incidents in which residential gas water heaters ignited the vapors from flammable liquids that spilled in the vicinity of the water heater. Because the staff was not aware of any design features that could be incorporated into water heaters to prevent such ignitions, the staff believed that the only way to address this risk was to try to change consumers' behavior.

In the spring of 1991, however, a New Orleans attorney, Edward F. Downing, III, made a presentation to the staff that included video tapes of tests which showed that raising water heaters on an 18-inch-high stand greatly reduced the risk of gasoline vapor ignition. (This elevation of water heaters by 18 inches was already required by the National Fuel Gas Code for gas water heaters installed in hazardous locations and garages.) Mr. Downing's tests also showed that ducting the air from 18 inches above the ground had the same effect as raising the water heater.

These measures appear to reduce the risk of ignition because the vapors from gasoline and many other flammable liquids are significantly heavier than air and accumulate in a layer at the floor of the room. By ensuring that the air coming into contact with the flames in the water heater is obtained at some distance off the floor – either by raising the water heater or ducting the air from a height of 18 inches – the bulk of the flammable vapors can be kept separate from the potential source of ignition. Accordingly, in many cases, the concentration of flammable vapor that constitutes the lower explosive limit ("LEL") for that substance will not be achieved.

The CPSC's staff arranged for Mr. Downing to make the same presentation to the American National Standards Institute ("ANSI") Z-21 Subcommittee, which is responsible for the ANSI voluntary standard for water heaters (ANSI Z21.10). That presentation occurred on November 13, 1991. Subsequently, an ANSI working group was formed to address this ignition issue. In addition, the Gas Appliance Manufacturers Association ("GAMA") funded a study of elevated water heaters to review available fire data and to examine the effects of elevation on ignition prevention. However, despite the staff's request, it was not allowed by GAMA to participate significantly in the development of, or testing during, the study.

In March of 1992, the Commission's staff formally requested that the ANSI subcommittee develop a performance standard that would provide ignition prevention performance at least equal to that achieved when a specified water heater is tested in a draft-free room at an elevation of 18 inches (or at another height if testing showed it to be needed). When the GAMA-funded study became available, it showed that, under some test conditions, fires could be produced at a water heater that was elevated 18 inches.

The Commission's staff does not consider the resulting study to be particularly useful for purposes of standards development. Although ignition occurred in a number of the scenarios tested with elevated gas water heaters, the test conditions were far more severe than those that probably caused many of the fires that have occurred in consumers' homes. For

example, the GAMA study used relatively large amounts of gasoline in their spills (up to 2 gallons). Although the amount of gasoline involved in the fires in consumers' homes is not known, it seems unlikely that consumers store or handle gasoline in quantities that would produce very many 2-gallon spills. In addition, GAMA's study heated the room and floor, which significantly increases the rate of vaporization. Even under this study's severe conditions, however, a substantial benefit of elevating the water heaters was shown.

When the GAMA-funded study was presented to the ANSI working group, a motion was made to disband the working group because stands used to elevate water heaters would not prevent all vapor-ignition fires. The CPSC staff person at the working group meeting objected to that proposal, and described plans for CPSC testing of ways to retrofit existing water heaters to provide protection against ignition of flammable vapors. The working group then decided that if the staff could demonstrate a retrofit method which would prevent ignition, there would be no strong basis for not doing so in new water heaters. Accordingly, the working group agreed not to disband.

The Commission's Engineering Laboratory staff conducted tests of a potential retrofit at the fire-testing facility at the National Institute of Standards and Technology ("NIST"). This retrofit involved the installation of a barrier made from a 6-foot piece of sheet metal roof flashing formed in a 14-inch high cylinder around the base of the water heater and sealed to the floor with duct tape. Flammable vapors would have to go over this

barrier before they could be exposed to the flames in the water heater. Vapor concentrations were measured electronically, and water heater operation was simulated by installing a fan in the water heater vent. This fan was used to pull air into the bottom of the appliance at the rate that would occur during normal operation of the heater.

CPSC testing of this retrofit showed the ability of a dam, or weir, at the base of the water heater to keep flammable vapors from the potential ignition source. These test results were presented to the ANSI working group, and GAMA then announced plans to test burners and perhaps other alternative designs to reduce the ignition risk. In addition, CPSC staff subsequently performed additional work showing that the use of a dam or weir did not cause hazardous levels of CO to be produced by the water heater burner. Subsequent live-fire tests by industry, however, have cast doubt on the ability of the barrier or weir to prevent vapor from reaching an ignition source.

