBs and the RSPB, and the programme of regular meetings is ongoing (Table 3.1). The focus of these meetings has been to discuss future monitoring for the currently consented Forth and Tay offshore wind farm projects (NnG, Inch Cape, Seagreen Alpha and Seagreen Bravo).

Table 3.1 Programme of FTRAG-O meetings & teleconferences

Meeting	Date
FTRAG-O Meeting 1	29/06/2015
FTRAG-O Meeting 2	3/09/2015
FTRAG-O Meeting 3	17/11/2015
Teleconference between MS, SNH & JNCC	1/12/2015
Teleconference between MS, SNH & JNCC	10/12/2015
FTRAG-O Meeting 4	26/01/2015
FTRAG-O Meeting 5	23/03/2015

8 Initial FTRAG-O meetings discussed and agreed the key species of concern, the relevant SPAs and the potential impacts that are to be the main focus for future monitoring programmes. The key species, SPAs and potential impacts that require monitoring by NnG are summarised in Table 3.2. Of the five species listed, guillemot was considered to be of lower priority in FTRAG-O discussions.

Table 3.2 Summary of key species, SPAs and potential impacts requiring monitoring for NnG

Species	Priority	SPA	Potential impact
Gannet	High	Forth Islands SPA (Bass Rock)	Collision
Kittiwake	High	Forth Islands SPA St Abb's Head to Fast Castle	Collision, Displacement & Barrier effects Collision & Displacement
Razorbill	High	Forth Islands SPA	Potential cumulative impact from Forth & Tay projects on SPA population due to displacement effects
Puffin	High	Forth Islands SPA	Displacement & Barrier effects
Guillemot	Low	Forth Islands SPA	Displacement

9 Recent FTRAG-O meetings held on 3rd September and 17th November 2015 focussed on identifying the key questions relating to potential impacts to be addressed by future monitoring programmes and the most appropriate methods to use. The full list of the key questions agreed by the FTRAG-O group is included in Appendix A. The methods considered most appropriate by NnGOWL for answering these questions are presented in Section 7.2.4.

10 The final discussion document arising from these meetings will be available on the Marine Scotland FTRAG-O website http://www.gov.scot/Topics/marine/Licensing/marine/scoping/ftrag/ornithology

4 Aims and Objectives

11 The aim of this document is to outline the most appropriate methods to identify impacts on seabirds from NnG, in the context of previously identified key bird species, Special Protection Areas (SPAs) and the questions referenced above.

12 Methods identified and selected as the most appropriate will be subject to regular annual review, taking into account:

a. Information gathered from this project;

b. Newly published information from monitoring of other offshore projects;

c. New technologies e.g. to identify collision/avoidance; and

d. Results from industry-led research projects such as the Offshore Renewables Joint Industry Programme (ORJIP).

13 It is important to note that proposals within this document relate to NnG alone are not intended to have implications for monitoring of other Forth and Tay wind farms. At the time of writing (March 2016) there is significant uncertainty regarding timescales for all projects, including NnG. Whilst there is the potential for future collaboration, different methods may be considered to be more appropriate for other projects e.g. depending on experiences from NnG or other wind farms. Ensuring flexibility for each project is essential from both a practical and commercial perspective.

5 Monitoring Methods

5.1 Methods to monitor displacement and barrier effects

14 FTRAG-O has identified the risk of displacement of kittiwake, puffin, razorbill and guillemot as a key area for monitoring.

15 This section outlines the monitoring methods to be employed at NnG to address the following questions on displacement impacts, as agreed at FTRAG-O meetings:

a. Can a significant change in densities of KI, PU, RA and GU in the wind farms be identified?
b. Can a significant change in densities of KI, PU, RA and GU be attributed to the wind farms?
c. Is there a significant difference in foraging activity inside and outside the wind farms, and can this be associated with the presence of the wind farms?
d. Do densities of KI, PU, RA and GU inside the wind farm change with time from construction (i.e. due to habituation)?
e. Is there evidence of connectivity between breeding birds from specific colonies and the wind farm footprints?

