Kitchen Fire Prevention Technologies Workshop Report

November, 2010

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The Institution of Fire Engineers (IFE), US Branch is the founding sponsor of Vision 20/20. DHS/FEMA Assistance to Firefighters Grants (AFG) Prevention and Safety funding supports core activities that are advised by a Steering Committee representative of major national fire prevention organizations and agencies. The Kitchen Fire Prevention Technologies Workshop carried out an action recommended in Strategy 4 of National Strategies for Fire Loss Prevention. A report of those strategies and information about Vision 20/20 is available at www.strategicfire.org.

Kitchen Fire Prevention Technologies Workshop Report

ABSTRACT

The Kitchen Fire Prevention Technologies Workshop took place February 19, 2010 at the Madison Lowes Hotel in Washington DC. The purpose was to explore technological pre-ignition interventions for cooktop[1] kitchen fires. The workshop was organized by the Vision 20/20, Strategy 4 task group. The focus of this task group is to promote technology to enhance fire and life safety.

Individuals with subject-related expertise in areas of research, manufacturing, code enforcement, and those who serve end-users were invited to participate in a one-day facilitated meeting. The invitation to participants identified the following items to be addressed:

1. Current technology for preventing cooktop fires
2. Barriers that impede advances in the application of kitchen fire prevention technology
3. Research needed to overcome the identified barriers

In breakout sessions, three groups of 12 – 13 individuals worked to discuss and report back in joint session their collective opinion as directed above. The complete record of items resulting from each breakout group session is included in this report. A final facilitated plenary session concluded the workshop. As a result of group discussion in that session, the priority for actions needed to advance technological solutions to prevent cooktop fires was determined to be:

1. Analyze existing data to develop and improve understanding of the cooking fire problem as a means to enable a gap analysis for the research needed and provide a focus for future research.
2. Examine the fire prevention capabilities and limitations of currently available cooktop technologies.
3. Research other technologies which may be used in cooktop fire prevention control systems. Such technologies would include timers, motion sensors, thermal sensors, and other technologies as they are brought to the attention of the testing and standards making community.

Emphasis was made in final discussion that "one size does not fit all". There is not a single technological solution to preventing cooktop fires. It was important to this group that we recognize the need for an integrated approach to the problem which would include educating consumers.

[1] This report uses the term "cooktop" to refer to cooking surface units that are part of a range or counter top unit. Terminology was not changed in referenced reports where "range", "stove", and "cook-top" were used.

ACKNOWLEDGEMENTS

We are especially grateful to State Farm Insurance for their support of the Kitchen Fire Prevention Technologies Workshop. Their funding allowed Vision 20/20 to carry out this important project in partnership with the National Institute of Standards and Technology (NIST).

Many volunteers lent their skills to this project. We are also grateful for their service which allowed us to meet objectives within our schedule and budget.

Workshop Facilitator

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INTRODUCTION

Vision 20/20 is an initiative supported by funding from the U.S. Department of Homeland Security Assistance to Fire Fighters Fire Prevention and Safety Grant program to the Institution of Fire Engineers (IFE), US Branch. IFE established a steering committee for Vision 20/20 comprised of noted fire service and related agency leaders to guide a national strategic planning process for fire loss prevention that results in a national plan that will coordinate activities and fire prevention efforts. A national forum held in Washington D.C. in April of 2006, determined actions within the five broad strategies listed below for collaborative, national attention. They are documented in the Vision 20/20 National Strategies for Fire Loss Prevention Final Report [1][2].

Strategy 1: Increase advocacy for fire prevention.

Strategy 2: Conduct a national fire safety education/social marketing campaign.

Strategy 3: Raise the importance of fire prevention within the fire service.

Strategy 4: Promote technology to enhance fire and life safety.

Strategy 5: Refine and improve the application of codes and standards that enhance public and fire fighter safety and preserve community assets.

Following the national forum and examination of the fire data, the Strategy 4 task group determined their initial activity would be a technology based effort to prevent cooktop cooking fires. This workshop is Vision 20/20's initial step in this area.

The Problem

Cooking is the leading cause of home fires according to the National Fire Protection Association (NFPA). During the period of 2003 through 2006, U.S. fire departments responded to an estimated average of 150,200 home structure fires involving cooking equipment. These cooking equipment fires resulted in an annual average of 500 civilian fatalities, 4,660 civilian injuries and $756 million in direct property damage. Approximately 60% of these fires involved ranges. 88% of the civilian deaths and 77% of the civilian injuries are related to cooking fires involving the range. Unattended cooking is the leading cause of these fires [2].

[2] Bracketed numbers correspond to reports listed in the reference section.

Previous Research

There are many potential approaches to reducing the problem of cooking fires including consumer education, improved detection, thermostatic safety controls on cooking equipment, and suppression systems. There have been several federal research efforts to address the feasibility of some of these solutions.

The Consumer Product Safety Commission (CPSC) working with the National Institute of Standards and Technology (NIST) previously studied various parameters of the cooking environment prior to ignition in order to identify a technology that may be used to detect these unique conditions and control the heat output to prevent fires [3 -7].

These studies demonstrated that the pan temperature is a potential indicator of pre-ignition conditions. The CPSC continues to consider technologies that improve on experimental temperature detection and control systems.

There are currently more than 124 million housing units in the United States, including single and multiple family homes [8]. The average life expectancy of a range is 16 to 18 years [9]. Based on these numbers, it is important to examine retrofit systems that are currently available for consumer use. One possible type of retrofit system is an automatic range-top fire suppression system. The Air Force conducted a study in 1987 to evaluate the performance of range-top fire extinguishing systems [10]. The study examined eight systems in order to outline a draft performance specification for use in Air Force housing and to assess available technologies. The study was not intended to replicate Underwriter's Laboratories (UL) testing but to recreate actual reported, unattended range-top fires in a realistic manner.

The study resulted in recommendations regarding the specifications of the systems that would be installed in Air Force housing.

Part of the work sponsored by the CPSC addressed fire suppression systems for ranges [11]. This study identified four types of fire suppression technologies that can detect and extinguish fires on range-tops. No evaluations of the feasibility of specific systems were performed.

The United States Fire Administration (USFA) in conjunction with CPSC has examined computer controlled cooking technologies [12]. In addition, USFA recently collaborated with the National Fire Protection Association (NFPA) to research the types of behaviors and sequences of events that lead to cooking fires and developed recommendations for behavioral mitigation strategies to reduce such fires and their resultant injuries and deaths [13].

In April 2006, The Workshop on Residential Kitchen Fire Suppression Research Needs was held at NIST [14]. The workshop provided a forum to discuss test methods, technologies, and research and development that can significantly improve residential fire protection, with emphasis on residential kitchen applications. The workshop program included representatives from standards, codes, testing, and research organizations, the fire protection industry, the fire service, the range industry, and federal government agencies. The workshop explored: recent developments in suppression system technologies, characterization of the performance of residential kitchen fire suppression systems, and barriers that impede the implementation of the systems.

Based on the results of the workshop, NIST began a series of experiments to examine the capabilities and limitations of currently available technologies used in localized suppression systems for cooktop cooking fires. More than 40 experiments have been conducted. Technologies used in the study include: automatic wet chemical, automatic dry chemical, high pressure water mist, and a residential automatic sprinkler. This research project is scheduled for completion in 2010.

In 1996-97, AHAM and NASFM conducted a 10-city study of the behaviors surrounding cooking fires and the demographics of the people involved [18]. Among the conclusions of that study were the following:

- The range top was involved in nearly 8 of 10 (79%) of the cooking fires studied.
- In nearly ¾ of the fires reported (73%) the person responsible for the fire was not in the area when the fire started.
- Among the major factors contributing to the cooking fires were unattended cooking, grease, food left on the range, and combustible materials on the range top.

- In nearly 2/3 of the fires reported (64%) people in the residence did not attempt to fight the fire and left the area.
- Of the responses on how people attempted to fight the fire, nearly half used improper methods.
- A larger percentage of cooking fires was caused by individuals in the age range of 19-69 than their representation in the population would predict.
- Women were involved in 58% of the cooking fires.
- Consistent with other studies of inner-city and disadvantaged populations, a disproportionately high number of cooking fires seem to have occurred in minority households.

In addition, the range manufacturers have contributed to several of these research projects and conducted additional research into technologies to reduce the number and severity of unattended cooking fires. Specifically, the range manufacturers conducted studies in Europe in 2008-2009 on computer temperature controlled systems on smooth top and induction ranges.

Workshop Objectives

Given previous research that focused on cooking fire suppression, the next step was determined to be identification of interventions that have the best potential for preventing kitchen fires. The objective for this workshop was consistent with actions recommended in National Strategies for Fire Loss Prevention. Strategy four in that report is to promote technology to enhance fire and life safety.

The invitation to participants identified the following items to be addressed during the workshop:

1) Current technology for preventing cooktop fires
2) Barriers that impede advances in the application of kitchen fire prevention technology
3) Research needed to overcome the identified barriers

WORKSHOP PROCESS AND PROCEEDINGS

A total of 39 individuals with subject-related expertise in areas of research, manufacturing, and code enforcement, and those who serve end-users participated in the one-day workshop. Mr. Allan Freedman, Executive Director of SFPE, served as facilitator of the workshop. Procedures and guidelines for achieving the workshop objective were developed collaboratively with Mr. Freedman, the National Institutes of Standards and Technology (NIST), and Vision 20/20 leadership. The focus for this one-day workshop was limited in order to achieve the desired outcome of identifying pre-ignition intervention technologies and research needs for broad implementation. Recognizing that valuable ideas would emerge during discussion related to other interventions, such as consumer education, the ideas not specific to our focus on technologies were recorded but not discussed in group sessions. Those ideas are included in the notes from breakout session appendix of this report. They will be shared with Vision 20/20 task groups working to support other strategies, not specific to technology, for fire loss prevention. The invitation to the workshop and workshop agenda are in Appendix I. The list of workshop participants is in Appendix II. Prior to the workshop, participates were given access to a number of reports which document the kitchen fire problem, previous research efforts, and international approaches to cooking fire prevention. The list of reports is in Appendix III.

Introductions and opening remarks were made in the morning session followed by two presentations which provided participants with an overview of the research conducted to develop systems and sensors intended to prevent range top fires. The complete presentations are provided in Appendix IV and V and are summarized below.

SUMMARIES OF PRESENTATIONS

UL Presentation

Mr. David Dini, a research engineer with Underwriters Laboratories, Inc. presented an overview of the activities of the UL 858 Electric Ranges Standards Technical Panel (STP) from 2000 through 2005. The starting point for the STP came from CPSC research which concluded that

thermocouples (temperature sensors) in contact with the bottom of cooking vessel provided the most consistent and reliable method for detecting pre-fire conditions. The STP began to develop an overall plan to address: potential test standards, new technology, research into the ignition and burning characteristics of cooking oils and consumer education. In 2001, the STP formed a Cooktop Fire Working Group. The group's objective was the development of Technical Feasibility Performance Goals (TFPGs)[3]. The focus of the group's effort was on devices that could be incorporated into a cooktop surface element/burner to measure the temperature of the cooking vessel. Practical tests were developed to examine the capability of the sensors to work with different types of pans, different food mixtures in the pans, and the effect of washing and wear and tear on the sensors. Cooking experiments were also conducted with pan temperature sensors on electric and gas burners. The findings of the research indicated that it would be premature to include requirements for a contact temperature sensor in UL 858 due the sensors inability to meet the TFPGs during the testing.

UL sponsored additional research at the University of Illinois to examine the use of infrared (non-contact) temperature sensors to measure the temperature of the pan from underneath the glass surface of the cooktop. The sensing technique showed promise, since it would be protected by the glass and not be affected by detergents, abrasion, or food residue as the exposed contact temperature was.

There has been no further research activity of the STP since 2005; however, UL maintains the STP process to address proposals that may be submitted on UL 858. Mr. Dini ended his presentation by explaining the STP process.

AHAM Presentation

Mr Wayne Morris, representing the Association of Home Appliance Manufacturers, presented "Cooking Safety: how can we improve?" Mr. Morris presented an overview of issues behind the cooking fire problem which include unattended cooking and other human factors such as impairment due to drugs or alcohol. Analyses of the unattended cooking fire incident data by

[3] TFPGs are the technical criteria that potential technology would be judged against.

CPSC, NASFM/AHAM and NFPA demonstrate trends that involve socio-economic issues. Data was presented to show that the United States leads other countries in the number of cooking fires per million people in the population. Mr. Morris also pointed out that there are more than 150 million ranges installed in the United States which are involved in approximately 31,000 unconfined range fires each year.

An overview of the technical research conducted on cooking safety in the United States and Europe since 1994 was presented. Although many technologies have been explored, the studies showed that the technologies did not assure fire prevention and many conflicted with consumer cooking activities. The UL TFPG were listed in the presentation. Mr. Morris also presented information on the range manufacturer's research in 2008-2009 on pan temperature control devices for smooth-top and induction ranges. Mr. Morris echoed the UL findings; the pan control temperature sensors are not yet acceptable in "real-world" situations.

The presentation concluded with suggestion in two areas: consumer education, and future research. AHAM has and continues to support consumer education. Mr. Morris encouraged the other organizations present to collaborate with AHAM in this important area. As for future research, it was suggested that any new system concept must meet the TFPGs and that consideration be given to safety solutions that are not part of the range.

BREAKOUT SESSIONS

Allan Freedman, workshop facilitator, reviewed the remainder of the day's agenda, operating procedures, and objectives for two breakout sessions (Breakout Instructions – Appendix C). Participants were assigned to one of three groups to achieve balance in each with representation from all disciplines: manufacturing, research, code enforcement, and end-users. A room facilitator and scribe were assigned to each group to facilitate discussion and note taking. This ensured that objectives for discussion and reporting back could be accomplished within parameters of the workshop. The objective for session one was to generate ideas and discussion on these key elements:

1. Current technologies for preventing cooktop fires -- Participants were asked to identify technologies, both existing and future, that could be employed to prevent cooktop fires.
2. Barriers that impede advances in the application of kitchen fire prevention technology -- Participants were asked to identify barriers, any and all, that impede advances to developing these applications.

After brainstorming, each group collated, restated and organized ideas to delete repetition. A volunteer reported major points of their discussion to the larger group during the lunch session.

Following the lunch session, groups reconvened in breakout session to address key technologies and barriers that may impede further development that were identified in the earlier breakout group reports. Participants were instructed to:

1. Brainstorm possible research projects that could be conducted to provide insight for practical technologies to help prevent cooktop fires.
2. Collate and restate to organize and delete repetition of items for reporting to the larger group.
3. Work collaboratively to assign each potential research project with a letter grade ranging from A to E, A being urgent priority, E being probably unnecessary or of very limited value.
4. Identify a volunteer to make the group report.

Following these reports, Allan Freedman led discussion to prioritize and harmonize recommendations for research that is needed to overcome barriers that impede advances in the application of kitchen fire prevention technologies. Summaries of each group's reports are presented in the following section.

GROUP REPORTS

Session I

Goals:

- Identify any current and possible future technologies that could be employed to prevent cooktop fires.
- Identify any and all barriers that impede advances in developing these applications.

Group A Report on Technologies:

Kitchen fire prevention technologies generally fell into two main identifiable categories, 1) design technologies, and 2) fire protection technologies.

Design technologies would refer to the actual range apparatus, and design aspects that could prevent fires, reduce the likelihood of fires, and deter fire growth and severity. Design technologies ranged from simple modifications to existing kitchens, such as installing smoke detectors in a hood, to more complex design changes, such as designing cook areas with metal side shields in order to compartmentalize a possible fire, or designing special ranges that govern the amount of heat output or shut off after detecting excess heat.

