Neart na Gaoithe and Inch Cape Offshore Wind Farm Transponder Mandatory Zone (TMZ)

Stakeholder Consultation

Executive Summary

Neart na Gaoithe Offshore Wind Limited (NNGOWL) and Inch Cape Offshore Limited (ICOL) wish to respectively develop the Neart na Gaoithe and Inch Cape Wind Farms, referred to as Neart na Gaoithe (NNG) and Inch Cape (IC). The Development Areas lie off the east coast of Scotland with NNG lying to the south of IC by approximately 8 kilometres (km). NNG will be located in the Outer Firth of Forth; 15.5 km from Fife Ness, with IC located approximately 15 km off the Angus coastline.

What is the issue?

Leuchars is located on the east coast of Scotland approximately 11 km southeast of the City of Dundee. The military base is the home of the Royal Scots Dragoon Guards; the Royal Air Force (RAF) continues its presence and the airfield is currently home to the East of Scotland University Air Squadron and No 12 Air Experience Flight whom provide training and air experience flights utilising the Grob Tutor aircraft.

The presence of offshore Wind Turbine Generators (WTGs) at NNG and IC would be detectable to the Leuchars Primary Surveillance Radar (PSR) and would have the potential to cause false radar returns to be displayed to an Air Traffic Controller. This radar "clutter" could obscure primary returns from actual aircraft and could interfere with radar tracking. This has the potential to affect an air traffic controller's ability to identify primary radar aircraft returns, diminishing the ability of the controller to provide the requisite Air Traffic Service (ATS), and increasing the risk of the controller not detecting a conflict between aircraft. This requires a change to the arrangements and procedures employed by ATS providers in the immediate airspace surrounding the Development Areas. Large numbers of WTGs can also potentially lead to saturation of the radar processing systems. For these reasons, a mitigation solution was included as a requirement of the consents granted by the Scottish Ministers.

Until a technical PSR mitigation solution becomes available, it is proposed to introduce airspace control measures through an Airspace Change Proposal (ACP) to remove and mitigate the clutter presented by the WTGs on the Leuchars PSR radar display screen. The ACP describes the method and responsibilities established to ensure that proposed changes to the dimensions, classification or use of UK airspace are initiated, considered, refined, approved and implemented, in a safe and controlled manner. It applies to all proposals for changes to the status of UK airspace. NNGOWL and ICOL, the sponsors of the airspace change, are working with the Ministry of Defence (MOD) and Leuchars to identify mitigation solutions to address the impact of the WTGs on the Leuchars PSR, which will enable the NNG and IC WTGs to be constructed and operated without affecting Leuchars flying and ATS operations. NNGOWL and ICOL have engaged Osprey Consulting Services Ltd (Osprey CSL) to project manage the ACP on their behalf.

Proposed solution

In developing the plans to resolve the issues detailed in Section 3, NNGOWL and ICOL have considered a variety of options to determine how best to meet the needs of the MOD as well as other aviation stakeholders. Range Azimuth Gating (RAG), commonly referred to as radar blanking, can be fitted to radar systems when local clutter conditions are considered detrimental to Air Traffic operations. RAG has the effect of desensitising the radar system by blanking out a portion of radar coverage over a specific area, RAG will need to be deployed over the Development Areas before the WTGs become operational; in order to prevent the display of WTG generated clutter on the ATC display at Leuchars. However, radar blanking will also remove primary radar returns from aircraft within the blanked area; hence, in isolation it would not provide sufficient mitigation. To mitigate this removal of primary radar data, it is necessary to establish a Transponder Mandatory Zone (TMZ[1]) over the Development Areas so that aircraft within the area will be visible to Air Traffic Control (ATC) utilising Secondary Surveillance Radar (SSR).

There are two design options for the implementation of the TMZ and these are included and illustrated within Section 1.3. The TMZs will have a lateral boundary that extends two Nautical Miles (NM) around the edge of the Development Areas for both NNG and IC to allow for any shadow effect and 'building' of primary radar tracks. The proposed ceiling of the TMZ is Flight Level (FL) 100 within the operating hours of Leuchars ATS provision, which are 24 hours to provide for military diversion aerodrome purposes and the provision of Lower Airspace Radar Service (LARS[2]). Once consultation is complete, the application to the CAA for a TMZ will be based on one of the two options. The TMZ will remain (subject to Civil Aviation Authority (CAA) approval) in respect of the proposed developments until such time as a permanent technical PSR mitigation solution can be identified and deployed in relation to the Leuchars PSR.

The establishment of the TMZ is one element of a two-part Mitigation Package aimed at negating the impact of the clutter from the NNG and IC WTGs upon the Leuchars PSR. The two parts are:

- Element 1: Establishment of a TMZ.
- Element 2: RAG blanking (suppression of PSR returns within the RAG).

This document outlines the proposal from NNGOWL and ICOL to maintain the safety of the airspace surrounding the Development Areas by mitigating the effects of the WTGs on Leuchars ATS flying and radar based ATS operations.

Safety Case

Both MOD Number 1 Group (1Gp) and the CAA Safety and Airspace Regulation Group (SARG) require assurance that the changes introduced by the Airspace Change will result in safe air operations at all stages of the project lifecycle.

[1] A TMZ is defined by the CAA as "a volume of airspace where aircraft wishing to enter or fly within the defined area will be required to have and operate secondary surveillance radar equipment". TMZs are notified for the purposes of Article 39(2) of the Air Navigation Order 2010.

[2] 24 Hours, 7 Days a week (H24). The service is available to all aircraft flying outside Controlled Airspace up to and including FL 100, within the limits of radar / radio cover.

CAA Civil Aeronautical Publication (CAP) 725 *Guidance on the Application of the Airspace Change Process* [Reference 1] provides detailed guidance on the ACP. It requires a robust Safety Management (SM) process to be an integral part of any proposed airspace change; Battlespace Management Safety Management Manual (BM SMM) [Reference 2] provides the MOD direction for the required safety assurance.

Stakeholder Consultation

NNGOWL and ICOL wish to engage with all parties that might be affected by this proposed airspace change. All constructive feedback received will inform the development of its proposal, ensuring that any positive impact is enhanced and negative impacts minimised.

This consultation is being undertaken in accordance with CAP 725 [Reference 1]. This consultation document will aim to provide all of the information required for stakeholders to make an informed decision on the impact of the proposed changes.

The consultation runs from 15 June 2015 to 7 September 2015, a period of 12 weeks.

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Acronyms

Acronym	Meaning
AAIB	Air Accident Investigation Board
ACC	Airport Consultative Committee
ACP	Airspace Change Proposal
ACAS	Airborne Collision Avoidance System
ADR	Air Defence Radar
AEF	Air Experience Flight
agl	Above ground level
AIP	Aeronautical Information Publication
amsl	Above mean sea level
ANO	Air Navigation Order
AOA	Airport Operators Association
AOPA	Aircraft Owners and Pilots Association
AR	Airspace Regulation
ARA	Advisory Radio Area

ASA	Advisory Service Area
ASL	Above Sea Level
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATSOCAS	Air Traffic Service Outside Controlled Airspace
ATS	Air Traffic Service
ATSU	Air Traffic Service Unit
BAA	British Airports Association
BABO	British Association of Balloon Operators
BALPA	British Airline Pilots' Association
BATA	British Air Transport Association
BBAC	British Balloon and Airship Club
BBGA	British Business and General Aviation Association
BGA	British Gliding Association
BHA	British Helicopter Association
BHPA	British Hand Gliding and Paragliding Association
BM	Battlespace Management
BMAA	British Microlight Aircraft Association
BMFA	British Model Flying Association
BPA	British Parachute Association
CAA	Civil Aviation Authority

CAP	Civil Aviation Publication
CAS	Controlled Airspace
CAT	Commercial Air Transport
CO_2	Carbon Dioxide
CTA	Control Area (Class D UK Airspace)
CQWI	Combined Qualified Weapon Instructors Course
DAATM	Defence Airspace and Air Traffic Management
DAP	Directorate of Airspace Policy (part of the CAA – now SARG)
DfT	Department for Transport
DME	Distance Measuring Equipment
DS	Deconfliction Service
ELFAA	European Low Fares Airline Association
ESUAS	East of Scotland University Air Squadron
FL	Flight Level
FOB	Forward Operating Base
ft	feet
GA	General Aviation
GASCo	General Aviation Safety Council
GAT	General Air Traffic
GAPAN	Guild of Air Pilots and Air Navigators
GATCO	Guild of Air Traffic Control Officers
HCGB	Helicopter Club of Great Britain

HI TAC	High TACAN
HMR	Helicopter Main Routes
HQ DAAvn	Headquarters Director Army Aviation
IAIP	Integrated Aeronautical Information Package
IFP	Instrument Flight Procedure
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IoMA	Isle of Man Airport
km	kilometre
LAA	Light Aircraft Association
LARS	Lower Airspace Radar Service
LJLA	Liverpool John Lennon Airport
LoA	Letter of Agreement
LOS	Line of Sight
MAA	Military Aviation Authority
Mil AIP	Military Aeronautical Information Publication
MMATM	Manual of Military Air Traffic Management
MOD	Ministry of Defence
MTWA	Maximum Total Weight Authorised
NAIZ	Non-Automatic Initiation Zone
NATMAC	National Air Traffic Management Advisory Committee

NATO	North Atlantic Treaty Organisation
NATS	The National Air Traffic Service Provider
NERL	NATS En-Route Ltd
NCHQ	Navy Command Head Quarters
NM	Nautical Miles
NO_2	Nitrous Dioxide
NOTAM	Notice to Airmen
OSA	Off-Shore Safety Area
OS	Ordnance Survey
PSR	Primary Surveillance Radar
QRA	Quick Reaction Alert
RA	Regulatory Article
RAF	Royal Air Force
RAG	Range-Azimuth Gating
RDR	Radar
RMZ	Radio Mandatory Zone
SAR	Search and Rescue
SARG	CAA Safety and Airspace Regulation Group
SID	Standard Instrument Departure
SM	Safety Management
SMM	Safety Management Manual
SRG	Safety Regulation Group (part of the CAA)

SSR	Secondary Surveillance Radar
TACAN	Tactical Air Navigation System
TMZ	Transponder (SSR) Mandatory Zone
TRA	Temporary Reserved Area
UAS	University Air Squadron
UAV	Unmanned Air Vehicles
UKAB	UK Airprox Board
UKFSC	UK Flight Safety Committee
VFR	Visual Flight Rules
VGS	Volunteer Gliding Squadron
VOR	VHF Omni Directional Radio Range

Defined Terms

Acronym	Meaning
Development Area	The area of the Inch Cape or NNG Wind Farm which includes the WTGs, inter-array cables, offshore substation platforms and initial part of the Offshore Export Cable and any other associated works
Development Areas	The combination of the Development Area as defined for both Inch Cape and NNG
TMZ	The Transponder Mandatory Zone, covering the Development Areas as defined with a 5 NM separation distance between the Development Areas, and a 2 NM buffer.

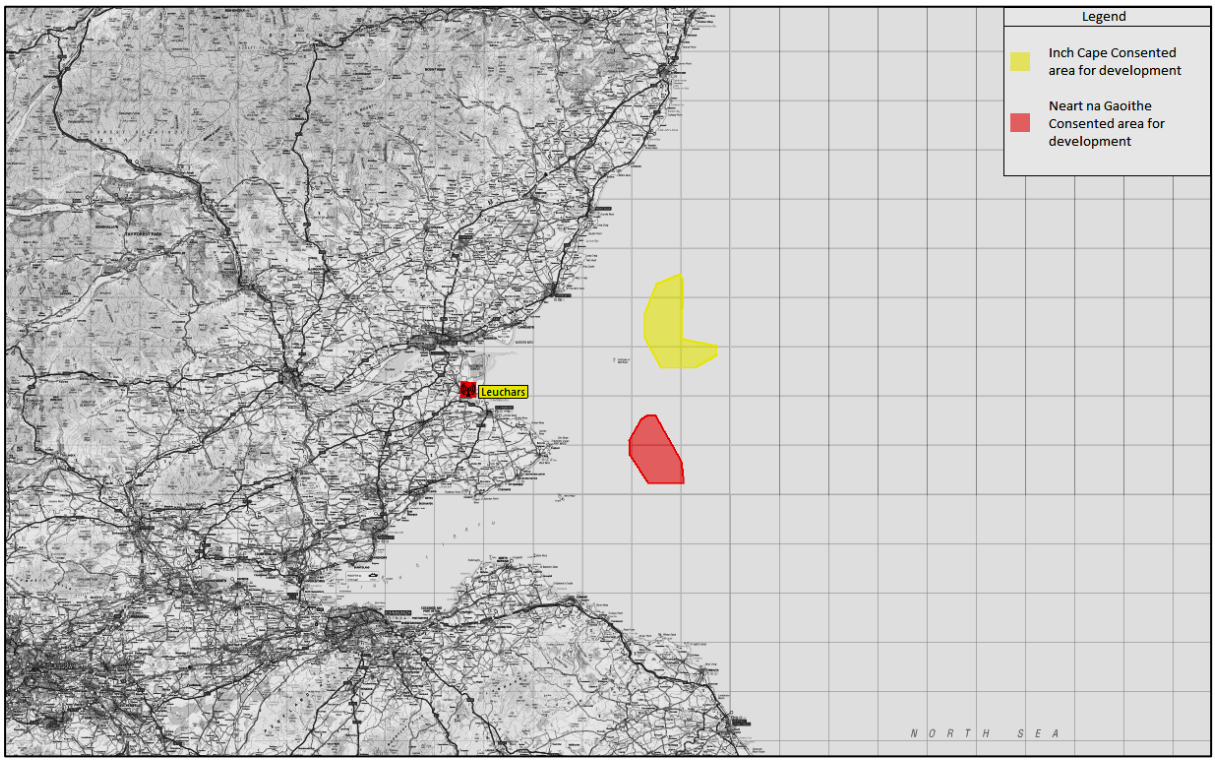
1 Introduction

The presence of the Neart na Gaoithe (NNG) and Inch Cape (IC) Wind Farms will affect Leuchars flying and Air Traffic Service (ATS) operations, with the most significant impact being the detection of the Wind Turbine Generators (WTGs) as unwanted clutter by the Leuchars Primary Surveillance Radar (PSR).

1.1 General

Neart na Gaoithe Offshore Wind Limited (NNGOWL) and Inch Cape Offshore Limited (ICOL) wish to respectively develop the NNG and IC Wind Farms. The Development Areas are illustrated in Figure 1 below and are adjacent to each other with NNG lying to the south of IC by approximately 8 kilometres (km). NNG will be located in the Outer Firth of Forth, approximately 15.5 km from Fife Ness, with IC located approximately 15 km off the Angus coastline.

Figure 1 Location of the Development Areas in relation to Leuchars.

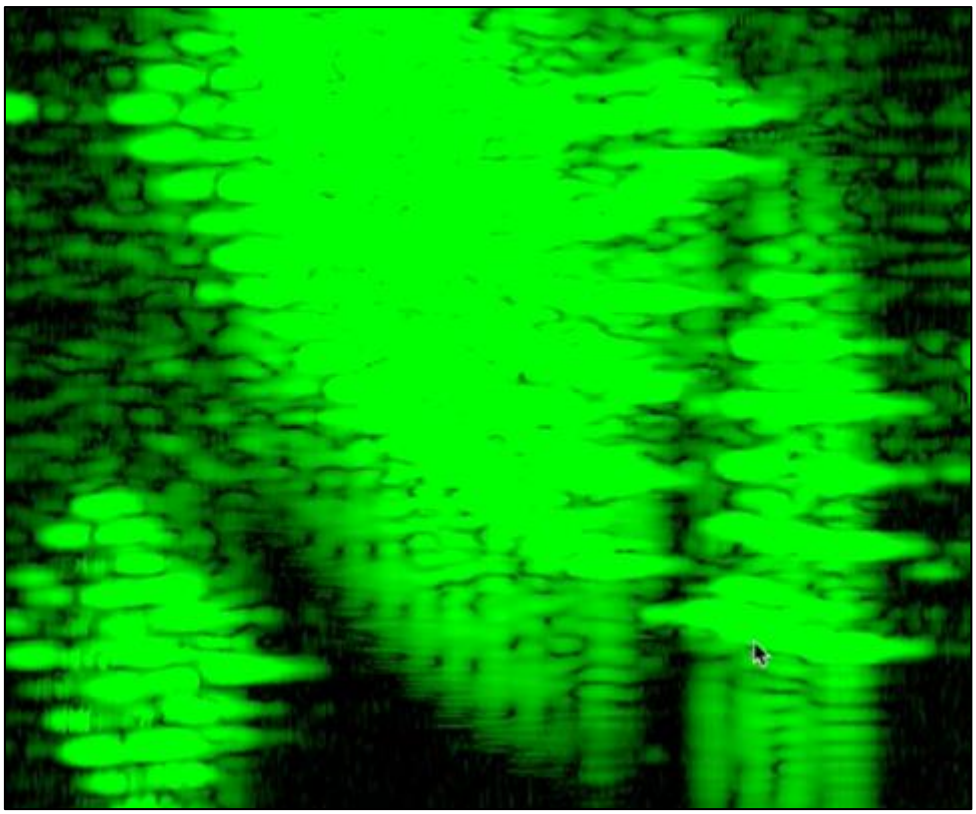


Leuchars is located on the east coast of Scotland approximately 11 km southeast of the City of Dundee. The military base is the home of the Royal Scots Dragoon Guards; the Royal Air Force (RAF) continues its presence and the airfield is currently home to the East of Scotland University Air Squadron and No 12 Air Experience Flight whom provide training and air experience flights utilising the Grob Tutor aircraft. However, the requirement for this airspace change is not based on the routine activities of the Leuchars permanently based aircraft, which are unlikely to operate near Development Areas, but on the ongoing and future military operations conducted at Leuchars, which are detailed in Section 3.2.

