

NIST NCSTAR 1-8 (Draft)

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

The Emergency Response Operations (Draft)

J. Randall Lawson
Robert L. Vettori

For Public Comment

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Building and Fire Research Laboratory

National Institute of Standards and Technology

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Phillip J. Bond, Under Secretary for Technology

National Institute of Standards and Technology
Hratch G. Semerjian, Acting Director

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CONTRIBUTORS

NIST Personnel

- J. Randall Lawson, leader, data collection, investigation, first-person interviews, analysis and report preparation.
- Robert L. Vettori, data collection, investigation, first-person interviews, analysis, and report preparation.
- Stephen A. Cauffman, first-person interviews and data collection.
- Schuyler Ruitberg, transcribed audio recordings and emergency response data files.
- Lisa Petersen, transcribed audio recordings and emergency response data files.
- Jason Averill, coordinated contractor data collection and coordination on occupant behavior, egress, and emergency communications.

NIST Emergency Responder Experts

The following personnel provided expert views related to the investigation's planning, data gathering, and review of information.

- Vincent Dunn, retired Chief Officer, New York City Fire Department (FDNY)
- John J. Hodgins, retired Chief Officer, (FDNY)
- Kevin S. Malley, retired Director of Human Performance, (FDNY)

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DEDICATION

On September 11, 2001, the City of New York was attacked by terrorists who flew large commercial aircraft into the twin towers of the World Trade Center. Immediately, emergency responders from across the city began operations to protect the citizens of New York City and to save lives at the World Trade Center. With these efforts, many emergency responders gave their lives, and many more were seriously injured. The injuries from this attack were more than physical. The emotional toll for these emergency responders and their families will always be with them. This report is dedicated to all the emergency responders who lost their lives that morning, to all emergency responders who were injured, and to all emergency responders and the families who live with the anguish caused by this attack.

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ABSTRACT

The September 11, 2001, attack on the World Trade Center (WTC) caused the deaths of 2,749 people. Included in the group were approximately 421 emergency responders from The Fire Department of the City of New York (FDNY), The New York City Police Department (NYPD), the Port Authority Police Department (PAPD), The Port Authority of New York and New Jersey (PANYNJ), from WTC security firms, and volunteer emergency responders who were in the WTC area of the city when the attack occurred. This report addresses the operations of these emergency responders, the technologies used during WTC operations, and the guidelines and practices that governed these operations. The objectives of this study were to 1) fully document what happened during the response by the emergency services to the attacks on the WTC, up to the time of collapse of WTC 7; (2) identify issues that need to be addressed in changes to practice, standards, and codes; (3) identify alternative practices and/or technologies that may address these issues; and (4) identify R&D needs that advance the safety of the fire service in responding to massive fires in tall buildings.

The approach taken was to conduct a comprehensive search for data related to the emergency response on September 11, 2001, analyze the data, and report on the findings. Data gathering included the collection of written documents, electronic recordings, visual data (both photographs and video), and first-person accounts of what happened during WTC operations. Results from this investigation show that the emergency responders were faced with the greatest disaster of the last 100 years in the United States. The emergency responders had one common focus: to save as many victims of this attack as possible. During the response, emergency responders had to function under war-like conditions as they carried out their rescue and evacuation efforts. Emergency responders operated with equipment, human endurance, and emergency response practices that were stretched well beyond normal limits. This report discusses how the emergency response activities and equipment were challenged. The emergency responders paid a heavy price in the loss of hundreds of their own lives when the WTC buildings collapsed.

This study focused on the following topics:

- emergency responder dispatch and response to the WTC
- emergency responder access to the WTC site and towers
- command and control associated with the emergency response
- communications during operations and the of communications in tall buildings
- firefighting in high-rise buildings and the evacuation from the WTC towers
- emergency responder situational awareness and the physiological impact of conducting operations in tall buildings

Keywords: Buildings, emergency responders, emergency medical service, evacuation, firefighters, firefighting, police, rescue, search, World Trade Center.

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronyms

EMS	Emergency Medical Services
ESU	New York City Police Department and PATH Police, Emergency Service Unit
FDNY	The Fire Department of the City of New York
HAZMAT	Hazards Materials
HT	Handie-talkie radio
HVAC	Heating Ventilation and Air Conditioning System
ICP	Incident Command Post
ICS	Incident Command System
NIST	National Institute of Standards and Technology
NYPD	The New York City Police Department
OEM	New York City Office of Emergency Management
PANYNJ	The Port Authority of New York and New Jersey
PAPD	Port Authority Police Department
PATH	Port Authority Trans-Hudson Transportation System
SCBA	Self-Contained Breathing Apparatus
UHF	Ultra-high Frequency Radio, frequencies from 300 to 3000 MHz
VHF	Very-high Frequency Radio, frequencies from 30 to 300 MHz
WFC	World Financial Center at the World Trade Center Complex
WTC 1	World Trade Center 1 (North Tower)
WTC 2	World Trade Center 2 (South Tower)
WTC 7	World Trade Center 7

Abbreviations

ft	foot
gal	gallon
in	inch
kg	kilogram
l	liter

lb	pound
m	meter
MHz	Megahertz
min	minute
mm	millimeter

METRIC CONVERSION TABLE

To convert from	to	Multiply by
-----------------	----	-------------

AREA AND SECOND MOMENT OF AREA

square foot (ft ²)	square meter (m ²)	9.290 304 E-02
square inch (in. ²)	square meter (m ²)	6.4516 E-04
square inch (in. ²)	square centimeter (cm ²)	6.4516 E+00
square yard (yd ²)	square meter (m ²)	8.361 274 E-01

ENERGY (includes WORK)

kilowatt hour (kW · h)	joule (J)	3.6 E+06
quad (1015 BtuIT)	joule (J)	1.055 056 E+18
therm (U.S.)	joule (J)	1.054 804 E+08
ton of TNT (energy equivalent)	joule (J)	4.184 E+09
watt hour (W · h)	joule (J)	3.6 E+03
watt second (W · s)	joule (J)	1.0 E+00

FORCE

dyne (dyn)	newton (N)	1.0 E-05
kilogram-force (kgf)	newton (N)	9.806 65 E+00
kilopond (kilogram-force) (kp)	newton (N)	9.806 65 E+00
kip (1 kip=1,000 lbf)	newton (N)	4.448 222 E+03
kip (1 kip=1,000 lbf)	kilonewton (kN)	4.448 222 E+00
pound-force (lbf)	newton (N)	4.448 222 E+00

FORCE DIVIDED BY LENGTH

pound-force per foot (lbf/ft)	newton per meter (N/m)	1.459 390 E+01
pound-force per inch (lbf/in.)	newton per meter (N/m)	1.751 268 E+02

HEAT FLOW RATE

calorieth per minute (calth/min)	watt (W)	6.973 333 E-02
calorieth per second (calth/s)	watt (W)	4.184 E+00
kilocalorieth per minute (kcalth/min)	watt (W)	6.973 333 E+01
kilocalorieth per second (kcalth/s)	watt (W)	4.184 E+03

To convert from	to	Multiply by
------------------------	-----------	--------------------

LENGTH

foot (ft)	meter (m)	3.048 E-01
inch (in)	meter (m)	2.54 E-02
inch (in.)	centimeter (cm)	2.54 E+00
micron (m)	meter (m)	1.0 E-06
yard (yd)	meter (m)	9.144 E-01

MASS and MOMENT OF INERTIA

kilogram-force second squared per meter ($\text{kgf} \cdot \text{s}^2/\text{m}$)	kilogram (kg)	9.806 65 E+00
pound foot squared ($\text{lb} \cdot \text{ft}^2$)	kilogram meter squared ($\text{kg} \cdot \text{m}^2$)	4.214 011 E-02
pound inch squared ($\text{lb} \cdot \text{in.}^2$)	kilogram meter squared ($\text{kg} \cdot \text{m}^2$)	2.926 397 E-04
ton, metric (t)	kilogram (kg)	1.0 E+03
ton, short (2,000 lb)	kilogram (kg)	9.071 847 E+02

MASS DIVIDED BY AREA

pound per square foot (lb/ft^2)	kilogram per square meter (kg/m^2)	4.882 428 E+00
pound per square inch (<i>not</i> pound force) ($\text{lb}/\text{in.}^2$)	kilogram per square meter (kg/m^2)	7.030 696 E+02

MASS DIVIDED BY LENGTH

pound per foot (lb/ft)	kilogram per meter (kg/m)	1.488 164 E+00
pound per inch ($\text{lb}/\text{in.}$)	kilogram per meter (kg/m)	1.785 797 E+01
pound per yard (lb/yd)	kilogram per meter (kg/m)	4.960 546 E-01

PRESSURE or STRESS (FORCE DIVIDED BY AREA)

kilogram-force per square centimeter (kgf/cm^2)	pascal (Pa)	9.806 65 E+04
kilogram-force per square meter (kgf/m^2)	pascal (Pa)	9.806 65 E+00
kilogram-force per square millimeter (kgf/mm^2)	pascal (Pa)	9.806 65 E+06
kip per square inch (ksi) ($\text{kip}/\text{in.}^2$)	pascal (Pa)	6.894 757 E+06
kip per square inch (ksi) ($\text{kip}/\text{in.}^2$)	kilopascal (kPa)	6.894 757 E+03
pound-force per square foot (lbf/ft^2)	pascal (Pa)	4.788 026 E+01
pound-force per square inch (psi) ($\text{lbf}/\text{in.}^2$)	pascal (Pa)	6.894 757 E+03
pound-force per square inch (psi) ($\text{lbf}/\text{in.}^2$)	kilopascal (kPa)	6.894 757 E+00
psi (pound-force per square inch) ($\text{lbf}/\text{in.}^2$)	pascal (Pa)	6.894 757 E+03
psi (pound-force per square inch) ($\text{lbf}/\text{in.}^2$)	kilopascal (kPa)	6.894 757 E+00

To convert from	to	Multiply by
TEMPERATURE		
degree Celsius (°C)	kelvin (K)	$T/K = t/^{\circ}\text{C} + 273.15$
degree centigrade	degree Celsius (°C)	$t/^{\circ}\text{C} \approx t/\text{deg. cent.}$
degree Fahrenheit (°F)	degree Celsius (°C)	$t/^{\circ}\text{C} = (t/^{\circ}\text{F} - 32)/1.8$
degree Fahrenheit (°F)	kelvin (K)	$T/K = (t/^{\circ}\text{F} + 459.67)/1.8$
kelvin (K)	degree Celsius (°C)	$t/^{\circ}\text{C} = T/K - 273.15$
TEMPERATURE INTERVAL		
degree Celsius (°C)	kelvin (K)	1.0 E+00
degree centigrade	degree Celsius (°C)	1.0 E+00
degree Fahrenheit (°F)	degree Celsius (°C)	5.555 556 E-01
degree Fahrenheit (°F)	kelvin (K)	5.555 556 E-01
degree Rankine (°R)	kelvin (K)	5.555 556 E-01
VELOCITY (includes SPEED)		
foot per second (ft/s)	meter per second (m/s)	3.048 E-01
inch per second (in./s)	meter per second (m/s)	2.54 E-02
kilometer per hour (km/h)	meter per second (m/s)	2.777 778 E-01
mile per hour (mi/h)	kilometer per hour (km/h)	1.609 344 E+00
mile per minute (mi/min)	meter per second (m/s)	2.682 24 E+01
VOLUME (includes CAPACITY)		
cubic foot (ft ³)	cubic meter (m ³)	2.831 685 E-02
cubic inch (in. ³)	cubic meter (m ³)	1.638 706 E-05
cubic yard (yd ³)	cubic meter (m ³)	7.645 549 E-01
gallon (U.S.) (gal)	cubic meter (m ³)	3.785 412 E-03
gallon (U.S.) (gal)	liter (L)	3.785 412 E+00
liter (L)	cubic meter (m ³)	1.0 E-03
ounce (U.S. fluid) (fl oz)	cubic meter (m ³)	2.957 353 E-05
ounce (U.S. fluid) (fl oz)	milliliter (mL)	2.957 353 E+01

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PREFACE

Genesis of This Investigation

Immediately following the attack on the World Trade Center (WTC) on September 11, 2001, the Federal Emergency Management Agency (FEMA) and the American Society of Civil Engineers began planning a building performance study of the disaster. The week of October 7, as soon as the rescue and search efforts ceased, the Building Performance Study Team went to the site and began their assessment. This was to be a brief effort, as the study team consisted of experts who largely volunteered their time away from their other professional commitments. The Building Performance Study Team issued their report in May 2002, fulfilling their goal “to determine probable failure mechanisms and to identify areas of future investigation that could lead to practical measures for improving the damage resistance of buildings against such unforeseen events.”

On August 21, 2002, with funding from the U.S. Congress through FEMA, the National Institute of Standards and Technology (NIST) announced its building and fire safety investigation of the WTC disaster. On October 1, 2002, the National Construction Safety Team Act (Public Law 107-231), was signed into law. (A copy of the Public Law is included in Appendix A.) The NIST WTC Investigation was conducted under the authority of the National Construction Safety Team Act.

The goals of the investigation of the WTC disaster were:

- To investigate the building construction, the materials used, and the technical conditions that contributed to the outcome of the WTC disaster.
- To serve as the basis for:
 - Improvements in the way buildings are designed, constructed, maintained, and used;
 - Improved tools and guidance for industry and safety officials;
 - Recommended revisions to current codes, standards, and practices; and
 - Improved public safety.

The specific objectives were:

1. Determine why and how WTC 1 and WTC 2 collapsed following the initial impacts of the aircraft and why and how WTC 7 collapsed;
2. Determine why the injuries and fatalities were so high or low depending on location, including all technical aspects of fire protection, occupant behavior, evacuation, and emergency response;
3. Determine what procedures and practices were used in the design, construction, operation, and maintenance of WTC 1, 2, and 7; and
4. Identify, as specifically as possible, areas in current building and fire codes, standards, and practices that warrant revision.

NIST is a nonregulatory agency of the U.S. Department of Commerce's Technology Administration. The purposes of NIST investigations under the National Construction Safety Team Act are to improve the safety and structural integrity of buildings in the United States, and the focus is on fact finding. NIST investigative teams are required to assess building performance and emergency response and evacuation procedures in the wake of any building failure that has resulted in substantial loss of life or that posed significant potential of substantial loss of life. NIST does not have the statutory authority to make findings of fault or negligence by individuals or organizations. Further, no part of any report resulting from a NIST investigation into a building failure or from an investigation under the National Construction Safety Team Act may be used in any suit or action for damages arising out of any matter mentioned in such report (15 USC 281a, as amended by Public Law 107-231).

Organization of the Investigation

The National Construction Safety Team for this Investigation, appointed by the NIST Director, was led by Dr. S. Shyam Sunder. Dr. William L. Grosshandler served as Associate Lead Investigator, Mr. Stephen A. Cauffman served as Program Manager for Administration, and Mr. Harold E. Nelson served on the team as a private sector expert. The Investigation included eight interdependent projects whose leaders comprised the remainder of the team. A detailed description of each of these eight projects is available at <http://wtc.nist.gov>. The purpose of each project is summarized in Table P-1, and the key interdependencies among the projects are illustrated in Figure P-1.

Table P-1. Federal building and fire safety investigation of the WTC disaster.

Technical Area and Project Leader	Project Purpose
Analysis of Building and Fire Codes and Practices; Project Leaders: Dr. H. S. Lew and Mr. Richard W. Bukowski	Document and analyze the code provisions, procedures, and practices used in the design, construction, operation, and maintenance of the structural, passive fire protection, and emergency access and evacuation systems of WTC 1, 2, and 7.
Baseline Structural Performance and Aircraft Impact Damage Analysis; Project Leader: Dr. Fahim H. Sadek	Analyze the baseline performance of WTC 1 and WTC 2 under design, service, and abnormal loads, and aircraft impact damage on the structural, fire protection, and egress systems.
Mechanical and Metallurgical Analysis of Structural Steel; Project Leader: Dr. Frank W. Gayle	Determine and analyze the mechanical and metallurgical properties and quality of steel, weldments, and connections from steel recovered from WTC 1, 2, and 7.
Investigation of Active Fire Protection Systems; Project Leader: Dr. David D. Evans	Investigate the performance of the active fire protection systems in WTC 1, 2, and 7 and their role in fire control, emergency response, and fate of occupants and responders.
Reconstruction of Thermal and Tenability Environment; Project Leader: Dr. Richard G. Gann	Reconstruct the time-evolving temperature, thermal environment, and smoke movement in WTC 1, 2, and 7 for use in evaluating the structural performance of the buildings and behavior and fate of occupants and responders.
Structural Fire Response and Collapse Analysis; Project Leaders: Dr. John L. Gross and Dr. Therese P. McAllister	Analyze the response of the WTC towers to fires with and without aircraft damage, the response of WTC 7 in fires, the performance of composite steel-trussed floor systems, and determine the most probable structural collapse sequence for WTC 1, 2, and 7.
Occupant Behavior, Egress, and Emergency Communications; Project Leader: Mr. Jason D. Averill	Analyze the behavior and fate of occupants and responders, both those who survived and those who did not, and the performance of the evacuation system.
Emergency Response Technologies and Guidelines; Project Leader: Mr. J. Randall Lawson	Document the activities of the emergency responders from the time of the attacks on WTC 1 and WTC 2 until the collapse of WTC 7, including practices followed and technologies used.

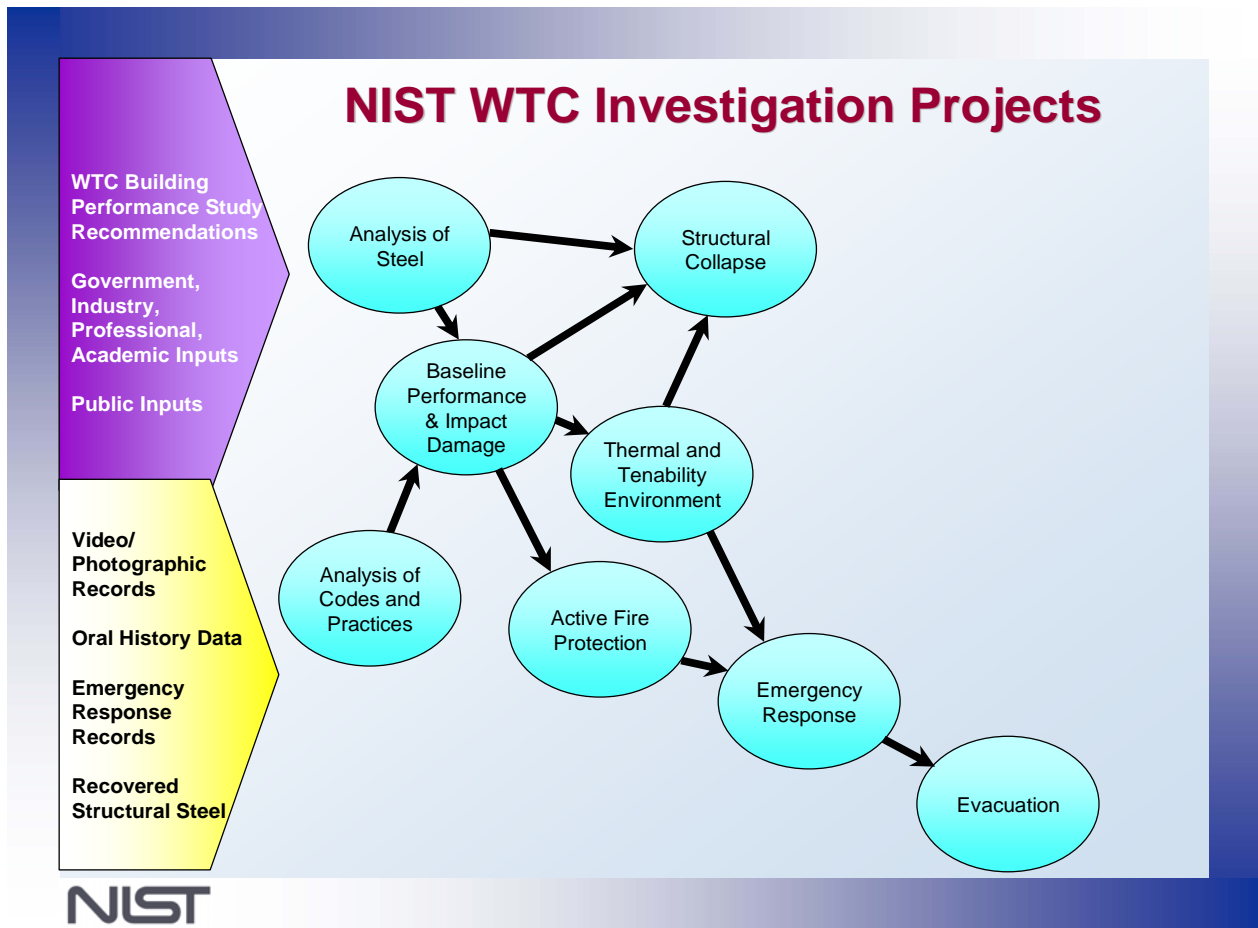


Figure P-1. The eight projects in the federal building and fire safety investigation of the WTC disaster.

National Construction Safety Team Advisory Committee

The NIST Director also established an advisory committee as mandated under the National Construction Safety Team Act. The initial members of the committee were appointed following a public solicitation. These were:

- Paul Fitzgerald, Executive Vice President (retired) FM Global, National Construction Safety Team Advisory Committee Chair
- John Barsom, President, Barsom Consulting, Ltd.
- John Bryan, Professor Emeritus, University of Maryland
- David Collins, President, The Preview Group, Inc.
- Glenn Corbett, Professor, John Jay College of Criminal Justice
- Philip DiNenno, President, Hughes Associates, Inc.

- Robert Hanson, Professor Emeritus, University of Michigan
- Charles Thornton, Co-Chairman and Managing Principal, The Thornton-Tomasetti Group, Inc.
- Kathleen Tierney, Director, Natural Hazards Research and Applications Information Center, University of Colorado at Boulder
- Forman Williams, Director, Center for Energy Research, University of California at San Diego

This National Construction Safety Team Advisory Committee provided technical counsel during the Investigation and commentary on drafts of the Investigation reports prior to their public release.

Public Outreach

During the course of this Investigation, NIST held public briefings and meetings (listed in Table P–2) to solicit input from the public, present preliminary findings, and obtain comments on the direction and progress of the Investigation from the public and the Advisory Committee.

NIST maintained a publicly accessible Web site during this Investigation at <http://wtc.nist.gov>. The site contained extensive information on the background and progress of the Investigation.

NIST’s WTC Public-Private Response Plan

The collapse of the WTC buildings has led to broad reexamination of how tall buildings are designed, constructed, maintained, and used, especially with regard to major events such as fires, natural disasters, and terrorist attacks. Reflecting the enhanced interest in effecting necessary change, NIST, with support from Congress and the Administration, has put in place a program, the goal of which is to develop and implement the standards, technology, and practices needed for cost-effective improvements to the safety and security of buildings and building occupants, including evacuation, emergency response procedures, and threat mitigation.

The strategy to meet this goal is a three-part NIST-led public-private response program that includes:

- A federal building and fire safety investigation to study the most probable factors that contributed to post-aircraft impact collapse of the WTC towers and the 47-story WTC 7 building, and the associated evacuation and emergency response experience.
- A research and development (R&D) program to (a) facilitate the implementation of recommendations resulting from the WTC Investigation, and (b) provide the technical basis for cost-effective improvements to national building and fire codes, standards, and practices that enhance the safety of buildings, their occupants, and emergency responders.

Table P–2. Public meetings and briefings of the WTC Investigation.

Date	Location	Principal Agenda
June 24, 2002	New York City, NY	Public meeting: Public comments on the <i>Draft Plan</i> for the pending WTC Investigation.
December 9, 2002	Washington, DC	Media briefing on release of the <i>Public Update</i> and NIST request for photographs and videos.
April 8, 2003	New York City, NY	Joint public forum with Columbia University on first-person interviews.
April 29-30, 2003	Gaithersburg, MD	National Construction Safety Team (NCST) Advisory Committee meeting on plan for and progress on WTC Investigation with a public comment session.
May 7, 2003	New York City, NY	Media briefing on release of the <i>May 2003 Progress Report</i>
August 26-27, 2003	Gaithersburg, MD	NCST Advisory Committee meeting on status of WTC investigation with a public comment session.
September 17, 2003	New York City, NY	Media briefing and public briefing on initiation of first-person data collection projects.
December 2-3, 2003	Gaithersburg, MD	NCST Advisory Committee meeting on status and initial results and the release of the <i>Public Update</i> with a public comment session.
February 12, 2004	New York City, NY	Public meeting: Briefing on progress and preliminary findings with public comments on issues to be considered in formulating final recommendations.
June 18, 2004	New York City, NY	Media briefing and public briefing on release of the <i>June 2004 Progress Report</i> .
June 22-23, 2004	Gaithersburg, MD	NCST Advisory Committee meeting on the status of and preliminary findings from the WTC Investigation with a public comment session.
August 24, 2004	Northbrook, IL	Public viewing of standard fire resistance test of WTC floor system at Underwriters Laboratories, Inc.
October 19-20, 2004	Gaithersburg, MD	NCST Advisory Committee meeting on status and near complete set of preliminary findings with a public comment session.
November 22, 2004	Gaithersburg, MD	NCST Advisory Committee discussion on draft annual report to Congress, a public comment session, and a closed session to discuss pre-draft recommendations for WTC Investigation.
April 5, 2005	New York City, NY	Media briefing and public briefing on release of the probable collapse sequence for the WTC towers and draft reports for the projects on codes and practices, evacuation, and emergency response.

- A dissemination and technical assistance program (DTAP) to (a) engage leaders of the construction and building community in ensuring timely adoption and widespread use of proposed changes to practices, standards, and codes resulting from the WTC Investigation and the R&D program, and (b) provide practical guidance and tools to better prepare facility owners, contractors, architects, engineers, emergency responders, and regulatory authorities to respond to future disasters.

The desired outcomes are to make buildings, occupants, and first responders safer in future disaster events.

National Construction Safety Team Reports on the WTC Investigation

A draft of the final report on the collapses of the WTC towers is being issued as NIST NCSTAR 1. A companion report on the collapse of WTC 7 is being issued as NIST NCSTAR 1A. The present report is one of a set that provides more detailed documentation of the Investigation findings and the means by which these technical results were achieved. As such, it is part of the archival record of this Investigation. The titles of the full set of Investigation publications are:

NIST (National Institute of Standards and Technology). 2005. *Federal Building and Fire Safety Investigation of the World Trade Center Disaster: Final Report of the National Construction Safety Team on the Collapses of the World Trade Center Towers*. NIST NCSTAR 1. Gaithersburg, MD, September.

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EXECUTIVE SUMMARY

E.1 PURPOSE AND SCOPE

This effort builds upon work already done by The Fire Department of the City of New York (FDNY), The New York City Police Department (NYPD), and McKinsey & Company by:

- fully documenting what happened during the response by the fire service and other emergency responders to the attacks on the World Trade Center (WTC), up to the time of collapse of WTC 7
- identifying issues that need to be addressed in changes to practice, standards, and codes

It goes substantially beyond the work previously done by others.

Task 1. Collect emergency response data to document emergency responder fatalities, command and control procedures, and equipment performance. Records of interest included dispatch logs, recorded radio communications, run logs from surviving responding units, 9-1-1 records, data recorded by The Port Authority of New York and New Jersey (PANYNJ or Port Authority) operations, FDNY, NYPD, and fire ground positioning of emergency apparatus. Information was collected on operations and functions of communication systems, on-site emergency information systems, fire alarm panels, elevator control panels, standpipes and fire hoses, and other pre-positioned emergency equipment. In coordination with project seven, oral history data was collected from witnesses, those in control of emergency operations, and surviving emergency responders to the extent their oral history had not already been documented. Technical experts reviewed and conducted a fact-based analysis of the data.

Task 2. Interpret the factual analysis to determine the effect on responder successes of factors such as:

- the influence of building design (e.g., height, stairways, elevators, smoke control systems) on fire service command and control procedures, life saving operations, and safety of emergency responders;
- the influence of aircraft impact damage and fuel run-off on fire service command and control procedures, life saving operations, and safety of emergency responders;
- the impact of systems failures (e.g., communication systems, water supply, sprinklers, standpipes) on fire service command and control procedures, life saving operations, and safety of emergency responders;
- building occupant egress as related to emergency responder operations;
- the ability to fight large fires on the upper floors of tall buildings;
- the impact that the 1993 bombing of the WTC had on codes, standards, and procedures that affected emergency responders in tall buildings;

- pre-planning, training, and standard operating procedures (including command and control) at the time of the WTC attack on September 11, 2001;
- emergency responder accountability, location, and tracking,
- fire and emergency response protocols for tall buildings;
- the resources available for initial situation assessment and incident management, and practices for determining the possibility of structural collapse; and
- communication and coordination of response activities amongst the various authorities at the WTC.

Review of various public records showed that most of the data needed for the investigation were maintained by the three organizations that contributed to the emergency response: the PANYNJ, FDNY, and NYPD. Also, a significant amount of information was available through the various media services. Data sources were identified using several different techniques:

- News media accounts were examined;
- Books and other public records concerning WTC operations were examined;
- Public comments were received via the WTC information e-mail address and phone line concerning information sources;
- Team members met with each of the various organizations in an attempt to identify data sources;
- First-person interviews were used to identify data; and
- Emergency responder experts were employed and assisted with identifying data sources.