Fire protection technologies could be further divided into 1) detection technologies, and 2) suppression technologies. Detection technologies included camera/computer visual systems, such as flame detectors and infrared detectors, as well as other solutions such as residual heat detectors or the creation of new technology that could detect a lack of mass on a given burner. Suppression technologies would include the installation of a proper suppression system, the use of fire blankets or other fire containment systems, or designing better, more effective suppression systems designed specifically for cooktop fires.

Group A Report on Barriers:

Unfortunately, it seemed as though for every possible solution there was also a potential barrier to overcome. The most frequently recurring conclusion appeared to be that there is no "silver bullet" solution to the problem of kitchen fires. The following are potential overarching barriers that were identified:

- Different kitchen configurations
- Public expectation
- Cost to the consumer (retrofitting, maintenance, clean-up, etc.) and other human factors
- The system's life span
- Testing and publishing of data
- Code and standard creation/compliance
- Related liability and indemnification issues
- Political and cost barriers of implementation of any large-scale changes
- Identifying a party to ensure accountability for the entire process
- Changes to cooking behaviors

- Other consumer products used with cooktops, e.g. pans

Group A said, simply put, there is no "cookie cutter" solution, just as there is no "cookie cutter" fire.

Group B Report on Technologies:

Group B initially focused on how sensor-based technology could be used in ignition prevention strategies, such as:

- Infrared sensors in range or hood to measure pan or food temperature
- Pre-ignition detection through sensors that recognize smoke and/or pyrolysis signatures
- Sensors integrated in pots and pans which could communicate information such as pan size, type, and temperature to cooktop controls

Other topics discussed included technologies that would make the entire range "smarter" by designing new, better ranges with different types of controls, timers, and cooking elements with a lower propensity for starting fires.

Group B also discussed various methods of improving fire mitigation by designing ranges and the surrounding kitchen area from a fire protection standpoint. This could be accomplished by installing cooking hoods to capture heat and smoke, and integrating detection and suppression technology, or by designing other types of heating elements with built-in self-monitoring temperature controls. Other ideas included moving the range location to prevent fire spread to cabinetry, etc., and chemically engineering cooking oils which are less prone to ignition.

Group B Report on Barriers:
Maintenance of new ranges was discussed as a main barrier, and how failure to maintain or clean ranges and exposed sensors would severely decrease the performance of a system.

Additionally, Group B cited cost as another major barrier. Consumer costs, retrofitting costs, research costs, and public education costs could all impede any potential progress.

Group C Report on Technologies:

Group C first identified the need for more data to be collected and analyzed in order to be better educated on the issue of cooktop fires. This included identification of the correlation between the frequency and severity of fire incidents and the types of cooktops, as well as other contributing factors involved in the fires. More data would allow for more specific identification of issues in cooktop fire incidents, which would allow more specific, technology-driven solutions to be identified.

Group C also came to the conclusion that there does not necessarily have to be one solution. Rather, due to the diversity of kitchens, and fires, no one solution is the answer to a widespread problem. Additionally, multiple solutions could be combined and employed to make a system more effective. Many technologies were identified by Group C, including:

- A “push button” selection of the cooking type (food and method) with preset temperature limits, similar to that of a microwave.
- Motion sensors that would trigger an alarm if the cook was absent for too long, and would shut down the range if the cook did not return.
- Infrared or video scanning of range from above with ability to sense a problem and alarm or shut down.
- Digital feedback about active burners, temperature, alerts, warnings, etc.
- Temperature detectors that could shut down a range if they detect excess heat.

Finally, Group C stressed the importance of retrofitting old ranges as a priority in addition to changing the standard on all new ranges if any significant impact is going to be made in the near future.

Group C Report on Barriers:

The first and most difficult barrier to overcome would be reconciling the cost of new, expensive technology with low cost ranges. Open coil electric cooktops are the most prevalent in the U.S. market as they are the simplest technology and are available to consumers at lower cost. The challenge, then, is creating a solution that integrates new technology while maintaining an affordable unit.

Another barrier could possibly be the consistency and/or general effectiveness of solutions such as motion detectors, which could be hindered by smoke, grease, or other debris.

Furthermore, user compliance could also be a potentially severe barrier in the operation of fire protection, that is to say that users may view alarms or warning as annoyances, and find ways to work around or disable them.

Session II

Goals:

- Brainstorm possible research projects to be conducted that could provide insight for practical technologies to help prevent cooktop fires.

- Working collaboratively, assign each of the research projects a letter grade according to the following categorization:
  A = Urgent Priority
  B = Important
  C = Fair Value
  D = Limited Value
  E = Probably Unnecessary or Very Limited Value

Group A Report on Research Projects:

Group A reviewed the potential research project identified in their brainstorming session. They identified the following three, all in the category (A) of "Urgent Priority":

- Data
  - Integrate fire and lab data
  - Remove ambiguity of data
  - Collect field data – users and technology
- Define problem that the technology need to solve
  - Better characterize ignition source –different types of electric elements
  - What are the needs of customers?
  - Cost vs. benefit
  - Nature of fire – what happens after ignition?
  - Target specific components
  - Identify target
- Performance of existing systems
  - Understand the performance of types of technologies for motion detection.
  - Auto shut off
  - Temperature limiters

Group B Report on Research Projects:

In session II, Group B brainstormed a variety of projects that could provide needed insight for advancing technologies. They are identified here according to priority. Those determined to be of "Urgent Priority" are:

- Review current data, including literature review and recap of all work previously done.
  i) Conduct surveys of the general public and/or consumers that have reported kitchen fires. Range characteristics (type, age)
  ii) Cooking habits (how often, what sort of oils, etc.)
  iii) Consumer characteristics
  iv) Any previous fires and/or injuries
  v) Was the range being used for cooking or as a supplemental heating source?
  vi) What was the first item ignited?

  Research projects determined to be of important value were:
- Peer review of current technologies -- Define test methods, test proposed technologies, and validate tests.
- Alternative solutions.
  i) Chemically engineered oils
  ii) Building codes
  iii) Pans
  iv) Fire extinguishing

Research projects that were determined to be of "Fair Value" were:

- Intelligent ranges
- Study induction cooktop controls for inherent fire-prevention benefits.

Group C Report on Research Projects:

Group C brainstormed research projects that could provide insight to practical technologies. They then prioritized those projects. Those they determined to be of "Urgent Priority" were:

- Gather more data on incident rates for gas, coil, and smooth top ranges.
- User interface options – Use experts in industrial human factors engineering to generate optimal controls/readouts.
- Sensor technology – generate potential list including foreign and other industry examples and evaluate them for reliability, effectiveness, practicality, and cost.
- Research retrofit options.

The one project deemed "Important" was:

- Generate data matrix and determine what data gaps exist to support decision making about required new research.
  i) Obtain more detailed reports from fire investigators
  ii) Conduct special fire investigations of sample incidents
  iii) Gather demographic info (where, who, socioeconomic status, cooking type, etc.)

The project they determined to be of "Fair Value" was:

- Customer acceptance factors

Workshop Session III

Focus of the final facilitated session was to distill primary recommendations from the workshop into actionable items. After a vigorous discussion, the workshop group condensed the day's efforts into three recommendations on the need for research to overcome technological barriers to improved cooktop fire safety. The prioritized list of recommendations is given below:

1. Analyze existing data to develop an improved understanding of the cooking fire problem as a means to enable a gap analysis for the research needed and provide a focus for future research.

2. Examine the fire prevention capabilities and limitations of currently available range top cooking technologies.

3. Research other technologies which may be used in cooktop fire prevention control systems. Such technologies would include timers, motion sensors, thermal sensors, and other potential technologies as they are brought to the attention of the testing and standards making community.

During the final discussion, it was emphasized that "one size does not fit all". There is not a single technological solution to preventing cooktop fires. It was important to the workshop group that this report recognizes the need for an integrated approach to the cooking fire problem which would include educating consumers on safe cooking practices. The Vision 20/20 Strategy 2 group will follow-up on educational aspects of kitchen fire safety with the continued support from State Farm Insurance.

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APPENDIX I -- Invitation and Agenda

Founding Sponsor
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Vision 20/20

National Strategies for Fire Loss Prevention

December 29, 2009

Dear Fire Prevention Colleague:

Vision 20/20 invites you to participate in a workshop to explore technological pre-ignition interventions for cook-top kitchen fires. The workshop will take place February 19, 2010 in Washington DC.

Kitchen fires are the number one cause of residential fires in the United States. According to the NFPA, during 2003 through 2006, "U.S. fire departments responded to an estimated average of 150,200 home structure fires involving cooking equipment per year. These fires caused an annual average of 500 civilian deaths, 4,660 civilian injuries, and $756 million in direct property damage. Ranges, with or without ovens, account for the majority (59%) of total reported home structure fires involving cooking equipment and even larger shares of associated civilian deaths (88%) and civilian injuries (77%). Unattended equipment is the leading cause of cooking fires [1]." The NPFA study also reports that the estimated direct property damage from unreported cooking fires is estimated at $328 million per year. Therefore the estimated direct property damage from cooking fires exceeds one-billion dollars annually [1].

This workshop will provide a forum for representatives with specific expertise in fire technologies, cooking equipment manufacturing, research, and code enforcement to collaboratively address:

1) Current technology for preventing cook top fires.
2) Barriers that impede advances in the application of kitchen fire prevention technology.
3) Research needed to overcome the identified barriers.

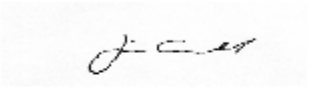
Twenty-five to fifty individuals will participate in a full-day session facilitated by Allan Freedman, Executive Director of SFPE.

To make the most efficient use of this opportunity, materials will be sent or made available for download for your review prior to the workshop. These materials include: Residential Kitchen Fire Suppression Research Needs: Workshop Proceedings (NIST Special Publication 1066), The Residential Fire Problem: A Statistical Look at Kitchen Fires from NFPA, and an Overview of Technologies in Use in Other Countries from TriData. You are asked to share additional documentation that you feel is pertinent to our deliberations for consideration.

Please confirm your intentions to participate with us by January 15, 2010 by returning the form that accompanies this letter. After notification, materials will be sent to you along with instructions for registration and travel.

This Vision 20/20 workshop is supported with funding from State Farm Insurance and in partnership with the National Institute of Standards and Technology (NIST). Vision 20/20 provides a collaborative process for achieving actions that are targeted toward bridging gaps in our Nation's fire prevention efforts. The Institution of Fire Engineers (IFE), US Branch is the founding sponsor. DHS/FEMA Assistance to Firefighters Grants (AFG) Prevention and Safety funding supports core activities that are advised by a Steering Committee representative of major national fire prevention organizations and agencies. This project carries out an action recommended in Strategy 4 of National Strategies for Fire Loss Prevention. A report of those strategies and information about Vision 20/20 is available at www.strategicfire.org.

Sincerely,



Jim Crawford

1. Ahrens, M., Home Fires Involving Cooking Equipment, National Fire Protection Association, November 2009.

Kitchen Fire Prevention Technologies Workshop Agenda

February 19, 2010 – Madison Loews Hotel – Washington D.C.

8:00 AM	**Sign-in and Coffee - Montpelier Ballroom Foyer**	
8:30	**Welcome** Dan Madrzykowski, NIST Jim Crawford, Project Manager, Vision 20/20 Jack Jordan, Research Administrator, Strategic Resources Technology Division, State Farm	
8:45	**Opening Remarks and Introductions** Allan Freedman, Executive Director, SFPE	
9:15	**Overview of STP 858** David Dini, Research Engineer, Underwriters Laboratories, Inc.	
9:45	**Overview of Appliance Manufacturers Technologies, Practices, and Research** Wayne Morris, Vice President, Division Services, AHAM	
10:15	**Break**	
10:30	**Charge for Breakout** **Breakout Session – Part 1** What is needed to reduce losses from kitchen fires?	Breakout A – Alexander Hamilton A Breakout B – John Adams A Breakout C – John Adams B
Noon	**Lunch Served in Dolly Madison Ballroom Foyer – Return to Montpelier Room**	
12:30 PM	**First Breakout Session Reports**	
1:30	**Breakout Session – Part 2**	
2:50	**Break**	

3:00	**Group Reports**
3:30	**Prioritization and Harmonization**
4:30	**Adjourn**

APPENDIX II

Workshop Participants

Scott Adams
Assistant Fire Chief/District fire Marshal
Park City Fire Service District

Marty Ahrens
Manager, Fire Analysis Services
NFPA

Meri-K Appy
President
Home Safety Council

Robert Backstrom
Sr. Staff Engineer
Underwriters Laboratories, Inc.

Larry Bell
Product Safety Manager
BHS Home Appliance

Patrick Boyer
Superintendent
State Farm Insurance

Nelson Bryner
Deputy Chief, Fire Research Division
Building and Fire Research Laboratory
NIST

Kevin Callahan
CEO
Pioneering Technology Corporation

Debra Carlin
Assistant Chief/Fire Marshal
Dallas Fire Rescue Department

Peg Carson
Education Specialist
Carson Associates, Inc.

Jim Crawford
Fire Marshal
Vancouver Fire Department

Earl Diment
Chief Safety Officer
Pioneering Technology Corporation

David A. Dini
Research Engineer
Underwriters Laboratories, Inc.

Sandra Facinoli
Prevention & Information/National Fire Programs
US Fire Administration
FEMA/Department of Homeland Security

Ron Farr
State Fire Marshal
Michigan Bureau of Fire Services

Allan Freedman
Executive Director
Society of Fire Protection Engineers

Randall Fuller
Manager, Product Safety
Electrolux Major Appliances, North America

Mike Gerdes
BSH Home Appliances Corporation
Design Engineering Manager, Gas Products

Don Grob
Senior Manager
Global Product Safety
Whirlpool Corporation

John R. Hall, Jr.
Division Director, Fire Analysis and Research
NFPA

Anthony Hamins
Chief, Fire Research Division
National Institute of Standards and Technology

Billy Hayes
Director of Public Information/Community Affairs
DC Fire and EMS

Erik (Rik) Johnsson
Mechanical Engineer
Fire Research Division
National Institute of Standards and Technology

Jack Jordan
Research Administrator
Strategic Resources Technology Division
State Farm Insurance

Bill Kehoe
Membership Chair
Institution of Fire Engineers, US Branch

David Kerr
Assistant Chief/Fire Marshal
Plano Fire Rescue

David Kinny
Safety Program Manager, Cooking Products
General Electric

David P. Klein, P.E.
Fire Protection Engineer
Department of Veterans Affairs

Daniel Madrzykowski
NIST/BFRL

Shivani Mehta
Fire Protection Engineer
Consumer Product Safety Commission

Angela Mickalide, Ph.D., CHES
Director of Education and Outreach
Home Safety Council

George Morgan
Regional Deputy Fire Chief
U.S. Navy

Wayne Morris
Vice President, Division Services
AHAM

Cathie Patterson
Section Chief, Assistance to Firefighters Grant
Federal Emergency Management Agency (FEMA)

Steve Polinski
Senior Manager Regulatory Affairs
Miele Inc.

Andrew Trotta
Division Director, Directorate for Engineering Sciences
U.S. Consumer Product Safety Commission

Cyral (Marty) Walsh
Product Safety
BSH Home Appliances Corporation

Michael Wilson
Research Administrator, Building Technology
Research, Strategic Resources – Research Laboratory
State Farm Insurance Companies

James Winston
Quality Control
Youngstown Metropolitan Housing Authority

APPENDIX III

Documents Provided for Study, prior to the Workshop

The following were made available for prior review:

1. *Home Fires Involving Cooking Equipment*, NFPA, Marty Ahrens, November 2009
2. *Residential Kitchen Fire Suppression Research Needs: Workshop Proceedings*, NIST SP 1066, February, 2007.
3. *(UL) Standards Technical Panel Report: STP858,* Underwriters Laboratories, July 27, 2000
4. *Study of Technology for Detecting Pre-Ignition conditions of cooking-Related Fires Associated With Electric and Gas Ranges and Cooktops*, NIST IR 5904, October 1996
5. *Technical, Practical and Manufacturing Feasibility of Technologies to Address Surface Cooking Fires*, CPSC, May, 2001
6. *An Evaluation of Sensor and Control Technologies to Address Cooking Fires on Glass Ceramic Cooktops*, CPSC February, 2002

In addition, three reports from System Planning Corporation, Fire, EMS and emergency Preparedness Publications, International Studies were made available for prior review of promising practices from recorded experience in other countries.