The most significant impact from WTGs on the Leuchars PSR and its operational environment is WTG generated radar returns causing false target generation. These false radar returns (also known as "clutter") displayed on the radar screen can be confusing to air traffic controllers; false tracks (which in many cases are indiscernible from real tracks) could obscure returns from real aircraft. This could affect an air traffic controller's ability to identify primary radar aircraft returns, undermining their ability to provide ATS and in turn increasing the risk of the controller not detecting a conflict between aircraft. The presence of the NNG and IC WTGs will affect Leuchars Aerodrome flying and radar based ATS operations thereby requiring a change to the arrangements and procedures in the immediate airspace surrounding the Development Areas.

Analysis completed as part of the Section 36 consent application for the NNG and IC Wind Farms concluded that it is highly likely that the Leuchars PSR will detect all WTGs located within the Development Areas. Annex A1 and Annex A2 provide example radar Line of Sight (LOS) profiles for reference. This means that the WTGs are highly likely to generate returns similar to those shown at Figure 2 below.

Figure 2 Example of wind farm clutter from an offshore wind farm presented on to a radar display screen.



The green areas illustrate the moving blades of the WTGs.

A reduction in the detection capabilities of the radar and the generation of false targets from WTGs will limit the ability of Leuchars ATC to discharge their responsibilities when providing air traffic services within their area of operations. When providing a Deconfliction Service (DS[3]), Leuchars ATC endeavours to provide five NM lateral separation between radar returns. Therefore, services would be reduced, limited or downgraded within five NM of the boundary of the clutter created by the WTGs.

1.2 Purpose and Objectives

An Airspace Change Proposal (ACP) to change the nature of the airspace within the area of the WTGs is proposed in order to remove the clutter presented on the Leuchars PSR display screen. The ACP describes the process and responsibilities established to ensure that proposed changes to the dimensions, classification or use of UK airspace are initiated, considered, refined, approved and implemented, in a safe and controlled manner. It applies to all proposals for changes to the status of UK airspace. NNGOWL and ICOL, the sponsors of the airspace change, are working with the MOD and Leuchars to identify mitigation solutions to address the impact of the WTGs on the Leuchars PSR, which will enable the NNG and IC WTGs to be constructed and operated without affecting Leuchars flying and ATS operations. Osprey CSL, on behalf of

[3] Deconfliction Service provides the pilot with traffic information and deconfliction advice on conflicting aircraft. However, the avoidance of other aircraft is ultimately the pilot's responsibility.

NNGOWL and ICOL and in accordance with Civil Aviation Authority (CAA) Civil Aviation Publication (CAP) 725, *Guidance on the Application of the Airspace Change Process* [Reference 1], has prepared this consultation document. The purpose of this document is to provide information regarding the proposal to establish a Transponder Mandatory Zone (TMZ) around the Development Areas to mitigate the effects of the detection of unwanted WTG radar returns by the Leuchars PSR. RAG has the effect of desensitising the radar system by blanking out a portion of radar coverage over a specific area; this area of RAG blanking will be located over the area of the development or developments specifically where WTGs are located. When the RAG is selected, there would be no primary radar contacts within the area of the RAG; there would therefore be a reliance on SSR data to provide surveillance radar cover for ATC purposes inside the RAG inhibited area. A TMZ is required to mitigate the impact of Radar-Azimuth Gating (RAG) of the Leuchars PSR.

1.3 Options for Application of the TMZ

A TMZ is airspace of defined dimensions wherein aircraft wishing to enter or fly within the defined area, will be required to have and operate SSR equipment.

- TMZs are notified for the purpose of Air Navigation Order (ANO) 2005 Article 20 [Reference 3] and a TMZ may be established for overriding safety reasons, where the airspace classification would not ordinarily require aircraft to carry a transponder; and
- This SSR equipment must include a pressure altitude reporting transponder capable of operating in Mode A and Mode C and have the capability and functionality prescribed for Mode S Elementary Surveillance.

There are two design options for the implementation of the TMZ:

- Option A: Individual TMZs with RAG blanking areas encompassing the separate NNG and IC Development Areas.
- Option B: A single TMZ with RAG blanking area encompassing both Development Areas.

Option A includes a lateral boundary that extends two NM around the edge of each of the Development Areas for both NNG and IC, to allow for any shadow effect created by the WTGs and 'building' of primary radar tracks.

Option B includes the same two NM lateral boundary extending around the single TMZ encompassing both Development Areas. The proposed ceiling of the TMZ is Flight Level (FL) 100 within the operating hours of Leuchars ATS provision, which are 24 hours to provide for military diversion aerodrome purposes and the provision the provision of Lower Airspace Radar Service (LARS). The proposed options for the TMZ are illustrated in Figures 3 and 4 below.

Figure 3 Design Option A of the TMZ application (the RAG will be located over the Developable Areas).

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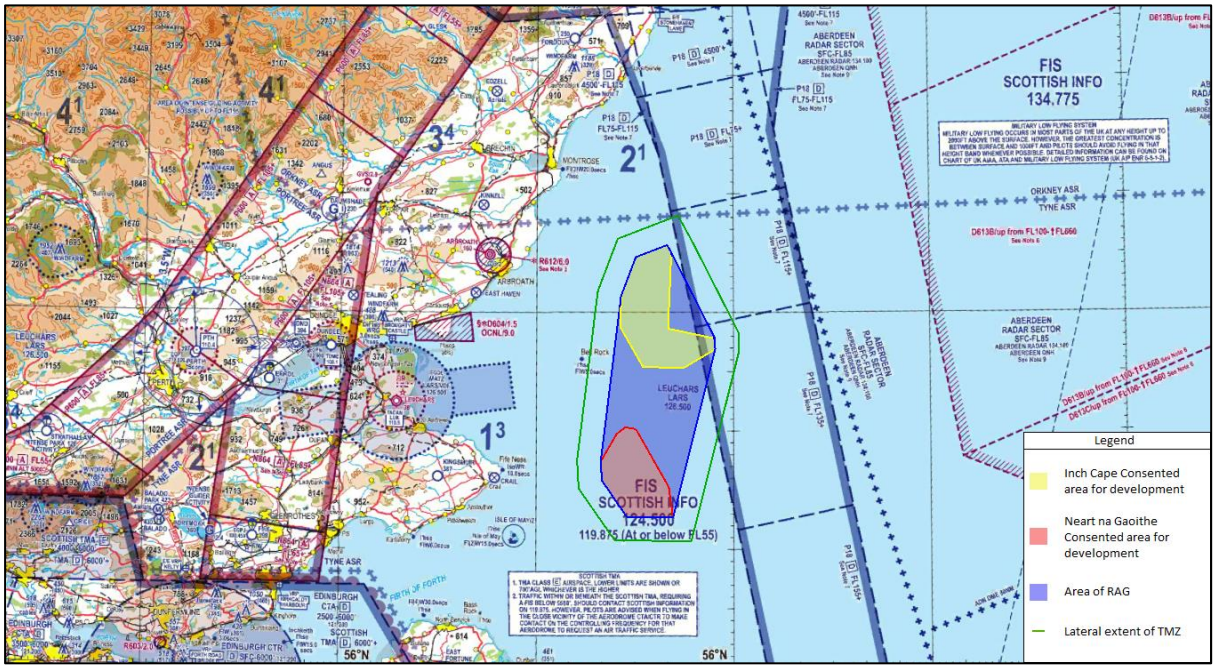
Figure 4 Design Option B of the TMZ application (the RAG is illustrated by the dark blue area emcompassing the Developable Areas).



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Once consultation is complete, the application to the CAA for a TMZ will be based on one of the two design options described above.

It is the responsibility of NNGOWL and ICOL as sponsors of the proposed change to consult with all relevant stakeholders directly, or indirectly, affected by the proposal.

1.4 Document Structure

The objectives of the document are to:

- Provide the background to the ACP;
- Describe the ongoing and future operations at Leuchars and how these may be affected by the NNG and IC WTGs;
- Detail the proposed change to the airspace over the Development Areas; and
- Describe the alternative options for mitigation which were considered and explain why they are rejected due to their inability to mitigate sufficiently for the effects of clutter created by the detection of WTGs.

This document contains eight main sections and six Annexes, outlined below for convenience:

- Section 1, this section, introduces the document;
- Section 2 outlines the consultation process;
- Section 3 explains the necessity for an ACP;
- Section 4 gives the proposed design option;

- Section 5 describes the development and options for the proposed TMZ;
- Section 6 details the environmental and economic considerations;
- Section 7 provides an outline of the next stages following consultation; and
- Section 8 contains the table of References utilised throughout the document.

There are six Annexes:

- Annex A1 details the radar LOS assessment for the NNG Wind Farm;
- Annex A2 details the radar LOS assessment for the IC Wind Farm;
- Annex A3 provides a cross section of airspace above the Development Areas;
- Annex A4 illustrates the published Leuchars Instrument Flight Procedures (IFP);
- Annex A5 provides the co-ordinates of the two design options for the proposed TMZ; and
- Annex A6 lists the Consultees.

2 The Consultation Process

It is a CAA requirement that the Sponsor of an Airspace Change Proposal must conduct a stakeholder consultation exercise prior to the submission of the Proposal.

2.1 Overview

The primary objective of the consultation process is to enable NNGOWL and ICOL to engage with all parties that might be affected by the proposed airspace change, in order to ensure that the development of the proposal is informed by constructive feedback. This section thus provides an outline of the consultation process for NNGOWL and ICOL's Airspace Change Proposal. It includes details of why a consultation is undertaken, who has been sought to engage in consultation and the method of consultation before explaining the CAA oversight of the consultation process.

2.2 What is This Consultation About?

This consultation concerns the proposed implementation of a TMZ to mitigate the impact of NNG and IC WTGs on the Leuchars PSR. The TMZ is required to enable Leuchars to continue to provide safe and efficient ATS to aircraft once WTGs are operational.

WTGs within the Development Areas are likely to cause false primary radar returns to be presented on Leuchars' ATC radar display screens. These false tracks can obscure the primary returns generated by actual aircraft and impede an Air Traffic Control Officer's (ATCO) ability to recognise genuine aircraft returns. Large numbers of WTGs can also saturate the radar processing systems leading to impaired radar performance.

Before the WTGs become operational, the developers must agree an ATC mitigation scheme with the MOD. At this time, there is no proven technical solution or mitigation technology which can be used to upgrade the radar to remove the 'clutter'; therefore, an operational solution is required.

Aircraft transiting or operating within the proposed TMZ would be required to carry and operate a working altitude reporting transponder. Within the Controlled Airspace (CAS) above and adjacent to the proposed TMZ, there will be no changes to ATC procedures, the general distribution of air traffic, or to the categorisation of the airspace.

It is a requirement of the CAA's ACP (CAP 725) [Reference 1] that a sponsor undertakes a stakeholder consultation process prior to the submission of an ACP. This ensures that all stakeholders directly or indirectly affected by the proposed change are consulted, and are made aware of any environmental and safety issues that may arise as a consequence of the proposed airspace change. The CAA lays down its regulatory requirements and process for consultation in CAP 725. The CAA Policy Statement for the Development of a TMZ [Reference 4] requires that such airspace developments must be carried out in accordance with the ACP.

NNGOWL and ICOL will collate and forward all consultation results to the CAA for their consideration during the regulatory decision process.

2.3 Who are the Consultees

Consultees broadly fall into two categories:

- Aviation consultees; and
- Non-aviation consultees.

Aviation consultees include aviation parties such as the MOD, airlines, aircraft operators, adjacent aerodromes, all local airspace users and the national bodies representing all UK aviation interests who may be affected by the regulatory requirements within the TMZ.

Non-aviation stakeholders for consultation include but are not limited to environmental and heritage organisations and the local lighthouse authority. The proposed TMZ would lie at a distance greater than six NM offshore and consequently, in accordance with CAA guidance, consultation with non-aviation stakeholders is limited. Fundamentally, the consultation will enable NNGOWL and ICOL to obtain or confirm views and opinions about the impact of the proposed airspace change. A full list of consultees, developed with the advice of the CAA, is provided at Annex A6. Consultees have a crucial role in providing relevant and timely feedback to NNGOWL and ICOL, giving their views and opinions on the impact of the proposed airspace change. Consequently, it is vital that stakeholders fully participate in this consultation.

2.4 Consultation Response

Stakeholders are invited to comment on the proposals contained within the whole document and the two design options for the TMZ. In reaching their conclusions, stakeholders are requested to individually consider each of the two options for application of the TMZ. A consultation response is requested if individually or any combination of the two options would affect stakeholder operations. Stakeholders should consider the operating environment within which the proposed TMZ lies and might like to consider the following questions before responding:

- Do you regularly fly in the airspace within the location of the Development Areas and within the region of the proposed TMZ?
- If yes, would the proposed TMZ affect your operation?
- Are there any unforeseen consequences of the proposed TMZ, which the developers should be made aware of?

2.5 Method of Consultation

The CAA requires that the consultation be conducted in accordance with the principles set out in the Cabinet Office Code of Practice on Consultation, as specified in CAP 725 [Reference 1].

This consultation document is widely available and can be viewed on the NNGOWL and ICOL websites at:

http://www.inchcapewind.com
http://www.neartnagaoithe.com

The developers request that you provide a written response; wherever possible, an early response will allow the developers to address any questions or issues as soon as practicable. The consultation period concludes at 1700hrs on 7th September 2015; responses received after this date may not necessarily be considered.

Responses should indicate whether the respondent supports or objects to the proposal. In the event that a respondent objects to the proposal, it is requested that supporting evidence is included in the response. This consultation will be via email and postal responses. Please respond even if you have no objection to the proposal.

Consultation responses may be sent by email to the following address:

NNI@ospreycsl.co.uk

Please compose your response in the following format:

Subject: NNG and IC Consultation Response

First Line of Text: "I am responding on behalf of [*inset name of organisation*]" or "I am responding as a member of the public".

Second Line of Text: Please select one of the following:

- "I/We support all options of the NNG/IC TMZ proposal";
- "I/We object to all options of the NNG/IC TMZ proposal"; or
- "I/We have no objection to all the options of the NNG/IC TMZ proposal".

Third Line of Text: (if required)

- "I/We support only options A B (delete as required); or
- "I/We object to options A B (delete as required).

Subsequent text:

Please include the reasons for supporting or objecting to the proposed NNG/IC TMZ; alternatively, indicate your support or objection to one or more of the options for the TMZ application.

Otherwise using the format above, correspondence may be sent by post to:

Osprey CSL
The Forge
Bentley
Hampshire GU10 5HY

Stakeholders should mark the letter "NNG and IC Consultation".

2.6 Consultation CAA Oversight

Osprey, in compliance with CAP 725 [Reference 1], manages the consultation process on behalf of NNGOWL and ICOL for the NNG and IC Airspace Change. Any complaints on the adherence of Osprey, or NNGOWL and ICOL to the consultation should be addressed to CAA Airspace Regulation (AR), using the contact details below:

Airspace Business Coordinator
Airspace, ATM and Aerodromes
CAA House
45-59 Kingsway
London WC2B 6TE

Email: airspace.policy@caa.co.uk

It should be noted that the CAA is responsible for overseeing the consultation process and will therefore not comment on the proposed changes.

2.7 Confidentiality

The CAA requires that all consultation material, including copies of responses from consultees and others, are included in any formal ACP submission to the CAA. Should stakeholders not wish to pass personal details to the CAA, this should be indicated formally within the response. However, the CAA is bound by the Data Protection Act and will protect all personal information where provided. NNGOWL and ICOL undertake that, apart from the necessary submission of material to the CAA and essential use by Osprey for analytical purposes, NNGOWL and ICOL will not disclose personal details, or content of responses and submissions, to any third parties.

