ANNOUNCEMENT OF THE SQUALLMOOR JIP - PHASE 2

Introduction

The SquallMoor JIP (Joint industry Project) was initiated in a joint effort by DNV GL and Bureau Veritas (BV) with the support from TOTAL. The objective of the SquallMoor JIP is to provide improved guidelines for the design of mooring systems of floating production units in areas with squall conditions.

In Phase 1 of the SquallMoor JIP we collected and analysed squall data, studied the physics of the squall phenomena, reviewed mooring designs and analysis methodologies, established a probabilistic squall model, developed response models, investigated design methods, conducted structural reliability analysis and calculated safety factors.

Two cases were studied, a turret moored unit at 1650 m, and a spread moored unit at 790 m water depth. For the two cases, different design methods were tested to establish the best analysis methodology for calculation of characteristic tension, the tension that will be applied in the code check. Furthermore, reliability analysis was carried out and safety factors calculated for different failure probabilities.

In Phase 1 we provided a first guideline for mooring system design in squall conditions. However, additional test cases, as well as investigation of challenges and limitations identified in Phase 1, are needed to recommend a design methodology for a squall governed environment that can be used for mooring system design in general.

Why SquallMoor JIP Phase 2?

Squall phenomena have concerned metocean specialists for the last 15 years. Still, existing design guidelines for squalls are insufficiently detailed, and different parties in the mooring industry have for a long time tried to initiate studies to close this gap.

With the SquallMoor JIP we have managed to gather important stakeholders to cooperate and contribute. The objective of the SquallMoor JIP Phase 1 and 2 is to provide a design approach that is internationally agreed.

Extensive work was carried out in Phase 1 of the SquallMoor JIP, and we demonstrated that we are able to perform the analyses required to perform a code calibration. Phase 1 provided conclusions on several topics:

1. Correlation between rise time and peak wind velocity was studied, and conclusions were given to whether concurrent scaling should be performed in the design process
2. For a squall database with more than 400 squalls, conclusions were given on:
   a) How to account for the variability of the squall rise time
   b) What direction strategy to apply in the design analyses – whether to perform calculations for all possible combinations of squall directions and vessel headings – or if this can be simplified.
   c) How to best calculate design tension - whether a direct simulation approach (DSA), a rescaled approach (RSA), or a more advanced statistical approach, is the best.
   d) The impact of background environment on the statistics of squall response for a turret moored system.
   e) Whether it is possible to apply the same safety factor for the two cases studied (a spread and a turret moored case). Still, more units are needed to perform a code calibration.

Conclusion 1 is general, and does not depend on the size of the squall database or the number of cases studied. To make the conclusions in 2 general, additional test cases, as well as investigation of challenges and limitations identified in Phase 1, will have to be performed. This is detailed in the brief scope included further down.

Thus, more work is needed before general conclusions for design in squall conditions can be made. It is important to continue this work now to benefit from the experience gained in the project, and while work processes, analysis models, postprocessing of results etc. are available and can be reused with ease and efficiency.

Objective for Phase 2

- To extend the number of mooring systems analysed, by including a broader portfolio of cases that are meant to be covered by the design guideline.
- To investigate statistical uncertainty due to limited squall data sets, and to document that the proposed design procedures are robust for a range of squall data sets.
- To give recommendations on the minimum amount of squall data required.
- To assess and validate the proposed analysis procedures and guideline for additional geographic locations.
- To document, and if required update, the proposed procedure from Phase 1 for how background climate should be analysed in a squall dominated region.
- It is intended that the results will be incorporated in future revisions of BV's and DNV GL's standards and/or recommended practices for the design of mooring systems.

Scope for Phase 2

The topics for further work in Phase 2 are:

- Additional systems

  Two mooring systems, with very different behaviour, were studied in Phase 1. This number of units is not sufficient to conclude on safety factors and to ensure that the design methods considered will be robust for any mooring system.

  The complete structural reliability analysis (SRA) was performed for one turret system. The code calibration requires that a set of systems within the scope of the code are considered.

  Thus, an important work element for Phase 2 is to carry out the SRA for several systems that are meant to be covered by the design recipe, including systems with different line characteristics (linear and non-linear systems), as well as different water depths.

  Additional studies will ensure that more experience is gained, will support specification of the preferred design recipe, as well as provide data required such that a formal code calibration can be conducted.

- Statistical uncertainty

  For specific projects carried out by operators and designers, the amount of squall data that is available for analysis will vary. For a limited data set there will be statistical uncertainty related to the 10-year and 100-year wind speed required for design, to the long-term distribution of offset and line tension, as well as to the estimated design tension. To provide robust recommendations, including documented requirements to the minimum amount of squall data required, studies are recommended to investigate statistical uncertainty due to small data sets. This work involves comparison of results obtained by the proposed design procedures with results obtained by more advanced and comprehensive statistical approaches.

- Background climate

  Further investigation of the effect of background climate. A tentative procedure was proposed in Phase 1. The objective is to investigate the robustness of the proposed approach in more detail, to ensure that a reasonable and balanced procedure is implemented in the design procedure.

- Additional locations

  Phase 1 of SquallMoor includes the development of a probabilistic squall model for one location, off the coast of Africa. Because some of the major squall mechanisms in other regions are not represented in the Africa data, it would be of interest to consider also some other regions.

  For example, this could be for Nigeria where the squall events are more severe than for Angola/Congo. Also, analysis for other geographic locations (Brazil, Australia) would be of interest.

Deliverables

The main delivery from SquallMoor Phase 2 is a Guidance Note outlining the main conclusions and recommendations. The Guidance Note will be supporting by technical reports.

Although not part of the scope in the SquallMoor JIP, the results from the JIP will be used in forthcoming updates of DNV GL and BV RP's and Standards ensuring consensus and predictability for the industry.

Participation fee

The fee for participation is:

- Oil and gas companies: 80 k€ payable over two financial years
- Others: 50 k€ payable over two financial years

For new participants in Phase 2 there is an additional late participant fee of 50% of the normal fee for Phase 1, i.e. 40 k€ for oil and gas companies and 25 k€ for other companies.

In-kind contribution by the designers

The most efficient way to extend the number of cases in the test set is to let the participants prepare the input models and possibly do the required mooring analyses for the complete set of analysis cases needed for squall database (will be specified by the JIP team) A reduced participant fee will then be offered. Two alternatives are proposed:

a) The designers prepare, check and validate the input analysis models for use in SIMO or Ariane. DNV GL or BV carry out the mooring analyses and postprocessing (scripts for this is easily and efficiently availale from Phase 1).

b) The designers prepare the analysis models and carry out the complete set of calculations.

Option a) will solve confidentiality issues related to the squall data base, also it will be more flexible w.r.t sensitivity analyses and rerunning of cases.

Participants

The following companies were participants in Phase 1 of the SquallMoor JIP: Total, Technip, Saipem, Doris Engineering, Sofec, SBM, APL NOV and Bluewater

New participants are always welcome, and so far Shell has joined the JIP in Phase 2, additional to all the Phase 1 participants.

Time schedule

Phase 1 was completed winter 2018, with the last steering committee meeting in Paris January 18th 2018.

Phase 2 was kicked off March 2019 and will be carried out over a 2 years' time period.

For more information, please contact

Siril Okkenhaug in DNV GL, Project Manager for the SquallMoor JIP:

Email: Siril.okkenhaug@dnvgl.com
Mobile: +47 908 59 141

The team leader at Bureau Veritas, Claire-Julie Frélaut:

Email: claire-julie.frelaut@bureauveritas.com
Phone: +33 (0)1 5524 7407