SeaGreen Offshore Wind farm
Gateway documentation:
Stage 2 Develop and Assess

2B: Options Appraisal
(Phase 1 Initial)
Including Safety Assessment

Publication history

Issue	Month/Year	Change Requests in this issue
Issue 1	July 2019	First issue released to SARG.

Contents

1. Introduction

1.1 This document forms part of the document set required in accordance with the requirements of the CAP1616 airspace change process.

1.2 This document aims to provide adequate evidence to satisfy Stage 2 Develop and Assess Gateway, Step 2B Options Appraisal (Phase 1 Initial), including Safety Assessment.

2. Change Level

2.1 The changes in this ACP only impact flights over the high seas (14.6nm offshore). Hence in accordance with the Levels as defined in CAP1616, it is expected that this proposal is categorised as a Level 2B change.

2.2 In line with the requirements for a Level 2B change the environmental impact assessment has been conducted on the basis of CO_2 emissions. There would be no perceptible change to noise impacts to stakeholders on the ground; hence no noise analysis has been undertaken.

3. Options Appraisal

3.1 This ACP is proposing a Radar Blanking mitigation solution for the proposed wind farm which will be located 27km (14.6nm) offshore from the Angus coastline. The wind turbines would be detected by radar, and the large number of turbines (150) would result in significant 'clutter' on radar displays. This would affect an air traffic controller's ability to identify aircraft via primary radar returns and hence introduce the risk of failing to detect a potential conflict between aircraft. A large number of turbines could also interfere with radar tracking and lead to a saturation of the radar processing systems.

3.2 Radar Blanking (or Radar Range Azimuth Gating (RAG)) is the proposed solution to be deployed over the area of the wind farm before it is constructed, to prevent primary radar detection from the turbines. However, radar blanking will also remove primary radar returns of aircraft within the blanked area. As such, a Transponder Mandatory Zone (TMZ) will need to be established in the same area so that aircraft will be visible to ATC using secondary surveillance radar (SSR).

3.3 The do nothing option does not provide any mitigation against radar clutter. It assumes that the wind farm would be built but there would be no changes implemented to prevent radar clutter and interference. The assessment for the "Do nothing" option against each Design Principle (DP) includes five DPs "Not Met" because of the anticipated clutter/ interference. The DPs related to safety are high priority.

3.4 This ACP has proposed four alternative options which could be used to provide appropriate mitigation against the impacts of wind turbine generators (WTGs) associated with the Seagreen offshore wind farm:

1. Option A: TMZ in line with proposed wind turbine locations
2. Option B: TMZ in line with proposed wind turbine locations plus 2nm buffer
3. Option C: simplified polygon TMZ "rubber banded" around proposed wind turbine locations with no buffer
4. Option D: TMZ aligned to smoothed/rounded off boundary plus 2nm buffer (preferred)

3.5 The detailed makeup of the above options is described in Seagreen Offshore Wind farm Gateway documentation: Stage 2 Develop and Assess Stage2A(i): Airspace Change Design Options.

3.6 Evaluation of the design options is detailed in the Stage 2 Develop and Assess Stage 2A(ii): Design Principle Evaluation, Options Assessment.

3.6 Baseline (do nothing) Option

The do nothing option assumes that the wind farm is constructed and the changes proposed in the ACP are not implemented. This table indicates the effects on communities and stakeholders should this be the case.

Group	Impact	Level of Analysis	Evidence
Communities	Noise impact on health and quality of life	Qualitative	No change in noise impact from today. (offshore – so no communities impacted)
Communities	Air quality	Qualitative	No change in air quality from today.
Wider society	Greenhouse gas impact	Monetise and quantify	No change in greenhouse gas emissions due to aircraft trajectory changes. (note: with no mitigation solution, under Condition 23 the wind farm would be unable to progress. As such the expected CO_2e benefits of 2million tonnes per annum would **not** be realised.)
Wider society	Capacity/ resilience	Qualitative	Radar clutter could increase ATC workload and impact ATC capacity, leading to reduction in ATC resilience.
General Aviation	Access	Qualitative	No change from today.
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Qualitative	No change from today.
General Aviation/ commercial airlines	Fuel burn	Qualitative	No change from today
Commercial airlines	Training cost	Qualitative	There would be no training required.
Commercial airlines	Other costs	Qualitative	There would be no associated costs for airlines.
Airport/ Air navigation service provider	Infrastructure costs	Qualitative	There would be no associated infrastructure costs.
Airport/ Air navigation service provider	Operational costs	Qualitative	There would be no associated operational costs.
Airport/ Air navigation service provider	Deployment costs	Qualitative	There would be no associated deployment costs.

Table 1 Options Appraisal (CAP1616 E2) – Do Nothing Option

3.7 Design Options: implementation of a TMZ

The design proposal is for the implementation of radar blanking, alongside a transponder mandatory zone (TMZ). There are 4 options identified for the size and parameters of the blanked area and TMZ. Most of the impacts are the same for all four options. The only difference between the options in Table 2 below is with regard to the capacity/resilience. This is identified by the grey shading in Table 2 which identifies the expected impact of the design proposal for all 4 options:

