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MEETING LOG  
DIRECTORATE FOR ENGINEERING SCIENCES

SUBJECT: Industry Activities to Address Water Heater Ignition of Flammable Vapors

PLACE: CPSC Headquarters

MEETING DATE: August 30, 1994

LOG ENTRY SOURCE: Donald W. Switzer *DWS*

ENTRY DATE: 10/11/94

COMMISSION ATTENDEES:

Donald W. Switzer	ES
William Rowe	EP
Harleigh Ewell	OGC
James E. Bradley	ES
Ronald L. Medford	EXHR

NON-COMMISSION ATTENDEES:

Mary Spock	Product Safety Letter
Douglas W. Dewerth	American Gas Association
	Laboratories
Joe Mattingly	Gas Appliance Manufacturers
	Association
Richard Topping	Arthur D. Little, Inc.

MEETING SUMMARY

The original purpose of this meeting was to discuss ongoing and planned, as well as completed industry activities regarding gas-fired water heater ignition of flammable vapors. Prior to the meeting CPSC staff was informed that industry would not be able to discuss either the ongoing or planned industry activities until the work had been reviewed and approved by the water heater manufacturers. The scope of the meeting was adjusted accordingly. CPSC staff had prepared written questions for the meeting. In the following discussion each question is presented, followed by industry's response.

**"EVALUATION OF A 14" BARRIER PROPOSED AS A MEANS TO PREVENT ACCIDENTAL IGNITION OF FLAMMABLE VAPORS BY A GAS-FIRED WATER HEATER"**

- Q1. What vapor concentrations were measured at the "different distances above the floor?"
- Q2. Have additional tests been performed subsequent to the work

described in this white paper?

A1&2 Two tests were conducted [CPSC has video tapes.] The data on vapor concentrations and height are available from AGA Labs and were requested. One sampling device was used to test different heights successively, so there may not be very much data from the first test.

### **FLAMMABLE VAPORS IGNITION HAZARDS STUDY**

#### ADL TASK 1

Q1. The following materials were reviewed in ADL Task 1, and are listed in Appendix A. Staff request full citations on the following documents or copies.

Doc #	Title
60	Proposal for a Homeowner Water Heater Safety Awareness Program, Loran Nordgen & Company 6/22/92
64	Tech. Comm. Rpts., Log # 20, NFPA 54-A92TCR
65	Tech. Comm. Rpts., Log # 27, NFPA 54-A92TC
67	County of LA Fire Dept., w/attachments re garage fires
68	So. Cal. Gas Co.: Re: Hearing on fuel Burning Appliances in Private Garages
69	County of LA: Synopsis of Minutes of Public Hearing on Fuel Burning Appliances in Private Garages
71	Calspan Tech Rpt.: Investigation of Safety Stds for Flame Fired Furnaces, Hot Water Heaters, Clothes Dryers, and Ranges
98	Calspan Report: "Identification and Classification of Potential Hazards Associated with the use of Residential Flame Fired Furnaces, Hot Water Heaters, Clothes Dryers, and Ranges"
140	LA city data
141	Sacramento city data

A1. The requested documents or their complete citations will be provided, less the Calspan reports, which CPSC has.

Q2. Please list which scenario was assigned to each Detailed Report listed in Appendix C of Task 1.

A2. Mr. Topping didn't know if the assignment of the reports to scenarios was readily available. He supervised Dale Larson who developed the scenarios. The reports exist in a data base. We can have the distribution if it is available. The complete files will cost approximately \$1000 for copying. CPSC may not want the complete set of files. The scenarios do not have a simple correlation to the Task 2 tests. The scenarios were used to suggest the direction of

the tests and are a framework for the tests. The tests may be within or outside of the scenario framework. ADL justified full scale testing by saying the unresolved complexity of the actual incidents could not be resolved by other approaches. They said the full scale testing did not follow the scenarios, and we did not try to discuss any relationship between the scenarios and the incident reports or the National Fire Incident Reporting System (NFIRS) data.

- Q3. Were there supplemental sources used with the Detailed Reports? For example, Document #28 is CPSC investigation 88018CCC0228. The Appendix C narrative summary says "Hot and humid." One might expect August 20 at 1:30 PM in Kentucky to be hot and humid; however, I do not find that statement in CPSC report or the attached civil action. The defendant or its insurance company may have had additional information.
- A3. It was unclear if supplemental information had been used.
- Q4. In the Task 1 report, page 9, part of the discussion of the Oregon data has been changed, per R.F. Topping's letter of 11/24/93. The original report contains the statement, "However taking these violations into account, the average incident rate is still above the national average." Is that statement retained in the current text, or does the paragraph end with, "...in violation of the state building code?"
- A4. The intent of revising the discussion of the Oregon data was to back off from making conclusions. Topping will check with Larson on the exact complete statement.

