

Sq Ldr David Payne

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20th June, 2008

Dear David,

Thank you for providing BWEA with the opportunity to review and give comment on the draft revision of CAP764, Policy and Guidance on Wind Turbines. This is a joint response from the BWEA and Scottish Renewables. The BWEA represents the interests of the wind energy, wave and tidal stream interests across the UK, whilst Scottish Renewables is the trade association for the Scottish renewable energy industry in Scotland. These industries are playing a crucial role in the UK and Scottish government's efforts to tackle climate change and increase its energy security, and must continue to do so in order to meet Scotland's carbon emissions reduction target of 80% by 2050.

As you will no doubt be aware, aviation is a major factor affecting wind farm developments both on- and off-shore in the UK and the wind industry seeks to continue to work with aviation stakeholders in finding operational and technical mitigation to overcome this complex issue.

There are a few points that I would like to highlight as observations:

- There is no longer a detailed assessment methodology for conducting the radar line of sight; the revised CAP764 document proposes a simplified process which may be too conservative. We would therefore request that the CAA reinstate the previous assessment methodology, or explain why it needs to be removed.
- There is an absence of Radar Absorbing Materials as a mitigation technique. Whilst it is noted that all possible mitigation techniques are not referred to, the list is currently comprehensive. The omission therefore of this emerging technology seems to be a short fall.
- References to the CAA considering aerodrome managers (or equivalent) as expert testimony could be misleading; an objection from an airport to a proposed development (on safety or economic grounds) should always be provided with a robust written case that may later be subject to rigorous testing.
- Could the CAA adopt the same terminology as the MOD when it comes to describing the effects of wind turbines on radar; for example 'clutter', 'obscuration' and 'shadow'?

- There is little or no mention of the role of the CAA as it relates to Defence Estates (DE). Whilst DE may not be bounded by CAA rules, there is an understanding that they adhere to them as a matter of routing practice where this does not conflict operationally. It would be helpful to clarify this relationship.

Feedback has been sought from across the industry, and hopefully you will find that the points have been clearly defined within this document. If you wish to discuss any of these matters further, please do not hesitate to contact me.

Yours sincerely,



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Foreword

- General The introduction of additional radars would place a future restriction on wind farm development. Should the CAA put forward guidelines on the procurement or upgrade of radar systems such that:
- the radar can mitigate wind farm effects.
 - where additional radar coverage is the reason for the radar installation, the airport should demonstrate that adequate radar coverage isn't available from existing radar.
- Maybe the BWEA should be consulted about new radar proposals?
- 1.5 The increasing role of wind energy in the national economy has been downgraded to a "Government aspiration".
- 2.1 and 3.1 Helpful acknowledgement that CAP764 has a wider audience than aviation stakeholders.

Chapter 1 CAA Responsibilities

- 2 Title now includes CNS safeguarding.
- 2.2 The footnote states that technical site safeguarding "was removed by Ofcom in 2007" and now has to be done through the unofficial safeguarding process. How does this relate to the process outlined in the TCPA Circulars which establishes technical site safeguarding as an official process? This is extremely important since this applies mainly to NATS En Route radars and nav aids which are heavily involved in wind turbine issues.
- 2.4 "...lays down specific safeguarding criteria for licensed aerodromes. These involve the definition of 3D surfaces where obstructions, such as wind turbine developments, should not penetrate."
- Is there any reference to how far this advice goes? How flexible is the 3D surface?
- 2.6 and 2.7 Welcome this addition for the process for unlicensed aerodromes.
- 2.7 States that safeguarding of unlicensed aerodromes "falls within the advice promulgated in [Circulars]" but the quote from the Circulars explicitly refers only to licensed aerodromes. Where does the advice come from that the same guidance should apply to unlicensed aerodromes? Is there any safeguarding guidance that should be applied to unlicensed aerodromes?

2.8 "In all cases, regardless of the status of the aerodrome, any development that causes pilots to experience or simply perceive an increase in difficulty...may lead to a loss of utility."

The reference to "perceive an increase in difficulty" is not quantified; should there not be a demonstrable objective increase in difficulty in using an aerodrome for the aerodrome to have a valid complaint?