16 Barrier effects have also been identified at FTRAG-O meetings as a key area to be addressed by monitoring programmes. The following question regarding barrier effects was agreed through FTRAG-O meetings:

f. What percentage of birds avoid the wind farm boundary?

17 The text below sets out NnG's intended methods for monitoring displacement and barrier effects.

5.1.1 Digital aerial surveys

18 To monitor **displacement**, NnGOWL will undertake a programme of regular monthly digital aerial surveys between March and October, covering the breeding and post-breeding periods. These months encompass the entire breeding season, which was highlighted during the FTRAG-O discussions as the key season regarding potential impacts at SPAs in the vicinity. This will include pre-construction surveys, to be undertaken for a minimum of one season prior to the start of construction. As the focus of monitoring is on operational impacts, it is proposed that surveys are not undertaken during the construction phase. Evidence from existing wind farms suggests that construction activities may result in temporary localised disturbance around construction activities for some species, therefore this would not provide a useful baseline against which to compare distributions.

19 The precise method to be used for the digital aerial surveys has yet to be decided and this will be determined through a competitive tender process. It is NnGOWL's view that both digital still photography and digital video are appropriate methods for monitoring any relative changes in distributions across the study area.

20 Once the wind farm is operational, regular monthly surveys between March and October will allow densities of the key species to be calculated and monthly totals for the development area and a buffer

area around the development area to be estimated. It is currently envisaged that post-construction surveys will be conducted for at least two seasons once the wind farm is operational. The requirement for further studies beyond this period will be considered in consultation with FTRAG-O following analysis of the second year of post-construction survey data. This will include a power analysis to consider the benefit of undertaking further surveys.

21 Post-construction digital aerial survey data will be directly comparable with the pre-construction digital aerial survey data, and therefore it will be possible to directly compare densities of key species within the development area and in the surrounding area for the pre- and post-construction periods.

22 Pre-application baseline surveys were undertaken using ESAS boat-based methods for 3 years between 2009 and 2012. Whilst the differences in methods which may make direct comparisons difficult, it will be possible to compare relative abundances and patterns of distribution between the two time periods.

23 The initial baseline boat-based surveys covered the NnG development area and a surrounding 8 km buffer. Although the digital aerial survey area has yet to be finalised, it is intended that this will cover a larger area. This will allow seabird distribution and densities around the development area to be placed in a wider context.

24 The use of digital aerial surveys will also allow seabird flight heights to be recorded and analysed. This information will inform questions on flight height listed in Section 5.2.

5.1.2 Tagging studies

25 Tagging provides an opportunity to analyse seabird behaviour in relation to the wind farm. It is intended that tagging razorbills, puffins and kittiwakes will allow analysis of potential **barrier effects**. GPS tracks can indicate whether birds are commuting or foraging. If individual flight lines of tagged birds to or from a colony are altered by the presence of the wind farm, this should be apparent from the GPS tracks. Conversely, if tracks show the majority of birds commuting through the wind farm, this would indicate that barrier effects are not occurring.

26 GPS tracks will also demonstrate **connectivity** between birds using the wind farm footprint and SPA colonies in the vicinity.

27 Depending on the suitability of the pre- and post-construction tagging data, it may be possible to undertake further analysis of **displacement** using tag data. For kittiwake this could include further analysis of any **macro-avoidance**.

28 As discussed at recent FTRAG-O meetings, when birds are tagged, this also provides the opportunity to record **survival** and **productivity** information for tagged breeding adults.

29 The first phase will involve one season of pre-construction tagging of razorbills, puffins and kittiwakes. To reduce disturbance to individuals and to increase data collection rates, it is proposed that remote download GPS tags are used during.

30 The study will be subject to annual review after each study season, to assess results and to review tag technology, which is likely to improve over time. Results from digital aerial surveys in the breeding season will also be used to inform decisions on any improvements to the monitoring programme.

