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From: Jee, Moonhak <jmhak@kepri.re.kr>
To: <nrcrep@nrc.gov>
Date: Fri, Feb 17, 2006 2:24 AM
Subject: Response from "Comment on NRC Documents"

Below is the result of your feedback form. It was submitted by

Jee, Moonhak (jmhak@kepri.re.kr) on Friday, February 17, 2006 at 02:24:24

Document_Title: NUREG-1824 ; Verification and Validation of Selected Fire Models for Nuclear Power Applications

Comments: Volume 4 : CFAST

Q1. 3.3.6 Targets. The calculation of the radiative heat flux to a target is similar to the radiative heat transfer calculation discussed in Section 3.3.6.1.
Comment-1) I can not find the Section 3.3.6.1.

Q2. The relative difference is expressed as epsilon (with the function of the model prediction and the experimental observation.) (this box does not accept the arithmatic equations)
Comment-2) The definition for Mp and Mo is the peak value of the evaluated parameter and its original value respectively. It means that the peak value was determined (or selected) among the input or output parameters for the CFAST simulation. Literally, it is reasonal but there is only one input parameter and only one simulation output against to the corresponding experimental observation. By the way, there is a systematic bias and random uncertainty for the experimental parameter but such kind of uncertainty does not exist in the input value or output result for the CFAST or other fire modeling program.
It is quite clear at the mention of the paragraph at the page 6-3,
"The means of model "accuracy" used throughout this study is related to experimental uncertainty. Volume 7 discusses this issue in detail. In brief, the accuracy of a measurement, e.g., the gas temperature, is related to the measurement device, e.g., a thermocouple. In addition, the accuracy of the model prediction of the gas temperature is related to the simplified physical description of the fire and to the accuracy of the input parameters, e.g., the specified heat release rate which in turn is based on experimental measurements. Ideally, the purpose of a validation study is to determine the accuracy of the model in the absence of any errors related to the measurement of both its inputs and outputs. Because it is impossible to eliminate experimental uncertainty, at the very least a combination of the uncertainty in the measurements of model inputs and outputs can be used as a yard stick."

Q3. At the figures 6-1, 6-2,..., the uncertainty range for the experimental parameters (measurements) is shown as ¡¾13%, ¡¾9% or so.
Comment-3) Normally the uncertainty is estimated with the equation, U = squareroot of [B*B +(2¥ò)*(2¥ò)] for the population analysis or U = squareroot of [B*B +(2*s)*(2*s)]for the sample analysis. Where B means the systematic error, and the ¥ò is defined as ¥ò=squareroot of ((summation[(xi-xmean)(xi-xmean)])/n) and s means ¥ò=squareroot of ((summation[(xi-xmean)(xi-xmean)])/(n-1)) to represent the standard deviation at population and sample analysis respectively. Then, through the expression for the measurement uncertainty at the NUREG-1824, what was used to represent the measurement uncertainty in calculation, that is, ¥ò or s?

Q4. The summary for each output of the model at 6. Model validation, the comprehensive assessment is expressed as color, that is , Green or Yellow.
Comment-4) My understanding for the general meaning for Green is that the prediction of the model is within the boundary of the experimental uncertainty and the Yellow case is beyond or below of the range of the experimental uncertainty. This speculates that the Green case is acceptable model case and the Yellow situation should not be acceptable for the use of fire model, I guess. My question is tht if further analysis is not performed for the Yellow case with the aspect of V&V, does that mean that the

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corresponding items such as smoke concentration can not be evaluated by use of CFAST fire model?

Volume 6 : FDS

Q1. At page 5-2, related with the 5.1 Grid Size, the paragraph is written as, " The results of the 10 cm and 20 cm grids, shown in Figure 5-2, are not noticeably different."
Comment-1) When looked at the Figure 5-2, the pressure was reversed for the fine grid (10 cm) to the coarse grid (20 cm). In addition, there is quite a big difference between the results of the fine and coarse grids when considering the inherent pressure change at the confinement fire situation. It means that "not noticeably different" is not acceptable at the above mentioning.

Q2. At page 6-4, the table 6-1 shows the value of D*/delta-x for the ICFMP BE #2 as 9-12.
Comment-2) The above value should be changed to 9-28.

Q3. At page 6-5, the sentence is "Past experience has shown that a ratio of 5 to 10 produces favorable results as a moderate computational cost". Another sentence remarks that "The rule of thumb about the value of D*/delta-x is not a substitute for a grid resolution study".