"The CAA considers that if the aerodrome manager (or equivalent) advises...their advice can generally be considered as expert testimony."

Any decision maker will consider the credentials and local operational knowledge and experience of the aerodrome manager and ATC staff when considering their comments; but aerodrome staff should not be given any additional credence simply because they are staff of the local aerodrome. Moreover, there must be no suggestion that just because statements come from the aerodrome concerned that they should be accepted at face value and not subject to rigorous testing. Where an airport objects, they should fully explain the objection: a robust written case for the objection should be provided by the airport.

The text here appears to be one-sided. Pilots and operators of GA airfields may well "perceive an increase in difficulty" from a position of some ignorance. This is accentuated by the fact that GA in the UK is under severe pressure on a number of fronts so is very much on the defensive, plus GA operations are economically extremely marginal so operators cannot afford to employ consultants to address the issues objectively. The last sentence implies that the Aerodrome Manager is the only source of expert testimony, and is a divergence from the general thrust of CAP764 which is to encourage consultation and collaboration between wind and aviation interests.

Suggest that some revised text is needed here which accentuates the value of early liaison between developers and GA operators and active collaborative discussion of mitigation measures.

3.1 En Route CNS Safeguarding – this is a new section, but does not clarify the current safeguarding status as outlined in 2.2.

5.2 c. Helpful additional text suggesting consultation with developers on mitigation.

5.3 This would be a nuisance for any operator: it would be far simpler to object to everything. Perhaps some statutory requirement to perform these actions rather than to object should be made.

5.3 a. Making a change to radar equipment: "The service provider must perform a safety assessment on the change... The final safety assessment cannot be made until all changes have been implemented and wind turbine developments are operational."

Would this be able to happen in practice? What is the process for getting safety case approvals on mitigation, with regards to

timelines of the developments becoming operational? Does this pose an immediate problem?

Could some additional text be considered e.g. "This means that an objection cannot be maintained simply because the safety assessment hasn't been completed, unless there are real grounds for believing that the safety issues cannot be satisfactorily addressed"?

Or alternatively, make it clearer in terms of what a "final safety assessment" defines and what takes place before.

It may be useful to add some guidance on how stakeholders should deal with the worst case situation where consent has been granted for a development but the final safety assessment after construction finds that aviation impacts are unacceptable.

5.3 f. Welcome the insertion of the word "properly" between "fail to" and "address the effects of a wind turbine development".

6.1 There is reference to the BERR Aviation Steering Group structure which has been disbanded since the signing of the Aviation MOU, and has been replaced by the Aviation Management Board.

Also referenced in Appendix 6.

Chapter 2 Impact of Wind Turbines on Aviation

General Although the theoretical potential effects of wind turbines on radar have been well rehearsed, there is little documented evidence for the actual effects in practice of different turbines on different radars at different distances. In order to advance a common understanding of these effects, it would be helpful if the aviation stakeholders were required to record any effects actually perceived from existing wind farms, together with any operational consequences, and to make such records publicly available.

1.1 The reference to turbulence has been removed here but is still addressed in the body of the chapter. There still seems to be some tension between the desire to mention it as a potential issue and (at section 9 of this chapter) a general dismissal of it as a substantive concern.

1.2 "... the local airport operator and ATC service providers are best qualified to provide expert interpretation of what this impact will be and how it will affect the safety, efficiency and flexibility of their specific operations."

This paragraph has generated considerable heat in public inquiries since airports use it to argue that the inspector should only listen to their witnesses.

The CAA should give more firm guidance rather than delegating all decisions to the individual in charge of an aerodrome.

