Moray Offshore Wind Farm (West) Limited

Moray West

Gateway documentation:

Stage 2 Develop and Assess

2A(ii): Design Principle Evaluation, Options Assessment

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Contents

1. Introduction

1.1 This document forms part of the document set 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 2A Design Principle Evaluation.

1.3 It is advised that this document is read alongside the Stage 2A(i) Design Options Document which gives diagrams and descriptions of each option.

1.4 The following options to provide airspace mitigation are proposed for consideration:

- Do Nothing
- Option A: TMZ over the proposed wind turbine locations not covered by the BOWL and MOWEL TMZs.
- Option B: Option A with 2 NM buffer
- Option C: Option B with TMZ extended to align with existing and planned TMZ boundaries.

2. Options Assessment: Design Principle Evaluation

2.0.1 Tables 1, 2, 3 and 4 below summarise the impacts/ benefits of the options evaluated. The tables are based on the pro-forma contained in CAP1616 Appendix E, page 187. The degree to which the design principle has been met is indicated by the following colour coding:

Green	MET
Yellow	PARTIAL
Red	NOT MET (Design Principle not met or change represents a detriment)

2.1 Baseline (Do Nothing Option)

Design Principle Evaluation			
Do Nothing Option			REJECT
No mitigation against radar clutter. This option assumes that the wind farm is built but no measures are implemented to prevent radar clutter & interference.			
Design Principle		Summary of assessment	MET?
DP1	Safety: Maintain or enhance current levels of safety.	The wind farm would result in unacceptable radar clutter/ interference. This would have an unacceptable impact on ATC Surveillance and aviation safety.	NOT MET
DP2	Operational: Minimise negative impact on other airspace users, specifically GA and helicopters in support of UK Oil, Gas and Renewables industries.	Aircraft without an operating transponder would not be restricted to where they could fly. However, they could be lost amongst wind farm clutter on ATC surveillance equipment resulting in a reduced level of service from ATC.	PARTIAL
DP3	Operational: Airspace change should maintain or enhance operational resilience of the ATC network.	The negative impact of the wind farm on primary surveillance radar would reduce the resilience of the ATC Network.	NOT MET
DP4	Operational: Airspace change should have minimal impact on operations/capacity of Aircraft Operators and ANSPs.	Primary radar surveillance would be ineffective in the vicinity of the wind farm increasing ATC workload. In busy periods this could lead to delays for aircraft operators.	NOT MET
DP5	Operational: The airspace change should be compatible with the requirements of the MoD.	No Change	MET
DP6	Environmental: Minimise impact on CO_2 emissions.	No Change	MET
DP7	Environmental: Minimise environmental impacts to stakeholders on the ground, including the impact of noise below 7,000 ft. (Note: *Due to the offshore location of the proposed changes, it is not expected that there will be any significant environmental impacts to stakeholders on the ground due to noise, visual intrusion and local air quality.*)	No Change	MET

DP8	Technical: Minimise economic impact on stakeholders.	No Change	MET
DP9	Technical: Airspace change will be based on technology widely available. *(Note: This technology could relate to navigation, radar enhancements, radar data processing, etc.)*	No Change	MET
DP10	Technical: The volume of airspace affected should be the minimum necessary to deliver a safe solution to counter the effects of wind turbine generators on ATC surveillance infrastructure. (Note: *Seek to create simple, easily definable solution.)*	No Change	MET
DP11	Technical: The airspace change should be compatible with the requirements of the Maritime and Coastguard Agency and United Kingdom Search and Rescue operators.	No Change	MET
DP12	Policy: The proposed airspace change will take account of government policy documents (such as the Air Navigation Guidance).	No Change	MET

Table 1: Design Principle evaluation of the "Do Nothing" option.

2.1.1 Do Nothing Option Conclusion

Unless appropriate mitigation to prevent radar clutter and interference is put in place the suspensive planning "condition 23" will not be discharged, and construction of the Moray West Wind Farm will not be able to proceed. For this reason, the "Do nothing" option is rejected.