Global Concepts In Residential Fire Safety

7. *Part 1 – Best Practices from England, Scotland, Sweden, and Norway, October, 2007*
8. *Part 2 – Best Practices from Australia, New Zealand, and Japan, August, 2008*
9. *Part 3 – Best Practices from Canada, Puerto Rico, Mexico, and Dominican Republic, July, 2009*

APPENDIX IV Presentation Slides by David Dini, UL

the standard in safety

Vision 20/20

National Strategies for Fire Loss Prevention

Kitchen Fires Workshop

February 19, 2010
Washington D.C.

Dave Dini
Underwriters Laboratories

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Cooking Remains Leading Cause of Home Fires

From 1999 NFPA Data –

- **96,200 home fires attributed to cooking equipment**
- **resulting in 331 deaths**
- **over 4,000 injuries,**
- **over $500 million in property damage**

"Cooking fires remain one of the toughest problems we face."

John R. Hall Ph.D.
NFPA's Fire Analysis and Research Division

Cooking Remains Leading Cause of Home Fires

COOKING

Cooking fires are the #1 cause of home fires and home fire injuries. More than half (55%) of home cooking fires started with the ignition of food or other cooking materials.

Facts & figures

- During 2003-2006, U.S. fire departments responded to an average of 6,600 home structure fires per year in which a microwave oven was involved in ignition. These fires caused an annual average of three civilian deaths, 110 civilian injuries and $22 million in direct property damage.
- Cooking equipment fires are the leading cause of home structure fires and associated civilian injuries. These fires accounted for 40% of all reported home structure fires and 36% of home civilian injuries.
- Twelve percent of the fires occurred when something that could catch fire was too close to the equipment.
- Three-fifths (57%) of reported home cooking fire injuries occurred when victims tried to fight the fire themselves.
- Thanksgiving is the peak day for home cooking fires.

Source: "Home Fires Involving Cooking Equipment," by Marty Ahrens, November 2009.

Also see: Fact sheet on home fires involving cooking equipment (PDF, 76 KB)

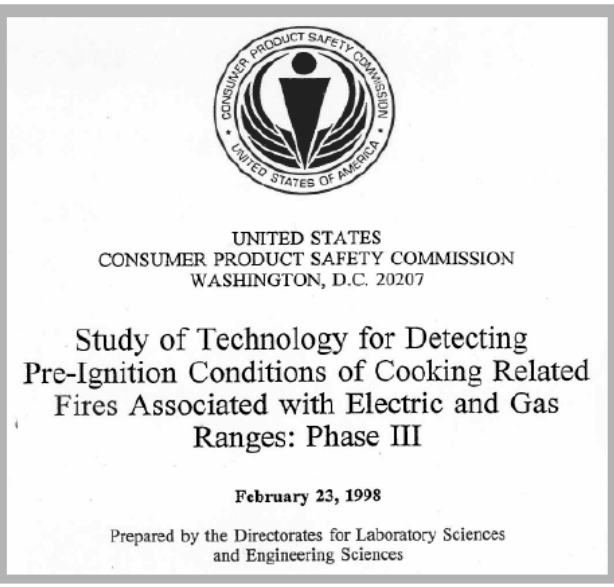
NFPA SAFETY TIPS

- Be on alert! If you are sleepy or have consumed alcohol don't use the stove or stovetop.
- Stay in the kitchen while you are frying, grilling, or broiling food. If you leave the kitchen for even a short period of time, turn off the stove.
- If you are simmering, baking, roasting, or boiling food, check it regularly, remain in the home while food is cooking, and use a timer to remind you that you are cooking.
- See all safety tips

AUDIO
Lorraine Carli, NFPA Vice President of Communications, talks about cooking safety:

- Simple ways to prevent cooking fires
- Clothes and cooking fires
- When do most cooking fires occur?
- Why you should avoid fighting a cooking fire
- The leading cause of cooking fires

CPSC Study of Cooking Related Fires



UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, D.C. 20207

Study of Technology for Detecting Pre-Ignition Conditions of Cooking Related Fires Associated with Electric and Gas Ranges: Phase III

February 23, 1998

Prepared by the Directorates for Laboratory Sciences and Engineering Sciences

CPSC Study of Cooking Related Fires

CPSC Study of Technology for Detecting Pre-Ignition Conditions of Cooking Related Fires Associated with Electric and Gas Ranges

Conclusion (one of several)

- **Pan bottom thermocouples provide the most consistent and reliable method for detecting pre-fire conditions.**

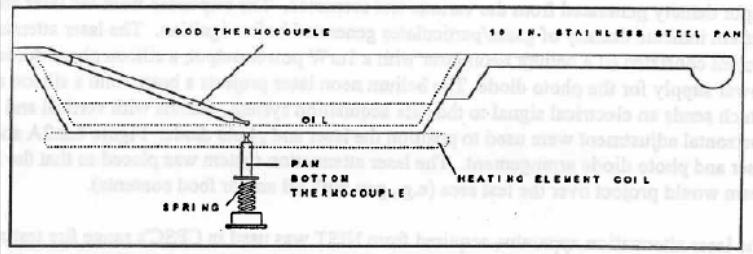


Figure 8.2.1B: Pan content and pan bottom thermocouple locations for the electric range

UL858 Standards Technical Panel

June 2000

UL858 Electric Ranges Standards Technical Panel Meeting.

- ***Presentations by CPSC, AHAM, and UL***
- ***Over 45 members and guests in attendance***

UL research suggests that the risk of electric range top fires might be mitigated if a worst case test were proposed. Ultimate results might require that the oil temperature not exceed 350C before thermal equilibrium is reached and/or no ignition of the oil.

UL858 Standards Technical Panel

Comments –
(Several were presented by STP members in response to UL's proposal)

- **Some new technology may be needed to adequately address the fire issue.**
- **More research needed into the fire characteristics of different cooking oils.**
- **An overall plan may be needed to address the issue, not just a test (e.g. - consumer education).**

UL858 Standards Technical Panel

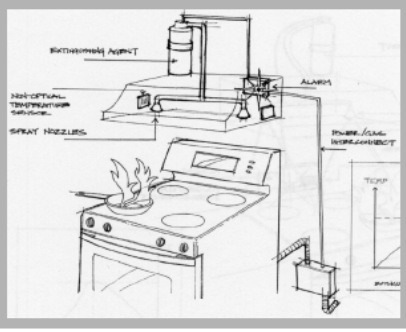
The UL858 STP meets again in May 2001

- **The general consensus of the STP was that it was premature to develop proposed new requirements for UL 858 to specifically address the cooktop fire hazard.**
- **However, the STP did request that efforts continue toward the development of test protocols and common acceptance criteria for future devices intended to mitigate range fires.**
- **As a result, a Cooktop Fire Working Group was formed.**
- **One deliverable from that group was the development of test protocols and common acceptance criteria for a cooktop fires test, thereafter referred to as the Technical Feasibility Performance Goals.**

Technical Feasibility Performance Goals

The Feasibility Goals focus on devices that could be incorporated into a cooktop surface element/burner and that would interface with a cooking vessel (pan) to sense the over temperature condition. Other devices/appliances may additionally be developed that could also accomplish a reduction in cooktop fires. Examples of these devices include, but are not limited to:

- **Fire Suppressions Devices**
- **Timers, Gas/Vapor Sensors**
- **Visual Fire Sensors**
- **and Others**



Technical Feasibility Performance Goals

TEST COOKWARE:

One of the important characteristics of a contact sensing device is its ability to sense different types of cookware, both new and used. Cooking performance and reliability tests to be conducted with new and used cookware of different types, sizes, and materials.

Technical Feasibility Performance Goals

FOOD MIXTURE(S):

It is recognized that food material burned onto the bottom surface of a pan may interfere with the temperature sensing ability of a contact device. The food material to be used as a "Standard" burned on mixture representing reasonable use.

Technical Feasibility Performance Goals

DETERGENT MIXTURE:

Any pan contact device that may be exposed to the cooking surface needs to be evaluated to show that routine cleaning will not interfere with the operation of the device.

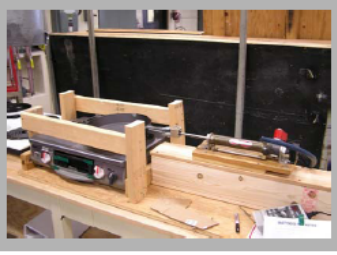
Sodium carbonate 40%
Sodium tripolyphospate 25%
Sodium sulfate 15%
Water 10%
Sodium silicate solids 8%
Nonionic surfactant (low-foaming alcohol alkoxylate) 1%
Sodium dichloroisocyanurate

Technical Feasibility Performance Goals

ENDURANCE:

Removable control components shall be removed and reinstalled 2,000 times without need for re-calibration. The performance of the device shall not change after 15,000 cycles of cleaning.

The pan is to be drawn across the burner with a horizontal motion of 4-6 inches a minimum of 50,000 times.



Technical Feasibility Performance Goals

COOKING TESTS:

Any components used to control pan temperatures must also not interfere with cooking activities, must operate in polluted environments, and must be able to be cleaned by ordinary persons using common tools, if necessary.

Blackening meat/fish

Stir-Frying

Technical Feasibility Performance Goals

COOKING TESTS:

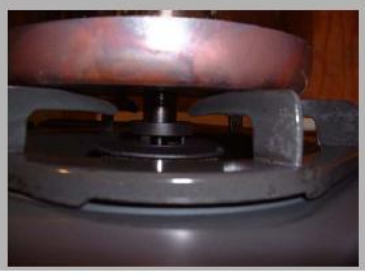
Heat recovery with fries

Simmering sauce

UL Sponsored Research

UL REPORT OF RESEARCH ON COOKING FIRES AND PAN CONTACT TEMPERATURE SENSOR TECHNOLOGY
August 11, 2003

A thermocouple-based control system to limit pot temperature to a threshold temperature below pre-ignition appeared to be the most promising technology investigated.



UL Sponsored Research

UL REPORT OF RESEARCH ON COOKING FIRES AND PAN CONTACT TEMPERATURE SENSOR TECHNOLOGY
August 11, 2003

UL Sponsored Research

Table 1 – Results of tests with gas cooktop without the sensor.

Test #	Skillet/Pot	Volume Oil (mL)	Time to Ignition (min:sec)	Fire (Y/N)	Max/Ignition Temperature (°C)
R-1	CC-2	100	2:40	Y	310
R-10	CC-6	100	1:35	Y	247
R-9	CC-9	100	4:37	Y	338
R-8	AL-8	100	3:37	Y	338
R-6	AL-10	100	3:12	Y	327
R-7	AL-12	100	3:47	Y	324
R-2	AL-G	100	4:18	Y	278
R-3	CS-12	100	5:37	Y	356
R-4	CI-11.5	100	7:30	Y	319
R-17	CC-2	200	4:26	Y	361
R-14	CC-6	200	3:26	Y	348
R-18	CC-9	200	5:36	Y	344
R-19	AL-8	200	5:12	Y	343
R-21	AL-12	200	4:50	Y	330
R-22	AL-G	200	5:51	Y	291
R-16	CS-12	200	6:20	Y	354
R-15	CI-11.5	200	8:21	Y	325
R-23	AL-8	50*	N/A	N	N/A
R-24	CC-7	50*	12:37	Y	328

UL Sponsored Research

Table 2 – Results of tests with gas cooktop with the sensor.

Test #	Skillet/Pot	Volume Oil (mL)	Time to Shutoff (min:sec)	Max/Ignition Temperature (°C)
RS-1	CC-2	100	2:03	279
RS-10	CC-6	100	*	*
RS-9	CC-9	100	2:03	151
RS-8	AL-8	100	2:34	185
RS-6	AL-10	100	2:18	200
RS-7	AL-12	100	2:40	113
RS-2	AL-G	100	2:04	144
RS-3	CS-12	100	3:32	222
RS-4	CI-11.5	100	5:56	216
RS-17	CC-2	200	3:03	258
RS-14	CC-6	200	2:48	276
RS-18	CC-9	200	3:10	206
RS-19	AL-8	200	3:04	231
RS-20	AL-10	200	2:38	198
RS-21	AL-12	200	2:37	186
RS-22	AL-G	200	2:34	148
RS-16	CS-12	200	3:55	250
RS-15	CI-11.5	200	6:37	252
RS-23	CC-6	50	**	**

UL Sponsored Research

REPORT OF RESEARCH ON COOKTOP PAN CONTACT TEMPERATURE SENSOR – TECHNICAL FEASABILITY PERFORMANCE GOALS
August 12, 2004

The goal of the project described in this report was to determine the usability of the TFPG's under laboratory conditions. The same gas burner and sensor technology studied in the previous report of 2003 was used to discern the usability of these TFPG's.

UL Sponsored Research

Preventing Fires Related to Glass-Top Kitchen Ranges
University of Illinois at Urbana-Champaign
Dept. of Mechanical Engineering
May 2004

1. **An investigation into using an infrared temperature-sensing device to measure the temperature of the pan from underneath the glass surface shows promise.**
2. **For oil, the percent free-fatty acid content was found to be the most significant parameter affecting fire development.**
3. **Two thermal models were created.**
4. **Work was done which identified some of the critical-case system parameters that lead to the onset of hazardous fire with minimum amount of heat input.**

UL Sponsored Research – Safe-T-Element

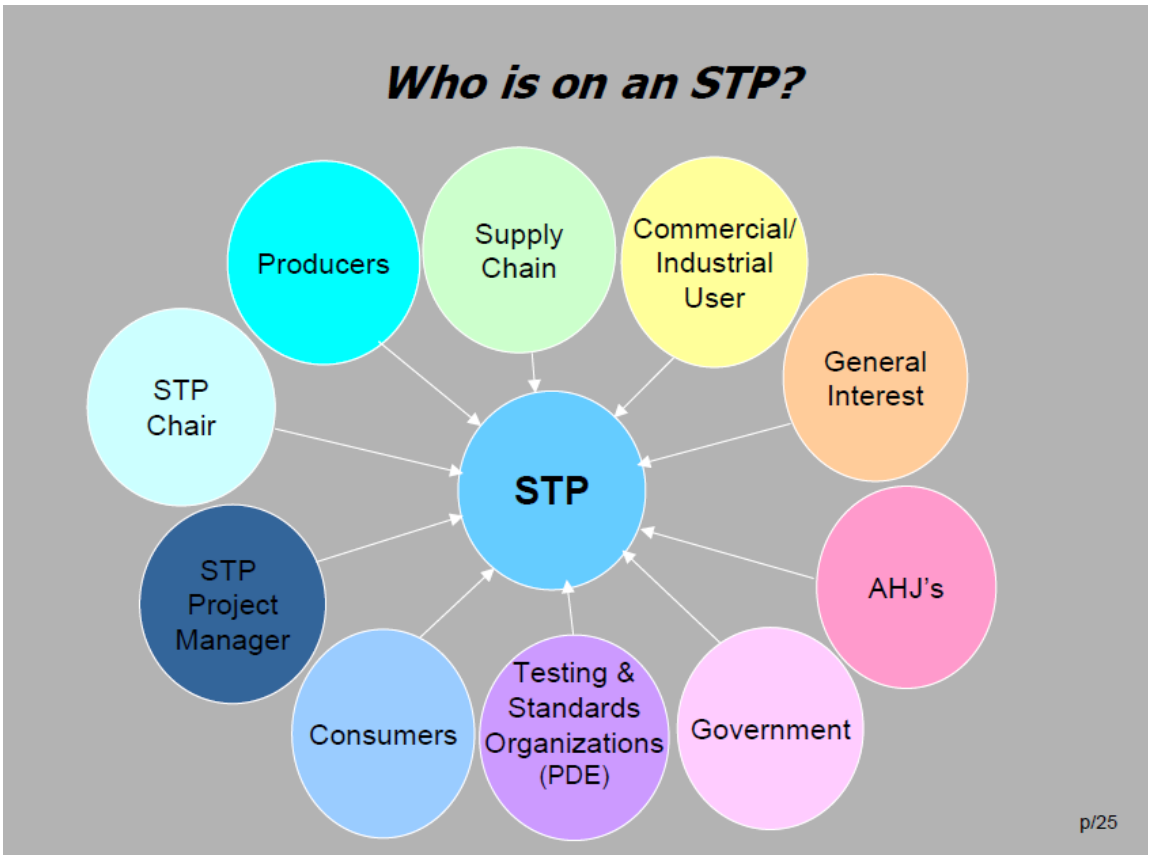
SPECIAL INVESTIGATION ON SAFE-T-ELEMENT™
manufactured by Pioneering Technology
Mississauga, Ontario, Canada
January 11, 2005