After the data sources were identified, written requests were made to each of the agencies that were determined to possess data. The requests were followed by meetings and discussions during which agreements were formalized, setting rules for the transfer and protection of the data. After the agreements were completed, the data were transferred to National Institute of Standards and Technology (NIST), or NIST team members accessed the data at locations identified in the agreements. Approximately half of the data requested were transferred to NIST and were entered into the investigation's files. The other half of the data was studied at agreed upon locations in the New York City area.

Four types of data were identified for this investigation: documentary data, electronic data, first-person interview data, and visual data.

Documentary Data

- Policies, protocols, and standards used by the various agencies for conducting operations at the WTC,

- Records and documents generated by the various agencies during operations at the WTC, and
- Records and documents generated following the incident, including investigative reports such as the McKinsey and Company reports for FDNY and NYPD, and records documenting investigative first-person interviews.

Electronic Data

There were two forms of electronic data collected from the three emergency responder departments:

- Radio communication recordings and
- Telephone communication recordings

First-Person Interviews

In October 2003, NIST entered into a three-party agreement between NIST, New York City (NYC), and the National Commission on Terrorist Attacks Upon the United States (the 9/11 Commission). The agreement provided procedures under which NIST and the 9/11 Commission would interview a maximum of 125 NYC emergency responders, 100 from FDNY and 25 from NYPD.

In December 2003, NIST officially requested and the Port Authority agreed to interviews with twelve Port Authority personnel, including emergency responders, safety, security, and management personnel.

The first-person interviews were conducted beginning in December 2003 and were completed in June 2004.

The following represents the number of interviews conducted by NIST with each organization:

- FDNY = 68

Senior management and officers, mid-level officers, company officers, firefighters, emergency medical personnel, and dispatchers

- NYPD = 25

Senior management and officers, mid-level officers, emergency service unit personnel, aviation personnel, and dispatchers

- PANYNJ/PAPD = 15

Senior management personnel, facility safety personnel, building security personnel, facility communication personnel, building vertical transportation personnel, senior PAPD officers, mid-level PAPD officers, and PAPD officers

- OTHER = 8

Interviewees in this group contacted NIST directly or through third parties and indicated that they would like to be interviewed. Approximately half of these individuals were retired FDNY personnel. The group consisted of a building security guard, building engineers, a dispatcher, firefighters, and a fire safety director.

- Total Interviews = 116

Visual Data

- Photographs, film, and digital;
- Motion images, video clips, and movie film

Dr. William Pitts of NIST and his staff acquired a large amount of the visual data. Numerous photographs and video records were acquired from FDNY and NYPD. Uncut video was acquired from the Naudet brothers' documentary and video news organizations. Thousands of photographs and video clips were obtained from the PANYNJ and other New York City sources, including the media and the public.

E.2 ANALYSIS AND FINDINGS

Changes Made by the PANYNJ Following the February 1993 WTC Bombing

After the February 1993 bombing, the following changes were made at the World Trade Center by the PANYNJ that had a direct impact on emergency responder operations on September 11, 2001:

- Work on the installation of automatic sprinkler systems was accelerated. The installation of automatic sprinkler systems began prior to 1993 and involved WTC 1 and WTC 2.
- Improvements were made to the Concourse level of the WTC to improve egress.
- A new Port Authority Police Command Center was established inside WTC 5.
- Fire Command Desks were installed in the lobbies of WTC 1 and WTC 2.
- A radio repeater (radio repeater: an electronic device for amplifying and retransmitting a radio signal) was installed in WTC 5 that operated on the FDNY city-wide high-rise frequency. The antenna was located on the top of WTC 5 and was directed at WTC 1 and WTC 2. Controls for operating the repeater were originally located at the PAPD Police Command Center inside WTC 5. During the spring of 2001, controls for repeater operation were moved to the Fire Command Desks inside the lobby of each of the two towers.
- The elevator intercom system was upgraded and could be monitored at the Lobby Fire Command Desk in each tower.

- A new Operations Control Center with the capability to monitor all HVAC systems and elevators was constructed on the B1 level of WTC 2.
- Multiple power sources were installed for exit stairway lighting in the towers.
- WTC 1 and WTC 2 received a new decentralized Fire Alarm System, Class E (Style 7), with three separate data risers to transponders located every three floors, with redundant control panels and electronics, and multiple control station announcement capability.
- Fire drills were conducted in conjunction with FDNY.

Changes Made by FDNY Following the February 1993 WTC Bombing

Incident Command System: The scope of the February 1993 bombing was beyond anything ever experienced by FDNY, and information overload occurred at the incident command level. Tasks to resolve issues related to the 1993 bombing were delegated along the lines of the FDNY incident command system in the following areas: command, planning, operations, logistics, and finance. It was also recognized that all agencies must be sensitive to and coordinate operations for effective incident command. The May 1997, Incident Command System manual and its new policies had been in operation with FDNY for approximately four years when the WTC attack occurred on September 11, 2001.

Communications:

- To improve communications at a large incident, the city purchased eighty 800-megahertz radios for use by deputy fire commissioners, each staff chief, and the Field Communications Unit. Twenty of the radios were to be distributed by the Field Communications unit at an incident, if needed.
- A high-rise repeater was requested by FDNY for operations in the WTC, and the Port Authority installed it in WTC 5.
- FDNY companies that were located near the WTC and often responded to the WTC were issued Port Authority radios that allowed them to communicate with the building's Deputy Fire Safety Directors and with PAPD.

Interagency Protocols: The New York City Office of Emergency Management (OEM) was established, and it took on the job of promoting the improvement of interagency operations; however, on September 11, 2001, the OEM center located at WTC 7 became ineffective as WTC 7 was evacuated by the emergency response personnel.

Building Systems and Fire Safety Personnel: In 1993, the Port Authority and New York City entered into two Memoranda of Agreement related to fire safety of Port Authority facilities located in New York City. The first agreement allowed for the implementation of fire safety recommendations that would be made by FDNY after they had inspected PANYNJ facilities located in New York City. The second agreement recognized the right of FDNY to conduct fire safety inspections of PANYNJ properties in New York City. It provided guidelines for FDNY to communicate needed corrective actions to the PANYNJ, and it assured that new or modified fire safety systems were to be in compliance with local codes and

regulations. It also required a third party review of the systems by a New York State licensed architect or engineer.

September 11, 2001, Attack on the World Trade Center

Initial “Size-up” and Impact of Aircraft Damage to WTC 1: The first command officer from FDNY to arrive at WTC 1 had actually seen the airplane strike WTC 1. While responding to WTC 1, he radioed Manhattan dispatch to advise them that “a plane had hit the World Trade Center” and that “they have a number of floors on fire.” Upon entering WTC 1 and going to the fire command desk to set up the Lobby Command Post, he met with the building Fire Safety Director to determine what damage the building had sustained. During first-person interviews, FDNY personnel provided the following information related to building conditions and emergency response operations in WTC 1:

- It was determined that the elevators were not working and/or were not safe for use; therefore, firefighters would have to gain access to injured and trapped occupants by climbing the stairs and carrying the equipment needed.
- It was likely that the water supply to the stand pipe and automatic sprinkler systems on the upper floors was damaged and that firefighting would not be an option until a reliable water supply was established and equipment was carried up to the fire floors.
- FDNY command personnel learned from 9-1-1 dispatch operators that smoke, fire, and structural damage in the building prevented many building occupants from evacuating floors above the impact zones.
- FDNY command personnel knew that jet fuel had flowed into the elevator shafts and into other parts of the buildings and presented a danger to building occupants and emergency responders.
- Communication systems to the upper floors via Warden Phones and Stand Pipe phones were not working.
- The building communication system used to make emergency announcements to building occupants was not working.

Based on the following facts, the fire chiefs who established the original Command Post inside the lobby of WTC 1 concluded that the fire department efforts should be directed toward evacuation and rescue of building occupants:^{1, 2, 3} the impact zone and fires were so high in the building, there were large fires on multiple floors, the building’s water supply was compromised, and there were no working elevators that could transport fire fighters and equipment up to a staging area just below the impact zone. Firefighting operations on the upper floors would not have been a reasonable option at that time. The building conditions indicated that, at best, it would take hours to establish meaningful firefighting operations on

¹ FDNY interview 2, winter 2003

² FDNY interview 7, winter 2004

³ FDNY interview 20, winter 2004

the upper floors of the building. The chiefs knew that this assessment did not give much hope for the survival of the people trapped above the fires since the fires would continue to grow and the toxic fire gases would occupy the building spaces where the people were trapped. It was likely that many of the occupants trapped at and above the impact zone would die before help could get to them.

Physiological Impact of Climbing Stairs: All three responding agencies sent personnel up the stairs in both WTC 1 and WTC 2. With the elevators inoperable, all equipment necessary for firefighting, rescue, and treatment of injured occupants had to be carried up the stairs. A normally outfitted FDNY firefighter wearing full protective clothing (coat, pants, helmet, hood, boots, gloves) and Self-Contained Breathing Apparatus (SCBA) carries approximately 23 kg (50 lbs) of equipment. Additional equipment, such as radios, lights, extra air bottles, forcible entry equipment, ropes, medical kits, or hose packs and appliances may add another 23 kg (50 lbs) or more to the work load. It is not unusual for firefighters to be carrying loads in excess of 46 kg (100 lbs) into a building when fighting a fire. The NYPD Emergency Service unit (ESU) and PAPD officers who ascended the stairs also wore SCBA. Much of the equipment they carried was similar to that of the Fire Department. The major difference between the Fire Department and Police Department outfitting was that the Police Department personnel did not wear protective clothing designed for firefighting.

From the time of the first airplane impact into WTC 1 to the collapse of WTC 2, a period of approximately one hour and 12 minutes, emergency responders inside WTC 1 were able to climb to floors in the 40s. However, a small number of emergency responders got to floors in the 40s by taking the only operating elevator to the 16th floor and then using the stairs. A report from one building occupant indicated that they saw firefighters located on floors about in the 50s.⁴ (NIST 2004) Within WTC 2, one FDNY Battalion Chief and Ladder Company got to floors in the 70s. They were able to take an elevator from the lobby to the 40th floor before having to walk up the stairs. According to interview information, the consequences of firefighters and other emergency responders having to climb many tens of floors to get to a fire or other high-rise building emergency without the use of elevators are summarized as follows:

- The ability to get both personnel and needed equipment to the desired location is limited by building height.
- Emergency responders wearing police uniforms, not wearing a SCBA or carrying extra equipment, were able to climb the stairs at a rate of approximately 1.4 minutes per floor while climbing to floors in the 40s inside of WTC 1.
- Emergency responders wearing full firefighter turnout gear, wearing a SCBA, and carrying extra equipment were able to climb the stairs at a rate of approximately 2.0 minutes per floor while climbing to floors in the 30s and 40s inside of WTC 1.
- Emergency response time factors related to the rate of fire growth, the ability to rescue building occupants, and the ability to bring a fire under control become more critical with every additional floor in building height.

⁴ Interview 1000118 (NIST 2004)

- The ability of emergency responders to climb stairs with equipment and remain physically fit to conduct rescue and firefighting operations, treat injured occupants, and remove them is diminished with every additional floor in building height that must be climbed.

Situational Awareness: Situational awareness was an overriding issue with all emergency responders during operations at the WTC site. First-person interviews with emergency responders from all agencies highlight the importance of situational awareness during this complex emergency response. Results from the interviews showed that there were two basic levels of situational awareness:

1. Emergency responders working outside the buildings, with the ability to observe events and conditions as they changed felt that they had good situational awareness. In addition, emergency responders who worked inside the buildings and had reliable radio communications with people outside the building felt that their situational awareness was good.
2. Emergency responders who worked inside the buildings and had no reliable means of communication other than face-to-face communications felt that they had poor situational awareness.

Some senior emergency responder officers inside WTC 1 felt that their situational awareness was poor even though they were in radio contact with other senior officers outside the building. One of these senior officers stated that *he would have known more about what was going on during the incident if he had been home watching it on TV.*⁵

For emergency responders already inside WTC 1, it took time to confirm that a second aircraft had actually hit WTC 2. A large number of emergency responders working inside WTC 1 realized that something had happened but did not know that a second aircraft struck WTC 2. Some emergency responders who were going up in the stairways inside WTC 1 did not know that anything had happened when the second aircraft struck WTC 2.

Accountability for and Tracking of Emergency Responders: Accountability encompasses the assignment, dispatch, checking in, tracking, locating, and checking out of emergency responders operating at an emergency. With the WTC attack, accountability also involved the recall of emergency responders. Recall refers to bringing emergency responders who are off duty back to duty status. All responding agencies had recall policies in place and did recall personnel for WTC operations. In addition, a few emergency responders self-dispatched to the World Trade Center, and as the recalls were put into effect some emergency responders went to the scene instead of reporting to their assigned location, causing accountability problems at the WTC complex.

All emergency responder organizations had accountability, location, and tracking plans in place, and they generally worked well during the first 30 minutes of WTC operations. However, the FDNY system became overwhelmed with the large number of units and personnel arriving at the scene. FDNY used magnetic Command Boards to keep track of personnel during operations. NYPD kept their personnel and tracking information on a clipboard and paper, and PAPD maintained their accountability and tracking

⁵ FDNY interview 7, winter 2004.

information at the PAPD Police Desk inside WTC 5. All emergency responder (FDNY, NYPD, and PAPD) accountability and tracking systems and records were lost when WTC 2 collapsed, and there was no backup for these lost records.

The FDNY Chiefs in charge of the Emergency Medical Services (EMS) operations at the WTC had some difficulties with accountability and tracking of their personnel. The size of the incident, the difficulty in determining early on what EMS units were there, and the self-dispatch of some non-FDNY ambulances added to their difficulties. Not all ambulances operating within New York City are part of the Fire Department. Some respond from hospitals or are from private ambulance companies. One of the biggest problems for the Emergency Medical Services was the lack of control of the ambulances that were not part of the Fire Department.

Location and tracking of personnel is an issue that has been studied by the emergency responder community for many years. Once responders report to a Command Post at the scene of an emergency, receive their assignments, and depart to accomplish their tasks, there is no effective means to locate and track the activities of the units or individuals. On September 11, 2001, the only means for locating and tracking units and personnel was through radio communications. During operations at the WTC, there were so many people using the FDNY radio system for ongoing operations that it became ineffective for locating and tracking personnel.

Emergency Medical Services Patient Tracking: There are many reasons to track patients who are triaged, treated and transported from an emergency. One important reason is to ensure that no one medical facility is overwhelmed by an unexpected influx of patients. The objective is not having an ambulance drop a patient off at a hospital, but at a hospital that has the best capabilities to take care of that person, avoiding situations in which any one hospital is overwhelmed. Within the individual triage and treatment areas that were set up by FDNY, efforts were made to keep track of patients. This was done with pencil and paper. All of the data on patients was lost when the buildings collapsed.

Building Access by Emergency Responders and Evacuation of Civilians by Stairways: During the September 11, 2001, operations, stairs were the primary means of access to and egress from the World Trade Center towers. Elevator service, practically speaking, did not exist in either of the buildings. Of the 99 elevators that were in each tower, only one elevator in each tower was functional and operated in a limited capacity to the lower third of each building. The egress of building occupants in the stairways and through the stairway doors of WTC 1 and WTC 2 generally had a negative impact on the emergency response operations. Emergency responders reported difficulties negotiating the stairway doors and stairways as occupants were coming down. Some of the problems experienced by emergency responders were:

- Difficulty accessing the stairway doors and stairways through the lobby and mezzanine levels because of building occupant flow out of the doorways and stairways; only one person could exit or enter the stairway at a time. If an occupant was leaving through the stairway door that stopped the flow of emergency responders into the stairway. If an emergency responder was entering the stairway through the stairway door that stopped the flow of occupants from leaving the stairway.
- Emergency responder team personnel became separated by the counter flow as building occupants moved down the stairs and the emergency responders attempted to move up.

- Emergency responders experienced difficulty in moving equipment up the stairs as building occupants were coming down the stairs.

Emergency responders interviewed stated that the 1.12 m (44 in)-wide stairways could be easily blocked by one person as they attempted to walk down the stairs. An average-sized person could walk down the center of the stairway and place one hand on each of the staircase handrails. This posture would block the stairway for other people who were trying to move faster down the staircase. This posture was identified as being used by mobility-impaired people who were only able to step down to the next step one foot at a time. This resulted in both feet standing on the same step, instead of the unimpaired gait where one foot is placed onto a step and the other foot is placed on the next step down.

Emergency responders also reported that the stairways became plugged and traffic was stopped as individuals with physical disabilities or obese occupants blocked the stairs.

After WTC 2 collapsed, emergency responders inside WTC 1 attempted to exit the building by going down the various stairways. On the way down, some emergency responders stopped and checked each floor to be sure that it was clear before they proceeded down. On about the 12th floor, FDNY personnel found approximately 40 to 60 people who had been removed from the stairway by others and placed onto the floor because these mobility impaired individuals had been blocking the stairway evacuation routes. The emergency responders stopped and began to assist these people with their evacuation. Depending on the disability or size of the person, it took from one to four emergency responders to assist one person with the evacuation. If the individual being assisted required a lot of assistance or was significantly overweight emergency responders had to change teams as fatigue set in. The evacuation pace while assisting the mobility challenged occupants was often described by the emergency responders as very slow. From the FDNY and PAPD interviews, it was not clear how many of the 40 to 60 occupants were safely evacuated from the building before WTC 1 collapsed. It is known from the interviews that a group of about 20 of these individuals were being moved out of WTC 1 just before the building collapsed.

Communications:

Building Communications: Upon arrival in the lobby of WTC 1, FDNY personnel were told that the building communication systems used to make emergency announcements to building occupants was not working. Communications to the elevators in the upper third of the buildings were lost. The Warden phones did not work, and attempts to use the wire line phones to upstairs were unsuccessful.

- Building occupants reported that the emergency communication system used to make the emergency announcements inside WTC 1 was inoperable as a result of the aircraft impact.
- The emergency communication system used to make the emergency announcements was inoperable as a result of the aircraft impact. FDNY personnel upstairs inside of WTC 1 also learned that the warden phone system was damaged and the standpipe phone system was not operating.

Radio Communications: All of the radio systems analyzed appeared to have been working well during the period of operations just before the attack on the WTC. There were two cases where handie-talkies experienced difficulties with stuck or open microphones just before and during the attack. One of these handie-talkies was used by PAPD, and one was used by NYPD.

High-rise buildings create problems with radio communications. The vast amount of metal and steel reinforced concrete in high-rise buildings is known to attenuate and block radio signals. This problem often occurs with low output power emergency responder handie-talkies. Various documents, including information from the 1993 WTC bombing, highlighted the problems FDNY experienced with radio communications in high-rise buildings. On September 11, 2001, FDNY again experienced poor handie-talkie radio communications within the towers. This had a major impact on FDNY operations particularly inside WTC 1 where no one used the WTC radio repeater system or a Battalion Car Cross Band Repeater. At WTC 2, the FDNY/WTC radio repeater system was used.

FDNY WTC Radio Repeater: The FDNY high-rise Channel 7 repeater that was located in WTC 5 was functional during operations at the WTC. This radio repeater received FDNY radio communications on a specified radio frequency, amplified the signal power, and retransmitted the radio communications on another specified radio frequency that the FDNY radios received. Data suggest that the repeater handset was broken and/or the handset volume was turned down so that it could not be heard when the repeater radio check was conducted. Data also suggest that the repeater's antenna system was not damaged. This is based on the fact that radio communications using the repeater system were carried out inside WTC 1 and inside WTC 2. The communications were recorded by the repeater's recording system; therefore, it is unlikely that the antenna was damaged by debris from the aircraft impact.

The recordings of radio communications by the WTC/FDNY repeater system suggest that operations communications inside WTC 2 were assisted by the repeater. Also, the radio recordings show that communications readability using the repeater was generally good to excellent. Where readability levels were poor, it was generally caused by doubling or multiple people attempting to communicate over the repeater at one time. If FDNY personnel in both towers attempted to use the repeater for operations, there would likely have been additional radio traffic that would have resulted in more unreadable communications. However, it would have been likely that the Lobby Command Post in WTC 1 would have had somewhat improved communications with personnel operating in the upper floors of the building up until the time when WTC 2 collapsed. The radio repeater recordings suggest that the repeater system failed during the collapse of WTC 2.

With the collapse of WTC 2 and the failure of the repeater system, the Lobby Command Post inside WTC 1 would have lost its primary means of communication with FDNY personnel. The loss of the repeater produced communications capabilities equivalent to the radio communications situation that the Lobby Command Post inside WTC 1 actually experienced.

Therefore, the apparent repeater failure with the collapse of WTC 2 would not have had any effect on saving lives of FDNY personnel located inside WTC 1. If the repeater had been in use inside of WTC 1 when WTC 2 collapsed, it would have taken time to establish that the repeater system had failed. FDNY personnel would have had to then change radio channels to continue radio communications.

Although the repeater in WTC 1 was working, the earlier tests had indicated, and emergency responders were informed that it was not working. Therefore, emergency responders did not use the repeater in WTC 1. When the repeater actually did fail, with the collapse of WTC 2, there was no effect on emergency responder communications inside WTC 1, since the repeater was not being used.

Radio Communications Quantity and Quality: All emergency responders struggled with the high volume of radio traffic at the WTC. The surge in radio traffic significantly impacted the quality of radio

communications during operations at the WTC. Data for the various departments demonstrate the significant changes that occurred in radio communications traffic during operations at the WTC. It is evident that PAPD, FDNY, and NYPD all experienced similar surges in radio traffic volume following the first aircraft impact into WTC 1.

Analysis of the radio traffic for each of the departments shows periods where radio traffic rates during the surge conditions potentially resulted in situations where base station radio operators were unable to relay important information.

It is estimated that one-third to one-half of emergency responder radio communications during operations at the WTC on the morning of September 11, 2001, were unreadable or incomplete.

Radio Communications and Incident Command and Control: The poor radio communications at the WTC had a serious impact on the FDNY Command Post's attempts to maintain command and control.

Radio Communications and Evacuation of Emergency Responders from WTC 1: With the collapse of WTC 2, each emergency responder department sent out radio messages calling for the immediate evacuation of WTC 1. At least three FDNY Chief Officers transmitted urgent radio messages over their handie-talkie radios calling for the evacuation of WTC 1. NYPD ESU personnel inside WTC 1 received their orders to evacuate from an ESU Mobilization Point staff person located at Church and Vesey Streets. PAPD command personnel also called for the evacuation of WTC 1.

From first-person interviews with *surviving* emergency responders who went upstairs in WTC 1, eight of the 15 FDNY personnel interviewed who had handie-talkie radios heard the order to evacuate over their radios. All three NYPD ESU officers interviewed heard the order to evacuate over their radios. Of the two PAPD officers interviewed, one heard the order to evacuate over his radio, and one did not.

Radio communications associated with the order to evacuate WTC 1 had mixed results after the collapse of WTC 2. Data show that some heard the evacuation orders while other personnel on the same floor did not hear the orders. Lack of timely information sharing and inadequate communications capabilities likely contributed to the loss of emergency responder lives.

Coordination of Response Activities with Other Authorities at the World Trade Center: In general, on the morning of September 11, 2001, all departments attempted to work together to save as many lives as possible and protect the citizens of New York City. At the same time, first-person interviews with FDNY and NYPD personnel showed that at times some issues related to a given department's operational responsibility and the competitive nature of departments did exist. However, emergency responder interviews also suggest that inter-agency competition had minimal effect on operations at the WTC before the towers collapsed.

The Office of Emergency Management (OEM) was established in New York City after the 1993 bombing, in part, to promote unified operations between and among the various city emergency responder departments. On the morning of September 11, 2001, OEM operations were disrupted with the loss of the city's OEM operations center located inside WTC 7. Since the OEM center was not available for operations, NYPD, FDNY, and OEM Commissioners met the Mayor on the street with the group initially assembling at Barclay Street. At the same time, NYPD was establishing an alternate command center for the Mayor and his staff at 75 Barclay Street so that he and his staff could oversee operations.

(Giuliani 2002). However, their operations from 75 Barclay Street were disrupted by the collapse of the towers, and they had to quickly evacuate from that site. Data show that there was no formal structure of unified command between departments below the Mayor and Commissioner level of operations. FDNY and NYPD department chiefs were not working together at the same command post, and they did not formulate unified orders or directions for their departments.

NYPD generally has different responsibilities from FDNY related to security, traffic control, protection of the public and the crime scene, etc. However, there were overlapping functions with NYPD ESU rescue team operations inside and around the WTC towers and FDNY operations. Although ESU rescue teams eventually joined and worked with FDNY personnel, functional unified operations were diminished as a result of the two departments' command posts being separated. In addition, the separate command posts could not communicate with each other on their different radio systems, and neither FDNY nor NYPD had liaison officers working with the other department's command post until after WTC 1 collapsed.

The coordination of communications and operations between the responding authorities at the WTC was a challenge for all emergency responders working that morning. The short time frame related to the attack and emergency responder operations coupled with successive significant threats requiring response (an aircraft hitting WTC 2 after WTC 1 was hit, the possible threat of a third aircraft coming in, the collapse of WTC 2, etc.) compounded the difficulty of establishing a unified operation. The challenges related to the establishment of unified operations were made significantly worse when the OEM facility located inside WTC 7 had to be evacuated. Although there was merit to having the FDNY and NYPD Command Posts separated, there was no uniform means for communicating between the two Command Posts at the time when WTC 2 collapsed. FDNY and NYPD primarily operated as independent organizations based on their operational responsibilities. However, FDNY, EMS, NYPD, PAPD, PANYNJ, and OEM attempted to work together. These attempts to work together were stymied by a lack of existing protocols that clearly defined authorities and responsibilities, communications systems problems, and multiple major attacks and threats.

Emergency Responder/News Media Communications: Evaluation of emergency responder/news media operations indicates that communications between the organizations was less than totally effective. Critical information related to life safety and evacuation from the WTC towers was not transmitted to the news media so that it could be broadcast to people threatened by the attack and building fires. At times, news media inquiries interfered with emergency responders as they attempted to carry out life safety operations. Appropriate emergency response agency contact points were bypassed or not used by some news media for gathering information. It appears that emergency response agencies were overwhelmed by news media requests for information.

Emergency Response Issues

Preplanning: Preplanning is an integral part of all emergency response operations. Building owners and operators, fire departments, emergency medical services, and police departments need pre-plans that address safety issues associated with potentially high risk properties like the WTC. Not only do these groups need to develop pre-plans for emergencies in high-rise buildings, they need to be sure that each of the pre-plans appropriately link to form a cohesive and functional unified plan. The 1993 attack on the WTC heightened FDNY's awareness of the need for preplanning and command organization that went beyond the scale of operations carried out during the 1993 bombing. Even with their preplanning, many

of the same difficulties experienced during the 1993 bombing were evident during the September 11, 2001, emergency response to the WTC. Some of these were:

- Poor radio communication inside the buildings and its effect on command and control.
- Buildings were not clearly marked, and many emergency responders did not know one building from the other. This resulted in units being assigned to one building and reporting to the other building without knowing that it was the wrong building.
- Emergency responder units that did not normally work in the lower Manhattan area were not aware of the buildings' design and construction and did not have information concerning the buildings' operating systems.
- Management of ambulance and other emergency apparatus access and exit from the site.
- Difficulties establishing a unified command system.

Access and Firefighting:

- Physiological impact on emergency responders climbing more than 10 to 12 floors during an emergency.
- Adequacy of building capacity for egress and firefighting access during full evacuation of fully occupied tall buildings. Access to high-rise buildings by emergency responders is hindered by counterflow, egress capacity, and lack of available elevators.
- Distance (i.e., remoteness) between stairwells where standpipes are located, redundant standpipe and water supply systems.
- Time factors associated with: structural fire resistance vs. firefighting/rescue operations

Emergency Communications:

- Lack of rigorous pre-emergency inspection and testing of radio communications systems within high-rise buildings to identify performance gaps and inadequacies.
- Performance requirements for emergency communication systems in buildings.
 - Design, testing, certification standards
 - Maintenance and inspection requirements
- Lack of communications network architecture (interoperability) and operational protocols for intra- and inter-agency communication at all levels of organizational hierarchy. This includes:
 - Scalability in terms of the number of emergency responders using the system and providing radio coverage in large buildings with challenging radio frequency propagation environments

- Interoperability with existing legacy emergency communication systems
- Localization techniques to identify emergency responders within indoor building environments
- Conventional two-way systems versus wireless network systems

Command and Control: On September 11, 2001, command and control was seriously affected by the lack of effective communications. In addition, the system used for maintaining records of unit assignments at each command post was not capable of managing the numbers of units and personnel being assigned to operate at the WTC. The following are key issues related to Command and Control:

- Availability of detailed procedures and methods for gathering, processing, and delivering situational information (including voice, video, and data integration) to all emergency responders, including 9-1-1 operators, wardens, incident commander, etc.
- Availability of effective codes and protocols for establishment and uninterrupted operation of the incident command and control system, and for preservation and dissemination of information managed by command posts.
 - Command posts established within the collapse zone of buildings that received serious impact damage and contained large multi-floor fires
 - Establishing the command post prior to the request and dispatch of units in excess of the initial alarm assignments (the ability to keep track of personnel before they are sent in.)
 - Effects of self-dispatch and freelancing of emergency responders and ambulances, especially teams lacking protective clothing and medical equipment
 - Robustness of assignment and tracking (accountability) system for large-scale emergencies
- Communication of the overall command strategy to all responders relative to conducting only rescue and evacuation operations below the fire floors.
- Secure location of state and local Emergency Operation Centers.
- Rapid adoption and execution of a unified emergency response mission by all emergency responder ranks
- The dispatch of large numbers of personnel and apparatus and the ability of management to maintain accountability in a timely manner. Additionally, the ability of the incident site to effectively accommodate large numbers of personnel and apparatus.

