moray offshore renewables ltd

Environmental Statement

Technical Appendix 5.3 A - Initial Aviation Assessment

Telford, Stevenson, MacColl Wind Farms and associated Transmission Infrastructure Environmental Statement

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MORAY FIRTH OFFSHORE WIND FARM: INITIAL AVIATION ASSESSMENT REPORT

November 2010

Report No. 10/283/MOR/4

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1. Introduction

1.1 This document reviews the desk study of aviation issues conducted for Moray Offshore Renewables Ltd (MORL) in 2009, taking into account consultation responses received from aviation stakeholders.

1.2 This assessment addresses potential aviation issues in relation to both Phase 1 of the Moray Offshore development, also referred to as the Eastern Development Area, and Phase 2, also referred to as the Western Development Area. The boundaries of the Phase 1 and 2 areas and relevant aviation features in the Moray Firth area are shown in Figure 1.

2. Review of MORL desk study

2.1 A high level screening of potential aviation issues for the Moray Offshore wind farm was conducted by Pager Power in 2009.[1] This study identified the following potential aviation issues associated with the Moray Firth proposal:

- line of sight to NATS Allanshill radar
- line of sight to RAF Lossiemouth primary radar
- obstacle clearance for helicopter instrument approach procedures to the Beatrice platforms
- location of parts of the Western Development Area within the Kinloss/Lossiemouth Area of Intense Aerial Activity (AIAA).

2.2 Following submission of a consultation proforma to the Civil Aviation Authority (CAA) and the Ministry of Defence (MoD), responses were received from those bodies which identified the following additional issues:

- obstacle clearance issues for helicopters flying on Helicopter Main Route X-Ray
- proximity to Wick Airport
- obstacle clearance issues for military air activity in Danger Area D807.

2.3 Of the potential issues listed above, the Kinloss/Lossiemouth AIAA can now be discounted since, following a review by the CAA Directorate of Airspace Policy (DAP) in 2008-9, this AIAA was removed from 31 December 2009.

2.4 In addition to the above, three further issues have been raised since 2009: (a) the potential for line of sight to the Moray Offshore turbines from the air defence radar at RAF Buchan, (b) the potential for impacts on operations by search and rescue helicopters and (c) the impacts of meteorological masts on aviation in the vicinity.

[1] Pager Power, *6131A – RPS Moray Firth – High Level Screening Assessment*, February 2009.

2.5 The full range of potential aviation issues addressed in this report is therefore:

- line of sight to NATS Allanshill radar
- line of sight to RAF Lossiemouth primary radar
- obstacle clearance for helicopter instrument approach procedures to the Beatrice platforms
- obstacle clearance issues for helicopters flying on Helicopter Main Route X-Ray
- proximity to Wick Airport
- obstacle clearance issues for military air activity in Danger Area D807
- line of sight to RAF Buchan radar
- impacts on search and rescue helicopter operations
- impacts of meteorological masts.

3. NATS Allanshill radar

3.1 Primary surveillance radar can be affected by wind turbines in three ways:

- Air traffic control radar is designed to detect moving objects, while filtering out static objects such as buildings, radio masts and terrain. The moving blades of a wind turbine may be detected and displayed by the radar, and may appear to controllers as being similar to the radar returns from an aircraft. Controllers may then have to treat them as if they were unknown aircraft, with consequences for the provision of services to known aircraft in the vicinity.
- Primary surveillance radars used for air traffic control are designed to filter out static and slow-moving radar returns by use of 'clutter mapping' techniques. The radar returns from wind turbines can have the effect of raising the clutter mapping thresholds in the area of the wind farm, resulting in a reduced probability of detection of real aircraft targets overhead the wind farm.
- Blocking of the radar signal by the wind turbine towers and nacelles can reduce the radar's ability to detect aircraft at low altitude behind the wind farm.

3.2 NATS En Route Ltd operates a combined primary and secondary surveillance radar station at Allanshill, 6 km south west of Rosehearty in Aberdeenshire (see Figure 1). The Allanshill radar supplies data to controllers located at Aberdeen Airport who provide services to helicopters and fixed-wing aircraft within the Aberdeen Radar sector (see Figure 1). The Allanshill radar was installed in the 1980s to supplement the main NATS Aberdeen radar at Perwinnes Hill (located 4 km east of Aberdeen Airport), which has poor low level coverage over the Moray Firth due to intervening terrain. The original Watchman radar at the Allanshill site was replaced in 2009 by a Raytheon ASR-10SS solid-state primary surveillance radar co-located with a Mode S Secondary Surveillance Radar (SSR).

3.3 The NATS self-assessment radar coverage diagrams show that the whole of the Phase 1 area, and approximately two thirds of the Phase 2 area, will be within

radar line of sight of the Allanshill radar. Figure 2 shows the Allanshill radar coverage at 140 metres above sea level, annotated with the boundaries of the Moray Offshore Phase 1 and Phase 2 development areas. It can be expected that turbines in the Beatrice Offshore Wind Ltd (BOWL) development, which abuts the MORL Phase 1 and 2 northern boundaries, will also be visible to the Allanshill radar.

3.4 The Allanshill radar's coverage at 182 metres above sea level – the maximum blade tip height on current plans – would extend slightly further south west than shown in Figure 2. However the radar's coverage of the south western parts of MORL Phase 2 would remain significantly constrained by high terrain within 5 km of the radar. This is illustrated in Figures 3 and 4, which show the line of sight from the radar to the blade tip height of 182m turbines located at points 12 and 13 of the MORL Phase 2 boundary, in the vicinity of the Beatrice C platform. In both cases, the line of sight is blocked by the terrain close to the radar.

3.5 The display of wind turbine returns on radar is not necessarily unacceptable from an air traffic control (ATC) point of view. If the wind turbines are in an area which is not operationally significant to ATC, or appear on radar in a manner which can be accommodated within controller procedures and practices, the effects on radar may be deemed acceptable, perhaps with some alteration to ATC procedures. However in view of the scale of the MORL development and its proximity to air traffic routes in uncontrolled airspace, NATS is unlikely to accept the MORL proposal without some form of technical and/or procedural mitigation.

3.6 In the case of the Moray Offshore development, both the Phase 1 and Phase 2 areas lie underneath two routes on which NATS ATC personnel provide air traffic radar services:

- Helicopter Main Route (HMR) X-Ray, which is used by offshore helicopters routing between Aberdeen Airport and the Foinaven and Schiehallion floating production facilities, 130 km west of Shetland. The section of the route which overlies the Moray Offshore development is bi-directional and extends from 1500ft above sea level up to the base of W4D (see below).
- Advisory Route W4D, which follows the same route as HMR X-Ray between Aberdeen and Wick but extends from Flight Level 55 (approximately 5,500 feet) up to Flight Level 185 (approximately 18,500 feet). Advisory Routes provide a degree of protection to aircraft using them, but unlike fully controlled airspace, do not provide separation against all other aircraft. W4D is predominantly used by Eastern Airways scheduled passenger services between Wick and Aberdeen and by light aircraft on transatlantic ferry flights between Europe and North America via Wick.

3.7 The locations of W4D and HMR X-Ray relative to the Phase 1 and Phase 2 areas are shown in Figure 1. A schematic diagram showing the profile of the airspace boundaries in elevation is at Figure 5.

3.8 Air traffic radar services to helicopters flying on the portion of HMR X-Ray between Aberdeen and Wick are provided by Aberdeen Radar controllers located at Aberdeen Airport. Services to aircraft flying on W4D are provided by Scottish

Control, located at the Scottish Area Control Centre at Prestwick. Since both routes are outside controlled airspace, controllers may be required to provide horizontal separation of five nautical miles (nm) between the aircraft to which they are providing a service and any unidentified radar returns. A large portion of both the Phase 1 and Phase 2 areas are located within 5nm of the centreline of HMR X-Ray/W4D, therefore radar-visible turbines in this area are likely to have an operational impact on provision of these air traffic radar services.

3.9 Mitigation for the effects of the Moray Offshore wind farm on the Allanshill radar could range from operational measures (e.g. re-routing traffic, changes to the type of radar service provided, changes to the airspace classification) to radar technical measures (e.g. provision of cover from another radar which cannot see the turbines; development of radar processing to filter out the turbines; provision of services using secondary surveillance radar only; multilateration).

