

Aviation Plan

**In respect to the interaction between
wind turbines and aviation interests**

Contents

| | |
|---|----|
| Introduction | 3 |
| Vision | 4 |
| Statement from the Prime Minister | 5 |
| Plan Objectives | 6 |
| Aviation Plan Governance | 7 |
| Aviation Plan Programme | 8 |
| Previous Studies / Baseline Information | 10 |
| | |
| Work-streams | 14 |

Introduction: The Aviation Plan

It is recognised that wind turbines can have a detrimental impact on the operations of aviation activities, in particular radar. Government has been working closely with a number of stakeholders to understand these impacts and identify and develop mitigation solutions that will allow the increased deployment of renewable technologies, in particular wind power, while ensuring National Security and a continued safe aviation operating environment.

This Aviation Plan has been developed to draw together the activities of identifying and developing mitigation solutions and to provide a coordinated approach to delivering solutions.

The prime aim of the Plan is to provide a tool to allow stakeholders to monitor progress of the delivery of solutions. As such it will present details of the key programmes for the delivery of mitigation solutions.

The Aviation Plan is a “living” document and will be updated as progress is made on existing work-streams and new ones are included within the Plan.

Vision

There is no universal solution to mitigating the effects of wind turbines on radar. Therefore,

the vision
is to establish
a suite of workable mitigation solutions
endorsed by aviation stakeholders

which offer the opportunity for constructive dialogue between wind farm developers and aviation stakeholders to identify, develop and implement mitigation measures that reduce the impacts of wind turbines on radar.

Statement from the Prime Minister

I have asked the Secretaries of State for Defence, Business and Transport to step up their efforts, in cooperation with industry and the regulators, to identify and test technical solutions to the potential difficulties windfarms pose to air traffic and defence radar.

The Rt. Hon. Gordon Brown MP
Prime Minister
19 November 2007

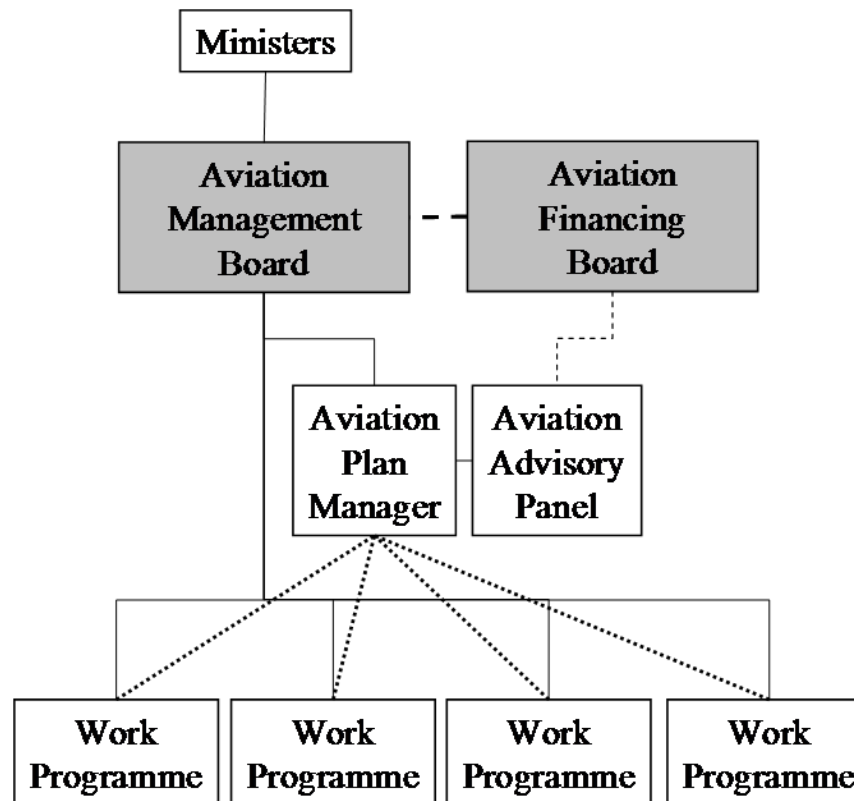
Objectives

- Remove barriers to the deployment of renewable energy
- Reduce objections to wind farm proposals arising from civil and military aviation organisations, in particular;
 - Airports (air traffic control)
 - Ministry of Defence (air defence and air traffic control)
 - NATS (en route)
 - Civil Aviation Authority
- Deliver the renewable energy targets
 - For 2010
 - Onshore
 - Round 2 Offshore
 - For 2020
 - Onshore
 - Round 2 Offshore
 - Round 3 Offshore

Aviation Plan Governance

Present Status

The governance of the Aviation Plan will be the responsibility of an Aviation Management Board, that will be supported by an advisory panel. The Aviation Plan will be managed on a day-to-day basis by the Plan Manager, provided by DECC. The BWEA have taken on the responsibility of establishing a central funding mechanism that will support, financially, the work-streams within the Plan.