- 2 This is an improved summary of the potential effects on primary radar. However the categories of effect are given titles which do not accord with the terms now becoming generally accepted in the industry. Could the CAA consider adopting the same category titles as the MOD, i.e. 'clutter', 'obscuration' and 'shadow'? Receiver saturation and memory overload would be additional to those.
- 2.1 "In the case of a wind turbine, the larger its RCS, the more energy it will reflect". The text here lapses into the misleading impression that wind turbines are unique in reflecting radar energy. The statement is true of any and all objects illuminated by radar, not just wind turbines.
- 2.2 The statements in this paragraph are generally well-put. It may be useful to also note in here that the further the range from the radar, the more earth curvature has an effect on RCS because the towers are at an angle to the radar beam and therefore do not reflect the energy directly back to the radar.
- 2.3 a. Receiver saturation: could there be further explanation of what happens when receivers are saturated, and perhaps provide some examples or try to quantify what "uncommon" means? Are there any cases of it ever happening with wind turbines, or being predicted to happen?
- 2.3 b. The issue – more commonly known as 'obscuration' - is presented here as if aircraft are either displayed or not displayed on the radar screen. This does not adequately portray the subtlety of the effect. It is better described as an effect on the probability of detection, so that, for example, without the wind farm Pd might be 90% (aircraft paints on 9 out of 10 sweeps on average), with the wind farm it might be 80% (aircraft paints on 8 sweeps out of 10 on average). There should also be some non-wind farm context, i.e. a description of where this phenomenon already occurs in radars and how it is dealt with (tangential fade, effects of permanent echoes on Pd etc). Finally, while there is no doubt that this effect exists in theory and was demonstrated in the RAF's Clatter trials, there remains an absence of empirical evidence e.g. of lost aircraft plots over existing wind farms within radar cover.
- "...the CFAR threshold must be raised in order to remove the clutter... This is a problem because..."
- For clarification, could this read "MTI/MTD processing that is adopted in a radar to filter out objects travelling at a certain velocity does not apply to wind turbines, as the tips of the rotating blades can move at the same speed or faster than slow moving aircraft, such that these aircraft would also be processed out and not displayed...."
- Or, if this is looking at CFAR, could this say "one means of removing the clutter would be to raise the CFAR threshold. This is a problem because...", as there are other mitigations available that don't involve raising the CFAR threshold.

- 2.3 c. This effect is commonly known as 'clutter'.
Reference to "formation of tracks" may be misleading since this can only occur in plot-extracted radars, and strictly speaking, only in those plot-extracted radars which also have track extraction. Most radars in the UK do not have these facilities.
- 2.3 d. "the developer must... prove that the ATC equipment will not be overloaded..."
Given that the in-depth knowledge of the ATC equipment sits with the ATC operator could this be changed to put the responsibility of the ANSP to prove that the equipment would not be overloaded? For example, "The ANSP will want to assess whether or not the ATC equipment risks being overloaded, and if this is the case discuss with the developer why how this has been assessed and what techniques may be available to prevent this happening." The onus would then be on the radar operator / ANSP to calculate the capacity of the plot extractor, and subsequently could advise the number of wind farms that can be accommodated.
Is "memory overload" a new issue? Whilst it is understandable that the CAA should advise ANSPs to demonstrate that the effect will not occur, in view of the wider audience for CAP764 it would be useful to have some indication of the likelihood of this being an issue e.g. with examples of its occurrence in practice or some figures on the limits on number of plots/tracks in a typical plot-extracted radar. The suggestion that it is the developer's responsibility to "prove" that this effect will not occur is impractical – in any event it is only the ANSP who can – and must – prove it to the CAA. The ANSP would also be able to advise what upgrade of equipment could be undertaken, and at what cost, in order to accommodate further wind farms.
- 2.3 e. Presenting an Obstruction: The term "obstruction" used here is generally referred to as the 'shadow effect'. While the new text provides more information and is more realistic about its extent, it still lacks clarity. Two points in particular: (1) this is clearly a phenomenon which already exists around any and every obstacle in a radar's path. How is it dealt with currently? (2) There is no reference to the fact that the effect can only have an operational effect if the radar is being used to detect aircraft operating at very low level in the airspace immediately behind a wind turbine/wind farm.
- 3.1 a. SSR Reflections: "The CAA advises that 24km (approx 15nm) should be used as the trigger point for further discussions... However, recent studies have indicated that the majority of effects will be within 10km but, because the possibility exists for effects out to 24km, these should be considered."
Is it possible to provide a reference to the rationale behind the 24km guidance on SSR? (24km ≈ 13nm – should it read 24km or 15nm?)
NERL routinely consider SSR impact to 10km – so could this text be

considered unreasonable? Suggest the text should read 10km, because the wind industry has not come across any objections beyond this.

