Capital Grant Scheme for Offshore Wind Annual Report – January 2006 – December 2006

EXECUTIVE SUMMARY

Scroby Sands Offshore Wind Farm has completed its second operational year as summarised within this report.

The wind farm is situated a little over two nautical miles off the coast of Norfolk. The boundary locations are given in Table 1.

The 30 off Vestas V80 2MW Wind Turbines are maintained by the original manufacturers Vestas Offshore A/S under a Warranty Operations and Maintenance Agreement. Offshore Design Engineering ltd. (ode), a company acknowledged as experts in offshore engineering act as the E.ON UK's representative on all issues related to the wind farm under a Site Management contract.

Overall the availability performance of the wind farm was in line with the budget forecast at the year outset. However a number of unplanned faults had an impact on generation, in particular the failure of an export cable joint which occurred during a period of high expected generation.

A significant amount of maintenance work was also required during the year to resolve ongoing technical issues particularly with gearboxes and generators, which were the main factors reducing output and availability.

As one of the first offshore wind farms in UK waters, Scroby Sands is a pioneering project and expertise and experience in offshore wind at the site continue to grow, which is proving invaluable in reducing downtime and maintenance at this and other offshore sites.

The longer term outlook is favourable with an agreed solution to the generator issues being implemented. In addition, following extensive investigation and analysis, the reasons for the gearbox bearing damage have been identified. E.ON UK is working with the supplier on a number of long-term solutions and has implemented short term measures.

Once this work on the gearboxes is complete, the future outlook is good and we expect generation to exceed original budget expectations and unit costs to reduce.

National Grid Reference			
East	**North**	**East**	**North**
655765	310945	656806	312673
655917	312384	657400	312200
655629	313600	657264	310997
657241	313600	655765	310945

Table 1 – Site Boundaries

SITE PLAN

The site plan showing turbine positions, water depths and cable routes is shown in Figure 1.