Aviation Plan High Level Programme

Present Status

This programme is a summary of the key milestones that are to be delivered by the various work-streams within the Aviation Plan. It is one of the tools to be used by the Aviation Management Board to monitor the progress of delivering solutions.

| | |
|------------------------|--|
| Provisional dates | |
| Milestone completed | |
| Original delivery date | |
| Present delivery date | |

| 2008 | | | | 2009 | | | | 10 | 11 | 12 |
|------|----|----|----|------|----|----|----|----|----|----|
| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | | | |

| Baseline | | | | | | | | | | | |
|---------------------------------------|-----|--|-----|-----|-----|-----|-----|--|-----|-----|--|
| Radars Review Programme | | | RR1 | RR2 | | | | | | | |
| Air Defence | | | | | | | | | | | |
| Greater Wash (T102, infill radar) | | | | GW1 | GW2 | | | | GW3 | GW4 | |
| Air Traffic Control | | | | | | | | | | | |
| Advanced Digital Tracking study 1 | | | | AT1 | | | | | | | |
| Advanced Digital Tracking study 2 | | | | | AT2 | | | | | | |
| SP3000 Study | | | SP1 | SP2 | | | | | | | |
| Transponder Mandatory Zones | | | | TM1 | | | TM2 | | | | |
| Raytheon Project | | | | | RP1 | | | | RP2 | RP3 | |
| Radars Interference Reduction Studies | | | | | | | | | | | |
| BAE Systems RAM Study | BA1 | | | | | | | | | | |
| QinetiQ RAM study | | | | | QR1 | QR2 | QR3 | | | | |
| HiTek RAM Study | | | | | HR1 | HR2 | | | HR3 | | |
| Consultation | | | | | | | | | | | |
| Web-based Site Screening Tool | | | | EC1 | EC2 | | | | | | |
| Civil Aviation Authority Remit | | | | | CA1 | | CA2 | | | | |

Key to Milestones

- RR1 Radar review completed
- RR2 Radar R&D gaps reported
- GW1 Infill radar study reported
- GW2 T102 installation stage 2 reported
- GW3 Wind Farm mods installed
- GW4 Wind mods assessment reported
- AT1 ADT review reported
- AT2 ADT2 commences
- SP1 Contract let with Sensis
- SP2 Workshop held and reported
- TM1 Airspace changes agreed
- TM2 Airspace changes implemented
- RP1 Contract let with Raytheon
- RP2 Demonstration complete
- RP3 Formal qualification complete
- BA1 RAM study reported
- QR1 Demonstration turbine installed
- QR2 Field test completed
- QR3 Assessment reported
- HR1 Demonstration material installed
- HR2 Field tests reported
- HR3 Study completed and reported
- EC1 Mapping on website / User requirements agreed / tender documentation circulated
- EC2 Contract let for interactive tool
- CA1 Funding agreed
- CA2 CAA staff in place

Aviation Plan FAQs

Why has the Aviation Plan been developed?

For a number of years there has been several work packages on-going to identify and develop solutions to the potential impacts of wind turbines on radar and other aviation interests. The Aviation Plan is a tool for prioritising, co-ordinating and managing these activities.

For a while there has been a growing frustration developing between key partners, how will the Aviation Plan help resolve this?

The Aviation Plan is only the beginning of a process to identify and develop solutions to the concerns that arise from the potential impacts that wind turbines may have on radar. For it to succeed it will require engagement from all the key stakeholders. This engagement has been formalised through a Memorandum of Understanding, signed by key stakeholders in June 2008. The Aviation Plan and its associated work-streams will help provide a route map for the development of solutions through enhanced co-operation between stakeholders.

Who will do the work required to deliver the work-streams?

The commitments given in the Memorandum of Understanding show the importance given to the Aviation Plan. The signatories have identified senior people within their organisations that will sit on the Aviation Management Board. In addition, BERR, the MOD and BWEA have all recently identified or recruited staff with specific responsibility to engage with the Aviation Plan.

Where will the funding come from to pay for the development and implementation of solutions?

This is one of the key challenges in developing solutions and one of the key objectives within the Memorandum of Understanding is to establish a central fund from which money can be drawn to develop and, where appropriate, implement solutions. The BWEA has been tasked with establishing the funding mechanism and its management board.

Can we be sure that the scope of the issues contained within the Aviation Plan is comprehensive?

The Aviation Plan has been developed around those work-streams already identified, some of which are already funded and under way. It is possible that as the number of wind farms increases then new aviation concerns will arise. An Aviation Advisory Panel has been established to monitor this and to provide expert advice to the aviation and fund management boards.

Who will monitor the success of the Aviation Plan?

The body with the overall responsibility to deliver the Aviation Plan and its associated work-streams is the Aviation Management Board. The Board will be supported by an Aviation Advisory Panel which will help monitor the delivery of existing work-streams and make recommendations for new ones. The Aviation Management Board will also work closely with the Fund Management Board to ensure the success of the Plan.

Baseline information

Previous Study Reports (Page 1 of 3)

| Name | Detail | Consultant | Status |
|---|--|---------------------------|---|
| Greater Wash Feasibility Study | Investigate practical feasibility of deploying Infill Radar in the Greater Wash | QinetiQ Ltd. | Completed Report BERR/COWRIE websites Presentation on 21.9.07 |
| Clatter 1 | Test potential software fixes for ADT & SPE3000 | BAE Systems/ Sensis | Completed Reported 2005 BERR website |
| Clatter 2 "Celtic Storm" | Test improved software fixes for ADT & SPE3000 | BAE Systems/ Sensis | Completed 2006 Information remains commercially confidential |
| Safety Case | Production of a draft safety case for baseline Watchman Radar and ADT and SPE3000 technologies | HVR onsulting Ltd. | Safety Case Part 1 completed 2007 BERR website Need information from Clatter 2 for other parts. |
| ATC safety requirement workshop | Capture of ATC safety requirements | Key Stakeholders | |
| Raytheon Study | Phase 1 (design options for mitigating radar interference) | Raytheon | Phase 1 complete |
| Feasibility of Mitigating the Effects of Windfarms on Primary Radar | Feasibility study to investigate mitigating technologies for primary radar systems | Alenia Marconi Systems | Completed 2003 |
| Wind Farm Impacts on Radar | Study to investigate wind farm interference on radar systems | QinetiQ Ltd. | Completed 2002 |