Could there be a point of clarification added after the description that Mode S SSRs are "virtually immune" to reflection effects, and therefore trigger ranges of 10 to 24 km which apply to current Mode A/C SSR technology are unnecessary?

There could be a reference here to the ongoing studies into RAM for towers and blades which may reduce the reflected energy, which would have an impact on SSR reflections.

4.1 Radar Assessment Methodology:

Please refer to comment under Appendix 7. There is a view that this has been over-simplified, and that the method from the previous CAP764 provided clearer guidelines.

5.1 Nav aids: As this document is going to be also referred to by the non-specialist (as per 4.1), could there be a brief explanation here as to the guidelines on ILS and VOR/DME?

It is disappointing that whilst wind turbines have been known for some time to have potential effects on radio navigation aids, the text here is unchanged from that in the initial issue of CAP764 and that "further work is still awaited". There is also disconnect between the assertion here that CAP670 standards are adequate and the stance of the main nav aid operator, NATS, on adequate separation distances.

6.1 Welcome this comment on reference to impact not only to radar service, but whether the effect on the radar has any significant impact on the ATC service being provided.

It should also be made clear that a significant impact on the ATC service will not of itself be a sufficient reason to justify grounds for rejection of the planning application. For example, aviation regulations clearly provide for the diversion of aircraft where necessary to maintain separation from unidentified returns (e.g. clutter); while there may be economic consequences (e.g. in terms of reduced traffic or the need for additional operators), there will be no compromise of air safety. Any objection to a planned wind turbine development must state clearly not only the potential effects on the radar and the potential operational consequences, but also the grounds (e.g. safety or economic) on which those operational consequences are considered unacceptable.

6.2 Should we define "ATC provision"? As there are different levels of ATC service.

6.4 I. "Future Airspace and Operational requirements where the airport growth is anticipated..." If it's anticipated, is it in accordance with the Aviation White Paper, and is it referred to in the airport Master Plan? Does this comment presume that airport expansion is more important than the expansion of wind energy?

- 7.3 Reference to Offshore Helicopter Operations, HMR is referred to here before being explained later in the document. Could the acronym be defined?
- 8.1 New text here on cumulative effects. The last sentence may be slightly misleading in that it refers to aviation interests not objecting to "a generic area" but then subsequently objecting to more than one development in that area. This is highly relevant to, for example, local authority/regional agency "preferred area" searches. It should be clear that a "preferred area" should be capable of accommodating something more than one wind farm. It is also notable that in some cases putting a second wind farm close to an existing one is the best possible option from an ATC radar point of view, and occasionally another wind farm may make little difference. The text of this paragraph does not reflect this.
- "... the combined effect of numerous individual turbines or multiple wind farm developments can be hard, if not impossible, to mitigate." Surely anything is possible with enough time and money?
- 8.3 "The basis for an objection... would be that... growth of an aerodrome... may be constrained... However, the decision concerning how firm these future plans have to be in order to be considered would be one for the planning authority."
- This statement is not supported. Aerodromes should not object to wind farms on the basis of planned or future upgrades of the aerodrome, unless these have been lodged with the planning authority as planning applications. It is disingenuous for the CAA to give the impression to aviation stakeholders that they should do this, and may cause uncertainty to other stakeholders.
- 9.1 The turbulence issue is presented in an ambivalent way, as mentioned in 1.1. The basic text of the original CAP764 is retained, saying it is not a real issue, but a sentence has been added saying that it's of more concern to e.g. parachuting.
- Could there be more clarity in terms of how this impact may be assessed, perhaps through providing a reference to turbulence assessment methods in use by wind energy developers?
- This paragraph could also be used to provide reassurance to pilots who may have concerns from wake turbulence from turbines; it could be stated that wind turbine wakes are generally much less significant than aircraft wakes.