3.10 In the case of the Allanshill radar, any mitigation of Moray Offshore Phase 1 will have to take account of cumulative impacts with Moray Offshore Phase 2 and the Beatrice Offshore Wind development. Because of the cumulative scale of these developments, operational mitigation measures on their own are unlikely to be sufficient. However the scale of the developments also increases the economic viability of technical mitigation measures.

3.11 Two strategies for mitigation of the effects on the Allanshill radar are likely to have particular relevance:

- implementation of the Raytheon upgrade programme on the Allanshill radar
- blanking of the Allanshill primary radar in the area over the wind farms(s), provision of radar services using secondary surveillance radar (SSR) only, and imposition of a Transponder Mandatory Zone (TMZ) over the area[2].

3.12 The Raytheon upgrade programme is a project funded by the wind industry, DECC and the Crown Estate to investigate a number of processing enhancements to the Raytheon radars in service with NATS En Route, in order to improve their performance against wind turbines. The research and development phase is under way and is due to report in June 2011. It is currently running to schedule. Raytheon and the Royal Netherlands Air Force successfully completed trials of the enhancements to the ASR-10 radar (the type installed at Allanshill) in early July 2010. Similar trials on the ASR-23 radar at Lowther Hill are due to be conducted in February 2011. The ultimate aim of the Raytheon upgrade programme is to achieve radars which are unaffected by wind turbines while maintaining or enhancing their performance against aircraft. Deployment of the solution is expected to commence in 2013 if development work proceeds according to schedule and wind industry funding for implementation is agreed. The NERL plan is to implement the upgrade on all 23 radars in its network, commencing with those most affected by wind farm proposals. The position of Allanshill in the implementation programme would be a matter for negotiation.

3.13 The blanking/SSR only/TMZ approach may be regarded either as a stop-gap measure pending the successful completion of the Raytheon project; a fall-back in

[2] Multilateration – the tracking of aircraft using triangulation by multiple SSR transmitter/receivers – would also be likely to require a Transponder Mandatory Zone.

case Raytheon does not meet required specifications; or as a stand-alone long-term solution. It has a precedent in the arrangements for mitigation of the effects of the London Array and Thanet Offshore wind farms on the radar at Kent Airport (Manston). This approach has the benefit of not requiring any technical upgrades since the required SSR coverage is already in place at Allanshill. Blanking of the primary radar is relatively straightforward, and imposition of a TMZ in an offshore area is also relatively simple since there are likely to be few aviation stakeholders who would want to fly through this area in aircraft not equipped with transponders.

3.14 In the event that neither the Raytheon upgrade programme nor the combination of blanking, SSR only and TMZ are found to be viable mitigations, a 'gap-filler' approach may be appropriate. This would use the data from a radar which has coverage of the airspace above the turbines but does not have line of sight to the turbines themselves, due to intervening terrain. The data from this radar would replace the affected radar's coverage over the wind farm. The gap-filler radar could be an existing facility with the required level of coverage or, if no such radar exists, a new radar procured specifically to mitigate the wind farm effects, and located so as to avoid line of sight to the turbines but provide adequate low level coverage above the turbines.

4. RAF Lossiemouth primary radar

4.1 RAF Lossiemouth has a Watchman primary radar located in the centre of the airfield. The potential effects of the Moray Offshore wind farm on this radar are the same as those outlined in paragraph 3.1 above.

4.2 RAF Lossiemouth ATC use their primary radar to provide services to aircraft inbound to and outbound from RAF Lossiemouth and RAF Kinloss, to military aircraft operating over the Moray Firth, including the area of the wind farm, and to transiting civil and military aircraft operating within a 40nm radius of Lossiemouth, up to 9,500 feet, from Monday to Friday between 0900 and 1700hrs.

4.3 The line of sight from the Lossiemouth radar to the blade tips of 182 metre turbines at illustrative positions on the south west, west and northern boundaries of the Phase 1 area is shown in Figures 6, 7 and 8. From these it can be summarised that turbines in the south western parts of the area will be fully visible to the radar; turbines in the central and western parts of the area will be partially visible; and turbines in the eastern and northern parts of the area will not be visible to the Lossiemouth radar because they will be beyond the radar horizon.

4.4 From the above it can be concluded that 182m turbines in all but the northern extremities of the MORL Phase 2 area will also be within line of sight of the RAF Lossiemouth primary radar. It can be expected that turbines in the Beatrice Offshore Wind Ltd (BOWL) development, which abuts the MORL Phase 1 and 2 northern boundaries, will also be visible to the Lossiemouth radar.

4.5 The display of wind turbine returns on radar is not necessarily unacceptable from an air traffic control (ATC) point of view. If the wind turbines are in an area which is not operationally significant to ATC, or appear on radar in a manner which can be accommodated within controller procedures and practices, the effects on

radar may be deemed acceptable, perhaps with some alteration to ATC procedures. The MoD has accepted the impact of the two Beatrice Demonstrator turbines on the RAF Lossiemouth radar and in 2009 approved a major expansion of the existing Rothes wind farm, also fully visible to the RAF Lossiemouth radar. However in view of the scale of the MORL development and subsequent shifts in MoD policy, the MoD is unlikely to accept the MORL proposal without some form of technical and/or procedural mitigation.

4.6 Technical mitigation solutions for the Lossiemouth radar may be more complex than for the NATS Allanshill radar. The MoD's long-term programme for replacement of all Watchman air traffic control radars in UK military service is likely to include a requirement that any new equipment is not vulnerable to wind farm effects. However this programme has already been delayed and may slip further due to public expenditure cuts. It cannot be relied upon to deliver a mitigation solution in the required timescale for development and construction of MORL.

4.7 'Gap-filler' solutions would depend on another radar to provide coverage over the wind farm. This could be:

- an existing radar which cannot see the turbines, but can see a short distance above them; or
- an existing radar which has been upgraded to eliminate wind turbine returns (such as Allanshill after the Raytheon upgrade); or
- a new radar funded by the Moray Firth offshore wind developers, in a suitable location chosen to avoid line of sight to the turbines.

4.8 A solution based on blanking, provision of services using SSR only, and implementation of a TMZ over the MORL wind farm, as outlined in paragraph 3.13 above in relation to the Allanshill radar, could also be applied to the RAF Lossiemouth radar. This would negate any requirement for a source of gap-filler radar data. However it would require MoD acceptance of the provision of air traffic services using SSR only over a significant part of the RAF Lossiemouth area of responsibility.

4.9 The Defence Review on 19 October 2010 announced the cancellation of the Nimrod MRA.4 programme and the closure of RAF Kinloss. It also announced a reduction in the Tornado GR.4 fleet and that two other RAF bases would be closed. However it stated that no decision had been taken on which bases these would be. One proposal is to disband two of the Tornado squadrons at Lossiemouth and move the remainder to the other RAF Tornado base at Marham in Norfolk. This would result in the closure of RAF Lossiemouth. However another proposal under consideration is to retain Losssiemouth on a care and maintenance basis for use during exercises. The latter option would result in the MoD continuing to safeguard the airfield and its radar services and would therefore sustain their objection to the MORL development.

5. Helicopter instrument approach procedures to the Beatrice platforms

5.1 The CAA advises that an area of 6nm radius around helideck-equipped offshore installations should be clear of obstacles in order to facilitate helicopter instrument approach procedures to those platforms from any direction.[3]

5.2 The boundaries of the MORL Phase 1 area have been defined in order to remain beyond this 6nm radius zone around the Beatrice A, B and C platforms and the Jacky platform, which was installed 2.7nm NNE of the Beatrice B in early 2009.

5.3 If all Phase 1 turbines are kept beyond the 6nm radius from all offshore platforms in the area, impacts on helicopter instrument approach procedures may be avoided, although an analysis of the impact on the vertical profile of the procedure may be required. Consideration may also have to be given to the acceptability of helicopter overflight of the wind farm below specified altitudes, in order to address emergency landing considerations.

5.4 Development of the BOWL and MORL Phase 2 areas will require placing turbines inside the 6nm obstacle-free zones. The impacts of this on helicopter access to the platforms in instrument conditions will require analysis of the existing obstacle environment on and around the installation, and of meteorological data, in order to define prohibited approach sectors, devise amendments to existing approach procedures, determine the frequency with which instrument approaches may be precluded, and develop mitigation measures.

