ELECTRICITY ACT 1989 (SECTION 36 AND SCHEDULE 8)
TOWN AND COUNTRY PLANNING ACT 1990 (SECTION 90)
THE ELECTRICITY GENERATION STATIONS AND OVERHEAD LINES (INQUIRIES PROCEDURE)(ENGLAND AND WALES) RULES 2007

PUBLIC INQUIRY TO CONSIDER SECTION 36 ELECTRICITY ACT 1989 APPLICATIONS BY:

(1) STEADINGS WIND FARM LIMITED FOR CONSENT AND DEEMED PLANNING PERMISSION TO CONSTRUCT AND OPERATE A WIND FARM AT KIRKWHELPINGTON, NORTHUMBERLAND (KNOWN AS STEADINGS)

(2) AMEC PROJECT INVESTMENTS LIMITED FOR CONSENT AND DEEMED PLANNING PERMISSION TO CONSTRUCT AND OPERATE A WIND FARM AT RAY ESTATE, NORTHUMBERLAND (KNOWN AS RAY WIND FARM)

(3) WIND PROSPECTS DEVELOPMENT LIMITED FOR CONSENT AND DEEMED PLANNING PERMISSION TO CONSTRUCT AND OPERATE A WIND FARM AT GREEN RIGG FELL, BIRTLEY, NORTHUMBERLAND (KNOWN AS GREEN RIGG WIND FARM)

ANDREW JAMES COLEMAN
PROOF OF EVIDENCE
IN SUPPORT OF OBJECTION BY
MINISTRY OF DEFENCE

Treasury Solicitor
Commercial & Property Litigation Team 3D
Treasury Solicitor's Department
One Kemble Street
London
WC2B 4TS

DX 123242 Kingsway
Tel: 020 - 7210 4566
Fax: 020 - 7210 2996
Ref: Colin Andress

Rebuttal proof

1. This proof addresses the operational aspects of the threat radar evidence submitted

   a. Duncan Lennox [WPD/8/2] on behalf of Wind Prospects Development, received early on Tuesday 24 June 2008 ("**Lennox**");
   b. Malcolm Spaven and Kenneth James [SWFL/12] on behalf of Steadings Wind Farm Limited, received late on Tuesday 24 June ("**Spaven and James**"); and
   c. Steve Turner and Chris New [AMEC/10/5] on behalf of AMEC Project Investments Limited, received late on Thursday 4 July ("**Turner and New**").

These were in response to my proof, which had been lodged on 17 March 2008. The technical issues covered in their evidence are dealt with in a rebuttal proof of Sgt William Edmond, a draft of which I have read.

2. The reports and statement total over 360 pages. So far as I am aware, at no stage did any of the developers indicate to the MoD the particular topics that might have to be further addressed, still less the lines of disagreement. This, alongside the limited time left by the developers before the resumption of the inquiry, has constrained the thoroughness of my reply. I have, nevertheless, attempted to cover the salient points in their reports.

The Object of Spadeadam

3. In order to determine whether any one or more of the proposed developments would have an unacceptable adverse impact on RAF Spadeadam, it is necessary to understand the object of Spadeadam, which is encapsulated in its mission statement:

> "To develop and replicate current and emerging Ground-to-Air threats, tactics and techniques relevant to contemporary warfare".

4. It is crucial to the effective functioning of RAF Spadeadam that it is able to present a range of representative threat scenarios to pilots using the facility. By "representative", I mean representative of the sort of threats that may be encountered by pilots in theatres of war. It needs to be understood that theatres of war, and the threats they present, vary. Pilots must be trained to deal with all of those they may expect to encounter. There is nothing to suggest that the range of threats presented by RAF Spadeadam will not

constitute real-life threats to RAF and other pilots in theatres to which they can expect to be deployed in the foreseeable future.

5. Two of the three developers address the object of Spadeadam in their evidence concerning threat radars. Spaven and James accept that Spadeadam's task is the "EW training of aircrew whose operational flying role brings them into dangerously close contact with anti-aircraft weapons" [§2.1]. Lennox acknowledges that the purpose of Spadeadam is to provide pilots with "practical experience of flying in a hostile environment" [§17]. This "hostile environment" is created by the threat systems – it entails pilots being actively acquired, tracked and 'fired' at by a range of threat systems that they may encounter in live combat, in a way that mimics live combat as closely as possible.

6. In order to replicate faithfully the hostile environment on which the functioning of Spadeadam depends, four elements are required:

a. Deployment of as much of a variety of ground-to-air threat systems as possible – i.e. deployment of the real SA-6, SA-8 and Skyguard systems ("**the real threat systems**", real in all senses except that missile firings are simulated rather than actual) and the emulated and simulated threat systems;
b. Optimum operation of those threat systems when they are deployed (i.e. optimum ability to acquire aircraft with the multi-beam surveillance radar (the "**TAR**"); optimum ability to track the aircraft with the mono-pulse radar (the "**TTR**") and optimum ability to lock-onto and 'fire' at the aircraft by activating missile guidance signals often bore sighted to the monopulse trackers);
c. Deployment of the threat systems to a suite of sites that present short-range, medium-range and long-range threats to aircraft; and
d. Deployment in such a way that the training does not become routine or predictable.

7. When Lennox states in §1.6 that "[t]he sole purpose of the threat emitters is to provide training to the crew," the true position is really the converse: the sole purpose of the training is to allow the crew to fly against the threat emitters. If the ability of those threat systems to acquire, track and lock-on to aircraft is diminished, then the efficacy and realism of the training is diminished.