10.1 Economic Issues: The economic assessment methodology should be considered carefully.

We do not support the view that the CAA should encourage and support objections by aerodromes based on anything other than air safety grounds. Objections on economic grounds undermine the fundamental principle that airspace is a common UK resource, and in fact CAA regulations should be drafted in order that all users can take advantage of it. We would recommend that in making objections to the authorities, aviation stakeholders make it explicitly clear whether the objection is based on safety, operational or economic grounds and support the comment that ambiguity is undesirable.

11.1 Suggest first sentence should read "It is possible that an existing or proposed wind turbine development which does not infringe any aerodrome obstacle limitation surfaces (OLS) may nevertheless have a potential impact upon local aviation activity."

There are plenty other examples of radio masts, pylons etc in vertically constrained pieces of uncontrolled airspace, and it is important that a consistent attitude is taken to the vertical obstruction hazard aspects of wind turbines and other obstacles.

Chapter 3 Safeguarding Considerations

3.1 Wind Turbine Safeguarding Maps: Is it possible to provide a list of where the maps can be obtained? And is there a process by which the maps are validated - what is the role of the CAA in this process?

4.1 Can the term "technical site" be explained further?
This paragraph appears to be in conflict with the earlier statements that NATS technical sites are no longer statutorily safeguarded, as a result of action by Ofcom. Further clarification/explanation is required.

5.5 "... the Authority would play an 'honest broker' role." What is the mechanism for getting a particular approach to resolving an issue formally agreed by 1. the wind farm developer; 2. the aviation stakeholder; 3. the CAA?

5.6 Obstacle lighting: The clear statement here is welcomed.

5.7 This requirement of white paint is at odds with most turbine colouring recommendations, which suggest an off-white or grey colour as being the most appropriate colour for wind turbines. It should also be noted that the new ICAO requirement does not include a definition of "white", so current off-white shades may be acceptable. Pure white turbines would be too prevalent in landscape terms.

7.1 Can JAR-OPS be defined?

- 7.2 There is no ban on other offshore installations within 6nm of an offshore HLS. In practice the CAA has been pragmatic in its assistance to developers and aviation stakeholders in finding solutions to offshore wind farms closer than 6nm to platforms.
- 9.1 Promulgation of Wind Turbine Developments: "LPAs routinely advise the Defence Geospatial Intelligence (DGI) organisation of all proposed developments", are LPAs required to do this? Feedback from the MOD to the wind industry is that they don't always have up to date turbine information. Is this statement saying that CAA and MOD can obtain this information from LPAs? And does this refer to the final consented turbine locations?
- 10 This new section on impacts on parachuting is a useful addition.
- 10.2 Parachute Landing Areas (PLAs): "These PLAs should be bordered on at least three sides by suitable overshoot areas, where parachutists may land if they are unable to land on the PLA; areas free from Special Hazards and largely free of Major Hazards)." This last sentence could be worth re-wording for clarification?
- 10.3 This is useful guidance.
- 11.1 Suggest a new paragraph:
 Identification of RCS cloaked Wind Turbines
 If developments in stealth or RCS cloaking technology reaches maturity such that the turbines are invisible to the impinging radar(s), in areas where there is a hazard to air navigation, a Constant K Reflector, or Luneburg Lens covering the frequency range of the impinging radars must be fitted on the top of the nacelle to ensure that an accurate precise radar cross section, RCS return of defined magnitude is returned. This will allow the accurate GPS location of each turbine to be seen and identified.

Chapter 4 Potential Mitigation Measures

- General Whilst the intro to this paragraph explains that this chapter defines "some" of the mitigation methods that are available, the list looks comprehensive. It would therefore be worth considering the addition of a couple of measures that are notable by their absence; RCS reduction techniques and the potential of holographic radar being two examples. There is also an absence of direct reference to "blanking", although this may be implied by the SSR-only paragraph, 2.10.
- While it is acknowledged that the air traffic service being provided and the type and density of the airspace affected will be relevant to the scale of any operational effects, these should not of themselves be key factors in the determination of whether such operational effects are 'acceptable'. What is relevant here is the extent, if any, to which they may compromise air safety or the extent to which

there may be economic implications for the aviation stakeholder.