5.5 The current standard instrument approach procedure used by helicopters to access offshore platforms, the Airborne Radar Approach (ARA), will shortly be replaced by the Satellite-Based Augmentation System Offshore Approach Procedure (SOAP). This offers some benefits over the ARA in terms of ability to work around obstacles and is likely to form a key element of any mitigation strategy for the Phase 2 development.

6. Helicopter Main Route X-Ray

6.1 HMR X-Ray is used by helicopters transiting between Aberdeen and the Atlantic Rim offshore installations west of Shetland. The potential impact of the MOR project on helicopters using this route is two-fold: (1) impact on air traffic radar services to these aircraft using the Allanshill radar (see section 3 above); and (2) potential obstacle clearance issues when icing conditions force helicopters to fly visually below cloud at altitudes lower than the normal minimum of 2000ft.

6.2 In order to address the obstacle clearance issue, the CAA advises in CAP 764 that HMRs should be clear of obstacles for a distance of 2nm either of the HMR centreline. The implications of this for the MORL project will depend on the current operational parameters for use of HMR X-Ray, including restrictions on low-level icing routings due to significant overland portions of the route to the north west of Aberdeen Airport passing over or within 5nm of terrain and obstacles up to 1300ft in height.

[3] CAP 764, Chapter 3, Section7.

6.3 Analysis of the impact on helicopter operations in icing conditions will require consultations with helicopter operators currently using this route.

6.4 Mitigations for this effect may include:

- tactical re-routing to be used when icing conditions prevail
- a re-design of HMR X-Ray so that it avoids the wind farm in all circumstances and permanently
- introduction of helicopters which are approved for flight in known icing conditions
- future changes to the location of the supply base for helicopter flights to the Atlantic Rim platforms.

7. Wick Airport

7.1 The Moray Offshore wind farm has the potential to conflict with instrument approach procedures to Wick Airport. To assess this, analysis has been conducted of the horizontal and vertical proximity of the closest turbines to these procedures.

7.2 The northern boundary of the Eastern (Phase 1) Development Area is located 25.8 km (13.9 nm) south east of Wick Airport. Instrument Flight Rules traffic inbound to Wick from the south east mainly flies along Advisory Route W4D. In the area within a 25 nautical mile (nm) radius of Wick Airport, the Minimum Sector Altitude (MSA) – the lowest altitude to which aircraft can safely descend while maintaining 1000ft vertical separation from all terrain and obstacles – is 1800ft above sea level. Descent below 1800ft is not authorised until the aircraft is established on the final approach track, which is more than 5nm from the northern boundary of the Eastern Development Area.[4] Therefore, any turbines in the Phase 1 area will be within the area where aircraft are currently permitted to descend to 1800 ft. On current plans the maximum tip height of any turbines will be 182 metres (597 ft). The current MSA of 1800 ft will therefore continue to give well in excess of the required minimum 1000ft vertical separation over the turbines. Consequently the Phase 1 development will have no impact on Wick Airport instrument flight procedures.

7.3 Consideration may also need to be given to the impact of the Moray Offshore development on handover arrangements between Wick ATC and en route ATC agencies in the area to the south east of Wick. Wick is not equipped with radar. Controllers may be handing aircraft over from Wick to radar controllers at Aberdeen Radar, Scottish Control or Lossiemouth Radar (and vice versa) in the vicinity of the Moray Offshore development. Impacts of the development on radar performance in this area may have implications for the handover process.

8. Danger Area D807

8.1 Danger Area D807 comprises a circle of 10nm radius, extending from the sea surface to 1500 feet above sea level. The south west corner of the Phase 1

[4] Civil Aviation Authority, UK AIP AD 2-EGPC-8-5, 1 July 2010.

area and approximately the south-eastern half of the Phase 2 area are within the boundaries of D807 (see Figure 1).

8.2 D807 is permanently notified, i.e. other airspace users are advised that this area is always active during its published activity hours, which are Monday to Friday, 0700hrs to 2359hrs local time (and other times as notified). However, in practice, other airspace users can contact RAF Lossiemouth air traffic control for information on whether the area is active or not and, if advised that the area is inactive, other aircraft may fly through it.

8.3 D807 is predominantly used for low level anti-submarine sonobuoy training by Nimrod aircraft from RAF Kinloss (currently inactive but re-equipping with the Nimrod MRA.4 from 2011). This activity may be conducted in any meteorological conditions including flight in cloud as low as 500 feet above sea level. Since this is below the proposed heights of the turbines, obstacle clearance from any turbines located inside D807 is an issue which must be addressed.

8.4 Promulgated activity in D807 includes live firing and bombing. However, unlike most weapons ranges, there are no byelaws which prohibit other aircraft from entering the area when it is active. This is believed to be due to the fact that D807 is wholly beyond UK territorial waters and therefore not within the jurisdiction of byelaws.

8.5 The nature and scale of the impact of the Moray Offshore wind farm on activities in D807 will depend on the extent to which the northern parts of the danger area are used by participating aircraft. In consultations with the MoD their initial response has been that no turbines are permissible within the lateral limits of D807. However further details of the nature, frequency and control of operations inside D807 will be required in order to assess the scope for discussion of mitigation measures.

8.6 Mitigation measures may include consideration of turbine locations and dimensions and amendment of the location, size and/or shape of D807 to accommodate wind farm developments.

8.7 The announcement of the withdrawal of all Nimrod aircraft and the closure of RAF Kinloss in the Defence Review of October 2010 is expected to mean the disestablishment of D807. This will require confirmation from MoD.

9. RAF Buchan radar

9.1 Potential impacts on the RAF Buchan air defence radar are similar to those outlined in paragraph 3.1. However the Type 92 radar which is currently in place at Buchan is known to have a good capability at filtering out wind turbine returns compared to other primary radars.

9.2 The line of sight from the RAF Buchan radar to the blade tips of 182 metre turbines at illustrative positions on the south eastern and eastern margins of the Phase 1 area is shown in Figures 9 and 10. From these it is clear that turbines in any part of the Moray Offshore development area will not be visible to the Buchan radar due to intervening terrain to the north of the radar site. Consequently no mitigation measures will be required for the Buchan radar.

9.3 The MoD has confirmed in a meeting on 20 July 2010 that it has no concerns about impacts on the RAF Buchan air defence radar.

10. Impacts on search and rescue helicopter operations

10.1 Search and rescue helicopter cover in the Moray Offshore Development Area is provided by two Sea King HAR.3 helicopters from D Flight No.202 Squadron based at RAF Lossiemouth. Plans for contractorisation of all search and rescue helicopter provision in the UK under a Private Finance Initiative contract were announced in February 2010 but put on hold by the incoming government in June 2010.

10.2 Search and rescue (SAR) helicopter operations within the Moray Offshore wind farm area could include:

- response to a vessel emergency within the wind farm
- response to an emergency involving wind farm personnel
- response to an aircraft ditching in the wind farm area
- emergency helicopter access to adjacent oil platforms.

10.3 Two studies relating to SAR helicopter operations within offshore wind farms have been carried out. The first assessed the performance of marine radar, radio communications and GPS in close proximity to wind turbines.[5] The second used an RAF Sea King helicopter to assess the effects of operating a SAR helicopter within an offshore wind farm.[6]

10.4 The first study found that the only significant cause for concern was the effect of wind farm structures on shipborne and shore-based radar systems. The second study concluded that, while a helicopter could be safely flown into a regularly-spaced wind farm in good visibility, there could be limitations on the use of helicopters in offshore wind farms due to:

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5 MCA and QinetiQ, *Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle wind farm by QinetiQ and the Maritime and Coastguard Agency*, November 2004.

6 Maritime and Coastguard Agency, *Offshore Wind Farm Helicopter Search and Rescue Trials Undertaken at the North Hoyle Wind Farm*, 2005.

- Significant radar side lobe returns from structures, limiting target detection when vessels were within 100 metres of turbines.
- The current inability of some wind farm operators to remotely lock turbine blades in rotation and in yaw.
- Limitations in approach distances from turbines in clear weather.
- Inability to effect surface rescues within wind farms in restricted visibility.
- Limitations of helicopters as radar search platforms if the wind farm was large and had irregularly spaced turbines.
- Limitations in the use of thermal imaging in conditions of mist or precipitation.
- Tracking, by vessel or shore-based marine radar, of helicopter movements within wind farms was generally poor.
- Increase of aircraft power requirements downwind of the wind farm.