8. Each aircraft type and role has differing training priorities and uses Spadeadam in different ways. This broadens the operational disruption posed by the proposed developments. Given that one or more of the turbines in each of the proposed wind farms will be within line of sight of one of more of the mainstay threat systems used at RAF Spadeadam when located at one or more of the sites available for those systems (see Table 4-2 pg 20 in Turner and New; pp 27-30 of Spaven and James and SWFL12b) and given that it is proposed to place the wind farms in the middle of one of the main entry corridors to the range (see MOD/0/9) at distances from the threat systems (depending on which sites they are located) at which those systems' radars are desperately trying to acquire the target, lock on to it and maintain that lock, and given the innate difficulty of that task already, the resultant degradation in the ability to perform this central task successfully is likely to be significant.

9. Short of erecting the turbines and trying it out, it is impossible to give a definitive measurement of that impact. But based upon the above facts and what I do know of the existing difficulties of the task carried out by the threat system operators, I would anticipate that it is quite likely that if any one or more of the wind farms proposed and shown at MOD/0/9 were erected, the approach to the Range from the east through the Otterburn-Newcastle corridor will be degraded to the point that it is no longer a realistic tactical option. Aircraft routing from tanker tow lines in the North Sea will, therefore, have to route around the north of Spadeadam around Otterburn D512 in order to gain access to D510 in as tactically realistic way as possible. Quite apart from the fuel considerations (the extra fuel requirements may render some missions no longer viable), one of the main available approach options will have to be discarded. In terms of breadth and realism of training, this cannot be compensated for by using one of the other approaches.

10. All three of the developers refer to the Kirkheaton wind farm: Lennox §31; Spaven and James §§6.29; 2.9 and Appendix G; Turner and New §3.2 and 4.4.3. It will be observed from the plan at MOD/0/9 that Kirkheaton is very close to the Newcastle Control Zone. It comprises three turbines and is confined to a smaller area than each of the three proposals with which this Inquiry is concerned. As a result of its proximity to the Newcastle Control Zone, it being on the edge of the corridor of entry to Spadeadam and it being of limited size, the impact upon threat system radars is manageable.

11. Lennox (at §16) appears to criticise the MoD for not having some sort of arithmetical calculation "as to the value of training that will be affected" by the wind tribunes interference with the operation of the threat systems. He states:

> "In evaluating the operational training provided by the range, it is necessary to consider not only the performance of the threat emitters, but to look at the value of the training to the aircrew. Indeed the sole purpose of the threat emitters is to provide training to aircrew. If the value of aircrew training is not affected, then any effect of the proposed wind farm development on the threat emitters or their operators does not impact upon the purpose of RAF Spadeadam. The POE by Sqn Ldr Coleman (para 14 to 27) explains the mode of operation of the threat emitters, but does not address the possible wind farm effects on the realism or efficacy of training (raised in the MOD Statement of Case Addendum para 5 [1]). MOD stated (letter from Mr Julian Chafer dated 3rd May 2008) in answer to question 4 that 'there is no calculation as to the value of training that will be affected'.
>
> 17. There is no evidence to support the MOD allegation on realism and efficacy stated in the Addendum, nor any evidence of any harm to aircrew training".

12. It is not clear to me what kind of "calculation" Mr Lennox had in mind when he wrote this. It is incorrect to say that there is "no evidence no evidence to support the MOD allegation on realism and efficacy stated in the Addendum, nor any evidence of any harm to aircrew training," as my proof dated 17/2/08 was just that. "Calculation" or no "calculation," it is an inescapable fact that:

a. To place numerous large turbines within line of sight of threat system radars will result in significant clutter on their screens;
b. To place those numerous large turbines in the middle of one of the main approaches to RAF Spadaeam will result in significant additional clutter on a part of their screens upon which the operators will be concentrating their attention in trying to acquire, lock on to and maintain luck;
c. That clutter will make that task considerably more difficult, sometimes impossible and will in some cases (possibly many) result in a failure to be able to do so; and

d. That failure for that reason will negate the value of that particular training run.

13. I do not seek to "calculate" a figure for the value of the training that will be so affected. I do not think that any responsible person can pretend that such a calculation can be undertaken. But the inevitability of the adverse effect on training is self-evidence for any one with experience of RAF Spadeadam.

Range of Threat System Radars

14. In order to assess the MOD's objection based on the threat systems, each of the developers has focused on the maximum range of those systems, although they have adopted differing approaches.

15. Lennox disputes the validity of using the maximum range of the various threat radars as a basis for analysis [§14], and Spaven and James assign a range of 45kms to the TAR of the SA-8 (despite the fact that MOD/0/10 and MOD/4/1 indicate the range as 28 kms), because 45 kms "accommodate[es] maximum range scale setting of Land Roll PPI display" [pg 9].

16. Maximum radar range depends on target size, height, speed and the surrounding conditions - weather, rainfall, cloud density etc. Probability of detection at a particular distance will vary significantly according to these factors. The maximum ranges provided by the MOD are known colloquially as the "planning ranges" – these are the ranges I would use when planning deployments. That is the reason the MOD believes they provide an acceptable basis for calculation. The actual threat radar performance may exceed the stated figure, but the MOD is unable to confirm or deny by how much, as the exact parameters are classified. Accordingly, while Spaven and James are correct that the Plan Position Indicator of the SA-8 (the round radar screen) is scaled out to 45 kms, it is preferable to base calculations on the stated range of 28 kms.