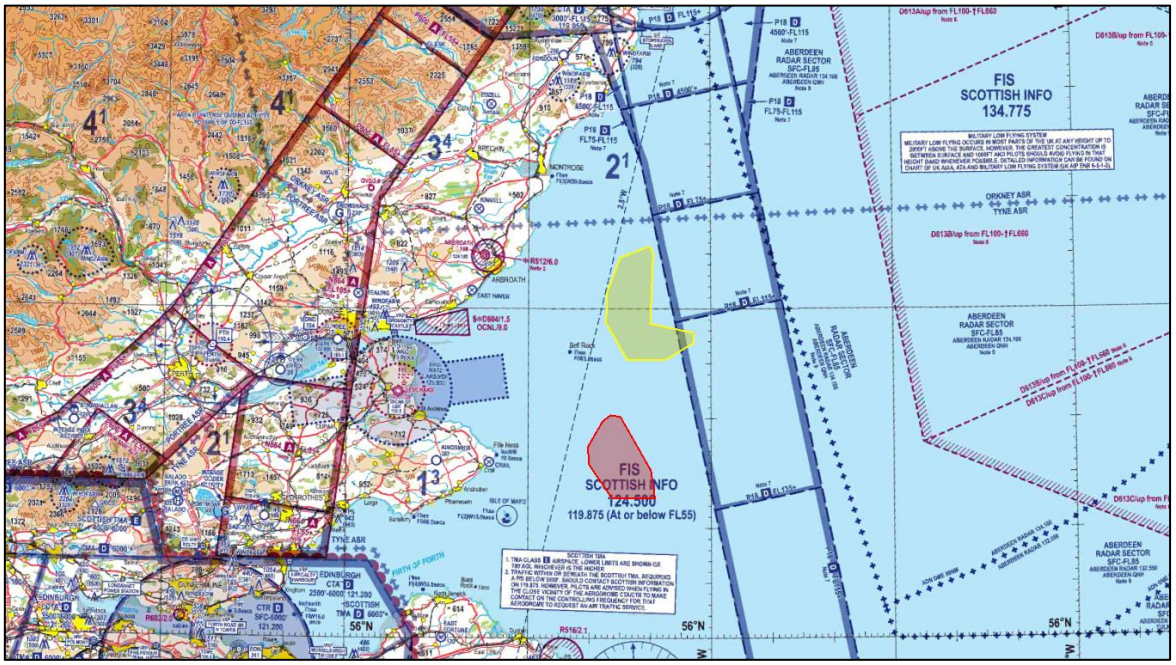
3 The Need for an Airspace Change Proposal

Leuchars ATC operates under regulatory oversight of the Military Aviation Authority (MAA), providing essential ATS to military and civil aircraft in the area the Development Areas

3.1 Overview

The UK Government is legally committed to supporting renewable energy in order to meet its target of generating 15% renewable energy by 2020[4]. Furthermore, the Climate Change (Scotland) Act 2009[5] contains provisions that set a legally binding target for reducing carbon dioxide emissions by at least 42% by 2020 and at least 80% by 2050, compared to 1990 levels. In order to increase and accelerate the generation of renewable energy in the UK, the UK and Scottish Government's policy, amongst other actions, sets out a plan for accelerating the use of offshore wind. Figure 5 below shows the Development Areas in relation to the local airspace environment.

Figure 5 Airspace in the vicinity of the Development Areas.



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[4] http://ec.europa.eu/energy/en/topics/renewable-energy
[5] http://www.gov.scot/Topics/Environment/climatechange/scotlands-action/climatechangeact

The presence of operational WTGs within the Development Areas will affect the provision of Leuchars ATS operations thereby necessitating a change to the arrangements and procedures in the immediate airspace surrounding the Development Areas. In the event that the effects of NNG and IC WTGs remain unmitigated, it is highly likely that the provision of radar based ATS at Leuchars would be detrimentally affected. WTGs located within PSR coverage can reduce the ability of the radar to detect aircraft. The WTGs present themselves as a large number of reflecting moving targets to the radar, which look very similar to aircraft radar returns. Each of these effects reduces the overall effectiveness of the radar in detecting targets, which can result in misidentification of aircraft, loss of track position, loss of track identity and false plots; these in turn can potentially cause safety and operational issues. To mitigate the effects of the WTGs it is proposed to implement an ACP through the establishment of a TMZ to mitigate the impact of radar blanking techniques on the Leuchars PSR.

Implementation of the TMZ will not occur until the first WTG becomes operational (radar clutter is not apparent until the WTGs are rotating). A positive decision on the application for a TMZ will form the basis for the discharge of certain conditions attached to Section 36 consents.

This section describes the relevant background information to this ACP by providing an overview of flying operations at Leuchars. It also highlights the primary areas of concern relating to the effects of NNG and IC WTGs on flying and radar based ATS operations at Leuchars. In this case, there are five principal issues concerning the effects of the NNG and IC WTGs on Leuchars operations.

- Approach Control and Departure Services to Leuchars;
- Radar based ATS provision within the vicinity of NNG and IC Wind Farms and the established Leuchars IFPs located overhead the Development Areas;
- Radar based ATS provision to military aircraft within the Leuchars Advisory Service Area (ASA);
- The capability to operate as a radar equipped Instrument Flight Rules (IFR)[6] aerodrome; and
- The requirement to host North Atlantic Treaty Organisation (NATO) and other major exercises.

[6] IFR – Instrument Flight Rules are a set of regulations that governs flights under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck.

3.2 Background

Following the 2010 Strategic Defence and Security Review[7], the MOD announced that the RAF would transition to one main operating base in Scotland; RAF Lossiemouth in Morayshire was identified as the selected base. Typhoon aircraft, formerly based and operating from RAF Leuchars, have now relocated to their new base at RAF Lossiemouth. On the 1st April 2015, Leuchars transitioned to British Army control. The East of Scotland University Air Squadron (ESUAS) and No12 Air Experience Flight (AEF) still operate from the airfield sharing a fleet of seven Grob Tutor aircraft, although two of these are based permanently at Glasgow International Airport for University Air Squadron duties. Leuchars Flying Club also operates three general aviation aircraft for hire and training. The requirement of the TMZ is not based on the routine activities of the Leuchars permanently based aircraft, which are unlikely to operate near the Development Areas, but on the ongoing and future military operations conducted at Leuchars, detailed below:

- The MOD Chief of the Air Staff has directed that Leuchars retain a 24/7 IFR radar service capability in order to act as a Diversion Aerodrome for military aircraft, primarily Typhoon aircraft based at RAF Lossiemouth, including those operating Quick Reaction Alert (QRA)[8] sorties from RAF Lossiemouth and RAF Coningsby, but also for other aircraft completing training sorties/missions from other military bases, to recover to the aerodrome safely in poor weather conditions;
- Leuchars will host exercises and detachments, both UK Mil and major NATO exercises (Joint Warrior); this capability will be maintained with Leuchars operating as a Forward Operating Base (FOB) within the military exercise scenarios;
- Leuchars will also host the Combined Qualified Weapon Instructors Course (CQWI); successful completion of this course leads to a formal qualification, which is essential to enable aircrew to return to the frontline to instruct weapons and tactics on operational squadrons. The Course is intensive, lasting five months, during which increased flying activity culminates into an 'operational phase' of tactical flying; and
- The proximity of the aerodrome to the military practice Danger Areas to the east and southeast makes Leuchars an attractive option for aircraft diverting in following an emergency or due to inclement weather conditions at their home base.

Leuchars ATC provides aerodrome control and approach control services to a range of general aviation and military aircraft in the airspace around Leuchars. In addition to these standard air traffic tasks, Leuchars ATC provides a service to aircraft participating in the Lower Airspace

[7] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/62482/strategic-defence-security-review.pdf.
[8] Aircraft are kept at a permanent readiness state in order to react to situations of national security.

Radar Service (LARS[9]) within a radius of 40 NM of the airfield every day of the year, 24 hours per day.

The Leuchars ASA is notified as an airspace of defined dimensions where military aircraft that are carrying out autonomous operations within the area are to receive, where possible, an ATSOCAS[10] from a nominated source. Pilots are responsible for selecting the ATS provider and the type of ATS required from the provider.

The obligation to provide standard radar based ATS, the requirement to host complex NATO exercises, the LARS commitment, the requirement to provide radar services within the ASA for military aircraft together with the requirement to standby as an emergency diversion aerodrome in all weather conditions, all combine to create an extremely complex controlling environment. The ability to mitigate the impact of the WTGs on the Leuchars PSR is paramount to ensure that the required levels of safety exist in order to operate a mix of aircraft efficiently and effectively in the local operating areas.

3.2.1 Leuchars ATS

The airspace around Leuchars is of medium complexity[11]. Leuchars ATC provides a radar based ATS to aircraft outside of controlled airspace, (generally Class G uncontrolled airspace) that are departing, arriving and transiting through the area (generally within 40 NM radius from Leuchars Aerodrome) as well as those military aircraft, requesting an ATS and operating within the Leuchars ASA.

3.2.2 Provision of an Approach Control and Departure Service

Leuchars ATC provides an approach control and departure service in accordance with the MAA Manual of Military Air Traffic Management (MMATM) [Reference 5]. Leuchars ATC provides an ATS to Grob Tutor aircraft following the recommendation from the Air Accident Investigation Board (AAIB) accident report 6/2010 into the mid-air collision between two AEF Grob 115E Tutor aircraft in 2009. Air Officer Commanding (AOC) No 22 Group (controlling authority for Grob Tutor aircraft) has mandated that Tutor aircraft are to maintain a radar service during flying operations. The five tutor aircraft presently permanently based at Leuchars are unlikely to operate in the location of the Development Areas. Due to their single engine status, sorties over the open sea area are likely to be restricted to a few miles offshore.

Leuchars publishes a number of precision approach, standard arrival and departure procedures within the Military Aeronautical Information Publication (Mil AIP) [Reference 6]. A number of these procedures are located within the vicinity of the Development Areas.

---

[9] LARS - The service is normally provided to radius 30NM, Leuchars provide the service to 40 NM.

[10] ATSOCAS – Air Traffic Service Outside Controlled Airspace. UK Flight Information Services provided by a number of air traffic units and is used by a variety of users.

[11] Can be characterised by the operation of a few CAT movements per hour and a number of flights in the airspace operating under Visual Flight Rules (VFR); the most prevalent being survey and offshore resource recovery operations and the Military.

3.2.3 Leuchars LARS

Leuchars ATC provides a LARS with the purpose of ensuring participating pilots are aware of other nearby aircraft and/or flying activities thus enhancing flight safety in the area. This service is available to any aircraft operating in uncontrolled airspace, from ground level up to 10,000 feet (ft), within a 40 NM radius of Leuchars and is provided in accordance with the policy determined by the CAA Safety and Airspace Regulation Group (SARG). LARS is regarded as a very important service which is sponsored by the Department for Transport (DfT) and is determined by the CAA SARG as key to enhancing the levels of safety of the airspace in an area that can be busy with a diverse mixture of aviation activities.

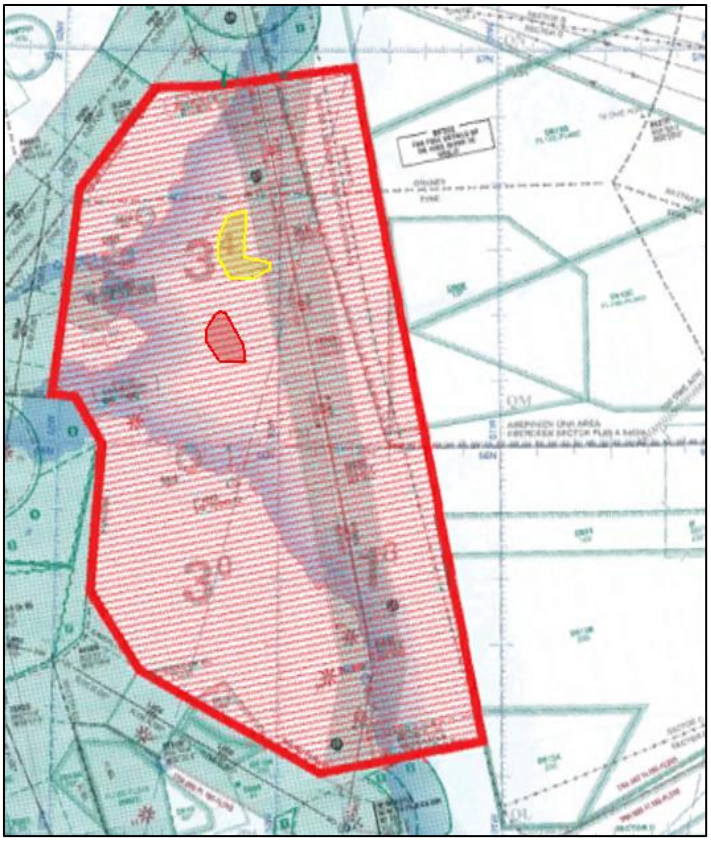
3.2.4 Leuchars ASA Activities

Leuchars ATC, together with other ATS providers, are responsible for providing radar services in the Leuchars ASA to enhance the safety of aircraft operating in the area. The Leuchars ASA is notified from 5,000 ft above mean sea level (amsl) to FL 195 (approximately 19,500 ft) where pilots of military fixed wing, fast jet aircraft are advised, where possible, to take advantage of receiving an ATS when flying within the area to enhance flight safety. Leuchars can only control aircraft within the ASA up to FL 195; above this level, aircraft are under the control of military controllers at an Area Control Centre (ACC) or Air Defence Controllers. The vertical limit of the ASA can be increased to FL 245 (approximately 24,500 ft) when Temporary Reserved Area (TRA) 007 / 007A is inactive, (Class C controlled airspace (CAS)). To avoid operational restrictions, TRAs allow military aircraft to work autonomously under Visual Flight Rules[12] (VFR) or be in receipt of an ATS from approved ATS units. TRA 007/A is activated Monday through to Friday between the hours of 0730-1700 during the summer and 0830-1700 during the months of winter; it may be activated by Notice to Airmen (NOTAM) at other times.

The Development Areas are located within the lateral extent of the Leuchars ASA. Unmitigated WTG radar returns on the Leuchars PSR will have an impact on the level of service provided to aircraft within the area. There would be a detrimental effect on the provision of timely information by the air traffic controller to assist the pilot in discharging his responsibility for collision avoidance within five NM of the Development Areas. Figure 6 below illustrates the Leuchars ASA and the approximate locations of the Development Areas.

[12] VFR – Visual Flight Rules. A set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going. The pilot operates the aircraft with visual reference to the ground and by visually avoiding obstructions and other aircraft.

Figure 6 Leuchars ASA and the locations of the Development Areas.



3.2.5 Leuchars Instrument Flight Procedures (IFP)

Leuchars has published a number of IFPs for its predominant Runways designated as 08/26. These consist of the following:

- Standard Instrument Departure[13] (SID) Runway 08;
- SID Runway 26;
- High TACAN[14] (HI TAC) to Precision Approach Radar[15] (PAR) Runway 08;
- HI TAC Runway 08;
- TAC or Radar (RDR) to Instrument Landing System; (ILS)/Distance Measuring Equipment[16] (DME) Runway 26; and

[13] SID – Standard Instrument Departure. An ATC coded departure procedure established at airfields. SIDs strike a balance between terrain and obstacle clearance, noise abatement and airspace restrictions.
[14] TACAN – Tactical Air Navigation System. A navigation system used by military aircraft; it provides the user with a bearing and a distance to a ground or ship based station.
[15] PAR – Precision Approach Radar. A type of radar guidance system designed to provide lateral and vertical guidance to an aircraft pilot for landing, until the pilot touches down.
[16] DME – Distance Measuring Equipment. A transponder based radio navigation system that measures slant range distance by timing the propagation delay of radio signals.

- HI TAC Runway 26.

Charts depicting the IFPs for Leuchars including an overlay of the proposed location of the NNG and IC development sites are illustrated in Annex A4.

3.3 Data Capture

Since Typhoon aircraft left Leuchars and during the months October 2014 to April 2015, the airfield has carried out, on average, 936 aircraft movements per month, which includes the normal activity of the based Tutor and Flying Club aircraft, rotary and other civil and military aircraft. The airfield also saw a number of visiting aircraft consisting of the following:

- Detachment of Alphajet, Hawk, King Air, Puma, Lynx and Tucano aircraft;
- Executive Aircraft, C130 Hercules and Boeing 737;
- During January to April 2015, 154 military aircraft consisting of Tornado GR4, Sentinel, Shadow, Learjet, Typhoon, DA20 and Hawk aircraft completed Practice Diversions[17] to the Airfield; and
- January to April 2015, Leuchars completed 148 instrument approaches consisting of Radar Talkdowns[18], Instrument Landing System[19] and Other Aids[20] approaches.

During the period October 2014 to March 2014, 20 aircraft of differing types diverted to the airfield. Notably during December 2014, 7 RAF Lossiemouth based Typhoon aircraft diverted to Leuchars after the runways at Lossiemouth became unusable. During February 2015, five Hawk aircraft and two Tucano aircraft diverted to Leuchars with varying emergencies. A number of non-SSR equipped general aviation aircraft were controlled up to the end of April 2015, none of which operated within the vicinity of the proposed TMZ, all staying close to the coastline.

3.4 Justification for an ACP

The impact of the NNG and IC WTGs on Leuchars' flying and ATS operations relate to the issues detailed in Section 3.1 and 3.2. These areas of concern have led to the requirement to mitigate the effects of the NNG and IC WTGs.