- 1.1 Re-routing: The document suggests re-routing as a mitigation, and then states that such re-routing would unlikely to be approved due to the requirement to comply with CAP725. There is no discussion of the requirements of CAP725.
- 1.2 It is not clear that vectoring aircraft to avoid clutter increases ATC workload; in fact it may reduce it compared to the alternative of routing an aircraft through clutter. Suggest "may" is more appropriate than "will".
- 1.3 Why are airspace changes unlikely to be accepted? Is it difficulty of implementation or the adverse affect on operations?
- 1.5 Clear statement that clutter is to be treated generically is welcome. However the extract from MATS Part 1 may not be helpful since this is only one small aspect of the policy/guidance on treatment of clutter, and if clutter is such that a radar service cannot be provided then this will (or should) have been assessed and avoided when the wind farm was being planned.
- 1.7 Much more informative text on how clutter is dealt with. This is welcome.
- One additional factor is missing from the list of circumstances when avoidance must be given: the "unknown aircraft" has to be in "dangerous proximity" to the traffic being controlled.
- 1.7 b. There is a typo in the penultimate sentence "may 'hide' **and** aircraft response" should read "may 'hide' **an** aircraft response".
- "Non-transponder equipped aircraft are not allowed into Class A, C or D airspace without permission." Nor are transponder-equipped aircraft! Should this read "no aircraft"?
- "...if wind turbine radar clutter generates a spurious radar return that may be interpreted as an aircraft..." If a turbine "may be interpreted as an aircraft" this does not necessarily (and usually does not) lead to controller action. Hundreds of actual primary-only aircraft pass under controlled airspace every day in the UK but controllers deem them to be underneath controlled airspace and do not avoid them. Turbine returns under CAS must be seen in that context.
- "Clearly, the impact of radar clutter within Class E, F and G airspace will have different consequences": Implications in Class E/F/G – it says these are "clearly...different" but no explanation is given. Could additional information for clarification be added?
- "... if radar derived or other information indicates that an aircraft is lost, has experienced radio failure or is making an unauthorised penetration of the airspace, then avoiding action shall be given and traffic information passed (see MATS Part 1 Paragraph 1-5-13)." What if it's not? There is no longer guidance in MATS Part 1.
- Would it be possible for CAP764 to provide information on

acceptable levels of impact that a development could cause before it were deemed a problem? For example, a set number of false plots per 100 scans of the radar?

- 1.7 c. Whilst this paragraph explains that objections are unlikely to be successful if the wind farm is in an area where there is no ATC provision, it is, however, likely that the LPA may take the airport's view as 'expert'.

".... Where possible, it *can be beneficial for the Service Provider* to record or plot real traffic patterns..." Could the language change to "where possible... *should* record or plot"?

- 1.7 d. The American spelling of "manoeuvre" is used here (maneuver).

- 1.7 k. Suggest a new paragraph entry:

Use of Radar Absorbent Materials (RAM) to reduce reflections

The controller making the assessment should also be aware whether any RAM has been fitted to any structure in the vicinity, and if not whether this should be considered.

- 1.8 Welcome this change in wording from previous, "Other factors that must be considered" rather than "Small areas of radar clutter...only when..."

However, it is not correct – or "fair" – to state that controllers "would have to" take avoiding action against a return they consider to be an aircraft (see 1.7 b.) For example, operations at all the London airports would cease if controllers avoided all primary contacts tracking under CTA stubs. Even to the extent that avoiding action is required, this should not be taken on its own to be "unacceptable"; its specific purpose is to ensure that there be no "unacceptable" compromise of air safety and any economic consequences will need to be weighed against the interests of other potential 'users' of the common airspace.

This paragraph appears to be referring to other CAA guidance concerning interpretation of radar clutter, which are not contained in CAP764 and which seem to be of crucial relevance to whether controllers are allowed to ignore clutter from wind turbines or not.

