



# **NASFM Foundation Project FAIL-SAFE Research Plan**

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## Executive Overview

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### Introduction

We wish to thank each of you that have already registered to attend the FAIL-SAFE Summit in Denver on October 29<sup>th</sup>, and encourage those who have not done so to [click here](#) to register and join us. A research plan for the first two years of the Project FAIL-SAFE plan is provided below, along with the total costs for those first two years. It is our hope that you will use the provided information to reserve a spot in your upcoming 2016 budget to support this important research project.

We heard you clearly when we met in June, and have worked diligently since then to develop a plan that will provide specific gateway deliverables that we trust will be of value to you and your organization. Ultimately, the deliverables will be available to inform and direct discussions in preparation for the next ICC code cycle in January of 2018. You will notice the absence of immediate plans to perform full-scale fire performance testing which was discussed previously. It has become abundantly clear that there is significant work to be completed prior to moving in that direction. Instead, we have developed a research plan to offer more definitive and cost effective answers that are achievable in two years.

### Research Snapshot

To that end, the NASFM Foundation has already commissioned an exhaustive analysis of tradeoffs in the IBC based on both occupancy and building type to provide focus for subsequent phases of the project. This report will be completed by the end of 2015. Utilizing the results of the analysis for clarity, an extensive literature review and report will be completed by mid-year 2016 under the direction of one of the leading academic experts in the field of fire protection engineering. Again, building on the direction gleaned from the code analysis and literature review, computer modeling will be undertaken by the same academic expert in an effort to test the theories resulting from in the previous work. The literature review and subsequent modeling will be initiated in January of 2016, with completed reports provided by mid-year and the end of the calendar year 2016, respectively.

Simultaneously, we will undertake and complete a fourth major deliverable, the NASFM Foundation Safety Layering Matrix. The Matrix will be built, tested, validated and the data fields will be populated with statistically relevant data over the course of 2016 and 2017. The data analysis will be capable of providing project sponsors with a much clearer picture of the existing building stock as it relates to fire protection feature risk and hazard analysis. The analysis of the data will be completed and released by October of 2017 under the direction of leading academic experts in the field of etymological data design and analysis. The Matrix will provide a valuable ongoing means of assessing both proposed and adopted changes to the model codes.

As you may recall, the NASFM Matrix is a computer aided decision-making tool utilizing fire risk indexes, such as those in the International Existing Building Code Section 1401. The Matrix provides code enforcement officials with an efficient and cost-effective means to facilitate the assessment of code compliance and make transparent the effect of alternative fire safety strategies. Functioning similarly to a Layer of Protection Analysis (LOPA), it is designed to minimize the risk of a process by ensuring that adequate safeguards are in place to mitigate the

hazardous consequences of potential incidents. LOPA and the Matrix in the context of building safety, assumes that one or more of the safety measures that are in place in a given structure will fail when needed, so other measures must be in place to ensure preservation of life and property.

The Matrix, through the assessment of over 200 individual building features grouped within 19 critical building and life safety categories, provides a holistic assessment of a building's overall safety, including property conservation and resiliency. As a web-based tool, the data on each building assessed for each of the building features analyzed provides a wealth of information. The Matrix, when completed, will provide clarity on the current status of our building stock and shed critical light on potential life safety issues associated with the ever increasing use of sprinkler "trade-offs". I encourage each of you to visit the NASFM Foundation Safety Layering website at [www.safetylayering.com](http://www.safetylayering.com) to explore the educational tools and experience the proof of concept "B" Occupancy Matrix for yourself. I'm sure you will see the benefit of getting this technology into the field.

As you can see, the proposed plan is aggressive. It is purposely designed that way in an effort to provide answers to critical life safety questions sooner rather than later. It is simply too important to hesitate and watch another code cycle come and go without finding answers about the safety of the public and the resiliency of our buildings. We look forward to detailing this research plan when we meet in Denver October 29<sup>th</sup>. Until then, please do not hesitate to contact us if we can be of any assistance.