Leuchars ATC is responsible for providing pilots with ATS in Class G uncontrolled airspace directly above the proposed developments; this includes those aircraft arriving/departing from the aerodrome as well as those military and civil aircraft transiting the area. Leuchars plays a key role in being a provider of LARS in the North East of Scotland as there is limited radar coverage below FL 100 in the area. This service would necessarily be reduced, downgraded or

[17] A practice diversion to an airfield is usually pre-booked. Aircraft will complete an approach to the runway for practice to simulate that the intended airfield of destination is unusable or that there is a simulated emergency with the aircraft.
[18] A controller guides aircraft down to the runway threshold or to a point where the aircraft reaches a defined decision height/altitude.
[19] ILS – a ground based instrument approach system that provides precision lateral and vertical guidance to the runway.
[20] May include TACAN / Internal Aid approaches, which are interpreted by the pilot.

limited near the Development Areas if the radar returns from the WTGs (clutter) remain unmitigated.

4 Proposed Design Option

The proposal is to establish a TMZ with associated RAG and a 2 NM buffer zone around the Development Areas.

4.1 Overview

In developing the plans to resolve the issues detailed in Section 3, NNGOWL and ICOL have considered a variety of design options in order to provide sufficient mitigation, whilst meeting the needs of the MOD and all other aviation stakeholders.

The following range of mitigation design options were considered:

- Do nothing;
- The ability to temporarily close down the operation of the WTGs;
- SSR Alone operations;
- Radio Mandatory Zone (RMZ);
- TMZ with associated RAG blanking and no lateral geographic buffer zone; and
- TMZ with associated RAG blanking and lateral geographic buffer zone.

4.2 Option 0 – Do Nothing

In the event that no mitigating actions are implemented for the NNG and IC Wind Farms, the clutter created by the WTGs will affect the safe and effective provision of a radar based ATS at Leuchars in the ways described below.

WTGs located within PSR coverage can reduce the ability of the radar to detect aircraft. The WTGs present themselves as a large number of reflecting moving targets to the radar (Figure 2), which look very similar to aircraft radar returns. WTGs detected by radar create the following effects:

- False returns causing false target generation;
- Loss of receiver sensitivity;
- Plot extractor/filter memory overload;
- Presenting an obstruction (shadow); and
- Receiver saturation.

Each of these individual effects reduces the overall effectiveness of the radar in detecting targets, which can result in the misidentification of aircraft, loss of track position, and loss of track identity as aircraft symbols and track history may be obscured. These in turn can affect the accuracy and timeliness of controller instructions and potentially cause serious safety and operational issues to ATC and the flying community operating within the area of WTG induced radar clutter.

The Chief of the Air Staff intends to maintain Leuchars as a radar equipped IFR Diversion aerodrome, available 24 hours a day, seven days a week in order to provide a suitable diversion aerodrome for QRA sorties from RAF Lossiemouth and RAF Coningsby, as well as other aircraft completing sorties from other RAF or NATO bases.

If mitigation is not introduced, Leuchars controllers would be required to 'reduce' the ATC radar services that it provides to aviation operating within the vicinity of the Development Areas to an unacceptable level. Controllers would be required to vector aircraft around the clutter and this would inevitably lead to greater track distances flown and an increase in both pilot and controller workloads. Established IFPs detailed in 8A4, which are located close to the locations of NNG and IC, for aircraft operating in and out of the aerodrome, are likely to require alteration or may even be prohibited, if the clutter created by the WTGs remains unmitigated. This would lead to greater noise exposure to communities, greater fuel burn and an increase in NO_2 and CO_2 emissions through extended routing around the WTG clutter.

4.3 Option 1 – Temporary WTG Suspension of Operations

Clutter on the Leuchars PSR would only be apparent once the WTGs become operational. The technical and commercial complexities associated with this option are listed below:

- Frequency and duration of switch offs. WTGs are turned off for maintenance however, any increase in the activation and deactivation of the WTGs would lead to excessive wear and tear;
- As any instruction to turn off the WTGs is not likely to be immediate, there is uncertainty over the time it would take for the WTGs to stop turning; and
- The MOD would effectively require the rights to turn off the WTGs at any point in time for any duration.

Consideration was given to providing the ability to close down the WTGs via a telephone call to the NNG or IC operations rooms. However, due to the unpredictable nature of operations within uncontrolled airspace, in which the WTGs are located, this option is unviable, as it would be unable to be sufficiently robust for the dynamic ATC operational environment. Control of the WTGs would remain with the respective developer, and the time taken in initiating the request and the cessation of WTG operations would introduce delay and increased workload at a time when speed is of the essence to ATC.

This option is also not practical from a technical point of view. Electrical generators have a ramp down rate: this is the limit at which the machine can safely reduce its power output to zero, without causing significant aging and/or damage to the equipment. The electrical machines and mechanical equipment need to brake and reduce speed in a controlled manner and emergency stop procedures should only be implemented in emergency conditions.

This option would not be acceptable to NNGOWL or ICOL; furthermore, in the fast moving, dynamic world of ATC operations, Option 1 would be operationally unmanageable, and

unacceptable to the MOD. Consequently, Option 1 is rejected as it provides insufficient mitigation for the effects on the Leuchars PSR.

4.4 Option 2 – SSR Alone Operations

SSR is a co-operative surveillance technique that relies on the aircraft being equipped with a transponder. The target aircraft's transponder responds to interrogation by the ground station by transmitting a coded reply signal.

It should be noted that the circumstances when SSR may be used alone in the provision of ATS are limited. The International Civil Aviation Organization (ICAO) Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM) states at Section 8, paragraph 8.1.9:

8.1.9 SSR systems, especially those utilizing monopulse technique or having Mode S capability, may be used alone, including in the provision of separation between aircraft, provided:

> *a) the carriage of SSR transponders is mandatory within the area; and*
>
> *b) identification is established and maintained.*

For the UK, the requirement is articulated within CAP 493 *Manual of Air Traffic Services (MATS) Part 1* [Reference 7], Chapter 3, as follows:

10B Use of SSR alone

10B1 Provided the pilots are made aware of the limitations of the service, SSR may be used to provide horizontal separation in the following circumstances:

> *1. In accordance with MATS Part 2;*
>
> *2. To overcome temporary deficiencies within PSR cover, such as fading or clutter, the SSR return only of one aircraft may be used to provide separation from the PSR or SSR return of another aircraft provided the PSR and SSR situation displays are correctly aligned. In this context 'unavailable for use due to maintenance' does not constitute a 'temporary deficiency'; and*
>
> *3. Immediately after PSR failure for the minimum time necessary to establish procedural separation. Once established, services normally provided using radar may be resumed when the PSR is serviceable.*

10B.2 SSR shall not be used to provide horizontal separation if a controller has any doubt about the accuracy of the position symbol due to equipment malfunction, reflections or any other reason.

The MOD and MAA provide Regulatory Articles (RA) to provide a framework of policy, rules, directives, standards, processes and the associated direction, advice and guidance, which governs military aviation activity and against which air safety is assessed. RA 3241 [Reference 8] covers contingency arrangements for the continued provision of ATS utilising SSR alone. Implementation of Leuchars ATS incorporating the NNG/IC TMZ will be acceptably safe and will

continue to be so within context of current operations. Military ATC terminal[21] radar controllers may provide an ATS using SSR alone providing its use is defined in unit orders. However, military controllers are encouraged (in accordance with local orders) to hand-over control of aircraft to adjacent units within overlapping radar coverage (subject to the adjacent unit's radar serviceability) at the earliest opportunity, when other mitigation methods are not available. This is impracticable within the vicinity of the Development Areas as there is limited overlapping radar cover with adjacent LARS units, (the nearest being RAF Lossiemouth, 81 NM to the north of Leuchars).

In areas of airspace that are not significant to the normal operations at an aerodrome, controllers in some cases are able to tolerate clutter presented onto radar screens. Since it is not possible to deselect PSR for specific areas and the airspace above the Development Areas is of operational significance to Leuchars, by deselecting the PSR would mean that the entire area of operations for the Leuchars controller would be without PSR data displayed. This means that it will not only be impossible to detect any aircraft entering the airspace above the Development Areas, but any aircraft operating within 40 NM of Leuchars without a transponder fitted and/or without the transponder activated would be undetectable. This would lead to an unacceptable loss of situational awareness for the controller and potentially an increased risk of mid-air collision.

The option of utilising SSR alone operations without a TMZ has been rejected. Non-transponding aircraft would remain undetectable within the Development Areas and potentially the entire area of Leuchars operations if the primary radar was deselected, resulting in an unacceptable loss of situational awareness.

4.5 Option 3 - Radio Mandatory Zone (RMZ)

An RMZ is an area of defined dimensions within which a pilot must be in two-way communication with the airspace owner, prior to entry. Pilots must also provide information pertinent to the flight, for example, route required and altitude/height. An RMZ created in the airspace above the WTGs would provide a degree of situational awareness to the controller about the nature of the aviation within the airspace.

Although ATC would be able to provide some level of service to aviation operating within the Development Areas, it would not prevent the generation and display of false tracks with the associated loss of situational awareness. An RMZ might also reduce the effectiveness of Airborne Collision Avoidance Systems (ACAS) in the zone, since there is no requirement for aircraft entering the area of clutter to be fitted with an SSR transponder. ACAS systems rely on the cooperative nature of SSR transponders to resolve potential collisions vertically. This operational mitigation does not go far enough to reduce the risk of collision, as it increases controller situational awareness but does not allow controllers to determine the position of all aircraftt; ATC would not see all aircraft within the clutter and would not be able to provide the

[21] Terminal Radar refers to radars situated at airfields.

prescribed separation between aircraft. For these reasons, Option 3 is rejected as it provides insufficient mitigation.

4.6 Option 4 - Transponder Mandatory Zone (TMZ)

4.6.1 Option 4a - TMZ with associated RAG (PSR blanking) and no lateral geographic buffer zone

A TMZ without blanking of the Leuchars PSR with RAG was not considered a viable option for mitigation. Without the use of RAG, primary radar clutter could negatively affect the degree, accuracy and timeliness of the instructions, advice and information a controller is able to provide to pilots within the TMZ, with consequent impacts on safety and expedition. There could be an increase in controller workload and the clutter could also result in poor radar performance as a result of processing saturation and desensitisation or shadowing, resulting in loss of radar detection of aircraft within the vicinity of the TMZ. For these reasons, the TMZ only option is rejected as providing insufficient mitigation.

Within this proposed solution, the establishment of the TMZ is one element of a two-part Mitigation Package aimed at negating the impact of the clutter from the NNG and IC WTGs upon the Leuchars PSR. The two parts are:

- Element 1: Establishment of a TMZ; and
- Element 2: RAG with associated suppression of PSR returns within the RAG.

A RAG involves blanking the clutter (WTGs) from showing on radar displays. It blanks all returns in the area of the source of clutter (WTGs) itself and removes it from the controllers display. This means that, within the area of the RAG, the radar will not detect any primary contacts (from WTGs or aircraft) and therefore they will not appear on the controllers radar display screen. However, since aircraft entering the TMZ area must be equipped with an operational transponder, the controller will be able to track the aircraft using its SSR transponder.

This proposed solution provides Leuchars ATC with the capability of assured positional identification and provides Commercial Air Transport (CAT) operators with collision avoidance mitigation through the cooperative use of ACAS. It will also maintain current levels of safety for the provision of radar services provided using SSR data-only within the vicinity of the Development Areas in accordance with ICAO PANS-ATM '*the carriage of SSR transponders is mandatory within the area*'. Aircraft flying through the TMZ will be required to be equipped with and operate SSR transponder equipment or to have established two-way radio communications with Leuchars ATC, the TMZ Controlling Authority. As stated in Section 4.4, military ATCOs may provide an ATS using SSR alone providing its use is defined in unit orders. SSR alone service can be provided to aircraft participating in LARS where no overlapping radar coverage is provided by adjacent LARS units, however once the aircraft is within overlapping radar coverage of an adjacent LARS unit, the aircraft should be handed over [Reference 8].

The airspace classification of a TMZ would remain unchanged. Hence, the ATS available within and around the TMZ would continue to be applied according to CAP 774 *The UK Flight Information Services* [Reference 9] through the assured provision of SSR data to the controller.

The TMZ proposed under Option 4a purely covers for the geographical layout of the Development Areas and does not consider the establishment of a buffer zone. As outlined below (section 4.6.2), this could have detrimental effects on ATS provision and its safety. Setting up a TMZ without an additional buffer zone around the RAG would prevent the controller from maintaining primary radar track identity as the aircraft enters / leaves the TMZ. Option 4a (TMZ without a Buffer Zone) has therefore been rejected as it provides insufficient mitigation.

4.6.2 Option 4b - TMZ with associated RAG (PSR blanking) and lateral geographic buffer zone

This option is identical to Option 4a above with the exception that in this case, the TMZ is increased slightly to cater for the addition of a buffer zone around the Development Areas. This allows the PSR to re-establish a target / plot once an aircraft has exited the RAG (blanked) area (particularly to the west of the RAG as aircraft approach Leuchars).

The Leuchars Watchman radar displays unprocessed video and on turning the radar on (usually the radar is operated H24, although in quiet periods during the evening, displays may be de-selected) it takes a few sweeps for the returns on the display to stabilise; essentially all returns are displayed in real time. The worst case would be a target appearing just after the antenna has passed, this target would not be picked up until the antenna illuminated it on its next pass which would be around 4 seconds (at 15 rpm), plus a small amount for the time it takes for the signal to pass through the circuitry. The TMZ around the London Array Offshore Wind Farm, administered by Southend ATC, has an internal buffer of two NM to cater for this type of occurrence.

Until a permanent technical solution to the PSR is identified and implemented, the MOD has agreed to support the establishment of a TMZ with Option 4b, to establish a TMZ with RAG and a two NM buffer zone around the Development Areas. The lateral TMZ boundary would extend two NM around the edge of the Development Areas to allow for any shadow affect and 'building' of processed radar track as aircraft leave or operate in the vicinity of the RAG. Section 5.3.1 below provides further details the TMZ horizontal buffer zone.

4.7 Conclusion

Each of the aforementioned options has been considered in depth. The mitigation option that provides the best solution for the effects of WTG generated clutter on the Leuchars PSR display is Option 4b, to establish a TMZ with an associated buffer, together with associated RAG, (blanking of PSR returns within the RAG). This mitigation option will also satisfy the Section 36 consent conditions imposed by the Scottish Government to mitigate the effects created by the development on the Leuchars PSR. The development of this mitigation option for the configuration of a TMZ is provided in Section 5.

5 Development of the Proposed TMZ

The overall aim of the NNG and IC Airspace Change Proposal is to maintain the current safe operation for all users, and mitigate the impacts of the NNG and IC WTGs on Leuchars flying and radar based ATS operations.

5.1 Overview

The CAA, in CAP 725 [Reference 1], lays down extensive regulatory requirements to be applied to the design of the airspace arrangements. However, most of these requirements, such as IFP containment, are relevant to the development of CAS, which is not the case with this TMZ proposal as the proposed TMZ lies within Class G uncontrolled airspace. The significant regulatory requirements applicable to this proposal are that the:

- Dimensions of the proposed airspace should be the minimum practicable to meet the safety and operational requirements; and
- Configuration of the airspace should be as simple as practicable.

Thus, the primary matters for consideration in the development of the proposed TMZ are the lateral and vertical dimensions, including alignment with any other, pre-existing, airspace boundaries and the impact on:

- Those aircraft wishing to use the airspace which are not and/or cannot be equipped with a transponder; and
- The operational impact on adjacent Air Traffic Service Units (ATSU) who may be radar equipped, but not be SSR equipped.

The second point can be discounted immediately since there are no adjacent radar equipped ATC units without SSR facilities. A potential drawback of establishing a TMZ is that non-transponding aircraft may choose to take an alternative route in order to 'bypass' the TMZ, resulting in a change in traffic patterns and ATC workload in this area. This would only reasonably occur when aircraft have been unable to establish two-way radio communications with Leuchars ATC, the TMZ Controlling Authority, who are available H24 as Leuchars could, subject to traffic, allow a non-SSR equipped aircraft to transit the TMZ. A survey of the airspace above the Development Areas was conducted over a weeklong period in March 2015 utilising the Leuchars PSR during good weather conditions. During the survey, no non-transponding aircraft were seen to transit the area of the proposed TMZ. Feedback from the ATC control staff at Leuchars indicated that since the location of the Development Areas is over six NM offshore, the incidence of non-transponding aircraft operating over the area is extremely rare. The survey will be repeated in June 2015.

5.2 Aim

The overall aim of the NNG and IC Airspace Change Proposal is to maintain airspace safety for all users, and mitigate the impacts of the NNG and IC WTGs on Leuchars flying and radar based ATS operations. It is envisaged that this will be achieved through the establishment of a TMZ with a combination of RAG (Leuchars PSR blanking).

The secondary objective of the mitigation solution is to minimise any known airspace impacts by allowing continuity of a full suite of ATSOCAS provision within the vicinity of the Development Areas. Consequently, the proposed TMZ designs are intended to be sympathetic to the existing airspace structure, traffic patterns and ATC operational norms in the area of the proposed TMZ.