17. Lennox's assertions about maximum range are addressed at §5 of Sgt Edmond's proof. Lennox bases his assessment on the maximum range of the tracking radar to come to the following conclusions:

a. In relation to the SA-6 (tracking radar range of 28kms), only six of the dispersed sites would potentially be affected [§32];

b. In relation to the SA-8 (tracking radar range of 25 or 28 kms), only three of the dispersed sites would potentially be affected [§33];
c. In relation to the Skyguard (tracking radar range of 15 kms), no dispersed sites would potentially be affected [§34].

18. Although Lennox acknowledged TAR's ranges (§14 first sentence and last two sentences; §21 first sentence), he appears to have either ignored or failed to understand the importance of the TAR picking up the aircraft. When Mr Lennox writes (§29) "It is my understanding that clutter would only be a problem for the tracking radars when the aircraft were flying low over or close to the wind farm", he seems to have proceeded on the basis that clutter would only be a problem for tracking radars (i.e. and not acquisition radars) and. Even then, only when aircraft were flying low over or close to the wind farm. If that was Mr Lennox's understanding, it would be a misunderstanding. This misunderstanding appears to have permeated his assessment and conclusions.

19. Spaven and James include both the acquisition and the tracking radars in their assessment, and come to the following conclusions:

a. In relation to the SA-6 (acquisition radar range 50 kms and tracking radar range of 28 kms), 12 of the dispersed sites would potentially be affected in terms of acquisition and four in relation to tracking [Table 2, pg 27];
b. In relation to the SA-8 (acquisition radar range 45 kms and tracking radar range of 28 kms), 11 of the dispersed sites would potentially be affected in terms of acquisition and four in relation to tracking [Table 2, pg 27]
c. In relation to the Skyguard (acquisition and tracking radar range of 16 kms), one dispersed site may potentially be affected.

20. Turner and New seem to include both the acquisition and tracking radars in their initial assessment, as they come to the following conclusion [§4.2]:

> "[N]one of the sites are within range of the Skyguard system…The Ray wind farm is within range of the SA-6 at all of the listed sites, apart from Charterhall Airfield [i.e. 20 sites]. The SA-8 will only be within range of the wind farm if it is located at Bell Crags, Bolts Law, Monkside, Otterburn or Albemarle Barracks [i.e. 5 sites].

21. In order to determine whether the proposed wind farms will have a material adverse impact on the efficacy of Spadeadam, it is necessary to consider the anticipated impact on both the acquisition radars and the tracking radars of the real threat systems. Aircraft have to be acquired by the acquisition radar (i.e. the TAR) before they can be tracked and lock achieved by the target tracking radar (i.e. the TTR). If the ability of either of these systems to acquire aircraft is degraded by the returns generated by the wind turbines, this will reduce the speed and capacity of the threat radars and so adversely impinge on the efficacy and realism of the training.

22. It should be remembered, however, that each of the turbines presents a large RCS, far larger than the aircraft that the threat system is trying to acquire. It is that overwhelming RCS (particularly with aircraft that may be flying at altitudes similar to the turbine tip heights) spread over a wide area that creates a very real difficulty for the TAR and TTR. Even though there are gaps between the individual wind farms, those gaps are far too small for a target to be acquired or re-acquired before being lost in the thick of turbine clutter again.

23. Looking at the various calculations carried out by the developers, as I have already noted it appears that Lennox has under-estimated the impact of the proposed developments on the real threat radars because he bases his analysis on the TTR only; while Spaven and James, on the other hand, have over-estimated the impact on the SA-8 because they wrongly proceed on the basis that the TAR has a range of 45 kms (rather than 28kms, as indicated in MOD/4/1). I do not mean this critically because mistakes like this can be expected from people with no real experience of the threat systems.

24. In §21 Lennox acknowledges that the SA-6 acquisition radar has a range of 50kms. He seems to justify not basing his analysis of the potential effect on dispersed sites by making a tactical observation that “this radar is not usually switched on in combat until as late as possible, so as not to give away the radar’s position”. This is a somewhat misleading statement. It is enough to say that “as late as possible” may cover up to any distance that is within the planning ranges to which I have already spoken. Spadeadam needs to retain the capability of using the threat systems up to their maximum ranges in order to maintain the ability to provide a range and variety of

realistic training, as there may be combat scenarios in which the ability to track targets at maximum range has tactical utility.

25. It should be noted that Spaven and James's confuse the T1 and the T1 (V) Mini-MUTES in their evidence. Both the website and MOD/5/2 refer only to the T1 system, and the MOD has never suggested that the 1994 Blinkbonny material, provided as part of the MOD's agreement to disclose all information relating to threat radars as it came to light, should be taken as indicative of Spadeadam's current threat capability.

26. The T1 and the T1 (V) Mini-MUTES are completely different systems and have no common features. The T1 is a full radar emulating SA-2 and SA-3, whereas the T1 (V) Mini-MUTES is an IFF/SSR tracker system that was removed from Spadeadam in 1998. Spadeadam has subsequently rejected IFF trackers, as IFF data cannot keep up with manoeuvring aircraft and are not sufficiently accurate to provides stable tracking. In 2004, the Multi Radar Emitter Set (MRES), a prototype threat radar suite, was used in a two-week exercise at Spadeadam but was thereafter rejected for being too cumbersome because it was not in fact a multi-capability emulator but rather an IFF tracker "simulator".