The Commission's staff recently obtained detailed information on previously unknown industry activities to address the ignition of flammable vapors. The first is GAMA-sponsored testing of a prototype technology to eliminate the hazard posed by vapor ignition. Preliminary results are promising, but a number of issues remain to be resolved. It is unknown at this time whether the technology will ultimately be usable for water heaters.

The second activity is the establishment of a formal project, funded by the Gas Research Institute ("GRI"), to develop

a test methodology to be included in the ANSI Z21.10.1 standard for residential gas-fired water heaters. The testing program should begin shortly and be completed in about 9 months. GAMA estimates it will take approximately 30 months from completion of the testing to incorporate the test method into the standard. GRI has invited CPSC membership on the Technical Advisory Group that is overseeing test development. The Commission views this as a positive development, but has reservations about the technical approach being proposed for the test method. Also, the Commission cannot now predict with confidence that the test method will ultimately be adopted by the industry.

In view of the uncertainty of the ANSI subcommittee's implementing a performance standard for gas water heaters, the Commission has decided to publish this advance notice of proposed rulemaking ("ANPR"). Publication of this document commences a proceeding that ultimately could require gas-fired water heaters to meet specified performance requirements to address the identified risk of ignition of flammable vapors.

B. Statutory Authority

This proceeding is conducted under provisions of the Consumer Product Safety Act ("CPSA"), 15 U.S.C 2051-2084. A proceeding to promulgate a regulation establishing performance or labeling requirements as a consumer product safety standard is governed by the requirements in sections 7 and 9 of the CPSA. 15 U.S.C 2056, 2058.

To commence a rulemaking proceeding, the Commission must issue an ANPR as provided in section 9(a) of the statute.

15 U.S.C. 2058(a). If the Commission decides to continue the rulemaking proceeding after considering responses to the ANPR, the Commission must publish the text of the proposed rule, along with a preliminary regulatory analysis, in accordance with CPSA section 9(c). 15 U.S.C. 2058(c). If the Commission then wishes to issue a final rule, it must publish the text of the final rule and a final regulatory analysis that includes the elements stated in section 9(f)(2) of the CPSA. 15 U.S.C. 2058(f)(2). Before the Commission may issue a final regulation, it must make statutory findings concerning voluntary standards, the relationship of the costs and benefits of the rule, and the burden imposed by the regulation. CPSA sec. 9(f)(3), 15 U.S.C. 2058(f)(3).

C. The Product

The products that are the subject of this proceeding are gas-fired water heaters that are used in residences. The Commission estimates that there are between 40 and 50 million homes in the United States that have gas water heaters. The Commission is also interested in information on whether other flame-producing appliances (such as gas-fired clothes dryers, furnaces, or ovens) are potential sources of ignition for flammable vapors.

D. The Industry

Information from the American Gas Association indicates that annual sales of residential gas water heaters have increased from 2.5 million units in the early 1960's to 3.5 million units in the late 1980's. Five manufacturers dominate the gas water heater market, with 99% of production.

E. Risks of Injury and Death

An average of 316 people were injured and 17 people died each year between 1986 and 1991 in incidents involving gas water heaters and flammable vapors. Of these incidents, an average of 239 injuries and 14 deaths each year involved gasoline. Many of the injuries involved severe burns.

For the period 1986 through 1991, gasoline and other flammable vapors accounted for the following percentages of incident categories associated with gas-fired water heaters: 20% (1,961 incidents) of the fires; 54% (316 people) of the persons injured; 44% (17 people) of the deaths; and 30% ($26,339,000) of the property loss. The societal costs from fires involving flammable vapors and gas-fired water heaters may exceed $300 million per year: $284 million in injuries, $85 million in deaths, and $26 million in property damage.

Assuming a discount rate of 5% and an average useful life of 11 years for a water heater, the estimated value of modifications that would prevent virtually all incidents involving the ignition of flammable vapors by gas water heaters would be between $68 and $85 per water heater.

F. Existing Standards

The ANSI Z-21 standard, discussed above, does not contain any performance requirements intended to prevent flammable vapors from coming into contact with the flames in gas water heaters. It does contain a labeling requirement for water heaters that are not installed in recreational vehicles. That label warns of the flammable vapor hazard and directs that water heaters be

installed so that any flame is at least 18 inches above the floor if the water heater is installed where flammable products will be stored or used. However, CPSC has not endorsed the warning label and has commented previously that its wording should be more concise, to help the consumer focus on the hazard being addressed. In any event, a warning label should not be used in place of a performance standard. To achieve product safety, the most effective approach is to design the hazardous feature out of the product. If labeling is used, it should, wherever possible, be used in conjunction with product modifications that address the risk.