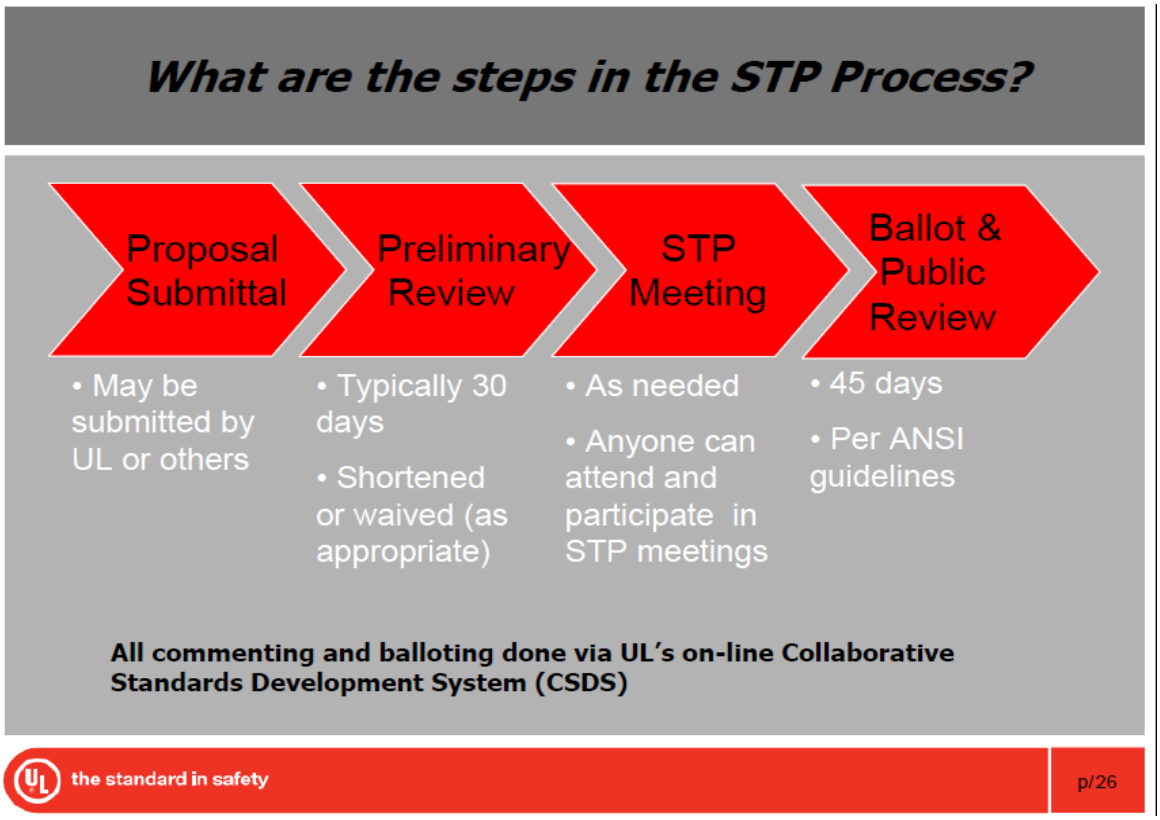
A safety device intended for addition to electric coil-type cooktops to help reduce cooking fires. Safe-T-element is an electronically controlled solid cover plate that can be installed on top of an existing electric cooktop coil burner. A separate control unit regulates the temperature of the plate allowing it to reach a maximum temperature. When the plate temperature exceeds this temperature, the control opens the circuit providing power to the burner. When the plate cools to a threshold temperature just below the maximum, the control restores the ability to power the burner. The manufacturer claims that the Safe-T-element product will not allow most cooking materials to ignite, while still providing for efficient and effective cooking.

UL Sponsored Research – Safe-T-Element

UL Sponsored Research – Safe-T-Element

Test	Pan	Burner	Oil (ml)	Safe-T-element	Oil Temperature, deg C		
					5 min	10 min	15 min
1	AL-1	2350 W	100	Yes	210	250	250
2	AL-8	2350 W	100	Yes	200	233	235
3	AL-12	2350 W	100	Yes	130	160	165
4	S-8	2350 W	100	Yes	175	220	223
5	SE-2	2350 W	100	Yes	195	220	230
6	AL-1	1325 W	50	Yes	200	220	225
7	SE-2	2350 W	100	No	Ignition at 3 min 30 sec, oil 335 deg C		
8	AL-1	2350 W	100	No	Ignition at 4 min 50 sec, oil 370 deg C		
9	AL-12	2350 W	100	No	Ignition at 7 min 00 sec, oil 380 deg C		


Who is on an STP?
Producers
Supply Chain
Commercial/ Industrial User
General Interest
STP Chair
STP
STP Project Manager
AHJ's
Consumers
Testing & Standards Organizations (PDE)
Government
p/25


What are the steps in the STP Process?
Proposal Submittal
Preliminary Review
STP Meeting
Ballot & Public Review
• May be submitted by UL or others
• Typically 30 days
• Shortened or waived (as appropriate)
• As needed
• Anyone can attend and participate in STP meetings
• 45 days
• Per ANSI guidelines
All commenting and balloting done via UL's on-line Collaborative Standards Development System (CSDS)
the standard in safety
p/26

What are the steps in the STP Process?

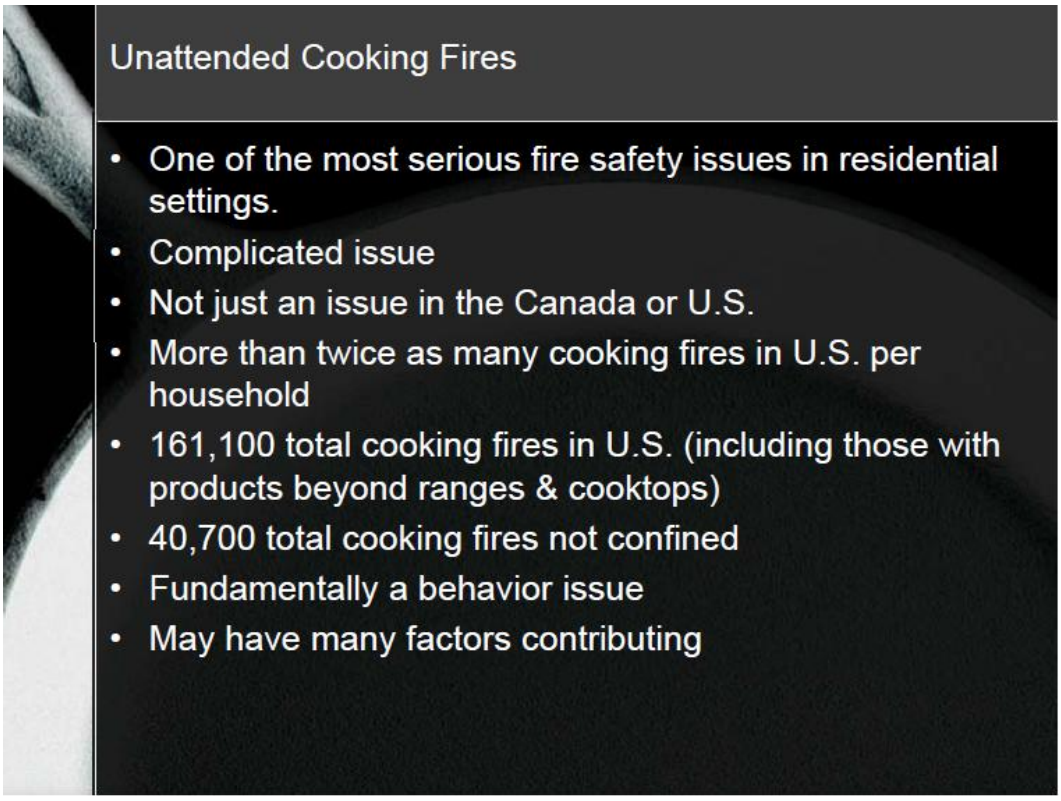
- Timing depends on number and complexity of comments received
- 30 to 45 days
- Per ANSI guidelines
- If consensus reached
- If not, proposal fails

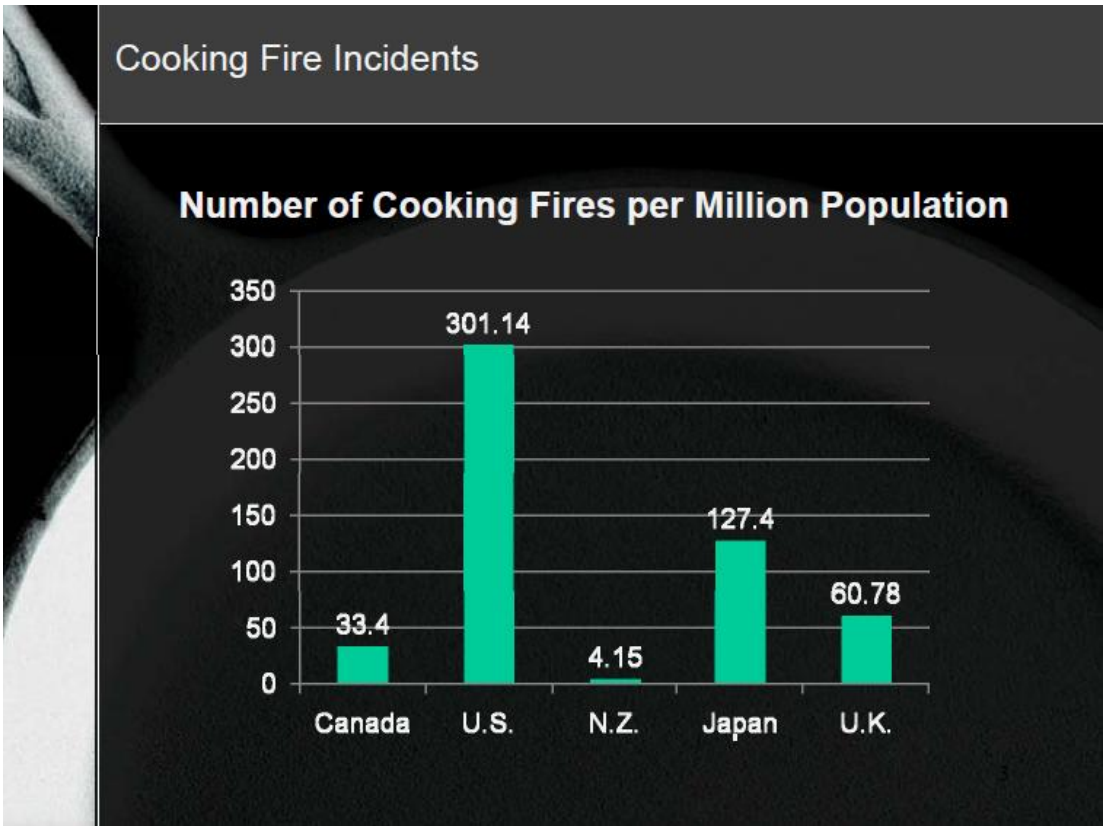
UL's STP Process

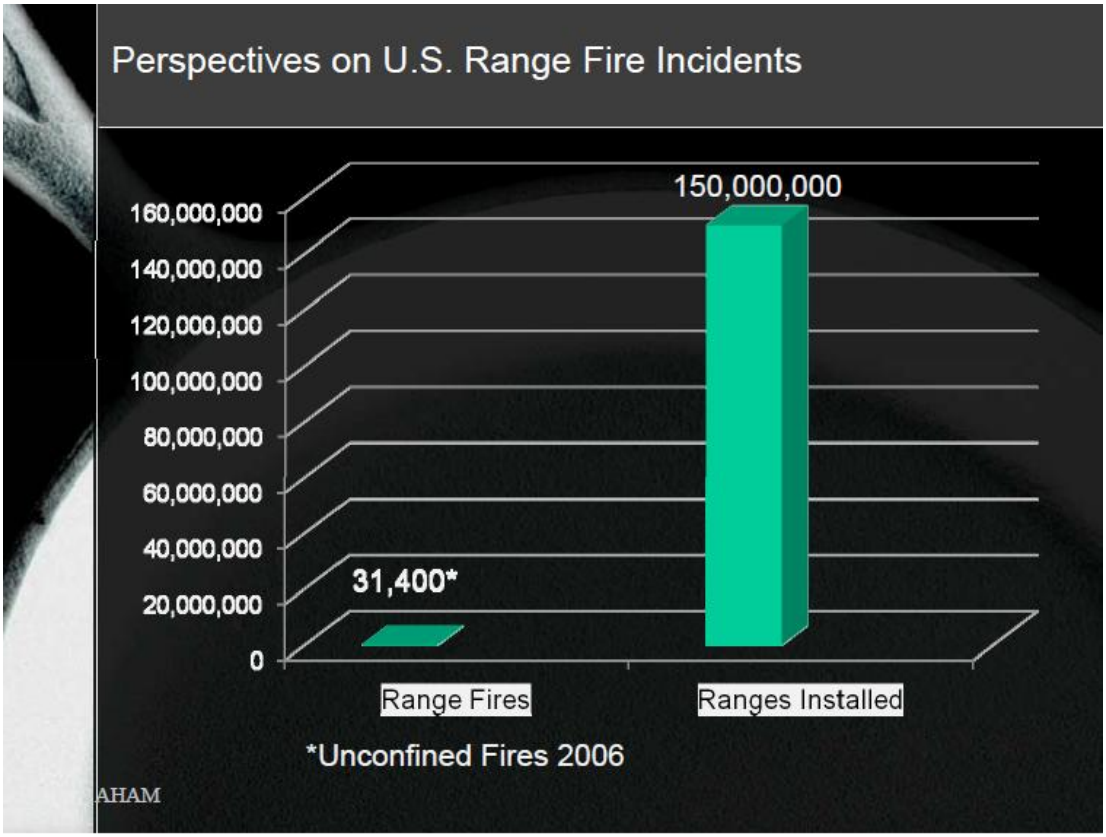
For more information about UL's Standards Technical Panels, or submitting proposals, contact:

Joe Musso
STP Chair, UL Standards
847 664-2964
Joseph.R.Musso@us.ul.com

APPENDIX V Presentation Slides by Wayne Morris, AHAM




Cooking Fire Incidents
Number of Cooking Fires per Million Population
350
300
250
200
150
100
50
0
301.14
127.4
60.78
33.4
4.15
Canada
U.S.
N.Z.
Japan
U.K.