E.3 REFERENCES

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Chapter 1

INTRODUCTION

On the morning of September 11, 2001, two hijacked aircraft were deliberately crashed into the World Trade Center (WTC) towers in lower Manhattan, New York City. Approximately 17,600 people, representing nations from around the world, were inside the buildings as the attack occurred. This attack caused a greater loss of human life than the December 7, 1941 attack on Pearl Harbor. The two aircraft striking the World Trade Center towers resulted in the deaths of 2,749 people. Many of these people died at the moment of aircraft impact, hundreds of building occupants were trapped in the buildings above the impact zones, and thousands were forced to escape from the buildings.

New York City emergency responders rushed to the scene in hope of saving human lives, and as a result, hundreds of emergency responders gave their lives when the buildings collapsed. A total of 343 Fire Department of the City of New York (FDNY) personnel were lost; 37 Port Authority Police Department (PAPD) officers plus one K-9 member, and 23 New York City Police Department (NYPD) personnel were lost, for a total of 421 emergency response personnel. In addition, there was one employee of the Federal Bureau of Investigation, one employee of the United States Secret Service, one Fire Patrolman, and 15 other ambulance and volunteer emergency responder personnel who sacrificed their lives that morning.

The names of all emergency responders who gave the ultimate sacrifice on September 11, 2001, are listed in Attachment 1 at the end of this report.

Many of these emergency responder fatalities occurred outside of the WTC towers; data from FDNY shows that approximately 160 of the 343 personnel were lost outside the towers. In addition, it is believed that all of the 15 volunteer responders were lost outside of the towers. The human toll was not just in lives lost; there were approximately 2,000 emergency responders injured as a result of the attack on the WTC towers.

As emergency responders began operations at WTC 1, they were faced with extraordinary conditions with hundreds of seriously injured, burned, and dying citizens at the scene. As they worked, the second aircraft came from the south and crashed into WTC 2, producing a large fireball and spreading burning fuel around the complex. In addition, thousands of aircraft and building fragments fell from the sky and struck people and equipment on the ground. Human bodies from the aircraft and buildings fell to the streets as a result of the aircraft impact. Even after the aircraft attack was finished emergency responders had to negotiate extremely dangerous conditions as they attempted to access the WTC towers. Falling building materials, glass, flaming debris, people falling and people deliberately jumping from the buildings and falling into the streets and plaza created an extremely dangerous zone around the buildings as emergency responders attempted to help those in need. The first FDNY member killed that morning was hit by a falling person. Many of the emergency responders at the WTC site indicated that they felt they were conducting rescue operations in a war zone.

This report describes the purpose of the NIST emergency response investigative effort, the methods used during the investigation, the analysis of evidence from the investigation, and findings that address the advancement of emergency responder operations and safety.

1.1 PURPOSE

The emergency response investigative effort focused on the following:

- fully document what happened during the response by the fire service to the attacks on the World Trade Center, up to the time of collapse of WTC 7
- identify issues that need to be addressed in changes to practice, standards and codes
- identify alternative practices and/or technologies that may address these issues
- identify R&D needs that advance the safety of the fire service in responding to massive fires in tall buildings.

1.2 TECHNICAL APPROACH

Project 8 was divided into four tasks as follows:

Task 1. Collect emergency response data in cooperation with FDNY, NYPD, and The Port Authority of New York and New Jersey (PANYNJ or Port Authority) to document emergency responder fatalities, command and control procedures, and equipment performance. Records of interest included dispatch logs, recorded radio communications, run logs from surviving responding units, 9-1-1 records, data recorded by the FDNY, the PANYNJ operations, and the NYPD, and fire ground positioning of emergency apparatus. Information also was sought on operations and function of communications systems, on-site emergency information systems, fire alarm panels, elevator control panels, standpipes and fire hoses, and other pre-positioned emergency equipment. In coordination with the NIST analysis of the occupant behavior, egress, and emergency communication (refer to NIST NCSTAR 1-7¹), oral history data were collected from witnesses, those in control of emergency operations, and surviving emergency responders to the extent that their oral history had not already been documented. This effort also used the FDNY and NYPD McKinsey & Company^{2,3} reports as one source of preliminary investigative information. Technical experts reviewed and conducted a fact-based analysis of the data.

¹ This reference is to one of the companion documents from this Investigation. A list of these documents appears in the Preface to this report.

² McKinsey & Company, Increasing FDNY's Preparedness, Fire Department of the City of New York, August 19, 2002.

³ McKinsey & Company, Improving NYPD Emergency Preparedness and Response, New York City Police Department, August 19, 2002.

Task 2. Interpret the factual data to determine the effect on responder successes of factors such as:

- the influence of building design (e.g., height, stairways, elevators, smoke control systems) on fire service command and control procedures, life saving operations, and safety of rescue personnel;
- the influence of aircraft impact damage and fuel run-off on fire service command and control procedures, life saving operations, and safety of rescue personnel;
- the impact of systems failures (e.g., communications systems, water supply, automatic sprinklers, standpipes) on fire service command and control procedures, life saving operations, and safety of rescue personnel;
- building occupant egress as related to fire service operations;
- the ability to fight large fires on the upper floors of tall buildings;
- the impact that the 1993 bombing of the WTC had on codes, standards, and procedures that affected emergency responders in tall buildings;
- pre-planning, training, and standard operating procedures (including command and control) at the time of the WTC attack;
- firefighter accountability, location, and tracking,
- fire and emergency response protocols for tall buildings;
- the resources available for initial situational assessment and incident management, and practices for determining the possibility of structural collapse; and
- communications and coordination of response activities with other authorities at the WTC.

Task 3. Identify alternative emergency response practices and technologies that may advance the safety and effectiveness of emergency responders, such as: knowledge/information systems for command and control decisions; elevator use by firefighters; firefighter tracking systems; interoperability of communication systems (occupants, firefighters, police, EMS); fire growth and smoke hazard prediction; structural safety monitoring, assessment, and prediction; and simulation tools for training.

Task 4. Report preparation: The results of this project synthesized into this report describe the actions of the fire service and performance of their equipment; identify available alternatives related to fire service technology, training, and operational procedures; and identify R&D needs in support of their capability to protect the public, themselves, and vital physical infrastructure during extreme events.

During the course of this investigation, the Project 8 staff interacted with the staff of other projects within the NIST WTC Investigation (see Figure 1–1 below). Information gained from interviews and radio/telephone recordings was shared, most notably with the following projects.

- Project 1. Analysis of Building and Fire Codes and Practices. Information regarding the built environment and how it impacted emergency responders. Information such as the effects of elevator usability on emergency responders, and the effects of stairway width and door widths on emergency responders in accessing the upper floors.
- Project 4. Investigation of Active Fire Protection Systems. Reports of any systems that were used by emergency responders or activated before their arrival.
- Project 5. Reconstruction of Thermal and Tenability Environment. Information from emergency responders on conditions in stairwells and other areas of the towers and WTC 7.
- Project 6. Structural Fire Response and Collapse Analysis (regarding WTC 7 only). Information from first-person interviews on the damage inflicted on WTC 7 by the collapse of WTC 1 and WTC 2.
- Project 7. Occupant Behavior, Egress and Emergency Communications. Information from both radio recordings and first-person interviews regarding difficulties civilians had descending stairs and evacuating from WTC 1 and WTC 2, emergency communications to civilians regarding the evacuation of the WTC complex, and interaction between emergency responders and civilians.

The implementation of this project is discussed in the remainder of this report.

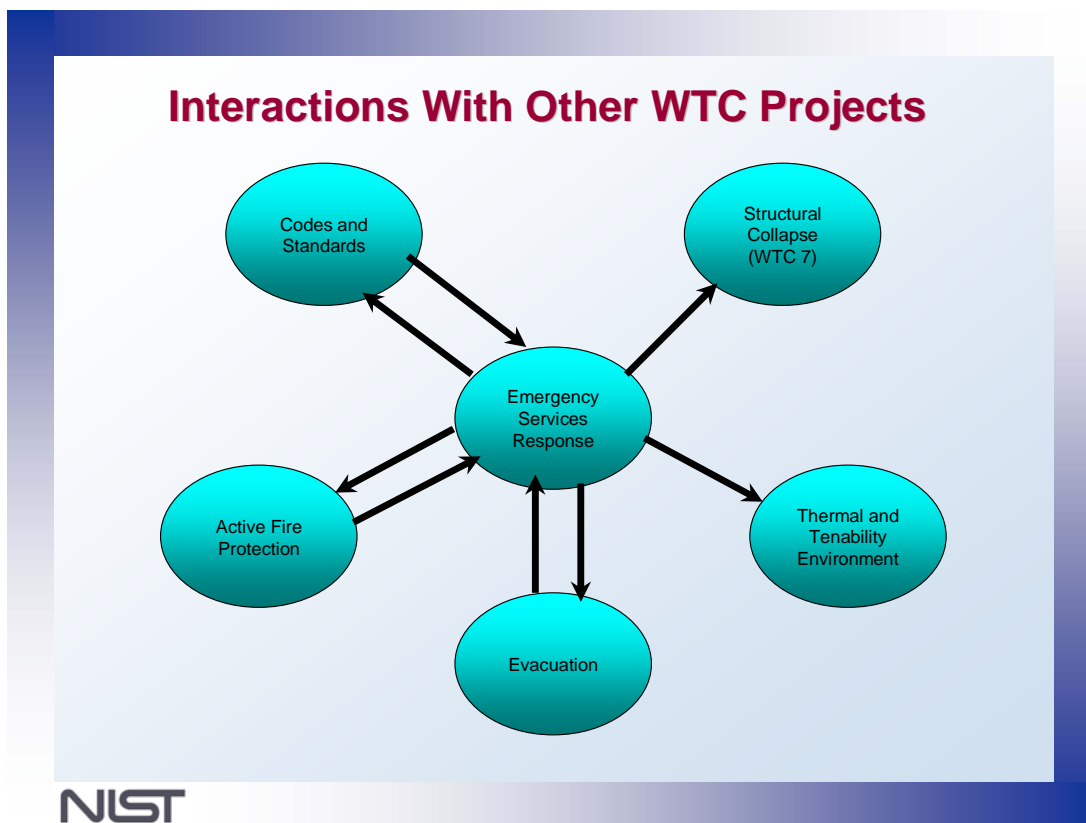


Figure 1–1. Project 8 interactions with other projects within the NIST WTC Investigation.

Chapter 2

COLLECTION OF EMERGENCY RESPONSE DATA

2.1 INTRODUCTION

The attack on the World Trade Center (WTC) generated a massive response from the emergency services departments within New York City, which produced a large amount of information concerning the attack and emergency response. However, in addition to the human losses, a large quantity of valuable information was lost when the building collapsed. The key to performing a valid investigation of emergency response operations during an event of this magnitude is to determine where data can be found and establish a means to acquire the data for analysis. Review of various public records showed that most of the data needed for the investigation were maintained by three organizations that contributed to the emergency response: The Port Authority of New York and New Jersey (PANYNJ or Port Authority), the Fire Department of the City of New York (FDNY), and the New York City Police Department (NYPD). There also was a significant amount of information available through the various media services. The National Institute of Standards and Technology (NIST) collected data for WTC emergency operations, cataloged the data, and filed the data for future analysis. NIST was able to acquire adequate information to support its findings, conclusions, and recommendations regarding the September 11, 2001, emergency response to the WTC attack. The following section discusses the methods used for collecting and preparing the data for analysis.

2.2 METHODOLOGY

Four types of data were identified for use in this investigation: documentary data, electronic data, interview data, and visual data. Each of these data forms can be subdivided into smaller groups.

2.2.1 Documentary Data

Documentary data includes the following:

- policies, protocols, and standards used by the various departments for conducting operations at the WTC,
- records and documents generated during WTC operations by the various departments, and
- records and documents generated following WTC operations, including investigative reports such as the McKinsey and Company reports for FDNY and NYPD, and documentation of investigative first-person interviews.

Data sources were identified using several techniques:

- examination of news media, books, and other materials,
- examination of public comments received by NIST,

- meetings with each of the three organizations listed above,
- first-person interviews, and
- discussion with emergency responder experts.

Data sources were identified using “lead following” methodologies. In the context of this report, lead following describes the process of gathering information and determining the facts, and using the facts to provide leads for identifying additional information that is needed. As the data sources were identified, written requests were made to each agency identified as possessing the data. The requests were followed by meetings and discussions that formalized agreements setting forth rules for the transfer and protection of the data. After the agreements were executed, the data were transferred to NIST or NIST investigation staff accessed the data at agreed upon locations. Approximately half of the data requested were transferred to NIST and were entered into the investigation’s files. The other half of the data was studied in the New York City area.

A large quantity of documentary and electronic data was transferred to NIST from the PANYNJ. This included files related to lists of deceased personnel, building operations, fire protection systems, alarm systems, elevator systems, emergency practices and protocols, communications transcripts, summaries of personal accounts during emergency operations, descriptions of the radio communications systems in the WTC towers and sub-grade levels (including the FDNY high-rise radio repeater), and copies of the actual radio and telephone communications that occurred during WTC emergency operations.

FDNY transferred the following documents to NIST: copies of the FDNY McKinsey and Company report and supporting documents, documents identifying deceased personnel, lists of personnel injured during the attack, lists of all known personnel that responded to the WTC, documents on high-rise firefighter training and department practices and protocols, dispatch records, company reports for units responding to the WTC, details on radio communications systems and operations, an audio tape of FDNY radio communications just prior to the attack on the World Trade Center, and documents concerning the 1993 attack on the World Trade Center. NIST reviewed the following data in New York City: transcripts of 500 interviews conducted by FDNY following the attack, and radio communications for FDNY Manhattan dispatch, Brooklyn dispatch, and FDNY City-wide communications.

NYPD transferred the following documents to NIST: copies of the NYPD McKinsey and Company report and supporting documents, documents identifying deceased personnel, information on injuries to NYPD personnel, information on aviation rescue, and copies of audio recordings of the NYPD Special Operations Division, Division 1, and NYPD City-wide radio communications that took place during emergency operations at the WTC.

As the data were gathered, they were cataloged and filed for use. Records were accessed as needed depending upon the part of the investigation that was being studied. When work on the documents was completed, the documents were returned to the investigation file system.

2.2.2 Electronic Data

There were two forms of electronic data collected from the three emergency responder departments:

- radio communications recordings, and
- telephone communications recordings.

The electronic data files were processed and transcribed using methods described in the following section.

Audio Data Files and Processing

An evaluation of methods for listening to the recorded communications files was carried out. Comparisons were made between the functionality of using tape recorders versus that of using digital computer-based software for listening to the various emergency response communications files. It became apparent that the computer based listening system had advantages over the use of tape recorders. Some of the advantages of the computer based system are the ease of operation, ability to use the computer monitor for visually observing the beginning and end of communications periods, and the ability to easily and accurately reverse through a recording to a selected location so that a selected section of a communication could be listened to multiple times. As a result, it was decided to conduct the audio communications study using computer based audio software. This decision had a direct impact on the type of data format and media that would be needed for conducting the audio communications study. Therefore, NIST requested that audio communications be provided in a digital format on CD-ROM disks.

The communications recordings provided by the PANYNJ were digital files that were copied onto CD-ROMs, and they were in a format that could be played by computers while using audio player computer software. The audio recordings on each of the NYPD cassettes had to be converted to a digital format, and each file was then recorded onto a CD-ROM disk. In addition, some of the recordings that were received were recorded at very low amplitude that made it difficult to hear the communications. NIST used audio software to increase the low audio volume recordings to a usable audio level.

An audiotape received from FDNY was unreadable with equipment possessed by NIST. NIST used the Forensic Audio Analysis section of the Federal Bureau of Investigation (FBI) Engineering Research Facility to listen to and copy segments of the tape relevant to the NIST work.

Audio Data Computer Software

Three types of software were used to conduct communications analysis of the audio recordings. Each of these software packages incorporated a clock for timing the audio recording enabling NIST to pinpoint the times of important communications during emergency operations at the WTC.

The first, Sound Forge 6.0, a product of Sonic Foundry, Inc. of Madison, Wisconsin, is a professional digital audio editor (Sonic 2002). It contains tools that can assist with increasing quality and volume of digital audio recordings. It has a graphic output to the computer monitor that allows for rapid evaluation of large audio files. It also is capable of operating as a tool for spectrum analysis. As a spectrum analyzer, it can be used to analyze waveforms by frequency, and it helps to identify noise problems in communications data. In addition, the audio waveforms can be expanded on various scales for detailed

analysis. This software was used throughout the study for analysis of the recordings that required audio adjustments to improve quality.

The other two software packages were used as general purpose audio players. Both have the same basic capabilities and were applied in the audio analysis process based on user preference.

Windows Media Player, a digital media player software package, is a product of Microsoft, Inc. (Microsoft 2003). This media player can be downloaded from the Internet. The player allows for viewing of audio wave forms from the digital audio files. It allows for easily changing a computer's audio volume, and it may be used effectively for locating specific points on an audio recording. The software also allows for movement through an audio file in a reverse direction so that selections of an audio file can be listened to multiple times.

WinAmp3 is a media playback software package for Windows that can be downloaded from the Internet, and it is a product of Nullsoft, Inc. (Nullsoft 2002). This player allows for viewing of audio wave forms from digital audio files. It allows for easily changing a computers audio volume and it may be used effectively for locating specific points on an audio recording. The software also allows for movement through an audio file in reverse direction so that sections of an audio file may be listened to multiple times.

Analysis of Audio Communications Files

Analysis of the communications recordings was a multi-step process that began with sorting and cataloging the files. The initial sort separated radio communications files from telephone communications files. The files were also cataloged by PANYNJ, PAPD, FDNY, and NYPD. The respective files were then checked for content, and primary emergency response channel files were selected for analysis first. Primary emergency response channels were channels specifically used by PAPD, NYPD, and FDNY for conducting emergency response operations at the WTC. WTC security and maintenance channels and other emergency responder channels that were not directly associated with operations at the WTC were considered secondary.

Analysis was performed using the computer-based software media players described above. The professional quality digital audio software, Sound Forge 6.0, was used for listening to and enhancing audio files that were difficult to hear. The two other media player software packages, Windows Media Player and WinAmp3, were used to listen to the majority of audio recordings.

Communications Transcription

Two processes were used to transcribe the emergency communications. Data from the primary emergency communications files were put into a spreadsheet format so that a detailed analysis of results could be made. The data put into the spreadsheets was used to assist in quantifying communications quality and the radio traffic volume as it related to time. The second and simplest form of communications transcription, which was used to record the secondary communications files, was the verbatim transcription of the communications into a word processor data file.

Some primary communications audio files were completely transcribed to generate information concerning the quality and quantity of communications. The files selected were the FDNY Channel 7/PA/WTC Radio Channel 30 radio repeater, the PAPD police desk radio channel 26/W, the NYPD Special Operations Division channel and the NYPD Division 1 channel. The data entered into the spreadsheets included the following:

- Start and end times of each radio transmission. Radio transmission times were taken from the media player clock and were adjusted for the audio file start time supplied with the communications file;
- Type of radio transmission (voice or tone only for primary emergency response communications channels);
- Readability signal quality as determined by NIST (done only for the primary emergency response communications radio channels); and
- Content of the communication.

Transcription Methods

The communications transcripts were generated using three different computer based media players. The media players were installed on computer systems that were stand alone and isolated from the internet. The process for preparing a communications transcript was the following:

- The communications data file was loaded onto the computer;
- The media player was opened and the data file was selected;
- The spreadsheet on the computer was opened and prepared for data input;
- The transcriber set the communications recording to the beginning and checked to be sure that the media player clock time was zeroed;
- The data file starting time was entered into the spreadsheet;
- The communications recording was started, and the output was written into the spreadsheet; and
- To improve accuracy of the transcripts, a second transcriber checked sections of the transcript against the audio recording.

For audio passages that were difficult to understand on the first pass, multiple passes of the section were used to improve comprehension.

2.2.3 First-Person Interviews

In October 2003, NIST entered into a three-party agreement between NIST, New York City (NYC), and the National Commission on Terrorist Acts Upon the United States (the 9/11 Commission). The agreement provided procedures under which NIST and the 9/11 Commission would interview a maximum of 125 NYC emergency responders, 100 from FDNY and 25 from NYPD.

In December 2003, NIST officially requested and the Port Authority agreed to interviews with twelve Port Authority personnel, including emergency responders, safety, security, and management personnel.

The first-person interviews were conducted beginning in December 2003 and were completed in June of 2004.

In addition to the interviews conducted under the agreements described above, NIST interviewed eight people who contacted NIST directly and volunteered. These interviews began in October 2003 and were completed in December 2004.

Most emergency responders who did not volunteer to be interviewed indicated that they did not want to relive the tragedy that occurred when the WTC was attacked. Conversely, many of the interviewees who did participate indicated that they wanted provide information that could help people in the future if there should be another attack on the United States.

Selecting Interviewees

The Port Authority of New York and New Jersey: The process of selecting individuals from the Port Authority to be interviewed began with studies to identify key personnel who worked at the WTC and were responsible for building operations and engineering, fire safety operations and equipment, building security, emergency response, and vertical transportation, along with PANYNJ personnel who conducted emergency operations inside the WTC buildings on September 11, 2001. These studies included the analysis of public information from the media, information gathered from the PANYNJ, people who contacted NIST indicating they had information relevant to the investigation, and the identification of individuals based on discussions with various people who NIST met as the investigation advanced. NIST prepared a list of PANYNJ personnel that it wanted to interview and submitted it to the Port Authority. The Port Authority then contacted the personnel that NIST had requested and asked them if they were willing to be interviewed. Only a small number of the people who NIST requested did not volunteer to be interviewed. During the interview process, “lead following” methods were used to identify other individuals of interest to the investigation. NIST was able to interview all personnel identified as critical to understanding building operations and activities associated with the emergency response on the morning of September 11, 2001.

The Fire Department of the City of New York and The New York City Police Department: With FDNY and NYPD, NIST again conducted an extensive study to identify key personnel who worked at the WTC during the attack. Once more, these studies included the analysis of public information from the media, information gathered from New York City agencies, people who contacted NIST indicating they had information relevant to the investigation, and the identification of individuals based on discussions with various people who NIST met as the investigation advanced. In addition, during the interview process lead following methods were used to identify other individuals of interest to the investigation.

Initially, NIST prepared two lists of New York City personnel who it wanted to interview, one for FDNY and the other for NYPD.

Since NIST's agreement with NYC indicated that 100 FDNY personnel could be interviewed, the initial list of approximately 200 names took into account the voluntary nature of the interviews and that many people may not have wanted to participate. This list was broken into categories relating to 1) functions carried out by individuals and 2) the locations where people worked during the attack. The names of individuals on the list were placed in the order of importance to the NIST investigation. The list included people who had been identified as working during the attack in senior staff positions, Chief Officers and incident command personnel who worked at the command posts and inside the buildings, radio communications personnel, dispatchers, FDNY personnel who worked at and inside the WTC towers, including Company Officers, firefighters, rescue squad members, and Emergency Medical Service personnel. This list included personnel who were still active with the Fire Department and approximately five FDNY personnel who had retired.

FDNY contacted personnel on the list and asked if they would volunteer to take part in the NIST interviews. As reported to NIST by FDNY, some individuals contacted did not agree to be interviewed, and the department followed up to obtain other interviewees that NIST had identified. As the interview process continued, NIST identified other FDNY personnel that needed to be interviewed and also added additional interviews with Emergency Medical Service personnel. NIST was able to interview personnel from all categories and units that were of interest to the investigation. In all but one case, NIST was able to interview multiple personnel from the categories and units identified. In addition, NIST was able to interview all personnel identified as being critical for understanding the emergency response operations at the WTC. In addition to those on the NIST request list, two FDNY firefighters volunteered and were interviewed by NIST.

For NYPD, NIST prepared a list of personnel divided into categories that included NYPD senior officers, incident command personnel, aviation unit personnel who operated the helicopters during the WTC attack and operations, emergency service unit personnel who worked inside the WTC the towers, and communications personnel. Three of the personnel requested from NYPD did not agree to be interviewed. In addition, as the interviews progressed additional names of people to be interviewed were identified, and NIST made requests to add the new names to the interview list. NIST interviewed personnel who were still employed by NYPD as well as three individuals who had retired.

NIST was able to interview all personnel identified as being critical to understanding the emergency response at the WTC.

Other: The category listed below as "Other" represents individuals who contacted NIST either directly or through third parties and volunteered to be interviewed. Approximately half of the interviewees in this category were retired FDNY personnel. The remaining individuals worked at the WTC on the morning of September 11, 2001, in building security, building engineering, and fire safety jobs. Several of these first-person interviews were conducted over the telephone.

NIST Interview Staff: The NIST interview staff consisted of two primary personnel who have experience with emergency response organizations and operations. One additional interviewer was added as a substitute interviewer. NIST personnel conducted all first-person interviews addressed in this report, and all interviews were conducted in the New York City and New Jersey area. Personnel from the 9/11

Commission participated in all of the emergency responder interviews conducted with employees of New York City (FDNY and NYPD) and the Port Authority. NIST conducted the interviews, which typically lasted from one to three hours, and then the 9/11 Commission personnel would address their questions over a time period of about one-half hour to one hour in length. NIST personnel sat in while the 9/11 Commission personnel asked the interviewees their follow-up questions.

The following represents the actual number of interviews conducted by NIST with each organization:

• FDNY	=	68
• NYPD	=	25
• PANYNJ/PAPD	=	15
• OTHER	=	8
• Total Interviews	=	116

First-person interviews were conducted with personnel from each of the following categories:

- FDNY: Senior management and officers, mid-level officers, company officers, firefighters, emergency medical personnel, and dispatchers
- NYPD: Senior management and officers, mid-level officers, Emergency Service Unit personnel, aviation personnel, and dispatchers
- PANYNJ/PAPD: Senior management personnel, facility safety personnel, building security personnel, facility communications personnel, building vertical transportation personnel, senior PAPD officers, mid-level PAPD officers, and line PAPD officers
- OTHER: A building security guard, dispatcher, firefighters, WTC building engineer, and a fire safety director

Each interview generally took from one to four hours to complete (including time when questioning was conducted by the 9/11 Commission staff), depending on the person's job and the complexity of their involvement in emergency operations. Most of the interviews were digitally recorded, and hand written notes were taken throughout all of the interviews. These investigative interviews were carried out using the following protocol:

- The interviewee was met at the designated time and place.
- Introductions were completed.
- The NIST investigation and the purpose of the interview were discussed with the interviewee.
- If a consent form was needed, it was explained to the interviewee, questions were answered, and the interviewee signed the consent form. (Only the Port Authority interviews used consent forms.)

- Just before the interview began and during the interview process, interviewees were asked if they needed to take a break before going further. This was particularly important during periods of the interview where emotional stress was evident.
- The interviewee began with an uninterrupted self-narrative that was followed by questions addressing specific areas of interest.

Self-Narrative, Emergency Responder's Experience at the WTC:

For response to World Trade Center Buildings 1 and 2:

- Each emergency responder was asked to describe their experience in their own words and end their narrative after WTC 1 and WTC 2 had collapsed.

For response to World Trade Center Building 7:

- Each emergency responder was asked to describe their experience in their own words and end their narrative after the WTC 7 collapse.

When the self-narrative was completed, the interviewee was asked if they would like to take a 10-minute break or proceed to the next step of the interview.

The next phase of the interview dealt with follow up questions.

Follow-up Questions: The follow-up questions were typically related to the interviewee's timeline of events and were used to probe specific points from the narrative. Questions were based on notes taken during the self-narrative. The follow-up questions consisted of questions related to the following topics and experiences of the interviewee during the WTC operations:

- dispatch, arrival, and job assignment during emergency operations;
- the resources available for initial situational assessment and incident management;
- practices for determining the possibility of structural collapse;
- command post establishment, information available, communications, and operations;
- firefighter accountability, location, and tracking;
- building occupant egress as related to fire service operations, rescue options for building occupants;
- fire and emergency response protocols for tall buildings;
- the ability to fight large fires on the upper floors of tall buildings (including the human physiological factors associated with operations in tall buildings);

- operations and function of information technologies, emergency responder information systems, alarm systems, building occupant information systems, communications systems, radios and repeaters, other communications systems;
- the influence of building design (e.g., height, stairways, elevators, smoke control systems) on fire service command and control procedures and rescue operations;
- firefighter operations and safety of emergency responders;
- elevator conditions and operations, elevator control panel information and function, and the use of elevators by emergency responders;
- environmental conditions inside and around WTC buildings 1, 2, and 7 before the buildings collapsed;
- the influence of aircraft impact damage and fuel run-off on fire service command and control procedures, life saving operations, and safety of emergency response personnel;
- standpipes and fire hoses, and other pre-positioned emergency equipment;
- the impact of systems failures (e.g., communications systems, water supply, sprinklers, standpipes) on fire service command and control procedures, life saving operations, and safety of emergency response personnel;
- pre-planning, training, and standard operating procedures (including command and control) at the time of the WTC attack;
- emergency responder evacuation from the WTC 1; and
- communications and coordination of response activities between various authorities at the WTC, i.e. fire wardens, fire safety directors, building security, FDNY, PAPD, NYPD, OEM, and PANYNJ building safety and operations personnel.