The Phases

27. Lennox states the following in §29:

> "There are then two distinct phases in the process of 'shooting down' a target aircraft. In the first phase the tracking radar [ie the TTR] has to track the aircraft for sufficient time to enable the fire control system to determine the time and direction for the SAM to be launched. If the aircraft can break the tracking lock, then the process has to restart. This first phase, up to but not including SAM launch, is carried out for real on the range. For the second phase a simulated SAM launch takes place, and if the tracking radar loses lock the missile will fly free and miss its target".

Although before then he states that the threat system operators would "look for the approaching aircraft using their acquisition radars", he fails to include this step in the process of "shooting down" an aircraft. The acquisition phase is distinct from the tracking phase. Target acquisition takes its own time and only once secured is the target "handed over" to the tracker. This is basic to even a rudimentary understanding of the operation of threat systems.

IFF

28. Spaven and James focus on "the overwhelming importance of Identification Friend or Foe (IFF), the military version of Secondary Surveillance Radar (SSR), to electronic warfare training on both the Spadeadam" [§1.13, also §4.1]. They say at §1.13:

> "It is used continuously to identify and track aircraft approaching the range, training on and around the range, and departing; it is used to provide 3-dimensional "truth" data about the aircraft's trajectory, against which recordings made by both the range and the aircraft can be compared; it is used to cue the range's threat systems for timely acquisition, tracking and engagement of the correct aircraft. In other words, the IFF/SSR element runs continuously in the background. Even were there potential wind turbine impacts on threat system primary radars, the continuing availability of the unaffected IFF/SSR information robustly safeguards the objective of maximising the exposure of aircraft training on the range to threat weapon system transmissions. It ensures that there can be no materially adverse impact upon the matters about which the MoD expresses concerns".

29. From this they conclude at §5.15

> "Even if target acquisition is affected by clutter from any source, the continuous availability of 3-D IFF/SSR target position from SPICCCS can be used to cue tracking radar pointing and use, effectively bypassing any ground clutter problems with the acquisition radar".

30. IFF/SSR does not provide the panacea that Spaven and James assert. The difficulties with IFF include the following:

a. IFF has a 4 second refresh rate, i.e the system only plots targets once every 4 seconds. This limits its ability to cope with high speed agile targets – in four seconds an aircraft can completely change direction or height. The target co-ordinates given to threats, which are displayed as a set of numerals on a screen, have lost currency the moment they are displayed. In any event, angular accuracy can be low.
b. Depending on aircraft attitude course and speed, the azimuth indicated may not be sufficiently accurate for a quick successful

track. Operators are given a set of numbers that can be difficult to match to displays in the equipment.

c. Spaven and James suggest IFF is "totally unaffected by clutter effects, as the signals received back from aircraft are at a different frequency from the IFF/SSR interrogating transmission" [§D.2.1]. This is incorrect. IFF is vulnerable to terrain and clutter masking – aircraft particularly at low level "go dark" and the IFF trace is lost especially if they fly behind and below crest lines. We often lose plots in the Otterburn-Newcastle corridor as aircraft descend into the Tyne valley, and the threat operators regularly catch up and track targets without it.

d. Hard and aggressive manoeuvres at higher levels, particularly height changes, cause the IFF height readouts to go blank, which means that elevation readings show zero or a minus figure causing the operator to look at the wrong elevation. Three dimensional manoeuvres in particular confuse IFF, just as they do active primary radars.

e. Spaven and James mention that IFF can be lost during aircraft manoeuvres because the airframe may temporarily obscure the aircraft's transponder [§D.2.1], but thereafter ignore the issue. It is indeed the case that, as manoeuvres are effected transponders can become masked, particularly if aircraft are inverted, meaning their returns are periodically absent.

31. As indicated above, the unreliability of IFF in the context of fine tracking targets is one of the reasons that Spadeadam no longer uses IFF-based tracking threat systems. None of Spadeadam's threat systems is electronically slaved to the IFF coordinates, as can occur on some US ranges.

32. IFF is far from "truth" data, and cannot be relied on to mitigate adequately the adverse effects of any of the proposed wind farms.

SPICCCS

33. Spaven and James also refer extensively to SPICCCs, which is RAF Spadeadam's bespoke command, control and communications system. Indeed, they devote the entirety of Appendix D to an analysis of this system. The basis of the SPICCCs system is IFF/SSR, and so is prey to the limitations outlined above. It should be noted that we do not slave any threat systems to

SPICCs, nor does the Range use unmanned threats (Spaven and James §§5.2-3).

Effect on Threat Systems Where They are Within LOS of Proposed Wind Turbines

34. Both Steadings and AMEC produce line of sight path profiles in relation to the remote sites. Lennox, for Wind Prospects, does not take line of sight considerations into account, nor does it seem that any path profiles in relation to Green Rigg were produced. Turner and New comment in §4.3 that the LOS results for Steadings and Green Rigg match those for Ray, except in relation to three of the remote sites. For present purposes, the MOD is prepared to proceed on the assumption that the LOS calculations are correct.

