

**Federal Building and Fire Safety Investigation  
of the World Trade Center Disaster**

**Project 7 – Occupant Behavior, Egress, and  
Emergency Communications**

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# Introduction

- One of the largest evacuation studies ever conducted
- Multidisciplinary approach is bridging knowledge and expertise in a new and innovative way
- Coordinated with other WTC studies in order to reduce respondent burden:
  - Columbia University
  - Centers for Disease Control and Prevention

# Purpose

To document egress by gathering and analyzing information about:

- evacuation systems, emergency communications, and human factors, and
- occupant location, evacuation experience, and observed building conditions, and
- interaction between occupants, first responders, and the buildings.

## Desired Outcomes

- Enhanced evacuation systems
- Enhanced safety of occupants

**Make all buildings safer  
for occupants and first responders**

# First Person Data Collection

- Essex IRB Approval – Complete
- NIST Institutional Review Approval – Complete
- Interviewer Training – Complete
- First Interviews – Under way
- Targeted Completion Date – January 2004

# Interviewer Training

- Investigation Overview
- Action-Cue-Goal Training
- Cognitive Interview Techniques
- Computer Application
- The World Trade Center and September 11<sup>th</sup>
- Occupant Behavior, Egress and Emergency Communications
- Human Subjects Protocols
- Dealing with Stress
- Practice, Practice, Practice
- Group Debrief

# Occupant Identification for Face-to-face Interviews

- Volunteers Solicited at Public Update in New York City on September 17, 2003
  - 1 (877) 221-7828 Occupants and Victims' Families
  - 1 (888) 804-7581 Anonymous tip line
  - <https://wtc.nist.gov/family> Victims' Families
- 260 Volunteers, 167 Meet Study Criteria, Including 26 Family Members (As of November 17, 2003)
- Snowball Sampling, Badge List, Published Accounts, and Telephone Interviews Will Complete Occupant Identification

# Analysis of Published Accounts

- 726 Accounts from Books, Newspapers, Television, Magazines, Emails, Websites, and other sources
- 465 Individual People, 435 Occupants Inside Towers
- 33 Coding Variables - Consistent with Subsequent NIST Qualitative Data Analysis Plan
- Work Performed by NFPA Under Contract to NIST



# Limitations of Published Accounts

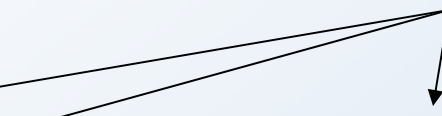
- Questions to Respondents are Unknown
- Not Generalizable Outside the Population
- Missing Data

This is one of many sources of data to be used in the NIST-led Investigation

# Analysis of Published Accounts

## Example of Data Matrix

## Coding Variables



ID #	Building	Floor	Sex	1st cue
1	conc	conc	f	smoke
2	1	78	m	swaying
3	1	91	m	roar of engine, impact - bldg shook, moved, oscillated; interior wall and ceiling of office came down
4	1	91	f	roar of engine; saw wing and tail
5	2	21	m	loud boom; colleagues said they saw fire high above in T1



Includes Name and Source

# Interim Findings from Analysis of Published Results

- Of the 96 people from Tower 2 who reported hearing an announcement to 'stay or return to their office,' a majority (69 people) decided to disregard and continue their evacuation.
- Of the 27 people reporting a disability and 47 reporting an injury, all were supported in their evacuation by their coworkers.
- Many people (143 in Tower 1 and 26 in Tower 2) mentioned being reassured and feeling safe when meeting firefighters in the building.

# Interim Findings from Analysis of Published Results

## Obstructions Encountered during Evacuation

	Tower 1, N=153	Tower 2, N=59	Both, N=212
Crowds/injured in stairs	46% (71)	46% (27)	46% (98)
Smoke	32% (49)	37% (22)	33% (71)
Debris	24% (36)	36% (21)	27% (57)
No power	13% (20)	14% (8)	13% (28)
Trapped	12% (19)	10% (6)	11% (25)
Door jammed/locked	13% (20)	3% (2)	10% (22)
Fire	7% (11)	14% (8)	9% (19)

# Completed Document Collection

- Published Accounts
- 9-1-1 Emergency Call Records
- OSHA Filings by Survivors and Families
- Communications Tapes from FDNY and Port Authority
- Design and Procedural Records for Emergency Evacuation
- Photographic and Video Evidence

# Evacuation Modeling of the WTC Towers

## 3 Classes of Models

- Movement (M): simulates movement of occupants only
- Partial Behavioral (PB): simulates movement and partial behavior by including delay times, smoke effects to occupants, occupant characteristics, etc.
- Behavioral (B): simulates movement and actual evacuation decisions and activities

## 3 Models Chosen

- EVACNET4 (M)
- EXIT89 (PB)
- buildingEXODUS (B)

Modeling efforts are under way

# Status of Project 7

- First Person Data Collection Under Way
- Further Analysis of Published and Other Accounts Underway
- Egress Modeling Under Way