5.3 TMZ Boundary Requirements and Operation

5.3.1 TMZ Horizontal Buffer Zone

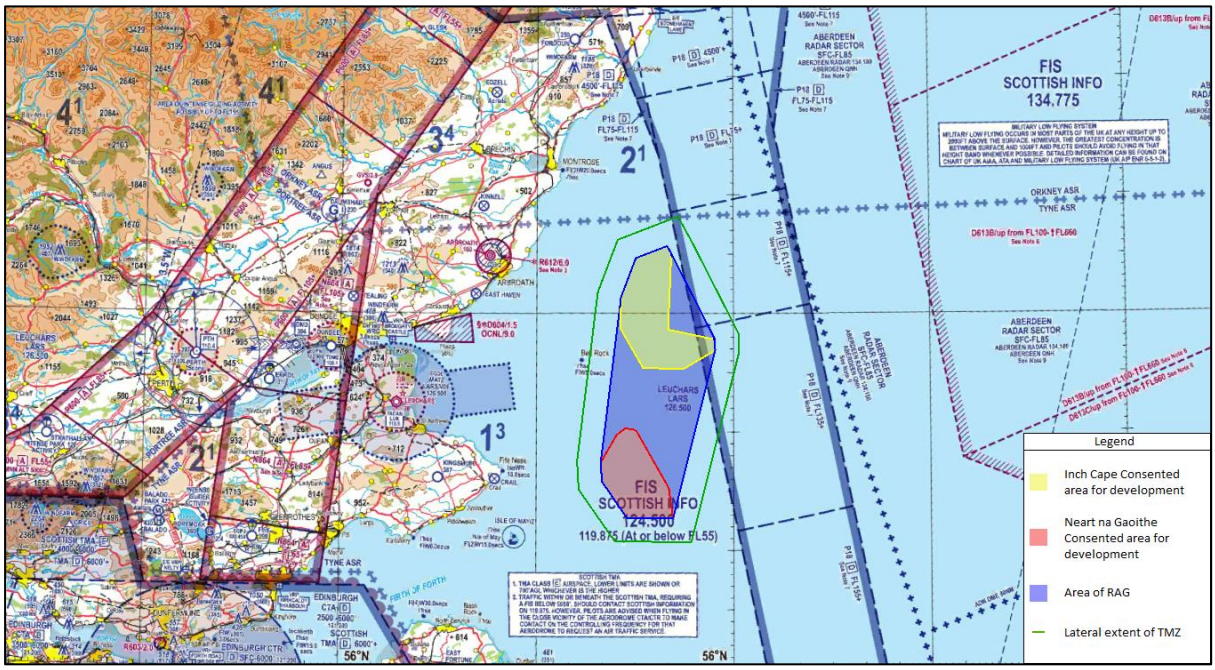
Removing the WTG clutter with Leuchars radar blanking (RAG) would have the consequent removal of all PSR returns within the Development Areas. The developers will define the precise layout of the WTG array. A decision on a final layout will occur post TMZ application. It is therefore likely that the blanked area of the Leuchars PSR will reduce to cover the WTG array. The objective of establishing the TMZ is not to prevent aircraft from operating near the WTGs, merely to require that they operate a transponder when so doing. Notwithstanding this, there is always potential for a non-transponder equipped aircraft to enter the TMZ inadvertently, thereby becoming invisible to the radar controller. This would pose a potential threat to other flights under the jurisdiction of the controller; a non-transponding aircraft entering the TMZ would simply disappear from the controller's display if the TMZ were to be restricted to the limits of the WTG array or the control of entry to the TMZ by non-transponding aircraft is not controlled. Once a non-transponding aircraft has entered the TMZ, assurance in providing separation from other aircraft operating within it is lost.

In order to assure safe and expeditious ATS provision, an additional lateral buffer for ATS purposes is necessary, particularly to mitigate the potential navigation error that might occur whenever pilots of non-transponding aircraft fly close to the 'blanked' area. Whilst the chance of non-transponding aircraft operating within the vicinity of the proposed TMZ is extremely remote, this means that controllers would detect a non-transponding aircraft tracking towards the lateral limits of the TMZ before it enters, and would be able to provide pertinent information to aircraft operating within the airspace. Thus, it is concluded that an additional volume of airspace should be added to the Development Areas to assure safe and expeditious ATS provision at all times.

Figures 7 and 8 below illustrate the lateral extent of the proposed TMZ in green for Option A and B.

Figure 7 Option A: NNG and IC Proposed TMZ including 2 NM Buffer Zone (lined in green).

Figure 8 Option B: NNG and IC Proposed combined TMZ including 2 NM Buffer Zone (lined in green).



5.3.2 Vertical Extent of the TMZ

It is proposed that the TMZ should extend from sea level up to FL 100 above the Development Areas, since transponder carriage within airspace above FL 100 is already mandated (with some exceptions).

5.3.3 TMZ Co-ordinates

The co-ordinates for the concept designs of the TMZ (with a two NM internal buffer zone) and its proximity to military and civilian aerodromes measured from the airfield reference points are provided at Annex A5.

5.3.4 Hours of Operation of the TMZ

Under normal UK Integrated Aeronautical Information Package (IAIP) [Reference 10] arrangements, the operating hours of a particular airspace segment established for ATS purposes are linked to the operating hours of the associated ATS Unit. Hence, it is proposed that Leuchars ATC are the TMZ Control Authority with the TMZ operating hours replicating the Leuchars ATC operating hours which are 24 hours to provide for military diversion aerodrome purposes and the provision of Lower Airspace Radar Service (LARS). The information would be published within the UK IAIP and other applicable aviation documentation, noting the LARS frequency and timings, as well as the boundary of the TMZ.

5.4 Impact of the TMZ on Military Operations

The majority of UK and European-based military aircraft carry and operate SSR transponders; in most cases, these are compatible with Mode S systems. The only UK military types that are not transponder equipped are gliders. It is considered that military gliders are highly unlikely to operate as far offshore as the Development Areas and so would be unaffected by the TMZ requirements. The nearest military gliding establishment is at Arbroath Airfield (RM Condor); informal consultation with the operators of the airfield concluded in no objection to the proposal, as they are unlikely to operate so far offshore in the location of the proposed TMZ.

5.5 Impact of the TMZ on Other ATSUs

The effect of the TMZ on other ATSUs depends entirely upon whether the rotating blades of the WTGs are detectable to the radar within the ATSU area of responsibilities. In addition, it will also depend to some extent as to whether aircraft under its ATS provision are transponder equipped.

5.5.1 Dundee Airport

Dundee Airport lies on the shore of the Firth of Tay and is located 3 km from the centre of Dundee. The airport does not operate a PSR, with Leuchars providing radar services to aircraft if requested. There is a twice-daily flight to London Stansted Airport and terminal facilities are available. Tayside Aviation Limited is a flight training and aircraft servicing company based at the airport and is the largest aircraft-training organisation in Scotland. The airport is open

seven days per week with the capability to continue flight operations into the hours of darkness. Fuel and aircraft servicing is available together with limited hangar space and repair facilities for visiting aircraft. In periods of bad weather, navigation facilities and an ILS is available to one of the runways.

Dundee Airport does not possess primary radar facilities and none of its IFPs is located within the vicinity of the Development Areas. The operators of the airport have confirmed during informal consultation that there would be no objection to the proposal to introduce the TMZ, as their operation would be unaffected.

5.5.2 Perth Airport

Perth Airport is a general aviation airport located 5.6 km northeast of Perth, Scotland. The airport is used by business and private aircraft and for pilot training. Perth Airport has a CAA Ordinary Licence (Number P823) that allows flights for the public transport of passengers or for flying instruction as authorised by the licensee although there are no commercial scheduled flights from the airport; the airport does not have a PSR. It is Scotland's main airport for general aviation and is the base of the Scottish Aero Club. The airport is also home to numerous flight training organisations providing private and commercial fixed and rotary winged flight training, as well as microlight and autogyro training.

Perth Airport has three runways and conducts VFR operations without radar support. There are no IFPs associated with the airport and no expected impact to operations conducted at the airport, created by the TMZ. The operators of the airport have confirmed during informal consultation that there would be no objection to the proposal to the introduction of the TMZ, as their operation would be unaffected.

5.5.3 Aberdeen Airport

Aberdeen Airport is an international airport located 9.3 km northwest of the City of Aberdeen; NATS provides ATC facilities under contract. The airport also serves as the main heliport for the Scottish offshore oil industry with Bristow Helicopters, CHC-Scotia and Bond Offshore Helicopters operating from the airport. General aviation flight training takes place and the Scottish Air Ambulance operates fixed wing aircraft from the airport.

IFPs for the airport, together with details of the offshore helicopter routes, are published within the UK IAIP. The Development Areas are at considerable range from the airport and the published IFPs. Furthermore, there are no oil and gas offshore platforms located within the vicinity of the Development Areas and none of the published helicopter routes will be affected by the construction and operation of NNG and IC. Informal consultation with NATS Aberdeen and the three helicopter operators concluded that there would be no adverse operational effects created by the introduction of the proposed TMZ.

5.5.4 Edinburgh Airport

Edinburgh Airport, located in the City of Edinburgh was the busiest Scottish Airport in 2014. NATS supply air traffic services under contract. The airport is operated H24 and has the ability to accept both visual and instrument traffic. Edinburgh Airport uses their PSR to support their provision of navigational services to aircraft operating to/from the airport and to aircraft requesting a service within proximity to their established controlled airspace. The closest development (NNG) is located approximately 39 NM to the northeast of the airport, outside of Edinburgh CAS and therefore no impact will be created by either development to ATC operations at Edinburgh Airport. NATS Edinburgh Airport have confirmed during informal consultation that no impact to their operations is expected by the introduction of the proposed TMZ.

5.5.5 NATS Scottish Area Control Centre (ACC)

The Scottish ACC provides an en-route ATS to aircraft over Scotland, Northern Ireland, Northern England and the North Sea, operated by NATS. In the area of the proposed TMZ, civil controllers control aircraft on airway P18 and provide an ATS to transit service to traffic operating above FL 195. Military controllers who are located in the London ACC also provide an ATS to aircraft outside of controlled airspace in the region of the proposed TMZ and to military aircraft operating in the area using the same radars as their civil counterparts.

During both pre and post application phase for both NNG and IC, NATS were consulted on the potential impact of the Development Areas on their operations. NATS examined both the NNG and IC applications from a technical and a safeguarding aspect, and had no objection to the proposed developments. Informal consultation on the proposed TMZ was requested with the Scottish ACC; however, they declined a meeting to discuss the proposal. NATS radars will not detect WTGs within either of the Development Areas and therefore the introduction of the TMZ is unlikely to affect NATS ACC operations within the Development Areas.

5.5.6 Arbroath Aerodrome

Arbroath Aerodrome also known as RM Condor is home to No 662 Volunteer Gliding Squadron who use conventional gliders for glider training, from familiarisation flights to solo validation, to members of the Air Training Corps and the Combined Cadet Force. The operators of the aerodrome have confirmed that operations at the aerodrome will be unaffected by the introduction of the TMZ.

5.5.7 Fife Aerodrome

Fife Aerodrome is an unlicensed aerodrome located two NM west of Glenrothes, Fife, Scotland. The airfield is used by Tayside Aviation to train pilots; an air ground communications service is provided during airfield opening hours. Parachuting also takes place regularly at the aerodrome, especially at the weekend. The aerodrome does not possess a PSR, there has been no response to a request for informal consultation; however, operations at the aerodrome are likely to be unaffected by the introduction of the TMZ.

5.5.8 Kingsmuir (Sorbie) Aerodrome

Kingsmuir Aerodrome is unlicensed and possesses a grass runway of approximately 580 metres in length. The aerodrome is a base to fixed wing, flex-wing and rotary general aviation aircraft. Operations at the aerodrome are likely to be unaffected by the introduction of the TMZ. A request for informal consultation was made to the aerodrome however, no reply was received.

5.5.9 East Fortune Aerodrome

East Fortune Aerodrome is home to the National Museum of Flight Scotland. The East of Scotland Microlight Club has been operating from the aerodrome since 1990 and it offers air experience flight and instruction. Operations at the aerodrome are likely to be unaffected by the introduction of the TMZ. A request for informal consultation was made to the aerodrome however, no reply was received.

5.5.10 Archerfield Airstrip

Archerfield Airstrip is a small private grass strip located on close to Archerfield Links Golf Club. It is not known if any aircraft are located at the airstrip, however, during the summer of 2014 it hosted general aviation aircraft positioning for the Scottish Air Show held at East Fortune. Informal consultation with the aerodrome informed that operations at the airstrip are likely to be unaffected by the introduction of the TMZ.

5.6 Impact of the TMZ on Light GA Operations

In theory, the implementation of a TMZ may require extra equipment to be purchased and installed into any aircraft not currently equipped with a transponder. This TMZ is proposed within an area that is not currently routinely utilised by light aircraft: additionally, the likelihood of civilian traffic, operating without either transponder or radio, adjacent to the Development Areas is likely to be extremely low. However, the possibility exists that civilian aircraft may wish to operate within the area and therefore there is a requirement to mitigate for the potential effects as mentioned previously.

All aircraft operating on Public Transport flights within UK airspace are required to be equipped with, as a minimum, Mode S Elementary transponders. It can be assumed that the majority of General Aviation (GA) aircraft over 5700 kg Maximum Total Weight Authorised (MTWA) are likely to be transponder equipped on the basis that such aircraft types which can be used for public transport operations are likely to operate from time to time within Classes A, C or D CAS. Thus, the predominance of non-transponder equipped aircraft affected by the proposed TMZ is likely to be aircraft of less than 5700 kg MTWA, which are not operated on Public Transport flights.

Whilst not prohibited from operating over water, the majority of pilots of light aircraft prefer to minimise their over-water flight time by using shorter over-water routes. Notwithstanding the transponder mandate within a TMZ, provision exists within the TMZ Rules for conditional access by non-transponder equipped aircraft through prior arrangement with the appropriate

ATS Unit. Occasionally, locally based (Dundee, Fife, Perth aerodromes) light aircraft might undertake offshore "sight-seeing" flights which may include the Development Areas.

It is recognised that the majority of locally based light aircraft are, or will be, transponder equipped. Given the ability for conditional access to the TMZ airspace by non-transponder equipped aircraft it is anticipated, and, indeed, has been confirmed by most through informal consultation, that the impact of a TMZ on light GA operations, including glider, microlight and balloon operations, will be minimal.

5.7 Impact of the TMZ on Offshore Helicopter Operations

As outlined in Section 5.6 above, likely aircraft to be affected by the proposed TMZ are those with an MTWA of less than 5,700 kg, as above this weight the aircraft are likely to be used for public transport operations and will therefore be transponder equipped.

Offshore helicopter types are categorised into the following MTWA groups:

- Extra Heavy Twin >20,000 kg (e.g. Chinook);
- Heavy Twin >5,700 kg (e.g. Bell 214ST, Super Puma, EC225, S61 and S92);
- Medium Twin 2,730 to 5,700 kg (e.g. Dauphin, EC155, S75 and AW139); and
- Light Twin <2,730 kg (e.g. Bo105).

5.7.1 Bristow Helicopters

Bristow Helicopters, operating from Aberdeen Airport, supports the transportation of oil and gas industry personnel in the North Sea. The Company has been awarded the UK Search and Rescue (SAR) contract and within Scotland and will operate from bases at Inverness, Sumburgh, Stornoway and Prestwick.

Bristow Helicopters operate a fleet of Eurocopter EC155 and EC225, SNIAS/Aerospatiale AS332L Super Puma, Bell 412 and Sikorsky S-61, S-76 and S-92. They will acquire the Augusta Westland AW 189 for future use in the SAR role.

5.7.2 CHC Scotia Ltd. Helicopters

CHC Helicopters, operating from Aberdeen Airport, is one of several global providers of helicopter transportation services to the offshore oil and gas industry. CHC operates the marine Search and Rescue service for the Irish Coast Guard at Shannon, Waterford, Sligo and Dublin Airports and provides commercial Search and Rescue helicopter services for the United Kingdom Maritime and Coastguard Agency.

CHC Helicopters' fleet consists in a Sikorsky S61, Sikorsky S76, Sikorsky S92, Eurocopter AS365, Eurocopter AS332, EC155, EC225 and AW139.

5.7.3 Bond Offshore Helicopters

Bond Offshore Helicopters, operating from Aberdeen Airport, specialise in providing offshore helicopter transportation services to and from the North Sea oil and gas platforms. Bond operations include offshore wind farm and lighthouse maintenance and aerial lifting.

Bond Offshore Helicopters' fleet consists of a Eurocopter 225 and AS365 Dauphin, Eurocopter AS332 Super Puma, Augusta Westland AW139 and Sikorsky S-92.

5.8 Helicopter Main Routes (HMR)

HMRs are routes where helicopters operate on a frequent basis between Aberdeen Airport and the offshore oil and gas platforms. There are no oil and gas platforms within the area of the two developments, therefore, the incidence of helicopter movements within the Development Area are likely to be helicopters supporting the developments within the Operations and Maintenance (O&M) phase and occasional transit helicopter flights. All three of the helicopter companies have confirmed in informal consultation that there will be no expected impact on their operations by the introduction of the proposed TMZ.

6 Environmental and Economic Considerations of a TMZ

Overall, it is anticipated that the environmental impact of a TMZ encompassing the Development Areas will be neutral within the three major categories of noise, fuel burn and local air quality because of the airspace change.