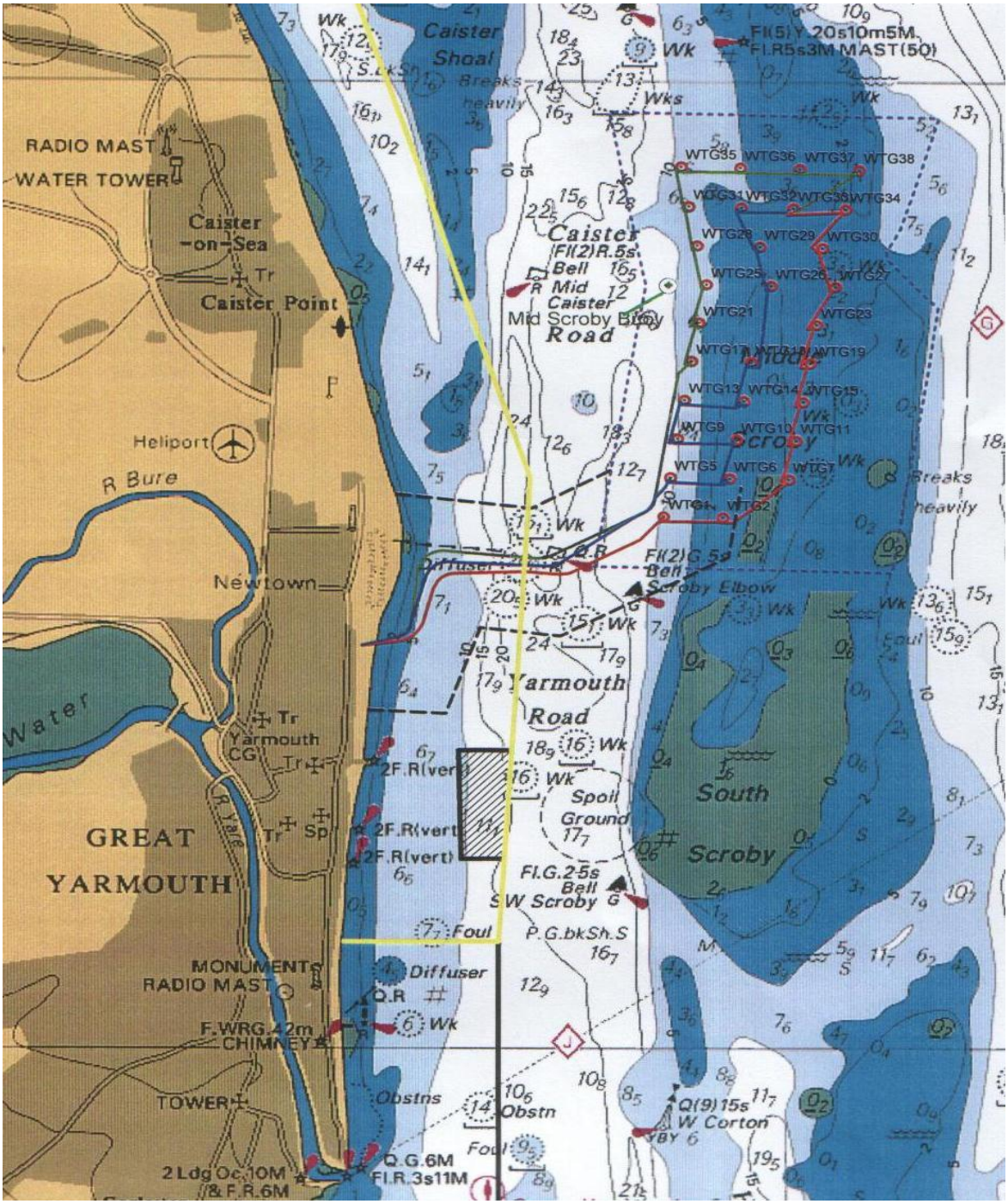

Figure 1- Site Plan

The 3 electrical circuits (String 1 Red, String 2 Blue and String 3 Green) each of 10 turbines connect to the National Grid at Admiralty Road Substation in Great Yarmouth.

WIND FARM ANNUAL OPERATIONAL INFORMATION

PERFORMANCE REPORTING

Availability

Three measures of availability are used to describe the performance of the wind farm.

- Technical,
- Commercial,
- Planned.

Technical Availability of the wind farm is the average time that the wind turbines are available to generate as a percentage, compared to the theoretical maximum. There is no allowance for maintenance or for the effects of outside influences, such as the loss of the external grid connection or for 'weather days' which prevent access offshore.

Commercial Availability includes alleviation for the loss of external grid connection and for weather days.

Planned Availability was the predicted availability taking into account all of the planned remedial work during the year, it was calculated from the annual work plan. The work plan detailed all of the routine and planned works for the year and was developed to ensure that all work was fully assessed, prioritised and completed within the required timescales.

The following Table 2 contains a breakdown of availability by month during 2006.

Month	Technical Availability (%)	Commercial Availability (%)	Planned Availability (%)
January	68.52	70.70	69.50
February	76.65	79.63	77.10
March	72.84	79.38	72.20
April	81.56	82.45	84.20
May	91.40	91.94	91.40
June	89.05	89.39	89.40
July	92.00	92.00	92.00
August	87.19	89.12	87.10
September	78.33	80.88	78.30
October	57.74	63.76	59.60
November	69.31	80.53	86.40
December	36.90	72.49	87.00
Average	**75.1**	**81.0**	**81.2**

Table 2 – Monthly Technical, Commercial and Planned Availability

Figure 2 shows that Technical Availability performance was as expected, as month by month there is a good correlation to the Planned Availability, until the final two months during an export cable transition joint failure (refer to Operational Issues).

