NATS

Technical and Operational Assessment (TOPA)

For Haggs Hall Farm

Windfarm Development

Issue 1

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1. Background

1.1. En-route Consultation

NATS is responsible for the safe and expeditious movement in the en-route phase of flight for aircraft operating in controlled airspace in the UK. To undertake this responsibility it has a comprehensive infrastructure of radars, communication systems and navigational aids throughout the UK, all of which could be compromised by the establishment of a wind farm.

In this respect NATS is responsible for safeguarding this infrastructure to ensure its integrity to provide the required services to Air Traffic Control (ATC).

In order to discharge this responsibility NATS is a statutory consultee for all wind farm applications, and assesses the potential impact of every proposed development in the UK.

The En-route radar technical assessment section of this document defines the assessments carried out against the development proposed in section 2.

2. Application details

Ribble Valley District Council submitted a request for a NATS technical and operational assessment (TOPA) for the development at Haggs Hall Far, Haggs Hall Fields, Ramsgreave, Blackburn as detailed in the table below.

Turbine	Latitude	Longitude	Easting	Northing	Hub Height (m)	Tip Height (m)
1	53.7843	-2.5004	367129	432117	18.7	22.3

Table 1 – turbine coordinates and height

3. Assessments Required

The proposed development falls within the assessment area of the following systems:

NERL Radar Sites	Latitude	Longitude	Range(nm)	Range(km)	Azimuth(deg)	Type
Claxby Radar	53.4501	-0.3083	80.9	149.7	285.3	CMB
Clee Hill Radar	52.3983	-2.5975	83.4	154.4	2.4	CMB
Debden Radar	51.9902	0.2638	147.3	272.8	318.1	CMB
Great Dun Fell Radar	54.6841	-2.4509	54.1	100.2	181.9	CMB
Lowther Hill Radar	55.3778	-3.7530	105.3	195.0	154.9	CMB
St Annes Radar	53.7684	-2.9908	17.5	32.4	86.7	CMB
Manchester Combined	53.3407	-2.2827	27.8	51.4	343.8	CMB
NERL Nav Aid Sites	**Latitude**	**Longitude**	**Range(nm)**	**Range(km)**	**Azimuth(deg)**	**Type**
None						
NERL AGA Comms Sites	**Latitude**	**Longitude**	**Range(nm)**	**Range(km)**	**Azimuth(deg)**	**Type**
None						

Table 2 – Impacted Infrastructure

3.1. En-route radar technical assessment

3.1.1. Predicted impact on St Annes Radar

Using the theory as described in Appendix A and development specific propagation profile it has been determined that the terrain screening available will not adequately attenuate the signal, and therefore this development is likely to cause false primary plots to be generated.
A reduction in the radar's probability of detection, for real aircraft, is also anticipated.

3.1.2. En-route operational assessment of radar impact

Where an assessment reveals a technical impact on a specific NATS radar, the users of that radar are consulted to ascertain whether the anticipated impact is acceptable to their operations or not.

Unit or role	Comment
Prestwick Centre ATC	**Unacceptable**
RDP Asset Management	Acceptable
London Area Control Centre ATC	Acceptable
London Military ATC	Acceptable

Note: The technical impact, as detailed above, has also been passed to non-NATS users of the affected radar, this may have included other planning consultees such as the MOD or other airports. Should these users consider the impact to be unacceptable it is expected that they will contact the planning authority directly to raise their concerns.

3.2. En-route navigational aid assessment

3.2.1. Predicted impact on navigation aids.

No impact is anticipated on NATS's navigation aids.

3.3. En-route radio communication assessment

3.3.1. Predicted impact on the radio communications infrastructure.

No impact is anticipated on NATS's radio communications infrastructure.

4. Conclusions

4.1. En-route consultation

The proposed development has been examined by technical and operational safeguarding teams. A technical impact is anticipated, this has been deemed to be **<u>unacceptable</u>**.

Appendix A – background radar theory

Primary Radar False Plots

When radar transmits a pulse of energy with a power of $\mathbf{P_t}$ the power density, **P**, at a range of **r** is given by the equation:

$$P = \frac{G_t P_t}{4\pi r^2}$$

Where $\mathbf{G_t}$ is the gain of the radar's antenna in the direction in question.

