

## **Mitigating the effects of wind turbines on NATS En-Route Ltd (NERL) operations**

### **Executive Summary**

Wind turbines can be detected by air traffic control radars and can appear to controllers as false aircraft targets and they can distort information data sent from aircraft so their actual position is incorrectly displayed. The resulting effects of these phenomena are many and in the worst case it can be impossible for controllers to differentiate between a wind turbine and an aircraft. As safety is our overriding concern it is NERL's responsibility to ensure that wind turbine developments do not present a hazard to air traffic control operations.

This position paper outlines the minimum expectations that proposed measures used to mitigate the effects of wind turbines on the Primary Surveillance Radars (PSR) used by NERL's en-route operations, will normally be expected to satisfy. It aims to highlight the issues which will generally need to be considered by wind farm developers in considering how to mitigate the impact upon NERL of a proposed installation.

NERL's priority is to develop a technical solution so that the returns generated by wind turbines can be removed from controllers' displays whilst ensuring that the current ability to detect, track and provide navigational assistance to aircraft is not degraded. This is a strategy agreed with the Department for Transport (DfT) and the Department for Business and Enterprise Regulatory Reform (BERR).

NERL supports more than 90 per cent of wind farm proposals. The company objects to a small number of proposals where there is an identified safety risk, and aims to work with the developer to try to find a solution.

The paper does not consider the effects of wind turbines on Secondary Surveillance Radar (SSR) or the ability to mitigate this effect. The paper similarly does not consider the effects on any other part of the Communications, and Navigation infrastructure which NERL owns and operates.

The paper does not consider the effect of wind turbines on airport operations.

This document has been subject to NATS' internal approval processes and is intended as a public document.

## Mitigating the effects of wind turbines on NERL operations

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## 1. Introduction

- 1.1. NERL's first priority is the safety of its operations. However we are also committed to efficiency and capacity improvements required by our customers and to which NERL is bound to deliver under the terms of its licence with the Civil Aviation Authority (CAA). The European Commission's Single European Sky Regulations also recognise the need for improvements within the industry and, increasingly, rules are being set at a European level.
- 1.2. NERL is continually striving to improve safety levels and whilst meeting future demand has made significant investments to ensure that these levels are maintained. This includes replacing and upgrading all of its current radars and to enhance all of its current radars and to enhance capabilities by installation of technologies such as multi radar tracking equipment.
- 1.3. NERL recognises the benefits of wind turbines in addressing the UK's commitment to reductions in carbon emissions and is extremely mindful of aviation's impact on the environment. To that end NERL has recently become the first air traffic company in the world to set targets to reduce the amount of CO<sub>2</sub> emitted by aircraft under our control, such improvements to the environment forming a core part of our current 'Brand Values' and company strategy.
- 1.4. NERL provides air traffic services across the UK and surrounding high seas airspace as well as across the north-eastern quadrant of the North Atlantic. To do this, it relies on a network of communications, navigation and surveillance radar as well as associated data processing systems. Surveillance data is also used by other air traffic service providers such as the Ministry of Defence and airports. NERL has a licence obligation to provide these services to a high quality and performance standard, for the benefit of the UK aviation as a whole.
- 1.5. This paper only considers the effects of wind turbines on NERL's PSR network.

## 2. NERL's approach to wind farm developments

- 2.1 NERL objects to the proposed development of wind turbines only when their effects are considered likely to be technically and operationally unacceptable. During 2007, NERL did not object to 94% of proposed developments upon which it was consulted. Most of the remaining six per cent to which it did object were subsequently progressed by working together towards on a mutually beneficial outcome.
- 2.2 Where turbines are assessed as being within the line of sight of a PSR they are subjected to an operational case by case test, which considers location and size of development and the type of ATC operation in the area, before a judgement is taken in line with the operational safety accountabilities on the potential impact.