Previous Study Reports (Page 2 of 3)

| Name | Detail | Consultant | Status |
|---|---|---------------------|-------------------------------|
| Scoping Study of the Effect of Wind Turbines on Aeronautical Radio Navigational Systems | Generic study investigating effect of wind turbines on radars and CNS. | Roke Manor Research | Unpublished Completed 2004 |
| Wind Turbines and Aviation Interests – European Experience and Practice | Study to gain insight into European experience and practices relating to wind turbines and radars | STASYS Ltd | 2002 |
| | | | |
| Mistral Crop | MoD Trials | | Unclassified report released |
| Quixotic Zephyr | MoD Trials | | Unclassified report released |
| Swift Crofter | MoD Trials | | Unclassified report released |
| Blind Guardian | MoD Trials | | Classified |

Previous Study Reports (Page 3 of 3)

| Name | Detail | Consultant | Status |
|---|--------------------------------------|-------------------|--|
| Stealth technology for wind turbines | Development of RAM for wind turbines | BAE Systems, ATC | Reporting Q1 2008 |
| Stealthy Wind Turbines – Addressing the Radar Issue | Development of RAM for wind turbines | QinetiQ Ltd. | Reporting Q3 2008 |
| A low cost, safety critical radar absorbing material for wind turbine nacelles and towers | Development of RAM for wind turbines | Hi-Tech | Completion January 2009 |
| Development of an innovative radar absorbing composite structure for wind turbine blades | Development of RAM for wind turbines | Hi Tech | New project - contract negotiation ongoing |

Work-streams

Baseline

Introduction

The provision of baseline information will help a wider understanding of the issues. The following studies have been identified as providing useful baseline information.

Studies

1. Radar Review
2. Turbine locations (this will form part of the e-consultation work-stream)
3. Level of objections – an exercise to understand how many wind projects and MW are subject to aviation objections to allow the prioritisation of work-streams. This will be an on-going activity and is not reported as a work-stream in the Aviation Plan
4. Information – the provision of a depository of relevant documentation – not currently reported

Relevant Documentation

Baseline

1. Radar Review

Introduction

A review of available reports to assess what information is available concerning the interaction of wind turbines with military radar systems. This will provide a base-line of information from which it should be possible to determine what other studies might be required.

Key Aims

- Review the available technical reports
- Establish the gaps in information

Relevant Documentation

Baseline

1. Radar Review: Programme

Present Project Status

Ongoing.

| Updated: 18 September 2008 | 2008 | | | |
|-------------------------------|------|-----|-----|-----|
| | Sept | Oct | Nov | Dec |
| Draft review report submitted | ■ | | | |
| Report issued | | | ■ | |
| R&D Gap analysis reported | | | | ■ |

| | |
|------------------------|---|
| Milestone completed | ■ |
| Original delivery date | ■ |
| Present delivery date | ■ |

Air Defence Radar

Introduction

It is recognised that wind turbines can have a detrimental impact on air defence radar. The development of appropriate performance criteria will be important in developing mitigation solutions in respect to defence radar.

There are presently in the order of 1,000MW (8 projects) of wind power presently subject to AD radar objections.

Studies

1.T102 / infill radar

Relevant Documentation

Air Defence Radar

1. T102, infill radar

Introduction

The greater Wash is an important area for the development of offshore wind. It is also strategically important for air defence. A number of trials are planned to establish what performance criteria can be appropriately developed for air defence coverage of the Wash and how existing and new radar might perform in the presence of turbines and what improvements are available to radar systems to make them less susceptible to interference from wind turbines.

There are presently in the order of 1,000MW (8 projects) of wind power presently subject to AD radar objections.

Key Aims

- Establish the performance criteria relevant to operating in the presence of wind turbines.
- Define and conduct trials in support of AD work stream development
- Review of AD methodology for wind farm assessments.
- Develop policy in response to higher directives, new trials, technologies and scientific evidence.
- Explore operational and technical mitigation options for both on and offshore developments.

Relevant Documentation

- Explore operational and technical mitigation options for both on and offshore developments.
- Tactical T101 radar trials reports Swift Crofter, Mistral Crop and Blind Guardian.
- BAE Systems ADT software upgrade technical specification - Sherringham Shoal.
- T102 performance specification.
- T93 radar performance benchmarking against Scroby Sands.
- T93 radar trials reports.
- Lockheed-Martin TPS-77 wind farm trial report.

Air Defence Radar

1. T102, infill radar: Programme

Present Project Status

Have refined the assessment method to be more permissive by eliminating the majority of generic assessment criteria and adopt a specific analysis for each development. Drafting a paper to clarify the MOD AD approach to wind turbine developments. MOD trial and tactics organizations leading development of Trials plan, Danish wind farm trial at Horn Rev planned for September 2008.

| Updated: 22 August 2008 | 2008 | | 2009 | | | | 2010 | | | | 2011 | | | |
|-------------------------------|------|----|------|----|----|----|------|----|----|----|------|----|----|----|
| | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| TSP Danish Trials Reported | | | | | | | | | | | | | | |
| T102 Stage 1 Report | | | | | | | | | | | | | | |
| T102 Stage 2 Report | | | | | | | | | | | | | | |
| T102 wind farm Mod | | | | | | | | | | | | | | |
| T102 WF Mod Assessment report | | | | | | | | | | | | | | |

| | |
|------------------------|--|
| Milestone completed | |
| Original delivery date | |
| Present delivery date | |

Air Defence Radar

1. T102, infill radar: FAQs

The MOD already has a heavy workload, how will this influence the resources for trials and research into effects of wind turbines on AD radar?