## **Research Methodology**

This proposed research effort, though potentially a more involved multi-year project, will focus solely on year one and two efforts with completion being the end of the 2017 calendar year. This aggressive timeline comes with an understanding of the need to provide valid scientific answers as we enter the 2018 state code adoption cycles and prepare for subsequent ICC code development proceedings. At that point, a clearly defined and scientifically valid analysis of holistic fire safety integration will have been completed. We will have a better understanding of how this holistic research efforts affects life safety, building resiliency and property conservation. Full-scale live fire testing may be warranted after years one and two are completed to answer identified knowledge gaps exposed through year one and two research. This determination will be made following the completion of the year two deliverables.

The research plan encompasses two main areas of importance which will be undertaken concurrently:

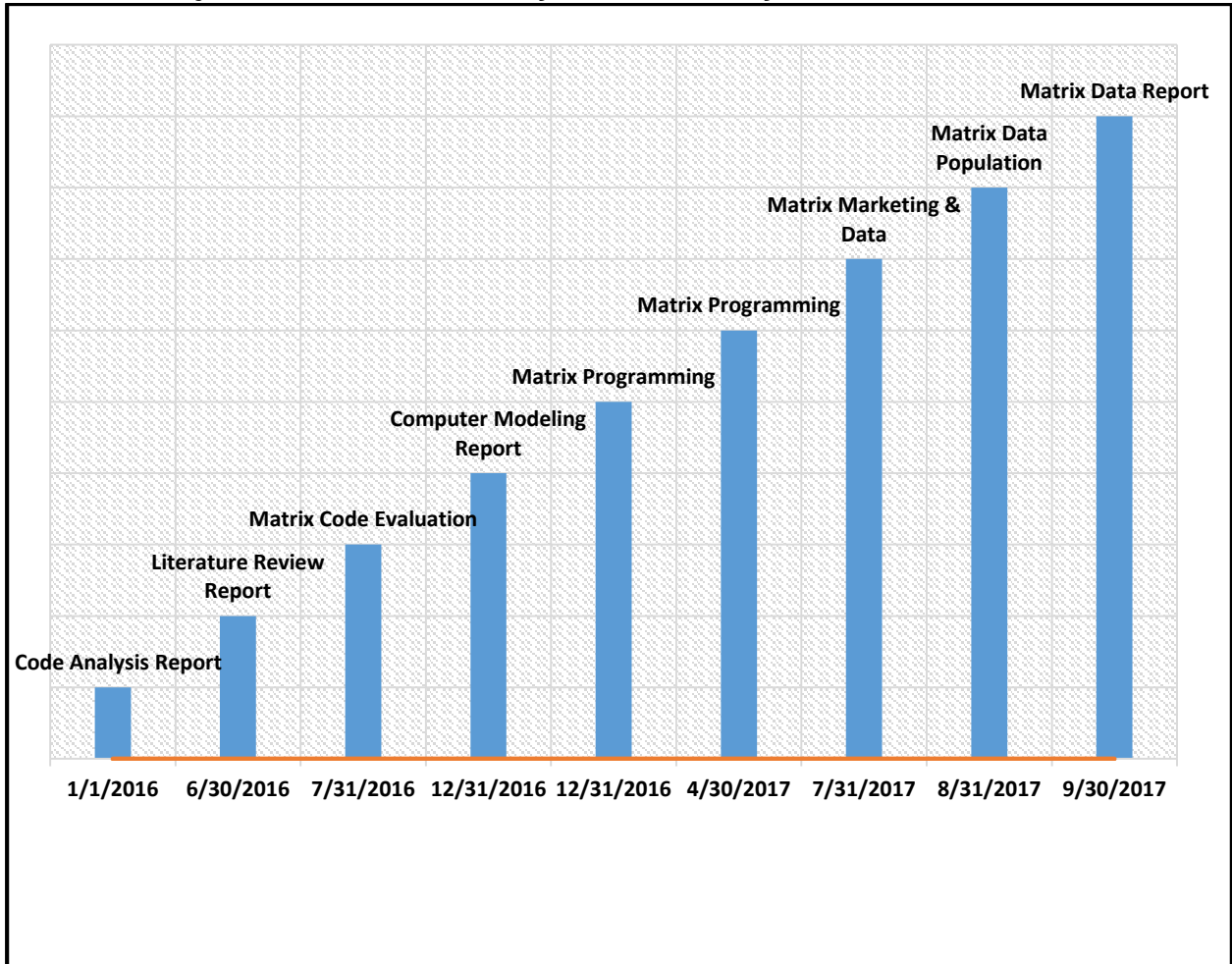
- Emphasis "A" involves the completion of a full academic research effort including an extensive literature review and computer fire modeling performed under the direction of an experienced Principal Investigator (PI). Utilizing the results of the already initiated preparatory code analysis to inform and focus the literature review, a thorough evaluation will provide direction and scope for a computer modeling analysis. Comprehensive peer-reviewed reports will be generated and made available to project sponsors following both the literature review and computer modeling phases.
- Emphasis "B" is the development and deployment of the NASFM Safety Layering Risk Assessment tool (The "Matrix"). Utilizing an initial investment from FEMA Fire Act Grant funds, the NASFM Foundation assembled a team of subject matter experts who