Ability to acquire target when aircraft in wind farm area

Acquisition Radar

35. None of the developers' threat radar evidence addresses in any detail the potential degradation caused by the wind farms to the real threat systems' multi-beam radars (i.e. TAR) and the consequential reduction in ability to acquire a target in the area of the proposed wind farms. As explained above, acquisition of the aircraft by the multi-beam TAR radar is the prerequisite to the real threat systems being able to switch to the mono-beam tracking radar (i.e. the TTR) to attempt to achieve lock. As also explained above and in the rebuttal proof of Sgt Edmond, depending on the site at which a threat systems has been deployed, each of the wind farms is located in an area that would be one of the areas of intense interest to a threat system radar operator trying to engage an aircraft coming in from the north-east.

36. As the multi-beam radar of the real threat systems functions in the same way as a Watchman ATC radar, the same technical problems of clutter and obscuration will arise. Accordingly, should one or more of the proposed wind farms be erected, I would anticipate that the turbines within each would generate clutter and result in obscuration that would adversely affect the operation of all those threat radar sites within the range of the real threat systems' TAR and with LOS to the wind farms. The effects of these problems will be more acute than in the Watchman radars, as the real threat systems do not have the same capacity as the Watchman radars to filter out clutter or to have fill-ins.

37. Only Spaven and James, in §§5.13-14, begin to address the possible effects of the proposed developments on the acquisition radars of the real threat systems. However, they do not deal with obscuration at all, but merely mention generic "clutter". They do not deny that such clutter will be an issue. Instead, they suggest that the multi-beam system could be used to mitigate against clutter caused by the turbines. This is dealt with in Sgt Edmond's proof at §11.

38. They then go on to suggest, at §5.14:

> "[The real threat systems'] operators, skilled in controlling the systems in existing clutter conditions, are well trained at compensating for the radars' deficiencies and will not be impacted by the extremely limited additional extent of clutter which might be caused by turbines.

This ignores the effect on the operators of the extra work-load caused by the new clutter source. Sgt Edmond has dealt with this in his rebuttal proof §§14-15.

Tracking Radar

39. In relation to the tracking radar, Turner and New acknowledge precisely the technical difficulty behind the MOD's concern [§2.2]:

> "A monopulse tracking radar is effectively four radars in one. The radar transmits radiation in one direction but effectively "listens" in four different, closely spaced, directions simultaneously. By comparing the signals from these four different directions, the radar is able to steer left, right, up and down to follow the target…This approach works well when there is a single target within the field of view, but can suffer problems when the desired target flies close to something which has a similar (or larger) RCS. In this case, the radar may mistakenly track the nearby object instead of the desired target".

That "nearby object" will, of course, be any one of the numerous turbines in any one of the proposed wind farms.

40. By combining the range analysis and LOS analysis, Turner and New conclude that the Ray wind farm would affect seven of the remote sites in relation to the SA-6 and three in relation to the SA-8; Steadings wind farm would affect nine of the remote sites in relation to the SA-6 and three in relation to the SA-8; and Green Rigg would affect eight of the remote sites in relation to the SA-6 and three in relation to the SA-8.

41. Combining the results in Tables 2 and 3 of Spaven and James' report [pgs 28-29], they agree that Steadings wind farm would affect nine of the remote sites in relation to the SA-6, but obtain the same result for the SA-8 (presumably because of the incorrect value assigned to the range of the SA-8's TAR).

42. Accordingly, where LOS analyses have been carried out, two of the developers' experts acknowledge that the those analyses, combined with the range of the real threat radars, indicate that the proposed wind farms will adversely impact the performance of the threat radar systems on least seven (33%) and at most nine (43%) of RAF Spadeadam's threat radar deployment sites. It should go without saying that the loss of 43% of Spadeadam's threat radar deployment sites would severely affect the functioning of the facility.

43. Turner and New go on to attempt to estimate the extent of the adverse impact by estimating the volume of airspace likely to be affected by the proposed wind farms by calculating the regions in which the returns from a wind turbine could be comparable to those from an aircraft [§4.1]. The reliability of this exercise is undermined, however, by the assumption that the tracking radar has lock upon the aircraft before it enters the wind farm.

44. Turner and New justify this assumption by stating that the approach is "supported by the evidence provided in [MOD/0/11]" ("**the Culdrose trial**" conducted in 1998) [§4.1]. The Culdrose trial is not "evidence" that such an approach is justified in the context of this Inquiry: we are here concerned with broader questions, particularly the potential disruption to the operation of both the acquisition radars TARs and the tracking radars (TTR) are clearly cause for concern. Also, given that a trial had been carried out at Culdrose in 1994 which found that wind turbines interfered with air traffic control radars, RAFSEE would in all likelihood have presumed the acquisition radar would be affected by the turbines.

45. Nevertheless, even on Turner and New's limited approach, the volume of airspace in which lock may be broken is considerable, reaching up to 3,400 ft (Bell Crags eg §4.4.1) or 4,100 ft (Berry Hill eg §4.4.2) and extending for several kilometers.

46. Spaven and James' assessment of the extent of the resulting impact upon the real threat systems is as follows:

> "5.17 If it is assumed that the Steadings wind farm appears on the acquisition radar display away from all other sources of ground clutter, the turbine-obscured area on the display (about 6 Km^2) represents 0.08% of the SA-6/Straight Flush surveillance coverage (50 Km max range), and about 0.09% for the SA-8/Land Roll. Even within these geographically limited areas, any potential for material wind farm impacts on the utility of the threat systems is minimised by the continuous availability of IFF/SSR data from SPICCCS.
>
> 5.18 The continuing availability of IFF/SSR information and the lack of any material effect of turbine clutter on their acquisition radars mean that the SA-6 and SA-8 threat weapon systems will not be materially affected by the presence of the turbines".