When the interview was complete, depending on the interview agreement, the interviewer gave the interviewee a copy of a psychological support resources information sheet containing contact information for Project Liberty and their employer's support services, and the interviewer would answer any remaining interviewee questions. (Project Liberty is a New York state program created in 2001 to provide supportive crisis counseling to individuals and groups affected by the World Trade Center disaster.)

The interviewer would thank the interviewee for participating and walk them to the door, ending the interview.

The interviewer would complete interview notes, secure the audio recording (if used), and prepare for completing work on written documentation of the interview.

2.2.4 Visual Data

- Still photographs, film, and digital images
- Motion images, video clips and movie film

The visual data were largely acquired by Dr. William Pitts of NIST and his staff. Numerous photographs and video records were acquired from FDNY and NYPD. Many of these images address the WTC towers prior to their collapse and images taken after the towers collapsed. Uncut documentary video of FDNY operations at the WTC was acquired from Jules and Gedeon Naudet. In addition, thousands of other photographs and video clips were obtained from PANYNJ and other New York City news media sources and the public. All of these visual data were critical for understanding the facts related to the attack and the emergency response that followed. For more information on visual data collection and analysis see NIST NCSTAR 1-5A.

Figure 2–1 provides a map of the WTC location in lower Manhattan.

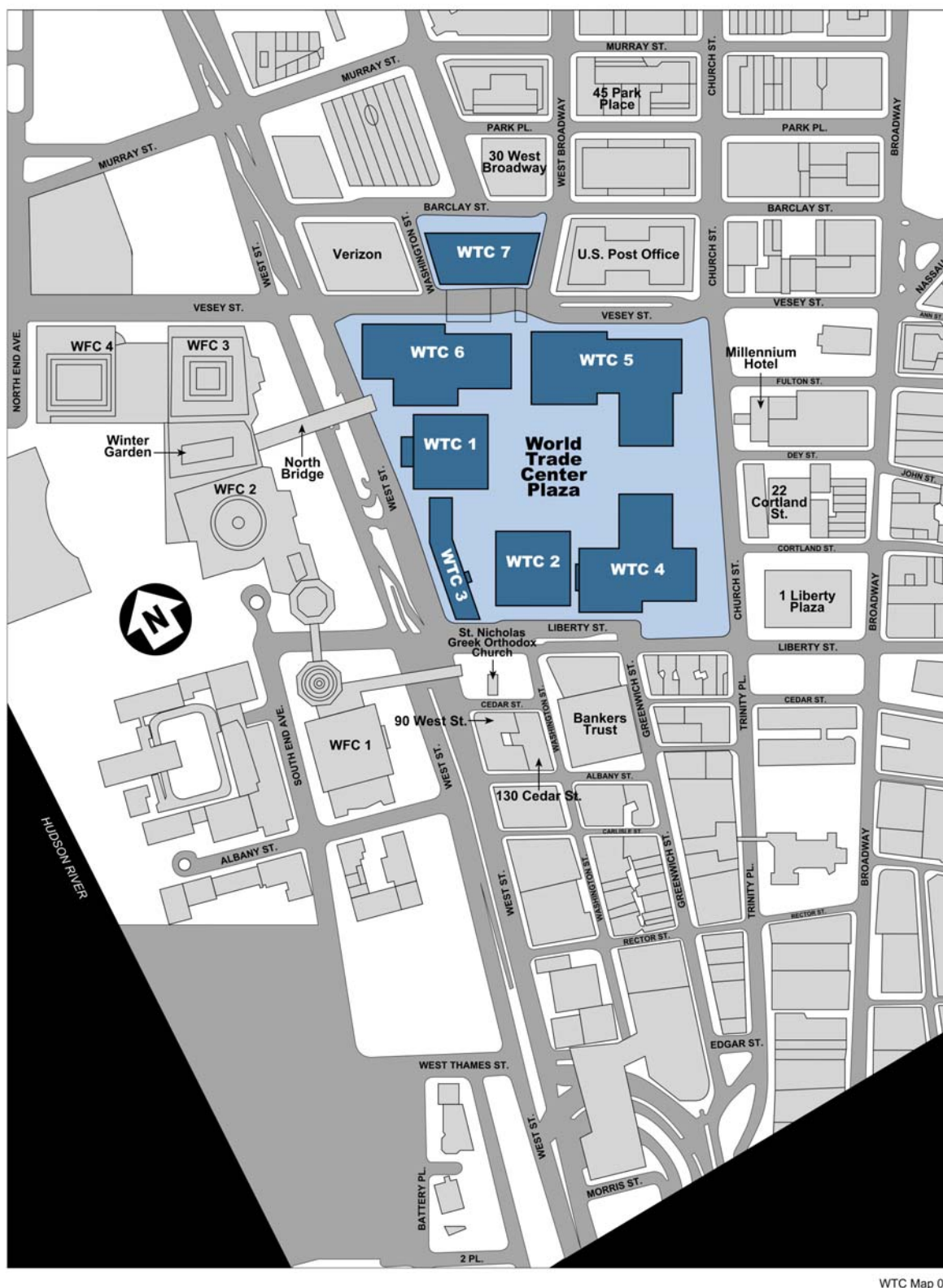


Figure 2–1. Map showing the World Trade Center location in lower Manhattan.

Chapter 3

IMPACT OF THE FEBRUARY 1993 BOMBING ON EMERGENCY RESPONSE IN TALL BUILDINGS

The February 26, 1993 terrorist sub-grade bombing of the World Trade Center (WTC) provided insight into the complications of a full evacuation of the towers and the complex nature of responding to a large incident at the towers. Investigations by The Port Authority of New York and New Jersey (PANYNJ or Port Authority) and New York City emergency response departments identified numerous issues concerning the WTC buildings and complex. This chapter addresses these issues and the changes made at the WTC following the 1993 attack. The multi-agency study of the WTC bombing identified security issues, occupant safety issues, and emergency responder operations and safety issues. Issues addressed by the Port Authority were discussed in a document provided for this investigation.¹ In addition, the Director of the Port Authority's World Trade Department discussed the findings from the 1993 bombing in his testimony before the 9/11 Commission on May 18, 2004 (Reiss 2004). The following changes were made at the World Trade Center after the 1993 bombing and relate to emergency responder operations during the attack carried out in 2001.

3.1 CHANGES MADE BY PANYNJ

- Installation of tower sprinkler systems was accelerated. The work on the systems began before 1993.
- Improvements were made to the Concourse level to improve egress.
- A new Port Authority Police Command Center was established inside WTC 5.
- Fire Command Desks were installed in the lobbies of WTC 1 and WTC 2.
- A radio repeater was installed in WTC 5 that operated on The Fire Department of the City of New York (FDNY) city-wide high-rise frequency. The antenna was located on the top of WTC 5 and was directed at WTC 1 and WTC 2. Controls for operating the repeater were originally located at the Port Authority Police Desk inside WTC 5. During the spring of 2001, controls for repeater operation were moved to the Fire Command Desk inside the lobby of each of the towers.
- The elevator intercom system was upgraded allowing for monitoring at the Fire Command Desk.
- A new Operations Control Center with the capability to monitor all HVAC systems and elevators in both towers was constructed on the B1 level of WTC 2.

¹ Port Authority Communication: "WTC – CHANGES TO EVACUATION SYSTEMS AFTER 1993." WTC-115-P.

- Multiple power sources were installed for exit stairway lighting in the towers.
- A new decentralized Fire Alarm System Class E (Style 7), with three separate data risers to transponders that were located every three floors. This system had redundant control panels and multiple control station announcement capability.
- Fire drills were conducted in conjunction with the FDNY.

Although significant effort and funds were put into improving the WTC complex after the 1993 bombing, the damage caused by the aircraft impact left many of these improvements non-functional on September 11, 2001 (addressed in Chapter 5).

In addition to the changes made by the Port Authority, FDNY addressed numerous issues that affected their operations and safety at the 1993 WTC bombing. These issues are discussed in a report prepared by the FDNY Chief of Department (Fusco 1993). The section below briefly describes each issue followed by a discussion of how the lesson-learned impacted FDNY operations on September 11, 2001.

3.2 CHANGES MADE BY FDNY

3.2.1 Incident Command System

Issue

A better understanding of the incident command system (ICS) was needed by all New York City emergency responders to ensure full implementation and better adherence to the system. (Fusco 1993):

Delegation of Functions: The scope of the 1993 bombing was beyond anything ever experienced and information overload occurred at the incident command level. The FDNY Incident Command System policies and procedures were upgraded following the 1993 bombing. The May 1997, ICS Manual reflects changes made to the Incident Command System, and these new policies had been in operation with FDNY for approximately four years when the WTC attack occurred in 2001. Therefore, the Incident Command System improvements had been in use by the department for several years before the 2001 attack and were being followed by department personnel during operations on September 11, 2001.

The FDNY 1997 Incident Command System Manual revised delegations of responsibility for the incident command system in the following areas (Fusco 1993):

- command,
- planning,
- operations,
- logistics, and
- finance.

A copy of the FDNY 1997, Incident Command System manual is found in Appendix A.

Issue

Interagency Representation: All agencies must be sensitive to and coordinate operations for effective incident command. A representative from each agency should be at the command post to make coordination easier (Fusco 1993).

Changes to Interagency Coordination: In an attempt to reduce the uncertainty associated with the issue of coordination of operations, the New York City Mayor's Office established an operations protocol. (See Appendix B) In April of 1994, FDNY and The New York City Police Department (NYPD) published a document entitled "Police/Fire Protocol." See Appendix B.

3.2.2 Communications

Issue

FDNY needed to improve communications at a large incident (Fusco 1993).

Change to Communications: New York City purchased eighty 800-Megahertz radios for use by deputy fire commissioners, staff chiefs, and the Field Communications (Field Com) Unit. Twenty of the radios were to be distributed by the Field Com unit at the WTC during the September 11, 2001, attack. FDNY made an effort to significantly improve the radio communications system for high-rise firefighting. The high-rise repeater was requested by FDNY for operations in the WTC and the Port Authority installed it.² Even though it did not solve all of the radio communications problems at the WTC FDNY personnel interviewed indicated that it did improve operations prior to the September 11, 2001, attack.³ Another item that improved FDNY radio communications at the WTC was that firefighting companies located near the WTC and that often responded to the WTC were issued Port Authority radios that allowed them to communicate with the building's Deputy Fire Safety Directors and with the Port Authority Police Department (PAPD).⁴ FDNY bought new 800 MHz radios to replace all the radios in the department used during the 1993 bombing. However, the new radios had been pulled from service because of operational difficulties prior to the WTC attack, and the older VHF radios used during 1993 were put back into service, leaving the service with equipment that had been judged to be less than ideal.⁵

Issue

Radios needed a **tone alert** capability for signaling emergency conditions (Fusco 1993). At the 1993 bombing, one firefighter became trapped and called a mayday. The incident commander was unable to communicate well during this emergency because the volume of handie-talkie traffic made it difficult or impossible to hear. It was recommended that a built-in alert tone be added to the radios so that the tone could be sent out to clear the air so that control could be regained over the radio system. (Fusco 1993)

² PA Interview 11, fall 2003

³ FDNY Interview 16, winter 2004

⁴ PA Interview 11, fall 2003

⁵ Written Communication from New York City, October 6, 2004

No tone alert was available on the radios used by FDNY firefighters on September 11, 2001.⁶

Issue

Command Posts: Command posts needed to be more isolated from the intense activity that takes place at a very large incident, and the command post must be clearly identified. Computer terminals and communications capabilities are needed in vans for command post operations and the operations should be duplicated at the branch and sector command locations. Any data added to the computer systems at any location would be automatically updated at all other command locations. (Fusco 1993)

The capabilities addressed above in the issue were not available to FDNY personnel on September 11, 2001.⁷

Issue

Transmission of Alarms: FDNY needed to more clearly identify alarms greater than a fifth alarm (Fusco 1993).

The FDNY Communications Manual in effect on September 11, 2001, did not address procedures for operations greater than a fifth alarm.⁸

Issue

Field Communications Unit: The field communications unit was expected to receive and transmit critical information on the fire ground. The incident command system relies heavily on a Field Com unit at large incidents, and an officer should be assigned to manage the operations (Fusco 1993).

Changes for Field Com: FDNY placed an officer in charge of Field Com units and the department's Field Com unit was improved. However, the primary Field Com unit was not available during the period of time before the WTC towers collapsed.^{9, 10}

3.2.3 Interagency Protocols

Issue

The 1993 post-bombing analysis indicated that frequent drills were needed to ensure that protocols would function as planned. All agencies working together needed to have a technical understanding of each other's role so that working cooperation would develop. It was recommended that FDNY and NYPD establish working relationships with each other, particularly with aviation rescue operations and that aviation rescue drills, including roof top operations, be conducted (Fusco 1993).

⁶ FDNY Communications Manual, DCN: 3.01.01, January 1, 1997.

⁷ FDNY Communications Manual, DCN: 3.01.01, January 1, 1997.

⁸ FDNY Communications Manual, DCN: 3.01.01, January 1, 1997.

⁹ FDNY Communications Manual, DCN: 3.01.01, January 1, 1997.

¹⁰ FDNY, Interview 58, winter 2004

Changes in Interagency Protocols: After the 1993 bombing of the WTC, New York City established the Office of Emergency Management (OEM), which took on the job of promoting the improvement of interagency operations; however, on September 11, 2001, the OEM center located at WTC 7 became ineffective as WTC 7 was evacuated.¹¹

3.2.4 Building Systems and Fire Safety Personnel

Issue

FDNY maintained that state legislation should be enacted to apply New York City building codes to all structures in New York City, including the World Trade Center (Fusco 1993). FDNY needed this to be able to enforce the codes and maintain standardization and knowledge of a building's fire protection features (Fusco 1993).

Changes to Building Systems and Fire Safety Personnel: FDNY made progress on this issue during the period between 1993 and 2001 through agreements with the PANYNJ. In 1993, two agreements were entered into by the Port Authority and New York City regarding fire safety of Port Authority facilities located in New York City. These agreements are located in Appendix C.

- The first agreement allowed for the implementation of fire safety recommendations that would be made by FDNY after they had inspected PANYNJ facilities located in New York City.
- The second agreement gave FDNY permission to conduct fire safety inspections of PANYNJ properties in New York City and provided guidelines for FDNY to communicate needed corrective actions to the PANYNJ. It assured that new or modified fire safety systems would be in compliance with local codes and regulations. It also required a third party review of the systems by a New York State licensed architect or engineer.

3.2.5 Elevators

Issue

Elevator searches needed to be prioritized, with public assembly elevators having the highest priority, and elevator mechanics needed to work with fire department personnel while conducting rescue operations (Fusco 1993).

Changes to Elevator Policies: By 1997, FDNY had instituted these new elevator policies and procedures. The 1997 FDNY elevator policy is located in Appendix D of this report.

¹¹ FDNY Interview 54, winter 2004.

3.2.6 Protective Clothing

Issue

The weight and bulk of turnout coats and boots were determined to reduce the effective working time of firefighters when they had to climb stairs for hours. Other work jackets and shoes were recommended for climbing the stairs if fire was not an issue, and they recommended that protective clothing be available when it was needed (Fusco 1993).

Changes for Protective Clothing: The recommendations from the 1993 post-bombing analysis had little impact on what happened during the attack of 2001. Firefighters climbed many flights of stairs while wearing their protective clothing and carrying heavy firefighting equipment. Since there were large fires burning in the buildings, this protective clothing and equipment would have been used if they had been able to reach the fire floors and conducted firefighting operations.¹² Also, the Port Authority had installed small stocks of firefighting equipment at the Sky Lobbies on the 44th and 78th floors. A Port Authority Police officer wearing his duty uniform was able to climb to the 44th floor and open the equipment storage locker. However, these supplies would not have been adequate for conducting the large-scale firefighting operations that were needed. In addition, NYPD Emergency Service Unit personnel were operating in the buildings with air-packs but without thermal protective clothing.¹³

3.2.7 Contaminated Stairwells

Issue

The stairways in the World Trade Center towers were smoke filled throughout their entire 110 floors during the 1993 bombing. Smoke moved through the building mainly by elevator shafts and stairways. Then the smoke moved onto the floors and into other stairways as evacuees opened stairway doors (Fusco 1993).

Changes for Stairwells: Although the Port Authority had made some changes to the buildings' stairwells, on September 11, 2001, the stairs above the fires again became filled with smoke and hot gasses, trapping people on the upper floors of the buildings.¹⁴ Primary improvements to the stairways were to new emergency lighting systems and painting photo-luminescent markings on the stairs and connecting stairway landings. Some of the changes did have a positive impact on the stairways located below the impact zones. Stairways are discussed in section 5.6.4.

¹² FDNY Interview 17, winter 2004.

¹³ PA Interview 10, fall 2003.

¹⁴ PA Interview 11, fall 2003.

3.2.8 News Media

Issue

A chief officer needed to be assigned to work with the media on large incidents (Fusco 1993).

The study of news media operations at a large incident was not a goal associated with the NIST investigation. However, during the course of the investigation, it became apparent that news media functions associated with a large disaster was a subject that required review. It is apparent from FDNY Chief Fusco's report of the 1993 bombing at the WTC that emergency responders and the news media needed a better means to coordinate their operations (Fusco 1993).

Changes Associated with News Media: The 1997 FDNY Communications Manual describes the department's policy for media liaison operations.¹⁵ However, on September 11, 2001, operations between emergency responders and the news media were not totally effective. The difficulties impacted emergency responders, the news media, people trapped inside the WTC towers, and the public at-large. As the attack and emergency operations at the WTC unfolded, many of the emergency responders either learned of the attack from the news media or obtained some of their most useful information about the attack from media coverage. In contrast, it is apparent that New York City emergency response agencies had less than effective operations associated with gathering information and communicating it to appropriate parties. This included the communication of some critical emergency response and evacuation information to the news media so that it could be broadcast to the public. One example of this was the fact that stairway "A" in WTC 2 was passable for evacuation from floors above the building's aircraft impact zone. (NIST NCSTAR 1-7, 2005) It is apparent that this information was neither gathered nor communicated to the news media so that evacuation directions could be broadcast to people trapped on the upper floors of the building.

News service personnel responded quickly to the WTC site to cover this tragic event. Mayor Giuliani and his staff of Commissioners attempted to provide information to the news media (Giuliani 2002). However, the number of reliable information sources available to the news media did not appear to be adequate for the influx of requests for information. Port Authority records indicate that the news media from around the world were attempting to access the emergency responder departments.¹⁶ This is highlighted by the fact that during the first two hours of the attack and emergency operations at the WTC, the Port Authority telephone system at WTC 5 recorded 19 telephone calls from the news media. Many of these telephone calls were received by the Port Authority Police Department (PAPD) at their desk located at WTC 5 while they were attempting to carryout life saving operations. This interfered with the PAPD's ability to conduct emergency operations that were critical to life safety issues such as medical aid for the injured, the rescue of trapped building occupants, and the evacuation of people from the WTC site. It also interfered with PAPD facilities security operations.

News media telephone calls were captured on PANYNJ telephone communications recordings covering Channels 2, 8, 9, 10, 23, 24, and 26. Some of these news media telephone calls were from New York City area organizations. Others were from news departments and radio talk shows from across North

¹⁵ FDNY Communications Manual, DCN: 3.01.01, Chapter 7, January 1, 1997.

¹⁶ Port Authority telephone communications recordings Channels 2, 8, 9, 10, 23, 24, and 26.

America. At least one of the media calls was received from Europe. All of news media telephone calls were transferred to the appropriate PANYNJ public information office.

The following summarizes findings associated with emergency responder/news media operations:

- Emergency responder/news media communications were less than totally effective during the WTC operations on the morning of September 11, 2001.
- Critical information related to life safety and evacuation from the WTC towers was not communicated to the news media so that it could be broadcast to people trapped inside the WTC towers above the building fires.
- Some news media contacts with emergency responder agencies interfered with the emergency response and life saving operations. Appropriate emergency response agency contact points were bypassed or not used by some news media for gathering information.
- It appears that emergency response agencies were overwhelmed by news media requests for information.

3.2.9 Preplanning and Command Organization

Issue

The magnitude of the 1993 attack heightened FDNY's awareness of the need for preplanning and command organization that went beyond the scale of operations carried out during the 1993 bombing. Intra and interdepartmental drills were needed to ensure operations, and the specter of larger disasters was raised (Fusco 1993).

As shown above, FDNY made numerous changes to department operations and planning in an attempt to successfully function under conditions where a large number of people are affected over a large area. As will be seen in the rest of this report, some of their improvements had a positive effect on fire department operations until WTC 2 collapsed. With the collapse of the towers and the loss of large numbers of personnel, emergency operations radically changed.

3.3 REFERENCES

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Chapter 4

CHRONOLOGY OF EVENTS BASED ON COMMUNICATIONS DATA

The chronologies listed in this chapter were drawn from the detailed chronology located in Attachment 2. These chronologies provide the reader with a sense of timing related to the WTC attack and the unfolding emergency response operations. The following selected communications provide information concerning (1) dispatch and arrival of emergency response units, (2) evacuation, (3) emergency response operations, and (4) chronology of the WTC towers.

Note: These chronologies are based on the best possible data provided to NIST for the analysis. The times are given to represent the event sequence. Based on the variations of recorded clock times for the data and times assigned for each recording provided by the departments, it is estimated that the margin of error for each time is approximately ± 2 minutes. (E) indicates that the time is an estimate from the original source or has been estimated by the authors based on the available data. All other times listed are based on time recordings or reported clock readings.

4.1 DISPATCH AND ARRIVAL OF EMERGENCY RESPONDERS CHRONOLOGY

The following chronology demonstrates that the emergency response to the World Trade Center (WTC) was immediate. Within the first three minutes after the aircraft impact into WTC 1, (1) the Port Authority Police Department (PAPD) responded by providing information on the attack to the police desk; (2) The Fire Department of the City of New York (FDNY) dispatched 26 units to the WTC; and (3) The New York City Police Department (NYPD) called a department mobilization that included dispatching aviation units to the WTC for visual assessment. In less than 10 minutes, PAPD called a chemical mobilization; NYPD dispatched five Emergency Service Unit (ESU) teams and had two aviation units at the scene providing observations. In less than 30 minutes, 121 FDNY units had been dispatched to the scene and 30 units had signaled their arrival at the scene.

8:46 a.m. FDNY Battalion Chief reports that an airplane has struck the upper floors of a WTC building and transmits a first and second alarm (FDNY, McKinsey & Company, 2002)

PAPD officer reports to the police desk an explosion at the WTC. (PAPD Radio Channel Y/Channel 2)

8:48 a.m. 26 FDNY units dispatched. (FDNY Dispatch log)

NYPD calls for a department mobilization. (NYPD Special Operations Division (SOD) Radio Channel)

8:49 a.m. NYPD requests that aviation units get into the air and make a visual assessment of the WTC (NYPD SOD Radio Channel)

- 8:50 a.m. PAPD officer calls for a chemical mobilization. (PAPD Radio Channel W)
- 8:52 a.m. A total of five NYPD Emergency Service Units dispatched. (NYPD, McKinsey & Company, 2002)
- NYPD aviation requests landing zone in the vicinity of the WTC. (NYPD SOD Radio Channel)
- NYPD aviation unit arrives at the WTC and examines possibilities of roof rescue. (NYPD, McKinsey & Company, 2002)
- 8:54 a.m. NYPD aviation advises they have two units in the air to do aerial survey. (NYPD SOD Radio Channel)
- 8:59 a.m. FDNY Chief calls for all but one Rescue Squad to the WTC. (FDNY Manhattan Dispatch Radio Channel)
- 9:00 a.m. A total of 66 FDNY units have been dispatched at this time. (FDNY Dispatch log)
- 9:03 a.m. FDNY Marine unit reports that a second plane struck WTC 2. (FDNY Manhattan Dispatch Radio Channel and FDNY, World Trade Center Incident Summary, 2001)
- 9:15 a.m. A total of 121 FDNY units dispatched, and 30 FDNY units signal* their arrival. (FDNY Dispatch log)
- 9:29 a.m. FDNY dispatcher relays that a department-wide recall has been instituted. (FDNY, World Trade Center Incident Summary, 2001)
- 9:59 a.m. A total of 171 FDNY units dispatched, and 74 FDNY units signal their arrival. (FDNY Dispatch log)
- 10:29 a.m. A total of 214 FDNY units dispatched, and 103 FDNY units signal their arrival. (FDNY Dispatch log)

*Note: FDNY arrival times are determined from 10–84 signals transmitted by units as they arrive at their assigned location. A 10-84 signal is sent by a firefighter from a fire department vehicle by pressing a button on the communications console. Figure 4–1 below gives a visual representation of the FDNY units dispatched versus a specific time.

4.2 EVACUATION CHRONOLOGY

The evacuation chronology exhibits a mix of responses to the disaster. It provides insight into the successes and shortcomings of the evacuation from the WTC buildings and site. The first noteworthy event is that multiple orders were given by a senior PAPD police officer to evacuate the WTC buildings and the entire complex. There is no evidence that these orders were transmitted to appropriate personnel at the site to initiate the full evacuation of the complex. Some of these communications also show that the

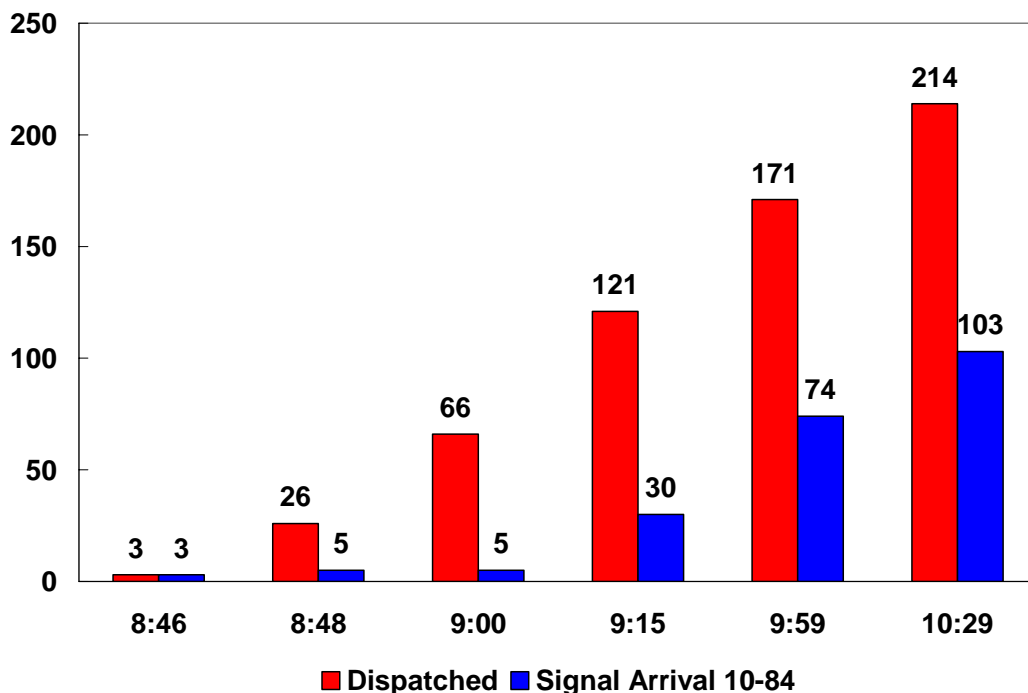


Figure 4–1. Number of FDNY units dispatched and signaling arrival at specific times.

evacuation process was not always orderly and controlled. It was reported that people were running from the PATH trains, and a report came in to the PAPD police desk from a police officer in WTC 5 stating that “I have people going crazy.” Since people could not evacuate from floors above the impact zone and large fires were burning below them, the first-person jumped from WTC 1 at 8:52 a.m., only 6 minutes after the first aircraft struck WTC 1. However, a significant portion of the evacuation process from the WTC complex was orderly. This chronology also indicates that PANYNJ, PAPD, and building security personnel held their posts in the face of life threatening conditions to assist people in the evacuation. In addition, these communications provide some basic information about the status of people trapped in the buildings and the fact that the elevators in the buildings were not functioning or dangerous to use. Finally, several cases are listed where injured, elderly, or physically impaired people were not able to walk down the stairs in the building and needed assistance to evacuate.

