



**1 Gp Headquarters**

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Reference: 20150819 Windfarm-Planning  
Applications-DIO23034-No objections despite  
LOS-O

Date: 19 Aug 2015

**KILRUBIE WINDFARM (DIO23034) WIND FARM DEVELOPMENT PROPOSAL - NO  
OBJECTIONS DESPITE LOS**

1. DIO requested that we review the proposal to erect a 7 x 115m turbine wind farm at Kilrubie Windfarm. Following a detailed examination of the proposal, the impact of the proposed development on ATC radars and the ATC usage of Airspace in the region it was considered that, although there would be an impact on ATC Operations, the impact was manageable.

Location	Affected Radar	Operations Affected	DIO No.
Kilrubie Windfarm	Deadwater Fell PSR	RAF Spadeadam	23034

2. At present, HQ 1 GP BM Safeguarding does not have objections with the Kilrubie Windfarm proposal (DIO23034) as it is assessed that the effect on ATC operations at Spadeadam are manageable. This level of objection is held on the basis that there will be no additional turbines or a change in turbine height without a separate planning request. Also considered is that this proposal would be constructed before the number of future consented proposals in the area exceeds that which the radar can manage. The cumulative impact of multiple turbines in any given area would result in the degradation of radar performance. It should therefore be noted that the propagation of turbines in this area could lead to a future objection being raised in order to protect the MOD's radar coverage.



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Ministry  
of Defence

**AIR DEFENCE & ELECTRONIC WARFARE  
SYSTEMS  
RADIO SITE PROTECTION  
TECHNICAL REPORT**

**Issue:** 1  
**Date:** 14 August 2015

**Title:** WR80026/01  
DIO 23034 – AIR TRAFFIC CONTROL (ATC)  
RADARS – ASSESSMENT OF THE DEVELOPERS  
PROPOSAL TO ESTABLISH KILRUBIE  
WINDFARM NEAR EDDLESTON IN SCOTTISH  
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Issue: 1 Dated: 14 August 2015

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**FOI FORMAT AND SUMMARY**

20150814-DIO23034 Concerns Kilrubie Windfarm-RSP1c-O

Radar Field Strength and/or Radar Line-of-Sight analysis indicates that the proposed wind farm at Kilrubie Windfarm shows a high degree of probability that it will be detected by one or more MoD radars to a degree that will affect their function.

Issue: 1 Dated: 14 August 2015

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**CONTENTS**

PRELIMINARY MATERIAL	Page
Title Page & Cover	
Copyright & Release Conditions.....	i
Document Authorisation .....	ii
FOI Format and Summary.....	ii
Distribution .....	iii
Contents.....	iii
References.....	iv
Standard Assumptions and Terms .....	v
Scope .....	1
Introduction .....	1
Effects of Wind Turbines on Radar Performance .....	1
Assessment of the Proposed Wind Farm .....	2
Conclusion and Recommendations.....	2

Figure 1 – Local area map for Kilrubie Windfarm

Figure 2 – Coverage prediction plot for Spadeadam Deadwater Fell Radar

Issue: 1 Dated: 14 August 2015

## Standard Assumptions and Terms

RLOS - Radio Line of Sight. This is a linear path estimation of line-of-sight at radar wavelengths that compensates for refractive effects by assuming a reduced earth curvature (4/3 earth radius).

Clutter is taken into consideration as part of the propagation model that generates coverage plots and can significantly reduce the probability of detection by the radar.

Stated accuracy for the Ordnance Survey ground height data is  $\pm 3\text{m}$  to 1RMS. DES ADATS maintains mapping data at far greater accuracy for the radar positions. The radar aperture heights used in calculation reflect this increase in accuracy.

All heights AMSL are referenced to the National Grid geoid. All angles are referenced to Grid north unless specifically stated.

Areas of the coverage plots shaded in blue indicate where a turbine of the dimensions given is predicted to be detected by the radar.

**Level 1 Assessment:** Considers RLOS only and is used for radars where no parameters other than physical location are available. This method is not considered to be particularly accurate.

**Level 2 Assessment:** Calculated probability of detection from available radar parameters, turbine parameters and terrain data. The total RCS of the turbine is used in all instances. This report constitutes a Level 2 Assessment except for NATS Great Dun Fell and MAA Yeovil. Coverage plots are not relevant for Secondary Surveillance Radars which are more concerned with short-range reflections.

**Level 3 Assessment:** A more extensive Probability of Detection calculation, utilising sectioned RCS. This method is considered to give more accurate answers when RLOS is not present and diffraction is the sole method of detection.

**Turbine RCS:** A measure of the radar reflectivity of the complete turbine structure.

**Turbine Visibility:** The amount of the turbine visible over terrain, considering RLOS only. In general, a large positive value is a strong indicator that the turbine will be detected. A level 3 assessment is generally requested in the report where this value is zero and detection is still indicated.

