THE FIRE PROTECTION RESEARCH FOUNDATION

PROJECT SUMMARY

Smoke Alarm Nuisance Source Characterization – Phase 2

16 June 2014

Background:

During the revision cycle for the 2010 edition of NFPA 72, National Fire Alarm and Signaling Code, the Technical Committee on Single- and Multiple-Station Alarms and Household Fire Alarm Systems (SIG-HOU) added new smoke detection placement requirements. The new requirements intended to reduce nuisance alarms from smoke alarms and detectors installed close to stationary cooking appliances.

During the development of the 2013 edition of NFPA 72 the SIG-HOU Technical Committee added two new provisions to Chapter 29 to further reduce nuisance alarms.

- 29.8.3.4(5): Effective January 1, 2016, smoke alarms and smoke detectors used in household fire alarm systems installed between 6 ft (1.8 m) and 20 ft (6.1 m) along a horizontal flow path from a stationary or fixed cooking appliance shall be listed for resistance to common nuisance sources from cooking.
- 29.7.3: Effective January 1, 2019, smoke alarms and smoke detectors used in household fire alarm systems shall be listed for resistance to common nuisance sources.

The 1/1/16 date is now being proposed to be harmonized so that both requirements would be effective 1/1/19.

Based on current available data, nuisance sources can be categorized by particle size into small, medium and large particle sources. This Phase II project will collect and analyze data that may be used to develop replicable UL 217/268 test protocols so that products can be listed to comply with resistance to cooking sources and other identifiable nuisance sources, specifically steam/water mist at a minimum. (Phase III task is to use the data from Phase II to develop replicable tests.)

Research Goal:

Characterize common nuisance sources for the development of new performance test protocols in ANSI/UL 217 and ANSI/UL 268 product standards in order to meet the NFPA 72-2013 requirements intended to reduce nuisance alarms.

- Collect data to characterize nuisance sources.
- Verify that the chosen criteria correlate with past NIST results.
- Compare results to existing fire test data.

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- Aid in developing new test protocols. (To be refined and solidified in Phase III.)

Project Tasks:

Task 1: Preliminary Research Plan/Cooking Nuisance Sources

The tasks listed below are designed to use the existing data to further characterize the identified nuisance sources. The data collected should include sensor locations, smoke and heat buildup rates, particle size and density, particle composition and build-up rates, gas concentrations and event time durations. This data is to be collected at various distances from the nuisance source. Using data from the Smoke Characterization Report, determine whether the characterized nuisance conditions are sufficiently different to enable differentiation from test fires currently in the UL standards.

The following cooking sources were selected as representative, based on analysis of NIST test data. Particle sizes with density concentrations (on gas and electric range):

- Small particle, high density = plain cheese pizza (frozen), dark edible toasted bread
- Medium particle, combination of small and high particle and density= grilled cheese, bacon, broiled hamburger (frozen)
- Large particle, low density = vegetable stir-fry (1 carrot, 1 onion, 1 celery stalk, 15 mL vegetable oil), hamburger (frozen)

These sources, and their grouping (underline represents the desired food product for generating particles in the particular category), were selected by analysis of the research because they represented the key characteristics of the particle groups.

Variables analyzed should include the following, chosen with the objective of duplicating NIST results.

- Tests to be conducted:
    - **Cooking scenarios**: three underlined scenarios above (toast and hamburgers broiled and fried). Toasted bread shall be made in an electric toaster.
    - Data shall be captured throughout the cooking process and test shall be continued beyond "reasonable" cooking scenarios. For example, toast burned beyond point where it would generally be considered "edible."

Cooking process shall replicate the NIST process as closely as possible and be fully documented (oven temperature, pan size and type, whether oven door opened, etc.) and incorporate packaged instructions, e.g. for pre-packaged frozen hamburger. (Link to the NIST cooking tests: http://dx.doi.org/10.6028/NIST.TN.1784)

    - Use commonly available appliances: electric and gas range/oven, electric toaster
    - A video of the cooking process, with time stamp, shall be made available for all tests. Images of food at various points is critical.
    - Each test to be run 3-5 times
    - **Current and proposed (foam) UL 217/268 fire tests**: Tests should be run, with data captured at distances specified below so that comparisons can be made

between smoke characteristics of "must alarm" fires vs. characteristics of nuisance tests.

- Room size and configuration: Tests to be completed in a room size that will allow correlation to current UL 217 and UL 268 fire tests.
- Data to be captured:
    - Analytical instrumentation: Obscuration beam, MIC, Temperature, CO & CO2 NDIR, particle number density, particle mass concentration, relative mean particle size (can be inferred from number density and MIC/mass measurements)
    - Alarm times via the following representative devices:
        - Analog alarms w/CO (1 – ion, 1 – photo)
        - Residential alarms (1 – ion, 1 – photo)
        - Alarms should be characterized for sensitivity before testing.
        - Alarms should represent multiple manufacturers.
    - Analytical instruments and alarms to be installed along the center line of the ceiling at 6 ft, 10 ft, 17.7 ft and 20 ft from the source.
    - Particle data to be captured along the center line of the ceiling at 10 ft from source.

Task 2: Other Nuisance Sources

Tests to capture data on water vapor should also be included in this project. The nuisance source testing should include the production of aerosol water mist, example steam from shower, in sufficient quantities to cause alarms in existing alarm/detection technologies. Document all variables that influence steam as a nuisance source, such as room temperature during testing.

Task 3: Framework for Phase III

Based on the findings from Tasks 1 and 2, analyze smoke characterization and detector responses and determine likely success of a device being able to differentiate nuisance from hazard smoke. Develop a proposed framework for a Phase III, which would include the development of a replicable set of tests that can be used by a NRTL to list smoke alarms per sections 28.4(5) and 29.7.3 of NFPA 72. This would include identification of which products of combustion might be used as discriminates for determining nuisance vs. hazard alarm and suggested thresholds for obtaining a "nuisance resistant" listing.

Implementation:

This research program will be conducted under the auspices of the Fire Protection Research Foundation in accordance with Foundation Policies and will be guided by a Project Technical Panel and UL 217 Task Group consisting of industry stakeholders who will provide input to the project, recommend contractor selection, review periodic reports of progress and research results, and review the final project report.

Schedule:

The final report will be issued in December of 2014.