- 2.3 NERL is required to safeguard its service by participating in the planning process. In the absence of strategic government guidance to the contrary, NERL will generally submit an objection where there is an unacceptable impact and where no currently available mitigation solutions, which have been assessed for their suitability, can be implemented. NERL is working with developers, both on an individual basis and as part of the wider strategic approach, to resolve issues where impacts are unacceptable. NERL is a member of the BERR Aviation Management Board (AMB) and Aviation Advisory Panel (AAP) and we work closely with BERR, DfT and the CAA to assist the development of wind farms whilst protecting the integrity of our operations.
- 2.4 Developers often accept that there will be an operational impact requiring technical mitigation, and that such a mitigation solution does not currently exist. In these circumstances, developers will often seek to deal with NERL's concerns by way of proposing to the decision making bodies, the imposition of planning conditions which restrict commencement of development until a technical mitigation solution has been developed (known as 'Grampian' conditions).
- 2.5 In the past NERL has experienced a mixed response from decision making authorities to the suggested use of such conditions in this way. NERL has previously met with the Energy Consents unit of the Scottish Government, and it was explained by the Scottish Government representatives that they were very reluctant to use Grampian conditions of this kind, as renewables targets had been set and the Government wanted to achieve certainty of delivery as far as possible. They wanted to see conditions that were able to identify a specific deliverable mitigation solution in order to ensure that their targets are met within a clear timeframe. They also requested that technical and operational issues be identified to them as early as possible so that efforts can be focussed on those developments in appropriate areas, whilst acknowledging that some proposals may not be worth pursuing.
- 2.6 Where the decision-making authority does wish to grant consent, then NERL will normally maintain its objection but attempt to agree between all parties, the content of a Grampian style condition on a without prejudice basis in the event that consent is granted. This gives NERL the surety that should consent be granted the commencement of the development will be restricted until a solution has been identified, developed, tested and implemented.
- 2.7 Ultimately, it is at the decision-making authority's discretion as to whether it is appropriate in all the circumstances to grant consent subject to Grampian conditions, having regard to the policy tests applicable for the relevant jurisdiction. The decision-making authority and developer will also need to ensure that environmental impact assessment requirements have been met before consent is granted.

2.8 PPS22<sup>1</sup> in England states that the onus is on developers to deal with aviation impacts before applications are submitted. NERL's experience has been that this is not always the practice followed by developers. NERL has made available some pre-planning tools to give a developer an early indication of the likelihood of a NERL objection before formal planning is applied for. A developer may request that an initial Technical Assessment or a more detailed Operational Assessment is carried out, to assess the impact of the windfarm on our technical sites. Further NERL provides BWEA with a set of Safeguarding maps to show potential developers where a development is likely to have an impact on primary and secondary radar areas of interest. These pre-planning tools supplement the guidance given in PPS22 and we would encourage developers to make use of them

### 3 Wind farm proliferation

3.1 Radar support for air traffic services covers most of the UK and large sections of the ocean. The airspace is structured in order to ensure safety for all users, civilian and military.

3.2 To assess accurately the effect of wind farm development on the air traffic control network, NERL needs to consider the entire picture and the cumulative effect of wind farms over large and increasing expanses of airspace. Cumulative effects can arise in respect of both the accumulation of wind turbines and also from the implementation of bespoke mitigation measures across the UK.

3.3 We are aware of some permitted developments which have not yet been built. This may cause difficulties for developers as NERL will always need to consider the full scale of the potential cumulative impact of a proposal, and will generally need to include all permitted developments in our assessments.

3.4 NERL does not have the authority or knowledge necessary to prioritise proposed wind turbine developments, which invariably depends on a number of factors, including:

- Their contribution to the UK's renewable energy targets
- Their likelihood of success due to other planning issues
- Their proximity to the National Grid

This position applies both to where NERL is concerned about the cumulative affect of several developments in a small area and is asked to make a choice of which is to proceed or a choice on a national scale as to which key developments may be able to benefit from a specific bespoke mitigation.