2.2 Option A – TMZ with no buffer over the proposed wind turbine locations not covered by the BOWL and MOWEL TMZs.

Design Principle Evaluation			
Option A: TMZ with no buffer over the proposed wind turbine locations not covered by the BOWL and MOWEL TMZs.			REJECT
Mitigation against radar clutter, with smallest area of TMZ covering only the RAG blanked area. See Stage 2A(i) document for detailed description of Option A.			
Design Principle		Summary of assessment	MET?
DP1	Safety: Maintain or enhance current levels of safety.	Whilst the wind turbines are blanked to prevent radar clutter, this option has no buffer surrounding the RAG blanked area. Hence, in the case of a non-transponder equipped aircraft infringing the TMZ, ATC will have no warning to identify and react to the situation. The infringing aircraft would simply disappear as soon as the TMZ boundary is crossed. This would increase ATC workload where non-transponder equipped aircraft are flying close to/along the TMZ boundary.	NOT MET
DP2	Operational: Minimise negative impact on other airspace users, specifically GA and helicopters in support of UK Oil, Gas and Renewables industries.	Non-transponder equipped aircraft would be unable to transit the windfarm. Increased ATC workload due to the requirement for heightened awareness & monitoring of non-transponder equipped aircraft close to the TMZ boundary could reduce capacity and lead to delays for other airspace users.	PARTIAL
DP3	Operational: Airspace change should maintain or enhance operational resilience of the ATC network.	Increased ATC workload due to the requirement for heightened awareness & monitoring of non-transponder equipped aircraft close to the TMZ boundary would reduce capacity and could lead to delays for other airspace users.	PARTIAL
DP4	Operational: Airspace change should have minimal impact on operations/capacity of Aircraft Operators and ANSPs.	Increase in ATC workload will lead to a reduction in capacity. In busy periods this could lead to delays.	NOT MET
DP5	Operational: The airspace change should be compatible with the requirements of the MoD.	The proposed Option A TMZ will be compatible with the requirements of the MoD.	MET
DP6	Environmental: Minimise impact on CO_2 emissions.	There would be no impact on commercial aircraft. Less than 1% of GA aircraft (those without a transponder) could be affected.	MET

DP7	Environmental: Minimise environmental impacts to stakeholders on the ground, including the impact of noise below 7,000 ft. *(Note: Due to the offshore location of the proposed changes, it is not expected that there will be any significant environmental impacts to stakeholders on the ground due to noise, visual intrusion and local air quality.)*	There would be no change to the noise impact as a result of this option. The windfarm is 22.5 km offshore so will not impact any population.	MET
DP8	Technical: Minimise economic impact on stakeholders.	Option A will have minimal economic impact on stakeholders. Only non-transponding aircraft, less than 1% of GA, will be unable to transit the affected airspace.	MET
DP9	Technical: Airspace change will be based on technology widely available. *(Note: This technology could relate to navigation, radar enhancements, radar data processing, etc.)*	Use of the airspace will require a transponder. All commercial aircraft are fitted with a transponder, as are >99% GA aircraft.	MET
DP10	Technical: The volume of airspace affected should be the minimum necessary to deliver a safe solution to counter the effects of wind turbine generators on ATC surveillance infrastructure. *(Note: Seek to create simple, easily definable solution.)*	"Option A" uses the minimal volume of airspace required to deliver a solution. However, without a buffer zone safety could still be compromised.	PARTIAL
DP11	Technical: The airspace change should be compatible with the requirements of the Maritime and Coastguard Agency and United Kingdom Search and Rescue operators.	"Option A" is compatible with the requirements of the MCA and SAR operations	MET
DP12	Policy: The proposed airspace change will take account of government policy documents (such as the Air Navigation Guidance).	The "Option A" proposed TMZ takes account of government policy documents (e.g. the Air Navigation Guidance).	MET

Table 2: Design Principle evaluation of "Option A".