#### ADL TASK 2

- Q1. What information in the Task 1 results led GAMA and ADL to believe that floor temperature played a part in accidents? It seems to staff that the floor temperature will be cooler than air temperature in almost all real-world instances.
- A1. The intent was not to vaporize the fuel more quickly. ADL feels seasonality and geographic location are factors in the data. The room chamber was heated to simulate "... the South baking at 100°F for days on end."

At this point staff asked what the purpose of the fire tests was: whether to try to recreate injury scenarios to see if ignition occurred, or to create a variety of conditions to see what would cause a fire. Mr. Topping replied it was more like the latter.

- Q2. It is not clear to staff how the room temperature can be

higher than the floor temperature if heating the floor was how the room was heated.

- A2. The tests were conducted in a chamber within a wood and plastic "green house" outside of the AGA Labs test building. The chamber ceiling and walls were drywall (unpainted?) and the floor was metal. Under the metal floor were water coils, to control temperature, on top of a 4 inch concrete slab. The chamber was heated by heating the floor and blowing hot air from a construction heater into the room. The floor was sometime hotter than the room because the room air cooled more quickly than the floor after the construction heater was removed. The tests were conducted in Cleveland, OH, in February through May.
- Q3. What was the air exchange rate in the rooms where the testing was performed?
- A3. The air exchange rate was not measured. It was loosely estimated at 0.1 volume exchanges per hour. During this discussion Mr. Topping stressed the apparent complexity of the problem to explain why ADL felt full scale tests were necessary. CPSC noted this statement explained why CPSC had to understand the Task 1 scenarios.
- Q4. The Task 2 report indicates that measurements were taken to ascertain the concentration of gasoline vapors during the testing. Please provide the maximum height the vapor cloud achieved while the concentration remained above the lower explosive limit (LEL).
- A4. The duration of the tests depended upon the vapor concentration. The LEL was measured, and when dispersion overcame vaporization, and the vapor concentration fell below the LEL, the test was stopped. The maximum height was not measured, but was stated as, 'over 18" for 1 gallon."
- Q5. Was ADL able to ascertain where ignition initiated? Did ADL staff record where ignition actually took place?
- A5. The location of the ignition was not determined. There is additional information in the complete files.
- Q6. Why was the floor heated?
- A6. See A2.
- Q7. What were the **maximum** temperatures achieved during each test, counting from the time the gasoline container was first placed in the test room?
- Q7. Question not asked.

- Q8. Were preliminary tests run that are not reported in the final report? What were the results of those tests?
- A8. There were no preliminary runs. One run, #5, was not recorded.
- Q9. What was the basis for the floor and air temperatures chosen in the tests?
- A9. The floor temperatures used were an attempt to duplicate climate. The question of developing temperature data from Task 1 was not raised.
- Q10. How did the empirical results for the location of the vapor cloud compare with the profiles predicted by the dispersion models?
- A10. The tests results are consistent with the profiles predicted by the dispersion model, but "verify" is too strong to describe the relationship between the two.
- Q11. Please rank the relative importance of the following parameters, as determined by the dispersion models; spill surface, floor temperature, room temperature, room boundaries, liquid composition, and ventilation. Was there an effort to ascertain the relative importance of agitation, as provided by the dummy?
- A11. Factor rank was based on observations, not the model. Ordinal data were not provided. See Task 2 3.4.5 Additional Observations, p.26.
- Q12. Question Intentionally blank (misnumbered).
- Q13. Were tests run using a three dimensional dummy? If so, what were the results?
- A13. A 3-D dummy was not tested. They were not trying duplicate a particular situation.
- Q14. What is the distribution pattern of air introduced into a operating water heater for combustion? Was the velocity profile depicted in Figure 3 of the Task 2 report symmetrical in all directions?
- A14. The combustion air velocity profiles were simulated at ADL using a blower in a water heater and were symmetrical. In the discussion of ignition Mr. Dewerth observed that 1/2 gallon of gasoline "wetted the whole corner of the room." The amount of gasoline used was discussed at this point. The Task 1 Basement/Garage Scenario specifies the amount of gasoline as "leak" this was described as the "Volkswagen scenario." Test(s) were not conducted on this scenario.

Q15. Staff presumes that the profile depicted in Figure 3 is with the water heater installed on the floor. Were any tests run to ascertain the velocity profiles when the water heater was installed on a stand?

A15. Velocity profiles were developed for elevated water heaters, and they were consistent with the floor level heater. On the floor the air velocity is 1.5 inch/sec measured 1 inch from the heater.

Q16. Was test 16 the only test run where the can was spilled away from the water heater?

A16. This was the only test where the can was spilled away from the heater. In test 16, two cans were tipped, one toward and one away from the water heater. The answer is not completely clear.

