GREEN VOLT

Technical Appendix 16.1

Aviation Impacts Review

Offshore EIA Report: Volume 2

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WIND BUSINESS SUPPORT

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Author: Ian Fletcher

GREEN VOLT

AVIATION IMPACTS REVIEW

A report for

FLOTATION ENERGY

Tel [redacted]
Info@windbusiness.co.uk

CONTENTS

INTRODUCTION

Wind Business Support were commissioned by Flotation Energy to review the aviation issues, identifying any 'red-flags' for the Green Volt development area.

AGREED SCOPE

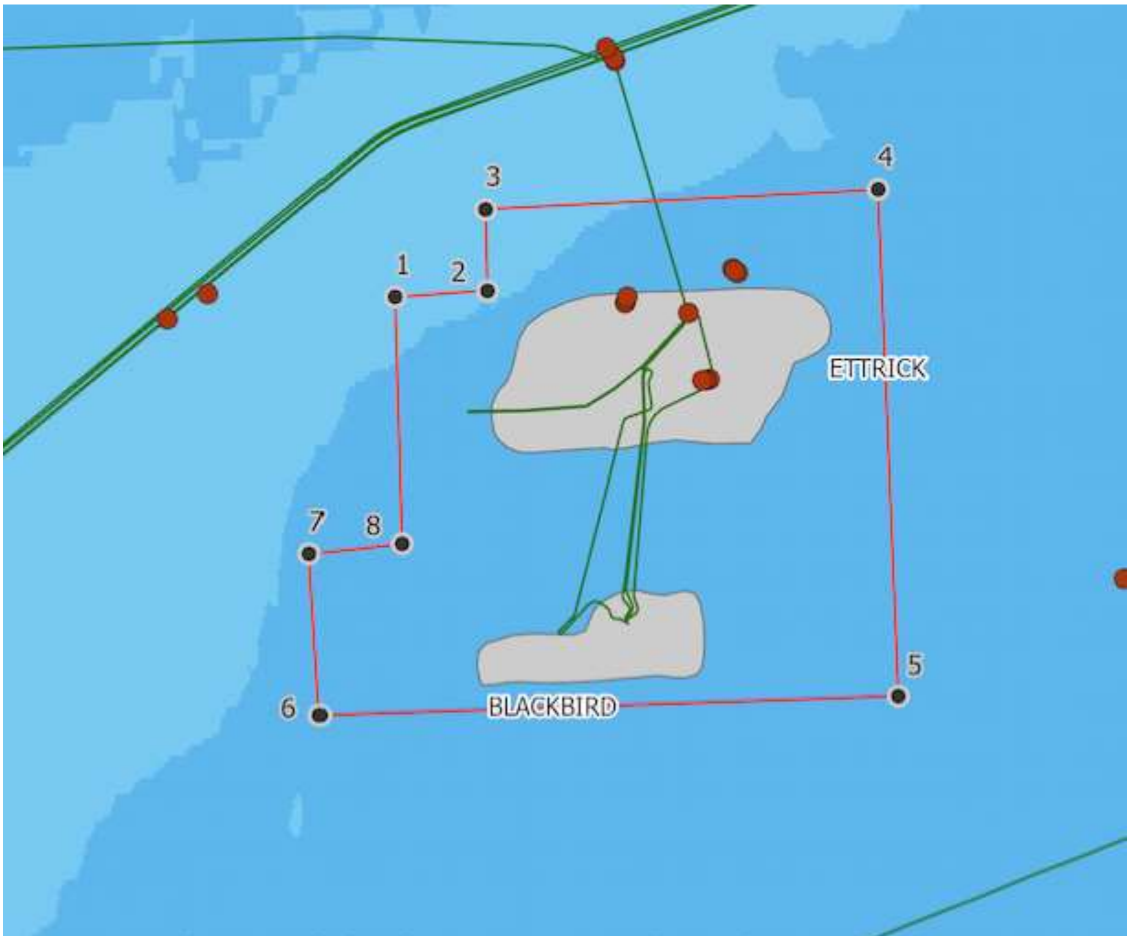
1) To determine the potential for radar impacts to the specified area;
    a) specifically, an analysis of impacts to the Buchan ADR, the NATS radars at Perwinnes and Alanshill, the MOD ATC radar at RAF Lossiemouth
2) Where impacts are likely (that is where the stakeholders are likely to assume impacts) to provide a commentary on the following
    a) The current mitigation capability
    b) The current and future mitigation options
    c) Relevant time-scales
    d) An indication of costs as far as possible
3) An overview of HMR impacts and mitigation
4) An overview of SAR impacts and mitigation
5) An overview of VFR transit route requirements
6) A summary of risks highlighting 'red-flag' issues
    a) Including likely future work requirements

SITE DETAILS

Currently looking at two candidate turbines, the GE Haliade-X 12MW and the Siemens SG 222-14 DD 14MW turbine.

