

# **DEVELOPMENT OF STANDARD COOKING FIRE SCENARIOS AND CANDIDATE TEST METHODS FOR EVALUATING COOKING FIRE MITIGATION TECHNOLOGIES**

## **PROJECT SUMMARY**

### **Background**

Cooking-equipment related fires are a leading cause of U.S. fire loss. The National Fire Protection Association reports that in 2003-2006, for example, there were 150,200 reported home cooking related fires per year (40% of all reported home fires), with associated annual losses of 500 civilian deaths (17% of home fire deaths), 4,700 civilian injuries (36% of home fire injuries), and \$756 million in direct property damage (12% of home fire damages).

Beginning in the mid 1980's, the National Institute of Standards and Technology, Consumer Product Safety Commission, and home appliance industry undertook a comprehensive review of strategies to mitigate death, injury and property loss from cooking fires. All strategies were engineering strategies defined by a condition to be detected (e.g., overheat of pan or food in pan, absence of person actively engaged in cooking process, early-stage fire on stovetop) and an action to be taken (e.g., shut off cooking heat, sound alarm, suppress fire). As part of this study, a comprehensive review of existing technologies was done.

In February of 2010, a Vision 20/20 workshop on this topic was convened in Washington D.C. Participants recommended that a study be undertaken to identify the barriers to the utilization of these technologies and to develop an action plan towards improving cooking fire safety.

In 2010, the Foundation conducted a study (ref 1) supported by NIST to develop this action plan. The study focused particularly on prevention technologies suitable for use on or with home cooking appliances. and consisted of a literature and technology review; the development of an enhanced technology evaluation methodology based on an in-depth review of cooking fire statistics; and the evaluation of currently available technologies using this methodology. The project culminated with a one day workshop of 35 leaders from the kitchen appliance, fire service, and user communities who met to review the above findings and identify gaps in information. The highest priority action item identified at that workshop toward implementation of commercially available cooking fire mitigation technologies was:

“Develop standard fire scenarios and create test methods and performance criteria which can feed into standards development”

### **Project Objective**

The goal of this project is to develop standard cooking scenarios and to create candidate test methods and performance metrics to evaluate cooking fire mitigation technologies.

## TECHNICAL APPROACH

### Project Methods and Equipment

The research program will be conducted by Hughes Associates, Inc. (HAI) under the auspices of the FPRF over a period of one year. The primary approach is to build off of existing work to formulate a set of performance goals for cooking fire tests and then to experimentally develop tests that meet the performance requirements. The details of each task of the program are:

- 1) **Project Steering committee:** The Foundation will form a Project Steering Committee consisting of the key stakeholders in cooking fire safety to provide strategic oversight to the program and ensure it is focused on the information most relevant to decision-making and implementation of proven technologies. These organizations will include: the Association of Home Appliance Manufacturers, the Consumer Product Safety Commission, National Institute of Standards and Technology, fire service organizations, national product testing and certification organizations, and others represented at the previous Foundation workshop held in 2011. The Steering Committee, which will consist of no more than 10 individuals, will meet twice in person during the course of this project as well as by teleconference as needed. It will provide input on the project detailed scope of work, provide input on draft and final reports, and will serve as a bridge to dissemination of the project results.
  
- 2) **Task 1 Select Representative Fire Scenarios:** Based on the work conducted in the recent FPRF program, there are three main categories of concern for cooking related fires: 1) Fires in a cooking vessel on a burner, 2) Fires due to spill-over onto a burner, and 3) Fires involving class A materials on or next to a burner/cooking vessel. At least one standard fire scenario will be developed for each of these categories. Category 1, fires developing from food material in a cooking vessel, will likely warrant multiple scenarios that reflect different types of cooking, including frying, which is a higher risk type of cooking. Types of cooking fires will likely encompass an evaluation of oil cooking and solid food scenarios. This task will include an analysis of previous testing involving cooking fires relative to selecting the target materials. For example, multiple studies (as cited in the previous FPRF program) have been conducted to characterize the burning characteristics of multiple oils. Limited test standards (i.e., UL 300A) utilize standard oil-in-pan fire tests.

