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RECOFF

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WP6: Operation and Maintenance
Task 1: Standardisation of collecting failures and maintenance data

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Acknowledgement/Preface

This report has been prepared within the EU project RECOFF (RECommendations for OFFshore wind turbines); EU project number is ENK5-CT2000-00322. The project has been financially supported by Novem (the Netherlands Agency for Energy and the Environment) under the project number 0224-01-57-21-0007.

Abstract

A generic database has been proposed in which O&M information of offshore windfarms can be gathered, processed and presented. The database should be organised, used and maintained by the windfarm owners. An international approach of countries around the North Sea seems most yielding.

CONTENTS

1. GENERAL OBJECTIVE

Collecting O&M data of hardware, systems and components is common practice in the present (oil industry based) offshore industry. The data is provided by many companies involved, resulting in a large amount of data giving statistical relevant analyses of good quality. Similarly this could be applied by the wind energy industry, especially now large scale offshore wind harnessing started and is expanding.
The aim of collecting O&M data is;

1. Determination of failure rates, downtimes and other information about failure behaviour. The database provides necessary input for optimising the RAMS aspects.
2. Getting better insight in quality of systems and components of different suppliers.

It is obvious that the larger offshore wind farms become and offshore O&M is a significant part in wind energy generation cost, optimising O&M procedures is a real need.
Presently offshore industry operates the OREDA database.

OREDA is a reliability database for the oil industry, which has been in use for more than ten years. It contains data from ten different oil companies, and consists of three parts:

Inventory - contains description of equipment units. This includes technical data such as the capacity and size of a unit, operating data such as operating mode and finally environmental data, such as the climate where the unit is operated.

Failure - contains all failure events reported. A record is stored for each failure. The failure event is related to one or several inventory items. Failures occur during operation and can be discovered during inspection, testing or maintenance.

Maintenance - contains preventive and corrective maintenance carried out. This can be related to inventory if the maintenance is preventive, or to failure, if the maintenance is corrective.

Most features in the database are composed of a number of codes, which for instance describe types of failures. Text strings that can give further information are usually provided. There are several missing feature values in the database.

2. DATA COLLECTION OF OFFSHORE WIND TURBINES MAINTENANCE ACTIVITIES AND FAILURES.

2.1 Introduction

The O&M database is of interest for:

1. Wind turbine manufacturers regarding: design, organisation and planning of maintenance, cost reduction, optimising RAMS.
2. Wind turbine operators: reduction of maintenance cost; optimising RAMS.

Specially offshore operation, where O&M is an important part of the wind energy generation cost, both groups of interest have benefits of extensive data collection to support their activities. The relevant interest of both groups is not in the same line. Manufacturers are seeking information to improve their specific products, and they mostly have their purpose tailored system.
The "driving force" to establish a Failure and Maintenance database should be collected by the maintenance organisations. Two groups exist:

1. Wind farm owners and their O&M teams;
2. Independent private maintenance companies.

Companies involved during preparation, installation and erection activities of the wind farms and cable network companies can also provide relevant data.
In this note it is the intention to describe a possible set up of a generic database for offshore wind activities in which wind farm owners/operators should be responsible for providing the data.

Users of the database:

- Wind farm owners/explorers to be able to compare their wind farm data with overall results on performance, downtime, failure rate, maintenance cost etc.
- Maintenance companies to detect weak spots in the machines to service, to plan maintenance tasks, to assess risks, etc;
- Insurance companies to assess their risks and where possible to lower the insurance cost.
- User groups to negotiate necessary adjustments with suppliers, guarantee issues, support of manufacturer to maintenance companies.

Type of information and format

The format roughly consists of three major parts. Part 1 and 2 will be available for all clients. Part 3 will be different for each individual client only.

1. *Database and population*

   In this first part, a general description will be given of the turbines (the “population”) that are in the database. Various cross sections will be made through the data, for instance to rank the types of turbines, to show trends in installed power or installation costs. In this part, also discussions will be held on the quality of the data and the completeness of the provided data. This is necessary to better interpret the analyses results.
2. *Generic Results*

   This part will show the results of the turbine performances in terms of energy output, availability, maintenance, etc.. The turbines will be categorised per turbine type.

3. *Client Specific Results*
   This part will show the similar results as mentioned in the second part, however in this case the analyses will only be performed for the population of the individual clients. Clients can benchmark the performances of their own turbines with the generic performances in part 2.

The information to be collected can be devided roughly into two major blocks:

1. General Wind Farm Information
2. Operational information.

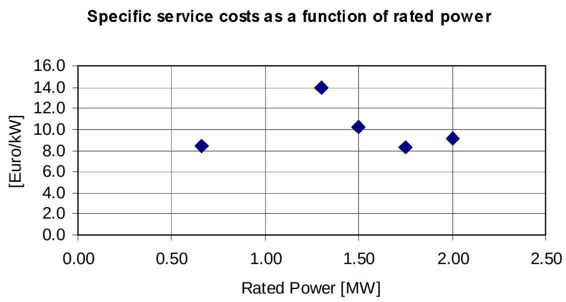
2.2 General information

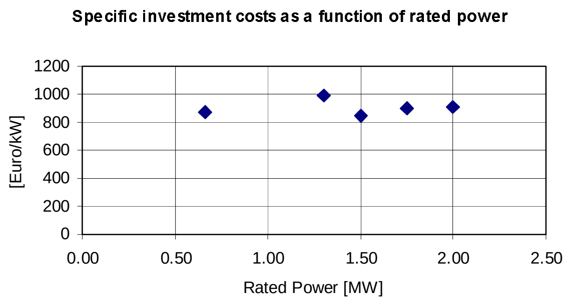
This contains description of wind farms, its location including climatic and environmental informtion, turbines, components and its main characteristics.