Turbine type	Haliade-X 12MW	SG 14-222m
Rotor diameter	220m	222m
Hub height	138m	133m
Maximum Rated wind speed	*Not on website*	28m/s
Proposed Capacity	12MW	14MW
Turbine height	260m	244m

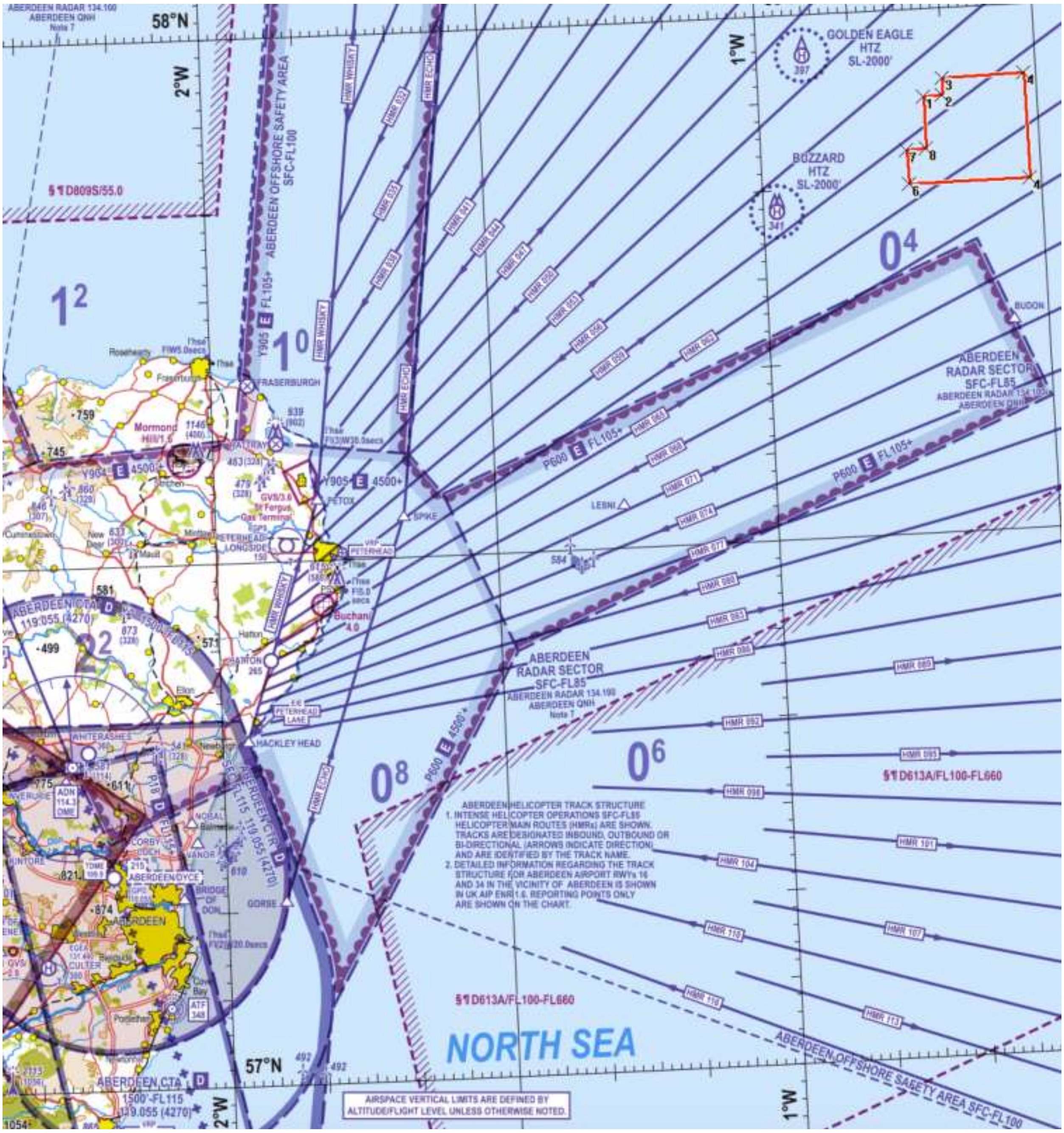
Whilst the turbine dimensions are not fixed, the above generates but expected to be up to 250 m to tip with up to a 222 m rotor diameter. Spacing between turbines is ~8 RD, with a RD of circa 222m, making the turbine separation approximately 1.8km (0.96nm)



Proposed Green Volt development area co-ordinates (WGS84 Z30N)

Number	Easting	Northing	Latitude	Longitude
1	636171.04	6421607.16	57° 54' 55.47192141" N	000° 42' 05.14628437" W
2	638216.51	6421757.82	57° 54' 58.07506979" N	000° 40' 00.64829502" W
3	638178.2	6423555.84	57° 55' 56.21013332" N	000° 39' 59.20491179" W
4	646854.87	6423982.52	57° 56' 00.00995850" N	000° 31' 11.28883422" W
5	647311.04	6412813.53	57° 49' 58.64765129" N	000° 31' 08.47723375" W
6	634522.91	6412390.18	57° 49' 59.46502500" N	000° 44' 03.95838927" W
7	634298.51	6415958.39	57° 51' 54.99993460" N	000° 44' 10.31749026" W
8	636329.79	6416183.07	57° 52' 00.04551571" N	000° 42' 06.70188417" W

