Subject: OE-D-14-00580: Decision
Date: Thursday, April 30, 2015 at 9:15:38 AM Central Daylight Time
From: ees.oe.0.30ef39.18aa1b97@eesmail.elsevier.com on behalf of Ocean Engineering
To: Faisal Khan

Manuscript No.: OE-D-14-00580
Title: A Risk-based Approach to Developing Design Temperatures for Vessels Operating in Low Temperature Environments
Article Type: Short Communication
Corresponding Author: Prof. Faisal Khan
All Authors: Sulistiyono Heri; Faisal Khan, PhD; Leonard Lye; Yang Ming; Donald Oldford
Submit Date: Nov 01, 2014

Dear Prof. Khan,

The reviewers have commented on your above paper submitted to Ocean Engineering. They indicated that it is not acceptable for publication in its present form.

However, if you feel that you can suitably address the reviewers' comments (included below) by Jun 14, 2015, I invite you to revise and resubmit your manuscript.

Please carefully address the issues raised in the comments. If a reviewer indicates that comments were uploaded in a separate file, this can be found by clicking "View Reviewer Attachments" under "Action Links" on your Author Main Page.

If you are submitting a revised manuscript, please also:

a) outline each change made (point by point) as raised in the reviewer comments

AND/OR

b) provide a suitable rebuttal to each reviewer comment not addressed

To submit your revision, please do the following:

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When submitting your revised manuscript, please ensure that you upload the source files (e.g. Word). Uploading only a PDF file at this stage will create delays should your manuscript be finally accepted for publication.

If your revised submission does not include the source files, we will contact you to request them.

Please note that this journal offers a new, free service called AudioSlides: brief, webcast-style presentations that are shown next to published articles on ScienceDirect (see also http://www.elsevier.com/audioslides). If your paper is accepted for publication, you will automatically receive an invitation to create an AudioSlides presentation.

PLEASE NOTE: Ocean Engineering would like to enrich online articles by displaying interactive figures that help the reader to visualize and explore your research results. For this purpose, we would like to invite you to upload figures in the MATLAB .FIG file format as supplementary material to our online submission system. Elsevier will generate interactive figures from these files and include them with the online article on SciVerse ScienceDirect. If you wish, you can submit .FIG files along with your revised submission.

I look forward to receiving your revised manuscript.

Yours sincerely,

Dr. Matthew Collette
Editor-in-Chief
Ocean Engineering

Reviewers' comments:
(Please note that some reviewers may upload attachments into the system. Please see the following for instructions on how to access these comments:
http://help.elsevier.com/app/answers/detail/p/7923/a_id/531/c/6261/kw/reviewer%20attachments)

Reviewer #1: Review for Manuscript OE-D-14-00580 - see also attachment on EES.
General Comments:
This short communication presented a useful approach to estimate design temperature for vessels operating in cold weathers. Overall, the methodology is easy to follow and the case study presented demonstrated feasibility of this proposed approach. However, the structure of the paper could be further improved; in particular, the implementing steps of the proposed technique may be summarized in a logical flow diagram. In addition, there are also several ambiguities in the definition of technical terms in this article.
Specific comments:
1. The effect of design temperature on the structural design and material selection of the vessels may be briefly introduced in the introduction section.
2. More recent research articles on risk-based approach should be cited.
3. In the methodology section, the risk of an event is defined as the product of probability of occurring and consequences. Consequence is normally interpreted as a qualitative term which describes the terminating state of an unwanted event. However, in this study, consequence is defined as a quantitative term. The reviewer would like to suggest the use of "severity" instead of consequences.
4. The notations used in Equation 2 should be explained
5. In Equation 3, the consequence is related to duration of occurrence and probability of

exceedance. A more detailed explanation on this relationship is recommended.
6. Equation 5 is missing
7. In addition to the detailed explanation of each implementing step, a logical flow diagram might also be used to summarize these steps in a more intuitive way.
8. On page 4, the word "required" in the first sentence of step 4 might be replaced with "acquired"
9. In the same paragraph, "the method of moving average was applied in this analysis to obtain the minimum values for each duration". How is the moving average method applied in the analysis? What is the interval used to determine the moving average?
10. On page 6, step 6 should be further explained.
11. On page 6, please define "return period" in step 8.
12. On page 7 step 5, there are many durations considered in this study (1, 6, 12, 24 and etc.). Why only the 1-hour duration is considered in determining the best-fit distribution?
13. On page 8 step 7, Equation 5 is missing.
14. On page 9 table 3, the "probability of occurrence" in the top row. Shouldn't it be "the probability of exceedance" ?
15. On page 10, the idea to develop a contour map of extreme low temperatures is brilliant. The software for drawing the contour map should be cited.