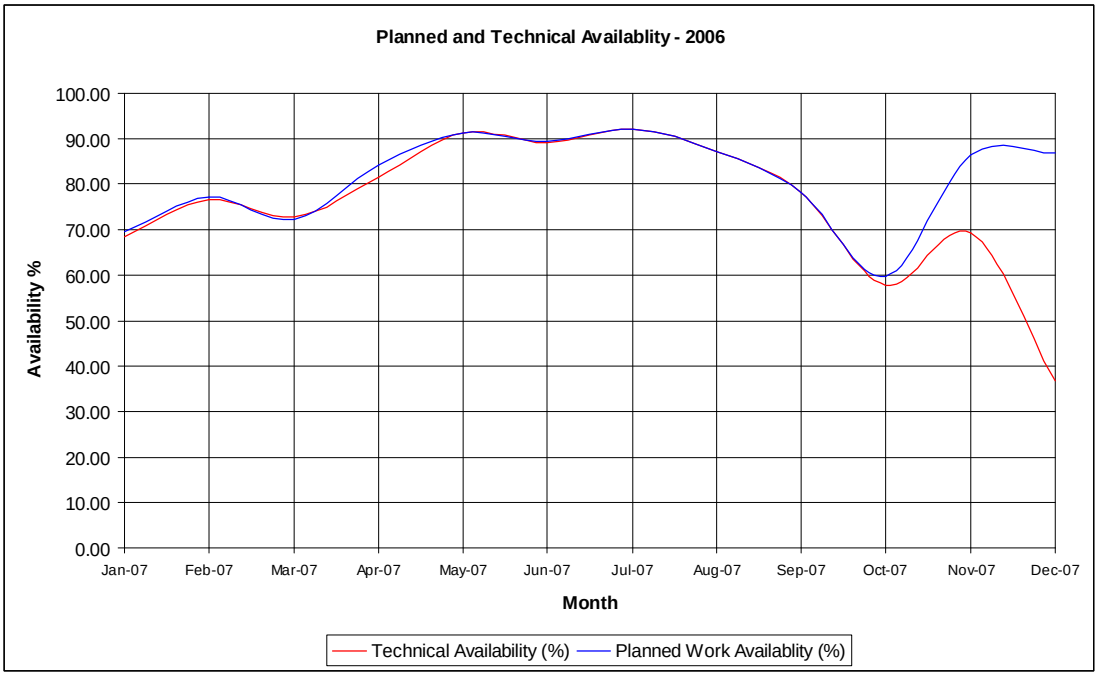

Figure 2 – Monthly Technical and Planned Availability

Wind Speed

The daily and monthly average wind speeds are shown in Figure 3 and the wind rosette is shown in Figure 4.