2.2.1 "Option A" Conclusion

Whilst the wind turbines are blanked to prevent clutter, this option has no buffer surrounding the RAG blanked area. Hence in the case of a non-transponder equipped aircraft infringing the TMZ, ATC would have no warning or time to identify and prevent the infringement. The infringing aircraft would simply disappear from the radar as soon as the TMZ boundary was crossed. This would increase ATC workload where non-transponding equipped aircraft are flying (legitimately) close to/along the TMZ boundary and therefore represents a reduced level of safety. The increase in workload on ATC could also lead to an increase in delays, unnecessarily impacting on airspace users. For these reasons "Option A" is rejected.

2.3 Option B – Option A with 2 NM TMZ Buffer (as per the existing MOWEL and BOWL TMZs)

Design Principle Evaluation			
Option B: Option A with 2 NM Buffer (as per existing MOWEL and BOWL TMZs)			REJECT
Mitigation against radar clutter, with 2 NM TMZ buffer around RAG blanked area. See 2A(i) document for detailed description of Option B			
Design Principle		Summary of assessment	MET?
DP1	Safety: Maintain or enhance current levels of safety.	The wind turbine area is RAG blanked to prevent radar clutter. The introduction of a 2 NM TMZ buffer around the blanked region will ensure only transponder equipped aircraft enter the radar blanked region.	MET
DP2	Operational: Minimise negative impact on other airspace users, specifically GA and helicopters in support of UK Oil, Gas and Renewables industries.	Non-transponder equipped aircraft would be unable to transit the windfarm. They would be required to keep >2 NM from the blanked area. This provides ATC with the warning they need, should a non-transponding aircraft infringe the TMZ, to prevent the aircraft from entering the RAG blanked area and disappearing from the radar screen. However, the complex shape the TMZ creates, when placed alongside the existing TMZs, could lead to pilot confusion and inadvertent infringements of the TMZ.	PARTIAL
DP3	Operational: Airspace change should maintain or enhance operational resilience of the ATC network.	Operational resilience of the ATC network will be maintained.	MET
DP4	Operational: Airspace change should have minimal impact on operations/capacity of Aircraft Operators and ANSPs.	The introduction of a radar blanked region with TMZ buffer should have minimal impact on operations/capacity of Aircraft Operators and ANSPs.	MET
DP5	Operational: The airspace change should be compatible with the requirements of the MoD.	The proposed "Option B" RAG Blanking with TMZ will be compatible with the requirements of the MoD.	MET
DP6	Environmental: Minimise impact on CO_2 emissions.	"Option B" would be no impact on commercial aircraft. Less than 1% of GA aircraft (those without a transponder) could be affected.	MET
DP7	Environmental: Minimise environmental impacts to stakeholders on the ground, including the impact of noise below 7,000 ft. *(Note: Due to the offshore location of the proposed changes, it is not expected that there will be any significant environmental impacts to stakeholders on the ground due to noise, visual intrusion and local air quality.)*	There would be no change to the noise impact as a result of this option. The windfarm is 22.5 km offshore so will not impact any population.	MET

DP8	Technical: Minimise economic impact on stakeholders.	"Option B" will have minimal economic impact on stakeholders. Only non-transponding aircraft, less than 1% of GA, will be required to avoid the affected airspace.	MET
DP9	Technical: Airspace change will be based on technology widely available. *(Note: This technology could relate to navigation, radar enhancements, radar data processing, etc.)*	Use of the airspace will require a transponder. All commercial aircraft are transponder equipped, as are >99% GA aircraft.	MET
DP10	Technical: The volume of airspace affected should be the minimum necessary to deliver a safe solution to counter the effects of wind turbine generators on ATC surveillance infrastructure. *(Note: Seek to create simple, easily definable solution.)*	Radar blanking of the windfarm area is required to remove clutter from the radar screen. The addition of a 2 NM TMZ surrounding the blanked region provides ATC with the reassurance they need to monitor non-transponder equipped aircraft and prevent these aircraft from entering the blanked region.	MET
DP11	Technical: The airspace change should be compatible with the requirements of the Maritime and Coastguard Agency and United Kingdom Search and Rescue operators.	"Option B" is compatible with the requirements of the MCA and SAR operations.	MET
DP12	Policy: The proposed airspace change will take account of government policy documents (such as the Air Navigation Guidance).	The "Option B" proposed TMZ takes account of government policy documents (e.g. the Air Navigation Guidance).	MET

Table 3: Design Principle evaluation of "Option B".