Reviewer #2: The paper deals with an interesting application of risk-based operation. However, the paper lacks statistical consistency in the proposed approach. First of all, section 2 does not define the parameters n, N, RP applied. Secondly, it is not clear why the definition of risk stated in Eq (4) is used instead of the usual definition: Risk = Prob(temp<T)*C(T), where T= is a set of user-defined temperatures and C the consequences if the temperature is less than T during D= 1 hour. This result, Prob(temp<T), could easily be obtained by the fitting the data from the weather stations considered. Before publication can be recommended this point have to be thoroughly discussed.
Other comments:

* Legends in Fig 1 must be defined.
* Eq. (5) mentioned on the bottom of page 8 is missing
* Table 4: All the columns (20%, 10%, 5%, 2% and 1%) are obvious as they are just the percentage multiplied by the duration, but why is that not so for the column with 50%?
* Table 5 does not provide a rigorous definition of the Design temperature as the acceptable Risk level on a one hour basis is not defined.

Associate editor: Please make significant changes to the paper based on two reviewers' comments.

topics, find answers to frequently asked questions and learn more about EES via interactive tutorials. You will also find our 24/7 support contact details should you need any further assistance from one of our customer support representatives.

Responses to the Reviewers' Comments

Reviewer 1: This short communication presented a useful approach to estimate design temperature for vessels operating in cold weathers. Overall, the methodology is easy to follow and the case study presented demonstrated feasibility of this proposed approach. However, the structure of the paper could be further improved; in particular, the implementing steps of the proposed technique may be summarized in a logical flow diagram. In addition, there are also several ambiguities in the definition of technical terms in this article.

1. **Comment #1 from Review 1**: The effect of design temperature on the structural design and material selection of the vessels may be briefly introduced in the introduction section.

   Response to Comment #1: The following discussion has been added to Section 1 on Page 2.
   " Therefore, it is important to define temperatures to verify that structures and systems are designed to the appropriate level for the intended service environment. Design temperature requirements may potentially affect operational limitations of vessel systems, material selection for structure and machinery, selection of equipment and testing regimes. For instance, material grades need to be selected based on design temperature, material class and thickness. The impact test temperatures of the material are to be set 20 or 30 degrees lower than the design temperature (ABS, 2010)."

2. **Comment #2 from Review 1**: More recent research articles on risk-based approach should be cited.

   Response to Comment #2: More relevant articles have been cited in Section 1.
   "Goerlandt et al. (2015) have developed a risk-informed ship collision alert system in a real-time operational environment. Dong and Frangopol (2015) have used the life-cycle risk associated with flexural failure as one of the criteria to develop inspection and maintenance strategies of ship structures. A risk-based approach to winterization of vessels has been proposed and applied to a North Atlantic-based ferry design (Yang et al., 2013 and 2015)."

3. **Comment #3 from Review 1**: In the methodology section, the risk of an event is defined as the product of probability of occurring and consequences. Consequence is normally interpreted as a qualitative term that describes the terminating state of an unwanted event. However, in this study, consequence is defined as a quantitative term. The reviewer would like to suggest the use of "severity" instead of consequences.

Response to Comment #3: Risk is often defined as the product of probability of an unwanted event and its associated consequence. Since the losses caused by an accident are difficult to be quantified due to lack of information/data and modeling approach in some cases, its consequence is often qualified. However, the trend is to quantify the consequence and integrate with the probability to estimate the risk. Therefore, it is reasonable to use the term consequence here in this paper.

4. **Comment #4 from Reviewer 1**: The notations used in Equation 2 should be explained.

   Response to Comment #4: The following notations have been added in Section 2: "Where: n is the number of the times that more extreme temperatures are encountered than the estimated extreme temperature for a given return period; N is the total number of temperatures in the whole data set; and RP is the return period of the estimated extreme temperature. "

5. **Comment #5 from Reviewer 1**: In Equation 3, the consequence is related to duration of occurrence and probability of exceedance. A more detailed explanation on this relationship is recommended.

   Response to Comment #5: This has been explained in Section 2, Step 8.

6. **Comment #6 from Reviewer 1**: Equation 5 is missing.

   Response to Comment #6: There is no Equation 5 and this is a typo.

7. **Comment #7 from Reviewer 1**: In addition to the detailed explanation of each implementation step, a logical flow diagram might also be used to summarize these steps in a more intuitive way.