Development area on client provided map



Site location on CAA VFR Aviation chart

VISIBILITY TO KEY RADAR

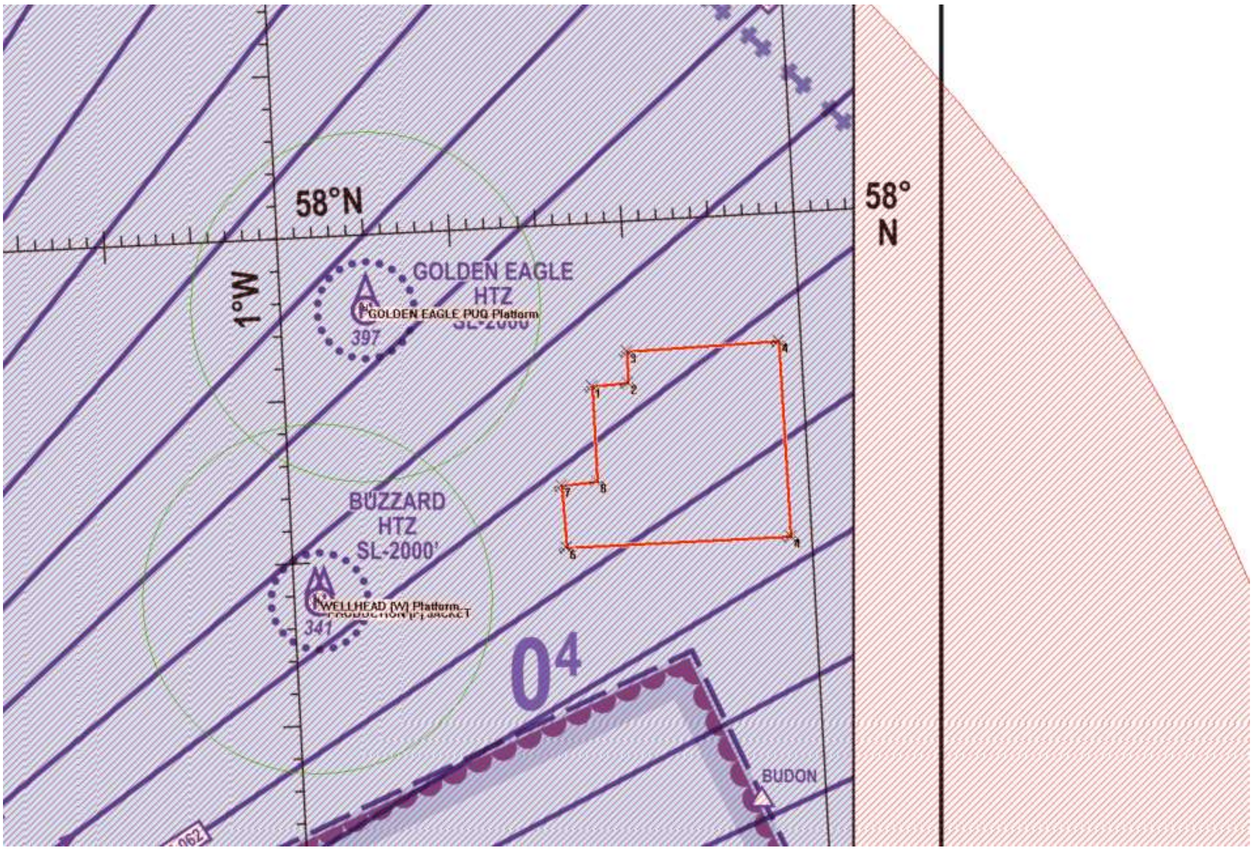
The radars in the area of concern are addressed individually below. There are three aspects to consider in establishing impacts, these are:

- The range to which the radars are used
- The range to which the radars may suffer impacts from offshore turbines
- Terrain screening preventing impacts

RAF BUCHAN ADR

The MOD will use this radar out to the limit of its range at circa 470km. However, the radar loses visibility of turbines before this range limit is reached, due to the curvature of the earth. Simple radar Line of Sight calculations against 250m tip turbines, give a range limit of 110km for the Buchan radar; the site lies between 77km and 94km. In practice, it is known that the radars see beyond radar LoS on occasions, due to anomalous propagation and that the MOD will assume impacts beyond the simple LoS range. There is no terrain screening.

It is therefore clear that the MOD will consider all turbines within the site as capable of generating impacts to the Buchan ADR.



Buchan ADR radar LoS – 110km

RAF LOSSIEMOUTH ATC RADAR

The Lossiemouth ATC primary surveillance radar will be used for air traffic management to 60nm (111km) but capable of seeing aircraft beyond this range. The curvature of the earth limits the low-level range. Simple radar Line of Sight calculations against 250m tip turbines, give a range limit of 95km for the RAF Lossiemouth ATC radar; the site lies between 155km and 169km distant. There is no terrain screening.

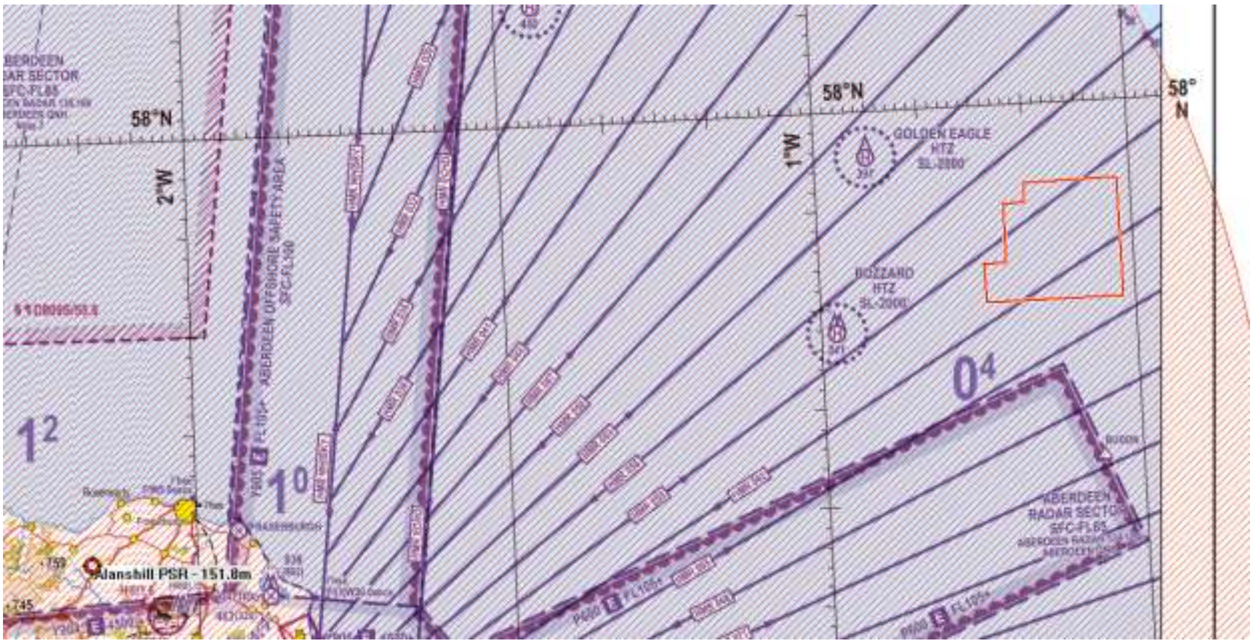
Even though the Lossiemouth radar may see further than the 95km LoS limit, it is considered highly unlikely that the MOD would have concerns about impacts to this radar at the given range of the Green Volt site. This radar can be eliminated as a significant concern.