The National Fuel Gas Code ("NFGC") has adopted a requirement, based on a rationale originally in the National Electrical Code, that water heaters in garages be elevated so that the burner and pilot light are at least 18 inches off the floor. However, this requirement does not apply to water heaters located elsewhere in the home. In addition, there is a requirement that "gas appliances shall not be installed in any location where flammable vapors are likely to be present, unless the design, operation, and installation are such to eliminate the probable ignition of the flammable vapors." The Commission's staff believes that this latter provision has not been considered as routinely applicable in homes to locations other than garages. Although one report indicates that 73% of U.S. homes have a garage (Flammable Vapor Hazards Ignition Study — Task 1 Report, Arthur D. Little, Inc., GAMA 1993) ("Task 1 Report"), not all homes with garages have the water heater in that location.

In addition, the Commission's staff believes that compliance with this provision of the NFGC has been poor. This lack of conformance may improve as this provision has recently been adopted by model building codes, such as the Southern Building Code Conference International ("SBCCI") and the Council of American Building Officials ("CABO") codes. However, adoption by model building codes does not guarantee that the provision will be incorporated into local building ordinances, where compliance is enforced.

Moreover, garage ignitions apparently represent only a portion of the problem. The Task 1 report referenced above assembled a database of 135 incidents involving ignition of flammable vapors by residential gas water heaters for which there were detailed incident reports; only 27 of these incidents were known to have occurred in a garage. (Thirty-one incidents did not specify the room location.) The report shows that, in the incidents where the room location was specified, the garage was involved in 10 of 27 deaths, 5 of 33 injuries, and 2 of 11 incidents in which there were both deaths and injuries. Therefore, even if all new construction of houses and commercial replacements of existing residential water heaters followed the NFGC requirement for water heaters in garages, there is a large portion of the incidents that would not be addressed.

The Commission is not aware of any other standard for residential gas water heaters that addresses the risk of burn injuries, deaths, and property damage from gas water heaters igniting flammable vapors. Therefore, for the reasons stated

above, the Commission believes that the existing standards would not eliminate or adequately reduce this risk.

G. Regulatory Alternatives Under Consideration

The Commission is considering alternatives to reduce the number of injuries and deaths related to the ignition of flammable vapors by gas-fired water heaters.

1. Performance standard. For the reasons discussed above, it appears that a performance standard can be developed that will reduce the risk of gas water heaters igniting flammable vapors.

2. Labeling and instructions. Another alternative is labeling the product to warn against this hazard and providing information on the risk in the product's instructions. The Commission believes such steps are necessary. However, as noted above, these steps alone are not likely to adequately reduce the risk and should be used in conjunction with product modifications, where possible.

3. Voluntary standards. For the reasons stated above, it appears that there is no voluntary standard in existence, or that can be predicted with confidence will be developed and implemented, that would adequately reduce this risk of injury.

H. Solicitation of Information and Comments

This ANPR is the first step of a proceeding which could result in a mandatory performance or labeling standard for gas-fired water heaters that present an unreasonable risk of igniting flammable vapors in residences.

All interested persons are invited to submit to the Commission their comments on any aspect of the alternatives

discussed above. As required by section 9(a) of the CPSA, the Commission specifically solicits:

(1) Written comments with respect to the risk of injury identified by the Commission, the regulatory alternatives being considered, and other possible alternatives for addressing the risk.

(2) Any existing standard or portion of a standard which could be issued as a proposed regulation.

(3) A statement of intention to modify or develop a voluntary standard to address the risk of injury discussed in this notice, along with a description of a plan (including a schedule) to do so.

Comments should be mailed, preferably in five copies, to the Office of the Secretary, Consumer Product Safety Commission, Washington, D.C. 20207-0001, or delivered to the Office of the Secretary, Consumer Product Safety Commission, Room 502, 4330 East West Highway, Bethesda, Maryland 20814; telephone (301) 504-0800. All comments and submissions should be received no later than [insert date that is 60 days from publication].

Sayde E. Dunn, Secretary
Consumer Product Safety Commission

Reference Documents

The following documents contain information relevant to this rulemaking proceeding and are available for inspection at the Office of the Secretary, Consumer Product Safety Commission, Room 502, 4330 East-West Highway, Bethesda, Maryland 20814:

1.