The MOD recognises this conflict in the demands on its resources. None-the-less, the MOD has committed, through a Memorandum of Understanding, to fully engage in the identification and development of solutions to ensure that the research and evidence is available to allow effect policy development to allow the MOD's activities to continue together with the increased deployment of wind farms.

Air Traffic Control

Introduction

One of the key barriers to the deployment of wind farms is their potential impact on aviation safety. Wind farms can have an unacceptable impact on the different radar systems employed for Air Traffic Control (ATC). Over the recent years studies have demonstrated the extent of the problems encountered by the Aviation Industry and have shown the potential for technological solutions. These studies have shown that for airport and approach radars the BAE's ADT and the Sensis SPE3000 have the potential to provide such solutions, but require further development. Studies have also been performed which have shown potential for providing a technology solution for the radar systems employed by en-route Air Traffic Control and further development work has been proposed.

There are presently in the order of 1,900MW (29 projects) of wind power presently subject to airport and aerodrome air traffic control objections and of this some 600MW (14 projects) arise from MOD objections and 1,300 (15 projects) from Airports. In addition, there are presently in the order of 3,100 MW (47 projects) of wind power presently subject to en-route air traffic control objections.

Work-streams

1. Advanced Digital Tracking Study (phase 1)
2. SPE3000 study
3. Transponder Mandatory Zones
4. En route Radar
5. Advanced Digital Tracking Study (phase 2) – currently not reported

Air Traffic Control

1. Advanced Digital Tracking Study (Phase 1)

Introduction

The provision of Air Traffic Control Services within the United Kingdom is regulated by the CAA and the MOD both of whom demand high levels of safety assurance. It has been demonstrated that wind turbines can adversely affect the performance of primary radar and other ATC equipment and work packages are being devised to develop potential mitigation technologies.

Key Aims

- To demonstrate to the MOD that the improved advanced digital tracking (ADT) has sufficient potential to warrant a formal development programme

Relevant Documentation

—

Air Traffic Control

1. Advanced Digital Tracking Study (Phase 1): Programme

Present Project Status

Contract signed week commencing 11 August 2008

| | KSH | 2008 | | | | Comments |
|---------------------------|-----|------|----|----|----|----------|
| | | Q1 | Q2 | Q3 | Q4 | |
| Scope agreed | | | | | | |
| Contract let | | | | | | |
| Air Command Demonstration | | | | | | |
| Lossimouth Trial | | | | | | |
| MoD Report | | | | | | |
| Project final report | | | | | | |

| | |
|------------------------|--|
| Milestone completed | |
| Original delivery date | |
| Present delivery date | |

Air Traffic Control

1. Advanced Digital Tracking Study (Phase 1): FAQs

This work-stream is an initial evaluation of a potential solution, where does it go from here?

The MOD is leading on this work-stream, with support from DECC. It is largely being funded by the MOD. Should the evaluation prove fruitful the work-stream could progress to a second phase, subject to funding being made available. There is the potential for this work-stream to have wider civil aviation applications.

Where will future funding come from?

This has yet to be agreed

Air Traffic Control

2. SPE3000 Study

Introduction

In the 2006 with the Celtic Storm trials in Wales the Sensis SPE3000 were trialled to assess performance in mitigating the effects of wind farms on the Watchman Air Traffic Control radar. In May 2007 a two day workshop, facilitated by BAE Systems, was held to further refine the Watchman safety case. A key recommendation from this workshop was to bring together the UK aviation policy makers, regulators, Air Traffic Service providers and subject matter experts to gather relevant standards, discuss and agree those applicable to providing a safe aviation environment when wind farms are in line of sight of primary surveillance radar. Subsequent workshops have been hosted by BAE Systems.

Sensis is also being contracted to hold similar workshops in order to progress the subject on performance criteria for wind farm mitigation technologies for air traffic control purposes.

Key Aims

- Further develop prototype wind farm mitigation techniques based on the SPE-3000 baseline.
- Host a workshop at Sensis for up to three representatives.
- Present results at a workshop in the UK hosted by BERR

Relevant Documentation

–

Air Traffic Control

2. SPE3000 Study: Programme

Present Project Status

Contract terms and conditions are being agreed.

| | KSH | 2008 | | | | 2009 | | | |
|-------------------------|-----|------|----|----|----|------|----|----|----|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Contract let | | | | | | | | | |
| Workshop details agreed | | | | | | | | | |
| Staffing agreed | | | | | | | | | |
| Workshop held | | | | | | | | | |
| Presentation by Sensis | | | | | | | | | |
| Final report | | | | | | | | | |

| | |
|------------------------|--|
| Milestone completed | |
| Original delivery date | |
| Present delivery date | |

Air Traffic Control

2. SPE3000 Study: FAQs

What is the outcome of this study expected to be?

The contract is for Sensis to facilitate a workshop to allow their SPE3000 radar to be evaluated to see what might be done to improve its performance in the presence of wind turbines. Should this be possible then a further work programme will be developed to progress the study further.

Where is the money coming from to pay for the studies?

BERR is paying for the workshops and others (e.g. MoD) are also providing staff to provide the appropriate experts to attend the workshop. The costs of any further studies have not been defined yet and will depend on what is proposed. At that point a source of funding would need to be identified.