Lossiemouth ATC radar LoS – 95km

NATS ALANSHILL PSR

NATS use this radar to a range of 60nm or 111km. Turbines of tip height 250m will be visible out to the limit of this operational range. There is no terrain screening in the direction of the site.

The development area lies at a range of between 88km and 103km. All turbines have radar Line of Sight and will be considered as detectable by NATS. Mitigation will be required.



Alanshill operational range – 60nm (111km)

NATS PERWINNES PSR

NATS use this radar out to 160nm (296km). However, the radar loses visibility of turbines before this range limit is reached, due to the curvature of the earth. Simple radar Line of Sight calculations against 250m tip turbines, give a range limit of 109km. In practice NATS have found that the radars see beyond radar LoS on occasions due to anomalous propagation over the sea. Perwinnes can detect turbines under some conditions out to the limit of its range, but with progressively decreasing frequency. There is as yet no hard and fast cut-off probability that gives a precise maximum range of impacts. None the less it is clear that this is well beyond the radar LoS range.

The development area lies at a range of between 109km and 125km. Whilst the entire development is thus just beyond the radar LoS range, NATS has stated that they consider the entire development to be visible to the Perwinnes radar, because of the propagation characteristics offshore. Mitigation will be required.

IMPACTS AND MITIGATION

There are expected to be impacts to the MOD air defence radar at RAF Buchan and the two NATS En-route radars at Perwinnes and Alanshill. NATS has confirmed their position.

Mitigation will be required to address impacts to all three of these radars.

MOD

The MOD can be expected to object, with a radar mitigation based condition needed to enable consent.

MITIGATION

Discussions with De&S at Abbey Wood were conducted as a part of this report.

Performance issues remain with the use of the TPS77 radar Non-Auto Initiation Zones (NAIZ) and they are not seen as an enduring solution now. None-the–less NAIZ remain as the only available mitigation currently and for the near term at least.

There is a programme of work to develop new solutions to mitigate the effects of wind turbines on Air Defence radar. The focus of effort continues to be through the joint MOD/OWIC (the Offshore Wind Industry Council) air defence task force – established to address the offshore wind sector deal and to finding solutions to the problems.

The aspiration on the MOD side at least, seems to be that solutions will be developed to address all developments and that funding will be vectored through OWIC and not through arrangements with individual developers.

There are two main strands of development:

1. Short-term; Repairing or restoring ADRs using high technology readiness level and off the shelf solutions
2. Long-term; The development of innately tolerant ADRs (no post installation work required), working with low readiness level solutions

The expectation with the latter is that delivery lies beyond 2030.

Near term solutions

There are two apparent near term solutions. These are the use of the existing Buchan NAIZs and potentially the use of an Indra LTR25 long range radar. It is likely that either would additionally require a stop-clause, allowing the MOD to request that all turbine rotors stop on a temporary basis. The MOD will accept no liability and provide no compensation for stopped periods.

The NAIZ solution has been established to have unacceptable long term performance issues, but it may be acceptable as an interim solution.

The MOD acquired an Indra LTR25 L-band radar, commissioned in 2021 with some offshore wind trialing having been conducted last year. The result of the trials is not known. What is known is that NATS is in the process of replacing its Lowther Hill En-route radar with this same Indra radar and is offering mitigation contracts on the strength of its mitigation capabilities. The NATS radar should be commissioned January or February. It is worth noting that NATS do not require the same low level coverage as the MOD and hence it cannot be assumed to be acceptable in all situations. The further the site is from the radar, the less effective the mitigation becomes.

There are problems with in-fill as a solution. The established onshore in-fill method is to exploit terrain screening to render the wind farms just not visible, but to be able to see the airspace above the turbines. This results in no turbine impacts and coverage to an acceptably low level somewhere above the turbine tips. This is problematic offshore because of the anomalous propagation effects can render turbines visible when they are well below the radar Line of Sight. The alternative is an established mitigating radar such as the Terma, that works with the turbines visible. However, this radar has a very limited range and so would need to be located offshore, in an area which captured as many developments as possible. It is far from clear whether or not offshore military radar are possible and politically acceptable. Such installations, beyond the 12nm UK territorial water limit, are deemed to be the militarization of international waters. As well as being politically difficult, an offshore radar installation presents problems for maintenance, repairs and security.

There is an acceptance that an interim solution can be less than ideal. The carefully selected hurdle phrase is that mitigation must be 'tolerable', only sustained as an interim solution. This might be a NAIZ with a stop-clause combination. Because this does not provide for an enduring solution, the agreement includes a large sum for future mitigation development. The stop-clause is needed for exceptional circumstances for the temporary removal of impacts. There have been issues is seeking the inclusion of a stop clause with the national grid, who do not want the sudden and unpredictable loss of a large generator.

The money for the funding of an enduring solution is preferred as a parent company guarantee, but could equally be a bond. There is no time limit on the life-span of the interim solution and the timing of the draw down of funds is in the gift of the MOD. It seems likely that the enduring solution will be integrated into the radar replacement scheduled for 2030-2032.