Perspectives on U.S. Range Fire Incidents
160,000,000
140,000,000
120,000,000
100,000,000
80,000,000
60,000,000
40,000,000
20,000,000
0
150,000,000
31,400*
Range Fires
Ranges Installed
*Unconfined Fires 2006
AHAM

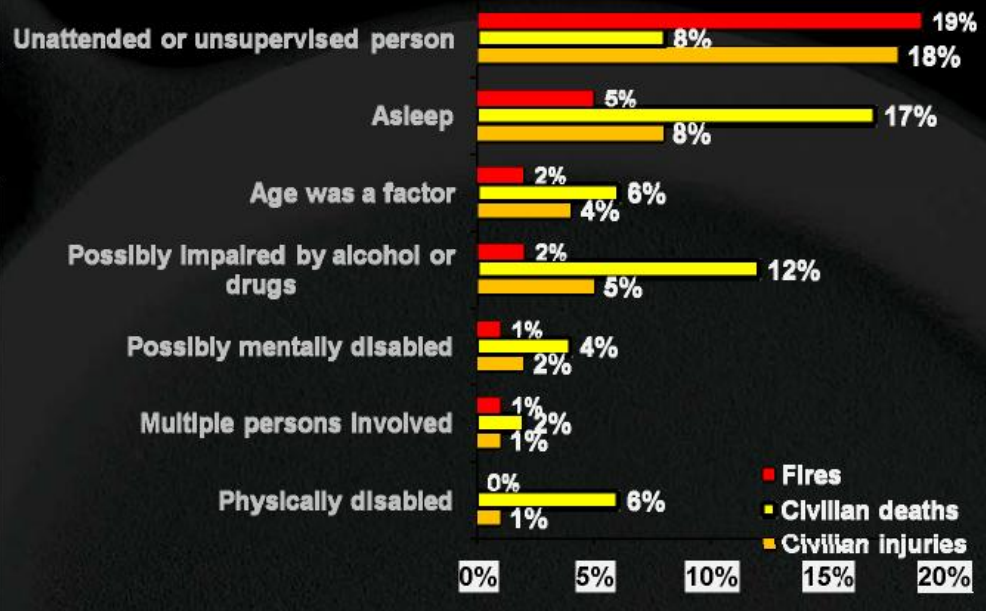
Where are the unattended cooking fires?

- 72% minor damage [1]
- 70% confined to the pan/vessel [3]
- 75% less than $35,000 annual income [1]
- Predominantly age 30-49 [2]
- Both men and women [2]
- Disproportionately high number in minority households [2]
- "Virtually all the electric power ranges had coil element burners." [1]
- Many gas ranges have no electricity supplied

[1] CPSC 1999 Study
[2] NASFM/AHAM 10 Cities Study
[3] NFPA 2008 Report

AHAM

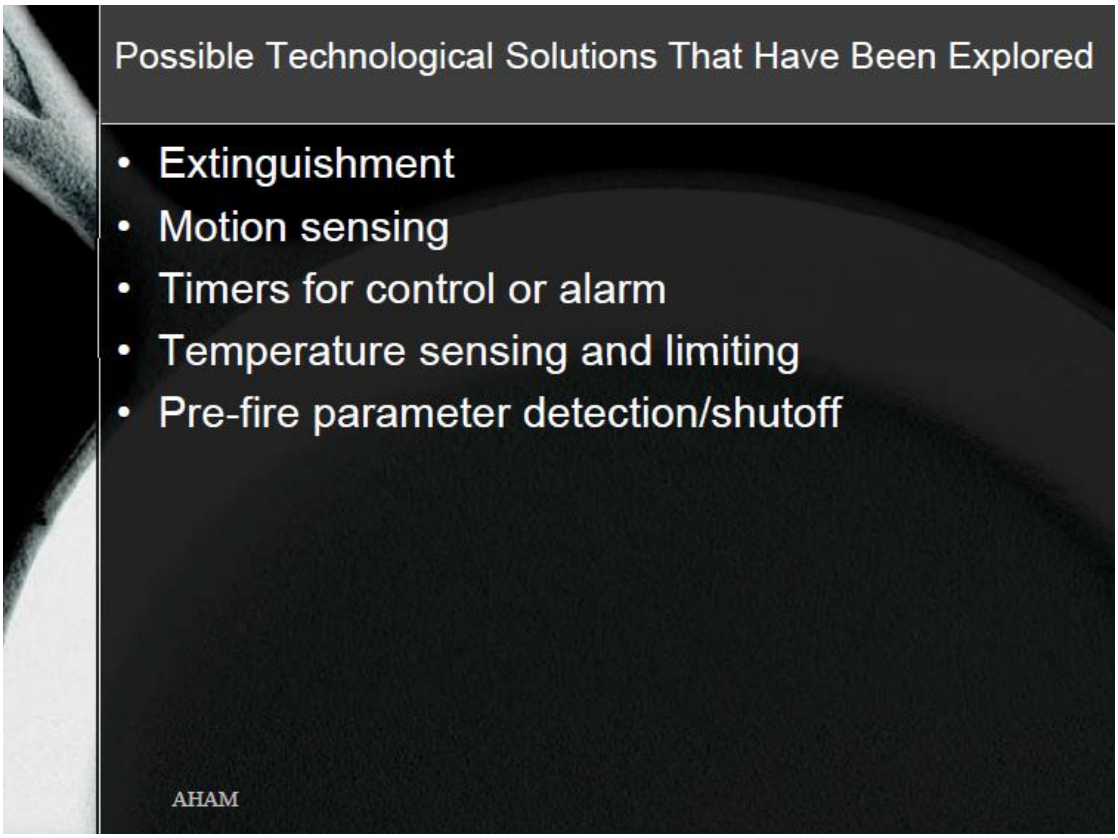
Human Factors Contributing to Home Kitchen Fires: 2000-2004

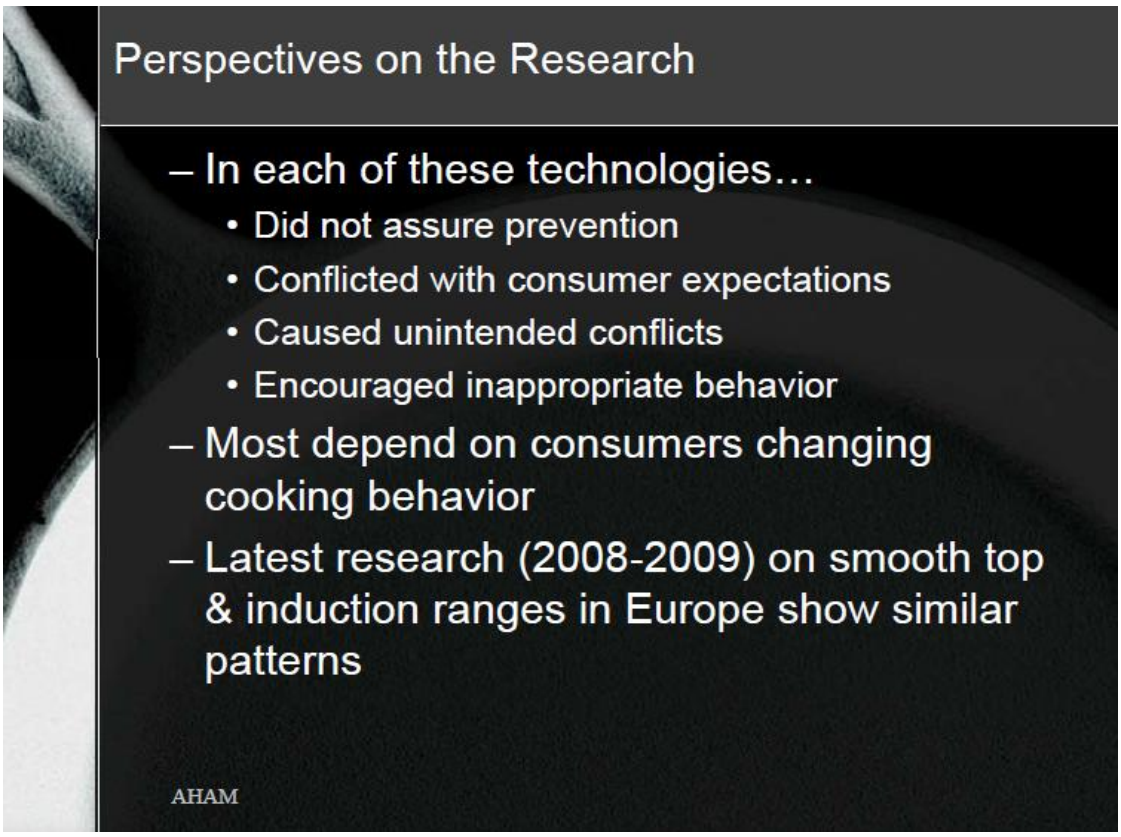


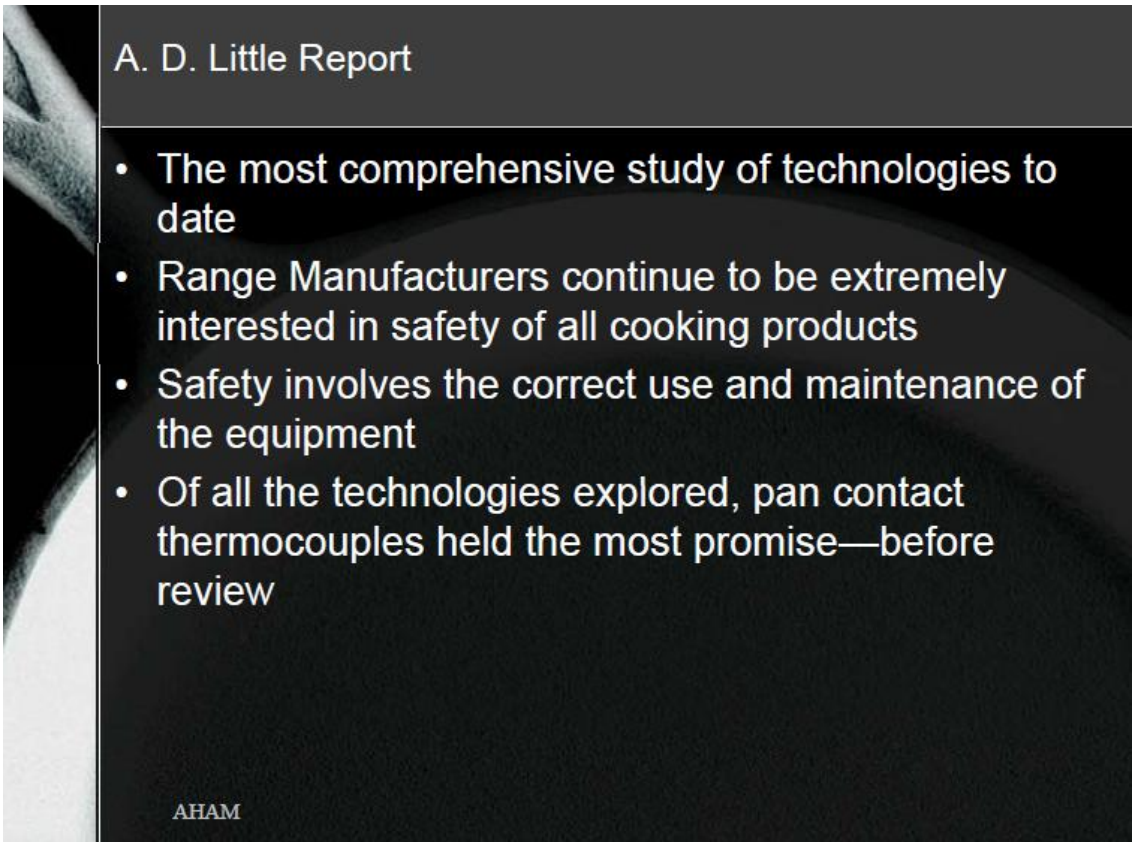
U.S. Data--NFPA

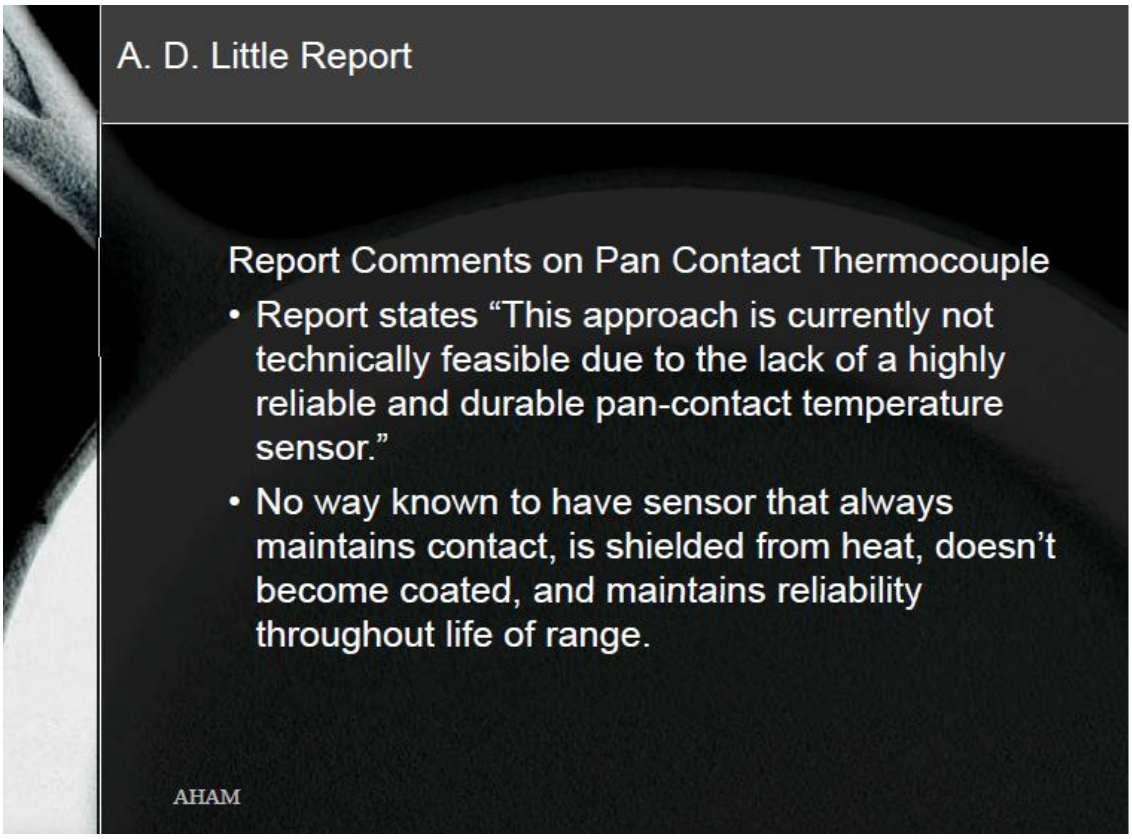
Where have we been? (AHAM opinion)

- Since 1994, there have been at least 10 studies done on technological developments of cooking safety.
  - NASFM/AHAM—studied in-depth fire statistics and demographics
  - NIST 1—found common pre-fire signatures
  - NIST 2—discussed problems with sensors
  - CPSC Lab1—tested cooking fire scenarios
  - CPSC Lab2—concept demonstration model of pan contact sensor and computer on range
  - Good Housekeeping—found pan contact sensors interfered with basic cooking activities
  - Energy International—pointed out problems with gas ranges
  - Arthur D. Little (hired by CPSC and Industry)—found pan-contact was best but no reliable and durable sensors exist
  - University of Illinois—confirmed A.D. Little study
  - AMTI Review of Smooth Top Ranges—in lab
  - CEN (Europe) Study on Smooth Top & Induction Ranges


Possible Technological Solutions That Have Been Explored
• Extinguishment
• Motion sensing
• Timers for control or alarm
• Temperature sensing and limiting
• Pre-fire parameter detection/shutoff
AHAM


Perspectives on the Research
– In each of these technologies…
• Did not assure prevention
• Conflicted with consumer expectations
• Caused unintended conflicts
• Encouraged inappropriate behavior
– Most depend on consumers changing cooking behavior
– Latest research (2008-2009) on smooth top & induction ranges in Europe show similar patterns
AHAM