- 8:47 a.m. WTC Vertical Transportation receives a message to evacuate the building (WTC 1) and send people out toward WTC 5. (PA/WTC Vertical Transportation, Radio Channel Z)
- WTC Vertical Transportation receives a message from a PAPD officer instructing employees to avoid the Concourse. (PA/WTC Vertical Transportation, Radio Channel Z)
- 8:48 a.m. WTC Vertical Transportation receives two orders calling for the evacuation of the building, WTC 1. (PA/WTC Vertical Transportation, Radio Channel Z)
- 8:52 a.m. PAPD police desk receives report from police officer that people are jumping out of the windows from WTC 1. (PAPD Radio Channel W)

- 8:53 a.m. WTC Security report indicates that people are running from the PATH trains. (WTC Security Radio Channel X)
- 8:54 a.m. A dispatcher relays information to the FDNY Command Posts that people are trapped on floor 106 of WTC 1. (FDNY, 9-11-2001 Time Line Document and FDNY 9/11 Summary notes)
- 8:56 a.m. PATH trains are still bringing people into the WTC site. (PAPD Radio Channel W)
- WTC Operations attempts to assemble personnel at WTC 1 exits to the plaza to show people how to get out. One Port Authority employee responds to the message saying that he cannot get over to the building exits because glass is falling all over the place. (PA/WTC Operations Radio Channel Y)
- WTC Security receives a radio message that they need assistance in WTC 4 because people are attempting to exit the building. (PA/WTC Security Radio Channel X)
- 8:57 a.m. WTC Security: a message is sent stating, “Don’t let anyone in the building evacuate to the Plaza at this time.” (PA/WTC Security Radio Channel X)
- 8:58 a.m. WTC Security instruction to security guards: hold your post and don’t allow people into the Plaza or out onto the Courtyard. (PA/WTC Security Radio Channel X)
- PAPD police desk reports that people are trapped on floor 79 of WTC 1. (PAPD Radio Channel W)
- 8:59 a.m. PAPD police desk: a senior PAPD officer calls for the evacuation of WTC 1 and WTC 2. (PAPD Radio Channel W)
- PAPD police desk: a senior PAPD officer calls for the evacuation of the entire WTC complex, all buildings. (PAPD Radio Channel W)
- 9:00 a.m. PAPD police desk: a police officer asks if building five should be evacuated, and he was told to stand by. (PAPD Radio Channel W)
- WTC Security receives a report that there are people trapped inside suite 8711 of WTC 1 and they can’t get out. (PA/WTC Security Radio Channel X)
- PAPD police desk: orders were given to evacuate WTC 1, B4 level. (PAPD Radio Channel W)
- WTC Operations: a Port Authority employee calls in that he is on floor 27 in the C staircase and has a man in a wheel chair and needs assistance. (PA/WTC Operations Radio Channel Y)
- 9:01 a.m. PAPD police desk: a senior PAPD officer calls for the evacuation of all buildings in the WTC complex. (PAPD Radio Channel W)

- 9:02 a.m. WTC Operations: Port Authority employee calls in reporting that he is stuck in an elevator on floor 78 of WTC 1 in car number 81A. (PA/WTC Operations Radio Channel Y)
- 9:03 a.m. A second aircraft strikes WTC 2. (FEMA 403)
- 9:04 a.m. WTC Operations: A call is made to evacuate everybody from the building now. Note: Building not identified. (PA/WTC Operations Radio Channel Y)
- 9:05 a.m. WTC Security: a security officer indicates that WTC 4 is being evacuated. He is then going to WTC 5. He also reports “I have people going crazy.” (PA/WTC Security Radio Channel X)
- WTC Operations: A report comes in that Port Authority employees heard people stuck inside of some elevators and also report that they are getting them out. (Note: Building and location not identified.) (PA/WTC Operations Radio Channel Y)
- WTC Operations: A call comes in to get everybody off the complex. (PA/WTC Operations Radio Channel Y)
- 9:07 a.m. WTC Operations: A report comes in that somebody is stuck in an elevator on floor 76. (Note: Building not identified.) (PA/WTC Operations Radio Channel Y)
- 9:08 a.m. WTC Security: report from an officer that debris is falling from WTC 2 by WTC 4 and Liberty Street, and to let the people out of WTC 4. (PA/WTC Security Radio Channel X)
- 9:09 a.m. WTC Security report is received indicating that FDNY is entering elevator bank 11, 12. (Note: Building not identified. Elevators 11 and 12 are shuttle elevators. Elevator 11 goes from the lobby to the 44th floor. Elevator 12 goes from the lobby to the 78th floor.) (PA/WTC Security Radio Channel X)
- 9:10 a.m. WTC Security receives a report that the express elevators could be in jeopardy of falling. (Note: Building not identified.) (PA/WTC Security Radio Channel X)
- 9:12 a.m. WTC Security receives a radio report from the Command Desk in the lobby of WTC 2 saying that they cannot communicate with the Warden phones and that they are making announcements telling people not to stay at the Warden phones. (Note: This communication indicates that the Warden phones in WTC 2 were not working. Warden phones are located on each floor of the building for the use of floor wardens. They are wired for communications with the fire command desk in the building lobby.) (PA/WTC Security Radio Channel X)
- 9:14 a.m. PAPD police desk receives confirmation that no elevators are working. (Note building not identified.) (PAPD Radio Channel W)
- 9:16 a.m. FDNY radio dispatcher advises a chief that there are people trapped in WTC 1 at the following locations: floor 82 east side; floor 83, room 8311; floor 103, room 103 near the

corner, floor 104; and floor 106, and in WTC 2 at the following locations: floor 82 west side; floor 88; and floor 89. (FDNY 9/11 Summary notes)

- 9:17 a.m. PAPD police desk reports that four callers have made contact and need assistance on floor 106 of WTC 1. (PAPD Radio Channel W)
- 9:20 a.m. PAPD police desk receives a message from an officer that no one is down on the B4 level of WTC 1. (PAPD Radio Channel W)
- 9:23 a.m. FDNY radio dispatcher advises FDNY Field Communications Unit that 100 people are overcome in WTC 1 on the northwest and southwest corners of floor 103. The dispatcher also reports that Ladder 3 reports numerous injuries in the stairwell at floors 35 and up. (FDNY 9/11 Summary notes)
- 9:24 a.m. PAPD police desk receives a report from an officer that people from floor 64 are now coming down onto the courtyard level of WTC 1. (PAPD Radio Channel W)
- 9:28 a.m. PAPD police desk receives a radio report of a person with burn injuries caused by a falling elevator. (Note: Location of injured person was provided as A20. This may mean WTC 1 on floor 20 on the A stairway.) (PAPD Radio Channel W)
- 9:29 a.m. WTC Security reports that there is a medical emergency in the B stairway; there is a person that cannot walk down. The people are coming down from floor 51, and the person needing assistance has asthma. (Note: Building not identified.) (PA/WTC Security Radio Channel X)
- 9:30 a.m. WTC Security receives a report that two elderly people on floor 51, B stairway, WTC 1, cannot walk down and need medical assistance. (PA/WTC Security Radio Channel X)
- 9:37 a.m. PAPD police desk recorded the following message: “All World Trade Center units to the Command Post. All World Trade Center units escort everybody over the land bridge on West Street to the Financial Center. Do not, repeat, do not send people out into the Concourse on to south side.” (PAPD Radio Channel W)
- 9:45 a.m. WTC Security receives a report that officers are sending people down, evacuating on the A stairway in WTC 1. (PA/WTC Security Radio Channel X)
- WTC Security gets a request for crowd control on Broadway. Answer to the request is that the City police should be responding. (PA/WTC Security Radio Channel X)
- 9:56 a.m. WTC Security receives a report that WTC 1 is not completely evacuated and that people are still coming out of each stairway. (PA/WTC Security Radio Channel X)

4.3 EMERGENCY RESPONSE OPERATIONS CHRONOLOGY

This section provides an overview of the emergency response operations carried out by FDNY, NYPD, and PAPD at the WTC. The chronology highlights several communications that identify cases where

emergency responders were assisting injured people, calling for EMS assistance, and searching for functioning elevators to help evacuate injured people. Some fires in the buildings are identified, and some firefighting operations in WTC 2 are identified. Communications from PAPD provide information on the locations of many people who were trapped in the buildings and in elevators. Several communications provide insight into FDNY operations in WTC 2 and show that some firefighters actually reached the 78th floor in WTC 2. This ascent to the 78th floor was assisted by the use of an elevator that operated until just before the building collapsed. The elevator became stuck in the elevator shaft, and the firefighter operating the elevator was chopping his way out when the building collapsed. Several radio communications provide insight into the difficulty that emergency responders had trying to climb the stairs of the WTC towers. Cases are noted where FDNY personnel had to stop and rest. Radio communications from the FDNY channel 7 repeater also point out the difficulty that some firefighters had with the identification of the two buildings. The exchange of communications by FDNY personnel at 9:29 a.m. clearly shows this difficulty. Several communications from NYPD aviation units show how the aircrews repeatedly explored the possibility of landing on the roof of WTC 1 and reported that conditions were not safe for landing. However, at 9:38 and 9:40 a.m., an aviation unit calls in for permission to land on the roof of WTC 1. No evidence has been found that indicates that WTC occupants were seen on the tower roof or that conditions had improved when these radio requests were made. Interviews with aviation personnel indicate that many of them were highly troubled by the number of occupants trapped in the buildings and the number of people jumping from the buildings, and they were distressed that they were unable to help them.^{1, 2, 3} At 9:43 a.m., a senior police department official ordered that no one from the aviation units was to “rappel” on the building’s roofs. Rappel in this case means to descend down a rope attached to a helicopter onto the roofs of the WTC buildings. Communications in this section also reflect the fact that many people were coming to the WTC to volunteer their assistance. Many volunteers were turned away as the emergency responders felt that they needed to get everybody away from the WTC complex.

8:46 a.m. An aircraft strikes WTC 1. (FEMA 403)

8:49 a.m. WTC Security: A message is received that Emergency Medical Service (EMS) is needed because there is an injured security guard. The message was not complete; the location was not understandable. (PA/WTC Security Radio Channel X)

8:50 a.m. FDNY establishes a command post in the lobby of WTC 1. (FDNY McKinsey & Company, 2002)

WTC Security message from an officer on the B2 level of WTC 1 saying that there are two workers injured on that level and that EMS is needed “ASAP.” (PA/WTC Security Radio Channel X)

PAPD police desk receives a radio call from FDNY Ladder 10 requesting information from PAPD about which building was struck and the location of the fire, WTC 1 or

¹ NYPD, Interview 14, winter 2004.

² NYPD, Interview 20, winter 2004.

³ NYPD, Interview 21, winter 2004.

- WTC 2. FDNY uses a Port Authority Radio for the communication. (PAPD Radio Channel W)
- 8:52 a.m. NYPD aviation unit arrives at the WTC to examine possibilities for roof rescue. (NYPD McKinsey & Company 2002)
- 8:56 a.m. WTC Security: an officer calls for an ambulance at WTC 4 for an injured person. (PA/WTC Security Radio Channel X)
- 8:58 a.m. NYPD aviation unit advises that they are unable to land on the roof due to heavy smoke conditions. (NYPD SOD Radio Channel)
- 9:00 a.m. WTC Security receives a message saying that there is an injured person between floors 14 and 15 of WTC 2. (PA/WTC Security Radio Channel X)
- 9:01 – 9:03 (E) FDNY Incident Command Post is established on West Street opposite WTC 1 (FDNY, McKinsey & Company, 2002)
- 9:01 a.m. WTC Security receives a report of a fire in a parking lot. (PA/WTC Security Radio Channel X)
- 9:02 a.m. WTC Security receives a report of a gas leak. (Note: Incomplete message, location of leak not identified.) (PA/WTC Security Radio Channel X)
- 9:03 a.m. An aircraft strikes WTC 2. (FEMA 403)
PAPD – by this time a PAPD senior officer has called three times for the evacuation of the World Trade Center, WTC 1 and WTC 2, and then “all buildings in the complex.” (PAPD Radio Channel W)
- WTC Security reports that another aircraft has struck WTC 2. (PA/WTC Security Radio Channel X)
- 9:05 a.m. PAPD police desk, an officer calls in and requests that every ambulance that can be spared be sent to the WTC. (PAPD Radio Channel W)
- 9:08 – 9:13 (E) FDNY establishes a Lobby Command Post inside WTC 2 at the Fire Command Desk.⁴
- 9:10 a.m. FDNY dispatcher receives a message saying that people are trapped on floor 86 of WTC 2. (FDNY 9-11-2001 Time Line Document)
- 9:11 a.m. FDNY Field Com unit begins operations to maintain status. (FDNY, McKinsey & Company, 2002)
- 9:11 a.m. FDNY reports that Engine 10 requests that all responding units stop short of the WTC buildings, either north or south of Liberty and West Street because of the large

⁴ FDNY Interview 7, winter 2004.

number of parked ambulances and debris falling from the buildings. (FDNY 9/11 Summary notes)

- 9:16 a.m. (E) FDNY Command Post and Staging area designated for WTC 2 at West and Albany Streets. (FDNY, McKinsey & Company, 2002)
- 9:17 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30) indicates that they are using an elevator for operations in WTC 2. (PA/WTC Radio Channel 30 recording)
- 9:18 a.m. FDNY radio communication from WTC 2 indicates they have one elevator working to floor 40, and it is staffed by a firefighter from Ladder 15. (PA/WTC Radio Channel 30 recording)
- PAPD police desk receives a report that FDNY is abandoning its command post and going across the street. (PA/WTC Security Radio Channel X)
- 9:22 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30) states that a Battalion Chief is on floor 43 or WTC 2 in the B stairway. (PA/WTC Radio Channel 30 recording)
- FDNY Battalion Chief now located on floor 43 of WTC 2 receives a message from a FDNY member that NYPD Emergency Service police officers (Emergency Service Unit) are in the building and want to provide support for him. The Battalion Chief gives the Emergency Service Unit police officers direction to his location on floor 43 in the B stairway. (PA/WTC Radio Channel 30 recording)
- 9:26 a.m. NYPD aviation unit advises that it is impossible to land on the roof at this time. (NYPD SOD Radio Channel)
- 9:29 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30): a Battalion Chief is communicating that he is located inside “Tower 2, the South Tower.” A firefighter follows the communication attempting to correct the Chief by saying that he was actually in the “North Tower, Tower 2.” (Note: This communication confused the actual location of the Battalion Chief, who later came back on the radio reporting that he was in the South Tower. Interviews with FDNY personnel⁵ conclusively show that the Battalion Chief was actually inside WTC 2, the South Tower.) (PA/WTC Radio Channel 30 recording)
- 9:30 a.m. PAPD police desk receives a report that EMS is setting up a triage station in the lobby of WTC 2. (PAPD Radio Channel W)

⁵ FDNY interview 2, winter 2003 and FDNY interview 7, winter 2004.

- 9:32 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30) Firefighters communicated that they have been able to get to floor 55 inside WTC 2. (PA/WTC Radio Channel 30 recording)
- 9:38 a.m. NYPD aviation unit calls in to request a landing on the roof of the North Tower as soon as possible. (NYPD SOD Radio Channel)
- 9:39 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30): FDNY officer inside WTC 2 indicates that he is sending 10 to 15 injured people down to floor 40 and that the firefighter at that location should take the injured to the building's lobby in the elevator. The officer also requests that the firefighter operating the elevator bring an EMS crew back up with him. (PA/WTC Radio Channel 30 recording)
- 9:40 a.m. NYPD officer advises that they need the aviation units on the roof as soon as possible. (NYPD SOD Radio Channel)
- 9:41 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30): Hazmat 1 (Hazardous Materials Unit) reports that they are on floor 48 of WTC 2 in the B stairway. (PA/WTC Radio Channel 30 recording)
- 9:42 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30) A firefighter informs the Battalion Chief that he cannot find any elevator banks that are operating above floor 40. The Chief advises the firefighter that he should climb the B stairway from his location. (PA/WTC Radio Channel 30 recording)
- WTC Security receives a report that people have arrived and want to volunteer to help and asks where they should be sent. Answer: "Right now just send everybody away from the World Trade. We are not letting anybody come close to it." (PA/WTC Security Radio Channel X)
- PAPD police desk receives a radio report that a triage center has been set up at WTC 4 at Victoria's Secret. (PAPD Radio channel W)
- 9:43 a.m. NYPD officer advises that no one is to rappel onto the tops of the buildings. (NYPD SOD Radio Channel)
- 9:44 a.m. WTC Security receives a communication saying that "They haven't evacuated the Fire Command over here in building 2 or 1." (PA/WTC Security Radio Channel X)
- 9:44 a.m. (E) The Office of Emergency Management operations center inside WTC 7 is evacuated. (FDNY, interview 24, winter 2004)
- 9:45 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30) A firefighter calls the Battalion Chief and reports that they had to take their coats off. (PA/WTC Radio Channel 30 recording)

- 9:49 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30) A Battalion Chief instructs a firefighter that it is imperative that he get down to the lobby command post to get some people up to floor 40. Injured people are being sent down from floor 70. The firefighter is inside an operating elevator and is reporting that it is not operating properly and expresses concerns about the elevator becoming stuck in the shaft. (PA/WTC Radio Channel 30 recording)
- 9:50 a.m. WTC Security receives a message saying that FDNY needs a resuscitator on floor 19, B corridor of WTC 1. (PA/WTC Security Radio Channel X)
- 9:54 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30) A Battalion Chief calls for a Ladder company in the A stairway to extinguish two fires. They are attempting to stretch building hose lines on about floor 78. (PA/WTC Radio Channel 30 recording)
- FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30) A firefighter calls to the Battalion Chief that he is on floor 55 and must stop to rest. (PA/WTC Radio Channel 30 recording)
- WTC Vertical Transportation message indicates that an officer is located on floor 22, fire command center and that there is heavy traffic in the B stairway. The person indicates that they cannot release any emergency locked doors due to fire and the loss of electrical power. (Note: Communication appears to originate from WTC 1.) (PA/WTC Vertical Transportation Radio Channel Z)
- WTC Security receives a report that there are 18 passengers stuck in an elevator on the floor 78 sky lobby of WTC 2 and that firefighters are working to get them out. They request EMS at the location on the double. (PA/WTC Security Channel X)
- 9:56 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30): inside WTC 2, a firefighter states they are in the B stairway and that they will have to put some fire out in order to get to the A stairway. (PA/WTC Radio Channel 30 recording)
- 9:57 a.m. WTC Security receives reports by radio on the Security Radio Channel X and by phone from floor 78 of WTC 2 that people are coming out of the elevator banks. (PA/WTC Security Radio Channel X)
- At and below floor 79 of WTC 2, FDNY, NYPD, and PAPD personnel are evacuating occupants, assisting the injured and fighting fires.
- FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30) A firefighter in WTC 2 reports that he is trapped in an elevator in the elevator shaft and that they are chopping their way out. (PA/WTC Radio Channel 30 recording)

- 9:59 a.m. FDNY Marine unit reports the collapse of WTC 2. (FDNY World Trade Center Incident Summary, 2001)
- 10:28 a.m. FDNY Marine unit advises that the second WTC tower collapsed. (FDNY World Trade Center Incident Summary, 2001)

4.4 CHRONOLOGY OF THE WTC TOWERS

Information provided by this chronology partially describes the variable conditions found in WTC 1 and WTC 2. The impact of the first aircraft into WTC 1 and the fires and overpressure that resulted created significant damage down to the building's basement. The impact of the aircraft into WTC 2 produced jet fuel fires in the building on the 51st floor. Other communications indicate that there was no smoke or fire on the 68th, 73rd, or 74th floors and that the walls in stairway B had been breached. A telephone call to a New York City 9-1-1 telephone operator at 9:37 a.m. indicates that a floor in the 90s level of WTC 2 had collapsed. According to NYPD records, information from this call concerning the floor collapse in the 90s appears to have been conveyed inaccurately by the 9-1-1 call taker and the NYPD radio dispatcher.⁶ The NYPD dispatcher transmitted the message at 9:41 a.m. and again at 9:51 a.m., identifying the collapsed floor as being the 106th floor. Communications from the NYPD aviations units describes a steady deterioration of the two WTC towers before they collapsed.

- 8:47 a.m. WTC Security reports that there is a fire on floor 22 of WTC 1 (PA/WTC Security Radio Channel X)
- 8:49 a.m. WTC Security reports that there is damage and a lot of debris on floor 22 of WTC 1 (PA/WTC Security Radio Channel X)
- 8:51 a.m. PAPD police desk receives a call that an explosion was observed in the basement of the B1 level of WTC 1. The police desk informs the officer on the B1 level that what he saw resulted from an explosion on the upper floors of the building. (PAPD Radio Channel W)
- 8:57 a.m. PAPD police desk receives report that water pipes are broken on the B4 level of WTC 1. (PAPD Radio Channel W)
- 9:02 a.m. WTC Operations receives a message from a person trapped in an elevator on floor 78 of WTC 1 that the area has smoke, and water and debris are coming down from above. (PA/WTC Operations Radio Channel Y)
- 9:10 a.m. PAPD police desk receives a report that there is burning jet fuel on floor 51 of one of the towers. (Note: Communications suggest this is WTC 2.) (PAPD Radio Channel W)
- 9:13 a.m. WTC Security receives a report that WTC 1 is flooding. (PA/WTC Security Radio Channel X)

⁶ McKinsey & Company, NYPD call-routing and message dispatch, "106th floor is collapsing," draft summary report July 23, 2002.

- 9:32 a.m. WTC Security receives a message from an officer that the WTC Concourse is flooding. (PA/WTC Security Radio Channel X)
- 9:37 a.m. New York City 9-1-1 telephone operator receives a message from an occupant of WTC 2 that a floor had collapsed below them in the 90's level. (Note: The person calling the 9-1-1 operator indicated they had gone to floor 105.) (NYPD, McKinsey & Company, call-routing and message dispatch summary report, 2002)
- 9:41 a.m. NYPD dispatcher advises units that floor 106 in WTC 2 is collapsing and that the message comes from someone on that floor. (NYPD Division 1 Radio Channel)
- 9:47 a.m. FDNY radio communications on the City-wide, high-rise Channel 7 (PA/WTC Radio Channel 30): a firefighter inside WTC 2 reports that he is standing in the B stairway on floor 74 and there is no smoke or fire problem. He reports that the stairway walls have been breached on floors 73 and 74. Another FDNY unit in the same stairway reports that the walls were also breached on floor 68. (PA/WTC Radio Channel 30 recording)
- 9:49 a.m. NYPD aviation unit gives a radio report stating that "large pieces" may be falling from the top of WTC 2. Large pieces are hanging up there. (NYPD SOD Radio Channel)
- 9:51 a.m. NYPD dispatcher advises that at WTC 2, floor 106 is crumbling per communications with victims trapped on the floor. (NYPD SOD Radio Channel)
- 9:58 a.m. NYPD aviation unit advises that the south tower is coming down. (NYPD SOD Radio Channel)
- 10:06 a.m. NYPD officer advises that it isn't going to take much longer before the north tower comes down and to pull emergency vehicles back from the building. (NYPD SOD Radio Channel)
- 10:20 a.m. NYPD aviation unit reports that the top of the tower might be leaning. (NYPD SOD Radio Channel)
- 10:21 a.m. NYPD aviation unit reports that the north tower is buckling on the southwest corner and leaning to the south. (NYPD SOD Radio Channel)
- NYPD officer advises that all personnel close to the building pull back three blocks in every direction. (NYPD SOD Radio Channel)
- 10:27 a.m. NYPD aviation unit reports that the roof is going to come down very shortly. (NYPD SOD Radio Channel)
- 10:28 a.m. NYPD officer reports that the tower is collapsing. (NYPD SOD Radio Channel)

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Chapter 5

ANALYSIS OF EMERGENCY RESPONDER OPERATIONS

5.1 METHODOLOGY

For this project, data were collected as described in Chapter 2. NIST personnel began analyzing the first data as soon as it was collected and continued throughout the investigation as new information was gathered. NIST personnel working on this part of the investigation carried out “lead following” activities to locate information critical for analysis, and as the “lead following” activities progressed analysis processes became a natural part of the work. The process of “lead following” was also used to assist in identifying emergency responders who needed to be interviewed. Information analysis and “lead following” made up a substantial part of the first-person interview process. However, the final analytical work was not completed until report writing was in progress.

One of the first steps in the analysis was to create a chronology of factual data associated with the emergency operations. The chronology was developed from a large number of sources that are identified in Attachment 2 of this report. The second step in the analysis was to convert all of the written documents and interview notes into a searchable computer database. ATLAS.ti, a commercial quantitative analytical software program, was used for structuring the database and conducting searches for any given emergency response subject of interest (Muir 1997). This software allowed personnel to assemble related data from numerous different digitally based data sources so that they could be brought together for final analysis. The analysis process consisted of one person analyzing information gathered followed by multi-person discussions among project staff and agreement on the findings.

ATLAS.ti Program Usage

For this part of the investigation, the ATLAS.ti program was limited to textual data only. All first-person interviews conducted by NIST were transcribed along with radio and telephone communications of interest. The transcripts and other pertinent documents were converted to a text file format and imported into the ATLAS.ti program. A total of 812 documents were entered into the ATLAS.ti program. First-person interviews accounted for 116 of these, radio and telephone transcriptions accounted for 46, and other documents obtained by the investigation accounted for the remaining 650. These other documents were from the various emergency response organizations mentioned earlier (The Fire Department of the City of New York (FDNY), The Port Authority of New York and New Jersey (PANYNJ), and The New York City Police Department (NYPD)) and contained a broad variety of information dealing with standard operating procedures, training, equipment, and practices used during operations at the WTC.

Information and topics selected for analysis were processed using ATLAS.ti by introducing codes into the text or marking specific portions of text and assigning them into categories of interest. The NIST investigation identified 125 categories associated with the emergency response analysis at the WTC, and the 812 documents were coded or marked so that ATLAS.ti could recover information for each of the categories. For example, one category of interest was accountability or tracking of personnel. Within the 116 first-person interviews conducted, the idea or concept of accountability of personnel was coded

93 times. Some individuals interviewed never mentioned accountability while others spoke about it multiple times. The information on accountability gathered from these interviews was further broken down by organization (FDNY, NYPD, or PANYNJ) and at what level in the organization the person was working. The interviewee could be identified as a firefighter, police officer, team leader, or command officer, etc. Whether the individual was speaking of something that happened on September 11, 2001 regarding accountability or something that they wished for in the future that would make accountability at any incident an easier task was also coded. By polling the database using ATLAS.ti, information from each source and category could be gathered for analysis. Review and analysis of each item located by ATLAS.ti in the database and analysis of the complete data set assembled provided detailed, as well as generalized, information about the category searched.

The following sections discuss results of the analysis, including supporting evidence of the emergency response carried out on September 11, 2001, at the World Trade Center.

5.2 ANALYSIS OF THE INFLUENCE OF BUILDING DESIGN ON EMERGENCY RESPONSE

Building design can have a significant impact on the ability of emergency responders to access involved areas, access areas where occupants may be trapped, evacuate building occupants, and conduct safe emergency response operations. Building access is critical to emergency responders, both for ground level entry and for all parts of a building where emergency response operations are needed. High-rise building designs present their own unique challenges for the emergency responder. Some of these challenges are: (O'Hagan 1977)

- entry and overall building access;
- elevators, elevator communications, elevator information panels, and control systems;
- egress, stairways, and the limits to firefighting strategy related to stairway locations;
- building information systems, fire alarm panels;
- emergency and fire alarm communications systems;
- active fire suppression systems, building water supply, fire pumps, and standpipe systems;
- smoke management systems;
- height of the building and limits related to exterior fire attack strategies;
- large area open floor plans with minimal compartmentation; and
- emergency responder communications, command and control.

Building height becomes an immediate challenge when safe and operational elevator systems are not available. As building height increases, emergency responder access becomes limited. The emergency

responder must rely on other building systems and other aspects of the building design to assist with managing an emergency.

Building design has an influence on emergency responder Command and Control as well. Building construction materials and separations can adversely affect the ability of emergency responders to communicate. Additionally, in recent years, lightweight building construction using truss joist systems has led many fire departments to institute additional safety policies related to the possibility of structural collapse (Dunn 1988). These policies relate to both metal truss and wood truss systems. This has affected fire department operations when addressing life saving and firefighting operations. The issues raised by truss construction are highlighted in the building construction section of the fire service training manual entitled, “Essentials of Fire Fighting” (Hall 2000). Building design is an integral part of emergency response and firefighting operations. As discussed below, building design can seriously affect emergency responder operations.

Prior to September 11, 2001, the largest fire in the World Trade Center towers above the lobby level occurred on February 13, 1975. This fire broke out on the 11th floor of WTC 1. The fire grew and involved approximately one quarter of the 11th floor. The fire also spread into the telephone equipment closets and extended from the 9th floor through the 16th floor (O’Hagan 1977). This experience provided FDNY with the first opportunity to fight a sizable fire in the towers and provided lessons for operations in the towers for the future. In his analysis of this fire, former FDNY Fire Commissioner John O’Hagan pointed out the following issues related to fighting fire in the World Trade Center towers:

- Floor size and the size of the fire in the 1975 incident: “If the alarm had been delayed an additional 30 to 60 minutes, it is reasonable to expect that the entire east half of the building could have been involved.” “If the east half of the building had been involved, it is unlikely that a direct attack would have been successful. In that case we may have had to choose a defensive strategy.” (O’Hagan 1977)

O’Hagan’s statement refers only to the east half of the 11th floor in WTC 1 and raises the issue of the large size of the floors in the World Trade Center towers. One half of one floor involved in fire would have been approximately 1,350 m² (15,000 ft²). According to standard calculation methods used by the fire service, it would take water flow rates of approximately 4,700 l/min (1,250 gal/min) to extinguish half of a WTC floor. This would require approximately five 63.5 mm (2.5 in) handlines with 28.5 mm (1.125 in) diameter smooth tip nozzles (NFPA 1997). With a fire this size on the 11th floor of the building, O’Hagan suggests that a defensive strategy may have been the only way to fight the fire until additional resources were available and master streams could be used against the fire. O’Hagan suggests a defensive strategy for attempting to stop fire spread across the remaining floor. This would be done by establishing handline fire hose operations at the floor’s central corridor and attempting to hold the fire’s progress long enough to get large master stream nozzles onto the floor.