   Response to Comment #7: A flowchart has been added to Section 2.

8. **Comment #8 from Reviewer 1**: On page 4, the word "required" in the first sentence of step 4 might be replaced with "acquired".

   Response to Comment #8: It has been changed to "acquired".

9. **Comment #9 from Reviewer 1**: How is the moving average method applied in the analysis? What is the interval used to determine the moving average?

   Response to Comment #9: The following description has been added in Section 2, Step 4:
   "This can be done by taking historical hourly temperature data for a reasonably long period, calculating average temperatures over specified durations as defined above (i.e., the intervals used to determine the moving average), and identifying minimum temperature for each year. The minimum values can then be noted for all

available years. These minimum values are called the annual extreme low temperatures for the given duration. ”

10. **Comment #10 from Review 1**: Step 6 should be further explained.

    Response to Comment #10: The following description has been added in Section 2.
    “For each duration, this can be done by converting the return periods into probabilities (e.g., 2 years to ½ =0.5), and taking the temperatures corresponding to these probabilities from the best-fitted probability plot. An example is given in Step 6 of Section 3.”

11. **Comment #11 from Reviewer 1**: Please define “return period”.

    Response to Comment #11: It has been defined in Equation 2, Section 2.

12. **Comment #12 from Reviewer 1**: On page 7 step 5, there are many durations considered in this study. Why only the 1-hour duration is considered in determining the best-fit distribution?

    Response to Comment #12: The other durations were also considered in determining the best-fit distribution. The 1-hour duration is used as example to show the process. It has now been clarified in the text.
    “Considering the 1-hour duration extreme low temperature data as an example, the distribution that best fits the data is the normal distribution. This is confirmed by the Anderson-Darling goodness-of-fit test, which gave a p-value of 0.199 (>0.05). Figure 3 shows the normal probability plot of the fitted data. The best-fitted distributions of other durations can be obtained through the same process.”

13. **Comment #13 from Reviewer 1**: On page 9 Table 3, the “probability of occurrence” in the top row. Shouldn’t it be “the probability of exceedance.”

    Response to Comment #13: Yes, it has been changed.

14. **Comment #14 from Reviewer 1**: On page 10, the idea to develop a contour map of extreme low temperature is brilliant. The software for drawing the contour map should be cited.

    Response to Comment #14: The following description has been added in Section 4.
    “Surfer 12 (http://www.goldensoftware.com/products/surfer) was used to draw this contour map.”

Reviewer 2: The paper deals with an interesting application of risk-based application. However, the paper lacks statistical consistency in the proposed approach.

15. **Comment #15 from Reviewer 2**: It is not clear why the definition of risk stated in Equation 4 is used instead of the usual definition: Risk = Prob (temp<T)*C(T), where T is a set of user-defined temperatures and C is the consequence if the temperature is less than T during D = 1 hour.

    Response to Comment #15: Equation 4 is defined in the same way as the reviewer described above. In Equation 4, P(O) (probability of occurrence) represents the probability of the event that more extreme temperatures are encountered than the estimated extreme temperature for the given return period. Equation 3 defines the consequence. It severity is dependent on the duration of the extreme cold temperature occurrence. To clarify this, the following description has been added to Equations 1 and 3.
    " Where: the probability of occurrence, $p(O)$ (i.e., the probability of the event that more extreme temperatures are encountered than the estimated extreme temperature for a given return period). "

    " And consequences, C can be estimated using Equation (3), which represent the severity of the consequence through the duration of the extreme cold temperature occurrence."

16. **Comment #16 from Reviewer 2**: Legends in Fig. 1 must be defined.

    Response to Comment #16: The legends have been defined.

17. **Comment #17 from Reviewer 2**: All columns in Table 4 are obvious as they are just the percentage multiplied by the duration, but why is that not so for the column with 50%?

    Response to Comment #17: The consequence is calculated as the product of P(E) and duration. The column of 50% was wrongly computed. These values have been revised. The corresponding risk values have also been revised in Table 5.

18. **Comment #18 from Reviewer 2**: Table 5 does not provide a rigorous definition of the design temperature as the acceptable risk level on a one-hour basis.

    Response to Comment #18: It has been defined as follows,
    "In Tables 5, the lowest risk is about 0. The risk value shown with an asterisk (*) is the lowest risk and the shortest return period (i.e., the largest probability of

exceedance). The estimated extreme temperature corresponding to cell in Table 2 was selected as the design temperature. From Table 2, the design extreme low temperature is -16.10 ^{o}C.”