Comment-3) I think that the above two sentence has inconsistency in their meaning. That is to say, the ratio of 5~10 is applicable for the selection of the reasonal grid size but the latter sentence does not support the first sentence.

For another context, the ratio of 5~10 is based on the HRR that is constant at the fire model. Whereas, if the HRR is time-square variable or the user want to utilize the experimental values for the time-depent, what is the recommended ratio of the D*/delta-x or the advice for this approach?

Q4. At the page 6-26, it said that "Indeed, in the present study the heat flux and surface predictions by FDS are more accurate than those of the two-zone models because FDS computes the local temperature within the hot gas layer, and the radiative heat flux is a function of this local temperature raised to the fourth power."
Comment-4) Above paragraph says more accurate tendency when compared the results between the CFAST and FDS. Nonetheless, even if the FDS shows more exact and less uncertain simulation results compared to those of CFAST, the FDS results do not guarantee all the output to be acceptable to the V&V point of view. In this regard, the generic assessment criteria must be shown at the summary part of the volume 6.

Volume 7 : Experimental Uncertainty

Q1. The language, "the relative expanded uncertainty", is used at some points throughout the major contexts.
Comment-1) What is the real definition of the relative expanded uncertainty"? That is U=squareroot of [B*B +(2¥ò)*(2¥ò)] or U = squareroot of [B*B +(2*s)*(2*s)] or other definition?

Q2. At table 2-1 of the page 2-3, the uncertainty is recorded at each box of the Peak HRR and the Radiative Fraction, for example, 110¡¾15% or heptane : 0.44¡¾16%.
Comment-2) It will be quite helpful for the engineers to understand if the rationale for the uncertainty calculation is shown for the calculation of the values on the table. My argument is that the uncertainty at the fire model depends on the uncertainty of the input measurement and the input parameters can not be changed for the target output regardless of the numbers of the fire simulation test.

Q3. Relative Weight was used at the table 3-4 (at page 3-14).
Comment-3) What is the basis for the weight?

Q4. At page 4-3, "The HGL depths varied from about 1 m (40 in) to 3 m (120 in) for all of the experiments considered here, and the relative expanded uncertainties in the values of the HGL depth varied from about

6 % to 23 % as seen in the Table 4-3.
Comment-4) If looked at the Table 4-3, the uncertainty is not a 6~23% but a 4~12 % range.

Q5. At the Table 4-1 (at page 4-4), there is Uw, Ur, Ua, and Ue.
Comment-5) It needs the ways to calculate the value for each case to show the method for the calculation.

Q6. The last sentence at page 4-4 is "The values of Ue for the plume varied from 4% to 11% as seen in Table 4-5 for the two tests considered here."
Comment-6) It does not match the sentence and the table contents.

Q7. At page 4-6, "Measurements of gas species volume fractions are considered for two of the experiments, namely BE #3 and BE #4"
Comment-7) Instead of BE #4, it should be BE #5

Q8. At page 4-8, "It is assumed that the measurement uncertainty in BE #4 and BE#5 was similar to BE#3 as listed in Table 4-8"
Comment-8) I guess Table 4-7 should be referred.

Q9. At page 6-1, "The values of Ue are taken from Table 3-2 to 3-9"
Comment-9) Table 4-2 to 4-8?

Q10. At page 6-1, the summary for the representative uncertainties is explained.
Comment-10) To make the final decision for the V&V of the fire models, it needs the Ue (the expanded relative measure uncertainty), Um (the expanded relative model input uncertainty), and ¥å (the relative difference between model prediction and the experimental measurement). For each fire model, the Volume 2 to 6 explains Ue quite specifically, but there is not specific explanation or estimation reference for Um without mentioning to ¥å itself.
In addition, if following the Table 6-1 to 6-7, there are many cases that Um is larger than the Ue, but the Uc is colored with Yellow. What is the meaning of the color and what is the way to get the background of the Um and ¥å. Finally what is the general approach to judge whether the individual output is acceptable with the used fire models for the aspect of V&V criteria?

organization: KEPRI

address1: 103-16 Munji-dong

address2: Yuseong-gu,

city: Daejeon

state: ---

zip: 305-380

country: Republic of Korea

phone: 82-42-865-5521

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Creation Date:	Fri, Feb 17, 2006 2:24 AM
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Created By:	jmhak@kepri.re.kr

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