developed, field tested, and released a computer application “app” for use in existing [B] Business group occupancy structures. The app utilizes a series of fill in the blank questions which allows users the ability to carefully and accurately assess the fire and life safety features of a building, consistent with performing a Layer of Protection Analysis (LOPA) as a Fire Protection Engineer.

This effort will allow completion of the code interpretation and software development process to expand the laptop and tablet app to include the remaining International Existing Building Code (IEBC) occupancy groups. The web-based application will also be populated utilizing a valid representative sample of fire departments and existing buildings. This will allow us to gain an understanding of common safety layering shortcomings and strengths present in existing buildings in a more expedient way than waiting for it to be completely populated by fire departments across the nation.

The research plan is detailed through the use of various project phases and deliverables, supplemented by budget figures for each phase. This is followed by supporting budget documents in Appendix “A”

**Chart 1 - Project Timeline & Gateway Event Delivery**



Detailed within the Project FAIL-SAFE timeline are 9 sequential project delivery dates. Each delivery date represents a measurable product delivery which is tied directly to a specific project phase detailed later in this prospectus.

## Research Plan

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### Year One Planning Cycle

#### Preparatory Work

**Already in Progress - Completion January 1, 2016**  
**DELIVERABLE: Code Analysis Report**

1. Through code analysis we will determine which building types appear to be most vulnerable to the effects of fire in the event of a power, water, or sprinkler system failure.
  - a. This will be based on a holistic building view after assessing the number and extent of the sprinkler “trade-offs” associated with a combination of the following:
    - i. Type of building
    - ii. Type of occupancy
  - b. A coordinated analysis encompassing “trade-offs” allowed for both the construction type and occupancy use will be used to determine the assumed vulnerability associated with possible building/occupancy combinations.
  - c. Review and approval of the analysis will be directed by the NASFM Model Codes Committee.

**DELIVERABLE: Final output will be a comprehensive chart detailing sprinkler tradeoffs allowed by occupancy type & building type, and analysis of those combinations with the highest risk potential.**

#### Phase A-1

**January 1, 2016 - June 30, 2016**  
**DELIVERABLE: Literature Review Report**

1. A literature review will be commissioned to further investigate the findings of the NASFM Foundation code analysis report. Oversight of the literature review will be performed by the NASFM Foundation.
  - a. Under the direction of a Principal Investigator (PI) with extensive experience in both fire protection engineering and research, work will be accomplished to answer the following broad questions:
    - i. Is there precedence for research of this specific type?
    - ii. What do we already know about holistic building safety, resiliency and preservation?

- iii. What assumptions can be made based on what we already know?
- iv. Ultimately, we will identify if there is a knowledge gap in this area.
  1. Identified gaps will be subject to further investigation through computer modeling and/or fire testing efforts.
- b. A combination of research assistants (RA) equal to a full time employee (FTE), will include MS, PhD, and post-doctoral personnel. All personnel will be selected by the PI with approval by NASFM Foundation personnel.

**DELIVERABLE: Final output of the literature review will be a technical, peer reviewed report summary detailing the nature of the problem, findings and recommended further actions.**

2. Based on the findings of the code analysis and literature review, an NFPA data search will be commissioned to help determine national information relative to “real world” incidents of fire in the identified building types.
3. Simultaneously, the Fire Marshal Offices from all 50 states will be surveyed in an attempt to identify relevant fire events that bear further investigation within the parameters of the research project.
  - a. The attempt is to use investigation and response reports to “inform” the NFPA data trends in support of the literature review findings.

