



MASTER THESIS SPRING 2019

for

Stud. Tech. Karoline Bakken

Fatigue of Dynamic Power Cables applied in Offshore Wind Farms

Utmattning av dynamisk kraftkabel til bruk i havvindmølleanlegg

Floating wind farms is expected to become an important solution with respect to developing future renewable energy. This will include dynamic power cables that will be exposed to hydrodynamic loads from wave and floater motion kinematics. A standard dynamic alternating current (AC) cable normally includes three 95 mm² copper conductors that will be exposed to fatigue. Each of the copper conductors consist of 19 wires which is manufactured in two layers outside the centre wire. During previous PhD works, fatigue data from both single wire and full conductor cross-section testing has been obtained so as to provide input to fatigue analysis. The present thesis deals with investigating which operating life that can be expected in a dynamic power cable exposed to realistic dynamic loads. The work is carried out as a continuation of the project conducted fall 2018 and is to be carried out as follows:

1. A literature review into power cable technology, local and global analysis of dynamic riser cables including local and global failure criteria as reflected in relevant design standards. Also familiarize with the computer programs SIMA (Riflex) and Bflex.
2. Establish a case scenario that includes a realistic wind mill floater and a dynamic cable cross-section. This is to include relevant environmental conditions in terms of current and waves, associated floater motions, cross-section details and cable SN fatigue data.
3. Establish a riser configuration and a global analysis model in SIMA
4. Establish a local analysis model in Bflex.
5. Perform global and local analysis to calculate the fatigue. This is to include sensitivity analysis with respect to drift-off, weather heading, cross-section friction coefficient, bending stiffener design and other parameters to be agreed upon during the course of the work.
6. Conclusions and recommendations for further work

The work scope may prove to be larger than initially anticipated. Subject to approval from the supervisors, topics may be deleted from the list above or reduced in extent.

In the thesis report, the candidate shall present her personal contribution to the resolution of problems within the scope of the thesis work

Theories and conclusions should be based on mathematical derivations and/or logic reasoning identifying the various steps in the deduction.

The candidate should utilise the existing possibilities for obtaining relevant literature.

Thesis report format

The thesis report should be organised in a rational manner to give a clear exposition of results, assessments, and conclusions. The text should be brief and to the point, with a clear language. Telegraphic language should be avoided.

The report shall contain the following elements: A text defining the scope, preface, list of contents, summary, main body of thesis, conclusions with recommendations for further work, list of symbols and acronyms, references and (optional) appendices. All figures, tables and equations shall be numerated.

The supervisors may require that the candidate, in an early stage of the work, presents a written plan for the completion of the work.

The original contribution of the candidate and material taken from other sources shall be clearly defined. Work from other sources shall be properly referenced using an acknowledged referencing system.

The report shall be submitted in electronic format (.pdf):

- Signed by the candidate
- The text defining the scope shall be included (this document)
- Drawings and/or computer models that are not suited to be part of the report in terms of appendices shall be provided on separate (.zip) files.

Ownership

NTNU has according to the present rules the ownership of the thesis reports. Any use of the report has to be approved by NTNU (or external partner when this applies). The department has the right to use the report as if the work was carried out by a NTNU employee, if nothing else has been agreed in advance.

Thesis supervisors:

Prof. Svein Sævik, NTNU

Deadline: June 11th, 2019

Trondheim, January 15, 2019

Svein Sævik



Candidate – date and signature:

18/01/19 Karane Bellu