10.5 While no concerns have been raised by the MoD about the impact of the Moray Offshore wind farm on SAR helicopter operations, consultations with maritime operators and the operators of the Beatrice and Jacky platforms will be required in order to address any issues relating to platform safety cases and rescue planning within the wind farm area.

11. Meteorological masts

11.1 Meteorological masts for the MORL development will constitute a potential hazard to low flying aircraft. Mitigation of this effect is normally achieved by passing full details of the location, height and construction of any obstacle to the Defence Geographic Centre prior to construction. DGC is responsible for maintaining the obstacles database from which civil and military aeronautical charts are compiled.

11.2 Lighting of offshore wind turbines is mandated by Article 220 of the Air Navigation Order. However this does not cover offshore obstacles which are not turbines and which are less than 150m in height. There is therefore no mandatory requirement for lighting on offshore met masts and no standards for the type and intensity of any lighting to be installed on them. Discussions are under way between the maritime and aviation industries and regulators on the preferred method of meeting lighting requirements for both industries.

12. Conclusions

12.1 The NATS Allanshill radar will be affected by the MORL Phase 1 and 2 developments. Mitigation will be required. Discussions with NATS will be required to determine the scope for different approaches to mitigation, including the Raytheon upgrade programme, a blanking/SSR only/TMZ solution, and gap-filler radar. Any mitigation for the Allanshill radar will require to address cumulative impacts of MORL Phase 1, MORL Phase 2 and BOWL.

12.2 Progression of a mitigation strategy based on the Raytheon upgrade programme will require ongoing consultation and liaison with RenewablesUK and the Fund Management Board in addition to NATS.

12.3 Progression of a mitigation strategy based on blanking/TMZ/SSR-only will require ongoing consultation and liaison with the CAA Directorate of Airspace Policy in addition to NATS and the MoD.

12.4 As a back-up to the principal mitigation options of blanking/TMZ and Raytheon upgrade, a feasibility study should be conducted of procurement and installation of a new radar to act as a gap-filler for both the NATS Allanshill and RAF Lossiemouth radars.

12.5 The RAF Lossiemouth radar will be affected by the MORL Phase 1 and 2 developments. Mitigation will be required. Discussions with MoD will be required to determine the scope for different approaches to mitigation, including a blanking/SSR only/TMZ solution, and gap-filler radar. Any mitigation for the Lossiemouth radar will require to address cumulative impacts of MORL Phase 1, MORL Phase 2 and BOWL.

12.6 The MORL Phase 1 area has been designed to remain outwith the CAA-recommended 6nm radius obstacle-free zone around the Beatrice and Jacky oil platforms. The Phase 1 development may therefore avoid impacts on helicopter instrument approach procedures to those platforms. However an analysis of the development's impact on the vertical profile of those procedures will be required.

12.7 The MORL Phase 2 and BOWL developments will require turbines to be placed within 6nm of the Beatrice and Jacky platforms. Detailed analysis of the scale and frequency of impact of this on helicopter instrument approach procedures, and potential mitigation measures, will be required. This work will require consultations with the relevant helicopter operators and the CAA.

12.8 The MORL Phase 1, Phase 2 and BOWL developments have the potential to create obstacle hazards to helicopters operating along HMR X-Ray, particularly in icing conditions. The development of mitigations for this effect will require consultations with the relevant helicopter operators, with NATS, the air traffic service provider on this route, and with the CAA.

12.9 Impacts on Wick Airport's instrument approach procedures are not predicted to occur. Confirmation of this may require submission of an assessment report to the airport's operator, Highlands & Islands Airports Ltd. The potential for effects on air traffic control handover arrangements between Wick and en route ATC agencies will require discussion with those agencies.

12.10 Turbines placed within danger area D807 will pose an obstacle hazard to aircraft operating inside that area. Development of mitigations for this impact will require further discussions with the relevant personnel within MoD.

12.11 There will be no impacts on the RAF Buchan air defence radar. No further action is required in relation to that facility.

12.12 No concerns have been raised by the MoD about the impact of the Moray Offshore wind farm on SAR helicopter operations. However consultations with maritime and offshore platform operators will be required in order to address any

issues relating to platform safety cases and rescue planning within the wind farm area.

12.13 Meteorological masts for the MORL development will pose a hazard to civil and military aircraft. This can be addressed in the normal way by promulgation of information through the Defence Geographical Centre. Lighting requirements for met masts are expected to emerge from aviation/marine industry discussions on this issue.

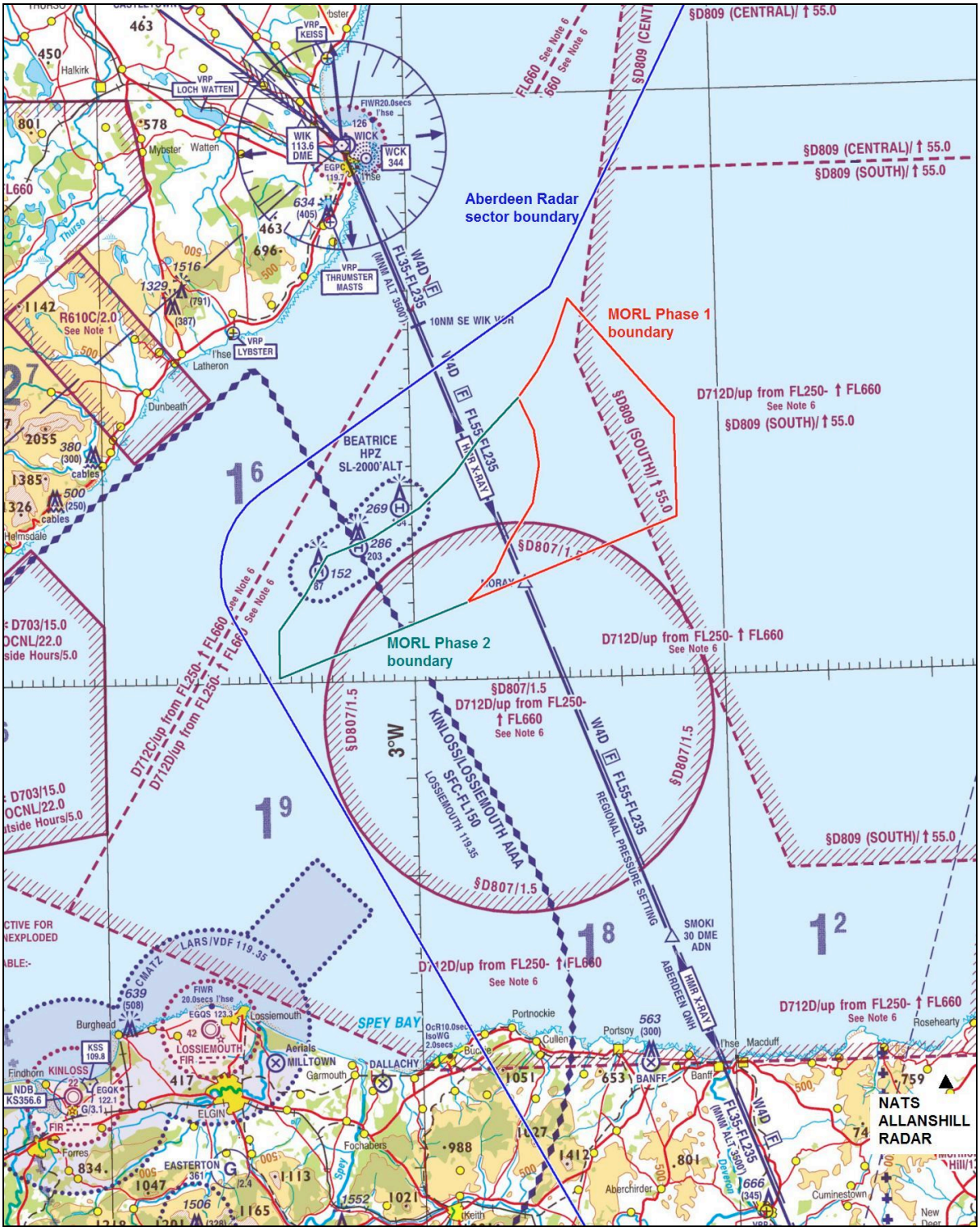

Figure 1: Aviation features in the Moray Firth area[7]

[7] NB the Kinloss/Lossiemouth AIAA has since been withdrawn.