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<sup>1</sup> PPS22 'Planning Policy Statement 22: Renewable Energy'. This sets out the Government's policies for renewable energy, which planning authorities should have regard to when preparing local development documents and when taking planning decisions.

<http://www.communities.gov.uk/publications/planningandbuilding/pps22>

- 3.5 NERL understands that the construction of a central database which would track the specific planning status and construction of wind turbines is a standalone workstream within the BERR Aviation Plan. We fully support this activity as it would assist BERR and other stakeholders to work with NERL to make decisions on developments based on a balanced assessment of what is in the best interests of the Nation or the region, against consideration of their cumulative affect on air traffic services.
- 3.6 As well as assessing the impact of a turbine development and proposed mitigations on the local air traffic services, NERL will also normally take a strategic view in terms of the impact on our UK operation as a whole i.e. the acceptability of its impact assessed with respect to other developments already operating in the immediate area of concern and where this is repeated in other regions, the cumulative impact on a national scale. A similar consideration will be the suitability of proposed mitigation measures in the context of maintaining the integrity of our surveillance infrastructure as a UK service. The cumulative affect on NERL's operations and surveillance infrastructure as a whole is a prime consideration but many developers are understandably focused on achieving their own individual planning consents and often suggest bespoke individual solutions without regard to this wider context.
- 3.7 Demands placed on NERL to progress bespoke individual solutions, even if having the potential to facilitate short term progress of individual wind farms, may divert resource and finances away from developing solutions which have greater applicability over more developments. As stated above, individual mitigation solutions may have a cumulative impact on NERL's systems and operations and so such bespoke solutions have the potential to undermine the technological and operational investments made by NERL in ensuring that existing and future aviation demand can be safely met in accordance with NERL's licence obligations.
- 3.8 In simple terms the issue of proliferation of developments affects the ability to progress and implement individual solutions and therefore NERL is focused on working with the wind farm industry and government to achieve strategic solutions for the benefit of all stakeholders concerned.

## **4 PSR Mitigation being identified by Raytheon**

- 4.1 NERL is focusing on the development of cost effective solutions to mitigate the impact of wind farms at a National level. NERL seeks to avoid the accumulation of bespoke mitigations for individual wind farm developments (that may not be being developed with the best interests of the region or Nation in mind), which would increase levels of Air Traffic Management complexity and may compromise the ability to provide a safe and efficient service in accordance with licence obligations.

- 4.2 NERL is currently undergoing a programme of radar upgrades. This includes the replacement of all NERL Primary Surveillance Radars with products manufactured and supplied by Raytheon Canada. Considerable investment has been made by NERL to replace its ageing and diverse collection of Primary Radars with a single of-the-shelf product. The common use of a single type of radar allows for significant savings in life cycle costs, and safeguards against obsolescence and capacity issues for the next twenty years.
- 4.3 The Raytheon radars, however, in common with nearly all other commercially available primary radar solutions currently available, do not satisfactorily mitigate the wind turbine effects where they occur.
- 4.4 In July 2006 a technical study paper was sponsored by the DTI (now BERR) to identify what modifications could potentially be undertaken by Raytheon to allow the radar to clearly distinguish real aircraft returns from those generated by turbines. The report was warmly received by both BERR and BWEA. The study also included a high level plan breaking the project for the assessment and development of the proposals into several phases and illustrating timescales and expected cost. The intention was to manage risk by allowing the financing of individual elements and to provide full visibility and control as the project progressed. NERL and Raytheon both consider that the development of such an integral solution (as outlined in the technical study and henceforth referred to as the 'Raytheon solution') is technically achievable. Attention is now focused on the projected timescales and funding for delivering the project.
- 4.5 NERL requires all Primary radars to be upgraded to a single common standard in order to protect the substantial investments NERL has already made to baseline our Primary Surveillance radars to a single platform to minimise logistical and support costs. This would be negated if only a small number of radars were modified. In addition, whilst there may be a small number of Primary radars which are not currently subject to wind turbine interference, it is clear that this situation is very likely to change over the lifetime of these facilities. The order in which radars are upgraded is prioritised accordingly and currently Lowther Hill, Great Dun Fell, Claxby, Cromer, and St Annes are considered critical sites.
- 4.6 The development of alternative solutions has focused on the implementation of a further stage of processing, introduced at the output stage of the radar. However NERL believes that these solutions have not demonstrated their suitability for all surveillance systems. Further both NERL and Raytheon agree that for a solution to have any real chance of success, the solution has to be integrated into the radar itself. This position has been arrived at after careful consideration of the options and should not be seen as undermining any efforts by BERR in supporting other activities in these areas, as detailed in the Aviation Plan.<sup>2</sup>

