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August 20, 2009

Mr. Morgan Hurley
Society of Fire Protection Engineers
7315 Wisconsin Avenue, Suite 620E
Bethesda, MD 20814

Re: SFPE Ethical Standards
Dr. Craig Beyler

Dear Mr. Hurley:

Canon 12 of the SFPE Canon of Ethics requires that members of the Society provide information to the Society regarding potential violations of the SFPE Canon of Ethics. Although I am not a member of SFPE, I am providing information regarding potentially unethical conduct by Dr. Craig Beyler in the litigation arising from the fire which destroyed McFrugal's Warehouse in New Orleans to the Society in conformance with Canon 12.

The SFPE Canon of Ethics includes the following statements:

> *"**Preamble**. . . .Accordingly, the services provided by fire protection engineers require honesty, impartiality, fairness and equity, and must be dedicated to the protection and enhancement of the public safety, health and welfare; and the environment. In the practice of their profession, fire protection engineers must maintain and constantly improve their competence and perform under a standard of professional behavior which requires adherence to the highest principles of ethical conduct with balanced regard for the interests of the public, clients, employers, colleagues, and the profession.. . ."*

> "***Fundamental Principles.*** *Fire protection engineers uphold and advance the honor and integrity of their profession by: . . . .Being honest and impartial, and serving with fidelity the public, their employers, and clients. . .* "

> "***Canon 6.*** *Fire protection engineers shall be honest and truthful in presenting data and estimates, professional opinions and conclusions, and in their public statements dealing with professional matters . . .* "

Attachment 1 to this letter includes an excerpt from page 18 of a paper authored by Dr. Craig L. Beyler and Leonard Y. Cooper titled "*Interactions of Sprinklers with Smoke and Heat Vents*" dated February 1999. A copy of this paper was obtained from the Hughes Associates, Inc. (HAI) website approximately 3 years ago. This paper is referred to as Paper 21 on the HAI website.

Based upon Dr. Beyler's statements in his deposition as a plaintiffs' expert in the litigation resulting from the fire at the McFrugal's Warehouse in New Orleans, Paper 21 was developed for the AAMA Smoke Vent Task Group subsequent to the publication of the final report on testing of the interaction of smoke/heat vents with standard spray sprinklers at Underwriters Laboratories (UL) for the National Fire Protection Research Foundation (NFPRF) in 1997/1998. (The report on the UL/NFPRF tests is titled "Sprinkler, Smoke & Heat Vent, Draft Curtain Interaction -- Large Scale Experiments and Model Development" and is dated September 1998. This report is referred to as NISTIR 6196-1.)

In the excerpt from Paper 21 , Beyler and Cooper state that "the model [referring to Version 1 of the FDS] was unable to predict the corresponding results in the rack storage tests [conducted in the UL/NFPRF tests] beyond first sprinkler activation". Concurrently, or shortly after the publication of Paper 21, Dr. Beyler developed his plaintiff's expert report in the McFrugal's Warehouse fire litigation and within 4 months of the publication of Paper 21 was deposed in this litigation. Excerpts from Dr. Beyler's expert report and from his deposition in the McFrugal's litigation are included in Attachments 3 and 4 to this letter.

The excerpts from Dr. Beyler's expert report and deposition in the McFrugal's Warehouse litigation contradict the statement regarding the capabilities of Version 1 of the Fire Dynamics Simulator made in Paper 21. In Dr. Beyler's expert report and deposition, Dr. Beyler clearly implied that the LES3D model is capable of accurately predicting the activation times of ceiling sprinklers, the total number of ceiling sprinklers which will activate and the effect of the ceiling sprinkler discharge on fire growth. Further, Dr. Beyler asserted that the capability of the LES3D model to accurately make these predictions was "validated".