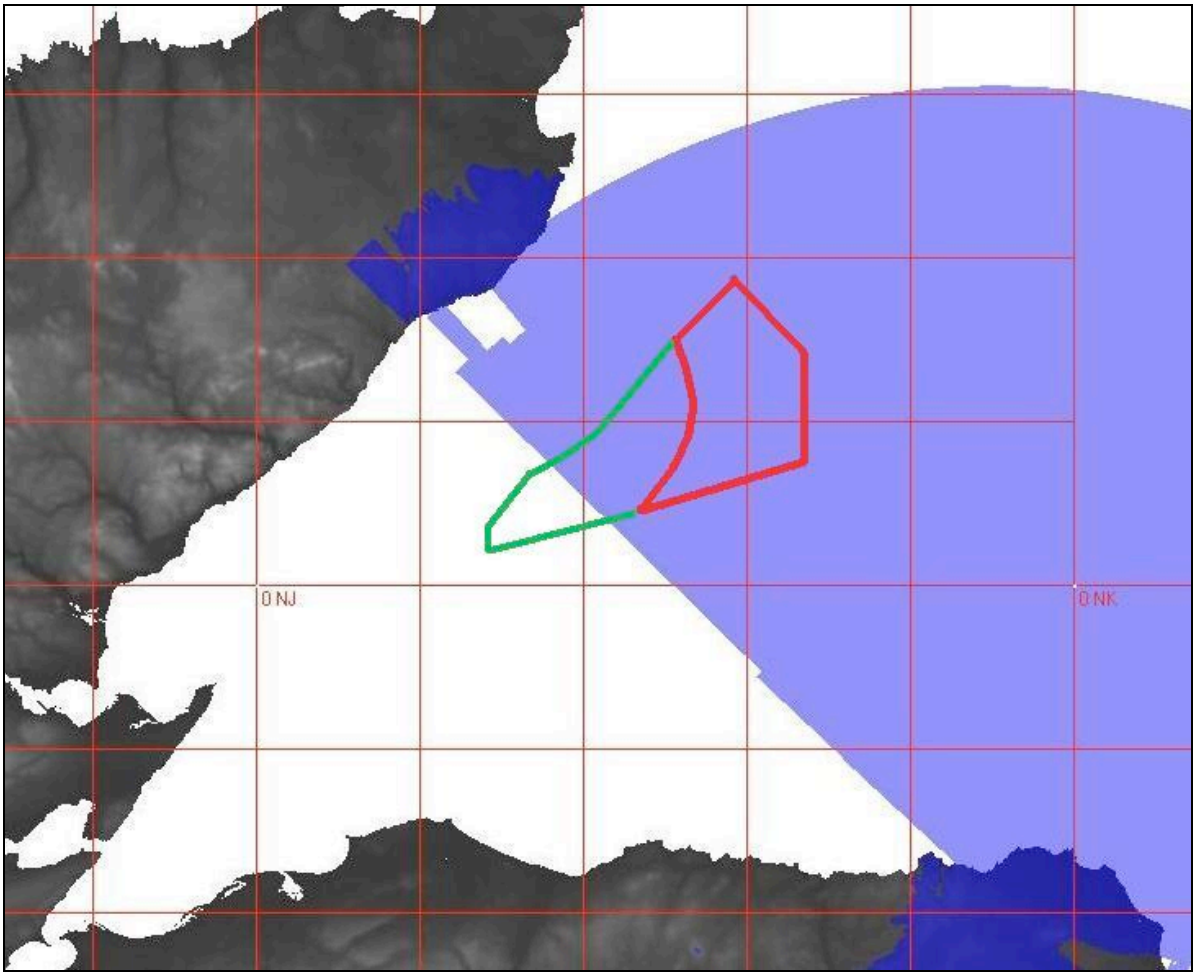

Figure 2: Allanshill radar coverage at 140m above sea level

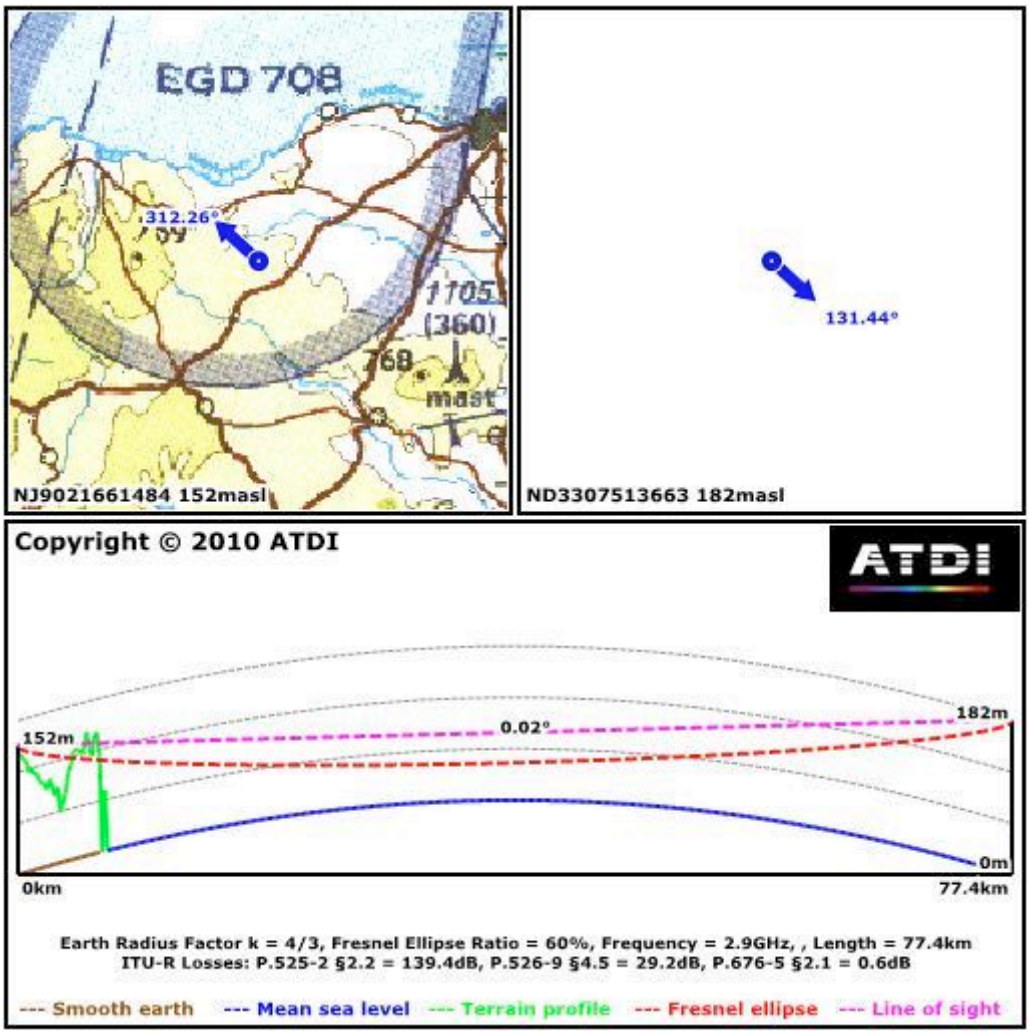

Figure 3: Radar line of sight from NATS Allanshill radar to 182m turbine blade tips at MORL Phase 2 boundary point 12[8]

[8] The upper, pink line shows the line of sight from the radar. Where this is infringed by the terrain (green line) or the sea (blue line), the radar will not have line of sight to objects at the illustrated location.