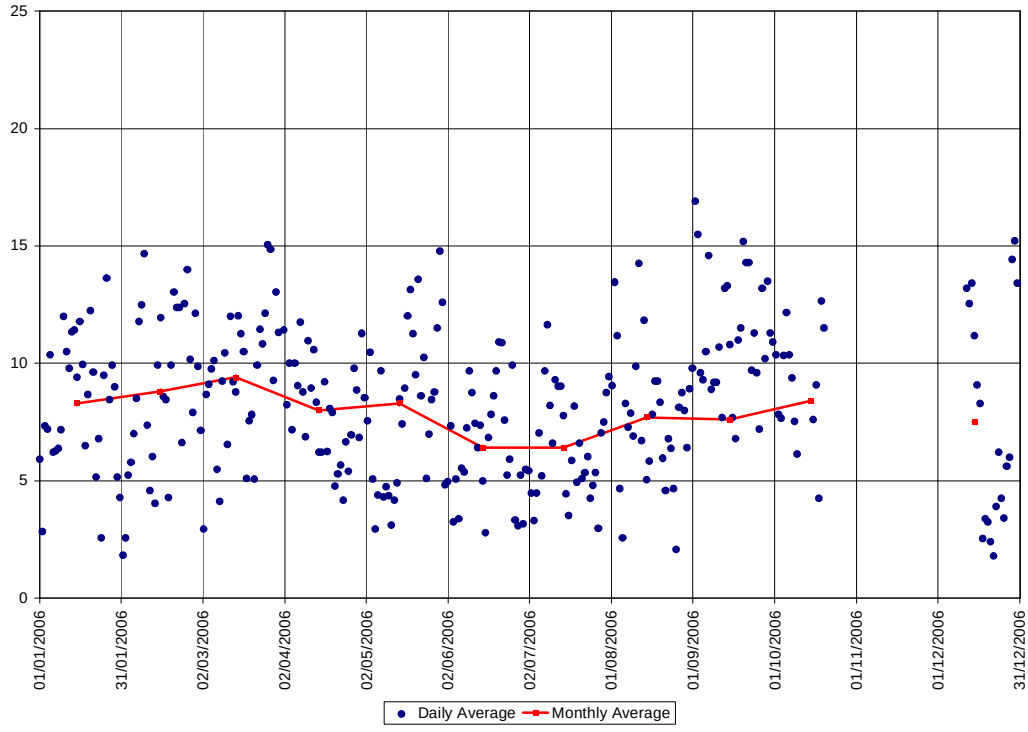

Figure 3 - Daily and Monthly Average Wind Speeds.

Please note that wind speed was not recorded during November and early December due to some data corruption and the isolation of power during the failed transition joint replacement.

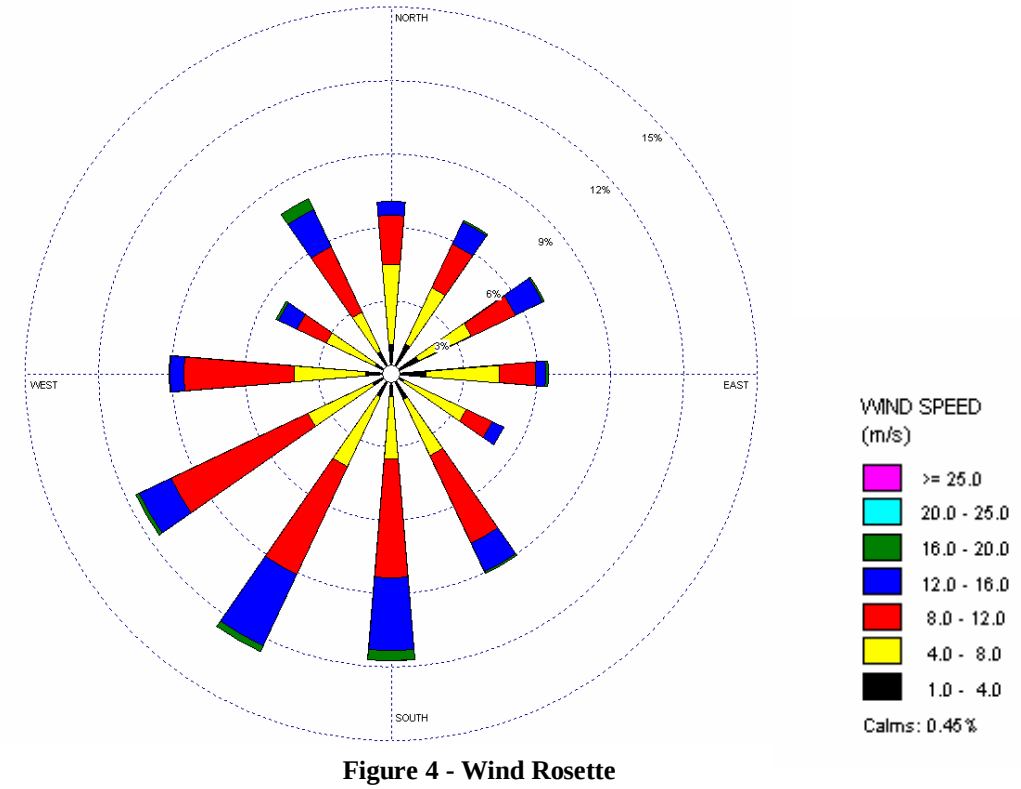

Figure 4 - Wind Rosette

Output and Capacity Factor

The monthly wind farm output measured at the sub-station is shown in Table 3.