Air Traffic Control

3. Transponder Mandatory Zones

Introduction

The CAA are responsible for Secondary Surveillance Radar (SSR) carriage policy within the UK. SSR is less susceptible to wind farms than primary surveillance radar; however, it only works for aircraft that carry a suitable transponder and the carriage of such transponders is not mandatory for all aircraft in all UK airspace. Therefore, areas within which the carriage of transponders is mandatory could be established to help maintain radar contact with aircraft flying over wind farms. However, the certification and approval costs are a significant factor that must be considered before transponder carriage regulations are amended and are key areas of concern to the General Aviation (GA) community. Given that these are regulatory costs, it would appear that they would be a logical candidate to offer financial mitigation if appropriate funding could be found.

Key Aims

- To assist with certification and approval costs for SSR transponder carriage.
- Establish the regulatory framework for the implementation of Transponder Mandatory Zones (TMZs).
- Establish the airspace change procedure that must be followed to request a TMZ.
- Development of a regulatory framework and suitable airspace change process to allow the establishment of TMZs.

Relevant Documentation

- Consultation Document: Proposal for an Incremental Expansion of the Use of Secondary Surveillance Radar Mode Select Transponders in UK Airspace, CAA, 31 January 2008.

Air Traffic Control

3. Transponder Mandatory Zones: Programme

Present Project Status

The public consultation period was completed on 31 May 2008 and the responses are being reviewed prior to the publication of a Response to Consultees document.

| Updated: 22 September 2007 | KSH | 2008 | | | | | | | | 2009 | | | |
|----------------------------------|-----|------|---|---|---|---|---|----|----|------|----|----|----|
| | | J | F | M | A | M | J | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Public Consultation | CAA | | | | | | | | | | | | |
| Airspace Change Procedure agreed | CAA | | | | | | | | | | | | |
| Implementation | CAA | | | | | | | | | | | | |

| | |
|------------------------|--|
| Milestone completed | |
| Original delivery date | |
| Present delivery date | |

Air Traffic Control

3. Transponder Mandatory Zones: FAQs

How Applicable will TMZs be as a solution?

This is difficult to say at this stage, it will depend on the circumstances in the vicinity of the proposed wind farm. However, it is safe to say that it is unlikely to be applicable to wind farm applications.

Air Traffic Control

4. En Route Radar

Introduction

NATS En-Route Plc (NERL), Raytheon Canada Limited (RCL) and BERR have been working together to develop a technical mitigation to the impact of wind-turbines on NERL's en-route surveillance infrastructure.

The development of the Raytheon Solution will potentially enable NERL's entire en-route primary surveillance infrastructure to effectively and safely mitigate the impacts of wind-turbines thus releasing a large number of wind-farm developments currently subject to NERL objections and potentially in the future.

After assessment of the available technologies and mitigation solutions, it is NERL's opinion that the enhancements proposed as part of the Raytheon Solution project offer the greatest potential to safely and effectively mitigate the effect of wind-turbines on NERL's en-route primary surveillance infrastructure.

Key Aims

- Complete the research and development of technological mitigations to safely and effectively eliminate the impact of wind-turbines on NERL's entire en-route surveillance infrastructure
- Complete trials of the technical mitigation solution on existing deployed Raytheon radars
- Demonstrate evidence of the technical feasibility of the Raytheon Solution
- Permit NERL to remove their objections to wind farm applications subject to subsequent deployment of the mitigation solution

Relevant Documentation

- Raytheon wind farm report and Annexes (Jul 2006), NATS report (Dec 2006)
- Raytheon proposal dated 17 March 2008 'UK NATS Wind farm Study Proposal ROM – validity extension'
- Minutes from BERR/BWEA/NATS/Raytheon meeting, May 2008

Air Traffic Control

4. En Route Radar: Programme

Present Project Status

An updated proposal has been received (Sep 2008) which requires negotiation between BWEA/NERL and Raytheon. The information contained below does not reflect the final status and is therefore subject to further refinement following negotiations with Raytheon. The project is awaiting confirmation that the funds are available for the next phases of the study.

| Updated: 2 September 2008 | Quarters | | | | | | | | | | | | Other Stakeholders |
|-------------------------------|----------|---|---|---|---|---|---|---|---|----|----|----|--------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Mitigation techniques refined | | | | | | | | | | | | | |
| ASR system test complete | | | | | | | | | | | | | |
| Field tests complete | | | | | | | | | | | | | |
| Formal qualification complete | | | | | | | | | | | | | |

| | |
|------------------------|--|
| Milestone completed | |
| Original delivery date | |
| Present delivery date | |

Air Traffic Control

4. En Route Radar: FAQs

This proposed solution has been around for a long time, what is happening to it?

The creation of the Aviation Management Board and the establishment of the funding vehicle was vital to enable this project to move forward. Funding will be secured through the Central Fund with contributions from the wind industry, NERL and Government. Clear acceptance criteria is also necessary before a contract can be signed, and this is being developed in collaboration between NERL and Raytheon.

What level of confidence do we have that this solution will be an effective mitigation?

As with the development of any new technology, there is some risk and uncertainty. A phased programme has been proposed to progressively reduce the risk during the development phase. Moreover, all parties are working together to define the acceptance criteria for the project. The development schedule will include milestones where progress can be regularly reviewed. Based on the available technologies and mitigation solutions known today, it is NERL's opinion that the enhancements proposed as part of the Raytheon Solution project offer the greatest potential to mitigate the effect of wind-turbines on NERL's en-route surveillance infrastructure.

Would the radar be field tested in the UK?

Data from NERL en-route surveillance network is expected to be used in the development programme. Field trials using representative systems are also proposed but these may not be in the UK.