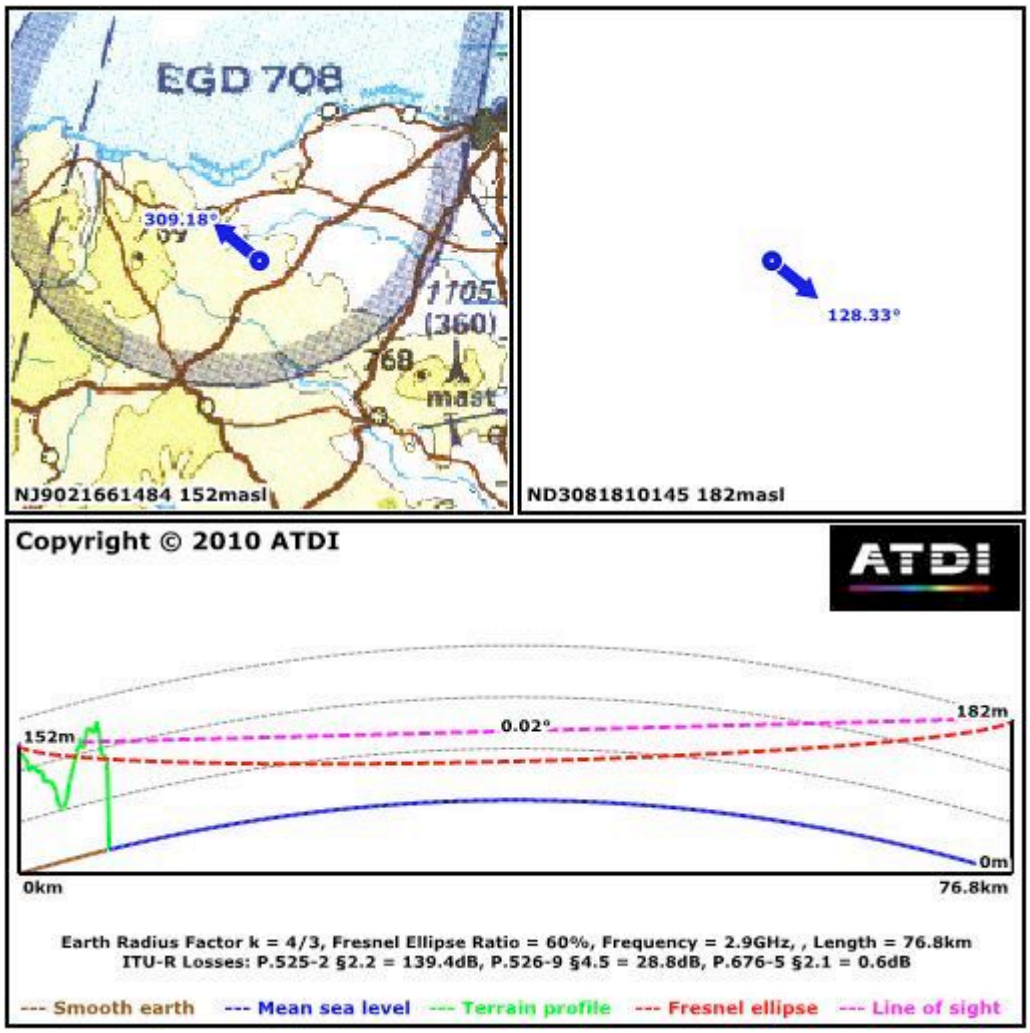

Figure 4: Radar line of sight from NATS Allanshill radar to 182m turbine blade tips at MORL Phase 2 boundary point 13