A. D. Little Report
• The most comprehensive study of technologies to date
• Range Manufacturers continue to be extremely interested in safety of all cooking products
• Safety involves the correct use and maintenance of the equipment
• Of all the technologies explored, pan contact thermocouples held the most promise—before review
AHAM

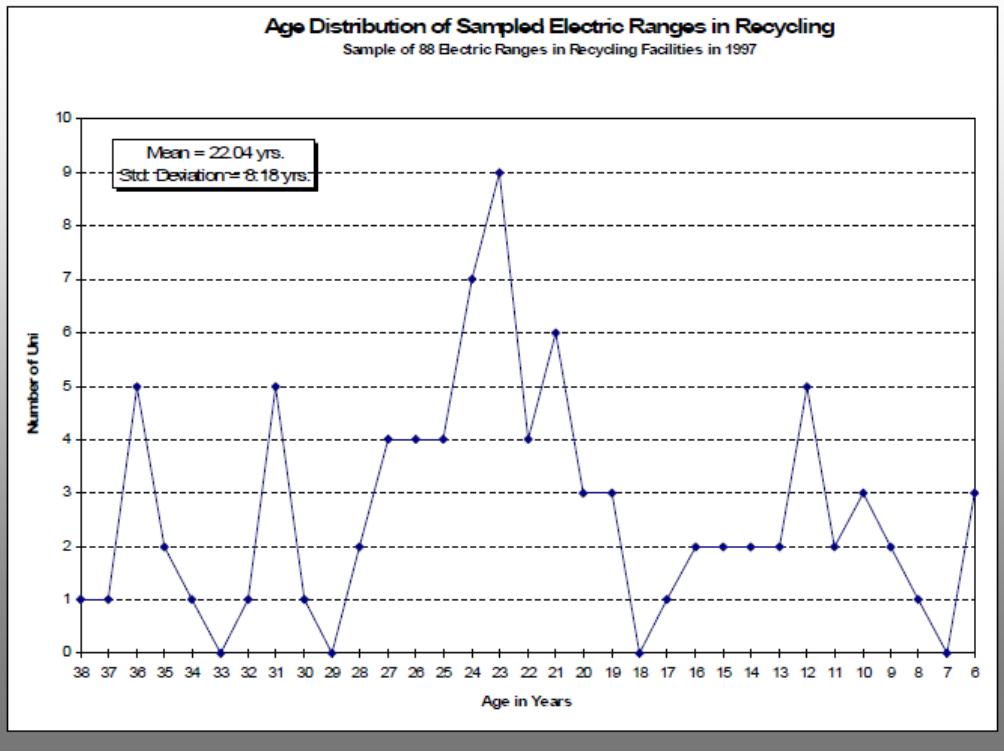

A. D. Little Report
Report Comments on Pan Contact Thermocouple
• Report states "This approach is currently not technically feasible due to the lack of a highly reliable and durable pan-contact temperature sensor."
• No way known to have sensor that always maintains contact, is shielded from heat, doesn't become coated, and maintains reliability throughout life of range.
AHAM

Good Housekeeping Study of Performance with Pan Contact Thermocouples

Activity	Results	% Change
1. Browning of shortening and flour in skillet	No Change	0
2. Cooking pancakes	No Change	0
3. Boiling 6 quarts of water	No Change	0
4. Boiling 1 quart of water in 3 quart light pan	Increased time from 7 minutes to 16:24 and from 4 minutes to 15:30	136%-287%
5. Boiling 2 cups of water in a 1 quart heavy pan	Increased time from 4:42 to 8:08 and from 5:33 to 7:03 and from 4:35 to 6:19	27% - 71%
6. Boiling 2 quarts of water in a teakettle	Increased time from 7:32 to 10:46	43%
7. Simmering spaghetti sauce	a. Unit shut off before completing b. Increased time from 1:30 to 6:00	360%
8. Cooking bacon	No change	0
9. Blackening fish	Pre-heat time longer Fish did not blacken properly	Significant
10. Frying chicken	No change	0
11. Searing steaks	Pre-heat time significantly longer Never achieved crisp sear	Significant

AHAM

Any technical solution will have to operate for decades



Where do we set controls?

- Auto-ignition point of used cooking oil as low as 283C, (Babrauskus)
- Corn oil fire point 359C
- Ignition temperature of sugar 410C
- Ignition temperature of Rice 340C ?
- Self ignition temperature polypropylene = 350C
- Cotton—Flash ignition 210C, Self ignition 400C
- Paper—Auto ignition temperature 232C

- Unclear what food stuffs or materials were igniting in the market

AHAM

2008-9 European Research

- A committee of European Standards 60335-2-6 CEN requested testing of smooth top ceramic and induction ranges
- Several findings
  - Cooking Oil fires can occur below 350 deg C
  - Commonly available thin wall pans will warp and render a thermostat sensor invalid
  - Food cooking problems

AHAM

Ignition Temperature

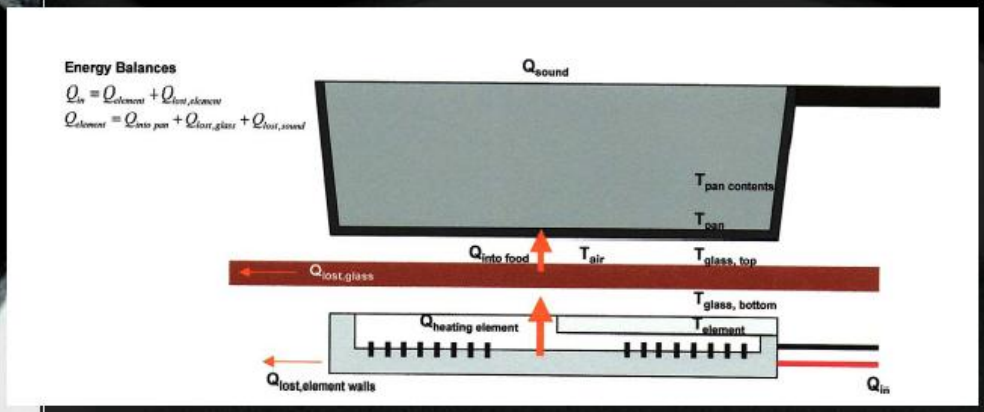
Type of oil/fat		Smoke point C°	Flash point C°	Fire point C°
Corn combination oil		218	317	344
Peanut oil	I	207	315	342
	II	198	333	363
Cotton seed oil	I	223	322	342
	II	185	318	357
Soybean oil	I	213	317	342
	II	242	330	360
Sunflower oil		209	316	341
Coconut oil		194	288	329
Palm oil		223	314	341

CEN 2008-9 Research

Ceramic Cooktops (Smooth Top)

CEN 2008-9 Research

2008-9 Ceramic Test Results



2008-9 Ceramic Cooktop Test Results

- **Frying 500g of mushrooms**
- **Control B – glass surface temperature set at** 370°C

- **Mushrooms "rubbery" texture and watery consistency**

2008-9 Ceramic Cooktop Test Results

- **Frying 750g Beef & 750g Onions (Goulash)**

• No cookdown. Meat wet, lack flavor, poor consistency

2008-9 Ceramic Cooktop Test Results

- **Frying 3 X 250g Steaks**

2008-9 Ceramic Cooktop Test Results—with controls

Beef Steaks – glass temperature set at 370°C

- nearly no browning, but roasting products produce flavor and aroma
- core temperature: 70-80°C, the steaks can only be fried well done
- meat juice leakage causes loss in weight and juiciness

2008-9 Ceramic Cooktop Test Results—without controls

Beef Steaks – glass temperature reaches 600°C

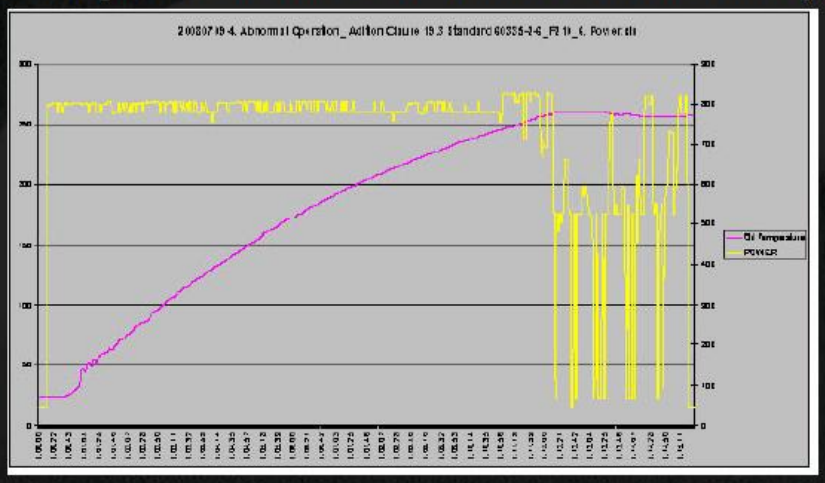
- good browning
- core temperature: 25-35°C, steaks can be fried raw and medium
- no meat juice leakage

Induction Ranges

CEN 2008-9 Research

Induction Test Results

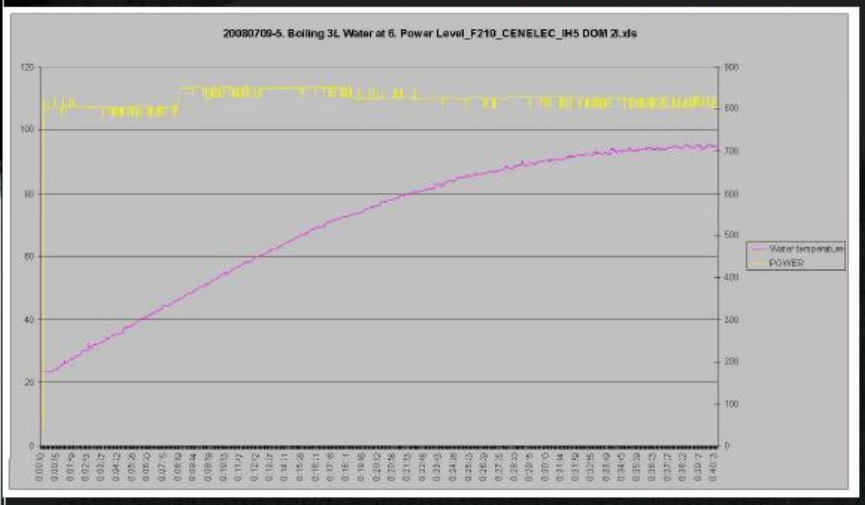
- 10mm of oil
- Control adjusted so that the oil does not exceed 265C
- Oil temperature reaches 257C within 15 minutes and cycles



CEN 2008-9 Research

Induction Test Results

- 3 Liters of water
- Control adjustment as previous tests
- After 40 minutes the water temperature is 95C