47. Spaven and James assessment of the extent of the resulting impact upon the emulators is as follows:

> "5.7 Without their own acquisition radar and display, they are each dependent on the provision of accurate target acquisition data from an external source so that they can detect and track the correct aircraft. It is understood that IFF/SSR data, routed through SPICCCS, are used for this purpose. This will not be affected by clutter from any source".

48. The simple arithmetic approach fails to appreciate that the whole efficacy of the threat system can be undermined (and exploited by aircraft) by a small hole in coverage. I repeat the observation I made above at §§12-13. To put in percentages as at §5.17 without as express consideration of the practical significance of those numbers is to overlook the critical element of the analysis. Moreover, as already demonstrated, the IFF/SSR point is plainly wrong.

49. It should be noted that Lennox makes no attempt to calculate the extent of the adverse impact of the turbines on the TTR tracking radar (eg the volume of air likely to be adversely affected; how pronounced the effects will be; the constancy of the adverse effects etc)

Ability to re-acquire target when aircraft in wind farm area

50. If lock is broken, then the operator has to perform a complete new re-acquisition of the target, beginning with the target acquisition radar, then

switching to the tracking radar and acquiring lock again. In the case of the SA-8, on a best case scenario this will take in the order of 10 seconds. The SA-6, which has to re-calculate target information to slew missile platforms to the new target and calculate engagement parameters may take slightly longer (perhaps in the order of 15 seconds). In the case of the emulated threat systems, if break lock occurs above or near a main source of clutter then the auto tracking will have difficulty differentiating between the target and the noise, with the result that the break may also be in the order to 10 seconds, despite the fact that the acquisition of the target is not performed by the emulator systems.

51. The loss of 10 or 15 seconds may not sound much, but in relation to the threat systems engaging an “enemy” aircraft manoeuvring at high speeds, it is a very significant amount of time for the operators concerned. It may be the difference between an effective kill and evasion by the “enemy” aircraft. In training terms, this would amount to a ‘false positive’, allowing the pilot to avoid the threat where he might otherwise not have done so. For all intents and purposes, that training mission will have been wasted.

Suggestion that SSR is used to re-acquire target

52. Turner and New suggest as a mitigation that, if lock were lost as a result of an aircraft flying over the proposed wind farm, “SSR data from the aircraft’s transponder could be used to re-establish its position” [§5]. As has been made clear above, SSR has neither the capacity nor the accuracy to fulfil this function.

Role of the camera system in acquiring and re-acquiring target

53. Turner and New state in §2.2 that, in order to compensate for the possibility that the radar may mistakenly track a nearby object with a large RCS instead of the desired target:

> “[M]any air defence radars also have a camera mounted on the tracking radar, so that the operators can see whether the radar is still locked onto the desired target and compensate manually if necessary. Such an approach is used on the SA-8 and Skyguard systems, for example (see below for more information on these systems) and was described by the one of the operators during the threat radar visit to Spadeadam”.

54. The camera is again referred to in the introductory section to Turner and New's mitigation §5, following the comment that "Threat radars are designed to cope with losing track, as pilots attempt to evade them by flying behind terrain or releasing decoys". The conclusion, §6, makes plain the suggestion:

> "Even if this were to happen, the operators could reacquire lock manually within a few seconds using the radar's built-in camera or information supplied by air traffic control".

55. This suggestion would not work in practice, as even limited experience in the operation of the threat systems would make obvious. Using the camera at high magnifications, which is what is happening when the camera is tracking the target, is like looking through a straw or a pair of powerful binoculars. The field of view is extremely narrow. The likelihood of even an experienced operator regaining the target if lock is broken is almost non-existent. This is particularly so given that breaklock can be quite abrupt and violent – targets, especially those travelling at high speed, oblique to the threat may move very quickly out of the camera's Field of View (FOV).The operator would have to change the camera's FOV to wide angle, which in itself would diminish its capacity to see the target, particularly if far away.

56. It should also be remembered that the process would be further complicated because the aircraft would obviously be on the alert, having already been tracked once, and would necessarily be performing manoeuvres to further distract the operator. Finally, the utility of the camera is very much dependent on light conditions and weather. Even though most systems are equipped with low light TV cameras, they can be difficult to use in the conditions often prevailing in the North of England, and are virtually blind at night.

Suggestion that aircraft should avoid the wind farm area

57. Another one of Lennox's suggestion (§35) is that aircrew could "programme the aircraft navigation system to avoid flying over or close to the wind farm" (see also §38).

58. This imposes an unwarranted, simplistic and unworkable procedural limit on our operations. At the very least this limits our capability to engage at a time and a place that is most tactically representative with no thought as to whether subsequent tracking is indeed possible after the instruction to avoid

no longer applies. When one looks at the location of the three wind farms (MOD/0/9), considers the area over which the turbines will spray clutter and bear in mind the narrow gap that the aircraft are already forced into at the point of the turbines, the practical unworkability of this suggestion becomes fairly obvious to anyone of any experience.

59. Furthermore, subsequent engagements, because they have been interrupted at a potentially crucial stage, may not be prosecuted successfully because of that interruption. At its highest, this suggestion would result in the abandonment of one of three routes into Spadeadam.