Month	Period Length Days	Import (MWh)	Theoretical Production at Maximum Rated Output (MWh)	Long Term Monthly Average Budget (MWh)	Gross Power Exported (MWh)	Capacity Factor (%)
January	31	10	44,640	16,929	11946	26.8
February	28	16	40,320	14,555	14303	35.5
March	31	6	44,640	15,030	16749	37.5
April	30	15	43,200	12,657	10421	24.1
May	31	33	44,640	11,549	13748	30.8
June	30	50	43,200	10,600	7401	17.1
July	31	47	44,640	9,176	7071	15.8
August	31	31	44,640	9,967	11068	24.8
September	30	31	43,200	11,549	10369	24.0
October	31	12	44,640	14,872	7109	15.9
November	30	2	43,200	15,188	12203	28.2
December	31	31	44,640	16,296	6665	14.9
Total	**365**	**284**	**525,600**	**158,368**	**129,053**	**-**
Average	**-**	**-**	**-**	**-**	**-**	**24.6**

Table 3 - Monthly Production and Capacity Factor

The Long Term Monthly Average Budgeted production for the site was calculated at the outset of the project as follows.

- Wind data collected from the anemometer mast during the site development phase was compared with simultaneous data from the nearby Met Office station at Hemsby.
- The resulting correlations were used in combination with long term wind data from Hemsby to provide a view of the Scroby Sands wind resource as though the wind farm had been in existence for the past 20 years.
- In turn this wind resource, taken with the turbine manufacturer's power curves and our understanding of turbine wake effects and other losses, has been used to predict generation levels averaged over the life of the wind farm.

Therefore any variations against this long term budget production can be attributed to availability variations or variations in normal weather patterns (which lead to changes in average wind resource or to the number of bad weather days which prevent access to the turbines).

Capacity Factor is calculated by the amount of generation produced over time, compared as a percentage, with the theoretical maximum generation that would have been produced if turbines operated at maximum output all of the time in that period. In reality the wind does not blow at full capacity all of the time and the turbines have to be maintained.

The Gross Power Exported over the year was less than the Long Term Monthly Average Budget due to the proactive maintenance work programme and effect of the export cable failure.

Wind Turbine Generator Analysis

The following Table 4 compares the performance of each Turbine during 2006.

Circuit	WTG Number	Production (MWh)	Capacity Factor (%)
String 1 Red	T01	4,875	27.8
String 1 Red	T02	4,871	27.8
String 1 Red	T07	4,491	25.6
String 1 Red	T11	4,768	27.2
String 1 Red	T15	3,203	18.3
String 1 Red	T19	4,579	26.1
String 1 Red	T23	3,832	21.9
String 1 Red	T27	4,367	24.9
String 1 Red	T30	4,939	28.2
String 1 Red	T34	4,560	26.0
String 2 Blue	T05	1,264	7.2
String 2 Blue	T06	5,494	31.4
String 2 Blue	T10	5,001	28.5
String 2 Blue	T09	4,756	27.1
String 2 Blue	T13	4,826	27.5
String 2 Blue	T14	3,511	20.0
String 2 Blue	T18	3,918	22.4
String 2 Blue	T22	4,936	28.2
String 2 Blue	T29	4,508	25.7
String 2 Blue	T32	4,449	25.4
String 3 Green	T17	5,261	30.0
String 3 Green	T21	3,143	17.9
String 3 Green	T25	3,197	18.2
String 3 Green	T28	4,584	26.2
String 3 Green	T31	4,621	26.4
String 3 Green	T35	4,072	23.2
String 3 Green	T36	2,523	14.4
String 3 Green	T37	5,294	30.2
String 3 Green	T38	3,429	19.6
String 3 Green	T33	3,161	18.0
Total		**126,433***	**-**
Average		**4,214***	**24.1***

* these turbine production and capacity factors are lower than the definitive value measured at the substation (Table 3) because of spurious SCADA data. In reality this figure should be higher than that recorded at the substation.