- 2.1 – 2.4 Useful new section on fill-in radar. However it omits one important alternative – the use of a feed from an existing or additional radar which is displayed on a separate adjacent console, or can be selected as an alternative display on the same console. This general approach has been in widespread use at many NATS units for decades.

- 2.4 Think this is raises a good point about finding radar which operate in frequencies that are deconflicted from those already in existence.

- 2.5 Physical or Terrain Masking: With reference to moving the radar to a position which does not see the wind turbines; is this believed to be a plausible solution? Are there any examples of this happening?
 "...man-made object would need to be... constructed of radar absorbent materials" – not necessarily; buildings and hills are not made of RAM.
 Could the use of the term "Artificial Radar Horizon" be inserted to elaborate on the "man-made object"? For example "... whereas a man-made object would need to be specifically designed [and would be constructed of radar absorbent materials (RAM)] in order to present an Artificial Radar Horizon."
- 2.6 It is not clear how multilateration would be mitigation in an area where primary radar cover is required. If so, would it be possible to provide some examples?
- 2.7 NAIZs are used for wind farm mitigation in other countries, why not here? It is possible to assess whether aircraft are likely to climb into cover in the region of a proposed NAIZ.
 "NAIZ should be avoided unless... the wind turbine returns are of significantly lower signal strength than the real aircraft returns in the area." Are there any guidelines on how this could be calculated? It would be helpful if the guidance defined the extent of possible NIAZs.
- 2.8 – 2.9 Perhaps these paragraphs do not reflect the recent and ongoing work to develop the BAE Systems ADT and Sensis SPE-3000 work, and indeed the tracking elements of the Raytheon proposal? There is certainly a lot of potential for eliminating or diminishing wind farm returns using radar processing techniques.
 "...These non-deterministic approaches to target detection and tracking have yet to be fully accepted in the UK civil radar arena..." What work needs to be done to make it acceptable? Are these accepted elsewhere?
 Perhaps the CAA, given government targets, should only licence new radars that are demonstrated to be effective at processing out wind turbines – then there'd be an incentive to fix the problem?
- 2.10 Use of SSR Only: Does this refer to "blinking", whereby the Primary Radar returns are blanked out from the display in the area of the wind turbines?
- 2.11 Useful clarification of the actual situation with regard to approval of SSR only for en-route.
- 2.12 Ambiguous wording on the responsibility for carrying out safety assessment of TMZs – why not say it could/should be done co-operatively? No mention of the CAA proposal for creation of TMZs, part of which is a streamlined Airspace Change Process (ACP) to make them easier to establish.

- 2.13 a. Typo: "The effect on other airspace users eg the General **Aviation** community..." should read "The effect on other airspace users eg the General **Aviation** community..."
- 2.13 d. It would be helpful to clarify the grounds on which CAA SRG would not allow control in a given area using SSR.
The reference to "para 2.3" does not appear to be correct.
- 2.15 Mechanical Beam Tilting: Should this also make reference to "electronic beam tilting", which is possible with some modern radar systems (although in the civil domain in the UK, perhaps there are no phased array radars capable of electronic tilting?)
Consider revising "mechanically raise the radar beam *by means including the use of Artificial Radar Horizon (ARH) technology*, so that it passes over the wind turbine development".
- 2.16 Suggested new paragraph
Radar Absorbing Materials (RAM)
Currently, work on Radar Absorbent Materials is focussing on the development of low cost solutions for towers, nacelles, spinners and blades and aviation stakeholders and wind farm developers should be aware of what is available to mitigate the effects of radar on wind turbines. Materials are currently commercially available for RCS reduction of towers and nacelles and development is progressing on innovative solutions for blades.
- 3.2 "In assessing proposed mitigations... it is not unreasonable for an aviation stakeholder to request a supporting safety case. The developer could be expected to carry out this work..."
This contradicts Chapter 1, 5.3 (a) "The service provider must perform a safety assessment on the change".
Surely the wording in Chapter 1 is correct and is to be preferred, because it is the ANSP who is in the best position to undertake the safety assessment and submit the safety case to the CAA. A co-operative approach could/should be adopted but it is difficult to see how an aviation stakeholder expectation that their safety case will be written by a wind farm developer could have positive results.
With regards to carrying out the safety case, could there be reference to the appropriate CAP?
- 3.3 Use of models to predict likely radar interference from wind turbines: Are there any suggestions on how to assess the 'marginal' cases, or are there any approved models that could be used?
"In such cases safety should always be applied in a conservative manner." Can it add that where safety is not a concern, but commercial impact is, the needs of the aviation stakeholder need to be balanced with the national need for energy security and meeting renewable energy targets?