31 Birds will be tagged during the chick-rearing stage of the breeding cycle. Related tagging studies undertaken previously are discussed below.

5.1.2.1 Razorbill

32 Tracking studies involving breeding razorbills on the Isle of May were conducted in 2010 by CEH at the request of FTOWDG. This study involved 18 tagged birds and results indicated that razorbills from the Isle of May use both coastal and offshore areas, with a mean maximum range of 14 km and a maximum range of 69 km, although they avoided the deeper water between the Isle of May and the Wee Bankie. The tagged razorbills did not use the NnG site for non-flight activities such as foraging or resting (Daunt et al., 2011a).

5.1.2.2 Puffin

33 Previous attempts to track puffins using tags have indicated that tagged birds appeared to change behaviour (Harris *et al* 2012). However, as the latest available tags have reduced in size and weight, it is thought that they may now be more suitable for use with puffins. There has been some discussion over the testing of these new tags on puffins in the 2016 breeding season by Marine Scotland, however the outcome of these discussions is not yet known.

34 If such tags prove suitable, NnGOWL intends to undertake a similar tagging study on puffins as has been outlined above for razorbills. The degree of additional information that could be collected, such as adult weight at start and end of tagging and breeding productivity may be limited by how much birds are disturbed by the additional handling required to obtain this information.

5.1.2.3 Kittiwake

35 Tracking studies involving breeding kittiwakes on the Isle of May were conducted in June 2010 by CEH, commissioned by FTOWDG. This study involved 36 birds (91 foraging trips) and showed that the mean maximum foraging range from the Isle of May colony was 42 km, with a maximum foraging range of 150 km recorded (Daunt *et al.,* 2011a).

36 Similar tracking studies were repeated in May and June 2011 at Fowlsheugh (35 birds, 93 trips) and St Abb's Head (25 birds, 70 trips) (Daunt *et al.,* 2011b). Foraging trips from Fowlsheugh were concentrated in a north-easterly to south-easterly direction, with a mean maximum foraging range of 35 km, and a maximum foraging range of 141 km recorded (excluding one outlier of 415 km). Foraging range from St Abb's Head was similar (mean maximum range of 32 km; maximum 108 km), but overall distribution was more focussed, in a south-easterly direction (Daunt *et al.,* 2011b).

37 The NnG site is within the mean maximum foraging ranges recorded by these tagging studies for the Isle of May and St Abb's Head, but is outside the mean maximum foraging range recorded at Fowlsheugh.

5.1.2.4 Guillemot

38 No tagging studies are currently being considered for guillemot as it is not considered a high priority key species by the FTRAG-O group. However, data on guillemot distribution data and densities within the development area and surrounding buffer area will be recorded by the digital aerial surveys and will be analysed to see if there is any detectable displacement effect.

5.2 Methods to monitor collision and/or avoidance

39 Potential collision impacts for gannet and kittiwake has been identified by FTRAG-O as a key consideration for monitoring programmes. The following key questions on collision impacts have been agreed through FTRAG-O meetings:

g. Does collision occur and are there empirical methods to record seabird collisions at offshore wind farms?
h. What are the collision rates? Or
i. What are the micro, meso and macro avoidance rates?
j. Do flight height distributions differ inside and outside the wind farm?
k. Do flight height distributions differ significantly in different weather conditions?
l. Do flight height distributions change over time as birds habituate to the presence of WTGs?

40 NnGOWL is considering the use of turbine mounted digital cameras to monitor collision. This technology has been used to monitor collision rates or to record bird avoidance behaviour at individual turbines. This allows bird flights to be tracked in three dimensions so height-based avoidance can be detected and the majority of species can be identified. It is also possible to use cameras with near-infrared technology to allow birds to be detected at night as well as in daylight.