Table 4 – Turbine Production

Annual Import

The annual and monthly electricity imports are given in Table 3.

OPERATIONAL REPORTING

Operating and Maintenance Costs

Operational Costs	Budget (£)	Actual (£)
Scroby Sands Windfarm	**1,719,635**	**1,649,728**

Table 5 - Operational Costs

The total annual operating costs in 2006 were just below budget.

The total annual operating cost was budgeted at **£1,719,635.**

This relates to a cost of £**28,661/MW** or **£57,321/Turbine** and **£10.05 per MWh** (long term yearly average)

The total actual spend for 2006 (including Turbine O&M costs) was **£1,649,728**

This relates to an actual cost of **£27,495/MW** or **£54,991/Turbine** and **£9.65 per MWh**

OPERATIONAL ISSUES

An unprecedented amount of work was successfully undertaken during 2006 this included:

- Routine Work, routine preventive maintenance
- Planned Work, pro-active maintenance
- Unplanned, breakdown maintenance

Routine Work

The annual routine work included:

- Six monthly interim turbine servicing
- Annual full turbine servicing
- Annual HV equipment inspections
- Annual insurance inspections
- Annual Inspections of fire fighting equipment
- Environmental surveys as agreed within Site Consent

All of the six monthly routine servicing and routine inspections were completed as planned with 70 percent of the annual servicing completed on time, and the remaining delayed as a result of high workload from the planned remedial work and adverse weather preventing access.

The environmental and cable survey work is agreed and managed between E.ON UK and the site manager ode. All work was completed in line with the site consenting requirements.

Planned Work

As a result of ongoing reliability issues on key components, there was a substantial amount of planned proactive maintenance activities, generally associated with the gearbox bearings and generators.

A work plan detailing all works for the year was developed, to ensure that the proactive maintenance was fully assessed, prioritised and completed within the required timescales. This work plan also allowed the availability to be accurately calculated. (Planned Availability).

The generator issue is being resolved by retrofitting each turbine with a generator from a different manufacture of proven design. Vestas have replaced all but 13 generators and this work will be complete in 2007. The new generators are performing without problem.

E.ON UK is working closely with Vestas to resolve the various gearbox bearing issues and a number of solutions are proposed. In the short term the proactive replacement of the outboard intermediate speed bearings is being carried out to minimise downtime, and this has been complete on 10 gearboxes. In addition 2 complete gearboxes were proactively exchanged following faults in inboard bearings found as a result of internal inspections.

Unplanned Work

There have been a number of unplanned work activities some involving the use of a jack up vessel, which had implications for resources and downtime. The primary cause was gearbox bearings and generator failures before planned replacements were undertaken.

In the year there were failures on 3 outboard intermediate speed shaft bearings, 9 high speed shaft bearings and 8 generators.

Generating capacity was also significantly reduced for two months when one of the three transition joints buried in the beach failed, causing one of the three circuits to be taken out of service for repairs. These joints connect the submarine export cables to the land export cables. The delivery of the specialist replacement joint took 12 weeks, seriously impacting generation during a high production period. Spare joints are now stocked on site as a contingency, which will substantially reduce downtime in the unlikely event of a future failure.

Turbine Access Arrangements

The turbines are accessed using specially adapted transfer vessels. Transfer can take place at wave heights up to approximately 1.5m, depending on wind and wave conditions. Adverse weather and sea conditions at times prevents safe access to the turbines, and when this occurs this is agreed as a contractual 'Waiting on Weather' (WOW) day.

There were a total of 76 WOW days when access to the wind farm was prevented, which are detailed in Table 6.

Month	Number of Adverse Weather Day	Monthly Average
January	5	16.1%
February	11	39.3%
March	13	41.9%
April	3	10.0%
May	4	12.9%
June	3	10.0%
July	2	6.5%
August	9	29.0%
September	6	20.0%
October	7	22.6%
November	11	36.7%
December	2	6.5%
Total	**76**	**21.0%**

Table 6 – Monthly Weather Days

The number of WOW days is reducing as experience in offshore working continues to grow and different access arrangements are utilised.