O’Hagan also raises the issue of time. He refers to a delay of 30 to 60 minutes that would allow the fire to grow. Since the 1975 fire was on the 11th floor, the time delay in getting personnel and equipment up to the fire floor was relatively short. However, on September 11, 2001, the lowest part of the aircraft impact zone for WTC 1 was the 93rd floor, and the lowest part of the aircraft impact zone for WTC 2 was the 77th floor. Without the use of elevators it would take firefighters approximately two hours or more to

get to the impact zones and fires.^{1,2} For more detailed information on firefighter climbing rates see section 5.6 in this report.

- John O'Hagan discusses the 1975 fire, building evacuation, and smoke control: "the only occupants of the building were maintenance and security employees and, therefore, there was no rescue problem. Had the building been occupied, and given the stack action that exists in this 110-story building, the rescue problem would have been tremendous." (O'Hagan 1977)

O'Hagan's prediction was proven correct during the bombing of the World Trade Center that occurred on February 26, 1993. (Cerreta 1993)

- "Tower 1 was acting as one of the main vents for the cellar fire; it had become a 110-story chimney. (We would later learn that a huge amount of smoke also was entering the elevator shafts from the B-2 level, where the explosion had demolished the shaft walls.)" (Cerreta 1993)

Observations of smoke density on the 44th floor of WTC 1 indicated that the visibility had dropped to about 0.3 m (1 ft) within one minute after the explosion. It was determined that the smoke on the 44th floor mainly traveled upward through the elevator shafts and stairwells (Isner 1993).

The observations above by O'Hagan and Cerreta illustrate some of the key issues associated with fighting large fires in tall buildings. In these cases the tall buildings were the World Trade Center buildings. It is noteworthy to remind the reader that the 1993 WTC fire was below grade, and the 1975 WTC fire was mostly contained on the 11th floor of the building. Smoke in the buildings seriously affected firefighting operations and the evacuation of building occupants. During the 1993 bombing, it is estimated that it took occupants 1 ½ hr to 3 hrs to fully evacuate from the upper floors of the World Trade Center towers, and it took approximately 5 hours to locate and free a group of kindergarten students and several adults trapped in an elevator in WTC 2. (Isner 1993)

5.3 AIRCRAFT DAMAGE, FUEL RUN-OFF, BUILDING SYSTEMS FAILURES, AND EMERGENCY RESPONDER OPERATIONS

5.3.1 Aircraft Damage and Fuel Run-Off

The aircraft impacting on the towers caused major damage to the buildings. In addition, the jet fuel distribution through the buildings and down the elevator shafts generated large fires. The elevator shafts inside WTC 1 contained a fast moving jet fuel droplet cloud fire which damaged shaft walls, elevator doors, and floors near the elevator shafts due to the over pressures that were generated (NIST NCSTAR 1-2, 2005 and NIST NCSTAR 1-5). At 9:10 a.m., the PAPD Police Desk inside WTC 5 received a report of burning jet fuel on the 51st floor of WTC 1.³ In addition, in first-person interviews PAPD personnel reported a huge fireball that came from the elevator shafts and filled the visible volume

¹ FDNY Interview 9, winter 2004.

² FDNY Interview 16, winter 2004.

³ PAPD Police Desk, PA Channel W radio recording.

of the Concourse level between WTC 1 and the entrance to the Marriott Hotel.⁴ PAPD personnel reported that they observed numerous people being enveloped in flames as the fireball swept through the WTC Concourse level.⁵ In addition, burning jet fuel and burning debris from the impact fell to the Plaza and streets and started fires at ground level.⁶ Several people on the Plaza were injured or killed by the falling debris and flames.⁷

Emergency responders observed burning jet fuel and the fires created by it:

- When WTC 2 was hit, the interviewee saw a cloud of burning oil. There was fire falling down and there was fuel on the ground. A person could feel radiant heat on their face from the fireball.⁸
- The jet fuel had gone down the elevator shaft and had blown out the elevator doors and that is why the lobby windows were blown out and why interviewees had seen seriously burned people in the lobby.⁹ (Inside WTC 1)
- Kids told us that the burning jet fuel rolled down the side of the building and burned people in the street.¹⁰
- The interviewee said he looked to the left and saw the fireball coming out of the lobby of WTC 1 on the Marriott side. He turned to his left and ran down the main corridor toward WTC 2 to get away from the fireball and dived into the corridor that led to a freight elevator.¹¹
- Elevators 6A and 7A were out of service for modernization. The doors were blown off by the fireball that came down the elevator shaft and the elevator cars were burned.¹² (Basement level of WTC 1)
- The interviewee said that he could actually see from his side of the building the fireball from the jet fuel coming down, and the blast blew out the windows on the 44th floor and knocked him and about 10 people on the floor.¹³ (Inside of WTC 1 when WTC 2 was struck)

⁴ PA Interview 1, fall 2003.

⁵ PA Interview 1, fall 2003.

⁶ FDNY Interview 52, winter 2004.

⁷ FDNY Interview 47, winter 2004.

⁸ FDNY Interview 30, winter 2004.

⁹ FDNY Interview 27, winter 2004.

¹⁰ FDNY Interview 47, winter 2004

¹¹ PA Interview 1, fall 2003.

¹² PA Interview 5, fall 2003.

¹³ PA Interview 10, fall 2003.

- A fire was started on the B4 level of WTC 1 when the first plane struck. The interviewee said that he believes that burning jet fuel ignited the fires.¹⁴

Since the first fire department personnel who entered WTC 1 following the aircraft impact actually saw the aircraft hit the building, these firefighters had a general idea of building damage before they got to the scene. They knew that the building safety systems were likely damaged and that the building had absorbed the energy of a large aircraft impact.^{15, 16} Upon entering WTC 1, FDNY personnel met with Port Authority personnel and the WTC 1 Deputy Fire Safety Director to learn more about building conditions.¹⁷ Also upon entering the building, FDNY saw victims burned by the fireball that came into the building's lobby. Some of these seriously burned people were still alive; fire department personnel tried to give them aid even though they were not likely to survive. Some of the bodies were still burning and firefighters used handheld fire extinguishers to put them out.¹⁸

FDNY personnel identified the following related to building conditions and emergency response operations in the building:^{19, 20}

- the initial fire department size-up of the event was that a large aircraft had hit WTC 1, and there were large fires burning on multiple floors at and above the impact zone,
- it was reported to the FDNY Battalion Chief who established the WTC 1 Lobby Command Post that the elevators were not working and/or were not generally safe for use during the WTC operations; however one elevator was used briefly by FDNY,
- people were trapped inside many of the elevators,
- firefighters would have to gain access to the injured and trapped occupants by climbing the stairs and carrying the equipment needed up the stairs,
- it was likely that the water supply on the upper floors was damaged and that firefighting would not be an option until a reliable water supply was established and equipment was carried up. It appeared that the sprinkler and standpipe systems were compromised at the impact zone,
- FDNY command personnel learned from 9-1-1 dispatch operators that smoke, fire, and structural damage in the buildings prevented many building occupants from evacuating floors above the impact zones,

¹⁴ Other Interview 1, fall 2003.

¹⁵ FDNY Interview 2, fall 2003.

¹⁶ FDNY Interview 20, winter 2004.

¹⁷ FDNY Interview 24, winter 2004.

¹⁸ FDNY Interview 13, winter 2004.

¹⁹ FDNY Interview 2, fall 2003.

²⁰ FDNY interview 7, winter 2004.

- FDNY command personnel knew that jet fuel had flowed into the elevator shafts and into other parts of the buildings and presented a danger to building occupants and emergency responder personnel,
- the known extent of the impact damage, fires in the buildings, and the height of the impact zones indicated that many of the people trapped above the impact zones were already dead or would likely die before emergency responders could reach them,
- the impact zones were located at heights in the buildings that would require hours for the emergency responders to accumulate appropriate equipment and personnel to carry out the large scale operations needed to successfully access the upper floors, and
- structural damage and fires caused by the aircraft impact would likely result in localized collapses in and above the impact and fire zones

As described above, aircraft impact damage and the fires started by burning jet fuel had a major impact on fire department operations. Access to the impact zone and fire floors was limited to climbing the stairs. Also, FDNY Chiefs knew that it would take hours to get enough people and equipment up to the impact zone to provide aid for the people trapped above the fires.

5.3.2 Systems Failures

The WTC towers contained building systems that were designed to help protect the occupants and the buildings, and also assist with emergency responder operations. Some of these key systems were as follows:

- fire detection and alarm systems,
- active fire suppression systems including the water supply,
- fire pumps and standpipe systems to supply water for firefighters to use in extinguishing fires,
- emergency communications systems for making announcements, elevator intercom systems, and communications systems for use by emergency responders,
- access and egress systems including elevators and stairways,
- emergency power and lighting systems, and
- smoke control and ventilation systems.

Each of the two aircraft struck the WTC towers at high speed, resulting in serious damage to their structural elements, and all of the life safety systems mentioned above were either damaged or

destroyed.^{21, 22, 23, 24} The structural damage, as well as the loss of the building's safety systems, had a direct negative effect on the evacuation of building occupants and emergency responder operations.

5.3.3 Initial Emergency Response

Building tenants, including Port Authority personnel, became the first “emergency responders inside” the WTC towers on the upper floors, and they had very little equipment to assist them. One building occupant from the 73rd floor of WTC 1 stated the following during their first-person interview:

- First responders on the high floors were the building tenants, and there were no adequate tools to use for rescue or fire suppression.²⁵ (NIST 2004)

Initial “size-up” of the conditions at WTC 1 was carried out by the first FDNY Battalion Chief who arrived on the scene. The following information is drawn from interviews with WTC 1 FDNY Command Post personnel and PANYNJ Fire Command Desk personnel and documents from the two agencies. The first Battalion Chief on the scene had observed the aircraft impact into the WTC 1 tower and immediately responded to the building.²⁶ Upon arrival at WTC 1, the FDNY Battalion Chief met with Port Authority personnel as he entered the building and requested information available concerning the attack, building conditions, and status of the elevators. A PANYNJ Vertical Transportation office employee had begun calling each of the building elevators over the dedicated elevator telephone system that was located at the lobby Fire Command Desk.²⁷ The building's Deputy Fire Safety Director who operated the Fire Command Desk was checking building alarms and trying to make evacuation announcements.²⁸ It was found that the emergency communications system used to make the emergency announcements was inoperable as a result of the aircraft impact.²⁹ It was also learned by FDNY personnel upstairs inside WTC 1 that the warden phone system was damaged and the standpipe phone system was not operating.^{30, 31, 32} However, the Deputy Fire Safety Director of WTC 1 indicated that he did receive calls at the Fire Command Desk over the warden phone system.³³ This information was communicated to the FDNY Chiefs. A building Fire Safety Director spoke with one of the FDNY Chiefs about the possibility of using elevator phones for communication with the building's Operations Command Center (OCC).

²¹ FDNY Interview 2, fall 2003.

²² PA Interview 3, fall 2003.

²³ FDNY Interview 27, winter 2004.

²⁴ FDNY Interview 58, winter 2004.

²⁵ Interview 1000118 (NIST 2004).

²⁶ FDNY Interview 7, winter 2004.

²⁷ PA Interview 5, fall 2003.

²⁸ Other Interview 3, spring 2004.

²⁹ Other Interview 3, spring 2004.

³⁰ FDNY Interview 20, winter 2004.

³¹ FDNY Interview 23, winter 2004.

³² FDNY Interview 29, winter 2004.

³³ Other Interview 3, spring 2004.

This person and a FDNY Battalion Chief were dispatched to go and check it out. These men were never seen again.³⁴

The FDNY chiefs who were establishing the WTC 1 Command Post received information from the data sources described above and through their personal investigation of systems in the building.

Emergency responders reported the failures of critical communications systems inside WTC 1:

- One firefighter called up on the warden phone. There was one on every floor in the building and you can call the Lobby Command Post with it. He called but he couldn't get through. We went to the Verizon Company on the 23rd floor, and he called the Manhattan dispatcher on the phone and told them to pass a message to the Lobby Command Post.³⁵
- The building intercom system was not working after the plane hit. Normally, announcements over the intercom would tell what stairways to use when going down.³⁶

The facts that the impact zone and the large fires were so high in the building and that the building's water supply was compromised led the fire chiefs who established the original Command Post inside the lobby of WTC 1 to conclude that fire department efforts should be directed toward evacuation and rescue of building occupants.³⁷ Also, there were no working elevators that could transport firefighters and equipment up to a staging location just below the impact zone. The building conditions presented to them indicated that at best it would take hours to establish meaningful firefighting operations on the upper floors of the building.³⁸ The chiefs knew that this assessment did not give much hope for the survival of the people trapped above the fires in the building since the fires would continue to grow and the toxic fire gases would increasingly occupy the building spaces where the people were trapped.

Several of the early arriving FDNY firefighter companies, however, were originally ordered by Command Post personnel to go up the stairways to a couple of floors below the impact zone and establish a staging area and operations post for rescue and firefighting operations.³⁹ Some of these firefighter companies carried high-rise hose line packs up with them so that they would have the equipment for fighting fires if a water supply was available. After these initial firefighter companies were sent up, newly arriving companies were instructed only to carry out occupant evacuation and search and rescue operations.⁴⁰

Failures of critical building systems (water supply, sprinkler systems, emergency egress routes, smoke control systems, and firefighting systems) and large fires that trapped large numbers of people on the upper floors of the exceptionally tall buildings created a difficult evacuation and rescue problem for the emergency responders. The fire chiefs at the original Command Post inside the lobby of WTC 1 knew

³⁴ FDNY Interview 20, winter 2004.

³⁵ FDNY Interview 29, winter 2004.

³⁶ FDNY Interview 43, winter 2004.

³⁷ FDNY Interview 20, winter 2004.

³⁸ FDNY Interview 45, winter 2004.

³⁹ FDNY Interview 7, winter 2004.

⁴⁰ FDNY Interview 2, fall 2003.

that they could not reach the building occupants trapped above the fires in time to successfully rescue them.⁴¹ This critical factor was made clear by the dozens of people jumping from the upper floors of the building, and it directly influenced FDNY's planning and operations.⁴²

5.4 ROOF RESCUE AND AVIATION OPERATIONS

Although the PANYNJ had not endorsed a plan for roof rescue from the towers, it appeared to be one of the few options available for occupants trapped above the fires. Recognizing the limited options for building evacuation at the WTC, the NYPD Special Operations Division (SOD) dispatched helicopters to the site for reconnaissance and to assess the possibility of roof rescue.^{43, 44}

Roof Access and the WTC Emergency Preparedness Plan

The PANYNJ's 2001 WTC Emergency Preparedness Manual and evacuation procedures did not include a plan to provide roof rescue for occupants trapped in a building at the WTC site. The standard policy was to keep the doors to the roof locked with a key being required to gain roof access. No fire safety procedures explicitly called for opening these doors, including anyone on a "key run." Instead, the standard occupant evacuation procedures and drills required the use of stairwells to exit at the bottom of the WTC towers (NIST NCSTAR 1-7). The PANYNJ reports that it never advised tenants to evacuate upward (NIST NCSTAR 1-7). The WTC building evacuation training did not explicitly instruct occupants not to evacuate upward or attempt to access the roof. This also is confirmed by statements made by the Port Authority World Trade Director during his testimony to the 9/11 Commission on May 18, 2004 (Reiss 2004). However, during the 1993 bombing, NYPD conducted successful roof rescue operations from the top of the World Trade Center towers. These operations were responsible for removing a small number of people during rescue operations.⁴⁵

Roof Access and the New York City Building Code

The 1968 Building Code of New York City (BCNYC) paragraph C26-604.8(k) required access to roofs with slopes less than 20 degrees from at least one stair in buildings greater than three stories (12.1 m or 40 ft) in height. The Code does not state the purpose for this access, but since it is in the section on stair construction and not Means of Egress, it does not necessarily imply roof rescue but more likely providing fire department access to flat roofs. The current Code (2003) permits such access from a stair, ladder or scuttle, even more clearly not intended as an egress way for rescue. There is no prohibition of locking this access, which is consistent with fire department use since they have the means to open locked doors.

⁴¹ FDNY Interview 2, fall 2003 and FDNY Interview 7, winter 2004.

⁴² FDNY Interview 34, winter 2004.

⁴³ NYPD, SOD radio channel communications.

⁴⁴ NYPD Interview 20, spring 2004.

⁴⁵ NYPD Interview 19, spring 2004.

Aviation Based Roof Rescue

Aviation-based roof rescue procedures have a history that goes back to the 1970's. O'Hagan writes about two high-rise building fires that took place in Brazil, the Andraus building fire (February 24, 1972) and the Joelma Building fire (February 1, 1974). (O'Hagan 1977) The first fire occurred in a 31-story building, so many occupants who were cut off by the fire went up to the roof. As the fire burned out in the building, helicopter rescues were conducted. Even under favorable wind, weather, and fire conditions, it took helicopters approximately four hours to remove approximately 350 victims from the building's roof. The 1974 fire occurred in a 25-story building, and again, occupants went to the roof to be rescued. On this day, however, the wind and fire conditions had a negative impact on the safe operation of helicopters above the building. There was no wind, and the thermal plumes and smoke went directly up. It was dangerous for helicopters to attempt to fly in these conditions. Changing thermal conditions cause serious problems with lift in aircraft, and the reduced oxygen levels in the smoke clouds can cause aircraft engines to fail. As a result, approximately 90 of the 150 people who went to the roof perished since helicopter operations were not possible.

After the 1993 bombing, FDNY and NYPD developed a plan for roof rescue in the event that it was needed. Both departments realized the dangerous nature of conducting roof rescues. The following is extracted from the FDNY September 9, 1993 All Units Circular 269 entitled, *Air Support Plan – High Rise Fires* (Air Support Plan).⁴⁶ The complete document is contained in Appendix E.

“In recent years, several high-rise fires have occurred throughout the world at which occupants became isolated from fire forces when they fled to the roof. Due to the media attention given to these events and the spectacular nature of helicopter evacuation, it can be anticipated that at future high-rise fires, people will ignore department advice and flee to the roof. Roof evacuation by helicopter is both hazardous and time consuming. Therefore, it shall only be undertaken as a last resort, and only upon the direction of the Fire Department Incident Commander (IC). However, large numbers of people on the roof cannot be ignored and the possibility exists that a helicopter approach may be the only access available.”

The Air Support Plan addresses roof evacuation issues raised by investigations of high-rise building fires in other cities:

“FDNY observers who visited the scene of these fires concluded that evacuation was unnecessary since the people on the roof were never in any immediate danger. On the other hand, many of the fatalities at these fires were people who suffered smoke inhalation in the halls and stairways while attempting to reach the roof. Had fire personnel been airlifted, ventilation and search of the stairwells and halls could have been effected.”

⁴⁶ FDNY September 9, 1993 All Units Circular 269 entitled, *Air Support Plan – High Rise Fires*.

Objectives of the Air-Support Plan were:

- Provide FDNY with the capability to place fire personnel on the roof of high-rise buildings, otherwise inaccessible due to fire conditions for the purpose of ventilating and search.
- Control, comfort, and direct people who view themselves as trapped and remote from help.
- Provide the lobby command post with intelligence on roof conditions.
- Evacuate persons in need of immediate medical attention.
- Provide a capability to evacuate the roof as a last resort.

The following information pertinent to this investigation was extracted from section 105-6 of the NYPD manual entitled, *Aviation Manual – “High Rise Emergencies”*.⁴⁷

High-Rise Emergencies:

- A high-rise emergency is an urgent situation in a building, which is over nine stories high, and in which persons are trapped or victims of crime and the rooftop is inaccessible from the ground level by emergency equipment or rescue personnel. The emergency may be the result of fire, explosion, terrorist act or other criminal activity.

Upon confirmation of a high-rise emergency:

- Operations Supervisor: If the emergency is a high-rise fire, have FDNY personnel respond to the staging area and the highest ranking Fire Officer and aide will board the primary Bell 412 after Emergency Services Unit has secured the rooftop landing zone.

Note: If persons are to be immediately removed from the high-rise roof via the hoist or by means of a rooftop landing, it is not necessary for any FDNY personnel to be onboard the aircraft, unless the FDNY personnel will be administering emergency care to those rescued.

- In the event of a non-crime fire, notify the flight crews that no landings on the roof will be attempted without FDNY approval.

During the first hour of the WTC operations, FDNY did not consider the option of roof rescue. The department was busy and focused on getting as many people out of the building as possible through the normal egress routes and providing aid for the injured.^{48, 49, 50} In addition, when the second aircraft struck WTC 2 it was clear that this was a terrorist attack, and it resulted from criminal activity.⁵¹ Therefore, the decision whether to conduct roof top operations became the responsibility of NYPD. Two NYPD

⁴⁷ New York City Police Department, *Aviation Manual – “High Rise Emergencies,”* 1993.

⁴⁸ FDNY Interview 2, fall 2003.

⁴⁹ FDNY Interview 7, winter 2004.

⁵⁰ FDNY Interview 9, winter 2004.

⁵¹ FDNY Interview 19, winter 2004.

helicopters crews looked at the towers in an attempt to 1) determine if there was initially anyone on the roof of WTC 1 that required rescue, and 2) assess the overall roof conditions for possible emergency responder access to the building from the air.^{52, 53} One of the two NYPD helicopters was almost hit by the second hijacked aircraft as it flew into WTC 2. Fortunately, one of the crew members on the helicopter saw the hijacked aircraft coming in from the south and yelled to the pilot to pull up.⁵⁴ The pilot immediately pulled up and looked through the viewing bubble at his feet and saw the airline pass just under the helicopter and crash into WTC 2.⁵⁵ Despite this near collision, the helicopters continued their observations, and one flew in toward WTC 1 to determine flight conditions near the northwest corner of the building.⁵⁶ Only the northwest corner of the building presented any chance for aviation operations since smoke from WTC 1 and WTC 2 covered the remaining top of WTC 1 and completely covered the top of WTC 2.^{57, 58} See Figure 5–1 and Figure 5–2.

As the helicopter approached the northwest corner of the WTC 1 roof, aircrew members observed that window washing machinery and equipment was in the way.⁵⁹ Then, one of the aircrew monitoring instruments on the aircraft noted that the engine temperature suddenly began to rise. The pilot was informed, and the helicopter retreated from the approach, reporting that roof operations were not possible at that time^{60, 61}. The following documents the radio transmissions from the aviation units to the SOD dispatcher concerning roof conditions and observations related to the possibility of roof operations:

- 8:52 a.m. NYPD aviation unit arrives at the WTC to examine possibilities of roof rescue. (NYPD, SOD Radio Channel) (NYPD, McKinsey & Company, 2002)
- 8:58 a.m. An aviation unit advises that they are unable to land on the roof due to heavy smoke conditions. (NYPD, SOD Radio Channel)
- 9:26 a.m. An aviation unit advises that it is impossible to land on the roof at this time. (NYPD, SOD Radio Channel)

⁵² NYPD Interview 7, winter 2004.

⁵³ NYPD Interview 10, winter 2004.

⁵⁴ NYPD Interview 20, spring 2004.

⁵⁵ NYPD Interview 20, spring 2004.

⁵⁶ NYPD Interview 20, spring 2004.

⁵⁷ NYPD Interview 10, winter 2004.

⁵⁸ NYPD Interview 20, spring 2004.

⁵⁹ NYPD Interview 14, winter 2004.

⁶⁰ NYPD Interview 10, winter 2004.

⁶¹ NYPD Interview 12, winter 2004.

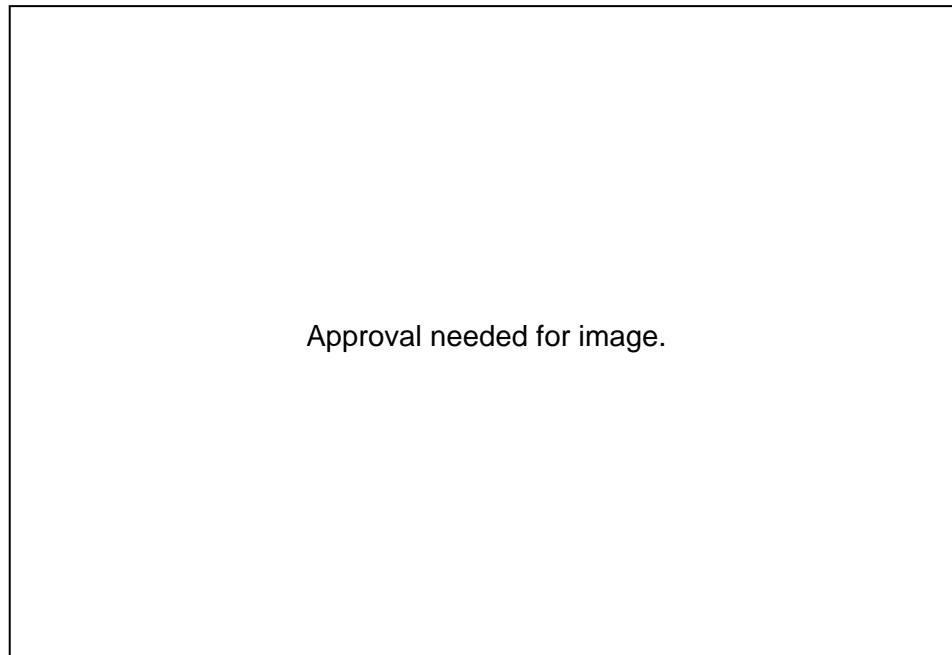


Figure 5–1. Video image showing a NYPD helicopter flying near the World Trade Center buildings before WTC 2 was struck by the second aircraft



Figure 5–2. Photographs of smoke covering the roofs of the World Trade Center buildings

While this was happening in the air, senior NYPD SOD officers at the mobilization point were discussing the possibility of putting an Emergency Service Unit team on the roof of WTC 1. A roof rappel team was assembled and dispatched to the ball field located just off of West Street and adjacent to the schools located at the site.⁶² A helicopter was dispatched to the site to pick them up. Over this same time period, NYPD aviation crews were observing increasing numbers of people jumping or falling from the towers and called for permission to land on the roof.⁶³ They stated that landing conditions had not changed on the roofs, but they wanted to help those people who were about to fall. At 9:35 a.m. the NYPD First Deputy Commissioner ordered that no roof rescues were to be attempted.⁶⁴ The NYPD aviation unit made the following radio transmissions:

9:38 a.m. A NYPD aviation unit calls in to request a landing on the roof of the North Tower as soon as possible. (NYPD, SOD Radio Channel)

9:40 a.m. A NYPD officer advises that they need the aviation units on the roof as soon as possible. (NYPD, SOD Radio Channel)

Shortly after these actions were taken, a senior NYPD SOD officer (after collecting information on the possibility of conducting roof operations) ordered that there would be no rappels onto the roofs of the towers.

9:43 a.m. NYPD officer advises that no one is to rappel onto the top of the buildings. (NYPD, SOD Radio Channel) Note: The term rappel refers to the process of using a rope suspended from a helicopter to descent on to the roof of a building.

The “no rappel” decision ended organized efforts to conduct aviation/roof operations on top of the World Trade Center towers.

5.5 EMERGENCY RESPONDER ACCOUNTABILITY AND TRACKING

The control of human resources is an important task and safety issue at all emergencies. It becomes significantly more important as emergency operations get larger and the numbers of units and people increase. Because of this, emergency responder organizations have instituted practices designed to help manage human resources. The policies and practices associated with the control of human resources at the scene of an emergency are referred to as *accountability* by the emergency responder community. Accountability includes the assignment, dispatch, checking in, tracking, locating, and checking out of emergency responders who operate at an emergency (IFSTA 2000). With the WTC attack, this also related to the recall of emergency responders. Recall refers to bringing emergency responders who are off duty or on leave back to duty status.⁶⁵ FDNY and the other responding agencies had recall policies in place and did recall personnel for WTC operations.^{66, 67} Some emergency responders self-dispatched to

⁶² NYPD Interview 24, spring 2004.

⁶³ NYPD Interview 20, spring 2004.

⁶⁴ NYPD, McKinsey & Company report, 2002.

⁶⁵ FDNY Recall Procedures, see Appendix H

⁶⁶ FDNY Interview 3, winter 2004

⁶⁷ FDNY Interview 17, winter 2004

the World Trade Center, and as the recalls were put into effect, it was reported that some emergency responders went to the WTC instead of reporting to their location of assignment.^{68, 69} This created accountability problems for FDNY at the WTC.⁷⁰

5.5.1 FDNY Accountability, Location, and Tracking

Firefighter accountability may be defined as the means of identifying and maintaining a time based record of where individual firefighters are located and working at an incident and what each firefighter is doing at the scene. Firefighter accountability is a critical part of the Incident Command System that assists with human resource management and the safety of individuals (IFSTA 2000). Basically, if there is a loss of firefighter accountability, the firefighter becomes lost at the incident. Unfortunately, failures of accountability on the fire ground have often been associated with the injury or death of firefighters (IFSTA 2000).

The FDNY Incident Command System Manual⁷¹ published in 1997 says the following about the Incident Command System and accountability:

- The Incident Command System will improve firefighter safety by providing better accountability of personnel and improved use of resources and tactical effectiveness.
- STAGING – A specific area to which resources are assigned before deployment. Staging has several advantages:
 1. It gives the Incident Commander (IC) breathing room to make better decisions about deployment.
 2. It is a checkpoint to provide accountability and prevent freelancing.
 3. It provides an area of protection from exposure in hazardous environments.
 4. It establishes a reserve immediately available for a contingency.