**DELIVERABLE: Following evaluation of the compiled information detailed above, a research hypothesis will be developed in an attempt to define the value of safety layering features in the identified building and occupancy types.**

- b. Developed with assistance of the Principal Investigator
- c. Evaluated by Fire Protection Engineers and Architects
- d. Validated by fire service professionals (Fire Chiefs, Fire Marshals)

## **Phase A-2**

**July 1, 2016 - December 31, 2016**  
**DELIVERABLE: Computer Modeling Report**

1. Utilizing the information gained in the Preparatory and Phase A-1 steps, targeted computer modeling will be designed and performed to test the research hypothesis. The goal is to further answer identified knowledge gaps and, if needed, provide an educated direction and plan for full-scale fire testing.
  - a. Modeling will be performed under the direction of the Principal Investigator (PI) with a combination of research assistants equal to a FTE. The RA(s) will again include a combination of MS, PhD, and post-doctoral personnel.



- i. Dependent upon information developed during the code analysis and literature review phases, modeling may be used to address the effects associated with one or both of the following areas;
  1. The movement of the fire and fire by-products of a fire event (smoke and heated gas movement) as they impact detection, evacuation, compartmentation and suppression;
  2. The consequences experienced by individual building assemblies, as well as the structure holistically, when exposed to the same type fire event.

**DELIVERABLE: Final output will be a technical, peer reviewed report summary detailing the identified knowledge gaps, identified strengths and weaknesses associated with both passive and active fire protection systems, direction on the inter-related nature as it relates to trade-offs, and recommended further actions.**

### **Phase B-1**

**January 1, 2016 - July 31, 2016**

**DELIVERABLE: Code analysis for the remaining 15 ICC occupancy types**

1. We will reassemble our code evaluation project team from the previous federal government funded proof of concept project to undertake the evaluation of the remaining International Building Code (now International Existing Building Code) occupancy types for incorporation into the software design to complete the Matrix.
  - a. A meeting will take place to coordinate planning, timeline, and methodology between Project Manager, code evaluation team, and software development company.
  - b. Goals and roles will be clearly established following the completion of this meeting.

**DELIVERABLE: Final output will consist of a risk analysis tool developed for the remaining 15 ICC occupancy types based on the 19 critical life safety features assessed in the IBC.**

### **PHASE B-2 Part 1**

**August 1, 2016 – December 31, 2016**

**DELIVERABLE: Software development of the first 7 ICC occupancy types**

1. Software developers will undertake, in consultation with the code evaluation team, development of the programming needed
  - a. Software programming for 7 Occupancy types will be developed at a quoted 100 hours per type for development.

- b. Code evaluation team will ensure validation of software development outcomes in alpha testing.

**DELIVERABLE: The Matrix software programming for 7 of the 15 needed occupancy types will be completed and ready for data population.**

## Year Two Planning Cycle

### Phase B-2 Part 2

January 1, 2017 – April 30, 2017

**DELIVERABLES: Software Development of 8 ICC occupancy types, Data Mgmt. Design**

1. Software developers will undertake, in consultation with the code evaluation team, development of the programming needed
  - a. Software programming for 8 Occupancy types will be developed at a quoted 100 hours per type for development.
  - b. Code evaluation team will ensure validation of software development outcomes.

**DELIVERABLE: The Matrix software programming for 8 of the 15 occupancy types will be completed and ready for data population.**

2. Project Manager will initiate work with academic personnel with extensive education and experience in etymological data analysis to determine parameters for population of Matrix data fields.
  - a. A representative sample of fire departments based on department and community demographics, building inventory, legacy code enforced and enforcement climate, among others, will be selected.
    - i. Final output of the design will provide organized data for use by project participants upon completion of data input.