2.3.1 "Option B" Conclusion

"Option B" almost meets all the design principles. The wind turbines are blanked from the radar screen, preventing clutter. This option benefits from a 2 NM buffer surrounding the RAG blanked area which allows ATC to spot infringement of the TMZ by a non-transponder equipped aircraft, before it enters the RAG blanked area. This option is therefore a feasible design option. However, the shape of the TMZ proposed in this design option when placed alongside the existing TMZs in the area creates a complex shape which could lead to pilot confusion to the boundary position for pilots flying non-transponding aircraft. This increases the possibility of an aircraft infringing the TMZ. For this reason, Option B is rejected in preference for Option C.

2.4 Option C – Option B with TMZ extended to align with existing and planned TMZ boundaries

Design Principle Evaluation			
Option C: Option B with TMZ extended to align with existing and planned TMZ boundaries			ACCEPT
Mitigation against radar clutter, with 2 NM TMZ buffer around RAG blanked area extended to align with existing and planned TMZ boundaries. See 2A(i) document for detailed description of Option C			
Design Principle		Summary of assessment	MET?
DP1	Safety: Maintain or enhance current levels of safety.	The wind turbine area is RAG blanked to prevent radar clutter. The introduction of a 2 NM TMZ buffer around the blanked region will ensure only transponder equipped aircraft enter the radar blanked region. Extending the buffer to align with existing TMZs in the region further enhances safety as the perimeters are more easily defined reducing the possibility of an aircraft inadvertently infringing the TMZ.	MET
DP2	Operational: Minimise negative impact on other airspace users, specifically GA and helicopters in support of UK Oil, Gas and Renewables industries.	Non-transponder equipped aircraft would be unable to transit the windfarm. They would be kept >2 NM the blanked area. This provides ATC with the warning they need, should a non-transponder equipped aircraft infringe the TMZ, to prevent the aircraft from entering the RAG blanked area and disappearing from the radar screen.	MET
DP3	Operational: Airspace change should maintain or enhance operational resilience of the ATC network.	Operational resilience of the ATC network will be maintained.	MET
DP4	Operational: Airspace change should have minimal impact on operations/capacity of Aircraft Operators and ANSPs.	The introduction of a radar blanked region with TMZ buffer should have minimal impact on operations/capacity of Aircraft Operators and ANSPs.	MET
DP5	Operational: The airspace change should be compatible with the requirements of the MoD.	The proposed "Option C" Radar Blanking with TMZ will be compatible with the requirements of the MoD.	MET
DP6	Environmental: Minimise impact on CO_2 emissions.	There would be no impact on commercial aircraft. Less than 1% GA aircraft (those without a transponder) could be affected.	MET
DP7	Environmental: Minimise environmental impacts to stakeholders on the ground, including the impact of noise below 7,000 ft. *(Note: Due to the offshore location of the proposed changes, it is not expected that there will be any significant environmental impacts to stakeholders on the ground due to noise, visual intrusion and local air quality.)*	There would be no change to the noise impact as a result of this option. The windfarm is 22.5 km offshore so will not impact any population.	MET