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<sup>2</sup> The Aviation Plan is a BERR initiative that aims to provide direction and a co-ordinated approach to identifying, developing and delivering solutions to the potential impacts that wind turbines may have on civilian and military radar systems.

- 4.7 NERL is optimistic about the effectiveness of the Raytheon solution and that once deployed it is anticipated that it will significantly reduce the number of objections to wind farm applications. However there are no guarantees as to its success in all instances and NERL will not be in a position to remove objections to wind farms until such time as the solution has been proven to work in an operational context. If consents were granted at this stage on a UK wide basis subject to the sort of Grampian type condition discussed above, in the event that the Raytheon proposals are not successful, or not sufficiently successful to mitigate the impacts of a particular wind farm adequately, there is the potential for a large build up of planning consents across the UK which are incapable of being implemented. If this occurred, such planning consents would not contribute to meeting renewable energy targets and could actually inhibit the development of other proposals which might otherwise be acceptable. It is also likely that after planning consent has been granted there would need to be further assessment of the mitigation proposal and any residual impacts.
- 4.8 NERL will keep the above position under review as the development of the Raytheon proposal progresses.

## **5. Bespoke Mitigations**

- 5.1 The basic premise for NERL in considering any mitigation is that, individually and cumulatively, it should:
- have no impact on the safety performance of our operations
  - have no material business or efficiency impact on our operations
  - be cost free for NERL for the lifetime of the requirement
  - be at least environmentally neutral
- 5.2 Additionally all mitigation measures will be expected to be compatible with the joint civil/military arrangements in place across the UK for ATC service provision. In instances where a development does not impact civil operations NERL may still be obliged to object because of a negative impact on a Communications, Navigation or Surveillance (CNS) service that we provide to the MOD under contractual arrangements.

## **5.3 Operational Solutions**

The most frequently proposed operational mitigation measure for reducing the effect of wind farms is to divert aircraft around the affected area, or to stop using Primary radar in the affected area and continue operations in an environment where the carriage of transponders is mandatory. These are dealt with briefly below. Such measures would need to be assessed for their applicability, practicability and whether they provide the integrated solution that best meets NERL's safety and operational objectives. Any proposal to utilise one of these

measures will be expected to include a detailed impact assessment and sufficient information to allow for hazard analysis and subsequent regulatory approval.

### **5.3.1 Routing around the development**

Increasing the amount of controller interaction with aircraft and consequently increasing the number of transmissions a controller has to make, will normally have a direct effect on safety and operational pressures, and will usually be contrary to ongoing safety improvement work and objectives.

NERL's aim is to reduce the amount of controller interaction in order both to manage the number of transmissions a controller makes and to reduce the possibility of introducing an error by either the controller or pilot.

There are also potential capacity and route efficiency implications in increasing the track distance an aircraft has to fly, which will normally have a cost and environmental impact in terms of revised noise footprint and increased carbon emissions. For these reasons, if a proposed development would require increased controller intervention, then from an operation perspective alone it will generally be unlikely to be the preferred form of mitigation.

### **5.3.2 Mandatory Transponder Carriage areas**

Any operational mitigation requiring a change to current airspace rules is likely to require full regulatory consultation. Consultation would include the effects on other airspace users as well as any environmental, business and cost impacts on anyone affected. Should any developer consider this approach, they will generally be expected to sponsor and initiate all consultation and cover all costs.