41 In the UK, this technology has been used at one offshore wind farm, Sheringham Shoal, where a camera was fitted to a turbine for a period of 10 months (Mellor & Hawkins 2013). High definition cameras are also being used as part of the current ORJIP study at Thanet. Elsewhere, near-infrared cameras are have been tested at onshore wind farms in the USA (HiDef 2014). In The Netherlands, a system utilising turbine-mounted digital cameras and vibration sensors in the turbine blades (WT-Bird) has been used to undertake collision monitoring at the OWEZ offshore wind farm since 2014.

42 As a possible alternative to camera technology, NnGOWL is considering the use of turbine-mounted radar to investigate levels of avoidance for species such as gannet and kittiwake. Horizontal radar has been used successfully at other offshore projects such as Gwynt y Mor, to show flight patterns around the turbines, although this particular project involved horizontal radar mounted on a vessel.

43 In addition to camera or radar methods and as noted in previous sections, it is anticipated that digital aerial surveys and tagging studies will provide information on macro-avoidance.

44 Neart na Gaoithe Offshore Wind Limited (NnGOWL) is committed to monitoring collision and/or avoidance, however as this does not require the collection of pre-construction data, it is not necessary to finalise methods at this stage. As technology will develop and knowledge will improve due to projects such as ORJIP, it is preferable to select methods closer to the time of deployment. Collision/avoidance methods will therefore be the subject of a future proposal, prepared for discussion with FTRAG-O.

5.3 Methods to monitor population level impacts

45 The potential for population level effects at key SPAs was highlighted at recent FTRAG-O meetings as a key consideration for future monitoring programmes.

46 This section outlines the monitoring methods to be employed at NnG to address the following questions on population level impacts, as agreed at FTRAG-O meetings:

m. What is the rate of adult productivity for each of the key species at the key SPAs for those species?
n. What is the rate of adult survival for each of the key species at the key SPAs for those species?
o. How do these vary across wind farms and SPAs with different levels of connectivity?

47 Different studies are likely to be required for each of the key species, and these are discussed below.

5.3.1 Razorbill, Puffin and Kittiwake

48 As part of the tagging operations outlined above, adult razorbill, puffin and kittiwake would be weighed and colour-ringed at the time of tagging, and weighed again when the tag is retrieved (if feasible). This would allow the condition of the tagged adult to be monitored, and could also be used to monitor adult survival, by recording presence/absence of colour-ringed adults in subsequent seasons. In addition, chick productivity of tagged and untagged individuals would be monitored to provide information on breeding success of tagged birds. This information could be used to address questions on productivity and adult survival raised at FTRAG-O discussions.

5.3.2 Gannet

49 The possibility of undertaking a long-term colour-ringing project of adult gannets from the Bass Rock colony was discussed at the FTRAG-O meeting on 26th January 2016. This would involve colour-ring of adult birds at the Bass Rock. Annual return visits would also be required to identify the presence of marked birds at the colony. The number of absent adults in subsequent seasons would give an indication of the survival rate of adult gannets.

50 In addition to investigating survival rates of adult gannets on the Bass Rock, it was proposed that a similar colour-ringing of adult birds at a colony with no offshore wind farms in the vicinity, such as Grassholm, off the Welsh coast could help in assessing possible population level impacts from an offshore wind farm. This would allow adult survival rates between the two colonies to be compared and possible conclusions

to be drawn about the degree of impact of offshore wind farms on adult gannets breeding on the Bass Rock.

51 The potential of such a study to demonstrate a possible effect from a wind farm requires further consideration. NnGOWL considers this to be a strategic study as there are several UK offshore wind farm projects currently consented and/or under construction that were considered a collision risk for gannet in the ES/AA process. Such a project could be strategically managed with developers potentially contributing. NnGOWL would consider contributing to the cost of marking adult gannets with colour-rings, as part of such a study, if it can be demonstrated that the results would be able to robustly detect potential wind farm related impacts.

52 NnGOWL considers that monitoring of chick productivity is not required for gannet, sub-lethal effects from displacement or barrier are not considered to be of relevance to gannet due to the very large foraging range of this species.