Remote Monitoring

To monitor, control, communicate and maintain the wind farm, the following systems are operational.

- Vestas Online SCADA (Supervisory Control and Data Acquisition) system.
- E.ON UK SCADA II system
- MAXIMO asset management and work planning system
- ode Site Management Database

Each turbine is controlled by an onboard intelligent control system which maximises the turbines output, provides plant protection and communicates with the SCADA systems to allow remote interrogation. Some faults are cleared by the onboard system and the turbines automatically restarted. Where human intervention is required for safety or plant integrity reasons, the turbine will stop until remote or local interrogation is completed.

The daily remote monitoring is carried out by the Vestas O&M Team and ode site management team at Great Yarmouth. Operational information is recorded in the ode Site Management Database.

When an error or alarm occurs the Site Operators are notified automatically and are able to interrogate the turbine, before sending a team out to reset or correct the defect. In some cases the alarms can be reset remotely removing the need to attend the turbine offshore.

The wind farm is also monitored by a Vestas control centre in Denmark so when an event occurs outside normal working hours, they will reset faults to restart turbines where possible. This reduces the time turbines remain out of service for minor errors and defects.

In 2006 E.ON UK implemented a SCADA II system which allows remote access to monitor each turbine at every E.ON UK Wind Farm from anywhere in the world. Currently additional monitoring is performed from a control room in Wales.

Health, Safety and Environmental

The health and safety standards at Scroby Sands are considered to be good and this is reflected by the low number of incidents during 2006, compared to the high work activity, number of man-hours worked and nature of the work. A number of initiatives were implemented during the year to further drive safety forward resulting in more reporting of hazards and reduction in their associated risks.

Classification	Total
Fatality	0
Lost Time Injury	1
Medical Treatment Injury (treatment by a medical practitioner)	1
Minor Injury (local site first aid only)	6
Near Hits	4
Environmental Incident	1
Hazard Reports	25

Table 7 – Health, Safety and Environmental Summary

Lost Time Injuries:

- Technician tore a calf muscle whilst lowering a navigation lighting pole

Medical Treatment Injuries:

- A ground worker received a superficial burn to the right forearm whilst working in an excavation

Minor Injuries:

- Technician cut thumb on junction box of a generator
- Technician received swarf in the eye whilst grinding
- Engineer nipped a finger while opening a steel gate
- Technician bruised knee when vessel was struck a wave
- Engineer bruised nose when a piece of rubber blew in the wind
- Technician bruised his back when vessel was struck a wave

Environmental Incidents:

- A hose failed on an oil pump resulting in a maximum of 25 litres of gearbox oil being released into the sea. The Marine and Coastguard Agency were informed, however they did not consider this constituted a reportable incident

RIDDOR reportable;

- Lost Time Injuries as detailed above
- A blade tip was damaged during a generator change, when it came into contact with the lifting vessel. NB there were no persons injured

Proactive Safety Initiatives

In order to support a continual improvement of health and safety standards a number of additional initiatives have been implemented:

- Wind Turbine Safety Rules Safe System of Work
- MAXIMO asset and work management system
- Daily site based tool box talks
- Weekly site based safety meetings
- Health and Safety Plan
- Hazard reporting system
- Annual safety conference
- Action plan for introduction of E.ON UK Electrical and Mechanical Safety Rules
- Rule One initiative

Environmental Monitoring Programme

The following environmental studies and surveys were carried in compliance with our Food and Environment Protection Act (FEPA) consent licence and for asset risk management reasons.

- Bathymetric surveys and analysis
- Export cable burial depth survey (Not FEPA requirement)
- Seal surveys and analysis (Not FEPA requirement)
- Little Tern surveys and analysis

Sea Bed Monitoring

In line with FEPA consent requirements, comprehensive bi-annual bathymetric surveys of the seabed have been undertaken along the export cable routes and across the Wind Farm site before, during and after construction.