For a Mandatory Transponder Carriage area to be effective mitigation, the size of a particular development may still require the removal of wind farm clutter displayed by the Primary radar. This is not only to prevent aircraft identification labels from being obscured by the clutter but also to manage the human factors issues associated with pronounced displayed clutter and the impact on controllers' efficiency.

## **5.4 Technical Solutions – minimum requirements**

- 5.4.1 Whilst the Raytheon proposal is anticipated by NERL to be the most promising in strategically mitigating the majority of effects of wind turbines on NERL's PSR infrastructure, developers often suggest bespoke technical solutions for individual developments to overcome a NERL planning objection prior to a strategic technical solution being developed.

5.4.2 These proposals often suggest the use of:

- an additional infill radar and the amendment of data processing systems to manage the extra data,
- technical adaptations to existing radars such as shielding, blanking zones, non-initialisation areas, antenna tilt and screen blanking.

5.4.3 The general minimum requirements underpinning these mitigations are outlined below<sup>3</sup>. Any mitigation measure proposed by a developer should take account of these general issues in a comprehensive manner. In accordance with PPS22 and good practice, these issues should be addressed early in the planning process and before an application is submitted by the developer.

## 5.5 Safety

5.5.1 Any proposal for mitigation should be accompanied by a supporting safety rationale which demonstrates that it:

- does not introduce any increased risk into operations
- is assessed as having no negative impact on existing safety assurances
- does not inhibit operational/system changes in other areas, in line with our commitment to proactively improve safety where we can.

5.5.2 Safety factors should generally include technical safety case evidence, human factors analysis, and hazard analysis along with appropriate mitigations to the hazards.

5.5.3 NERL considers these requirements to be in line with the NATS Safety Management Principles to which the company is required to comply with under Single European Skies common requirements legislation and which are the legal framework for air navigation service provider certification.

5.5.4 Whilst NERL will also need to complete its own safety assessment in line with our obligations, we will expect all proposals to include sufficient data to achieve this and will generally require all safety costs for implementation and ongoing risk assessment to be met by the developer.

## 5.6 Environmental

5.6.1 NATS is the first air traffic company in the world to commit to reducing the amount of CO<sub>2</sub> emitted by aircraft under its control. It is likely that within the next three years NERL will be set performance targets in this respect by the

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<sup>3</sup> A detailed breakdown of the technical requirements is available by contacting NERL at 'natssafeguarding@nats.co.uk'

European Commission and/or national regulators. NATS is the only service provider in the world to pre-empt this by setting our own targets.

- 5.6.2 There is little point in enabling wind farms to go ahead if the environmental cost of doing so undermines the benefit they bring. At worst, mitigation measures should have a neutral environmental impact on the environment and, at best, add to the work to reduce aviation's contribution to climate change.
- 5.6.3 As part of the process to meet the targets, NERL now assesses all proposed changes to its estate for an environmental impact. Developers will similarly be expected to provide a detailed assessment of the environmental impact of proposed mitigation measures in order to assess whether the effects are neutral. This should include carbon emissions estimates on the through life construction, implementation and operation of any proposed mitigation.
- 5.6.4 The assessment should also consider visual impact (and issues of planning consent where necessary) if the mitigation measure includes any change to the radar station infrastructure across the country. This particularly applies if any additional radar is proposed, the effects of which must be also assessed on the Radio Frequency environment. Primary radar systems require their own unique frequencies to ensure one radar system does not interfere with an adjacent service. The bands in which ATC radars operate are very congested (Airports and MOD also operate radars in these bands) and their management is now the subject of greater scrutiny, particularly in terms of availability and pricing. A proposal to use a new radar to address the problems of a single wind farm development must therefore consider these issues and directly address the question of whether it is an efficient use of the spectrum. It can be expected to be both costly and finite in the number of times it can be implemented.