Group	Impact	Level of Analysis	Evidence
Communities	Noise impact on health and quality of life	Qualitative	There are no proposed changes to air traffic patterns so there will be no impact for noise. The designated area is approx. 27km from the Angus coast.
Communities	Air quality	Qualitative	No changes to aircraft trajectories below 1,000ft.
Wider society	Greenhouse gas impact	Monetise and quantify	The introduction of the wind farm is anticipated to provide CO_2e benefits of 2 million tonnes per annum[1], which is a benefit of this project. This will only be realised if the airspace change is implemented. The estimated cost value of this CO_2e benefit is £2,260,146,915 (£2.3bn) over 25 years[2].
Wider society	Capacity/ resilience	Qualitative	Options A & C represent a reduction in capacity/resilience. Options B & D will have no impact. Option A: reduction in capacity/resilience Option B: no anticipated impact on capacity/resilience Option C: reduction in capacity/resilience Option D: no anticipated impact on capacity/resilience
General Aviation	Access	Qualitative	For those GA aircraft equipped with a transponder there would be no change and no restriction in access due to the proposed TMZ. Aircraft without an operational transponder would be restricted from entering and hence would be required to route around the TMZ. This could restrict access for some GA users or provide a one-off cost implication (approx. £2,000 to purchase a transponder) for these users to enable access to this area. Given the offshore location (27kms from Angus coast), the demand for GA aircraft without a transponder needing to fly over this area is likely to be minimal. The vast majority of GA aircraft are transponder equipped. Those which are not tend to be historic/vintage aircraft and as such are highly unlikely to be flying so far offshore. Normal practice is to follow the coastline, so as to be within safe gliding range of land in case of emergency.
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Qualitative	There would be no increase in effective capacity. Relative difference in capacity between each of the options is small and would not be likely to affect ATC sector monitor values[3]. It should be noted that the TAY ATC sector (within which the proposed TMZ will lie) is not currently capacity constrained, hence a small change in sector capacity is unlikely to result in an increase in delays.
General Aviation/ commercial airlines	Fuel burn	Monetise	No expected change to fuel burn for commercial airlines as flight plannable routes will remain unchanged and they will be able to route through the TMZ as currently. General Aviation users may incur increased fuel burn if they are forced to reroute around the TMZ if they do not have the relevant equipage. However, the likely volume of non-transponder equipped aircraft which may pass through this area and any potential increase in fuel burn as a result would be negligible (estimate <1 per week).
Commercial airlines	Training cost	Qualitative	N/A – there are not expected to be any airline training cost associated with this development.
Commercial airlines	Other costs	Qualitative	Updates to FMS and flight planning systems will by the routine AIRAC updates. There are no other known costs which would be imposed on commercial aviation.
Airport/ Air navigation service provider	Infrastructure costs	Qualitative and quantitative	No cost to the ANSP - The cost to the ANSP of implementation of the TMZ and adaptation of systems is being paid by Seagreen Wind Farm Ltd.
Airport/ Air navigation service provider	Operational costs	Qualitative	N/A – this proposal would not lead to changes in operational costs. The developer has agreed to cover all engineering costs for implementation of the Radar RAG Blanking.
Airport/ Air navigation service provider	Deployment costs	Qualitative	N/A – no costs anticipated for the deployment of the TMZ

Table 2 Options Appraisal (CAP1616 E2) –Options A-D

(note rows where there is a difference between options are coloured grey.)

[1] https://www.seagreenwindenergy.com/benefit

[2] Calculated using WebTAG

[3] Sector Monitor Values indicate the approximate number of aircraft per hour that an ATC sector can accommodate. If traffic demand rises above the monitor value, flow restrictions can be implemented to ensure that ATC are not overloaded to maintain safety. The imposition of flow restrictions can result in delays to aircraft.

4. Safety Assessment

4.1 Options Appraisal Safety Assessment – Do nothing

If the wind farm were constructed and no mitigation against radar clutter/interference were implemented, this would have the following impacts.

- WTGs cause clutter on radar displays (150 WTGs in the wind farm)
- The clutter make ATC tracking & identification of non-transponder equipped aircraft in the cluttered area impossible
- The clutter make ATC tracking & identification of transponder equipped aircraft in the cluttered area difficult due to obscuring.
- Interference & saturation of radar processing due to excessive radar returns can degrade radar performance across the whole operating are of the radar.

Due to the above impacts the suspensive Condition 23 requires that appropriate mitigation is put in place. Hence "Do Nothing" is not a viable option.

4.2 Options Appraisal Safety Assessment – Option D

The Option D "TMZ aligned to smoothed/rounded off boundary plus 2nm buffer" design (plus RAG blanking), is proposed as the optimum solution to mitigate the impact of the WTGs on the Perwinnes radar system.

This option will provide:

- Effective suppression of all primary radar clutter associated with the WTGs.
- The promulgation of a TMZ over the RAG blanked area will ensure that aircraft within the TMZ area must be transponder equipped and hence will be visible to ATC via secondary radar.
- The dimensions of the TMZ include a 2nm buffer which is adequate to ensure that ATC have sufficient time to identify when an infringement of the TMZ is taking place and take appropriate action.

Experience from previous wind farm developments has demonstrated that the implementation of radar RAG blanking coupled with an associated TMZ provides effective and safe mitigation against the radar issues associated with WTGs.

Initial qualitative assessment from NATS safeguarding has confirmed that the proposed Option D TMZ design would provide adequate mitigation to fulfil the requirements required of the NERL Perwinnes: PSR Mitigation Scheme.

Detailed safety analysis will be undertaken in due course by NATS based on the TMZ Option D proposed herein.

4.3 Safety Assessment Conclusion

The proposed Option D TMZ coupled with radar RAG blanking provides effective and safe mitigation against the radar issues associated with WTGs.

5. Conclusion and Next Steps

5.1 All 4 options would have the same impacts on communities and stakeholders, except with respect to the capacity/resilience as presented in Table 2 above. The CO_2e benefits which the proposed wind farm will provide annually far outweigh any potential fuel burn costs to GA aircraft which are negligible.

5.2 Option D (a TMZ aligned to smoothed/rounded off boundary plus 2nm buffer) is the preferred solution, and this is the only option which will be carried forward to consultation.