Solution Acceptability
Whilst no firm position can be provided informally and without a thorough assessment process, the site does benefit from being relatively compact. It is not well separated from the Scotwind NE7 area though, with some potential for negative cumulative impacts from a mitigation perspective.

Informally the further north the site is the less contentious from an MOD perspective, presided over by Air Command, with sites pushing up to the Orkneys better than immediately north of the border. This is a positive.

Overall, as a development of national importance, it appears likely that the MOD would seek to approve the site with a radar mitigation scheme condition that included the use of NAIZ with a stop-clause as an interim solution and a large payment guarantee to fund an enduring solution in the future.

The current thinking is to install a new suite of radars in 2030-2032. Any mitigation up until that point will be considered interim and looking to enhance the compromised performance to the point of being at least tolerable.

Mitigation Cost
The initial, interim solution cost will not be high if it is NAIZ plus stop-clause. The total cost of the Buchan upgrade was circa £10m, with this cost distributed proportionately across the benefiting developments, plus a £2.5m bond for offshore projects.

There is no information available on the size of the enduring solution bond required other than that it is very large. It should be born in mind that the MOD cost a conventional ATC radar over a 15-year lifespan at circa £25million and that we are seeking more expensive solutions here. A regional solution should of course, have costs distributed across all the benefiting projects.

NATS

NATS technical were contacted as a part of this review. The statements in this report reflect these discussions. NATS are expected to object on the basis of impacts to their primary surveillance radars at Alanshill and Perwinnes; their reference 32512.

Consent will be achievable with a radar mitigation based condition. NATS are also likely to object on the grounds of impacts to offshore helicopter operations in order to ensure that work is conducted to address the safety needs of this use of the airspace.

MITIGATION

The simplest, least risk and least cost solution would be the introduction of a TMZ (Transponder Mandatory Zone) around the development area. At this range offshore the use of a TMZ is unlikely to be contentious with relevant civil airspace users.

Longer term NATS is aiming to roll-out a replacement programme that will see all the older En-route radars replaced by 2030, including Perwinnes.

Solution Acceptability
From a civil perspective, a TMZ will work here, with weak arguments for non-co-operative traffic conflicts. Airspace users carry reliable dual mode S transponders.

The implementation of a TMZ is through an Airspace Change proposal (ACP). Whilst to date ACPs to enable offshore wind TMZs have been unproblematic, the MOD is becoming increasingly concerned because a TMZ doesn’t mitigate air defence interests. The concerns at this time relate to expanding TMZs off the east coast of England, being at the front end of this expanding offshore development arena.

Time-Scales
The longest lead time item is the ACP, which may take 2 years.

Mitigation Costs
Implementing an ACP is essentially a bureaucratic process and hence relatively low cost at broadly £100k.

IMPACTS TO AERODROME INSTRUMENT FLIGHT PATHS

The Green Volt site is too remote from DYCE aerodrome to generate any impacts as a physical obstruction to instrument approach procedures.

ABERDEEN AIRPORT (DYCE)

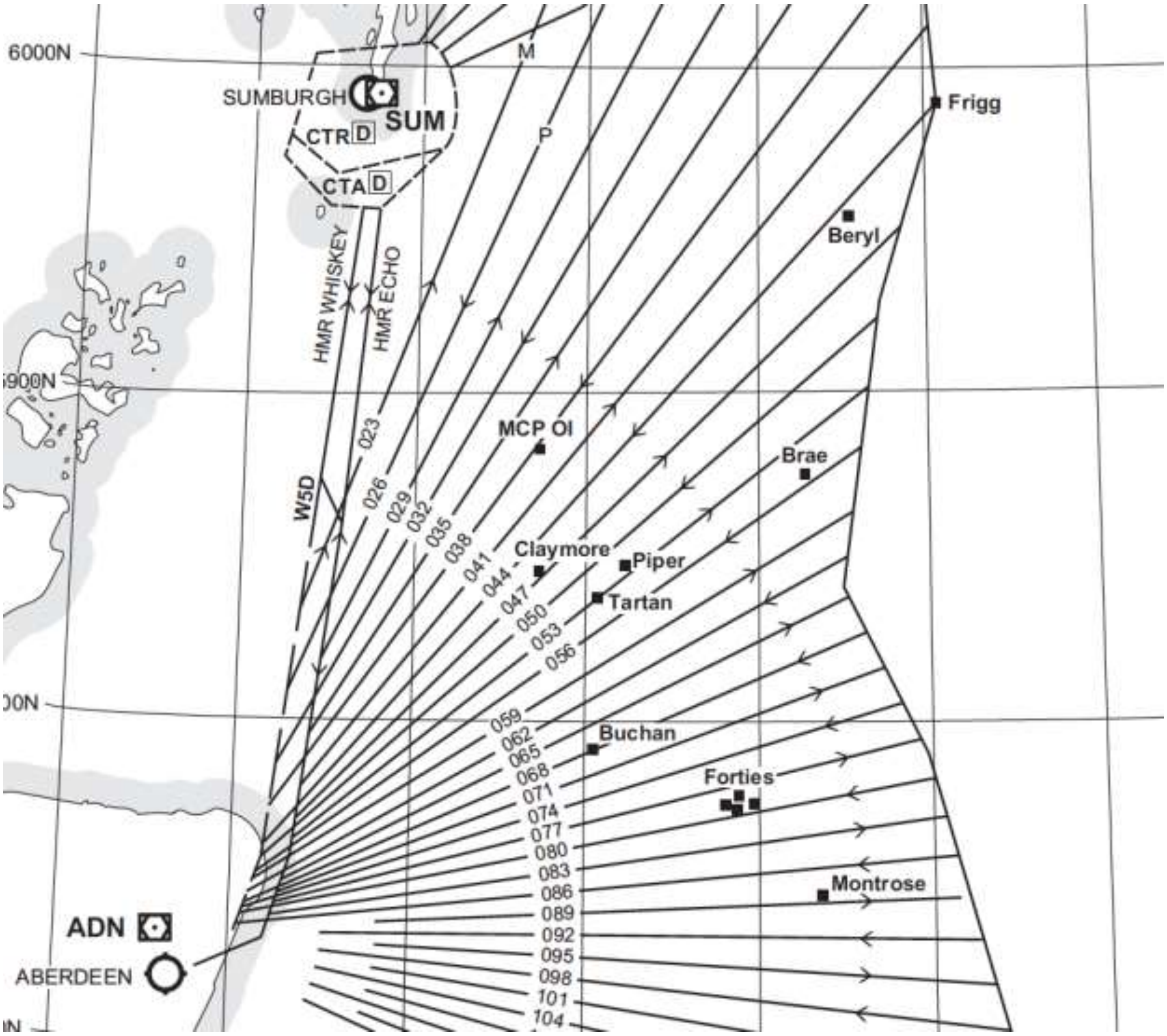
The Offshore helicopters operate out of Aberdeen and hence the airport will represent the interests of those operators in its response. Where there are potential impacts to the helicopter routes or to air traffic control provision, through radar impacts, then an objection should be expected.