What are the full costs for implementing this solution?

These are TBC and an initial estimated has been provided. For the maximum benefit to be derived the implementation is required to be rolled out at all NERL en-route sites. In order to exploit full potential of the proposed solution the implementation at existing NERL en-route surveillance sites may require specific tuning, testing and acceptance. Potential synergies exist with the roll out of the NERL investment programme and where possible and practical these synergies will be exploited in order to reduce costs and ensure that the solution is rolled out as soon as possible.

Has the safety case been made for this solution?

The existing safety arguments are expected to remain valid but a gap analysis will be required to be performed. A qualification period has been proposed as part of the development programme to satisfy any safety related concerns.

NERL is currently upgrading its radar system, is this part of that programme?

No. The long term investment programme that NERL have commissioned is separate to this project. The roll out of the radar system upgrades across NERL's infrastructure has already started and the majority of sites will have been already rolled out by the time the Raytheon Solution is available. NERL will however endeavour to integrate the implementation of the Raytheon Solution project into the existing investment programme.

Do we understand the full extent of the upgrades, for example would it involve the upgrading of the ATC centre systems?

The solution will not require upgrading of the ATC centre systems but will be implemented at the radar site.

Radar Interference Reduction Studies

Introduction

Previous studies have indicated that radar absorbing material (RAM) technology may significantly reduce the radar cross section of turbine blades, the column and the nacelle. Whilst this will not completely remove the detrimental impact on military and civil radar systems it may be sufficient to remove planning objections. Three projects are currently being delivered and one was completed in December 2007. These projects have been supported through the UK Governments R&D programme.

Studies

The QinetiQ and Hitek studies form part of the Aviation Plan.

1. QinetiQ RAM study
2. Hitek RAM studies (2 separate projects)
3. BAE Systems RAM study (complete)

Radar Interference Reduction Studies

1. QinetiQ Radar Absorbing Material Study

Introduction

Studies have indicated that RAM technology can significantly reduce the radar cross section (RCS) of wind turbines. While this will not completely remove the detrimental impact on radar in all scenarios, it may be sufficient to remove objections in many cases. Furthermore, the ability of radar solutions (such as ADT) to mitigate turbine effects should also be much improved by lower turbine RCS. Consortium consists of QinetiQ Ltd. and Vestas Technology UK.

There are presently in the order of 1,900MW (29 projects) of wind power presently subject to ATC objections and of this some 600MW (14 projects) arise from MoD objections and 1,300 (15 projects) from Airports.

Key Aims

- Develop RAM technology to significantly reduce the wind turbine RCS
- Gain aviation stakeholder acceptance of the technology
- Demonstrate at full scale in line of site ATC radar
- Gain manufacturers and developers acceptance

Relevant Documentation

- “Study to Investigate Wind Farm Interference on Radar Systems”. QinetiQ Ltd. (BERR URN)
- “Design and Manufacture of Radar Absorbent Wind Turbine Blades”. Qinetiq Ltd. (W/44/00636)

Radar Interference Reduction Studies

1. QinetiQ Radar Absorbing Material Study: Programme

Present Project Status

Modelling and test panel programme complete. A site in Scotland has been identified to demonstrate RAM enhanced turbine in L-O-S of a Glasgow Airport ATC radar (SPE3000).

| Updated: 14 August 2007 | KSH | 2008 | | | | 2009 | | | | Other Stakeholders |
|-----------------------------|---------|------|----|----|----|------|----|----|----|--------------------|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | |
| BAE Systems | | | | | | | | | | |
| Report | BAE | | | | | | | | | |
| QinetiQ | | | | | | | | | | |
| Identify demonstration site | QinetiQ | | | | | | | | | BAA/NATS |
| Blades manufactured | Vestas | | | | | | | | | |
| Turbine installed | Vestas | | | | | | | | | QinetiQ |
| Field test completed | QinetiQ | | | | | | | | | BAA/NATS |
| QinetiQ report | QinetiQ | | | | | | | | | Vestas |

| | |
|------------------------|--|
| Milestone completed | |
| Original delivery date | |
| Present delivery date | |

RadAR Interference Reduction Studies

1. QinetiQ Radar Absorbing Material Study: FAQs

Is a site available to field test the technology?

Yes, a potential site has been identified, planning objection from BAA has been lifted and a letter of intent has been issued by the developer (Castlemilk Development Cooperation). Other sites are also being investigated.

The chosen site is not in view of an ADR (Air Defence Radar), is the chosen site appropriate?

Although difficulties in finding a site have resulted in selection of one without an ADR problem, the intention has always been to erect a single turbine rather than an entire wind farm. One of the major problems presented to an ADR by wind turbines is shadowing and it is not believed that a single wind turbine will have a large effect making any trial inconclusive. It would however be possible to measure the RCS of the turbine and use this data to predict the effect on an ADR more accurately.

Does the project have full funding?

The work-stream is currently funded under the Technology Strategy Board (TSB). An extension has been granted to accommodate delays in securing a suitable site.

How confident of the effectiveness of the solution?

RadAR absorbing material will not remove the “visibility” of turbines to radar, but those developing it are confident of a substantial reduction in the radar cross section from the blades of wind turbines, exactly by how much has to be tested under field conditions.

Do we know how much a RAM blade would cost?

Estimated that RAM application will increase turbine cost by 5 – 10 %

Does the mitigation solution used classified materials and if so will clearance be given for its commercial use?

Yes, MoD clearance is not considered to be an issue as material is narrowband (2.9-3.0 GHz). In addition, a material aimed at the RFID market but based on the same technology has already been downgraded to unclassified.

