Wind Farm Gapfiller Concept Solution

Eldar Aarholt[#1], Clive A. Jackson[*2]

[#]*Teleplan AS*
Fornebuveien 31, 1324 Lysaker, Norway
[1]aar@teleplan.no

[*]*BAE Systems Integrated System Technologies Ltd*
Eastwood House, Chelmsford, Essex CM1 1QW, United Kingdom
[2]clive.jackson@baesystems.com

Abstract— **This paper describes a Gapfiller concept solution to mitigate the potential negative effect from a wind farm upon a military surveillance radar system. The problem is described as well as the technical solution to mitigate the problem. This paper does not describe signal processing techniques that can be applied to the main surveillance radar, but it describes some important technical requirements and a Gapfiller solution that can be used to complement a surveillance radar system. The application of a Gapfiller deployed within an offshore wind farm is described and other relevant applications are suggested.**

I. Introduction

The Gapfiller project came about as a result of plans for constructing an offshore wind farm. The two Norwegian renewable energy companies Statoil ASA and Statkraft ASA have formed the company Scira Offshore Energy building the Sheringham Shoal Offshore Wind Farm consisting of 88 turbines located 25 km off the coast in North Norfolk UK (see Fig 1). An air defence radar system covering the area, operated by UK Ministry of Defence (MoD), is located in the seaside town of Trimingham. Due to some signal processing and hardware limitations in the radar system, a shadowing zone is created behind the wind farm that may reduce the performance of the radar system.

For full wind farm operation a condition has been imposed upon the wind farm operator that the negative effects on the military radar shall be mitigated.

In general, three alternative mitigation solutions exist; either to modify the existing surveillance radar, or to replace the existing radar with a wind farm hardened surveillance radar, or to use a gap infill radar (Gapfiller) that provides radar surveillance coverage of the affected area. This paper describes the Gapfiller concept and its proposed implementation.

Fig 1. Sheringham Shoal Offshore Wind Farm in United Kingdom

II. The Problem

Preliminary impact analysis carried out in 2008 [1] indicated that, for turbines with a predicted peak RCS of 35 000 m^2 [2] in line of sight to the air defence radar, there could be a number of potential radar impacts:

- **Clutter**: Increased number of unwanted returns reported in the area of the wind farm due to the detection of wind turbine echoes, both stationary towers and the rotating blades that have a considerable Doppler frequency spectrum.
- **Desensitisation**: Potentially reduced probability of detection for wanted air targets in a region extending above and around the wind farm in both range and azimuth. Due mainly to potentially large turbine range processing sidelobes extending behind the wind farm for a distance comparable to the length of the transmitted signal pulse; i.e. up to 10-20 km beyond the wind farm
- Consequent loss of wanted target plotting and tracking performance in the affected areas

In the case of the Trimingham radar, the affected area was predicted to extend to about 10-20 km behind the wind farm (see Fig 2). Hence, any reduced radar performance within the affected area must be mitigated.

During 2008-2009 BAE Systems conducted a feasibility study [3] on contract with Statoil that has formed the basis for pursuing alternative means of mitigating negative effects on the regional military air surveillance radar.

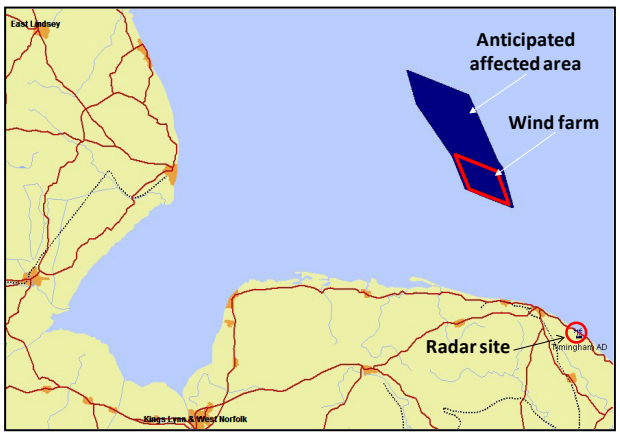

Fig 2. Overview of the scene with MoD radar site at Trimingham, the wind farm located 25 km offshore and the anticipated affected area