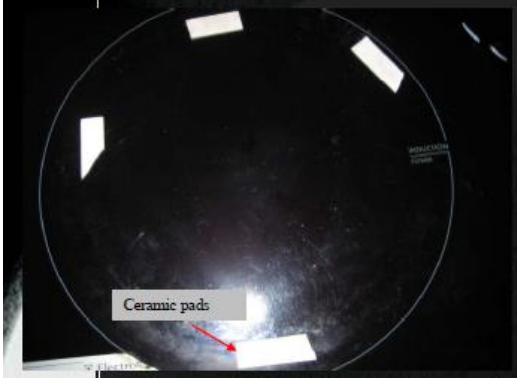


CEN 2008-9 Research

Induction Test Results

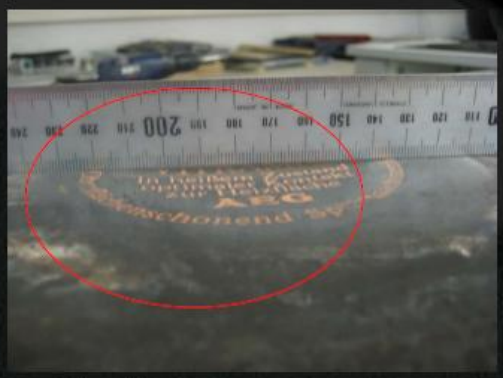
- 2 tests with bad pots & pans

1. Simulated distance



Simulated distance between pot and glass = 1 mm

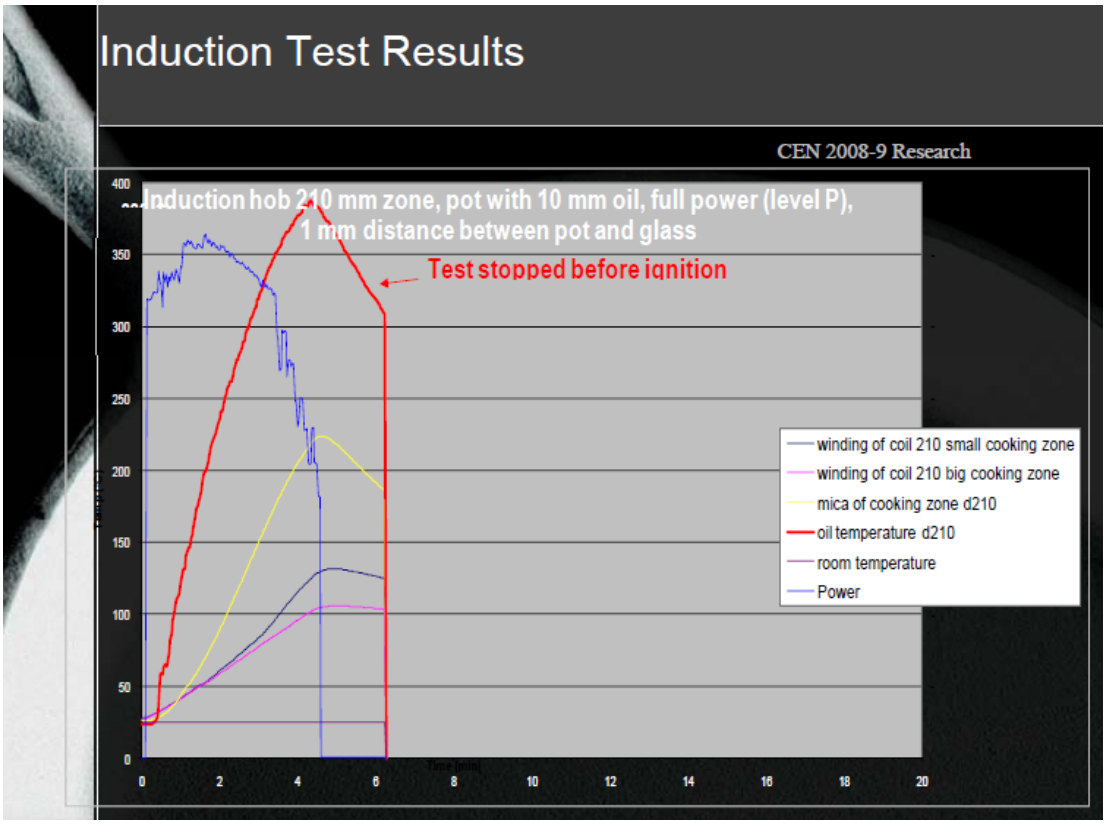
2. Bad pot



Bending of bottom = 2.1 mm

CEN 2008-9 Research

Induction Test Results

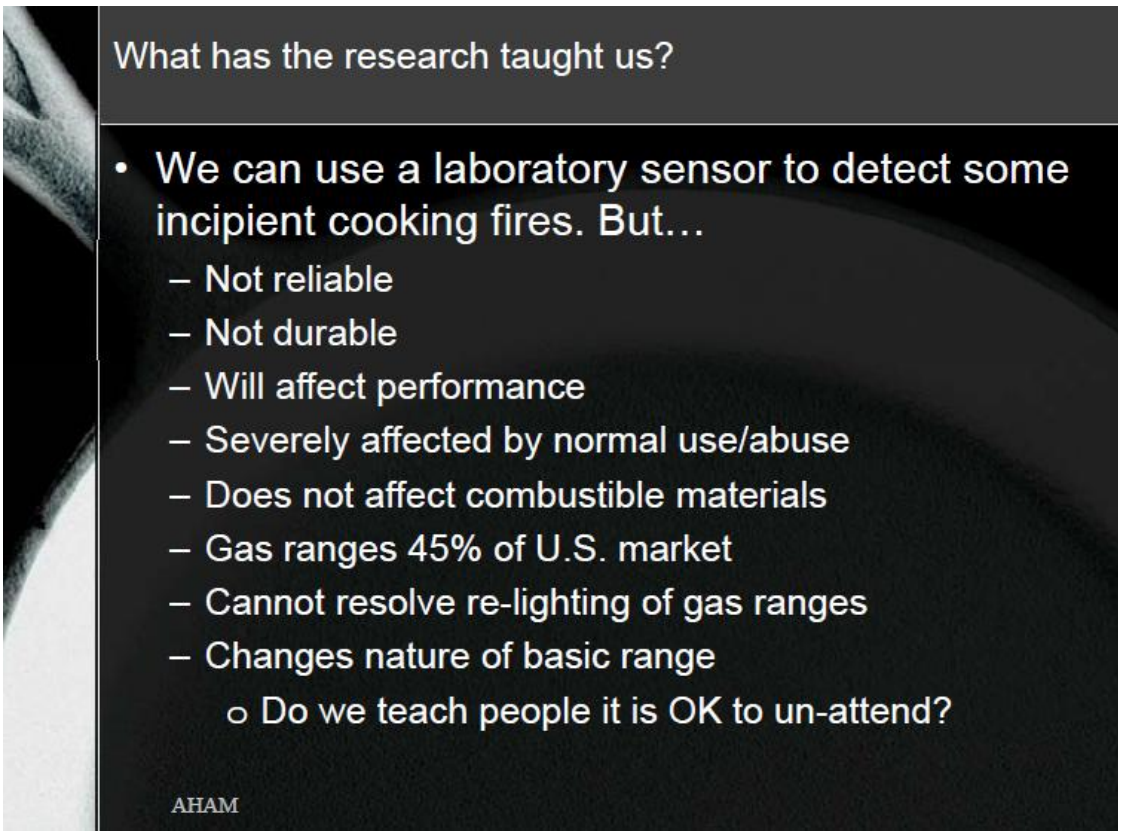


Summary for Induction

- Induction – Can present some successes
  - May reduce "boil-dry" issues
  - Will comply with the pan temperature limit concept only with good flat pans.
  - Will not comply with concept if the pans are bowed; oil will ignite.
  - Performance will be reduced to a point it will not be considered as acceptable to consumers

CEN 2008-9 Research

2008-9 European Research
• Beef, chicken and other meats did not reach safe food temperatures
• Several vegetable dishes were watery and rubbery
• Water would not boil consistently and increased in time by +50%
• Burner cycled too early on the new set temperature (below oil fire temperature limit)
• Frying meats increased times from 8 min to 27 min
CEN 2008-9 Research


What has the research taught us?
• We can use a laboratory sensor to detect some incipient cooking fires. But…
– Not reliable
– Not durable
– Will affect performance
– Severely affected by normal use/abuse
– Does not affect combustible materials
– Gas ranges 45% of U.S. market
– Cannot resolve re-lighting of gas ranges
– Changes nature of basic range
o Do we teach people it is OK to un-attend?
AHAM

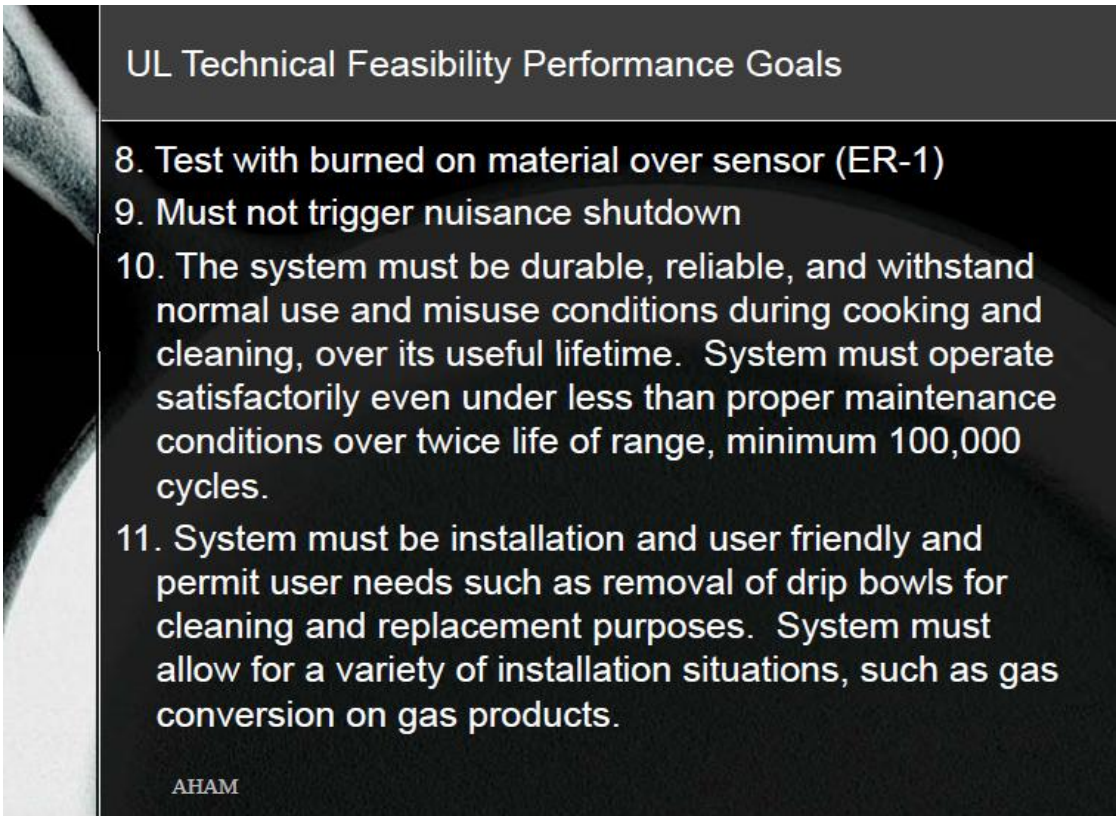
One of the key variables is pan quality/composition

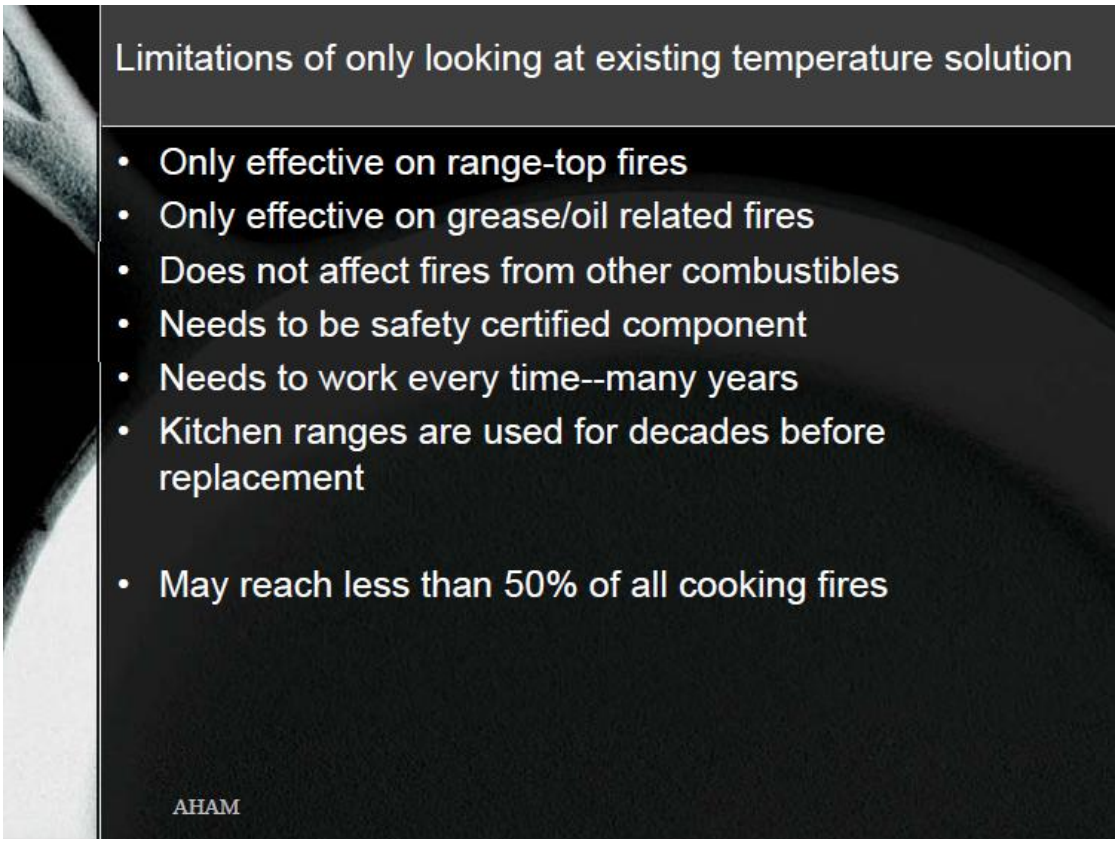
AHAM & CAMA

UL Technical Feasibility Performance Goals

1. Must detect incipient fire due to overheating of food including oil, grease, etc. in cooking container (pots, pans, woks, etc.) alarm, shut power off and prevent fire from occurring.
2. System must comply with all applicable UL, CSA, ANSI, and CGA standards
3. Must work equally well in gas or electric cooktops
4. Must not limit the cooking functionality
5. Must not interfere with cooking behaviors or recipes
6. Must not affect the speed of cooking
7. Must not limit the use of different types of pans (materials, quality, thickness, flatness, size, etc.)

AHAM


UL Technical Feasibility Performance Goals
8. Test with burned on material over sensor (ER-1)
9. Must not trigger nuisance shutdown
10. The system must be durable, reliable, and withstand normal use and misuse conditions during cooking and cleaning, over its useful lifetime. System must operate satisfactorily even under less than proper maintenance conditions over twice life of range, minimum 100,000 cycles.
11. System must be installation and user friendly and permit user needs such as removal of drip bowls for cleaning and replacement purposes. System must allow for a variety of installation situations, such as gas conversion on gas products.
AHAM


Limitations of only looking at existing temperature solution
• Only effective on range-top fires
• Only effective on grease/oil related fires
• Does not affect fires from other combustibles
• Needs to be safety certified component
• Needs to work every time--many years
• Kitchen ranges are used for decades before replacement
• May reach less than 50% of all cooking fires
AHAM

Effectiveness of possible solutions

Potential Solution				Type of Incident				
	Oil In Pan	Oven Fire	Component Failure	Dirt/Grease In Burner Bowls	Clothing Textiles	Spills	Adjacent Combustibles	Heating Element Failure
Pan Contact Sensor	X							
Timer	X							
Limit Temperature	X							
Education	X	X		X	X	X	X	
Smoke Det./ Kitchen Suppression	X	X	X	X	X	X	X	X

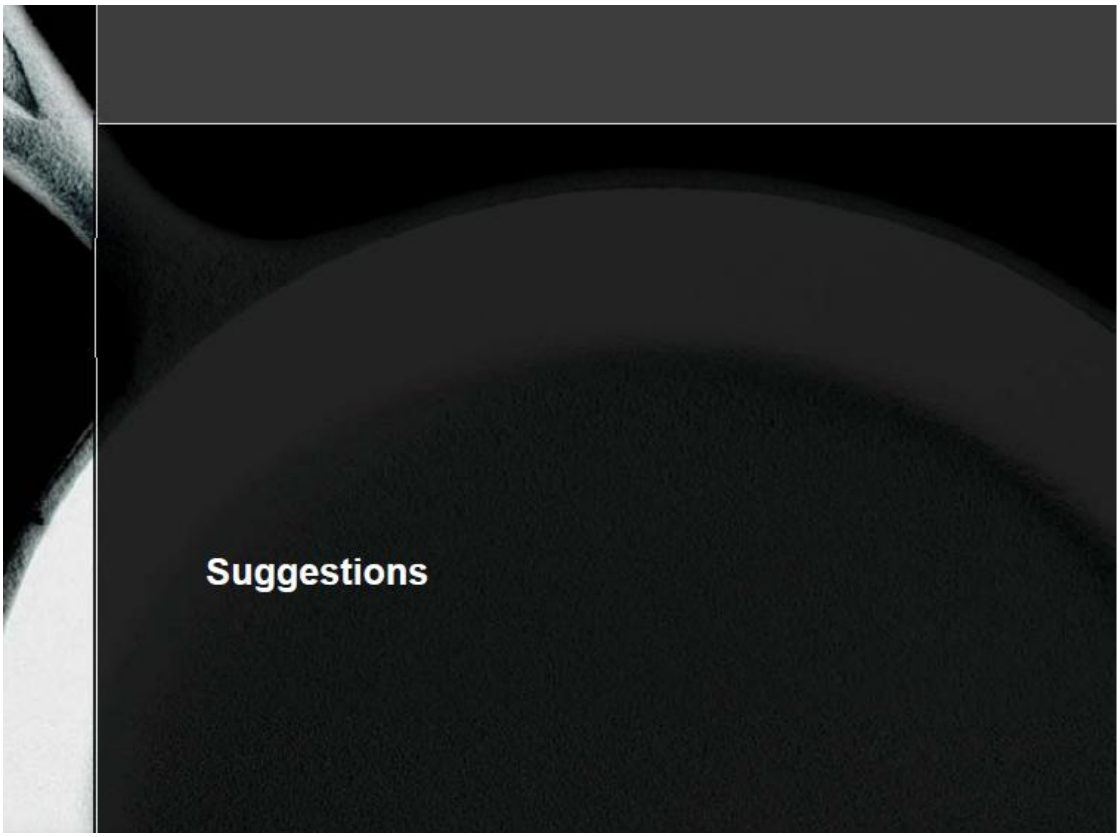
Next Steps

- Would be significant advantage for industry if bona fide solution could be found.
- The Research tells us that pan control temperature sensors are not acceptable yet in real-world situations

and

- We should not give up on the one area that will have an affect today--<u>fire safety education</u>