Fields that need to be filled in to define wind farms, turbines and components in a unique way (indicative, not complete!)

1. Region
2. Wind Farm
3. Wind Turbine (manufacturer, type, characteristics)
4. Main Systems
5. Components
6. Sub- Components (The lowest level of detail to be considered has to be decided, e.g. maintainable items)
7. Date in use
8. Wind climate
9. Terrain characteristics
10. Investment costs
11. Initial costs for service contracts, insurance, warranties, etc.
12. Etc.

Here below some examples of the analyses are shown that will be performed on the wind farm/turbine population to determine trends in the investment costs and costs for regular service during installation phases of the projects.





2.3 Operational data

2.3.1 Energy production information

Beside the amounts of produced wind energy per year or per month, the wind speed distribution and wind rose can be provided when available.

2.3.2 Maintenance and reliability aspects

The emphasis is put mainly on obtaining insight in the failure behaviour, downtime (availability) and the maintenance aspects of the different wind turbine types and its components. A certain level of detail for data collection is therefore required. A list of recommended fields is given below.

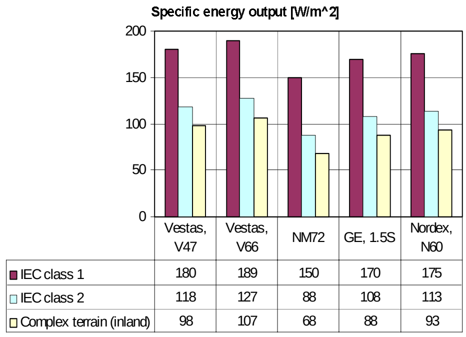
Fields recommended for collecting failure and maintenance data

Definition of failed item
1. ID of failed turbine and component
2. Date, time, kWh
3. External conditions (lightning, storm, etc.)

Failure data
4. Failure mode
5. Failure cause
6. Failure effect
7. Detected by (alarm, preventive maintenance, other)

Maintenance and repair data
8. Repair action (cleaning, replacement, reset, other)
9. Spare parts, consumables (costs)
10. Actual repair time
11. Logistics time (travelling, waiting)
12. Labour (hrs, costs)
13. Equipment (external crane, boats, other)

Every item has to be filled in as a new record.

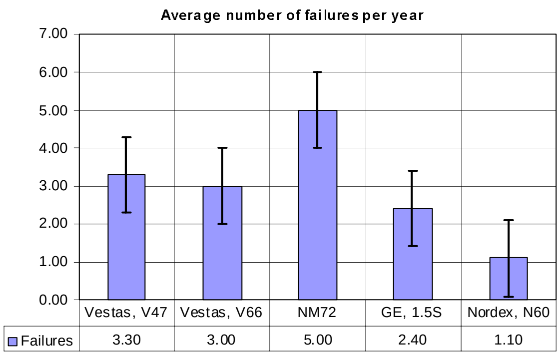


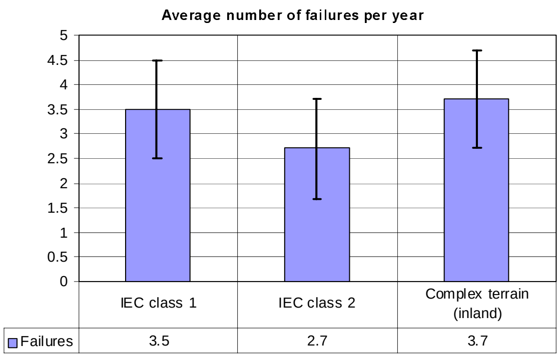
Example: Specific energy production per turbine type and per wind class

2.4 Results and reports

Based on these data the maintenance requirements and the reliability of the different types of turbines can be compared, for instance by considering:

- Average number of failures per farm, turbine, system, component.
- The downtimes;
- Number of alarms leading to shut down of turbine;
- Maintenance costs per year per turbine.





Number of failures per turbine type and per wind class, as an example of general processed data.

Standard reports can be provided on the basis of the collected information.
To be subdivided into:

1. Generic results (for instance categorised per turbine type) and
2. Partners Specific results showing only results of own population of wind turbines, which can be compared with the generic results.

2.5 Organisation

Similar to the OREDA database a separate organisation should be set up. This organisation, consisting of offshore wind farms owners and operators, is owner of the database. The operation of the database is done by a organisation established by its members. Parties recognised by the owners get access to the database.

The database should be organised in a way that parties having access to the database only can call on information of own wind farms plus generic averaged results of all information involved. In case the organisation can operate in all EEZ countries much information can be brought together and the value of the database increases. This implies that many participants should join the database for offshore wind energy failure and maintenance data.

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Key words offshore windfarms, O&M database

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