The FDNY Incident Command System Manual, Part 1, 1997 is located in Appendix A.

The understanding of firefighter accountability is a basic part of initial firefighter training. It is a concept and a practice learned during the first phases of training and it receives continued training throughout a firefighter's career because of its importance to personal safety and successful emergency responder operations (IFSTA 2000). The 4th edition of Essentials of Fire Fighting (2000) says the following about personnel accountability systems (Hall 2000).

“Each department must develop its own system of accountability that identifies and tracks all personnel working at an incident. The system should be standardized so that it is used at every incident. All personnel must be familiar with the system and participate when operating at an emergency incident. The system must also account for those individuals

⁶⁸ FDNY Interview 58, winter 2004

⁶⁹ FDNY interview 63, winter 2004

⁷⁰ FDNY Interview 68, spring 2004

⁷¹ FDNY Incident Command System Manual, ICS Manual, Part 1, May 1997

who respond to the scene in vehicles other than fire department apparatus.

Accountability is vital in the event of a serious accident or structural collapse. If the IC does not know who is on the fireground and where they are located, it is impossible to determine who and how many may be trapped inside or injured. ...Too many firefighters have died because they were not discovered missing until it was too late.”

In career fire departments, firefighter accountability typically begins at the fire house. Firefighters working on a company shift are managed by an officer who ensures that the company roster has a full complement of firefighters for that shift. Firefighters are checked in, and a riding list is prepared for each company. The riding list identifies personnel and job assignments for each firefighter.^{72, 73} On September 11, 2001, the attack occurred just before shift change.^{74, 75} In some firehouses, this resulted in two crews of firefighters being available at the firehouse to fill one company’s riding list.⁷⁶ Since the previous shift’s crew was technically off duty, they would normally not be a part of a crew responding to an operation after the shift change had occurred. However, FDNY has a policy that allows a company officer to assign extra volunteer members to the crew, and they would be added to the company’s riding list.⁷⁷ When the alarms for the WTC started coming into the firehouses, numerous firefighters from the previous shift were available to work. Interviews with FDNY company officers and firefighters indicated that there were many cases where firefighters that had just gone off duty were officially added to the company roster for work at the WTC.⁷⁸ FDNY company officers typically limited the number of volunteer members to the maximum number of riding positions located on a fire apparatus.⁷⁹

FDNY Safety Bulletin 67, *Approved Riding Positions on Apparatus*⁸⁰, dated December, 1982 describes approved riding positions:

- Bearing in mind that an enclosed, seated, belted position is the safest location while riding an apparatus, officers shall assign these positions first. The officer then assigns positions in a descending order of priority. Ex.: 1. Enclosed, seated, belted position; 2. Seated, belted position; 3. Standing – side positions/ with restraining devices; 4. without restraining devices.
- The rear step of the apparatus is never to be used as a riding position. Its sole function is to load and unload hose.

Safety Bulletin 67, *Approved Riding Positions on Apparatus*, 1982 is reproduced in Appendix F.

There was one report that off-duty firefighters rode the rear step of a fire apparatus to get to the WTC.⁸¹ It is not known if the company officer was aware that these individuals were riding on the apparatus. The

⁷² FDNY Interview 1, fall 2003.

⁷³ FDNY Interview 31, winter 2004.

⁷⁴ FDNY Interview 20, winter 2004.

⁷⁵ FDNY Interview 37, winter 2004.

⁷⁶ FDNY Interview 20, winter 2004.

⁷⁷ FDNY Regulations, Chapter 11, *Fire and Emergency Operations*, DCN 3.01.00, January 1997.

⁷⁸ FDNY Interview 20, winter 2004.

⁷⁹ FDNY Safety Bulletin 67, *Approved Riding Positions on Apparatus*, December 1982 (See Appendix F).

⁸⁰ FDNY Safety Bulletin 67, *Approved Riding Positions on Apparatus*, December 1982.

⁸¹ FDNY Interview 12, winter 2004.

practice of firefighters riding the rear step of an apparatus is unsafe and was discarded by FDNY in 1982 as a result of firefighter injuries and deaths that were occurring across the country.⁸²

After arrival at the scene of an emergency, firefighter accountability becomes a matter of the units reporting to a Command Post or Staging Area, maintaining unit cohesion and discipline, and keeping the Command Posts informed of unit locations and operations (IFSTA 2000).⁸³ The first Command Post established at the WTC was set up at the Fire Command Desk inside the lobby of WTC 1.⁸⁴ This was the primary Incident Command Post that was moved outside and managed by the Chief of Department.^{85, 86} Figure 5–3 shows locations for the FDNY Incident Command Post setup on West Street just outside of World Financial Center 2, the NYPD Mobilizations Points set up around the WTC site, the general locations of other Command Posts, and the Engine 10 / Ladder 10 firehouse location. Figures 5–4 and 5–5 show locations of the buildings' fire alarm panels, Fire Command Desks, and FDNY Lobby Command Post locations inside WTC 1 and 2.^{87, 88, 89, 90, 91, 92, 93} Also, it should be noted that the elevator operations data system and elevator communications phone was located at each of the buildings' Fire Command Desks.

When FDNY sets up a Command Post, it also sets up a Portable Command Post for the operation. The Portable Command Post is described in Appendix G. The Portable Command Post is also referred to by the firefighters as the Command Board. The Portable Command Post consists of an aluminum case measuring approximately 457 mm x 711 mm x 203 mm (18 in. x 28 in. x 8 in.). See the photograph of the Command Board that was set up inside WTC 1 in Figure 5–6. The Command Board case contains the following (Appendix G):

- A vertical magnetic surface for recording box identification, time out, incident location and height, construction, dimensions if building is involved.
- A supply of magnetic identifiers that provide color code identification for units: Engine, black; Ladder and Tower Ladder, red; Battalions, gold; special units, blue; and sectors, purple. Unit numbers were typically written on the identifiers by marking pens.
- A 25 Watt, 6 channel radio with DC power supply and AC power pack and a magnetic base antenna with wiring and terminal blocks.
- A folding aluminum stand with legs and nylon straps to support the Portable Command Post.

⁸² FDNY Safety Bulletin 67, *Approved Riding Positions on Apparatus*, December 1982.

⁸³ FDNY Interview 56, winter 2004.

⁸⁴ FDNY Interview 7, winter 2004.

⁸⁵ FDNY Interview 2, fall 2003.

⁸⁶ FDNY Interview 7, winter 2004.

⁸⁷ PA Interview 11, fall 2003.

⁸⁸ FDNY Interview 2, fall 2003.

⁸⁹ FDNY Interview 5, winter 2004.

⁹⁰ FDNY Interview 20, winter 2004.

⁹¹ FDNY Interview 62, spring 2004.

⁹² FDNY Interview 65, spring 2004.

⁹³ NYPD Interview 24, spring 2004.

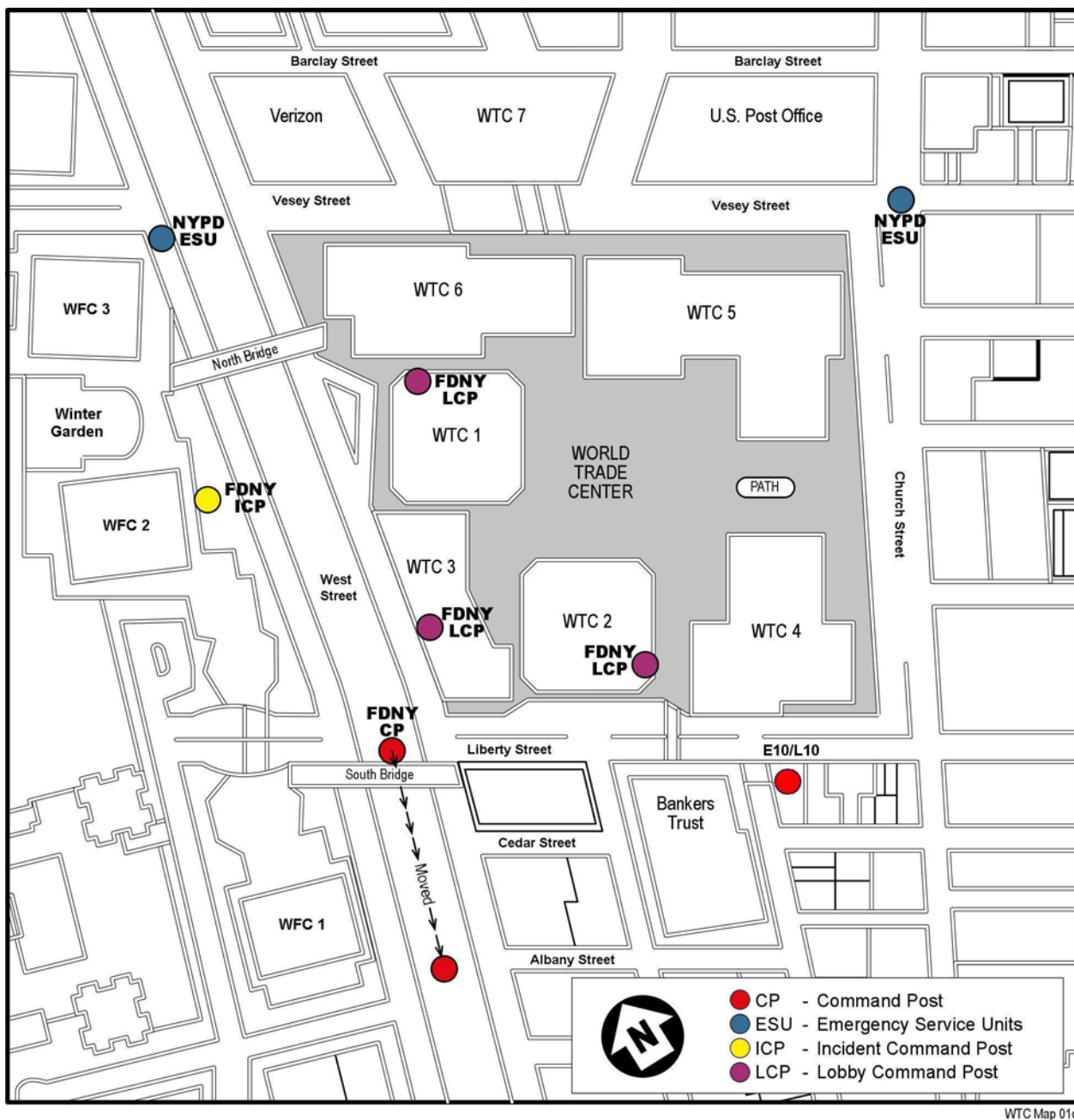


Figure 5–3. Diagram showing emergency responder command post locations.

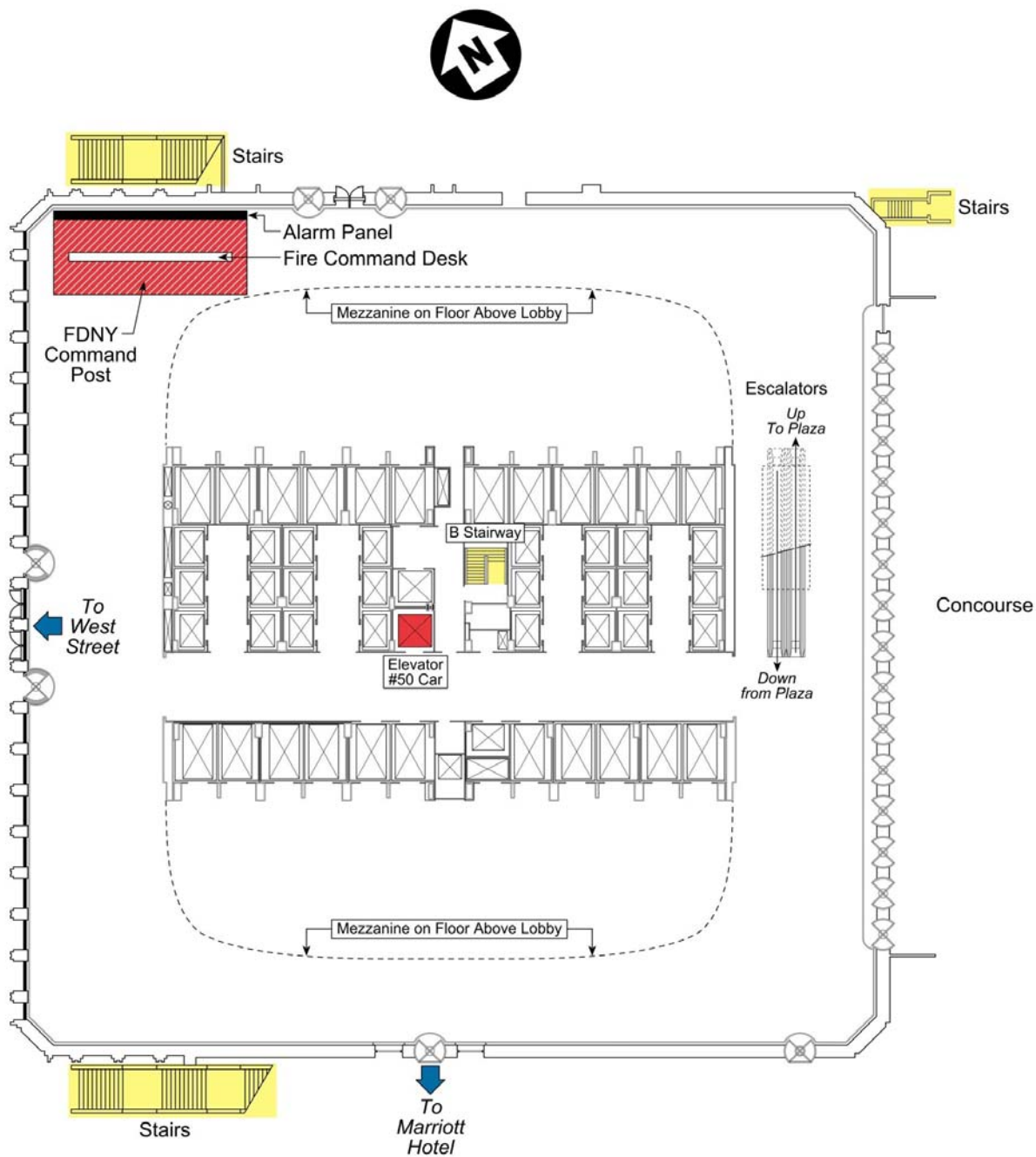


Figure 5–4. Diagram of lobby command post location inside World Trade Center 1.

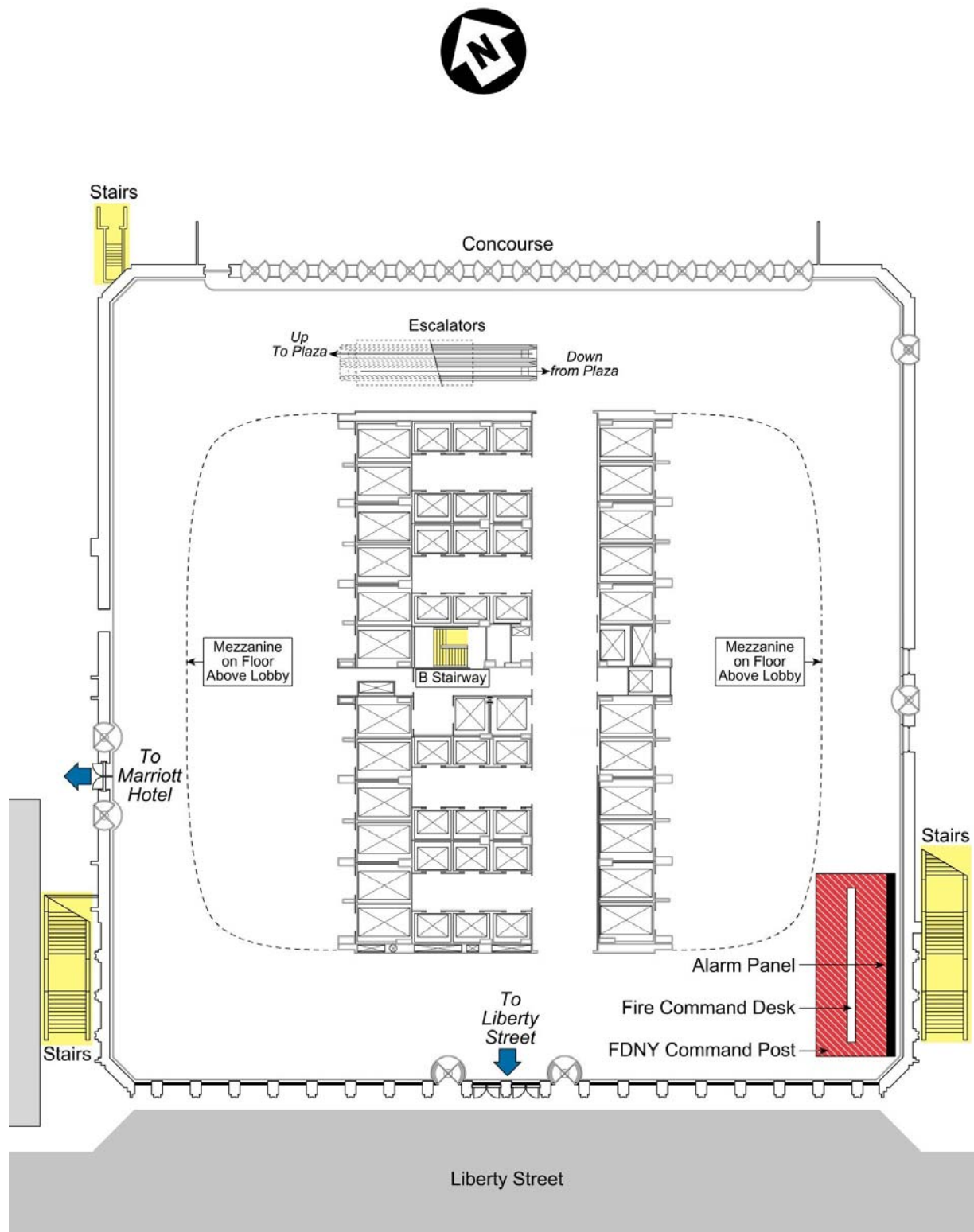


Figure 5–5. Diagram of lobby command post location inside World Trade Center 2.



Figure 5–6. Video image of the FDNY Fire Command Board located in the lobby of WTC 1.

FDNY Training Bulletin, Tools 22, December 1991⁹⁴ says the following about the Portable Command Post:

- The Portable Command Post (PCP) will be carried in the division vehicle. Deputy Chiefs shall utilize the PCP at fires, emergencies and other incidents where its deployment will assist the operation.
- The Portable Command Post will assist the Incident Commander in efficiently executing the responsibility of incident management.

The training bulletin highlights the following advantages of the Portable Command Post:

- Establishes a Fire Department Command presence at the scene.
- Serves as a physical focal point for incoming Fire Department Units as well as other agencies reporting to the operation.
- Provides a convenient means of direct radio communication with the Borough Communications Office.
- Facilitates the recording of the location and status of Fire Department units.

⁹⁴ FDNY Training Bulletin, Tools 22, December 1991 (See Appendix G).

- Facilitates the recording of the ranking official present from other agencies.
- When manned by an aide, the Incident Commander will be freed from the distraction of units and agencies reporting in to the operations.
- Satisfies federal regulation regarding the establishment of a Command Post.
- Provides own light for viewing and recording information.
- Improves safety by promoting accountability of personnel, efficient use of resources and tactical planning.
- As a visual aid the PCP will assist Incident Commanders in assigning Chiefs areas of responsibility.

The complete FDNY Training Bulletin, Tools 22, December 1991 on the Portable Command Post is reproduced in Appendix G.

The Command Board is used by Command Post personnel for logging in and assigning units for operations at an incident.⁹⁵ A FDNY interviewee indicated that on September 11, 2001, the Command Board approach to managing operations at the WTC became overwhelmed with the number of units and personnel reporting in for operations. In addition, the interviewee indicated that not all personnel that arrived at the WTC site were logged in on the Command Board.⁹⁶ This is partially due to the size and complexity of operations at the WTC, but it also relates to personnel not always following department policies on reporting to the Command Post for assignment.^{97, 98}

Another problem related to accountability and tracking of personnel faced by the emergency responders as they arrived at the WTC site was that some emergency responders did not know which building was Tower 1 and which building was Tower 2.^{99, 100} The towers were not well marked.¹⁰¹ First-person interviews with firefighters coming in from other parts of the city showed that they were not familiar with the WTC site and did not know one tower from the other.^{102, 103} Some units assigned to WTC 2 by dispatchers or from staging areas arrived at the scene and had to take time to find out which tower was which. Some of these units were approaching WTC 2 when it collapsed and members of their company survived.¹⁰⁴ Other firefighters that were interviewed and were assigned to work in WTC 2 went through WTC 3, the Marriott Hotel, and ended up inside WTC 1. They attempted to get to WTC 2 by following

⁹⁵ FDNY Training Bulletin, Tools 22, December 1991.

⁹⁶ FDNY Interview 65, spring 2004.

⁹⁷ FDNY Interview 65, spring 2004.

⁹⁸ FDNY Interview 63, spring 2004.

⁹⁹ FDNY Interview 65, spring 2004.

¹⁰⁰ FDNY Channel 7 / PA WTC Channel 30 radio communications recording.

¹⁰¹ FDNY Interview 18, winter 2004.

¹⁰² FDNY Interview 60, winter 2004.

¹⁰³ NYPD Interview 7, fall 2003.

¹⁰⁴ FDNY CD 12 (Chief's Report of Service at Fire) / CD 15 (Report of Company Operations).

the Concourse level to the building.^{105, 106} Fortunately, this delay in getting to WTC 2 played a part in saving the lives of these firefighters when WTC 2 collapsed.

In general, FDNY units responding to the WTC followed good practices as related to reporting in and accountability. However, there were a few cases where individuals did not report in to the Command Post and became freelancers. Interviews with FDNY personnel showed that some fire department personnel came to WTC facilities without unit approval. In addition there were various emergency responders from NYPD and PAPD that entered the towers without reporting into the FDNY Command Posts. The following statements were taken from first-person interview notes:

- One FDNY interviewee said that there were a lot of guys freelancing at the WTC. Many of them were FDNY guys that were off duty and wanted to help, and they were coming into the buildings.¹⁰⁷
- Another FDNY interviewee reported that he and three or four other firefighters from his company attempted to get from Brooklyn to Manhattan by crossing the Brooklyn Bridge. Some of the firefighters were stopped by FDNY Chiefs at the bridge staging area. The group got back together and hid in the back of an ambulance that agreed to carry them into Manhattan and to the WTC site.¹⁰⁸

The account below by the PAPD officer suggests either their unfamiliarity with the FDNY operating procedures for high-rise fires and the function of the FDNY Lobby Command Post and that the firefighters in the lobby were awaiting check-in and assignment.

- One PAPD officer reported that his group went into the lobby of WTC 1 and that there were a lot of fire department units in there just standing around. The interviewee said that they could hear people screaming and that there were a lot of casualties in the sky lobby of the building. The interviewee remembered thinking “What is everybody standing around for?” The interviewee gathered up his team and started up stairs without reporting in to the FDNY Command Post.¹⁰⁹

There also was at least one case where an NYPD team entered WTC 1 without checking in with the FDNY Lobby Command Post. Again, this may be attributed to the lack of knowledge on the part of NYPD personnel concerning FDNY operations in high-rise buildings. At approximately 9:22 a.m. a NYPD Emergency Service Unit (ESU) team reported to the WTC 2, FDNY Lobby Command Post and received an assignment to meet with and assist a Battalion Chief who was located on the 43rd floor of the building in stairway B. Evidence of this assignment was found on the recording of the FDNY high-rise radio repeater channel/PA/WTC Radio Channel 30. The radio communication provides significant details on this Command Post assignment. Also, an interviewee from the OEM staff indicated that he saw an ESU team enter WTC 2 and ordered them to report to the FDNY Command Post. The interviewee

¹⁰⁵ NYPD Interview 22, spring 2004.

¹⁰⁶ FDNY Interview 62, spring 2004.

¹⁰⁷ FDNY Interview 58, winter 2004.

¹⁰⁸ FDNY Interview 63, spring 2004.

¹⁰⁹ PA Interview 8, fall 2003.

indicated that the ESU team reluctantly complied with his order.¹¹⁰ Data analysis suggests that this may be the same team that received the assignment to assist the Battalion Chief. It is critically important that emergency responder departments that work together have a good understanding of each other's operational practices as far as safety and personnel accountability is concerned.

It is clear that the NYPD and PAPD units that entered the buildings without reporting to the FDNY Command Post felt that they were conducting operations within the bounds of their responsibility and authority.¹¹¹ However, these police department units and other FDNY personnel who entered the buildings without being logged in with the Command Posts and receiving assignments created personnel accountability problems for FDNY.¹¹² At times, command personnel at a fire department command post have to make immediate decisions that may relate to the life safety of all personnel at an incident. These decisions often have altered the degree and direction of fire growth, and in some cases, emergency responders have died because the Incident Commander was not aware that the individuals were in the path of the altered and dangerous conditions.¹¹³ In addition, fire can change in characteristics and in the direction of travel as a result of changes in building and/or weather conditions. Again, the Incident Command needs to know where all personnel are in order to carryout a successful and safer operation.

The collapse of WTC 2 seriously complicated the task of accountability and personnel tracking. When WTC2 collapsed, each of the three FDNY Command Posts and all of their data were lost. Information for unit and personnel assignments that were being maintained on FDNY's Fire Command Board disappeared into the rubble. There was no backup of these records at the site or at an offsite location.¹¹⁴ This created a problem for FDNY when it came time to locate missing personnel.¹¹⁵

5.5.2 FDNY Recall Procedure

The following was extracted from the FDNY recall procedure (FDNY Regulations, Chapter 18, Recall, January 1997)¹¹⁶ that was in effect at the time of the WTC attack:

The Recall Procedure:

- In the event it becomes necessary to augment temporarily the numerical strength of manpower on duty within the Department during actual or potential emergency conditions, the signal 65-2 will be transmitted under jurisdiction and authorization of the Fire Commissioner.
- Upon receipt of signal 65-2 transmitted to implement recall, chief and company officers shall follow instructions transmitted. Depending upon the area affected and the degree of

¹¹⁰ FDNY Interview 54, winter 2004.

¹¹¹ NYPD Interviews 5 and 6, winter 2004.

¹¹² FDNY Interview 2, fall 2003.

¹¹³ NYPD Interview 24, spring 2004.

¹¹⁴ FDNY Interview 65, spring 2004

¹¹⁵ FDNY Interview 65, spring 2004

¹¹⁶ FDNY Regulations, Chapter 18, Recall, January 1997

necessity, the orders relative to scope of the recall will be announced over the Department radio, voice alarm, and by teleprinter messages.

- Recall may be total (city-wide) or partial (confined to one or more boroughs). It may affect all units or selected units, such as Engine companies only. The time frame may run from continuous duty to specific tours or hours.

Notification of Members:

- In those instances requiring a citywide recall, it shall be the responsibility of each member to monitor the news media and report for duty as required.
- In limited recall situations where media coverage may be limited officers on duty shall immediately notify affected off duty members as necessary.
- Commanding officers shall, in order to insure prompt telephone notification of off duty members, maintain a current and accurate personnel record of emergency telephone numbers in the office record journal.

The complete FDNY recall procedure (FDNY Regulations, Chapter 18, Recall, January 1997) is contained in Appendix H.

5.5.3 EMS Accountability, Location, and Tracking

The FDNY Chiefs who had responsibility for the Emergency Medical Services (EMS) response to the WTC developed a plan of action.¹¹⁷ They divided the area into quadrants, set up staging, triage, and treatment areas. Inside those areas other FDNY EMS officers were sectoring the workload as described below. The following are statements extracted from EMS first-person interviews regarding EMS plan of action:

- I informed him that I was there as well and he had other representatives from the fire department. We started to set up our treatment and triage sectors as units were reporting in and officers were reporting in. Because of the large area involved, we sector off different EMS areas in accordance with our incident command system where they functioned as teams so they could deal with patients as they come out of the complex. As I was doing that, a chief reported in and I asked him to become my operations officer so this way I could be involved and function as liaison with the incident commander. I recall speaking to a commissioner there because he had some questions as far as resources coming in and where they were coming from and how I was going to set up the EMS operation.¹¹⁸

¹¹⁷ FDNY Interview 64, spring 2004.

¹¹⁸ FDNY Interview 68, spring 2004.