If an object at this point in space has a radar cross section of **σ**, this can be treated as if the object re-radiates the pulse with a gain of **σ** and therefore the power density of the reflected signal at the radar is given by the equation:

$$P_a = \frac{\sigma P}{4\pi r^2} = \frac{\sigma G_t P_t}{(4\pi)^2 r^4}$$

The radar's ability to collect this power and feed it to its receiver is a function of its antenna's effective area, $\mathbf{A_e}$, and is given by the equation:

$$P_r = P_a A_e = \frac{P_a G_r \lambda^2}{4\pi} = \frac{\sigma G_t G_r \lambda^2 P_t}{(4\pi)^3 r^4}$$

*Where $\mathbf{G_t}$ is the Radar antenna's receive gain in the direction of the object and **λ** is the radar's wavelength.*

In a real world environment this equation must be augmented to include losses due to a variety of factors both internal to the radar system as well as external losses due to terrain and atmospheric absorption.

*For simplicity these losses are generally combined in a single variable **L**.*

$$P_r = \frac{\sigma G_t G_r \lambda^2 P_t}{(4\pi)^3 r^4 L}$$

Secondary Radar Reflections

When modelling the impact on SSR the probability that an indirect signal reflected from a wind turbine has the signal strength to be confused for a real interrogation or reply can determined from a similar equation:

$$P_r = \frac{\sigma G_t G_r \lambda^2 P_t}{(4\pi)^3 r_t^2 r_r^2 L}$$

Where $\mathbf{r_t}$ and $\mathbf{r_r}$ are the range from radar-to-turbine and turbine-to-aircraft respectively. This equation can be rearranged to give the radius from the turbine within which an aircraft must be for reflections to become a problem.

$$r_r = \sqrt{\frac{\lambda^2}{(4\pi)^3}}\sqrt{\frac{\sigma G_t G_r P_t}{r_t^2 P_r L}}$$