As predicted by the original Environmental Impact Assessment, local scour pits formed around each of the turbines which were back-filled with rocks for scour protection. A number of increased resolution bathymetric surveys have therefore been undertaken in order to understand and fully assess the integrity of inter-array and export cables close to the monopiles. Survey results have clearly shown scour tails and a variation in the shape of local scour pits. The information has been very useful to determine the necessity for scour protection replenishment and requirements for future projects.

Studies indicate that the volume of local scour around each monopile is insignificant when compared to the size of the sand bank and the quantity of global scour.

During the past year, methods of analysis have evolved in order to correlate the seabed profile and cable burial depth. Additional surveys are likely to be undertaken over the next few years.

Cable Burial Depth Surveys

A programme of post construction monitoring of the cable burial depth has been undertaken concurrently with sea bed monitoring for asset risk management. Underwater surveys have varied from the use of a towed sled behind a small workboat to using a Remote Operated Vehicle and inspections by professional Divers.

Additional remedial works were undertaken in 2006 in order to protect the export cables from becoming exposed or damaged. A number of concrete mattresses were successfully positioned on the seabed at areas of shallow burial.

Further surveys and analysis work is currently ongoing in order to fully assess the integrity of export and inter-array cables.

Seal Monitoring

The FEPA consent requirements for Seal Monitoring was achieved in 2005, however eleven additional aerial surveys of the Scroby Sands bank were undertaken during 2006 on a fortnightly basis from April until September. The results and analysis of this work are currently ongoing.

Little Tern Monitoring

In line with FEPA consent requirements, an environmental monitoring programme for Little Terns is now complete.

Scroby Sands Offshore Wind Farm is located directly offshore from the Great Yarmouth North Denes Special Protection Area (SPA), designated as such due to the presence of the largest colony of Little Terns in the UK. Little Terns are an endangered species and have been in long-term chronic decline in the UK.

Pre-construction studies suggest that Little Terns did not perform well until 2003, where record numbers of chicks fledged the nest at Winterton.

The construction of Scroby Sands Offshore Wind Farm 2003/2004 had the potential for a short term impact on fish prey to feed the chicks, however Sprat seemed to arrive early and there was just enough for the adult birds to compensate by working harder (travelling further).

This was not the case in 2004/2005 as evidenced by the unprecedented failure of birds at the egg stage at Winterton in these years through predation.

With the successful supplementary feeding of kestrels by the RSPB in 2006, there was little predation of chicks and these fledged in record numbers.

Furthermore, results show that birds are routinely using all areas of Scroby Sands bank, as well as close to the colony. Additional analysis is therefore being undertaken in order to assess the interaction of Little Terns with Offshore Wind Turbines.

Public Relations

The popularity of the wind farm in general is evident from around 30,000 visitors who annually pass through the doors of the Visitors Information Centre during the holiday season. In August of 2006 the visitor centre took part in the British Wind Energy Association 'Wind Weekend' when over 1,450 members of the public visited in just two days, to learn more about renewable energy.

Scroby Sands has also proved popular with the national media as a broadcast location, with coverage on BBC 10 O'clock news, BBC News 24, BBC 1 Politics Show and filming also took place for the BBC Coast series.

This year there was a huge effort involving public relations, including;

- A £4,000 Sponsorship of the Caister Life Boat fire works display
- Hosting numerous visits including DEFRA, the Energy Saving Trust, Chinese Renewable Developers, Shell Renewables (Holland) and E.ON groups
- Participating in several school educational programmes
- Giving presentations to several interested parties and conferences
- Gave presentations to several interested parties and conferences

This report was prepared by E.ON UK.
For further information on the Scroby Sands Wind Farm contact E.ON UK Renewables either by telephone on 02476 424000 or via email address renewables@eon-uk.com.

For further information on the Capital Grant Scheme contact Mark Thomas at mark.thomas@aeat.co.uk or on Tel 0870 190 6286.