## **5.7 Technical interoperability**

- 5.7.1 Any proposal for implementing a technical solution should not negatively affect the current operation of our technical systems and must be fully interoperable with them. It will be expected that the developer can show that any mitigation measure proposed will ensure that the systems we provide for our own business remain unaffected in any way. This includes the addition of new radars into the NERL infrastructure, utilisation of any data processing equipment, and the bandwidth of all data communications equipment.
- 5.7.2 Should a proposal affect our ability to make the full use of our end-to-end surveillance systems as currently specified and consequently our current capability to support air traffic services, developers will normally be expected to pay the full lifetime costs of upgrading these systems to maintain their capability levels.
- 5.7.3 All systems implemented must, as well as meeting safety obligations, comply with Single European Skies Interoperability Regulations.

## 5.8 Operational efficiency/business

- 5.8.1 NERL system architecture is developed and optimised for our own business and licence requirements as well as for contracted obligations to customers. Where NERL has what are perceived to be multiple levels of redundancy in our systems, e.g. overlapping radar coverage, any proposal to mitigate the effects of wind turbines should be neutral to this level of redundancy.
- 5.8.2 If a developer wishes to propose a solution to use a different radar source from NERL's existing surveillance pool, that source can be assessed for its operational suitability but it is not to be assumed that such an assessment represents an acceptance that mitigation can be drawn from NERL's current capabilities and availabilities. Where it is appropriate and suitable it may be considered but only after consideration of NERL's business resilience principles, which require that the systems in which NERL has invested, be made available at all times and to the same capability level, in order to service the safety and efficiency of the airspace. It will usually be the case therefore that for any proposal to use an alternative radar as mitigation, such a radar should be supplied in addition to NERL's current capabilities.

## 5.9 Cost of bespoke solutions

- 5.9.1 The basic premise of cost neutrality to NATS will generally mean that all set up, assurance, and through life costs, should be met by developers or from other sources. Through life means for the length of time any mitigation is required to be in place including any reversion costs should the wind farm reach the end of its life and the mitigations need to be reversed. For example should an additional radar source be proposed we would expect that all the costs to implement, approve and operate the facility be covered throughout the lifetime of the radar, including de-commissioning and frequency spectrum costs.

## 6. Conclusion

- 6.1 It is NERL's view that an individual bespoke solution will be very challenging to implement in a cost-effective manner and in a way which does not prejudice NERL or other developers. For this reason NERL is focussing on the Raytheon solution as being the most promising mitigation and with the greatest applicability, for both NERL and UK developers. The strategic importance of both aviation and wind farm developments to the UK requires that both be addressed in a co-operative and holistic manner.

- 6.2 NERL's priority is to implement technical and operational improvements which give direct safety and service benefits to our customers and allows us to fulfil our commitments under the terms of our licence. We are required to achieve this within a strictly regulated economic regime. Our ability to accommodate and resource bespoke solutions for the number of developments being proposed is already stretched and with the number of planned developments likely to increase under the Government's Renewable Energy Strategy<sup>4</sup>, it is unlikely to be feasible to continue to work on individual solutions in all cases.
- 6.3 All assessments of wind farms by NERL will take into account the strategic requirements of aviation and the cumulative impact of proposed developments on our operations. NERL is not, however, in a position to comment on the strategic relevance of different wind farm developments and so cannot make judgements, where there is a cumulative impact as to which developments should go ahead or benefit from mitigation.
- 6.4 Any developer wishing to propose a form of mitigation other than that proposed by Raytheon, should first take into account the details provided in this document to assist them in determining the viability of their approach.
- 6.5 NERL is committed to the continuing development of the Raytheon proposal and will be making a financial contribution 'in kind' as part of our commitment to reducing carbon emissions which are directly within our control and indirectly where appropriate.

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<sup>4</sup> [http://renewableconsultation.berr.gov.uk/consultation/consultation\\_summary](http://renewableconsultation.berr.gov.uk/consultation/consultation_summary)