2009 BFRL Project Description

Project Title: Large Fire Laboratory Operations

September 5, 2008

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BFRL Program: Reduced Risk of Fire Spread in Buildings

Objective: To maintain, improve and expand measurement capabilities at the NIST Large Fire Laboratory (LFL) and to use the facility to conduct safe and accurate large-scale fire experiments.

Problem:

What is the problem? The ability to conduct safe, repeatable and accurate intermediate and large scale fire experiments is essential to understanding fire behavior. A quality facility is needed to provide researchers with well quantified large fire measurements to support fire model validation studies, enable advances in fire standards and codes and enable fire investigations. New facility capabilities are needed to quantify the fire resistance performance of different real scale structural system components and connections.

Why is it hard to solve? The LFL supports many users with different needs (space, time, instrumentation, safety hazards). Very high demand for testing time in the LFL (schedule backlog up to 18 months) allows limited time for developing measurement infrastructure. In addition, due to the very high volume flow required to evacuate the combustion gases, the LFL operations and fire experiments can be adversely affected by extreme weather conditions.

How is it solved today, and by whom? The are several other federal and commercial labs with similar capabilities to the NIST Large Fire Lab including ATF, FM, UL, and SWRI in the US and 10 to 15 international labs. The LFL is unique in providing a high level of expertise in a wide range of fire measurements. An experimental facility for studying and testing the performance of components, assemblies, and systems under realistic combined fire and load conditions does not currently exist in the US.

Why NIST? There is a critical national need for a facility to conduct large fire research. The development of large fire measurement capabilities is consistent with the BFRL mission of meeting the measurement science, standards, and technology needs of the U.S. building and fire safety industries. Additionally, BFRL supports the fire research needs of other federal and state government agencies. The operation of the LFL is needed to support the BFRL core

competency of fire protection and fire spread within buildings and communities. The expansion of the LFL to include a new National Structural Fire Resistant Lab (NSFRL) would improve the performance, reliability and resilience of structures under extreme loads.

Approach:

What is the new technical idea? The Large Fire Laboratory will continue to conduct fire experiments to support advances in fire metrology, enable fire model validation studies, enable advances in codes and standards and support building and fire safety investigations. In order to meet the needs of the testing community that use the Large Fire Laboratory (both internal to NIST and external) the focus is placed on improving the operating capabilities of the three large calorimeters. Together with the Heat Release Rate project, a significant effort is in progress to resolve technical issues associated with the 3 MW and 10 MW calorimeters in order to reduce their respective uncertainties. The development of new instrumentation and standardized test methods will be supported to provide reference data for comparison against numerical predictions at multiple levels: sub-scale, single item response to fire, and full scale reconstructions.

Why can we succeed now? The need to maintain and improve the testing capabilities of the LFL is supported by a growing demand by end users for large fire test data. This is the right time for a new structural lab because there is increasing international competition for innovative products, and services related to the fire resistance design of structures.

What is the research plan? New instrumentation and test fixtures will be developed and maintained. The ISO 9705 experimental enclosure and the Large Experimental Enclosure will be utilized during ongoing projects such as the Gas Velocity Measurements and FDS validation. The repeated utilization of these enclosures has resulted in significant savings.

A new version of the MIDAS (Modular In-situ Data Acquisition System) will be programmed and implemented. Currently, different project experimental set-ups require customized programming adjustments to one of the previous MIDAS programs. The planned improvement is to have customized input files that describe all of the instrumentation types and operational parameters and use a static DAQ program that is flexible and self-configures based on the input file. This will allow non-LabView programmers to prepare experimental configurations and improve measurement traceability.

An outline for a Quality Control plan for the LFL will be initiated. The aim of the Quality Assurance/ Quality Control effort will to provide a standardized level of high quality data for LFL users. The NIST Quality Manual for Measurement Services QM-I will be used to set the overall framework of the LFL QA/QC system. Accreditation by an independent entity such as ISO 17025 will not be pursued. Instead the QA/QC system will focus on providing valuable guidance to fire testing laboratories on best practices for fire metrology and intermediate and large scale fire experiments.

The supervisor of the LFL will continue to act as the NIST representative to NAFTL. In addition to supporting the ongoing E119 proficiency study, the planning of a new HRR proficiency study is in progress. Additional interactions with NAFTL will focus on developing a

prioritized list of the fire laboratories' fire metrology requirements and integrating these findings in the NIST fire metrology plan.

A new Interagency Agreement with ATF is planned that will allow BFRL project leaders to conduct large fire experiment at ATF's Beltsville facility. This facility can accommodate larger test structures than the LFL and will alleviate some of the schedule backlog for BFRL users.

The LFL staff will assist with the planning and design of the NSFRL. The current plan would expand the LFL (Bldg. 205) by 1700 m^2 to include a strong floor and strong walls where experiments on structural connections and assemblies could be conducted with precise control on temperature and loading in three dimensions, and where two-story high building frames could be subjected to full-scale fires.

Recent Results:

- The LFL staff successfully completed 16 different experimental test series in FY 2008.
- The facility capabilities were demonstrated to more than 30 groups of external visitors.
- The LFL emissions permit was renewed for five years by working with the NIST environmental compliance group. The pollution control system bag house was successfully repaired resulting in minimal downtime.
- Two new staff members were hired including an instrumentation specialist and an apprentice engineering aid technician.
- The LFL supervisor participated in two NAFTL meetings to discuss ongoing proficiency studies.
- ***Output:*** A contract was awarded to modify the exhaust duct on the high bay roof (scheduled to start in late FY 08) for improved performance of the 10 MW calorimeter.
- ***Outcome:*** Three new instrument racks were assembled to expand the LFL capabilities to analyze combustion gases.

Standards and Codes: The NAFTL consortium proficiency work is directly related to the development of the ASTM E119 "Standard Test Methods for Fire Tests of Building Construction and Materials" and CFR 1633 "Standard for the Flammability (Open Flame) of Mattresses and Mattress". NIST will play a leading role in analyzing and interpreting the data from these studies.