DP8	Technical: Minimise economic impact on stakeholders.	"Option C" will have minimal economic impact on stakeholders. Only non-transponding aircraft, less than 1% of GA, will be unable to transit the affected airspace.	MET
DP9	Technical: Airspace change will be based on technology widely available. *(Note: This technology could relate to navigation, radar enhancements, radar data processing, etc.)*	Use of the airspace will require a transponder. All commercial aircraft are transponder equipped, as are >99% GA aircraft.	MET
DP10	Technical: The volume of airspace affected should be the minimum necessary to deliver a safe solution to counter the effects of wind turbine generators on ATC surveillance infrastructure. *(Note: Seek to create simple, easily definable solution.)*	Radar blanking of the windfarm area is required to remove clutter from the radar screen. The addition of a 2 NM TMZ around the blanked region provides ATC with the reassurance they need to monitor non-transponder equipped aircraft and ensure these aircraft do not enter the blanked region. Aligning the TMZ buffer with existing TMZs for the MOWEL and BOWL windfarms increases safety as it simplifies the boundaries of the TMZ on navigation aids and ATC radars.	MET
DP11	Technical: The airspace change should be compatible with the requirements of the Maritime and Coastguard Agency and United Kingdom Search and Rescue operators.	"Option C" is compatible with the requirements of the MCA and SAR operations.	MET
DP12	Policy: The proposed airspace change will take account of government policy documents (such as the Air Navigation Guidance).	The "Option C" proposed TMZ takes account of government policy documents (e.g. the Air Navigation Guidance).	MET

Table 4: Design Principle evaluation of "Option C".

2.4.1 "Option C" Conclusion

"Option C" meets all the design options. The wind turbines are blanked from the radar screen preventing clutter. This option benefits from a minimum 2 NM buffer surrounding the RAG blanked area which has been extended to align with existing TMZs. This buffer allows ATC to spot infringement of the TMZ by a non-transponder equipped aircraft, before it enters the RAG blanked area. The simplified geometry of the combined Moray Firth TMZs resulting from this design option would be easy to comprehend on charts, pilot navigation aids and ATC radars. This option is therefore a feasible design option and is the preferred solution. For these reasons, "Option C" will be taken forward as the sole option.

3. Safety Assessment – Option C TMZ (preferred)

3.1 Safety analysis (Hazard Identification) has been performed as follows. The primary list of hazards identified is:

- WTGs cause clutter on primary radar displays;
- RAG blanking of the Allanshill PSR over the WTGs will leave an area where no PSR data is displayed to the ATCO;
- Aircraft which are non-transponder equipped will not be presented to the ATCO within the RAG blanked area;
- Aircraft which are not operating their transponders will not be presented to the ATCO within the RAG blanked areas;
- 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 on secondary radar;
- The extension of the TMZ 2 NM around the RAG blanked area (buffer zone) will ensure that ATC have sufficient time to identify when an infringement of the TMZ is taking place and take appropriate action.

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

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

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

4. High Level Qualitative Cost Assessment

4.1 The costs associated with implementing the required airspace measures are relatively small when compared to the substantial environmental benefits enabled by permitting the wind farm development to proceed, and will be met by the developer so shall have no financial burden on the aviation industry. Hence this assessment incorporates all of these factors. The headline figures are:

- Cost of implementing TMZ + RAG blanking: c £900,000
- Value of CO_2 emissions saved (calculated using WebTAG): £1.04 bn (range £0.57 - £1.72 bn, over 25 years).

4.2 The Option C TMZ solution has been evaluated as beneficial due to the mitigation it provides against the impacts of the proposed Moray West Wind Farm on radar systems. The relatively small expenditure required to implement this mitigation solution will enable significant benefits (including environmental benefits of substantial savings in CO_2e emissions). These benefits justify the cost associated with progressing this change, and hence it will be progressed.

5. Conclusion and Shortlist

5.1 Option A does not meet 2 DPs including the high priority safety DP, DP1. As such it is rejected and will not be carried forward to consultation.

5.2 Option B fully meets most of the design principles. However, the TMZ proposed could lead to pilot confusion due to the complex shape formed when placed alongside the existing BOWL and planned MOWEL TMZs. For this reason, Option B has been rejected in preference of Option C.

5.3 Option C (Wind turbine locations RAG blanked, with a minimum 2 NM TMZ buffer aligned to existing TMZs) meets all the design principles and is the preferred option due to the simpler TMZ shape formed when existing TMZs are taken into account. As such, only Option C will be carried forward to consultation.

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