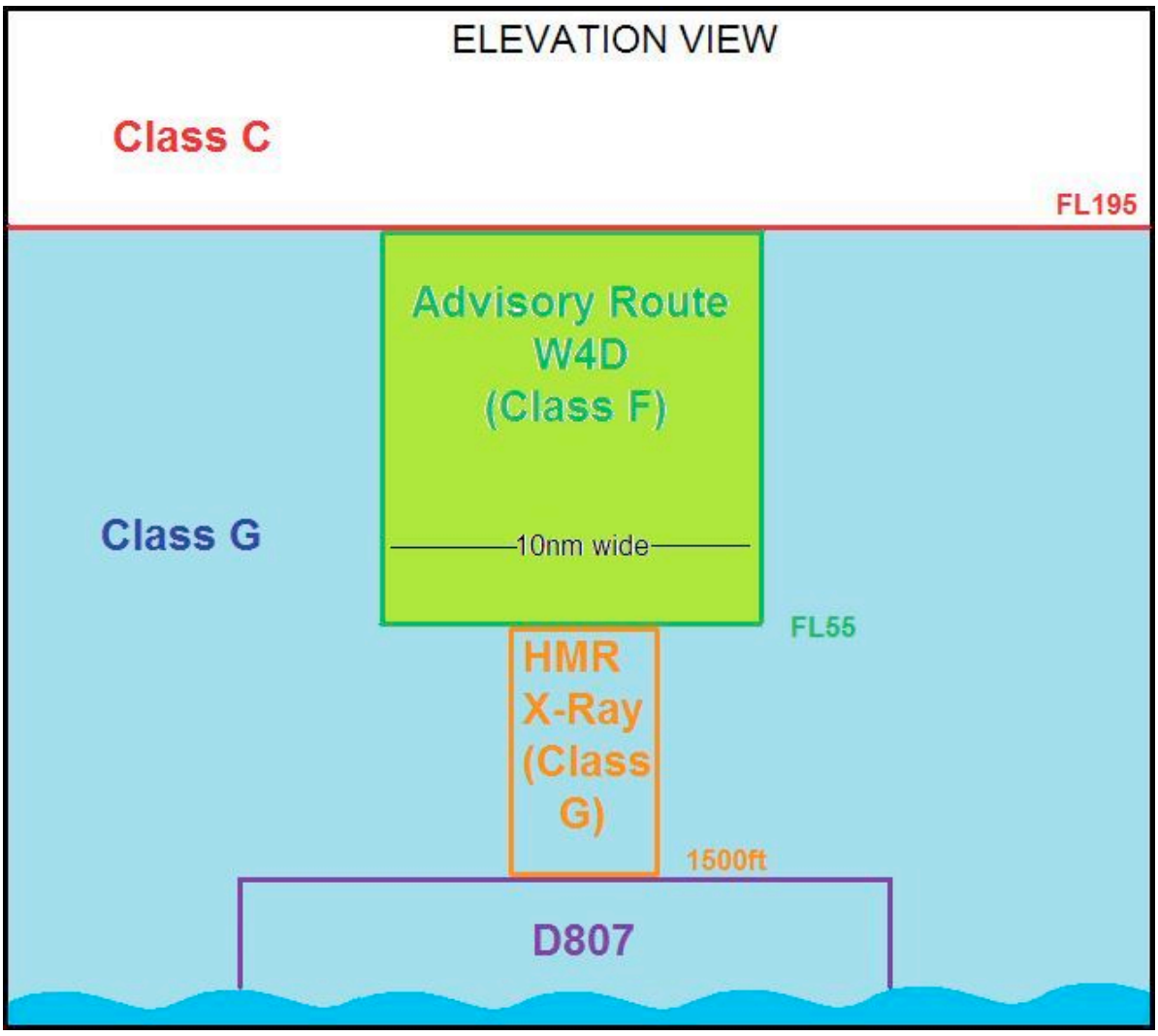

Figure 5: Elevation view of airspace features in the vicinity of MORL

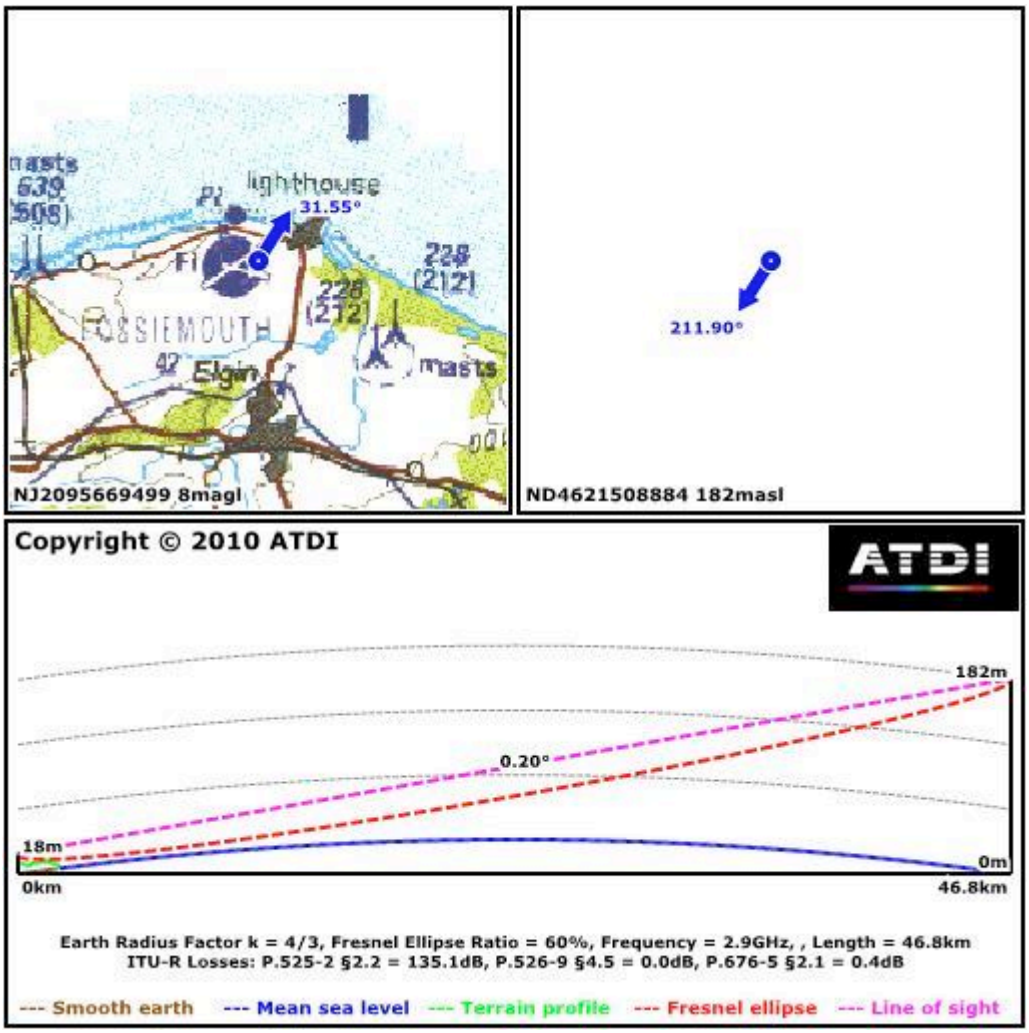

Figure 6: Line of sight from RAF Lossiemouth primary radar to 182m turbine in SW corner of Moray Offshore Phase 1 area

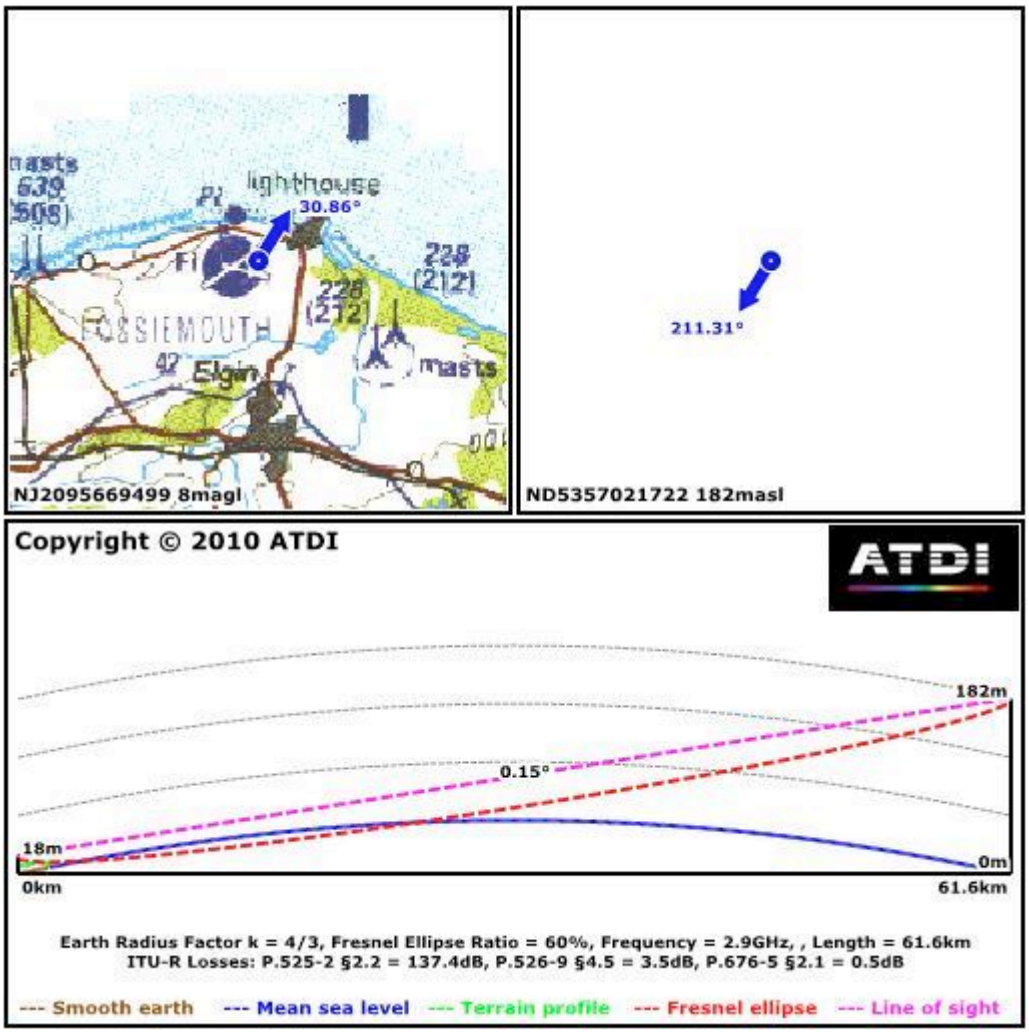

Figure 7: Line of sight from RAF Lossiemouth primary radar to 182m turbine on W boundary of Moray Offshore Phase 1 area

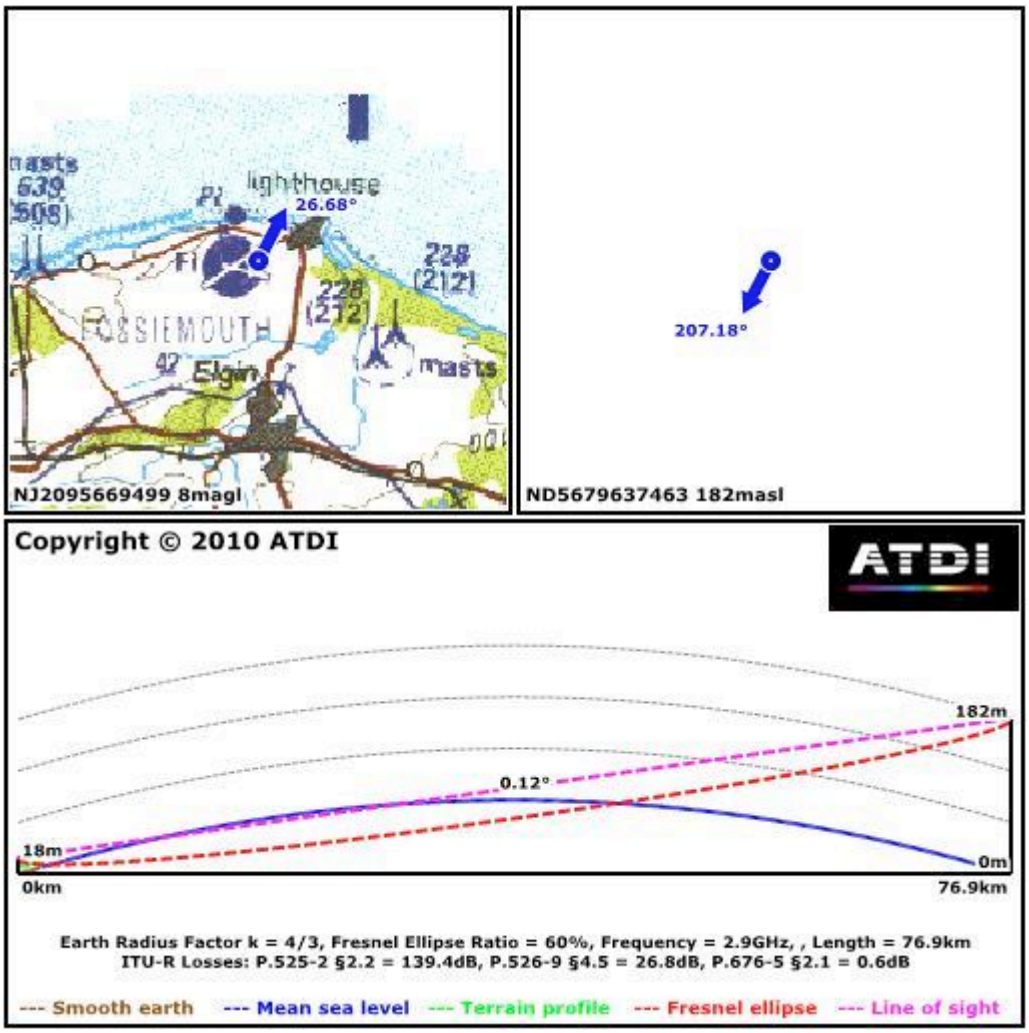

Figure 8: Line of sight from RAF Lossiemouth primary radar to 182m turbine in N corner of Moray Offshore Phase 1 area