**Max height for no visibility:** A sample cut-off height below which all of the turbine would be obscured by terrain. Note that this figure will vary between turbines with different ground heights in the same proposal.

**Visibility over clutter:** The amount of the turbine which is un-obscured from the radar by building clutter and terrain (where this is the same as the Turbine Visibility, no clutter exists in the beam path). Where this value is zero or very small, the turbine is completely obscured by clutter and the detection probability will be greatly reduced. Note that clutter is represented by average values for a type in an area (forest, suburban, urban, etc) and not to the individual building level.

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**REFERENCES**

- A. E-mail from Defence Infrastructure Organisation, DIO 23034 dated 14 Aug. 15
- B. JSP 604 Part 2, Vol.2, Leaflet 3032( formerly JSP 846)
- C. QINETIQ/D&TS/SEA/TA0705054/1.0 – Assessment of Wind Turbine Effects for DCSA
- D. AWC/WAD/72/655/TRIALS dated 10 May 05 – The effect of wind turbine farms on ATC radar (Qixotic Zephyr trial)
- E. AWC/WAD/72/655/TRIALS dated 06 Jan 05 – The effects of wind turbine farms on Air Defence radars (Swift Crofter trial)
- F. Further evidence of the effects of wind turbine farms on AD radar dated 12 Aug 05 (Mistral Crop trial)
- G. Trial report Weave Elbow (Stage 3) dated 21 May 2014 – Further testing of wind turbine effects on the TPS-77 radar.

Issue: 1 Dated: 14 August 2015

## **1 Scope**

1.1 The purpose of this report is to ascertain the likely effects of the proposed wind turbines at Kilrubie Windfarm on the performance of Radar Systems at MoD-related sites.

## **2 Introduction**

2.1 Reference A is a proposal to establish 7 turbines Kilrubie Windfarm, near Eddleston. National Grid References were provided for all positions (NT 21833 47992). The highest point of the turbine blades will be 115 metres above ground level. A local map of the proposed area is shown at Figure 1.

2.2 Siting restrictions for radars are defined in Reference B. Reference C details methods of determining Radar Cross-Section (RCS) values from a generic turbine model. Reference D defines specific restrictions for siting wind turbines, which apply when there is Line of Sight (RLoS) between radar and turbine. References E, F and G define additional restrictions applicable only to Air Defence (AD) radars.

## **3 Effects of Wind Turbines on Radar Performance**

3.1 It has been shown that where RLOS exists and/or Radar Field Strength detection occurs, the wind turbines will appear as genuine aircraft targets. This effect has been shown to mask aircraft responses, even when the aircraft is in a high elevation beam and the turbine is in a lower sidelobe. The radar may also be desensitised by its clutter processing within the sector containing wind turbines.

3.2 Additionally, shadowing of aircraft at similar radar to target elevation angles at the wind turbines may occur, degrading radar performance. However, this is only expected to occur over short distances from wind turbines.

3.3 In close proximity, turbines can cause spurious reflections of returns. This is particularly a problem for Secondary Surveillance Radars.



#### **4 Assessment of the Proposed Wind Farm**

##### **4.1 Deadwater Fell ATC Radar Field Strength Coverage summary**

4.1.1 Range to Wind farm: 64.71km  
Angle to Wind farm: 320.46°

RLOS Visibility 37m  
Turbine RCS: 248.8m<sup>2</sup>  
Aux Beam: Outside

4.1.2 A Field Strength Coverage plot was generated for the radar using these parameters (Figure 2), indicating that one of the turbines (14) will be detected by the radar.

4.1.3 All other radars at this site have been checked.

4.2 There are no concerns regarding the following radars, which have been checked:

4.2.1 RAF – Leuchars, Berry Hill

4.2.2 ASACS – Brizlee Wood, Staxton Wold, Buchan, Benbecular

4.2.3 MAA – Warton

4.2.4 NATS – Great Dun Fell

4.3 The proposed wind farm is beyond the protected range and/or outside the protective arcs of all other radars.

#### **5 Conclusion and Recommendations**

It is recommended that the Operations Staff check whether the proposed Kilrubie Windfarm is in an area of vital air traffic operations controlled by the radar at Deadwater Fell. If so a decision to object to the proposal should be considered on the grounds referred to in paragraph 3.1 and paragraph 3.2.

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Local area map for DIO 23034 Kilrubiie Windfarm (NT 21833 47992)

Figure 1

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DIO 23034 coverage estimate plot for Deadwater Fell Radar (115m, 248.8m<sup>2</sup> RCS)

Figure 2

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Issue: 1 Dated: 14 August 2015