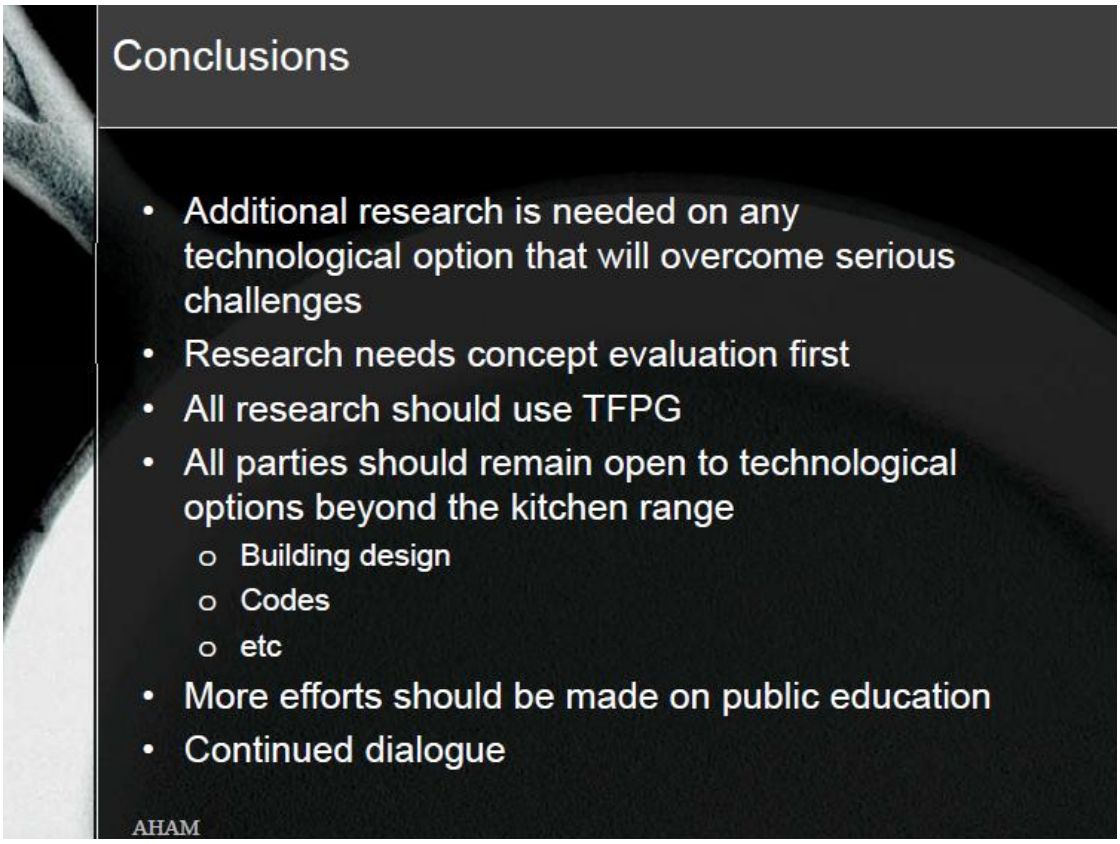
AHAM



Education

- Since 1996, the U.S. appliance industry has participated in industry sponsored education programs
  - Reached millions of consumers through web site, brochures, print ads, videos, & other materials.
  - Annual campaign to reach fire departments, libraries and schools
  - Safety education through web site outreach

AHAM


Conclusions
• Additional research is needed on any technological option that will overcome serious challenges
• Research needs concept evaluation first
• All research should use TFPG
• All parties should remain open to technological options beyond the kitchen range
o Building design
o Codes
o etc
• More efforts should be made on public education
• Continued dialogue
AHAM

APPENDIX VI Breakout Group Notes

The following are notes for each of the three groups from all breakout sessions.

Session One Technologies

Group A Technologies - Brainstorming

- Vision system: camera /computer visible & infra-red implemented for electric & gas (separate solutions)
- Pre-ignition detector & warning: visual & smell
- Motion sensor: user present or not
- Detector for mass on burner. If no mass, burner shuts down
- Residual heat detector
- Kitchen smoke alarm
- Temperature limiters: need to have 3rd party field testing to furnish much needed data
- Sprinklers using kitchen resources
- Single station suppression systems preventing fire growth/development
- Kitchen design: reduce severity, metal cabinets, paints
- Metal side shield: compartmentalization
- Blanket – range top
- New oil frying technology: frying w/less, new frying process, different oil, instrumental frying pan

Group A Technology – Consolidation

Continue to innovate!

- New ideas: vision system – camera with computer, visible + IR
- Expand to gas ranges
- Pre-ignition detectors + warning (visual, smell)
- Motion sensor – user present
- Lack of mass on burner – shut down
- Residual heat detectors
- Smoke alarm in kitchen (adapted)
- Kitchen design (compartmentalization, paint, barriers, etc.)
- Look beyond range: new oils for frying with lower propensity to ignite
- Instrumentation on frying pans

Group B Technologies - Brainstorming

- Sensor-based Ignition-Prevention Strategies
    - Infra -red sensors in range or hood to measure pan or food temperature
    - Pre-ignition detection by sensing and recognizing smoke and/or pyrolysis signatures
    - Analog temperature controls or heating algorithms for improved open-loop control of heating elements
    - Motion sensors to monitor consumer presence

    - Sensors located within pot or pan for ignition resistance or incorporating wireless technology (e.g., a radio-frequency identification device) to communicate information such as pan size and type or even pan temperature to cooktop controls
    - Sensors, including pan-contact and others, to measure pan temperature
- Timers, including simple user-manual reset type or combinations with motion detector and/or heating element setting.
- Other types of hobs: non-spiral heating elements (e.g., ceramic radiant-element or induction cooktop)
- Coil elements with integrated self-contained temperature control, either retrofitted (as an add-on to an existing cil element) or designed into a cooktop.

Additional from Group B - Fire Mitigation: During the brainstorming session, the group also named the following that were later categorized as mitigation approaches rather than prevention approaches.

- Extinguishing systems
- Hardening of range location
- Smoke detection within power circuit
- Hood design to capture heat
- Retrofit the new technologies
- Oven vent protection (as a solution for cooktop fires)
- Look at cooking oils
    - Design ignition resistant oils
- Move range location to avoid spread to cabinetry, etc.

Group C Technologies - Brainstorming

- Add user push button selection of the cooking type (food and method) with the associated temperature limits. This already exists on some induction models. It was deemed analogous to the presets on a microwave. Some said this is hard to use, and they ignore those controls and use generic ones. Also consider preset cooking times for the cooking types/foods/amounts selected.
- Add a motion sensor for the presence of cook. After a certain period of absence, an alarm would warn for a period, and then shutdown would occur.
- Look at fire and smoke detection external to the range and implement suppression systems. It was mentioned that this was already addressed at the previous workshop and post-ignition was outside the scope of the current workshop.
- Design and add a better user interface with clear coloring of which burners are active and how hot or what cooking level and with numerical readouts for current temperatures.
- Add infrared or video scanning technology looking down at the range surface and cooking process from above and able to sense problem and alarm or shut down. Also add alerts, warnings, and cooking feedback to the cook.
- Add a simple plug-in sensor to read pot temperature.
- Add the pot temperature sensor plus a motion detector. This seemed to be the simplest and potentially most effective combination.
- Implement a shut down technology triggered by heat or other input. This is commercially available.

- Develop a retrofit solution consisting of modular smooth top sections with sensors in the sections for surface or pot temperature.
- Develop a smart smoke detector which looks at multiple sensor inputs. It was discussed how some versions of this already exist.
- It is a priority to retrofit old ranges in order to have significant impact in the near future.

Session One Barriers

Group A Barriers - Brainstorming

- There is no one "silver" bullet to solving the problem of kitchen fires through technology.
- How the technology will interact with the range could be a challenge.
- New technology must address any combination of grease, food, objects.
- Solutions must consider different kitchen configurations: island, hood.
- Cost implication for homeowner could be a stopper.
- End of service life must be considered.
- Nuisance alarms/activation is a critical component.
- The challenge of how the technology can/cannot be retrofitted.
- Multiple approaches are necessary for a wide variety of scenarios—this is a challenge.
- Maintaining & updating technology
- Recertification of retrofit technology
- Energy cost/benefit of new technology (using range to heat space)
- Mainlining "proven" technology
- Results/data not published for new technologies
- If service call is required rather than being consumer resettable
- Risk of introducing new technology by the industry

Group B Barriers - Brainstorming

- Maintenance of ranges with new types of technologies
- Periodic cleaning and career of cook Stops with exposed sensors
- Lack of knowledge of technologies
- Cost to consumer
- Retrofit times & difficulty
- Education of consumers on new technology
- Consumer acceptance of changes to range operation and their own cooking behaviors
- Fire safety community acceptance
- Feasibility/reliability (performance of control system)
- Consensus of all stakeholders (need to take incremental approach)
  - Need to develop performance standards that would be acceptable to all stakeholders
- Lack of detail in incident data
- Consensus on what is a cooktop fire? $\rightarrow$ What are we solving?
- Political

Group C Barriers - Brainstorming

- Open coil electric range is the highest contributor to the fire problem but has the lowest cost. It is hard to add more to the cost of the low end range.

- New technology is expensive relative to the low cost of ranges. The increase in costs would not be associated with the quality of the range and improved cooking capability. Cost savings for a very large number of units was mentioned.
- Controls/feedback need to be developed which indicate the cooking process being used.
- Motion detectors can be impacted by fans and accumulation of dirt/debris
- New safety technology could affect the cooking functions of the range and create other unforeseen safety problems such as consumers assuming the cooking is safe to leave unattended.
- How can the pan temperature be measured away from flame/element contact area with the pan?
- Feedback such as limits and alarms may be seen as annoyances by customers who will find ways to disable or work around them.

Group A General comments on the morning session for new technologies and barriers:

- Seek multiple solutions
- Maximize use of proven technologies thru full-scale demonstration projects, cost/benefit analyses, more marketing
- Focus on those at highest risk to realize outcomes fast (low income), target opinion leaders + institutional applications

Group A – Report on Technologies

- (B) Vision/visual fire detector
- (B) Feasibility & potential effect of cooking oil labels
- (C) Impact of warped/damaged cookware
- (A) Research in adaptation of gas fueled products

Group A Report on Barriers:

- Cost implications
- Consumer expectations (maintain performance)
- Liability/indemnification
- Diverse kitchens/settings (island)
- Life span – will solutions last?
- Human factors
- Lack of pre-renewed data/published

Group C Report Session I

<u>Technology</u>

1. Implement push buttons to select type of cooking and automatically vary the cooking temperatures and times
2. Add motion sensors to detect smoke before open flame
3. Add IR scan of burners, pans, food, spills
4. Design sensors that respond to potentially dangerous conditions and the presence of activity near the range.
5. Add colors or other improvements in user interface feedback
6. Expand home inspections for range cleaning, maintenance

Barriers

1. Open coil is most used but lowest cost so it has the least room for change. What about modular burner retrofit?
2. Factors in customer acceptance: appealing for voluntary purchase, ease of proper use, not defecting (false alarms, poor quality cooking).
3. Synthesize existing data into a comprehensive matrix to identify research gaps and support decision making.
4. Gather more data on fire risk by scenario, technology, etc.

Session Two Research

Group A - Brainstorming

- Remove ambiguity of data
- Risk analysis: gas (more serious) vs. electric (more common)
- Link research to problem
- Define the "problem"
- Biggest bang – cost vs. benefit
- Video games to identify fires
- Research to bring "proven" technology to scale, move real possibilities into field
- Collect additional field data on existing technology application
- Define target areas: impact vs. cost, unattended cooking (especially frying), clothing fires – higher mortality
- Automatic shutdown technology
- Identify specific issues – focus window for solution: food, grease, clothing
- Target engineering solution
- Define data – better define problem, avoid paralysis
- Balance study: statistical value
- Define nature of cooking fire: cooking event, impairment
- We need to capture "non claim" fires: the data is missing small fires
- Refine ignition sources: limited study, more detail data/survey
- Characterize performance of different types of ranges
- Collect field data: performance, select group of users, comparison groups (fire act grant)
- Understand current-state-of-art, publish data
- Merge/consolidate/integrate fire and lab data, target technologies
- Vision – fire recognition: look at fires, "see" fire, consider existing video, convert human recognition of fire into "machine"
- Visual technology to recognize fire
- Retrofit comparison of performance: sprinkler, hood, temperature limiter
- Controlled field test: same user group/different ranges
- Develop matrix of problem vs. technology
- Characterize needs of population: aging, non owners, supervised vs. non-supervised

Group B - Brainstorming

1. Review of available information, including literature review and recap of all work previously done.

- Develop a "Parado" chart based on available data (like Arthur D. Little Report to CPSC) to identify gaps where more data/work is needed.
- Find incident data, test data, product data, surveys that could build consensus and bridge knowledge gaps

2. Conduct surveys of the general public and/or of consumers that have reported kitchen fires. Include the following in the survey:
   - Range characteristics (type, age)
   - Cooking habits (how often, what sort of oils, etc)
   - Consumer characteristics (age(s), income, household number,
   - Any previous fires
   - Any previous injuries
   - Was the range being used for cooking or as a supplemental heat source,
   - What was the first item ignited
3. Peer review on present technologies, per TFPGs ,
4. Define test methods
5. Validation of proposed technologies
   - Per TFPGs
   - In field → to sort & filter
   - Cost benefit
   - Doesn't create more problems
6. Project to bring costs down of implementation of technolgies
7. Cooking oil changes (attn. Research)
8. Pan improvement (attn. Research)
9. Code improvements (attn. Research)
10. Containment/extinguishment versus prevention
    - Can timers/sensors be combined with controls and consumer behavior for a smart/intelligent range
11. Research inherent benefits of induction cooktops

Group C- Research Brainstorming

- Determine what the problem is
- Gather data on incident rates on gas, coil, smooth top
  - Get more detailed reports from fire investigators
  - Have special fire investigations of a sample of incidents
  - Gather demographic info: where, who, income, type cooking, education, culture
- Generate data matrix and determine what data gaps exist to support decision making about required new research.
- Research customer acceptance of new technology.
- Generate a short list of sensor options with the most potential.
- Investigate user interface options using experts in industrial, human factors engineering to generate optimal controls/readouts
- Study foreign experience, technologies, and data/stats from Europe, Canada, and Asia.
- Research technologies from other industries. Other potentially dangerous products implement safety sensors and controls.

Group C – Research General Needs

- We need to know which types of ranges have the greatest fire incidents. More analysis of data is required. We need comprehensive analysis on all existing research and identification of where there are gaps. Determine the specific types of cooking known for greatest risk to better warn/educate public. We should synthesize the existing data into a comprehensive matrix related to the Arthur D. Little solution criteria.
- More research is needed in differentiating nuisance versus danger (approaching ignition).
- Paid range inspections similar to those done for fireplaces and dryer vents is a market that could be encouraged and developed. It was mentioned that the fire service could do some of this as part of their community outreach/education. Fire service reps said they are already overwhelmed and couldn't add this easily.

Group A – Research Report

- Data (A)
    - Integrate fire & lab data
    - Remove ambiguity of data
    - Collect field data – users & technology
- Define problem that the technology needs to solve (A)
    - Better characterize ignition source—different types of electric elements
    - What are needs of customers?
    - Cost vs. benefit
    - Nature of fire—what happens after ignition?
    - Target specific components
    - Identify target
- Performance of existing systems (A)
    - Understand the performance of Types of technologies for motion detection.
    - Auto shut off
    - Temperature limiters

Group B - Research Report

Research Ideas: The team decided that of all the ideas listed above, the following 7 categories would cover them all.

Each member of the break out group had 3 votes and the colors represented as follows:
Blue: Industry
Red: Fire Service
Green: Government
Black: Other (Insurance companies, interest groups, etc.)

1. Review existing data (A) XXXXXXXXXXX
2. Get new data (A) XXXXXXXXXX
3. Review current tech (B) XX**X**XX
4. Review proposed tech (B) XXX**X**XX
5. Alternative Solutions: X**X**XXXX
    a. Oil
    b. Codes (building)

c. Pan
d. Fire extinguishing

6. Intelligent range (C)
7. Induction top benefits (C)

Group C – Research Report

1. a. Analyze existing data to generate matrix showing gaps (B) XXXX
   b. Gather more data (A) XXXXXX
2. Explore user interface options including foreign and other industry examples. (A) XXXXXX
3. Pursue sensor options. Generate a potential list including foreign and other industry examples and evaluate them for reliability, effectiveness, practicality, and cost. (A) XXXXXX
4. Study consumer acceptance factors. What approaches lead to acceptance? (C) XX
5. Conduct further research on pan temperature to optimize its effectiveness. (C) XX
6. Research retrofit options. (A) XXXXXXXXXX

Topics for the further consideration

- Documenting "near miss" incidents, interconnect smoke alarm
- Inappropriate installation of equip, non supervised tech in supervised housing
- Consumers non aware of "non flatness" for pots and pans
- Impacting high risk groups
- Limit fuel load
- Revisit conclusions of suppression workshop