Is this solution also appropriate for offshore wind farms?

Yes, the technology can also be made to operate at the higher frequency used by navigation radars.

Radar Interference Reduction Studies

2. HiTek Radar Absorbing Material Study: Programme

Introduction

The project will investigate using novel radar absorbing technologies that will be installed onto turbine towers to radically reduce the incidence of radar shadowing and ghost signals created by wind-farms on civilian radar.

There are presently in the order of 1,300MW (15 projects) of wind power presently subject to civil ATC objections.

Key Aims

- Develop RAM technology to significantly reduce the wind turbine radar cross section
- reduce the incidence of radar shadowing and ghost signals on civilian radar by >50%.

Relevant Documentation

“Safe Passage”

www.technologyprogramme.org.uk/site/publicRpts/default.cfm?subcat=publicRpt3&ProjID=414E4E

“Blade Runner”




No public domain information available.

Radar Interference Reduction Studies









2. HiTek Radar Absorbing Material Study: Programme

Present Project Status

Safe Passage: Month 19 of 26. Production of lab-scale broadband absorbing materials. Attachment method to turbine towers established

| | |
|------------------------|---|
| Milestone completed |  |
| Original delivery date |  |
| Present delivery date |  |

Blade Runner: Month 4 of 24. Initial consortium building, material selection, modelling and specifications being prepared

| Updated: 29 May 2008 | KSH | 2008 | | | | 2009 | | | | 10 | Other Stakeholders |
|-----------------------------|-------|------|--|---|---|--|---|----|----|---|--------------------|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | | |
| Safe Passage | | | | | | | | | | | |
| Existing material installed | | |  | | | | | | | | |
| Field test report | Hitek | | |  | | | | | | | |
| TSB project report | Hitek | | | |  | | | | | | |
| New material installed | | | | | |  | | | | | |
| Field test report | Hitek | | | | | |  | | | | |
| Blade Runner | | | | | | | | | | | |
| TSB project complete | | | | | | | | | |  | |
| Turbine installed | AMEC | | | | | | | | |  | |
| Field test report | Hitek | | | | | | | | |  | |

Radar Interference Reduction Studies

2. HiTek Radar Absorbing Material Study: Risk Register

Is a site available to field test the technology?

Not yet, potential sites are also being investigated.

Does the project have full funding?

The work-stream is currently funded under a TSB [full name]. External funding may be required if the product is to be carried on to make it market ready.

How confident of the effectiveness of the solution?

Radar absorbing material will not remove the “visibility” of turbines to radar, but those developing it are confident of a substantial reduction in the radar cross section from the blades of wind turbines, exactly by how much has to be tested under field conditions.

Do we know how much RAM material will would cost to install?

Not at this stage.

Does the mitigation solution used classified materials and if so will clearance by given for its commercial use?

ANSWER

Radar Interference Reduction Studies

3. BAE Systems Radar Absorbing Material Study

The main objectives of the STWT project were:

- 1.To identify the major Radar Cross Section (RCS) sources within a wind turbine which cause it to interfere with radar systems and to identify where the application of Radar Absorbing Material (RAM) treatments and/or component shaping would be of benefit.
- 2.To develop RCS treatments for the tower, nacelle and blades through a combination of turbine modelling, shaping and absorbing or reflecting materials design.
- 3.To demonstrate the practical implementation of commercially viable RCS reduction techniques through the manufacture and characterisation of representative turbine component sections.

Significant outcomes:

- The project managed to address the first two objectives very successfully. The consortium partners now have a better understanding of the major scatterers within a wind turbine and the project has delivered a number of material and shaping schemes which will reduce the turbine's RCS.
- In addition, the programme has identified and where necessary developed low risk treatments for the turbine tower and nacelle components. A low RCS blade component was partially developed but unfortunately it was not possible to complete this activity within the current programme due to the construction of the blade, especially in areas with lightning mesh, and increased weight constraints due to blade design change during the course of the project. Further work is therefore required in future in order to complete the development of a low RCS blade component.

Relevant Documentation

Stealth Technology for Wind Turbines, Final Report, December 2007

Consultation

Introduction

It is recognised that the process by which developers and consultees interact can be improved. These are process improvements that will improve the dialogue and response time between developers and the aviation stakeholders.

There are presently some 4,500MW (36 projects) of wind power subject to civil aviation objections; 3,200MW (21 projects) subject to en route objections and 1,300MW (15 projects) from objections from airports.

Studies

Two potential solutions are being considered;

1. An e-consultation website to facilitate an easier site screening process
2. A change in CAA remit to allow the CAA to take a formal facilitation role in finding solutions for specific projects

Consultation

1. Web-based Site Screening Tool

Introduction

There is a recognised need for an interactive web tool that can be used by developers during the site selection stages of project development. The development of an interactive tool will be progressed in two phases:

- Phase 1: An interim solution consisting of a series of maps with various downloadable GIS layers.
- Phase 2: A comprehensive interactive web tool encompassing phase 1 and a host of other features.

This work-stream aims to establish a situation whereby developers are able to undertake aviation issues into account during their site selection processes without the need to consult the aviation consultees. Thereby freeing the aviation consultees the opportunity to respond to more specific enquiries within shorter timescales than is presently the case. It is not appropriate to identify the number of MW that are presently subject to objections in this case.