Four items relevant to the test conditions were discussed at this point. 1) There was concern that a spill on a metal floor would spread further than a similar spill on a concrete floor. ADL conducted a spill test, and the spill on the concrete floor seemed about the same size or a little larger. 2) The air opening to the test chamber was in accordance with the National Fuel Gas Code. 3) The gasoline was stored outside prior to the tests. 4) ADL felt that mass transport of gasoline vapor was more important in these incidents than vapor diffusion.

#### **GENERAL COMMENTS AND REQUESTS**

Q1. There is some information that may help us to get started on a more thorough economic analysis of the issues involved. This information may be obtainable through industry sources. Your help in obtaining this information would be much appreciated. On the models, or equivalents listed below, I would like to have the best information available on 1) the estimated useful life of the product, 2) the wholesale and retail prices, 3) the estimated annual energy cost, and 4) possible restriction on product use because of conflicts with local codes.

#### **Bradford White Corporation**

M-I-40S10LN (40 gallon, gas, *Energy Saver*)

M-I-50310LN (50 gallon, gas, *Energy Saver*)

M-I-40S10DS (40 gallon, electric, *Energy Saver*)

M-I-50T10DS (50 gallon, electric, *Energy Saver*)

M-II-504S10CN (50 gallon, gas, *Deluxe Extra Recovery*)

DV-II-40S10LN (40 gallon, gas, *Direct Vent Deluxe Energy Saver*)

DV-II-50S10LN (50 gallon, gas, *Direct Vent Deluxe Energy Saver*)

**A.O. Smith**

FPD-40 (40 gallon, gas, *Sealed Shot*)  
FPD-50 (50 gallon, gas, *Sealed Shot*)  
PGCG-40 (40 gallon, gas, *Conservationist*)  
PGCG-50 (50 gallon, gas, *Conservationist*)

**Ruud Water Heater Division**

WL40 (40 gallon, gas, *Performer*)  
WL50 (50 gallon, gas, *Performer*)

**State Industries**

SEX-40-NXRT (40 gallon, gas, *Turbo Super-Saver*)  
SEX-50-NXRT (50 gallon, gas, *Turbo Super-Saver*)  
SR8-40-NADS (40 gallon, gas, *Turbo Super-Saver Direct-Vent*)  
SR8-50-NADS (50 gallon, gas, *Turbo Super-Saver Direct-Vent*)  
TCL-40-2LRT (40 gallon, electric, *Lifetime*)

It would also be helpful to obtain any available information concerning the proportion of new water heater shipments that are higher priced models and the proportion that are lower priced models.

- A1. GAMA can provide energy used items, but they do not collect product life, wholesale or retail pricing, or building code conflict information.
- Q2. Please provide a listing of residential gas-fired water heaters that are currently marketed which draw combustion air from the top of the appliance. Please provide a similar listing of water heaters that take combustion air from outside the room in which the appliance is installed. Please provide the market share for each design.
- A2. AGA Labs suggested we look at the AGA listings for water heater drawing their combustion air from the top and from outside. It was suggested we look at Appliance magazine for market data.
- Q3. Please provide assembly drawings depicting major components of the appliances and how they are assembled.
- A3. GAMA will try to get typical useful drawings.
- Q4. What is the estimated average life of water heaters that draw combustion air from the top of the appliance or from outside the installation room? Is it different from conventional water heaters?
- Q5. How many of each of these appliances are currently produced?

A4&5 Suggest we look at the September issue of Appliance magazine for product sales and life data.

Q6. What is the retail price of each model produced?

A6. GAMA does not collect price data.

Q7. GAMA states that there are 579 models of water heaters on the market. How is this number broken down? How many residential gas water heaters models are there? Of these models, how many are essentially duplicates? For example, Rheem sells what are essentially the same models under the names Rheem, Ruud, Marathon, and Sears. Are these being counted as one model or four models?

A7. AGA Labs will look at how the same design is certified under different listings and provide relevant information.

Q8. If the Commission directs publication of an Advance Notice of Proposed Rulemaking, what effect will that action have on ongoing industry activities to address the issue of water heater ignition of flammable vapors?

A8. Mr. Mattingly thought that rule making could delay product innovations. He said the need to address the hazard is recognized, and research will be funded by manufacturers. They might delay that funding if CPSC was going to direct the solution so as to avoid research in a direction that would not fit with CPSC's regulatory plans.

#### **New Technology Development and Evaluation**

Q1. Are new technologies being evaluated to address the hazard of water heater ignition of flammable vapors?

Q2. What is the status on the new technology development and testing?

A1&2 New Technology and Test Method Development will be discussed after evaluating work in progress.

#### **Test Method Development**

Q1. Are industry efforts planned to develop performance requirements for gas-fired water heaters to address the issue of water heater ignition of flammable vapors?

Q2. What is the status of standard development efforts?

A1&2 New Technology and Test Method Development will be discussed after evaluating work in progress.

GAMA agreed to answer the written questions from the CPSC staff contained in the CPSC letter to Frank Stanonik, dated August 17, 1994.