Given the contradictions in Dr. Beyler's statements regarding the capabilities of the FDS/ LES3D model made essentially concurrently in two different venues, it appears to me that it is evident that Dr. Beyler has violated the ethics provisions which require that "*fire protection engineers . . . be honest and truthful in presenting data and estimates, professional opinions and conclusions, and in their public statements dealing with professional matters*". There is no doubt in my mind that Dr. Beyler's assertions regarding the "validation" of the LES3D model in sworn testimony in 1999 were erroneous given that there is presently near unanimous consensus that the capabilities of the FDS to accurately predict the effect of sprinkler discharge on a fire in ordinary combustibles has not been "validated". It is my opinion that this can only lead to one of two conclusions-either Dr. Beyler is not the expert in fire modeling which he purported to be in 1999, or that Dr. Beyler knowingly provided false testimony in his deposition in the McFrugal's litigation. Whichever conclusion is correct, it seems obvious to me that Dr. Beyler has violated the provisions of Canon 6.

Based upon my recent experience with the application of its Canon of Ethics by the SFPE (in my previous two complaints against Dr. Beyler regarding statements regarding the "validation" of the FDS in his presentations to the ICC Code Technology Committee), this letter should **not** be construed to be an ethics complaint against Dr. Beyler. As presently constituted, I have no confidence that the SFPE will enforce its ethics code in matters involving Dr. Beyler and the issue of "validation" of fire models. I will leave it up to the SFPE to conduct its own investigation into this matter if the Society so wishes, however, it is my intention to make public this letter along with the attachments. It should be noted that Canon 12 of the SFPE gives the Society the authority to conduct its own investigation into ethics violations, while individual members and non-members have no such authority to request information from other members of the Society. Hence, it is practically impossible for any ethics complaint to be proven (unless the SFPE conducts an investigation).

With respect to whether or not the issue of "validation" is simply a "technical issue" not subject the standards set forth in Canon 6, it is my opinion that where there is any question regarding the "validation" of a fire model, or portion of a model, the user of the model is required to disclose that the "validation" of the model is questionable in any technical presentation. Failure by any user of a model to comprehensively address the issue of "validation" and to disclose that the "validation" of a model may be questionable in a presentation should be considered to be *prima facie* evidence that a violation of Canon 6 has occurred. While knowledgeable individuals in the field of fire protection can certainly disagree on the issue of "validation" of a model, failure to disclose the fact that there is disagreement on the issue of "validation" seems to me to be both intentionally dishonest and unethical.

I will be more than happy to cooperate with the SFPE in any ethics investigation of Dr. Beyler's conduct in his testimony in the litigation involving the fire at the McFrugal's Warehouse and, as proposed in the previous two complaints, will be more than happy to appear before the SFPE Ethics Committee to provide additional information and answer questions regarding the above.

Given that it is my opinion that Dr. Beyler appears to be willing to contradict himself in different venues whenever and wherever required to represent clients of Hughes Associates, Inc., I would hope that SFPE would take this information regarding Beyler's ethical lapses in the McFrugal's Warehouse litigation seriously for the good of the fire protection profession. Once again in my opinion, providing false testimony or disinformation regarding the capabilities and "validation" of the FDS in the context of litigation (i.e. sworn testimony) is an extremely serious matter which should be dealt with firmly (and harshly) by the SFPE.

Yours Very Truly,

Richard C. Schulte
Schulte & Associates

attach.

cc: Allan Freedman, SFPE
Richard Davis, FM
J. Quiter, Arup
S. Sunder, NIST BFRL
K. McGrattan, NIST BFRL

# ATTACHMENT 1

## BEYLER/COOPER PAPER (PAPER 21) EXCERPT
## FEBRUARY, 1999

The following excerpt is from a paper titled **"**Interaction of Sprinklers with Smoke and Heat Vents" authored by Craig L. Beyler and Leonard Y. Cooper dated February, 1999:

> ". . . . While there have been many attempts to model all or part of the interactions of sprinklers and vents, the issues are more complex than can be dealt with using even the most sophisticated modeling methods available today [1999]. The most clear indication of this is the recent NFPRF research project. While modeling of the fluid mechanical aspects of the problem were quite successful in predicting aspects of sprinkler activation in the first heptane spray fire series, the model was unable to predict the corresponding results in the rack storage tests beyond first sprinkler activation. . . ." (Page 18)

# ATTACHMENT 2

## McGRATTAN STATEMENTS
## MODEL VALIDATION

The following are Dr. Kevin McGrattan's comments regarding the "validation" of the Fire Dynamics Simulator used for the purposes of predicting the activation times of sprinklers. These comments were posted on the FDS/Smokeview Bulletin Board on February 17, 2009 by Dr. McGrattan.