Suggestion that the Post-Mission Report Should be Adapted

60. Then Mr Lennox suggests (§42) that the post-mission report could be suitable annotated to indicate when a lost lock was due to turbine clutter rather than aircrew actions.

61. This suggestion is puzzling. It is no real mitigation of the degradation of training for that degradation to be incorporated into the post-mission report. It certainly does not ameliorate the loss of realism of the training. As I have noted above, lock lost due to turbine clutter is a wasted training mission. It does not re-acquire training value simply by having this noted on the reports.

62. Also, the software that underpins SPICCCs and the production of the PRM has evolved over time and suggestions that it could be adapted have a significant cost implication.

Effect of Loss of Certain Remote Sites on Training Efficacy

63. RAF Spadeadam has over many years worked long and hard to build up its portfolio of suitable remote sites. By “suitable” I mean sufficiently large (not just to locate the equipment but to ensure that a no entry zone is created, preventing people from entering an area of radiation hazard) and sufficiently diverse. Bit by bit RAF Spadeadam has created a facility that offers a high degree of realism. The degree of realism goes hand in hand with the efficacy of the training.

64. Taken together, the portfolio of sites now enables Spadeadam to present a pilot with a battery of different threat systems (i.e. long, medium and short range). The remote sites provide a layered defence system: i.e. long-range, medium range and short-range threats. Recent developments have

seen the potential of the Range enhanced. Over the period 2006-07, as a result of frequency clearances, hardstandings and data connections to SPICCCS on Charterhall, Albermarle, Carlisle Airport and part of Otterburn have been secured. These will facilitate six-monthly large exercises. I have no doubt that, as a result of all the above, Spadeadam is able to provide the most comprehensive, sophisticated and effective EW training to pilots anywhere in Europe.

65. Spaven and James acknowledge that: “It is of course quite possible that the pattern of deployments seen at the off-range sites in 2006-7 could change and that the RAF might in future wish to deploy potentially affected systems to other sites where they are within range and line of sight of the Steadings turbines” [§6.23].

Polygone

66. The implication of §§1.9–1.14, 8.8 and Appendix C and D to the Spaven-Trott report is that:

- since Polygone and Spadeadam are both “major electronic warfare training ranges in Europe” (§1.9);
- since “radar line of sight exists from one or more of the four Polygone threat emitter sites to some 26 wind turbines at distances ranging from 400 metres to 66 kilometres” (§1.10);
- since the threat systems at Polygone include two SA-6 and two SA-8 missile systems (§C.3.2); and
- since “no evidence has been found that the existing wind turbines on the Polygone range cause difficulties for the operation of the range facilities” (§1.11),

RAF Spadeadam could continue to operate successfully as an electronic warfare training range “with numerous wind turbines and wind farms within radar range and line of sight of its threat systems” (§8.8).

67. This suggestion does not bear analysis. Not only does it not bear analysis, but upon analysis the very concerns which the MoD has expressed about the placement of each of these wind farms is borne out.

68. The first point that needs to be made is that Polygone is divided into two halves, the French half and the German half. An aircraft will use either one half or the other half. They will not use a combination of both. Nor, once booked on a mission, can an aircraft switch from one half of the range to the

other half of the range. They are, for all intents and purposes, separate ranges.

69. The Spaven-James report has concentrated on the German half of the range and so I shall respond to that report by dealing with it too.

70. In preparing this response, I consulted with Oberstleutnant Emig. He is the German Commander Polygone EWTF. I faxed him copy of Annex C to the Spaven Report and asked him to comment on it. Having done that, I had a number of telephone conversations with him. I have relied on what I have learned from him to prepare this section of my rebuttal proof. Oberstleutnant Emig also referred me to Hauptmann Luettmann, his Senior Engineer, and I have spoken to him on the telephone. Again, I relied on what I have learned from him to prepare this section of my rebuttal proof.

71. Oberstleutnant Emig told me that there were several turbines in the vicinity of Polygone and that a number of those turbines were close to sites where SA-8s and SA-6s were located. He said the turbine locations identified in the Spaven-Trott report seemed accurate.

72. Both Oberstleutnant Emig and Hauptmann Luettmann reported that the wind turbines showed up on the radar displays of both the SA-6 and the SA-8 threat systems.

73. Both Oberstleutnant Emig and Hauptmann Luettmann said that as a consequence of the presence of the turbines it was very difficult for the radars of the SA-6 and the SA-8 to track helicopters at low level in the vicinity of the turbines. His more modern ROLAND SAM system (short range – of the SA-8 variety but more sophisticated) could deal with effects of turbines by “sector blanking” otherwise known as selective transmit mute. This involves instructing the radar not to transmit between certain azimuths. It could also mean use of Constant False Alarm Rate (CFAR) filter whereby alarms in that area are ignored or “blanked out”. SA-8 and SA-6 cannot do this and as such the turbines were visible making tracking very difficult.

74. The turbines to the north of BANN A (PCC) were not that much of a freestanding concern because of the presence of the Ramstein Control Zone. This Zone means that aircraft using Polygone are not going to fly in the vicinity of those turbines in any event. The range is shown in Figure 3 in

Appendix 3 of the Spaven-Trott report as a dashed blue line in the NE corner (and beyond) of the Polygone RAFIS mandatory area. I would note that Ramstein Air Force Base is one the largest USAF bases in Germany. It is the US Air transport Hub for operational theatres in the Middle East and is very busy.