The selection process of the different cooking fires will be based on existing fire statistics and industry input to demonstrate that the selected scenarios reflect realistic fire conditions. The goal is to identify fire scenarios for each category mentioned above as well as identify various food type fires that are deemed particularly challenging or generally representative of a large number of fire casualties (i.e., injuries or death).

- 2) Task 2 Performance Goals: A set of fire test performance goals will be established and used to guide the selection of each fire scenario candidate. The goals will establish the scope of the tests and will consider items such as the size of the fire, the applicability of the test fires to real incidents, the applicability to different types of range tops, etc. The performance goals will be used to establish specific test requirements/parameters (e.g., possibly fire size, fire spread, and physical configuration around the range top). In addition to establishing guidelines how the tests will be set up and conducted, the work of this task will frame out how the results of the fire tests will be used to assess candidate cooking fire mitigation technologies. For instance, tests could be set up as pass fail, or different types of cooking scenarios or times of detection could be used to assess different levels of fire mitigation performance. A review of existing and past fire test standards will be conducted and a strawman list of performance goals will be developed for review and input by the Project Technical Panel. Task 1 and 2 will be conducted in parallel, being an iterative process.

As noted in Task 1, candidate fire scenarios must be representative of real fire conditions and have a technical basis for consideration. This basis includes demonstrating the fire is representative of a select group of fire incidents, such as the leading cooking scenario contributing to injuries (based on the fire statistics). Other performance goals for candidate scenarios may include the ability of the fire to spread away from the source to other kitchen structures/items. For example, a pot/pan fire of a certain food that cannot produce flames above the lip of the pot may not be deemed a fire of concern to evaluate a specific fire mitigation technology. However, depending on the final test objectives, the same pot/pan fire may be deemed useful as a challenging scenario for a different technology or to discern different levels of fire mitigation technology performance. The goals will need to reflect the scope of fire mitigation technologies for which the tests will be applicable, and may also reflect differences in the type of range top technology (e.g., gas, electric, induction). For example, fire category 2 and 3 above (Fires due to spill-over onto a burner and Class A materials on or next to a burner/cooking vessel) would not be applicable to induction range tops, which inherently will not cause these types of fires.

- 3) Task 3 Evaluate Candidate Fire Scenarios and Establish Test Conditions: This task will include a systematic experimental evaluation of the candidate cooking fire scenarios. The complete set of variables to be systematically evaluated will be based in part on the results of Tasks 1 and 2. For example, the testing will establish the range of material parameters (i.e., food selection) and operating test conditions (e.g., heating rate of burner) that will adequately meet the test performance goals and provide an accepted level of repeatability. Measured test conditions may include utensil temperature, smoke production, IR signature, flame height, fire heat release rate, etc. Important factors that will be assessed will include whether the candidate scenario meets the performance goals, accuracy of measurements, and repeatability of test conditions (pre-fire signatures, ignition time and fire development). A sensitivity of the measured test conditions to the various test setup and procedure requirements will be conducted.

It is anticipated that a standard cooking vessel (utensil) will be developed as part of this task (possibly several may be used if the cooking scenarios dictate). Having a specifically fabricated

utensil will eliminate many uncertainties associated with establishing criteria for selecting commercially available utensils that will satisfy the test requirements. The fabrication of this utensil will be based on representative criteria of cookware on the market.

- 4) Task 4 Reporting and Dissemination: Interim reports on the progress of each task of the project as well as draft and final reports will be provided. The final report will be made available electronically to the general public through the FPRF website and directly transmitted to the relevant standards development committees of UL, CSA and to the Vision 20/20 initiative on this topic.. A presentation on the project will be made at one national fire safety meeting.

## **References**

- [1] Dinaburg, J. and Gottuk, D.T., "Home Cooking Fire Mitigation: Technology Assessment – Final Report," prepared for The Fire Protection Research Foundation, Quincy, MA, HAI Project #1DTGO 2049.006, October 31, 2011.

## **Schedule**

- Task 1) Select Representative Fire Scenarios – 2 month from initiation.
- Task 2) Task 2 Performance Goals – 2 months from initiation.
- Task 3) Evaluate Candidate Fire Scenarios and Establish Test Conditions – 9 months from initiation.
- Task 4) Reporting and Dissemination – 12 months from initiation – September 2013.