> "The purpose of the FDS Validation Guide is to present comparisons of FDS predictions against full-scale measurements. We work very hard to present the data in a form that enables those who use FDS, or those who are thinking of using it, to decide for themselves if the model is appropriate for a given application. We do not believe that our role is to say whether or not the model is appropriate because we cannot be sure about what the application could potentially be or what the required level of accuracy should be. We prefer that people use their own judgment to decide what is the best tool for the job. That is essentially what you are doing [referring to Schulte]. You are making an argument that the model is not sufficiently accurate to predict multiple sprinkler activation. We do not want to make such a statement because we don't know exactly what you intend to use the model for, and furthermore, there is no consensus metric in fire protection engineering by which a model is considered validated or not for a particular application. We prefer to do the technical work in developing the model and quantifying its accuracy as we have done in the Validation Guide. We prefer to leave the decision about validation up to you. We even provide you with this forum by which you and others can discuss the merits of the model for this and other applications. We make the source code available for those who want to check the model themselves, or publish their results in the open literature. We feel that an open discussion of model strengths and weaknesses is healthy, and we do everything we can to promote it.

In that spirit, let me point out the second plot in Figure 6.2. Throughout the Validation Guide, there are scatterplots similar to those shown here, except all the other scatterplots have off-diagonal lines that represent the estimated experimental uncertainty. All large scale fire experiments have a considerable amount of uncertainty in the reported heat release rate, environmental conditions, sprinkler characteristics (like droplet size, RTI, etc), and various other parameters that are input into the fire model. Because of the complexity of the experiments and simulations of fires in large warehouse-type facilities, especially those involving multiple sprinkler activations, we do not have a good way (yet) of quantifying the experimental uncertainty. It might be as hard to do that as to predict the experimental results themselves. So rather than try to quantify the experimental uncertainty, we have added the second plot in Figure 6.2. In the UL/NFPRF test series, Phase I, there were 22 experiments, all involving a heptane spray burner and a heat release rate of approximately 4.4 MW. Of those 22 tests, there were three replicate tests (Tests 1 and 8, Tests 4 and 7, and Tests 9 and 10). These were not designed as replicates, but in each case, a vent was either closed for the duration or did not activate, making the two tests essentially the same. The second plot in Fig. 6.2 compares the measured activation times for the sprinklers in one test against the measured activation times in the other (replicate) test. This is only comparing one experiment against another. This has nothing to do with FDS. For example, in Test 8, four sprinklers activated at about 4.5 min after ignition whereas in Test 1, these same four sprinklers activated after about 2 min. There was even a sprinkler that activated after 6 min in Test 8 and after about 2.25 min in Test 1.

This information tells us something about the reproducibility of large scale sprinkler experiments. It is not an indictment of the testing lab, UL, because this sort of behavior is not surprising for those who do this sort of testing. I observed these experiments, and I noted that following the first activation, there was a considerable effect on the fire because these sprinklers release about 1 gallon of water per second. The burner was placed exactly between four sprinklers [in] each test, and because there is some variability in the activation temperature of a real sprinkler, there was usually one sprinkler that activated a few seconds before the others, which caused the fire, the plume, and the subsequent activations to trend in a particular direction. FDS has no such bias -- the sprinklers in these calculations were programmed to activate at exactly 74 C (165 F). I suppose that we could build in a random component to the activation temperature to mimic reality, but we worry that this would simply add an additional uncertainty to an already complicated problem. We prefer that the model produce a result that, on average, compares favorably with a number of replicate tests. The fact that FDS sometimes over-predicts and sometimes underpredicts the number of activations is a good thing. Our goal is to predict the total number of activations and the average activation time of each "ring" of sprinklers. We are less concerned about one or two outliers because we know that there is a randomness to this kind of experiment that simply cannot be predicted.

This kind of information is part of what goes into deciding if the model is appropriate for your purpose. It is my job to provide you with as much information as I can so that you can make an informed judgment. But it is not my place to tell you that the model is right for you. You decide. Ask me questions about the data if something is not clear. But I hope you understand that I simply cannot make a blanket statement like "FDS is validated for predicting multiple sprinkler activations." You have made an argument above that it is not, and you have every right to that opinion."