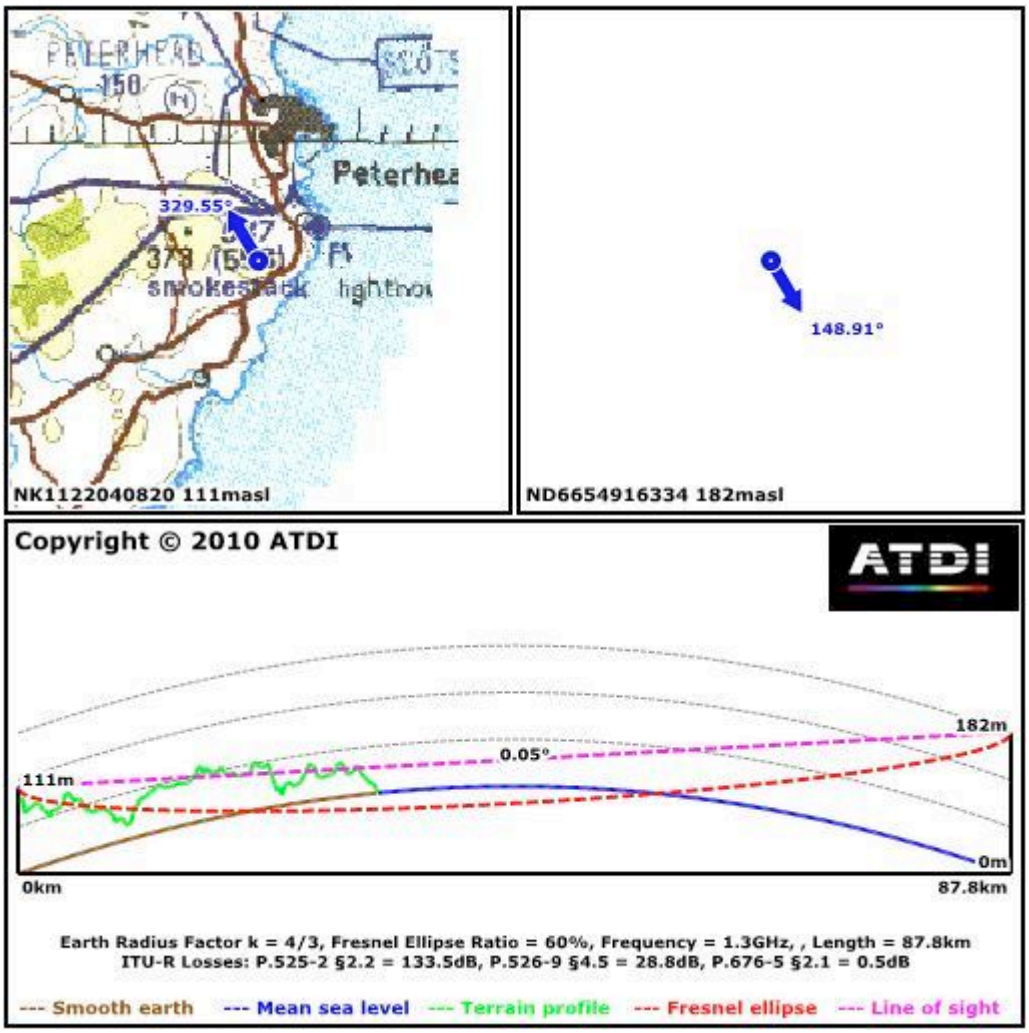

Figure 9: Line of sight from RAF Buchan primary radar to 182m turbine in SE corner of Moray Offshore Phase 1 area

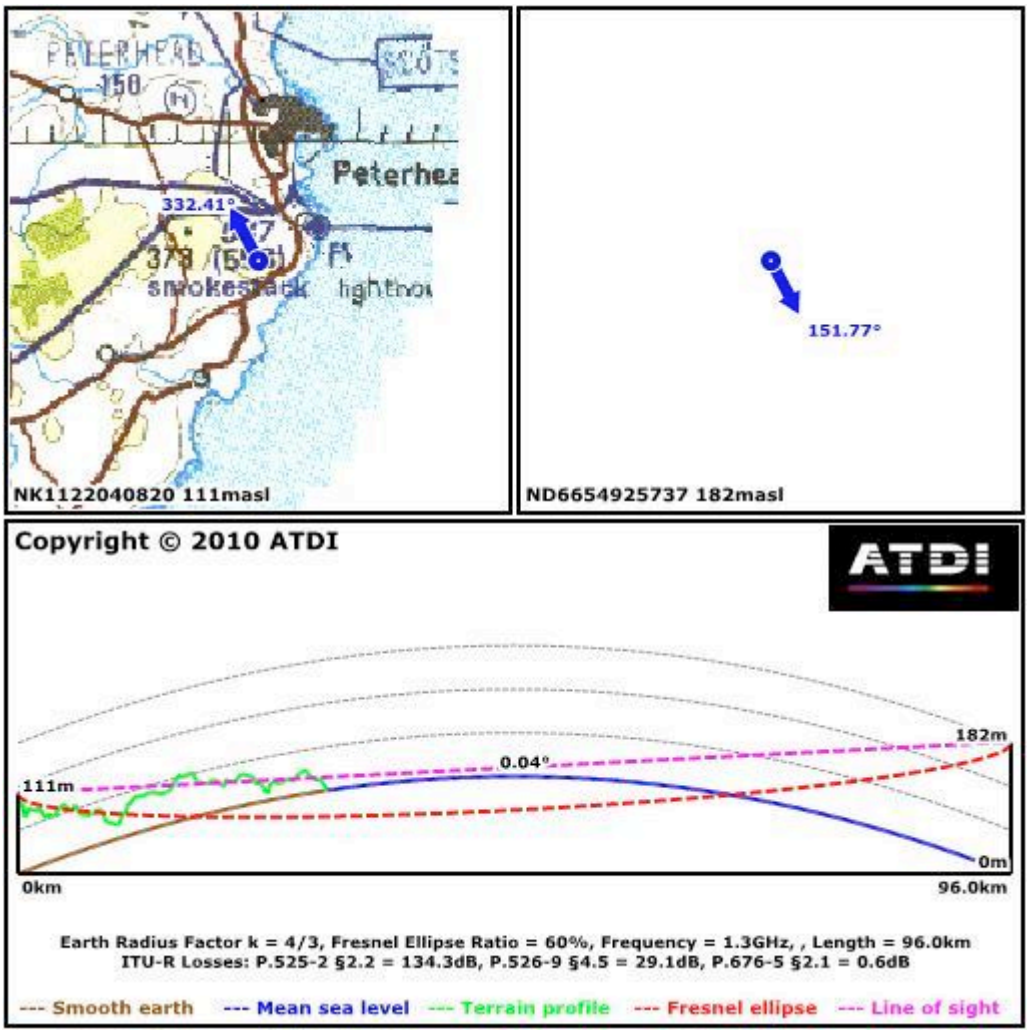

Figure 10: Line of sight from RAF Buchan primary radar to 182m turbine on eastern boundary of Moray Offshore Phase 1 area

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