There are impacts to Helicopter Main Routes (HMRs) and to the ATC radar that both the airport and NATS use. In all cases dialogue with the airport and the Offshore Helicopter Operators would be required in order to agree suitable mitigation prior to a conditional approval.

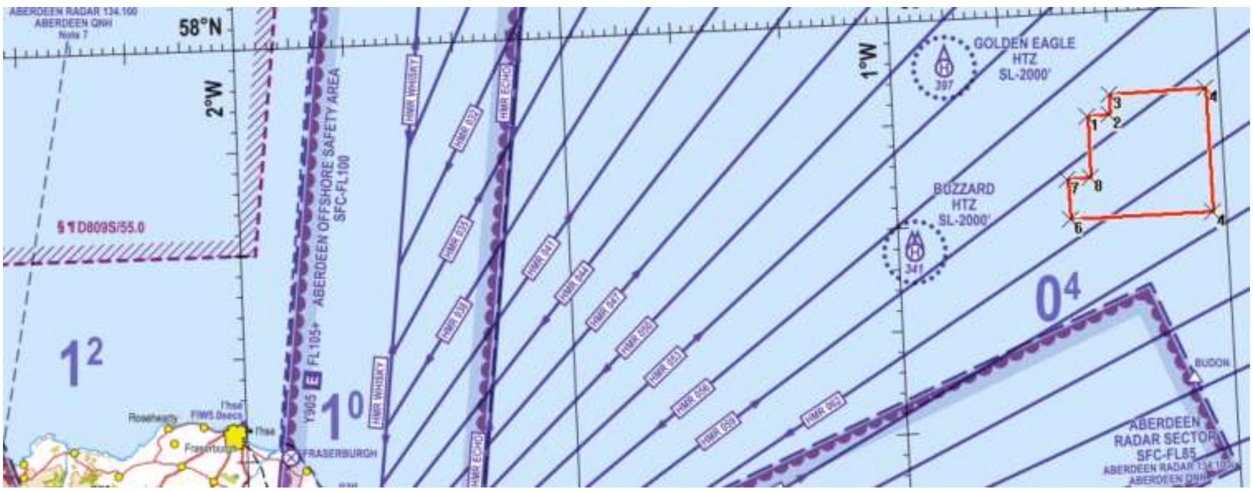
The Offshore Helicopter Operators at Aberdeen are:
Bristow Helicopters
CHC Helicopters
Babcock MCS Offshore Helicopters
NHV Helicopters

HMR IMPACTS

The below map shows the network of HMRs operated out of Aberdeen Airport.



HMRs in Northern North Sea area



The Green Volt site straddles HMRs 059 and 062 beyond the buzzard oil field

Offshore helicopters, routing from UK mainland, will use direct routing rather than HMRs where the ATC coverage is comprehensive. However, in the case of the northern North Sea in the area to the East and North of Aberdeen ATC coverage is less comprehensive and routing is generally along Helicopter Main Routes (HMR). Where and when HMRs are used, inbound and outbound helicopter flights are height de-conflicted (by 500') to minimise the risk of collision.

An HMR is not a mandatory routing that helicopters must, or indeed do always, follow. It is a single line rather than a corridor or airway. However, CAP 764 suggests that an area 2NM either side of an HMR should be maintained clear of obstacles for safety purposes. Further, it states that a large wind farm development built beneath an HMR could force a transiting helicopter to fly higher to maintain minimum vertical separation height above the wind turbine generators, increasing the risk of it entering cloud.

HMRs in the vicinity of windfarms may be rarely used, if at all. Duty Holders are recommended to discuss and consult with the CAA, ANPs (Air Navigation providers) and helicopter operators.

Helicopters using the HMRs routinely fly at between 2000ft and 3000ft, depending upon the meteorological conditions prevailing. Hence, under these normal conditions the aircraft are operating in excess of 1000ft above the 250m (820ft) turbines. This is an acceptable vertical separation distance.
However, under 'icing conditions', helicopters may need to drop underneath the zero degree isotherm, below 2000ft. In the event that the wind farms cannot be avoided completely, then corridors through the wind farm will be required to facilitate safe helicopter operations when low level flight is required to avoid icing.