# ATTACHMENT 3

**EXPERT REPORT EXCERPTS**
**DR. CRAIG BEYLER DEPOSITION**
**IAN DAVID McAUSLIN, et al v.**
**GRINNELL CORPORATION, et al**
**NEW ORLEANS DISTRIBUTION CENTER FIRE**
**(McFRUGAL'S WAREHOUSE)**

The following are excerpts from Dr. Craig Beyler's expert report in the litigation arising from the fire at McFrugal's Warehouse in New Orleans:

> "In a recent study sponsored by the NFPA Research Foundation, LES3D was used to predict the interaction between sprinklers and heptane spray fires. The sprinkler activation times predicted by LES3D compared well against the heptane spray fire experiments done at Underwriters Laboratories for the same study. First ring sprinkler activation times were predicted to within about 15 percent, and second ring sprinklers activation times were predicted to within about 25 percent. Predictions of the total number of sprinklers activated by the spray fires were generally very good with most predictions within 25 percent with greater deviations in three of the 21 tests. " (Page 16)

> "You and Kung (1984) and Kung, You and Spalding (1986) showed that the plumes and ceiling jets resulting from rack fires can be described using formulations presented in Beyler (1986) for simpler beds. This means that a simple representation of the burning racks as a simple surface at the top of the rack is a valid means of specifying the fire for use in performing calculations of the interaction of rack fire plumes/ceiling with the sprinkler spray." (Page 17)

> "For this study, the data in Beyler (1977b) were used for this purpose. The mean drop size, initial velocity, and water flow rate are dependent on the sprinkler pressure and orifice diameter. The experiments (Beyler, 1977b) used for establishing the parameters were 12.7 mm (½ inch) sprinklers flowing at 114 lpm (30 gpm). The median size was not reported in that work and a value of 1 mm was used based on the work of You (1986)." (Pages 25 and 26)

> "The standard clearance fire caused activation of four sprinklers over a period of 100 to 350 seconds. The MacFrugal's NODC clearance resulted in a fire that activated nearly 70 sprinklers during the simulation and clearly did not control the fire." (Page 41)

"The modeling results provided in this report confirm that the excessive ceiling clearance in the NODC sprinkler design caused the failure of the sprinkler system." (Page 44)

"The graphs on this page indicate the estimated operating times of sprinklers for a fire in a Class II commodity which is three tiers high with top of storage to ceiling clearances of 10 feet and 50 feet." (Page 62)

"The graph for the 10 feet clearance indicates that the first operating sprinkler will activate in approximately 100 seconds and that the fire will be controlled by a total 4 operating sprinklers." (Page 62)

"The graph for the 50 feet clearance indicates that the first operating sprinkler will activate in approximately 215 second and that the fire will not be controlled and will continue to grow." (Page 62)

# ATTACHMENT 4

**DEPOSITION EXCERPTS**
**DR. CRAIG BEYLER DEPOSITION**
**IAN DAVID McAUSLIN, et al v.**
**GRINNELL CORPORATION, et al**
**NEW ORLEANS DISTRIBUTION CENTER FIRE**
**(McFRUGAL'S WAREHOUSE)**

The following are excerpts from Dr. Beyler's deposition on May 12, 1999:

**Page 418**

**Q.** If I understood your response, the model does not include or can't determine what goes on within the rack itself. Is that correct? Did I repeat what you had stated earlier accurately?

**A.** You may have, but I'll make a comment on it, not because you mis-characterized it, but because I made it clear to me that I didn't describe it very well.

**Q.** Okay.

**A.** The computational domain does not include the racks themselves. That does not mean that we aren't predicting or otherwise know what's going on within the racks, but that is done as a sub-model as opposed to being a part of the - - fluid mechanics domain. What has been done is the fluid mechanics domain starts at the top of the racks up to the ceiling, of course. We predict using the LES model how much water arrives at the top of the racks and we use other models to establish, one, how the fire grows within the racks, and to, what the effect of that water is. So they are - - they are modeled, but they are not modeled in the fluid dynamical part of the LES 3D.