6.1 Overview

This section explores how the proposed changes may have an overall effect on the environment in terms of noise pollution, fuel burn and local air quality. It further details what studies, if any, are required to analyse the environmental impact of the proposed changes.

The airspace within which the TMZ is proposed lies offshore in Class G airspace. The closest proximity of the TMZ to the coastline is greater than six NM. Notwithstanding that the proposed TMZ airspace is not CAS, and no aircraft operations are excluded from it, although unlikely, it is possible, that some GA operators might elect to route on or closer to shore to avoid the requirements of the TMZ rather than routing offshore, directly through the TMZ. As airspace activity in Class G airspace is not routinely monitored, it is not possible to accurately gauge or anticipate those flights that would elect to re-route simply because of the TMZ, even though a TMZ itself does not inhibit flight operations.

A survey of the airspace above the Development Areas was completed over a weeklong period in March 2015 utilising the Leuchars PSR, during good weather conditions. During the survey, no non-transponding aircraft were seen to transit the area of the proposed TMZ; furthermore, feedback from the ATC controlling staff at Leuchars indicated that due the location of the Development Areas being over six NM offshore, the incidence of non-transponding aircraft operating over the area is extremely rare and none were regularly seen. The amount of civilian GA traffic that will operate in the vicinity of the Development Areas is expected to be minimal with the large majority of transit GA expected to remain close (within two NM) to the coastlines. This survey on airspace usage will be repeated in June 2015.

6.2 Impact of Noise

For both design options, it is expected that the noise impact immediately after implementation is not likely to be significantly different from the pre-implementation situation. The proposed TMZ lies greater than six NM from the coastline and any additional air activity due to the location of the TMZ is unlikely.

6.3 Anticipated Level of Fuel Burn/CO_2 Emissions

It is recognised that aircraft contribute to CO_2 emissions and this has an impact on climate change. A responsible approach to airspace planning is to balance the competing demands and ensure that the most direct routes possible are used with optimal aircraft performance, as this will minimise fuel burn and emissions and therefore reduce the impact upon climate change. This airspace change proposal ensures that the present efficient routing of aircraft will be sustained.

Access to the TMZ will be available whenever and wherever practicably possible; little displacement or re-routing is anticipated for either of the design options; any re-route (although highly unlikely to be required) is likely to be insignificant. The TMZ proposal will produce a qualitative assessment of any environmental impacts and is anticipated to ensure sustainability of the efficient routing of aircraft.

6.4 Anticipated Effect on Local Air Quality

CAP 725 [Reference 1], Appendix B, Annex 8 identifies that local air quality at ground level remains largely unaffected by aircraft emissions that take place above 3,000 ft agl because dispersion reduces concentration levels for these emissions. It is understood that in the context of local air quality, the overall objective under CAP 725 is to determine whether the proposed airspace changes will exceed any statutory air quality standards, and if so, what contribution the airport operations make towards such departures.

Given that the proposed TMZ lies well offshore, Air Quality Standards are not anticipated to be breached. An atmospheric dispersion modelling assessment is unlikely to be required because of the airspace change.

6.5 Conclusions

Overall, it is anticipated that the environmental impact of a TMZ will be neutral within the three major categories of noise, fuel burn and local air quality because of the airspace change. It is not anticipated that the TMZ will reduce the environmental impact of aviation in the subject airspace; however, it is reasonable to expect that the environmental impact of aviation in the subject airspace will not worsen as a consequence of the change. Both tranquillity and visual intrusion is unlikely to be impacted and, in the worst case, the numbers of those negatively affected are not likely to increase significantly upon implementation. The establishment of the TMZ is a safety requirement to enable radar-based ATS to be sustained near the NNG and IC Development Areas. Any economic and environmental benefit is derived mainly from enabling the Wind Farms to proceed and the avoidance of protracted re-routing of military aircraft operating to and from Leuchars.

7 Next Stages

Once stakeholder consultation has been completed and any issues arising have been dealt with accordingly, NNGOWL and ICOL will submit a formal Airspace Change Proposal to the Safety and Airspace Regulation Group (SARG) of the CAA, detailing the case for the proposed TMZ.

7.1 Overview

This section summarises the consultation process and outlines the next steps to be taken following the consultation period with a view to Airspace Change Proposal submission to the CAA.

7.2 Consultation Summary

This document has presented the mitigation option proposed by NNGOWL and ICOL, in order to maintain safe operations and effectively mitigate the negative effects that the NNG and IC WTGs will have on Leuchars flying and radar based ATS provision of ATS. It is envisaged that this will be achieved through the establishment of a TMZ with associated RAG (PSR blanking over the area of the WTGs). The secondary objective of the mitigation solution is to minimise any known airspace impacts. Consequently, the proposed TMZ design is intended to be sympathetic to existing airspace structure, traffic patterns and local ATC operational norms.

NNGOWL and ICOL are consulting widely on the proposed solution in order to identify any unforeseen impacts. It is anticipated that overall environmental impacts of the proposed airspace change will be neutral within the three major categories of noise, fuel burn and local air quality. Both tranquillity and visual intrusion are also unlikely to be impacted. NNGOWL and ICOL believe that any economic and environmental benefit will be derived mainly from enabling the Wind Farms to proceed and the avoidance of protracted re-routing of military aircraft operating on established IFPs to and from Leuchars.

7.3 Consultation Results

All consultee responses will be recorded and closely monitored as they are received. Individual responses will not be acknowledged unless the consultee requests an acknowledgement. However, if any clarifications are required, consultees will be contacted for further details in order to provide an informed response. All objections to the proposal will be considered carefully and a response will be provided to the consultee. On closure of the consultation period, feedback will be provided to all consultees by means of a report that will highlight the key themes that arise and how NNGOWL and ICOL will incorporate those concerns into their plans. The Consultation Feedback Report will be published on the NNGOWL and ICOL websites at:

http://www.inchcapewind.com
http://www.neartnagaoithe.com

The records of consultation correspondence and the analysis of the results will be presented in a Consultation Report, which will be presented to the CAA as part of the overall airspace change submission.

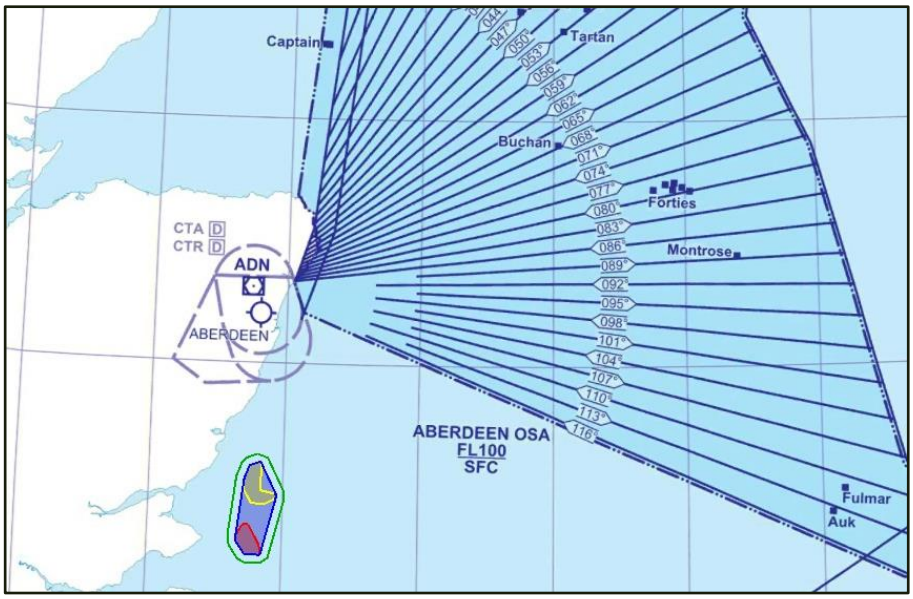
7.4 What Happens Next?

Following the completion of the stakeholder consultation, modifications may be required in light of responses. Once analysis of all responses has been completed, NNGOWL and ICOL will submit a formal Airspace Change Proposal to SARG at the CAA detailing the case for the proposed solution. It is a requirement of the consultation process that NNGOWL and ICOL will provide the CAA with full details of the consultation (including copies of responses and correspondence) together with all documentation necessary for the promulgation of the proposed TMZ.

The CAA requires a period of 16 weeks in order to conduct its own internal analysis of the final proposal and consultation results, before arriving at a Regulatory Decision. Should the CAA accept the Airspace Change Proposal without the need for further design optimisation or analysis, NNGOWL and ICOL suggest that the implementation of the TMZ should take place on a single date to coincide with the earliest operational date of the NNG and IC Wind Farms. Clutter will not be apparent on radar systems until the WTGs are operating.

NNGOWL and ICOL propose to detail the TMZ within the UK Mil AIP, in UK IAIP ENR GEN 1.5 (Aircraft Instruments, Equipment and Flight Documents) and ENR 6.1 (Helicopter Main Routes and Northern North Sea Off-Shore Safety Area (OSA), and any other applicable military documentation. Figure 9 below is an example of how the TMZ would be publicised. This would serve the purpose of formally notifying the TMZ.

Figure 9 NNG and IC Proposed TMZ (lined in green) ENR 6.1 proposed entry based on design Option B.



Reproduced from CAA digital map data © Crown copyright 2014. UK IAIP ENR.

8 References

Table 1 Table of References

Reference	Name	Origin
1	CAP 725 CAA Guidance on the Application of the Airspace Change Process Third Edition (corrected) April 2007	CAA ISBN 978 0 11790 739 3
2	MOD HQ Air Command (HQ Air) Battlespace Management Safety Management Manual (BM SMM), Edition 2.1 (AL3), 2 June 14	MOD
3	CAP 393 Air Navigation: The Order and the Regulations Fourth Edition 21 January 2015	CAA
4	DAP Policy: Transponder Mandatory Zone (TMZs) 17 April 2009	CAA
5	MAA Manual of Military Air Traffic Management First Published 17 November 2014 Last Updated 4 February 2015	MOD
6	Military Aeronautical Information Publication AIRAC Cycle 04	No1 AIDU
7	CAP 493 Manual of Air Traffic Services (MATS) Part 1 Version 5.2 6 March 2014 Superseded 16 October 2014	CAA ISBN 978 0 11792 780 3
8	Regulatory Article 3241 SSR Alone Operations February 2015	MAA
9	CAP 774 The UK Flight Information Services Version 2.3 4 February 2015	CAA

10	UK Integrated Aeronautical Information Package AIRAC 04/2015	NATS AIS

A1 Annex 1 NNG Wind Farm Line of Sight Assessment

A1.1 Overview

This Annex contains the results of the radar Line Of Sight (LOS) assessment for the NNG WTGs in respect of the PSR located at Leuchars.

The analysis was carried out using representative points, (labelled 1-11) on the NNG Development Area, as illustrated in Figure 10, and detailed in Table 2 below.

Figure 10 NNG Boundary Points around the Development Area considered for the LOS Assessment.

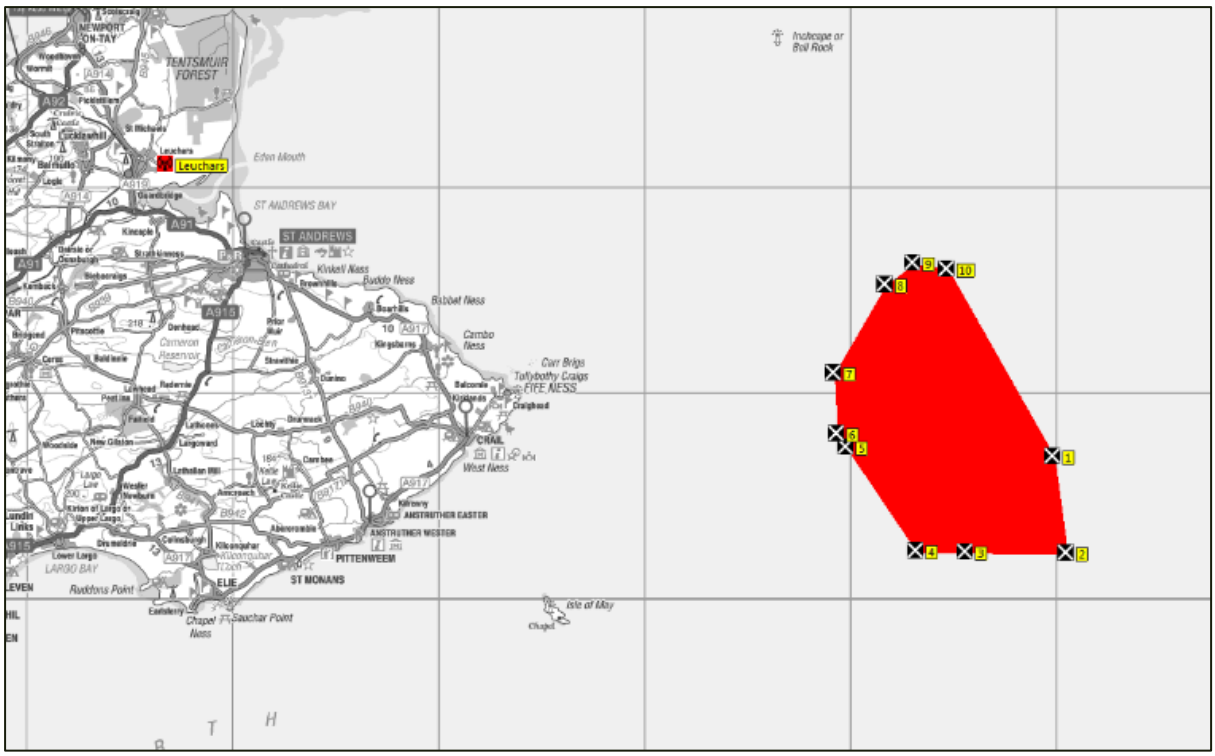


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Table 2 Summary of Development Area boundaries.

Boundary Point	**Latitude** WGS84	**Longitude** WGS84	**Blade Tip Height (m)**
1	N56.254514º	W2.164969º	197
2	N56.212024º	W2.154251º	197

Boundary Point	Latitude WGS84	Longitude WGS84	Blade Tip Height (m)
3	N56.212526º	W2.233308º	197
4	N56.212768º	W2.271549º	197
5	N56.257986º	W2.327131º	197
6	N56.263775º	W2.334248º	197
7	N56.290508º	W2.337206º	197
8	N56.329192º	W2.297092º	197
9	N56.338526º	W2.275308º	197
10	N56.336184º	W2.248497º	197

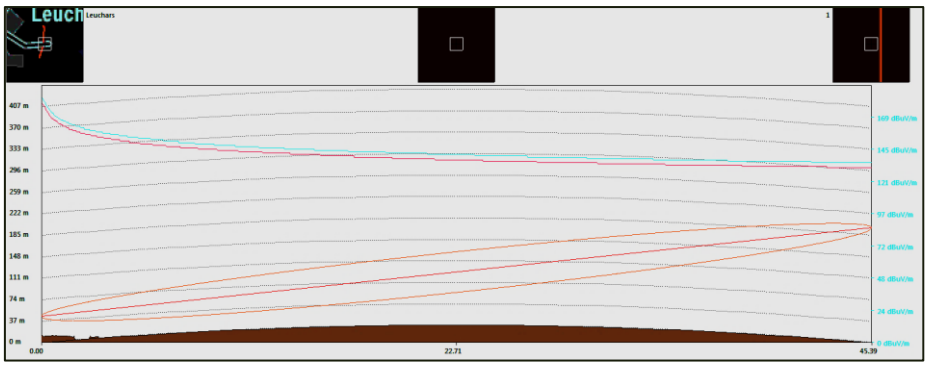
A1.2 LOS Assessment Methodology

Over the distance between a PSR and a WTG, radar signal will attenuate (lose power) and be refracted and diffracted (change direction). The likely radar performance characteristics for the assessed radar station were predicted in order to model the radar signal. The intervening terrain and signal path between the assessed radars and the boundary points of the Development Areas of NNG have been modelled using ATDI ICS LT. For LOS analysis, the terrain path has been assessed to determine whether the intervening terrain is likely to be significant enough to prevent the WTGs / boundary points being detectable by radar. The direct LOS and the 1st Fresnel zone, an elliptical zone around the direct LOS where the radio waves remain strong, were assessed. Objects that infringe upon the Fresnel zone or the direct LOS will cause the signal to diffract and attenuate. The effect of diffraction means that the direct transmitted radio waves and those in the upper 1st Fresnel zone can still reach the WTG and be returned to the radar receiver, hence why it is not always obvious that terrain shielding is sufficient.

A1.3 LOS Assessment Results

The LOS assessment has been completed based on a selection of five boundary locations spread around the Development Area. The consented tip height 197 m above sea level (ASL) has been used for the analysis. Osprey concludes that all of the NNG Development Area boundary points are highly likely to be detected by the Leuchars radar: direct line of sight exists between the radar and the WTG / boundary points. Due to the fact that the boundary points with WTGs of 197 m for the NNG Development Area share the same results, the image for Point 1 will only be shown in this section to provide an example of Osprey's findings.