6 Summary

53 Table 6.1 summarises proposed ornithology monitoring for NnG.

Table 6.1 Summary of monitoring proposals for NnG

Project Phase	Proposed Survey	Timing and Duration	Data Acquired	Reason
Pre-construction	Digital aerial surveys	1 season (March to October) prior to construction	Pre-construction seabird distributions, densities, flight heights, flight directions	Baseline data for comparison with later phases
	Tagging studies: razorbill, puffin and kittiwake	Breeding season prior to construction	Tracks between colonies & feeding areas	Baseline data for comparison with later phases
	Colour-ringing and weighing of razorbill, puffin and kittiwake adults Chick productivity of tagged and untagged birds	Breeding season prior to construction	Weights of tagged adults Productivity data	Monitoring condition of tagged birds Baseline data for comparison with later phases
Post-construction	Digital aerial surveys	Minimum of 2 seasons (March to October) (TBC)	Post-construction seabird distributions, densities, flight heights, flight directions	Comparison with pre-construction data Displacement monitoring
Post-construction	Turbine-mounted digital cameras or radar	To be confirmed prior to operational phase, depending on	Evidence of any collisions or avoidance with turbines fitted	Monitoring collision rates or

		available technology	with digital cameras/radar	avoidance behaviour
Post-construction	Tagging studies: razorbill, puffin and kittiwake	Minimum one breeding season after turbines operational, potentially subsequent seasons depending on data collected	Tracks between colonies & feeding areas in relation to turbines	Comparison with pre-construction data Monitoring barrier effect Data could feed into potential displacement study
Post-construction	Colour-ringing and weighing of razorbill, puffin and kittiwake adults Chick productivity of tagged and untagged birds	Minimum one breeding season after turbines operational	Weights of tagged adults Productivity data	Comparison with pre-construction data Data could feed into potential displacement study

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Appendix A

This appendix provides a summary of key questions which have been discussed at the recent series of FTRAG-O meetings.

Some questions may be appropriate for developers to address in post-construction monitoring, whereas others may be more appropriate to be addressed through strategic research projects.

Collision, Avoidance and Flight Height

1. *Does collision occur and are there empirical methods to record seabird collisions at offshore wind farms?*
2. *What are the collision rates?*

   Or
3. *What are the micro, meso and macro avoidance rates?*
4. *Do flight height distributions differ inside and outside the wind farm?*
5. *Do flight height distributions differ significantly in different weather conditions?*
6. *Do flight height distributions change over time as birds habituate to the presence of WTGs?*

Displacement and Barrier

7. *Can a significant change in densities of KI, PU, RA and GU in the wind farms be identified?*
8. *Can a significant change in densities of KI, PU, RA and GU be attributed to the wind farms?*
9. *Is there a significant difference in foraging activity inside and outside the wind farms, and can this be associated with the presence of the wind farms ? [N.B. this may be very challenging to measure and methodologies able to tease apart wind farm from other drivers remain uncertain]*
10. *Do densities of KI, PU, RA and GU inside the wind farm change with time from construction (i.e. due to habituation)?*
11. *Is there evidence of connectivity between breeding birds from specific colonies and the wind farm footprints*
12. *What percentage of birds avoid the wind farm boundary?*

Other initial MS questions considered differences between displacement rates and barrier effects at wind farms with different turbine spacings and at different distances from colonies. If the key questions of whether displacement/barrier occurs can be answered, then it may be possible for subsequent strategic projects to consider differences between projects such as:

13. *Are the densities of KI, PU, RA and GU different between wind farms with different turbine densities?*

Population impacts

14. *What is the rate of adult productivity for each of the key species at the key SPAs for those species?*
15. *What is the rate of adult survival for each of the key species at the key SPAs for those species?*
16. *Where it is possible to compare between SPAs, are there differences in the rates of adult productivity and survival for the key species at these SPAs?*