**Q.** Which portions are they modeled in and what sub-programs or models are those two phenomenon?

**A.** Those sub-models are a fire growth model that's described subsequently in the report as well as the effect of water is. There's a sub-model for that that we added for that. Both of those are - - We'll talk about them in detail, I'm sure. Both of those come out of work done at Factory Mutual.

**Q.** And the effect of the size of the flue does have an effect or is part of that equation, is it not?

**A.** The - -

**Q.** If you change the flue size, it will change the outcome?

**A.** The testing that was done that supports those sub-models were with the standard six-inch flue spaces and, yes, there is a - - there is an effect of flue space width on, you know, the air flow through the commodity.

**Page 423, Line 3**

**Q.** Let's mark that as 34 then. And let the record reflect the correction to Exhibit 34. Now, with respect to the Yao and Chan articles, your purpose was to discuss RDD and ADD?

**A.** Yes. Basically the modeling approach that we adopted that I just described in terms of dealing with the domain only above the commodity is the same approach that's inherent in the ADD-RDD or RDD-ADD concept that Factory Mutual has been using I'm going to say a couple of decades, but I'm not absolutely sure, in terms of how they have conducted experimental programs to understand the interaction of sprinklers and fires. They in fact have reduced it, I don't mean reduced in the sense of diminish, but reduced it that is, developed it to the point where it's actually a standard type of a test that they use to establish the commodity classification of some commodity that may not have been tested previously or for whatever reason they have some doubt as to how it's expected to burn. So the intention of including these here is simply to indicate that this is not an approach without precedent. It is the underlying basis for a whole body of research that Factory Mutual has done over the years. And obviously if the prior references we talked about, You and Kung and Kung, You and Spaulding, if those weren't true they wouldn't be doing it. But in fact, they have been and have been successful.

**Page 430, Line 21**

**Q.** Okay. Now we pick up the first - - Is this, on page 19, the first of the algorithms that were imported into the program. Is that what that is at the top of page 19?

**A.** Yeah. What we're doing in this part is describing how we're going to model the commodities in terms of surface areas and then we'll go on in the subsequent page to burning rate per unit areas and then subsequently into flame spread rates, which are the things that are needed to - - that's the fire growth model. And, you know, which are coming out, as we're seeing here, as out of data in correlations of data provided by various authors at Factory Mutual.

**Page 450, Line 1**

**Q.** And then explain the significance, the role of Exhibit 42.

**A.** Sure. Bert did experiments in which he looked at a range of sprinklers and looked at the drop size distributions that were produced and correlated those drop size distributions. This is a report of that work. And you will find that equation 13 is included in Bert Yu's work as a means of correlating the mean droplet diameter to the flow rate and we are using this correlation. So as the flow rate from the sprinkler diminishes, as more sprinklers are activated, not only does the flow rate change, which we have produced in our modeling input, but also the mean droplet size changes, and that is also reflected through the use of this correlation developed by Bert Yu in Exhibit 42.

**Page 490, Line 14**

Q. Would you be able to model that by use of a different program or do you have to make a qualitative decision, non-quantitative decision as to the effect of the water discharged by the sprinklers in the rack?

A. I mean the substance of the meaty, you know, the meaty part, the central portion of this, our report, are the modifications that we made to LES to allow the modeling of the effect of sprinkler sprays on the burning of the commodities. We added that, we used that. What we did would be - - is applicable to ceiling sprinkler systems, and as indicated yesterday and again today, that I don't know how to expand that to in-rack sprinklers.

The following are excerpts from Dr. Beyler's deposition on June 23, 1999:

**Page 1345, Line 24**

**Q.** Okay. I thought it was clear from the content what we were referring to, and if there are multiple reports, I readily stand corrected. But I thought it was clear it was the report that you and Mr. Trelles worked on . Where there more than one report that you worked on for the AAMA?

**A.** The review paper that I did with Mr. Cooper was also funded by that organization.

**Page 1352, Line 25**

**Q.** Did you, in your review of the inventory, and by you, I am referring to the imperial you, determine whether or not any aerosols or flammable liquids were present in the warehouse?

**A.** Don't know.

**Q.** Do you recall whether anyone else that was part of the Lloyd's team made that determination or came to that conclusion or did that identification?