Figure 11 LOS Profile between the Leuchars PSR and Point 1 at NNG.



LOS diagrams have been produced illustrating the likely detectability of the NNG Offshore Wind Farm by the assessed radar stations. Within the diagram above), the signal propagation is modelled from the radar (far most left) to the WTG blade tip (far most right). The black line in the diagram with area underneath filled in dark brown represents the terrain profile between the radar and the boundary point. The red line in the diagram represents the direct LOS between the two locations. The orange ellipse around the direct line of sight represents the 1st Fresnel zone. The light blue and magenta lines are not relevant to this assessment.

Table 3 Summary of LOS results.

Radar Station	Approx. Range to NNG Development Area Boundary	Assessment Result
Leuchars (PSR)	34 km / 18.4 NM	Yes (for all points)

A1.4 Conclusion

In conclusion, with a blade tip height of 197 m above sea level (ASL), the boundary points for the NNG Development Area are highly likely to be detected by the PSR at Leuchars due to the lack of intervening terrain that exists between the radar and the proposed development. Although every care has been taken during the line of sight modelling and analysis process, modelling limitations and assumptions obviously lead conclusions to be based on theoretical results. The results are therefore indicative, and actual radar performance may differ from this analysis.

A2 Annex 2 IC Wind Farm Line of Sight Assessment

A2.1 Overview

This Annex contains the results of the radar Line Of Sight (LOS) assessment for the IC WTGs in respect of the PSR located at Leuchars. The analysis was carried out on representative points (labelled A to N) on the IC Development Area as illustrated in Figure 12 below and presented in Table 4.

Figure 12 IC Boundary Points around the Development Area considered for the LOS Assessment.

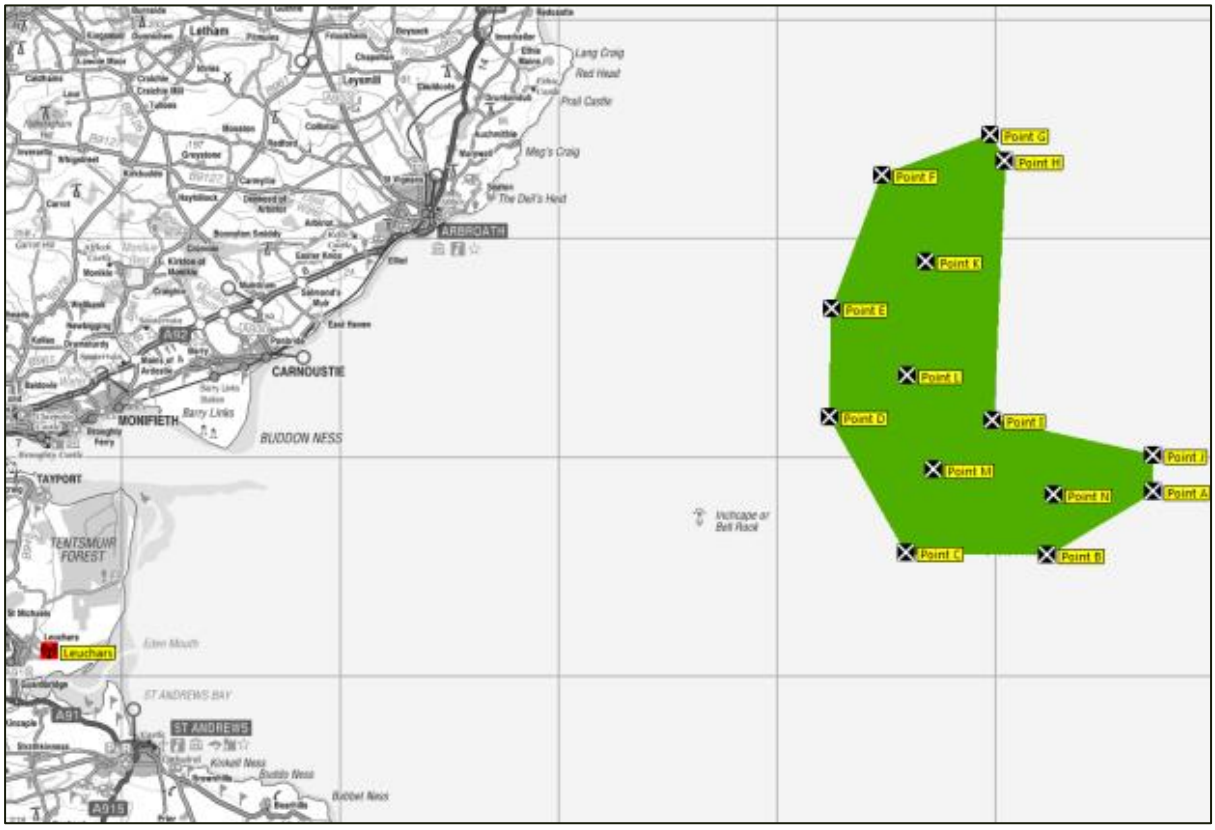


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Table 4 Summary of Development Area Boundaries.

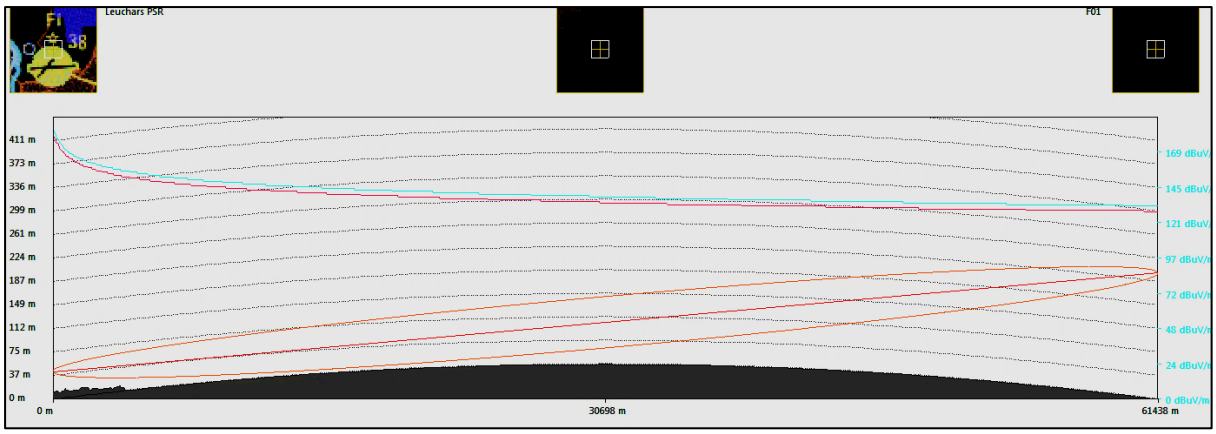
Boundary Point	Easting/Northing	Blade Tip Height (m)
Point A	397208/728451	215

Boundary Point	Easting/Northing	Blade Tip Height (m)
Point B	392328/725577	215
Point C	385902/725670	215
Point D	382411/731833	215
Point E	382484/736818	215
Point F	384813/742889	215
Point G	389723/744763	215
Point H	390371/743575	215
Point I	389830/731691	215
Point J	397183/730129	215
Point K	386775/738980	215
Point L	385940/733755	215
Point M	387142/729476	215
Point N	392637/728294	215

A2.1 LOS Assessment Results

The LOS assessment has been completed based on all boundary locations around the Development Area. The consented tip height 215 m above sea level (ASL) has been used for the analysis. Osprey concludes that all of the IC Development Area boundary points with WTGs of 215 m are highly likely to be detected by the radar: direct line of sight exists between the radar and the WTG / boundary points. Due to the fact that the boundary points for the IC Development Area share the same results, the image for Point A will only be shown in this section to provide an example of Osprey's findings.

Figure 13 LOS Profile between the Leuchars PSR and Point A at IC.



LOS diagrams have been produced illustrating the likely detectability of the IC WTGs by the assessed radar station. Within the Figure above, the signal propagation is modelled from the radar (far most left) to the WTG blade tip (far most right). The black line in the diagram with area underneath filled in dark brown represents the terrain profile between the radar and the boundary point. The red line in the diagram represents the direct LOS between the two locations. The orange ellipse around the direct line of sight represents the 1st Fresnel zone. The light blue and magenta lines are not relevant to this assessment.

Table 5 Summary of LOS Results.

Radar Station	**Approx. Range to IC Offshore Development Area Boundary**	**Assessment Result**
Leuchars (PSR)	37 km / 20.1 NM	Yes (for all points)

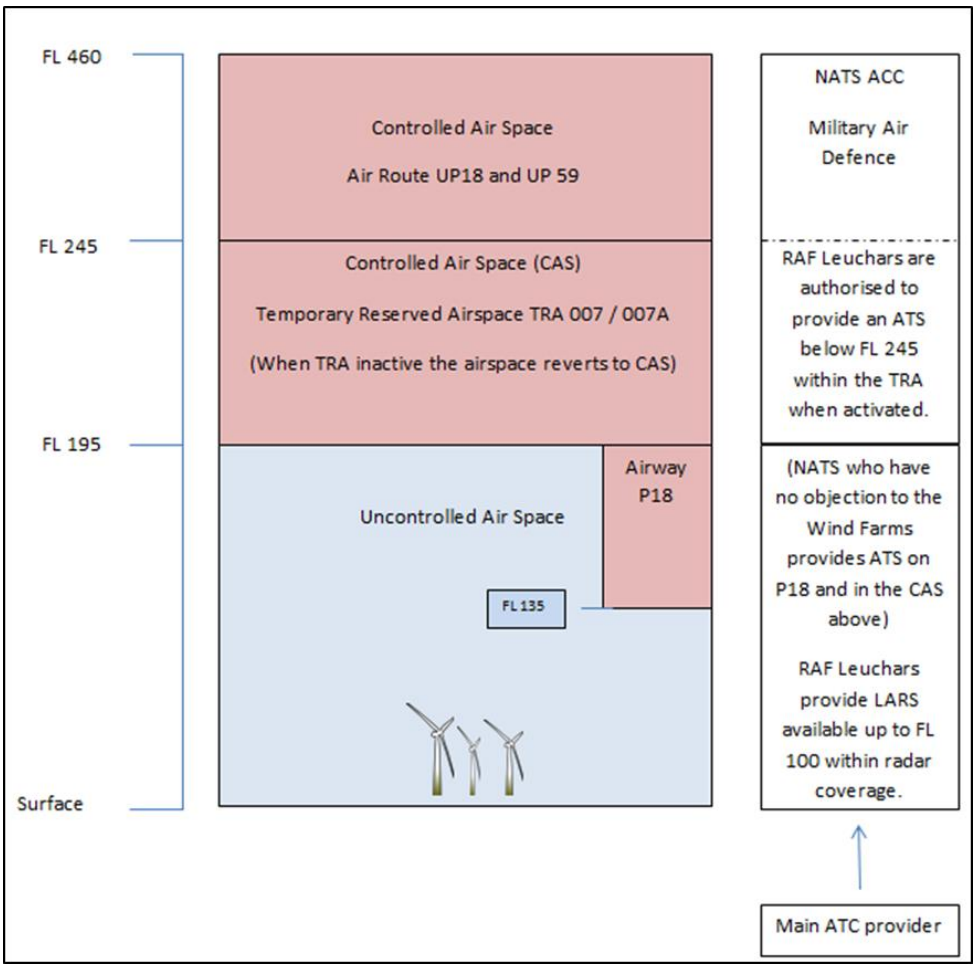
A2.2 Conclusion

In conclusion, with a blade tip height of 215 m above sea level (ASL), the boundary points for IC highly likely to be detected by the PSR at Leuchars Airfield due to the lack of intervening terrain that exists between the radar and the Development Area.

A3 Annex 3 Cross Section of Airspace above the Development Areas

Figure 11 below illustrates a cross section of the airspace above the NNG and IC Development Areas, with the main providers of ATS noted at the right hand side. Airway P18 that straddles the eastern edge of IC is included for completeness.

Figure 14 Cross Section of Airspace above the Development Areas (not to scale).



A4 Annex 4 Leuchars Instrument Flight Procedures

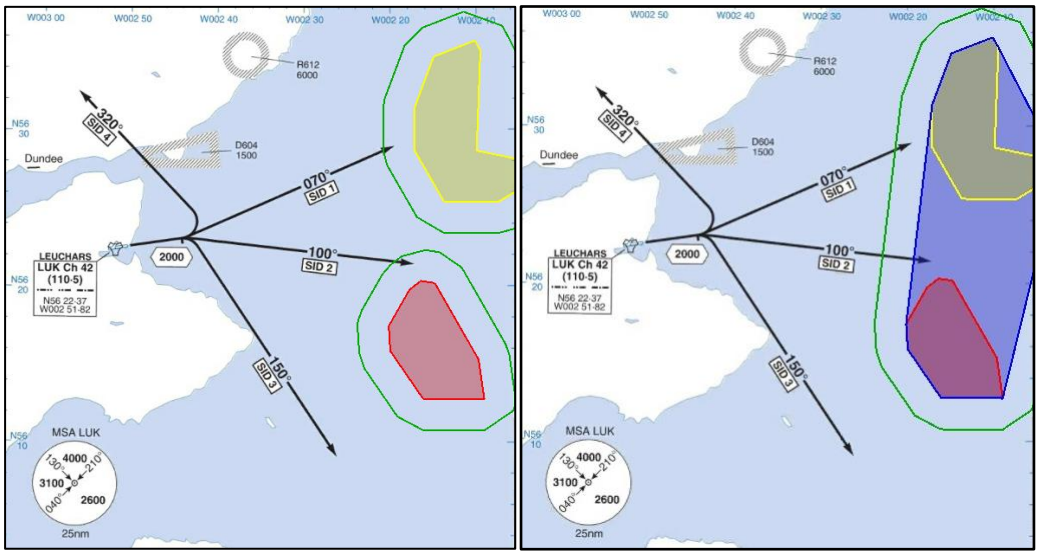
A4.1 Overview

The following figures provide a visual indication of the location of the Leuchars IFPs and design Options A and B within the Development Areas, both of which will effectively mitigate the effects created by the operational WTGs.

A4.2 Leuchars Standard Instrument Departures (SID) – Runway 08

Figure 15 Leuchars SID Runway 08.

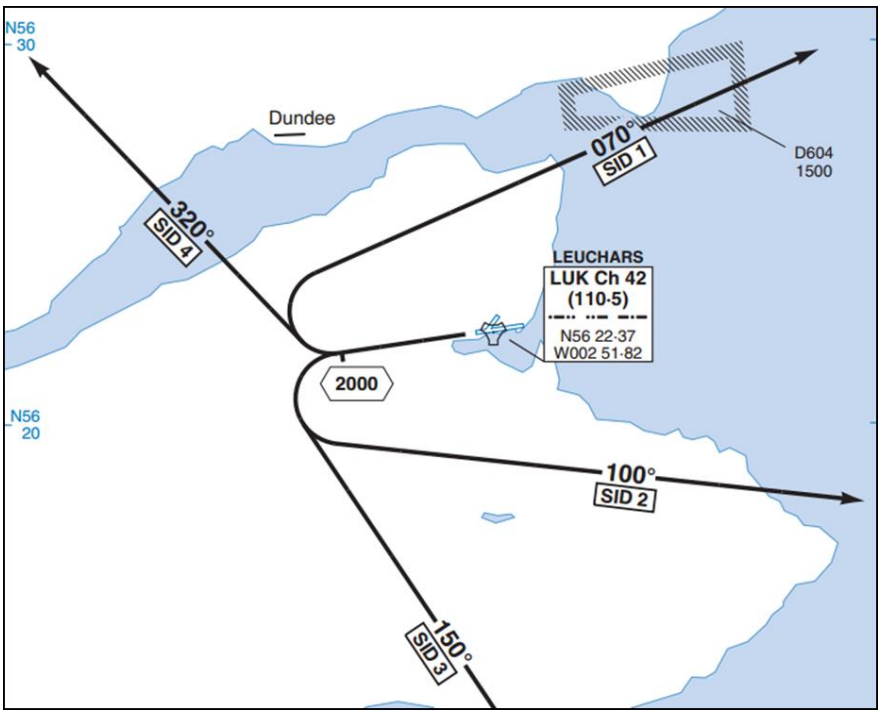
Option A Option B



A4.3 Leuchars SID - Runway 26

Both Option A and B designs are located to the east of the published route outside of the area of the figure, however, the SIDs heading east will take departing aircraft utilising the SID towards the Development Areas.