The key Aims of the work-stream are to:

- Reduce speculative applications / enquires to help manage their resources
- Combine information on all radar
- Be a repository for all information about proposed developments
- Integrate the aviation consultation proforma
- Automatically distribute enquiries to relevant stakeholders
- Provide an assessment methodology
- Make information available
- Ensure sensitive information is secure

Relevant Documentation

- Minutes of a initial meeting held on the 1 April.
- Minutes of the meeting held on the 24 July

Consultation

1. Web-based Site Screening Tool: Programme

Present Project Status

Defence Estates have initiated the preparation of a detailed specification for undertaking a programme of work to upgrade their current database (WIND). It is possible that some of the features for a wider discussed above would also form part of these requirements. A programme needs to be established to allow features for a wider applicable tool to be developed.

| 5 June 2008 | KSH | 2008 | | | | | | | 09 | |
|---|------|------|---|---|---|---|---|---|----|--|
| | | J | J | A | S | O | N | D | | |
| Phase One (Web based maps) | | | | | | | | | | |
| Aerodromes and airfields map placed on RESTATS | CAA | ■ | | | | | | | | |
| NATS maps placed on RESTATS | NATS | ■ | | | | | | | | |
| Esdalemuir Seismic map on RESTATS | DE | ■ | | ■ | | | | | | |
| Met Office maps on RESTATS | DE | ■ | | ■ | | | | | | |
| Low Flying maps on RESTATS | DE | | ■ | ■ | | | | | | |
| ATC/AD maps on RESTATS | DE | | | ■ | | | | | | |
| Relevant Round 3 information placed on RESTATS | BERR | ■ | | ■ | | | | | | |
| Final review of information and draft website | | | | | ■ | | | | | |
| Web site goes live | | | | | ■ | | | | | |
| Phase Two (Interactive tool) | | | | | | | | | | |
| Agree key user requirements | | | | | | ■ | | | | |
| Milestones and Programme to be defined, expected to include; contract let, Turbine location audit, web tool launch. | | | | | | | | | | |

| | |
|------------------------|---|
| Provisional date | ■ |
| Milestone completed | ■ |
| Original delivery date | ■ |
| Present delivery date | ■ |

Consultation

1. Web-based Site Screening Tool: FAQs

Will the novel nature of the IT requirements cause delays in its procurement?

This is entirely possible, but having identified this as a risk to the programme it can be managed. This is a small project, with a small budget, therefore a simple procurement process should be possible. The important issue is getting the IT specification correct. The complexity arises from wanting to include the needs of military and civilian aviation interests into the tool. However, although the organisations involved are different their requirements are fundamentally similar.

No budget has been allocated to developing the web tool, who is going to pay.

This has yet to be determined, but some external funding may be required.

Where will the tool be placed on the internet?

This has still to be determined, but there are a number of options including a site called RESTATS which already holds information about renewable energy projects.

It is very likely that information on specific location of individual turbines will be required for the tool to function effectively. How will this be collated and the information maintained?

We are currently investigating how this can be most effectively undertaken. The involvement of the wind development community will be important in achieving this.

Consultation

2. CAA Remit

Introduction

The CAA is the independent, specialist aviation regulator for the UK. Current Ministerial Direction does not task the CAA with formally carrying out any work related to wind turbines and their effect on aviation. Nevertheless, the CAA already provides advice concerning wind turbines and their potential effect on aviation as well as facilitating discussions between developers and aviation stakeholders where an impasse has been reached. However, these services are constrained by the limited resources available and could be significantly improved if additional resources were found. To do this would require a revised CAA remit as directed by the DfT pursuant to Section 16(1) of the Civil Aviation Act 1982. Any change to the CAA's role does not imply a change to the prime responsibility as the independent aviation regulator where safety is paramount.

Key Aims

- to formalise the role of the CAA with respect to wind turbines and their potential effect on aviation
- to obtain additional resources for the CAA thus allowing an expansion of their current role.

Relevant Documentation

- Draft Job Specification
- Ministerial Direction to the CAA

Consultation

2. CAA Remit: Programme

Present Project Status

The job specifications have been drafted by CAA.

The project now awaits formal agreement on funding. This will fall in place once the Central Funding Mechanism is established. Once funding is available a programme can be finalised.

| Updated: 18 December 2007 | KSH | 2008 | | | | 2009 | | | |
|-------------------------------|-----|------|----|----|----|------|----|----|----|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Job Specifications Drafted | CAA | | | | | | | | |
| Financial support agreed | FMB | | | | | | | | |
| CAA letter submitted to DfT | CAA | | | | | | | | |
| Ministerial direction amended | CAA | | | | | | | | |
| Job adverts Published | CAA | | | | | | | | |
| Interviews | CAA | | | | | | | | |
| In post | CAA | | | | | | | | |

| | |
|------------------------|--|
| Provisional milestones | |
| Milestone completed | |
| Original delivery date | |
| Present delivery date | |

Consultation

2. CAA Remit: FAQs

The current staff resource in CAA would not support the proposed enhanced remit, how will this be achieved?

New staff would need to be recruited. Presently it is proposed that two new posts be created.

The CAA is unable to financially support any new posts for the proposed changed in remit, who will pay?

There would be a need to secure external funding, for example from the central fund.

Despite a revised CAA remit is it possible that the level of unresolved objections remains unchanged?

This is unlikely. The CAA already provides a facilitation role and have provided views on the appropriateness of aviation objections. With the enhanced role it could be more involved in finding and agreeing mitigation, where these exist. There will be some projects for which there is currently no solution and having this point clearly articulated to the developer will save time and hopefully avoid unnecessary public inquiries.

What if suitably qualified personnel cannot be found to fill the new CAA roles?

This is a matter of defining the job specification and the salary range properly.

END