75. The turbines to the NNW of Polygone (numbered 89, 138, 75, 23, 181, 105 and 180) are within the Baumholder Danger Area. Part of this range is shown in Figure 3 in Appendix 3 to the Spaven-Trott report as a red line with an almost right-angle in it. This is barred to aircraft from ground to 18,000 ft, so aircraft using Polygone should not be flying over it.

76. To the south of the range is the Franco-German border, and aircraft using the German section of Polygone will not enter French airspace.

77. That leaves aircraft using Polygone entering the range either straight from the east or straight from the west. And that is what I am told they do. Moreover, it was confirmed to me that aircraft using the range are not permitted to fly below 1,000ft.

78. Oberstleutnant Emig indicated that the Range and the German equivalent of the MOD have blocked/prevented any further wind farm developments within the vicinity of Polygone. He indicated that the turbines that are already there had been erected without consulting either Polygone or the German equivalent of the MOD.

79. I also spoke to Hauptmann Koch, the Polygone German Air Force Air Traffic Controller. He supplied me with the aircrew information manual for Polygone.

80. I have now studied that aircrew information manual, particularly in light of statements made in the Spaven report and my conversations with Oberstleutnant Emig and Hauptmann Koch. Having done so, I would note as follows:

(1) There are 3 Airfield Control Zones in and around Polygone: Saarbrucken, Zweibrucken and Ramstein. I have already identified Ramstein. Saarbrucken is shown in Figure 3 in Appendix 3 to the Spaven-Trott report as a thick dashed blue rectangle, half of which is in the SW corner of the Polygone

RAFIS mandatory area. Zweibrucken is shown in Figure 3 in Appendix 3 to the Spaven-Trott report as a thick dashed blue rectangle, more-or-less in the middle of the Polygone RAFIS mandatory area, at something of an angle. The area of each of these is barred to aircraft entering the range from ground to either 3,600ft (in the case of Saarbrucken and Ramstein) or 3,100ft (in the case of Zweibrucken).

(2) There is also Baumholder Danger Area, which, as I have already mentioned, is barred to aircraft from Sfc to 18,000 ft amsl is positioned to the NW.

(3) The French-German Border to the south is a barrier to aircraft approaching from anywhere along that line. As noted above, the French and German Ranges are 2 separate facilities and aircraft only use one or the other. Cross border sorties are not allowed.

(4) TCAS corridors project east and west of the Ramstein ATZ and despite the fact that in some cases military traffic has precedence over civil, crossing TCAS corridors is not the norm and inbound aircraft to Ramstein would not have low level FJs crossing them as they land or take off.

81. All the above points to a general trend for aircraft to approach and use the Polygone range at a minimum of 1000ft agl (a long standing German national restriction on low flying) and predominantly from directly east or west. The presence of Baumholder Range and the 3 ATZs mean that only these approaches will be routinely feasible. An analysis of the Instrument Flight Rules for example (Para 4.2.1.4 IFR Flight Profiles) also confirms that approaches are limited to East-West Transits. This accorded with Hauptmann Koch's confirmation that VFR FJ LOAs were often confined to E-W and W-E because of the various airspace obstacles around the range.

82. Table 3 of the Spaven Annex details the locations of turbines in and around Polygone. For the reasons already set out above, the only significant turbine locations would be those inside an imaginary triangle formed by BANN-A + BANN-B, PIRMASENS and ZWEIBRUCKEN, i.e. 52, 70, 78, 57, 65, 131,151 and 184.

83. Although these turbines are between the threat system locations, only 139 (about 40km away from the closest edge of the imaginary triangle) is directly east or directly west of this triangle of sites. Threats are largely free to

engage targets as they approach along LOAs that are less restrictive, i.e. east or west. The threat's LOSs are thus clear of significant interference from turbines within the distances that are most importance to TAR and TTR.

84. On analysis, then, the lines of approach to Polygone are almost entirely free of interfering turbines. Approaches from the North or South would theoretically be compromised by turbines. But they are not in practice and will not be used because of the presence of Ramstein and Baumholder to the North, and the French border to the South.

85. Furthermore, due to the complicated nature of the airspace in and around the German half of Polygone, most aircraft are non-manoeuvring – they fly largely straight and level.

86. I have also spoken to Mr Scott Frater , the CAS contractor formerly based at Polygone. What he told me confirms my analysis. He indicated that the Polygone EWTF was known largely as a RWR tester or a Suppression of Enemy Air Defence practice area. It does not possess the flexibility of Spadeadam in that:

- low flying is not permitted;
- the use of chaff is not permitted;
- active jamming is not permitted.

87. Thus, instead of a range controller who has almost complete freedom to act as the situation develops, whose limits are only based on the training objectives required, Polygone have a Contractor Scenario controller who only reacts to a limited number of available scenarios. This makes it easier for threat systems to detect and track aircraft. And it means that wind turbines can be tolerated at Polygone in the locations shown without distracting the operators of the threat systems.

88. What is here being proposed by each of the three wind farm developers is the equivalent of placing numerous turbines due east or west of the imaginary triangle Bann-A + Bann-B, Pirmasens and Zweibrucken. I would be extremely surprised if Polygone could continue to operate effectively if that were done.

SQN LDR A COLEMAN
11/7/08