**DELIVERABLE: Matrix data management design will be finalized and incorporated into software programming.**

### **Phase B-3**

**May 1, 2017 - July 31, 2017**

**DELIVERABLE: Marketing Strategy Developed and Executed**

1. The Project Manager and marketing contractor will develop and produce a coordinated marketing strategy for use with the Project FAIL-SAFE deliverables to gain broad acceptance and use.
  - a. Includes a national, state and local roll-out strategy
  - b. Mixed media strategy to include:
    - i. Branding and product recognition
    - ii. Targeted social media, including video development and release
    - iii. Trade publication articles and advertising
    - iv. Presentation at national fire and building services conferences
    - v. Marketing materials for state and local roll-out campaigns

**DELIVERABLE: A project marketing strategy with accompanying materials will be completed for use at the local, state, and national code development levels.**

### **Phase B-4**

**May 1, 2017 – August 31, 2017**

**DELIVERABLE: Matrix Data Population**

1. Once beta testing is completed, the decision-making tool will be provided for use in 10 selected communities throughout the country for use in documenting targeted buildings within their jurisdiction.
  - a. Selected communities will be representative of a valid sample for statistical purposes as determined in PHASE I “B”, Step 2a.
  - b. Each community will be asked to complete a pre-determined number of inspections based on needs for statistical sampling.
2. As an incentive for participation, each jurisdiction will be eligible to receive up to \$3000.00 in equipment purchases necessary for completion of the assignment.

**DELIVERABLE: Upon completion, the NASFM Foundation Matrix will be populated with representative data suitable for analytic assessment. The Matrix will also be made available free of charge to the fire service to aid in building risk assessment and hazard identification in their communities.**

## **Phase B-5**

**September 1, 2017 – September 30, 2017**

**DELIVERABLE: Matrix Data Final Analysis Report**

1. The NASFM Foundation, with the assistance of a recognized national expert in data analytics, will finalize work on producing a final report outlining the results of the data collection project.
2. Project sponsors will be provided with the Matrix data final analysis report for review and comment.

**DELIVERABLE: Project sponsors will receive a data analysis report detailing trends, strengths, and weaknesses inherent in the national existing building stock.**

## **Future Research Opportunities**

Phases C-1 and C-2 should not be considered part of the proposed FAIL-SAFE research project and are provided here solely as informational in nature should the cumulative results of the proposed two year research plan expose knowledge gaps of a significant nature. Should this situation arise, the NASFM Foundation will seek to leverage the research work previously completed to obtain funding from various sources including federal grant programs and industry partnerships.

### **Phase C-1**

1. If research in the form of the literature review, computer modeling and Matrix data analysis identify a knowledge gap that warrants further study, full-scale fire performance testing will be undertaken.
  - a. The fire performance testing will be undertaken under the direction of a certified third party testing facility, selected through a competitive bid process.
  - b. The fire performance testing will be developed to test the research hypothesis developed in Phase I, Step 4 during the first year activities.
    - i. This effort may characterize and quantify increased fire hazards or risks, or decreased building fire performance, associated with the use of automatic fire sprinkler system “trade-offs” in commercial buildings.
      1. The safe level of individual passive fire protection system usage may be identified and addressed in subsequent code adoption cycles resulting in a reduction of allowable “trade-offs”.
    - ii. This effort may characterize and quantify the presence of acceptable risk levels relative to fire hazards or risks, or decreased building fire performance, resulting from the proper design, installation and maintenance of fire protection sprinkler systems.
      1. Design, installation and maintenance issues and obstacles may be identified and addressed in subsequent code adoption cycles.
    - iii. This effort may characterize and quantify acceptable levels of fire and life safety associated with the use of automatic fire sprinkler systems regardless of the number and type of passive fire protection system “trade-offs” allowed.
      1. The increased installation of automatic fire protection sprinklers may be expanded to additional occupancy use and building construction types.

### **Phase C-2**

1. Results obtained during Phase C-1 will be evaluated and used to validate, and amend where needed, fire risk factors used by the NASFM Foundation Safety Layering Matrix for existing buildings.
  - a. The validated amended values may be used in subsequent code adoption cycles to justify code corrections relating to fire protection system integration.

2. Results from previous research will be used to provide the basis for discussion and development of a numerical point system for evaluation of fire protection features and systems.
  - a. The acquired numerical point system will be utilized to expand the NASFM Matrix for use in new construction and design.
  - b. The newly established building and design values may be used in subsequent code adoption cycles to justify code corrections relating to fire protection system integration.