Mitigation of HMR impacts may be achieved through one or a combination of the following:

- Redesign the HMRs to avoid the wind farm completely
- Redesign the HMRs to include corridors through the wind farm
- Agree tactical routing for use under icing conditions
- Use helicopters approved for specified icing conditions compatible with overflying turbines

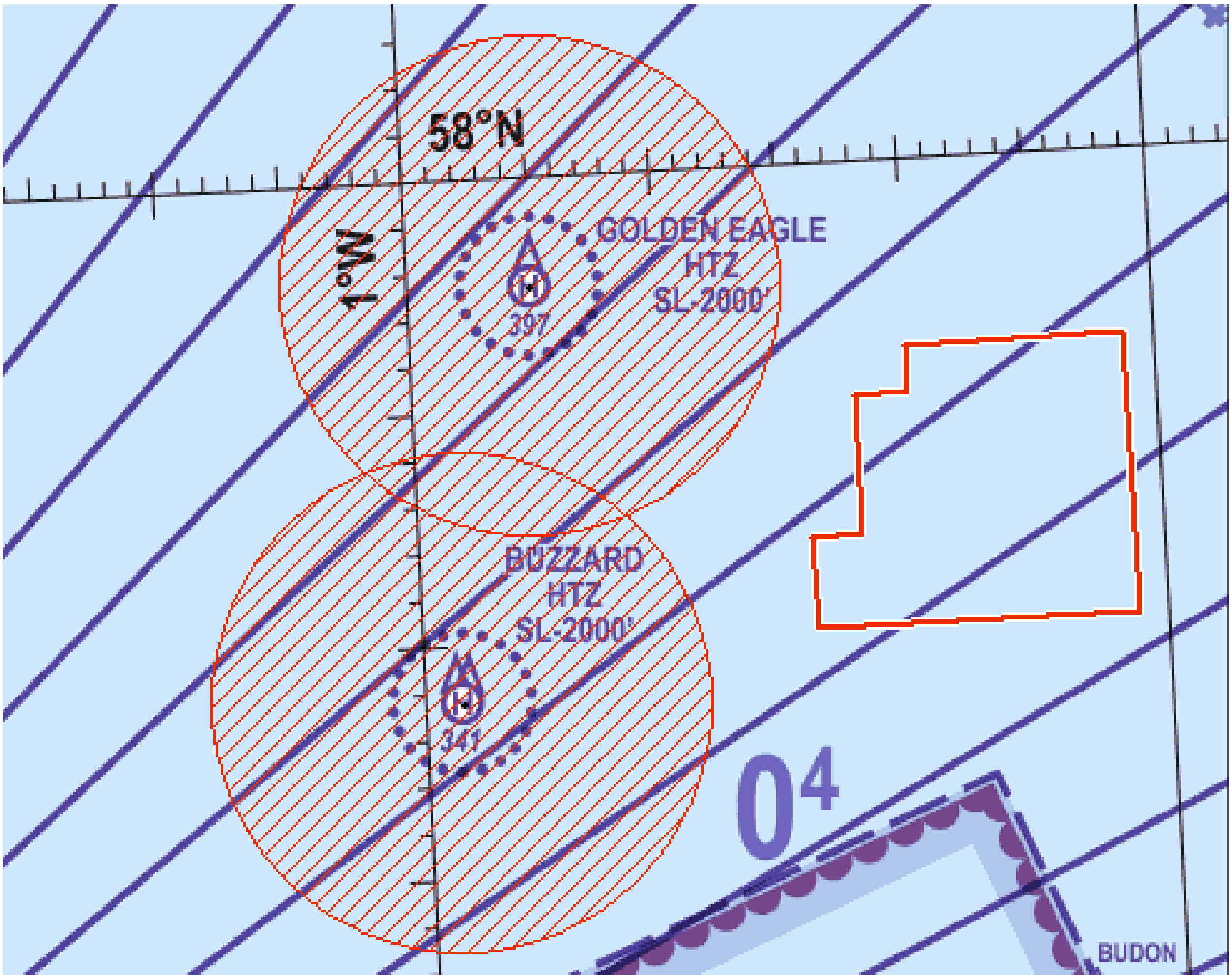
Under normal conditions outbound flights are at 3000ft and inbound at 2000ft along the HMRs. These flights can operate over the wind farm, with a minimum altitude of 1900ft flying IFR and as low as 1400ft VFR.

Helicopters without heated blades have limited icing capability, enabling then to fly in temperatures down to -6^{0}C with no time limit, but a need to monitor ice accumulation. Below -6^{0}C they can fly for 5 minutes. In practice, at the distance that the DPOs are offshore, the occasions where they are forced to fly low are 'very rare'. Under these rare circumstances the helicopters can carry more fuel and fly around the wind farm.

OFFSHORE HELICOPTER LANDING AREA IMPACTS

There appears to be no impacts to Offshore Helicopter Landing Areas.

The CAA advises that an area of radius 6nm (11km) around offshore helidecks, be kept obstacle free to facilitate instrument approach procedures from any direction. The map below shows the site and a 10km buffer zone around close offshore helipads.



10km buffer zones around offshore helidecks

SAR IMPACTS

Information on SAR (Search and Rescue) requirements can be found in OREI SAR Requirements v3 - "Offshore Renewable Energy Installations: Requirements, guidance and operational considerations for SAR and Emergency Response", November 2021

The MCA has statutory obligations to provide Search and Rescue (SAR) services in and around OREIs (Offshore Renewable Energy Installations) in UK waters, using both SAR helicopters and emergency response vessels. Turbine layouts of every offshore renewable energy project with floating and/or surface piercing devices and structures must be designed to allow safe transit through OREIs by SAR helicopters operating at low altitude in bad weather.