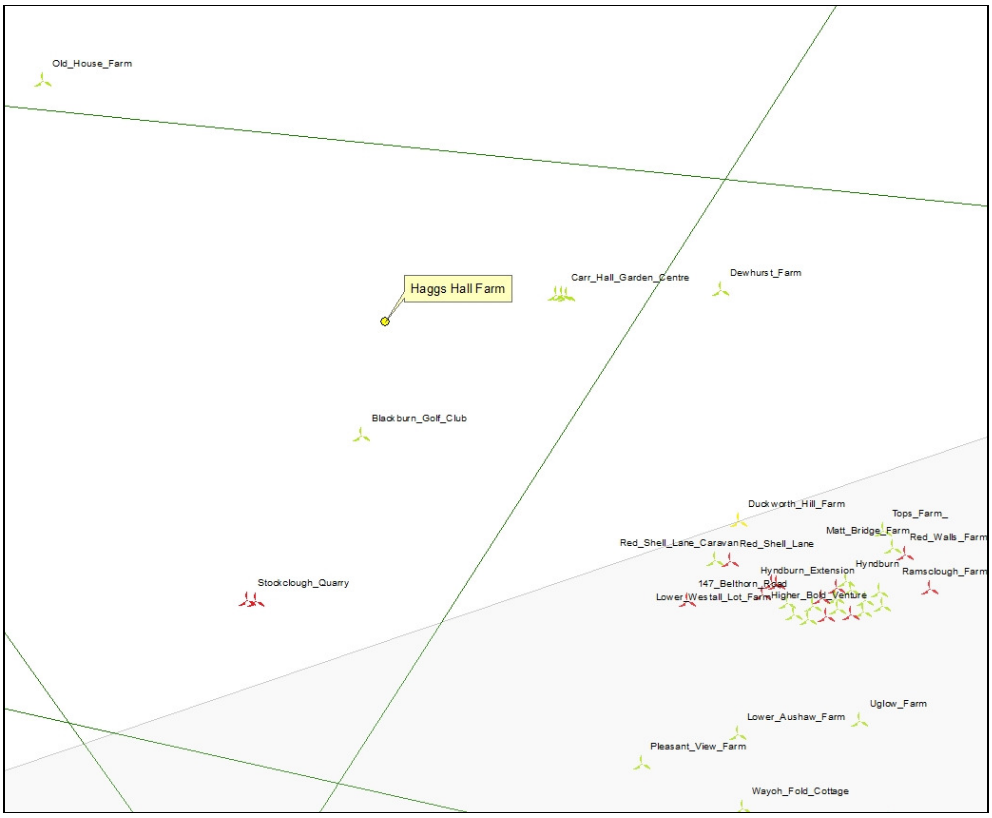
Shadowing

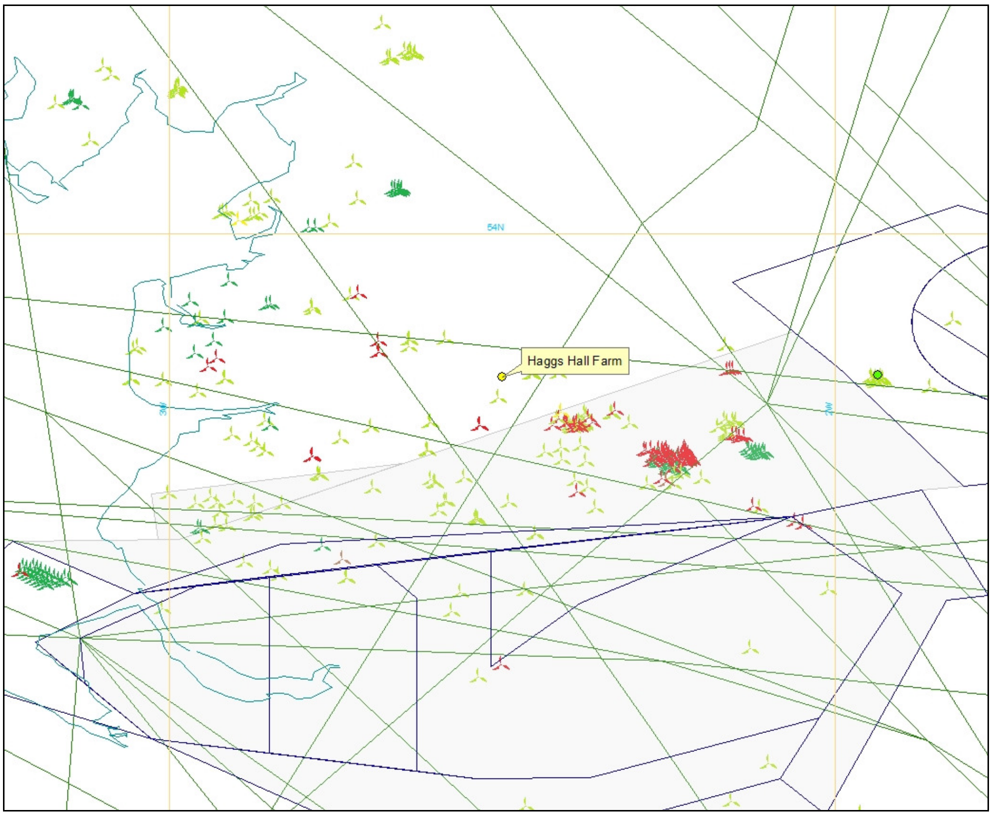
When turbines lie directly between a radar and an aircraft not only do they have the potential to absorb or deflect, enough power such that the signal is of insufficient level to be detected on arrival.
It is also possible that azimuth determination, whether this done via sliding window or monopulse, can be distorted giving rise to inaccurate position reporting.

Terrain and Propagation Modelling

All terrain and propagation modelling is carried out by a software tool called ICS Telecom (version 11.1.7). All calculations of propagation losses are carried out with ICS Telecom configured to use the ITU-R 526 propagation model.

Appendix B – Diagrams





consented/built impact –accepted impact –objection mitigated
mitigation –proposed no impact refused/withdrawn