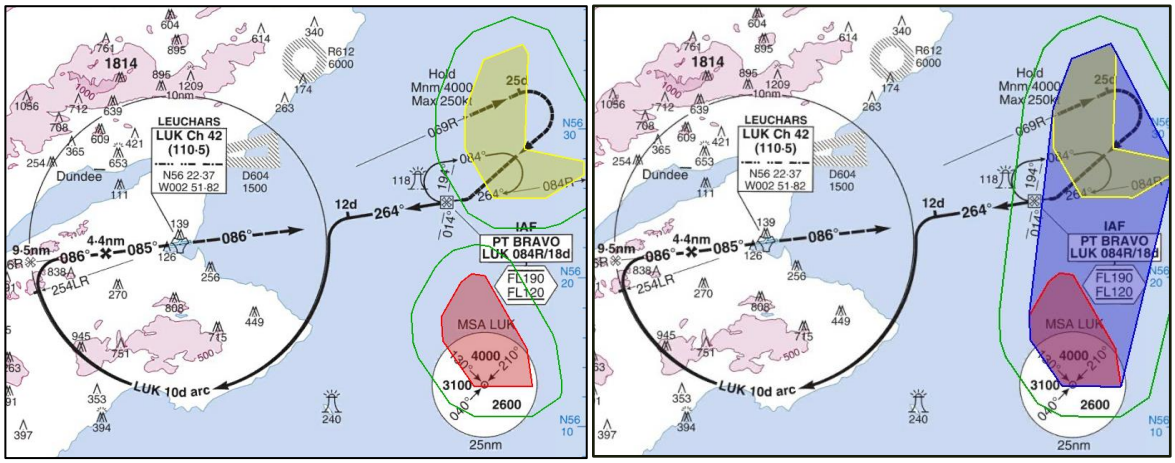
Figure 16 Leuchars SID Runway 26.



A4.4 Leuchars HI TAC to Precision Approach (PAR) – Runway 08

Figure 17 Leuchars HI TAC to PAR Runway 08.

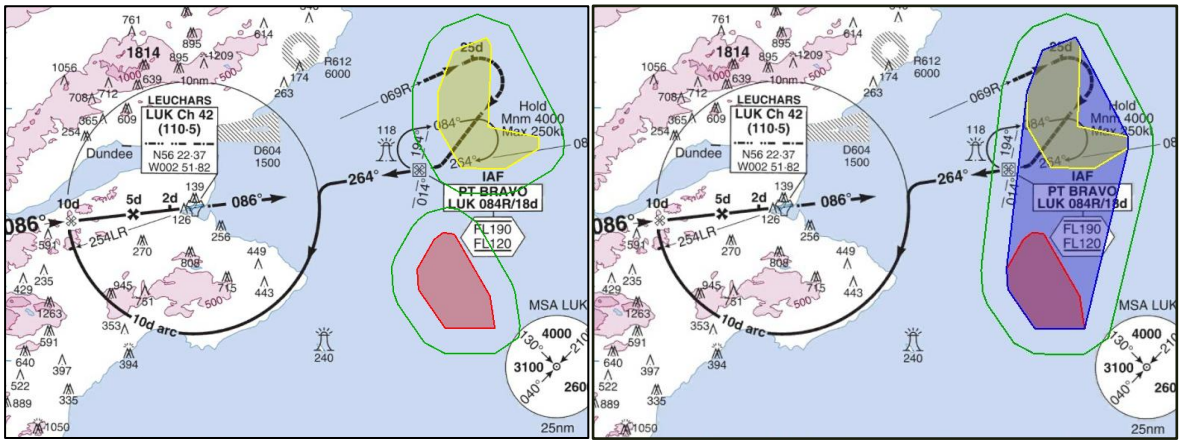
Option A Option B



A4.5 Leuchars HI TAC – Runway 08

Figure 18 Leuchars HI TAC Runway 08.

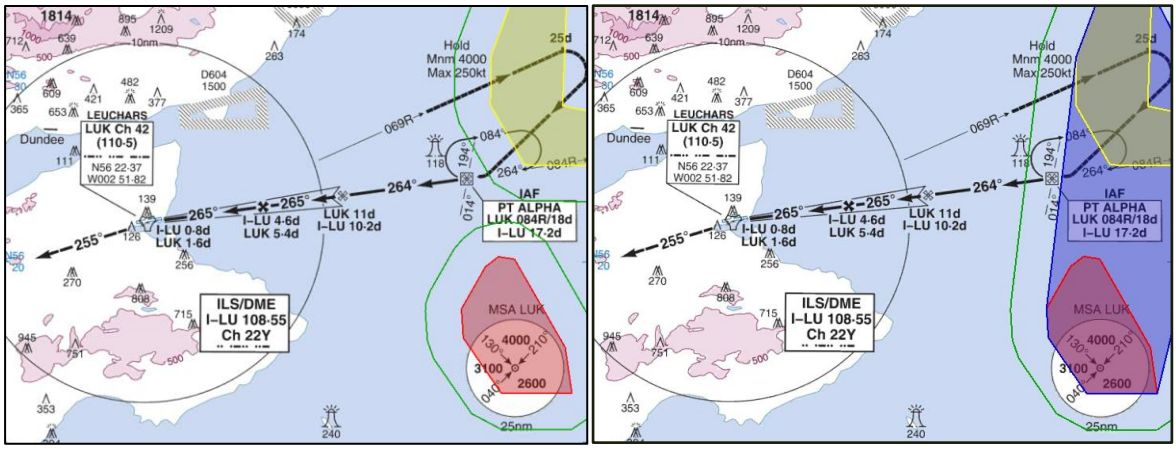
Option A Option B



A4.6 Leuchars TAC or RDR to ILS/DME - Runway 26

Figure 19 Leuchars TAC or RDR to ILS/DME Runway 26.

Option A Option B



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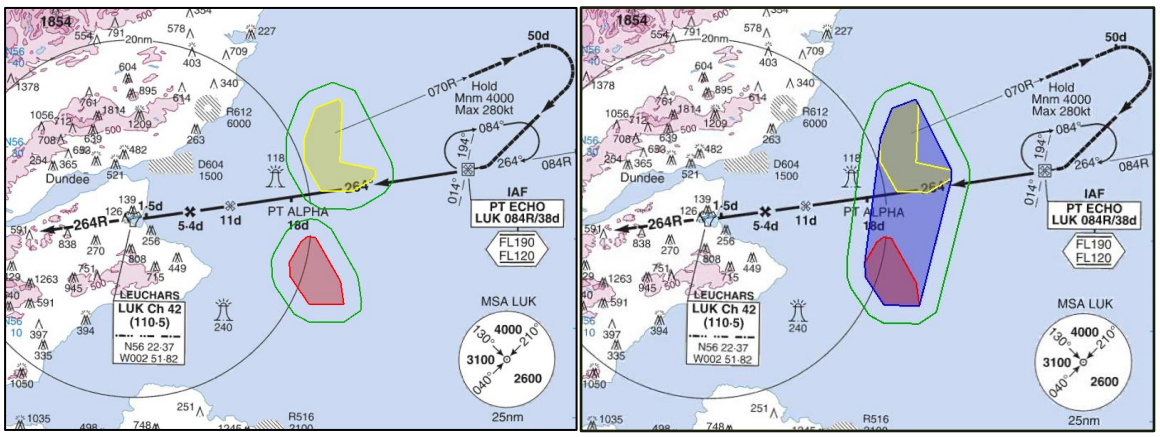
A4.7 Leuchars HI TAC - Runway 26

Figure 20 Leuchars HI TAC Runway 26.

Option A Option B



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A5 Annex 5 Proposed TMZ Co-ordinates

The co-ordinates for the two options for concept design of the TMZ (including an internal two NM buffer zone) are provided below.

Table 6 Option A TMZ Co-ordinates.

Point ID	NNG		IC	
	Latitude	Longitude	Latitude	Longitude
1	N56° 12'14.70"	W2° 5' 46.22"	N56° 31' 30.76"	W2° 20 47.05"
2	N56° 11' 58.96"	W2° 5' 55.48"	N56° 32' 0.71"	W2° 20 36.52"
3	N56° 10' 43.41"	W2° 9' 17.87"	N56° 32' 6.06"	W2° 20 33.15"
4	N56° 10' 45.21"	W2°14' 2.32"	N56° 32' 7.62"	W2° 20 32.02"
5	N56° 10' 46.08"	W2°16' 19.96"	N56° 35' 22.07"	W2° 18 18.85"
6	N56° 11' 38.24"	W2° 19 15.05"	N56° 36' 31.44"	W2° 16 13.94"
7	N56° 14'20.98"	W2° 22 35.30"	N56° 37' 32.56"	W2° 11 26.27"
8	N56° 14' 41.85"	W2°23' 0.98"	N56° 36' 38.27"	W2° 6' 57.65"
9	N56° 15' 42.17"	W2° 23 38.28"	N56° 35' 59.90"	W2° 6' 19.58"
10	N56° 17' 18.48"	W2° 23' 49.09"	N56° 35' 59.71"	W2° 6' 19.39"
11	N56° 17' 44.53"	W2° 23' 46.82"	N56° 35' 56.70"	W2° 6' 16.54"
12	N56° 18' 25.37"	W2° 23 20.80"	N56° 35' 54.76"	W2° 6' 14.74"
13	N56° 20' 44.69"	W2° 20 56.52"	N56° 28' 42.09"	W1° 59' 37.19"
14	N56° 21' 19.74"	W2° 20 1.62"	N56° 27' 49.67"	W1° 59' 13.83"
15	N56° 21' 53.36"	W2° 18 43.18"	N56° 27' 4.98"	W1° 59' 12.66"
16	N56° 22' 16.98"	W2° 15 57.50"	N56° 26' 24.53"	W1° 59' 18.40"

Point ID	NNG		IC	
	Latitude	Longitude	Latitude	Longitude
17	N56° 22’ 8.54”	W2° 14 20.90”	N56° 25’ 10.45”	W2° 0’ 58.71”
18	N56° 21’ 9.30”	W2° 11 46.97”	N56° 23’ 37.37”	W2° 5’ 43.21”
19	N56° 16’ 15.16”	W2° 6’ 46.54”	N56° 23’ 20.60”	W2° 7’ 36.22”
20	N56° 15’ 32.80”	W2° 6’ 20.80”	N56° 23’ 23.08”	W2° 13 50.92”
21	N56° 12’ 59.81”	W2° 5’ 42.45”	N56° 24’ 23.60”	W2° 16 56.26”
22	N56° 12’ 21.33”	W2° 5’ 44.06”	N56° 27’ 42.40”	W2° 20 21.65”
23	N56° 12’ 14.70”	W2° 5’ 46.22”	N56° 28’ 42.90”	W2° 20’ 50.09”
24			N56° 31’ 24.14”	W2° 20’ 47.31”
25			N56° 31’ 30.76”	W2° 20’ 47.05”

Table 7 Option B TMZ Co-ordinates.

Point ID	Latitude	Longitude
1	N56° 10’ 43.410”	W2° 9’ 17.874”
2	N56° 10’ 45.216”	W2° 14’ 2.323”
3	N56° 10’ 46.089”	W2° 16’ 19.964”
4	N56° 11’ 38.247”	W2° 19’ 15.051”
5	N56° 14’ 20.989”	W2° 22’ 35.306”
6	N56° 14’ 41.859”	W2° 23’ 0.987”
7	N56° 15’ 42.175”	W2° 23’ 38.288”
8	N56°17’18.487”	W2° 23’ 49.097”
9	N56° 17’ 44.539”	W2° 23’ 46.828”

10	N56° 31’ 30.766”	W2° 20’ 47.054”
11	N56° 32’ 0.710”	W2° 20’ 36.524”
12	N56° 32’ 6.063”	W2° 20’ 33.155”
13	N56° 32’ 7.620”	W2° 20’ 32.024”
14	N56° 35’ 22.077”	W2° 18’ 18.858”
15	N56° 36’ 31.442”	W2° 16’ 13.943”
16	N56° 37’ 32.565”	W2° 11’ 26.275”
17	N56° 36’ 38.278”	W2° 6’ 57.655”
18	N56° 35’ 59.903”	W2° 6’ 19.580”
19	N56° 35’ 59.718”	W2° 6’ 19.391”
20	N56° 35’ 56.701”	W2° 6’ 16.547”
21	N56° 35’ 54.763”	W2° 6’ 14.744”
22	N56° 28’ 42.096”	W1° 59’ 37.191”
23	N56° 27’ 49.678”	W1° 59’ 13.838”
24	N56° 27’ 4.984”	W1° 59’ 12.660”
25	N56° 26’ 24.530”	W1° 59’ 18.402”
26	N56° 12’ 14.704”	W2° 5’ 46.226”
27	N56° 11’ 58.966”	W2° 5’ 55.480”

The proximity of TMZ to military and civilian aerodromes (measured from the aerodrome airfield reference point where provided) are provided below.

Table 8 TMZ Proximity to Military and Civilian Aerodromes.

Aerodrome	**Proximity of edge of TMZ (NNG) (NM)**	**Proximity of edge of TMZ (IC) (NM)**
Leuchars	18.1	20
Dundee Airport	24.9	24.6
Perth Aerodrome	36.5	36.2
Aberdeen Airport	52	36.5
Edinburgh Airport	39.5	47.6
Arbroath Aerodrome (RM Condor)	18.4	11.4
Fife	28.9	35
Kingsmuir (Sorbie) Aerodrome	13.9	19.7
East Fortune Aerodrome	20.7	30.4
Archerfield Aerodrome	20.4	29.7

A6 Annex 6 Stakeholder / Consultee List

A6.1 Aviation Consultees

National Organisations (NATMAC)

Consultation	Acronym
Airport Operators Association	AOA
Aircraft Owners and Pilots Association	AOPA UK
Association of Remotely Piloted Aircraft Systems	ARPAS
Aviation Division Navy Command Headquarters	NCHQ
Aviation Environment Federation	AEF
BAE Systems	BAES
British Air Transport Association	BATA
British Airline Pilots' Association	BALPA
British Airways	BA
British Balloon and Airship Club	BBAC
British Business and General Aviation Association	BBGA
British Gliding Association	BGA
British Hang Gliding and Paragliding Association	BHPA
British Helicopter Association	BHA
British Microlight Aircraft Association	BMAA
British Model Flying Association	BMFA

British Parachute Association	BPA
Civil Aviation Authority	CAA SARG
Defence Airspace and Air Traffic Management (incl. the Military User Advisory Consultative Team)	DAATM (MUACT)
Euro UAV Systems Centre Ltd	UAVS
European Low Fares Airline Association	ELFAA
General Aviation Safety Council	GASCo
Guild of Air Pilots and Air Navigators	GAPAN
Guild of Air Traffic Control Officers	GATCO
Heathrow Airport	
Heavy Airlines	
Helicopter Club of Great Britain	HCGB
Light Aircraft Association	LAA
Light Airlines	
Low Fares Airlines	
Military Aviation Authority	MAA
Ministry of Defence	MOD
National Air Traffic Services	NATS
NATS En-route plc	NSL
PPL/IR Europe	PPL/IR
Safety and Airspace Regulation Group	SARG
UK Airprox Board	UKAB
UK Flight Safety Committee	UKFSC

3 AF-UK/A3	

Local Aerodromes

Consultee	Also known As	Point of Contact
Leuchars	EGQL	SATCO
Dundee Airport	EGPN	SATCO
Perth Aerodrome	EGPT	SATCO
Aberdeen Airport	EGPD	SATCO
Edinburgh Airport	EGPH	SATCO
Arbroath Aerodrome	RM Condor	OC 662 VGS
Fife Aerodrome	EGPJ	SATCO
Kingsmuir Aerodrome	Sorbie	Mr D Smith
East Fortune Aerodrome		Mr G Douglas
Archerfield Airstrip		Duchess of Hamilton

Aviation Organisations

Consultee	Point of Contact
Bristow Helicopters Limited Aberdeen	Bristow Helicopters Limited Aberdeen Dunlin Road Aberdeen AB21 0PB +44 (0) 1227 723151
CHC Scotia Helicopters Aberdeen	communications@chc.ca Head Office (Aberdeen) +44 (0) 1224 846000
Bond Offshore Helicopters Aberdeen	adoyle@bondoffshorehelicopters.com
British Association of Balloon Operators (BABO)	comms@babo.org.uk

Eastern Airways	customerrelations@easternairways.com
Fisheries Protection Agency	
Helicopter Safety Steering Group	hssg@stepchangeinsafety.net
Loganair	neilheron@loganair.co.uk
NATS Limited Aberdeen	john.mayhew@nats.co.uk
NHV UK (North Sea Helicopters)	colinhancy@nhv.be
The General Aviation Alliance	facilitator@gaalliance.org.uk

A6.2 Non-Aviation Consultees

Consultee	**Point of Contact**
Friends of the Earth	Friends of the Earth Edinburgh, Edinburgh Peace and Justice Resource Centre St. John's Centre, Princess Street, Edinburgh EH2 4BJ
Scottish National Heritage	Scottish National heritage Aberdeen Inverdee House Baxter Street, Torry, Aberdeen AB11 9QA enquiries@snh.gov.uk
Northern Lighthouse Board	Northern Lighthouse Board, 84 George Street, Edinburgh, EH2 3DA
Maritime and Coastguard Agency	HM Coastguard Operations Bay 2/06 Spring Place, 105 Commercial Road Southampton, Hampshire, SO15 1EG

A6.3 Information Organisations: Civil Aviation Authority

Consultee	**Also known As**

Safety and Airspace Regulation Group	SARG
Safety and Airspace Regulation Group Head of Aerodrome & Air Traffic Standards Division	SARG Hd AATSD
Safety and Airspace Regulation Group Flight Ops Division	SARG Flight Ops Division
Safety and Airspace Regulation Head of Airspace Regulation	SARG Hd AR