Chapter 5 Wind Turbine Development Planning Process

- General Does this consultation process apply equally to micro- or small-wind turbine developments?
- 1 Can a reasonable time limit be recommended for initial responses from aviation stakeholders?
- Can it be stated that where aviation stakeholders charge for pre-planning consultation, it discourages wind farm developers from consulting them and may lead to greater problems in the future.
- It should be clarified that aviation does not and should not necessarily take precedence over wind farm developments where there is a conflict.
- 1.2 a. We do not support that aerodromes be encouraged to object to radar turbines at distances greater than 30km, as there is often little operational impact at such distances.
- Last sentence, missing word "to":
- "... advise the DAP of any requirement **to** extend..."
- 3.1 Call-Ins: The present CAP764 has additional words on the end "This procedure is only applicable to those aerodromes that are 'officially' safeguarded." Is there a reason for these words having been removed?
- 5 Helpful new section on CAA advice.

Appendix 3 Flow of Information Involving CAA/DAP

- General Should there also be reference to the LPA responsibility for contacting the DGI?

Appendix 4 References

- General A reference to guidance on Safety Case preparation should be added.

Appendix 6 BERR Governance and Meeting Structure

1. This section needs to be revised (timescales also incorrect, as this refers to "a programme of work for 2005-2007").

The Aviation Steering Group (ASG) has been redefined under the MOU that was signed on 13.06.08 between BERR, CAA, DfT, MOD, NATS and BWEA. The ASG will be replaced by an Aviation Management Board, and underneath this will sit an Aviation Advisory Panel (AAP). Is it worth putting in a revised organogram illustrating the different groups and terms of reference?
2. As above, this has been disbanded and will be replaced by the Aviation Advisory Panel (AAP) under the Aviation MOU structure.
3. Editorial Sub-Group: Does this still exist? And if so, is it possible to further define terms of reference and membership?

Appendix 7 Method for Determining if a wind turbine is within line-of-sight

- General Numbering is out for the headings after 4.0 Line of Sight.
- Could the RCS characteristics of a range of turbines be tabulated? Previous measured data and new modelled data could be used to populate the table, for example including results from past and current BERR studies. Although there will be site-specific considerations to be taken into account, this could provide a useful starting point for calculations.
- 2.0 Appendix 7 to the initial CAP764 described a method for further detailed assessment. This should be here, or a justification for its removal written in its place. The CAA should bear in mind that as the CAA have published it in the past, developers will continue to use it and justify its use from the original CAP764 unless a robust argument is provided justifying its removal. Although the previous method required complex calculations, it was used by some specialists and accepted by some aviation stakeholders. Simple LOS analysis is often too conservative.
- 4.0 Line of Sight Method: This assumes that radar information is readily available, whereas in practice this can be difficult to find. Radar operators should be required to provide radar data unless they can make a robust case for not doing so.
- This method relies on highly inaccurate paper and ruler methods and takes no account of earth curvature, radar beam refraction or changes in scale. There are resources readily available such as WindFarmer and the ATDI tools which provide far more consistent and reliable information.
- 5.0 (6.0?) Further Detailed Assessment: This should state that diffraction reduces the probability of a wind turbine within line-of-sight being detected, but increases the probability of wind turbines below the line-of-sight being detected.
- Also, radar parameters, including antenna gain at varying elevation angles can be very significant.
- The old CAP764 had a method which accounted for these factors. It should be mentioned here.

To add to the glossary:

- HMR Helicopter Main Route
RAM Radar Absorbing Material
ARH Artificial Radar Horizon

Inconsistent uses of terminology:

- En Route / enroute / en-route
Nm / nm