**A.** Don't know.

**Q.** Did you receive any documents from Mr. Mazarat that would indicate whether or not there were aerosols present in the warehouse?

**A.** Don't remember. I mean we have reviewed the materials I got from him. I don't remember what those are. We could review any of those that were made exhibits, but I don't remember as I sit here.

**Q.** Your understanding is, to the extent that there were aerosols present within the warehouse, that was contrary to the variance? Is that correct?

**A.** Yes.

**Page 1359**

**Q.** Okay. Multi-row. That is you had that configuration and the same design for the overhead as was at the warehouse, that the overhead, if it was ten feet or less above the top of storage, would control that fire? Is that correct?

**A.** That's what the modeling indicated.

**Q.** That's what the model indicates.

**A.** Yes.

**Q.** Okay.

A. That is the prediction.

**Page 1397, Line 20**

**Q.** This is still a point where I am a little bit confused and I need you to assist me if you would. Are the fire growth rate and suppression algorithms used in your model based upon tests and experiments done on double row racks or multi-row racks?

**A.** The two configurations of tests that were used in the testing, as I best remember them, some were arrays of four racks, two by two. Typically the calorimetry tests are done in that geometry. And then there are other tests that are a double row rack. That is, the one dimension being longer that the other.

**Q.** That partially answers my question. Let's split it in half.

**A.** Okay.

**Q.** For the suppression algorithms, - -

**A.** Yes.

**Q.** - - does it use double row racks or multi-row racks?

**A.** Those are tests, and I think those were Bert Hughes' tests that are a two by two array.

**Page 1412, Line 10**

**Q.** We talked about this a little bit earlier. Going back to the model. What is the proper, in your mind, or in your opinion, method for validating computer fire models? Let me restate it again. All right. Do you understand the question, sir?

**A.** I'm going to review it again, but I think I do. Obviously validation of a computer model is involved in both assurance that the code does what you think it does and that the model that's implemented compares - - involves comparison with data. You used the word "proper" and I'm not sure I can define for you what "proper" is. That is, I'm not sure I could give you a definition of "proper" versus "improper" validation. Not a word I would have picked, but, you know, you did.

**Q.** What word would you pick? Is there a correct method for validating a model, computer model?

**A.** There's not a well established protocol per se. There are some - there are some, you know, general ideas, which I think I have tried to indicate in my answer already; that is, comparison, the idea of the validation by comparison of data, you know, doing things - - doing checks on calcs to see that they do what you intend them to do. But I don't think there's a prescription that, you know, this is the proper method. There are certainly - - there's information around as to the process, but I don't know what I could identify this is a proper one and this is an improper one.

**Page 1414, Line 15**

**Q.** Okay. The model, the LES3D model encompasses or takes into account pre-wetting. Is that correct? Or does it?

**A.** The water does flow on to commodities and the water density does affect the burning rate. Those are the ways in which the model includes - - includes, you know, water application. It doesn't accumulate water on surfaces or anything of that sort.

**Page 1425, Line 11**

**Q.** Had Mr. McGrattan, et all disclosed what their margin of error or error rate is with respect to the LES3D program? At least as of the margin that you used?

**A.** I think the published papers, you know, that are cited in the report include comparisons with data that are illustrative of the margins of error and I think I we talked about some of those last time.

**Q.** Okay. And with respect to the inclusion of additional suppression algorithms that were proprietary or have been asserted to be proprietary to Hughes & Associates, have they been subjected to review for determination of how they affect rate of error?

**A.** As I indicated last time, the models that we used, the models aren't proprietary. It's the source code. And, of course, the models that were used are in the open literature and have comparisons available, data versus - -

**Q.** You said models. I was referring to algorithms. Were you using them - -

**A.** Algorithms are an implementation of a model.

**Q.** Okay.

**A.** And so I mean you have the question there of does the source code do what you want it to do, and that's error checking, which was done. And then there's the question of given the - - you know, a correct implementation of the model, how well does that model do relative to data. Those comparisons of model to available experimental data are included in the references we cited, which I believe are all exhibits to my deposition. I mean they exist.

**Page 1426, Line 24**

**Q.** In the model, the suppression algorithm decreases the rate of heat release over time?

**A.** The heat release rate is reduced by the application of water.

* * * * *