For windfarms, the SAR access requirement is so that a SAR helicopter can fly from one side of a windfarm to the other, or Helicopter Refuge Area in the case of larger windfarms, entering from outside the windfarm at altitudes below 500 feet, to either conduct searches amongst turbines or to access a location or turbine within the field. Given the distance offshore of some UK windfarms, helicopters may be the only viable means of SAR. While in clear weather, searches can be conducted from above the maximum blade tip height, operations in poor weather and rescues themselves may necessitate SAR operations within a windfarm below blade tip height. When long transits to a SAR area are required, the presence of windfarms along the transit route can provide obstacles to SAR helicopters if conditions do not permit transits to be flown above maximum blade height. SAR aircraft would be highly unlikely to descend into a windfarm from above.

The low-level helicopter paths through an offshore wind farm are termed 'SAR access lanes'. For practical purposes this means that, depending on type and size of turbine used, the overall shape, size and geographical coverage of a wind farm, and any proximity to other wind farms, there shall be no structures in the wind farm or on the boundary that present an obstacle or risk to SAR helicopters flying along such 'SAR access lanes'. The spacing between internal turbines, and those on the boundary at the end of 'SAR access lanes', must be discussed with the MCA prior to final design of a layout.

For wind farms, developers should start with a layout option with at least two consistent lines of orientation (which may include perimeter turbines with smaller spacing than internal turbines) and then be refined as appropriate for the project. The layout of a wind farm or other OREI should also be as regular as possible e.g. a grid pattern, and take into consideration any lateral movement of floating devices. The MCA will not consider any layout proposals with just one line of orientation, without supporting documentation which fully justifies the proposed layout to the satisfaction of MCA. A layout with zero lines of orientation will not be acceptable to the MCA.

To address situations where an aircraft captain is solely reliant on instruments to navigate through a windfarm, the aircraft will not enter the windfarm where turbines are located less than 500m between blade tips, transverse to the turbine lanes. This spacing can be achieved by rotating rotors away from the lane to increase the distance to more than 500 metres. Note that where a floating structure is used, the extent of surface drift should be taken into account.

The MCA has provided the following guidance to mitigate SAR risks:

1. Turbines are positioned in straight lines with a common orientation across the whole development, creating safe lanes for SAR access; SAR lanes.
2. The initial layout at least should be based on two orientations of SAR lanes.
3. Curved or non-linear designs should be avoided.
4. SAR lanes should be at least 500m wide between blade tips, allowing for any surface drift.
5. The wind farm should be fitted with lighting that is controllable from the development control room and which is NVG compatible.
6. The control room for the development should be equipped with VHF (air and maritime) communications with remote antennas in the wind farm to facilitate SAR communications.
7. Turbines should be marked with geographically logical numbering to facilitate navigation within the wind farm.
8. Substations and meteorological masts should be aligned with turbines so as not to impede SAR lanes.
9. Where possible, SAR lanes should be aligned with those of adjacent wind turbine developments or buffer zones created.

These guidelines can be observed without constraining the site.

VFR TRANSIT ROUTES

ORAG advises that Duty Holders should scope the use of corridors within offshore wind farms to allow helicopters to conduct VFR transits. Planning consideration should be given to the creation of such VFR flight corridors early in the wind turbine array design process. CAA guidance recommends these corridors to be no less than 1NM wide. However, engagement with helicopter operators should provide greater clarification of the dimensions required on a case by case basis.

CONCLUSIONS

Overall the project risk is medium to low. The most significant risk element is from an MOD objection arising from the impacts to the RAF Buchan Air Defence Radar (ADR). There is no fully effective and proven mitigation available. There is a strong possibility that the MOD will accept a NAIZ combined with a stop-clause as an interim solution, with a large bond to fund an enduring solution drawn down from the late 20s. The details of the stop clause are not available, but could affect finance if too open ended.

Impact	Stakeholder	Potential Mitigation	Risks	Costs
Buchan Air Defence Radar	MOD	Buchan NAIZ with stop-clause as the interim solution. Large bond to cover the enduring solution.	Medium/low. There is no certainty that interim solutions will be accepted. Enduring solutions carry a project delay if interim is not accepted.	High, but likely to be acceptable per MW of installed capacity across all benefiting projects. Initial costs low, major costs down-stream.
Alanshill PSR	NATS/DYCE	TMZ, SSR Only	Low	Low
Perwinnes PSR	NATS/DYCE	TMZ, SSR Only	Low	Low
HMRs	DYCE	Avoid during low level flying conditions	Low	Low
SAR	MCA	Corridors of 500m plus the rotor diameter in two orientations	Low	Zero. No loss of development area
VFR Transit routes	CAA	1nm wide corridors	Low	Minor loss of development area.

VFR transit requirements can be managed with very slightly wider corridors across the development area, with very little net impact on the developments.

SAR can be effectively managed through array design, without otherwise constraining the site. The main requirement is a regular pattern of turbines allowing straight line transit.

REFERENCES

1. Offshore Renewables Aviation Guidance (ORAG); “Good Practice Guidelines for Offshore Renewable Energy Developments”, June 2016
2. Catapult; “Helicopter Crew Transfers at Westermost Rough - DONG Energy’s early experience during the operational phase”, Sally Shenton April 2017
3. CAP 764
4. OREI SAR Requirements v3 - “Offshore Renewable Energy Installations: Requirements, guidance and operational considerations for SAR and Emergency Response”, MCA, November 2021.
5. ENR1_15 Offshore operations
6. ENR 1.6 ATS SURVEILLANCE SERVICES AND PROCEDURES

GREEN VOLT

Flotation Energy Ltd | 12 Alva Street | Edinburgh EH2 4QG | Scotland
Tel: [redacted] | enquiries@flotationenergy.com | www.flotationenergy.com