- At this point we had quite a few FDNY EMS supervisors coming in. I happened to be the highest ranking officer in the area. There were no chiefs; it was me and some Lieutenants. As they came in, I started to assign them sectors to organize in the area; a transportation officer, a treatment officer, a triage officer among others. So we were using our triage tags and we're trying to separate the patients into different categories of priority and as ambulances were coming in, we'd load the most serious first to be taken away. We had little areas for people badly hurt people, right on the corner. We separated the area with tape to designate it as an area for patients and also to keep the flow of people from tracking through that area on their way out. So this corner was rapidly becoming overwhelmed with the amount of people coming out who were hurt. That was becoming almost 10 o'clock. We had just really started getting a foothold on the patients; ambulances were coming in and going out. We were starting to get some organization of where the ambulance should park, then load up and leave. We were thinking about alternatives of patient transport because there were so many, maybe commandeering city busses. I asked the Lieutenant with the portable radios to request additional units as well as city busses to come and help us out.¹¹⁹

Several obstacles with regard to accountability of EMS personnel added to the Chiefs' difficulties. The first was the size of the event as it unfolded and the difficulty that EMS Chiefs had in determining who was at the scene.¹²⁰ The second was the "self dispatch" and "freelancing" of some non-FDNY ambulances.¹²¹ The third was the inability of FDNY EMS supervisors to communicate with some of the non-FDNY ambulances.¹²² The following are statements taken from first-person interviews:

- We turned and looked and there were two ambulances coming with stretchers from opposite directions. If they were ours I would have recognized them. I thought who is controlling these guys; we needed to get this under control.¹²³
- I think the biggest problem at the World Trade Center was lack of control of non fire department personnel. City and private, we are supposed to be in control of them, even though they are supposed to listen to us, but it does not happen. It is hit or miss if a voluntary ambulance will follow your command. It is a safety issue for those units, on September 11, 2001, there were units that responded there that wanted to run in, I saw my guys stop them and tell them no, there were words exchanged, there was no time to argue the point.¹²⁴

¹¹⁹ FDNY Interview 49, winter 2004.

¹²⁰ FDNY Interview 50, winter 2004.

¹²¹ FDNY Interview 51, winter 2004.

¹²² FDNY Interview 64, spring 2004.

¹²³ FDNY Interview 40, winter 2004.

¹²⁴ FDNY interview 51, winter 2004.

- A few blocks up, it had gotten safer and some ambulances were coming in and I was trying to flag them down telling them not to go further because it was too dangerous. Some of them stopped, some of them didn't.¹²⁴
- The private ambulance teams that responded had no equipment and no protective clothing at all. They also do not have the same radios so it was not possible to communicate with them via radio. Those who were in the EMS and mutual aid system did have radios that were operating.¹²⁵

5.5.4 EMS Patient Tracking

There are many reasons to track patients that are triaged, treated, and transported from an emergency. One important reason is to ensure that no single medical facility is overwhelmed by an unexpected influx of patients.¹²⁶ At the scene of a mass casualty incident, an emergency medical services officer is usually designated the duty of seeing to it that no one hospital is inundated with patients beyond its capabilities. This emergency medical services officer often is called the “transport officer” within the incident command system. The “transport officer” not only helps to prevent overwhelming of each hospital but also ensures that each injured patient goes to a medical facility best able to treat the medical condition.¹²⁷ The objective is not having an ambulance drop a patient off at a hospital, but at a hospital that has the best capabilities to take care of that person. The following description of one of the triage areas was extracted from a first-person interview.

- At the triage area we basically triage and rapid transport with strict Mass Casualty Incident Protocol. The first arriving medical authority on the scene, the first EMT or Paramedic becomes the triage officer, and they are also in charge until an officer gets to the scene. Usually we try and turn it over to a paramedic officer. Then you have someone responsible to make sure the patients are triaged, and the treatment officer who stays in the treatment area determines what kind of treatment we give them. Then you would have the staging officer who would be responsible for ambulances, there is egress for them, there is ingress for them. The transport officer would work right where the patients are being loaded from the treatment area and direct what hospital the patients should be transported to. Normally patients are transported based on injury, closest trauma center, nearest 9-1-1 center, nearest burn center, etc. In times like this there are so many patients a lot of times you may overwhelm one hospital. What you need to do, for instance Saint Vincent's which is a trauma center, if there are too many patients there it might be worth sending patients somewhere else further away and they can get treated more quickly. I felt that when I got there some patients had been transported, that actually the patients were transported in a system. I was surprised that we were already sending people out to Brooklyn and stuff

¹²⁵ FDNY Interview 64, spring 2004.

¹²⁶ FDNY Interview 51, winter 2004.

¹²⁷ FDNY Interview 51, winter 2004.

like that, which was really a good idea. At least we were thinking globally at that point.¹²⁸

Within the individual triage and treatment areas that were set up it appears that efforts were made to keep track of patients. This was done with pencil and paper.¹²⁹ All the data on patients was lost when the buildings collapsed.¹³⁰ The loss of WTC 7, which housed the Office of Emergency Management (OEM), hampered the ability to track patients within the system.¹³¹ One of the EMS Chiefs assigned to go to WTC 7 was inside the OEM when it was ordered evacuated, describes what the loss of OEM meant to them, not only for the ability to track patients but other aspects of command and control.¹³² The following is taken from a first-person interview:

- My concern was if there were things needed by the Fire Department then I could get them from OEM. We had a lot of different tools available to us. We had 4 or 5 positions in the OEM Operations Center that were assigned to the Fire Department. We had the terminals where we could monitor the dispatch system, and patient tracking information. We had the EMS radio frequencies and their transmitting capabilities. We had a monitoring terminal for the fire dispatch system. We had all the fire radios as well. We had a lot of technology there to assist us, mapping capabilities and mapping files to show where our units are. We were at a disadvantage because we didn't have those tools. I would have had a better idea of what was going on.¹³³

Another factor that had an effect on the FDNY's ability to track patients was the self-dispatch of some non 9-1-1 ambulances. The following was extracted from a first-person interview:

- Because of the self-dispatch of non 9-1-1 resources there were patients being removed from the location by those units, and the EMS officer did not know it. Normally, what we try to do with patient tracking is to get the information before the patient leaves the scene, but because of the way this operation developed, we had to put systems in place to retrieve the information from the hospitals.¹³⁴

There also were people who transported themselves to the hospital.¹³⁵ Due to the size of the disaster and number of patients generated, medical aid was not confined only to one jurisdiction. This situation was much like the Sarin gas attack that occurred in Tokyo, Japan where injured people obtained medical aid from numerous medical facilities in various jurisdictions (Strasser 1995). The following was taken from an emergency responder first-person interview:

¹²⁸ FDNY Interview 51, winter 2004.

¹²⁹ FDNY Interview 51, winter 2004.

¹³⁰ FDNY Interview 51, winter 2004.

¹³¹ FDNY Interview 45, winter 2004.

¹³² FDNY Interview 45, winter 2004.

¹³³ FDNY Interview 45, winter 2004.

¹³⁴ FDNY Interview 50, winter 2004.

¹³⁵ FDNY Interview 50, winter 2004.

- Not all patients at the hospitals arrived by ambulance. Nor was this situation isolated to just New York City. Because of self-evacuation to Jersey and other Boroughs within the city people were just jumping on transit buses. We found out later that buses were just going to hospitals and dropping off patients. This may have caused some hospitals to have a lot more minor injuries to take care of at one time.¹³⁶

5.5.5 NYPD Accountability, Location, and Tracking

Information in this section was drawn from first-person interviews with NYPD Special Operations Division, Emergency Service Unit personnel, NYPD Special Operations Division (SOD) Division radio communications and department documents.

The primary mobilization point for the NYPD Special Operations Division that sent Emergency Service Unit (ESU) rescue teams into the WTC was located at the corner of Church and Vesey Streets.¹³⁷ The post was managed by a SOD detective that had just gone off of duty and was still at his office when the attack occurred.¹³⁸ He traveled to the WTC with the on duty ESU team, and since he was not in full uniform, it was decided that he would manage the mobilization point for the operations in the towers. As the post was set up, the detective obtained information on the attack over the radio, began assembling ESU teams and then sent them into WTC 1 and WTC 2.¹³⁹ Only six ESU teams were dispatched from the mobilization point to the towers. Each team consisted of about five ESU personnel. Records for each team were written onto paper attached to a clipboard.¹⁴⁰

A second SOD mobilization point was established at the corner of West and Vesey Streets.¹⁴¹ This post operated in the same fashion as the first. However, this post was associated more with providing security for the site.¹⁴² ESU teams that came to the WTC typically came to the mobilization points as teams with all members present. Since the NYPD efforts at the WTC were primarily focused on the aviation units and the ESU teams, there was not a large influx of people coming to the command post as was experienced by FDNY. Therefore, the tasks associated with personnel accountability, location, and tracking were not as complex as those experienced by FDNY. The mobilization point officer was able to maintain reasonable radio communications with all units assigned to duty at the site, and tracking problems were minimal until the collapse of WTC 2.¹⁴³ With the collapse of WTC 2, all written records were lost as the high winds and debris blew through the mobilization points.¹⁴⁴ Since NYPD had only a limited number of personnel actually operating at the site, managers of the mobilization points were able to easily reconstruct the lost data on their personnel.

¹³⁶ FDNY Interview 50, winter 2004.

¹³⁷ NYPD Interview 24, spring 2004.

¹³⁸ NYPD Interview 24, spring 2004.

¹³⁹ NYPD Interview 24, spring 2004.

¹⁴⁰ NYPD Interview 24, spring 2004.

¹⁴¹ NYPD Interview 24, spring 2004.

¹⁴² NYPD Interview 24, spring 2004.

¹⁴³ NYPD Interview 24, spring 2004.

¹⁴⁴ NYPD Interview 24, spring 2004.

5.5.6 PAPD Accountability, Location, and Tracking

Information in this section was drawn from first-person interviews with Port Authority Police Department (PAPD) personnel, radio communications recorded at the PAPD Police Desk, and Port Authority documents.

Immediately after PAPD officers reported the impact of the first aircraft into WTC 1, the PAPD police desk began a roll call to determine condition of their police officers and where they were located.¹⁴⁵ PAPD had the primary law enforcement responsibility at the WTC site and officers were working their assignments at the WTC when the attack occurred.¹⁴⁶ In addition, several PAPD teams were dispatched from various locations from around the city and from Jersey City to the site.¹⁴⁷ The PAPD officers who arrived at the WTC before the collapse of WTC 2 typically reported to PAPD personnel that were located at the WTC 1 lobby Fire Command Desk.¹⁴⁸ A PAPD Inspector was working at the command desk and was working with FDNY at their Command Post. This officer gave direction to incoming PAPD personnel.¹⁴⁹ The WTC Police Desk was located inside of WTC 5 and had a view of the Plaza area. PAPD operations for the WTC site were normally conducted from this location.¹⁵⁰ In addition, the WTC radio system was maintained at WTC 5 with antennas located on top of the building.¹⁵¹ With the collapse of WTC 2, the PAPD Police Desk and Command Center was evacuated, and many of the emergency response records were lost. Police Desk communications tape recordings were recovered some days later.¹⁵²

5.5.7 General Comments Concerning Accountability, Location, and Tracking

All of the emergency responder organizations that responded to the WTC on September 11, 2001, had accountability, location, and tracking plans in place, and they generally worked well during the first 30 minutes of operations at the WTC. However, the FDNY system became overwhelmed with the large number of units and personnel arriving at the WTC. The PAPD system became stressed with the collapse of WTC 2 and the loss of the WTC 5 Police Desk operations.

The location and tracking of personnel is an issue that has been studied by the emergency responder community for many years. Once responders report to a Command Post at the scene of an emergency, receive their assignments, and depart to accomplish their tasks, there is no positive means to locate and track the activities of the units or individuals. On September 11, 2001, the only means for locating and tracking units and personnel was through radio communications, and during operations there were so many people using the system for ongoing operations that the FDNY radio system and procedures were inadequate for locating and tracking personnel.¹⁵³ In addition, all three FDNY Command Posts and their

¹⁴⁵ PAPD Police Desk communications, Channel W, 2001.

¹⁴⁶ PA Interview 1, fall 2003.

¹⁴⁷ PA Interview 6, fall 2003.

¹⁴⁸ PA Interview 14, summer 2004.

¹⁴⁹ PA Interview 14, summer 2004.

¹⁵⁰ PA Interview 15, summer 2004.

¹⁵¹ PA Interview 2, fall 2003.

¹⁵² PA Interview 3, fall 2003.

¹⁵³ FDNY Interview 65, spring 2004.

Command Boards and the NYPD mobilization points with their records were destroyed, and all operations records were lost for the hundreds of emergency responders who were operating at the site, and there was no backup for these lost records.

Resources Available for Initial Situation Assessment and Incident Management, and Practices for Determining the Possibility of Structural Collapse

Information for initial situational assessment and “size-up” of an event begins with the fire department when the incident report is filed through the 9-1-1 emergency dispatch center or from an alarm received from a pull box at the scene (NFPA 1997) (Bush 1979). Information gained from these sources is the basis for information provided to the fire department responders when they are dispatched to an incident. On September 11, 2001, a FDNY Battalion Chief observed the first aircraft crash into WTC 1, and he immediately got on the radio and reported the aircraft crash to the FDNY dispatcher. In addition, he reported to the dispatcher that he and his companies were responding to the WTC.¹⁵⁴ The 9-1-1 emergency dispatch center began receiving telephone calls from citizens and Port Authority personnel concerning the attack and gathered additional information (NIST NCSTAR 1-7, 2004). As fire department companies received dispatch orders for the WTC, the FDNY dispatch center sent out a Critical Information Dispatch System (CIDS) message for the site.¹⁵⁵ This provided basic information concerning known hazards at the WTC site and was based on information from facility inspections that were done earlier.

The following information is based on first-person interviews with FDNY, Port Authority, and WTC personnel:

When the first FDNY units arrived at the WTC, the Battalion Chief went inside the building to the WTC 1 Fire Command Desk that was located inside the lobby. Information concerning building conditions related to fire alarm status and the activation of sprinkler systems were displayed on the wall panels behind the Fire Command Desk and on the Command Desk’s computer terminal.¹⁵⁶ The Deputy Fire Safety Director, who operates the Fire Command Desk, reported the building status as he understood it to the Battalion Chief.¹⁵⁷ The Battalion Chief inquired about elevator status and was told by a Port Authority employee that it appeared that no elevators were operating in the building. After a few minutes other WTC officials arrived at the Fire Command Desk. The Battalion Chief then met with the WTC personnel as needed, the Port Authority Fire Safety Directory, and Port Authority Vertical Transportation personnel. The Vertical Transportation personnel worked with the elevator systems and reported to FDNY the locations of elevators where occupants were trapped.¹⁵⁸

The following statement about initial “size-up” and building conditions was extracted from an FDNY first-person interview:

¹⁵⁴ FDNY Interview 7, winter 2004.

¹⁵⁵ FDNY Communications Manual, DCN: 3.01.01, January 1, 1997.

¹⁵⁶ FDNY Interview 7, winter 2004

¹⁵⁷ Other Interview 3, summer 2004

¹⁵⁸ PA Interview 5, fall 2003

- As the interviewee entered the door from West Street he saw two very badly burned people lying on the floor. The lobby had been badly damaged. Some of the windows had been broken out, glass was on the floor, and marble from the walls had been broken and fell to the floor. The interviewee initially met with the WTC 1 Deputy Fire Safety Director and received a report that fires were burning above the 78th floor. They began to set up the Command Post and he again met with the Deputy Fire Safety Director and asked about elevator status. He was told that no elevators were operating in the building.¹⁵⁹

A senior-level Chief arrived, and the interviewee reported his findings. They discussed the rescue plans. The plan was to rescue people in the building who needed help, get people out of the building, and cut a way through the damaged floors above to create a rescue path for those trapped above the impact zone and fires in the upper part of the building.¹⁶⁰ Firefighters were sent upstairs in the building, accompanied by Chief Officers. The orders given were to go no higher than the 70th floor.¹⁶¹ This would leave eight floors above them as a buffer. Initially, firefighters were ordered to take hose up with them for cutting through the fires on the floors to rescue the people above. Additionally, firefighters were told to go up and report their observations back to him since he didn't really know what the conditions were at the aircraft impact area.¹⁶²

As described above, information was available during initial "size-up" that defined the building conditions, but details needed for refining FDNY operations were limited. As time passed, additional information came into the Command Post from radio communications, the Port Authority, and FDNY personnel.¹⁶³ However, some information did not get transferred to the FDNY Command Post inside WTC 1. The following comments from a 9/11 Commission hearing address this issue:

Chief Officer's Comment:

"One of the most critical things in a major operation like this is to have information. We didn't have a lot of information coming in. We didn't receive any reports of what was seen from the helicopters. It was impossible to know how much damage was done on the upper floors, whether the stairwells were intact or not. A matter of fact, what you saw on TV we didn't have that information." (9/11 Commission 2004)

Another Chief Officer's Comment:

"People watching on TV certainly had more knowledge of what was happening a hundred floors above us than we did in the lobby. Certainly without any information, without critical information coming in, it's very difficult to make informed and critical decisions without that information. And it didn't exist that day. Our communication systems

¹⁵⁹ FDNY Interview 7, winter 2004

¹⁶⁰ FDNY Interview 7, winter 2004

¹⁶¹ FDNY Interview 7, winter 2004

¹⁶² FDNY Interview 7, winter 2004

¹⁶³ FDNY Interview 7, winter 2004.

were down. Our building suppression systems were down, the elevators, we had no video capability throughout the entire operation. (9/11 Commission 2004)

Other information that was not available to the FDNY command personnel was information on building conditions near the aircraft impact zones. One example is information transmitted to a family member over the telephone describing building conditions inside WTC 1. At approximately 8:58 a.m., a telephone call to a relative noted that the 92nd floor (just below the aircraft impact point) was flooding with water (NIST NCSTAR 1-7, 2004). This is one of the only piece of data that potentially supports the conclusion by FDNY that the water supply at the impact zone had been compromised, and this information was not available for FDNY command personnel.

As far as assessments related to the structural stability of the building were concerned, the WTC 1 Command Post knew that significant damage had been done to the building.¹⁶⁴ They knew that large fires were burning above them. Their firefighting experience led them to believe that the buildings would remain in place throughout their operations, but they did expect that there would be some localized collapse conditions in the impact zone and the fire zones. No one interviewed indicated that they thought that the buildings would completely collapse. This perception is reflected in the following first-person interview statement:

- The issue of total structural collapse was not taken into consideration in the plan. Today it is. There was no information on the vulnerability of the buildings to total collapse. That type of information is needed on all operations today. There should be a guide for collapse of different types of structures, an assessment that is accessible but is secure. The question is, if you lose so many floors what is the condition of the building? The buildings should be rated for structural capability. NIST could help with this.¹⁶⁵

5.6 FIGHTING LARGE FIRES ON THE UPPER FLOORS OF TALL BUILDINGS

Fighting fires in tall buildings is not the same as fighting fires in buildings that are less than 30 m (100 ft) high. The height of a building has a direct impact on the ability of fire departments to carry out successful operations, and each high-rise building has design factors that may alter the way firefighting operations are carried out. O'Hagan (O'Hagan 1977) discusses this in his book.

“a high-rise building may be defined as one that lacks viable exterior access to the upper floors for firefighting, and in which firefighters must place almost complete reliance on the building's systems and components for fire suppression. This definition takes in all buildings in excess of 100 feet in height which are beyond the reach of the standard Aerial Ladder.

¹⁶⁴FDNY Interviews 2, 7, and 20, fall 2003 and winter 2004.

¹⁶⁵ FDNY Interview 7, winter 2004.

Since reliance must be placed on the building's integrity, this criterion suggests the mandatory use of fire-resistive construction. However, in New York and many other cities, fire-resistive construction is required in all buildings exceeding 75 feet in height. This difference does provide an additional margin of safety, but it also serves to illustrate the rather loose definition of a high-rise building. *From a fire fighting viewpoint, the distinguishing characteristic of a high-rise is its excess height which deprives a fire strategist of exterior attack and at the same time restrains his strategy to interior attacks from locations that are dictated by the building design."*

There are issues specific to fighting fires on the upper floors of high-rise buildings that become more challenging as building height increases. Generally, a firefighter can climb a stairway at a rate of about one floor per minute.¹⁶⁶ Climbing the stairs causes a significant physiological impact on firefighters wearing protective clothing and equipment, and carrying equipment needed for fighting fires and carrying out rescue operations. Fatigue becomes a factor after approximately 12 floors of climbing, and fatigue caused by climbing diminishes the functional capabilities of the emergency responder to carry out operations once they reach the fire floor.¹⁶⁷ Fire burning rates for different fuel loads and ventilation vary. A fuel load of about 48.8 kg/m² (10 lbs/ft²) with normal interior finishes, furnishings, and contents will take approximately one hour to burn out, depending on ventilation (Gross 1977). Without the use of elevators to access the floors just below the fire floor, it will take fully equipped firefighters carrying equipment approximately 60 minutes to get up to a fire on the 60th floor. In addition, it will take time to prepare the water supply - if there is one - and stretch hoselines for firefighting. Over this time period, the floor may have completely burned out, and the fire may have spread to other floors and other parts of the building.¹⁶⁸

Even though the WTC towers contained large fires, very little firefighting was conducted during operations that morning. Analysis of electronic and interview data identified three cases where firefighting was carried out inside the WTC buildings before the collapse of WTC 2. They are as follows:

- Firefighters used handheld fire extinguishers to extinguish flames on people located in the lobby of WTC 1.¹⁶⁹
- A Port Authority employee was using a fire hose to suppress a fire along a stairway wall inside one of the staircases in one of the WTC towers. (No tower or floor identification was available.) It was reported that the Port Authority employee indicated that he was going to keep trying to suppress the fire until the firefighters got there. Also, the Port Authority employee is credited with holding the flames in check to allow many people to get by on the stairway. It was stated that no one would have gotten out from this level if this man was not trying to control the fire and keep the staircase clear for evacuation. (Atwell 2002)

¹⁶⁶ FDNY Interview 9, winter 2004.

¹⁶⁷ FDNY Interviews 1, 7, and 11, fall 2003 and winter 2004.

¹⁶⁸ FDNY Interview 11, winter 2004.

¹⁶⁹ FDNY Interview 13, winter 2004.

- At approximately 9:55 a.m. firefighters were attempting to stretch building hose lines in the “B” stairway on about the 78th floor of WTC 2 in order to extinguish two fires. The collapse of WTC 2 occurred at approximately 9:59 a.m.¹⁷⁰

The challenge of firefighting at the WTC on September 11, 2001, was greater than any that had been experienced before.¹⁷¹ The height and size of the fires in the buildings produced varying strategies related to how operations should be conducted. These strategies varied across a range based on the firefighter’s years of experience, knowledge, and the quality of information they received. For complex operations to function smoothly, it is important that personnel working the task have an understanding of the mission and an understanding of the strategy applied for accomplishing the task.

5.6.1 Strategies for High-Rise Operations on September 11, 2001

According to the FDNY first-person interviews, there appear to be three approaches for the FDNY response to the World Trade Center. These different approaches are associated with the level of command responsibility for the different individuals at the WTC and are identified as follows: 1. Outside Command Post and Inside Command Communicating with the Outside Command Post, 2. Inside Command Post for Building Operations, and 3. Company Level Command.

Outside Command Post and Inside Command Communicating with the Outside Command Post

The approach to these operations by many of the Chief Officers appeared to be based on knowledge from the perspective of outside views and additional information that was being fed back from inside the buildings. Some Chief Officers in this category were totally aware of the nature of the multi-floor fires that were burning on the upper floors of the building. An understanding of the nature of multi-floor fires, the height of the fires in the building, the lack of adequate equipment and water in the building, and their experience over the years has shown that the extinguishment of high rise fires greater than 15,000 feet square on a single upper level floor is almost impossible (O’Hagan 1977). A Chief Officer referenced a 1977 publication on high rise firefighting by John T. O’Hagan, a former New York City Fire Chief and Fire Commissioner (O’Hagan 1977).¹⁷² O’Hagan uses the World Trade Center fire of February 13, 1975, as an example in his book. This fire was located on the 11th floor of WTC 1 and consumed approximately one quarter of the floor. O’Hagan’s analysis of this fire indicated that “If the east half of the building had been involved, it is unlikely that a direct attack would have been successful. In that case, we may have had to choose a defensive strategy.” In this case, O’Hagan is referring to a fire that covered only one quarter of the 11th floor, a floor that is much more accessible than anything above the 77th floor where the aircraft struck the WTC buildings. Also, O’Hagan’s reference to the “east half of the building” only refers to the east half of the 11th floor. This knowledge led some officers in this category to believe that the people above the impact zone and fires were not likely to survive, and that it would not be possible to rescue them before the fire gases and thermal conditions on the upper floors became

¹⁷⁰ FDNY Channel 7 / PA, WTC Channel 30 radio repeater communications recording.

¹⁷¹ FDNY Interview 2, fall 2003.

¹⁷² FDNY Interview 20, winter 2004.

untenable.¹⁷³ In addition, the Chief Officers in this category, taking note of the large fires on these multiple floors and recognizing the impact of the structural damage, expected that there would be some localized structural collapses inside the building.¹⁷⁴ Communications between the Chief Officers at the Outside Command Post and a primary Chief Officer inside WTC 1 indicated that they recognized the possibility that a large portion of the top of the tower might collapse, breakaway, and fall into the streets below.¹⁷⁵ The following statements were extracted from FDNY Chief Officer interviews:

- Different Chief Officers would come into the building (WTC 1) from the Command Post outside mostly to discuss the possibility of collapse. There were discussions related to the collapse of not only portions of the buildings but also about the collapse of complete floors in the buildings. A Safety Chief came in one time and discussed the possibility of collapse. The feeling at the time was that there would be some type of collapse. There may be a collapse of the upper floors or an upper section of the building. No one envisioned the magnitude or the type of collapse that occurred and particularly at the early time that it occurred.¹⁷⁶
- There were reports coming into the building (WTC 1) from outside that they all thought that there may be some form of collapse, local on a floor or a portion of the building falling into the street. There was no discussion of a total collapse of the WTC buildings.¹⁷⁷

The experience and training of these officers, relative to past large high rise fires within the city or elsewhere in the world, did not lead the officers to expect a total collapse of either structure. Based on the above understanding, the Chief Officers in this category saw the operations at the World Trade Center during the first hours as strictly an attempt to evacuate occupants from below the fire floors, rescue trapped occupants from below the fire floors, and provide medical assistance to the injured.¹⁷⁸ This strategy is supported by the following statement drawn from the FDNY first-person interviews:

- The Chief at the Incident Command Post said that they were not going to be able to put the fire out and that they were just going to be saving people.¹⁷⁹

Command Officers for Inside Operations

Generally, FDNY Command Officers who were planning for operations inside the towers saw the unfolding building and operating conditions from the perspective that the fires on the upper floors were too large to extinguish. For some of these officers, the goal was to get enough equipment and personnel up stairs to use hose lines to cut safe zones through the multi-floor fires to get to the upper floors for

¹⁷³ FDNY Interview 2, fall 2003.

¹⁷⁴ FDNY Interview 20, winter 2004.

¹⁷⁵ FDNY Interview 2, fall 2003.

¹⁷⁶ FDNY interview 20, winter 2004.

¹⁷⁷ FDNY Interview 2, winter 2003.

¹⁷⁸ FDNY Interviews 2, 7, and 20, fall 2003 and winter 2004.

¹⁷⁹ FDNY interview 45, winter 2004.

rescuing the hundreds of people trapped above the impact zone and fires.¹⁸⁰ These officers also knew that it was unlikely that they would be able to control the multi-floor fires over the short term.¹⁸¹ However, they felt that they could cut a safe path through to make the rescues.¹⁸² These officers also expected that there would be localized collapse conditions on the damaged fire floors. The officers did not expect that there would be any massive collapse conditions or complete building collapse.¹⁸³

Company Level Command

Although FDNY Company Officers were given information defining their mission at the WTC, several of them saw the event as a very large and dangerous yet still conventional high rise fire.¹⁸⁴ Their approach to the fire conditions inside the building was to get up to the fire as soon as possible, put the fire out, and get ready for their next assignment.^{185, 186, 187} This approach was based on their normal company operations, and was generally compatible with the expected mission.¹⁸⁸ These officers believed that there would be some localized collapse conditions at the impact zone and at the fire floors. They did not expect a massive collapse of the structures.¹⁸⁹

These three operations strategies highlight differences that may be attributed to years of experience, level of training, and institutional focus of the various command levels. As the senior command level operational strategies were communicated to the lower levels, the concepts appeared to take hold at a slower pace at the next level down. Some firefighters at the Company level were disturbed by the operations orders that signaled a change toward assisting with the evacuation. They wanted to go up and put the fires out.¹⁹⁰ It is possible that the orders to assist with the evacuation saved the lives of many more firefighters. This was because the orders may have resulted in fewer firefighters being assigned to firefighting preparations on the upper floors.

5.6.2 Fighting Fires on the Upper Floors of the WTC

On the morning of September 11, 2001, FDNY was faced with the possibility of having to extinguish multi-floor fires in both towers of the WTC. In high-rise buildings, fire departments must rely on the building design, fire suppression systems, ventilation control systems, fire pumps, and standpipe systems to assist them with controlling and extinguishing fires. Fire pumps and standpipe systems must be able to provide enough water flow to extinguish any fires beyond the reach of apparatus operating from ground

¹⁸⁰ FDNY Interview 7, winter 2004.

¹⁸¹ FDNY Interview 2, fall 2003 and FDNY Interview 20, winter 2004.

¹⁸² FDNY Interview 7, winter 2004.

¹⁸³ FDNY Interview 2, fall 2003.

¹⁸⁴ FDNY Interviews 16, 18, and 27, winter 2004.

¹⁸⁵ FDNY Interview 41, winter 2004.

¹⁸⁶ FDNY Interview 35, winter 2004.

¹⁸⁷ FDNY Interview 9, winter 2004.

¹⁸⁸ FDNY Interviews 16, 18, and 27, winter 2004.

¹⁸⁹ FDNY Interviews 27 and 66, winter and spring 2004.

¹⁹⁰ FDNY Interviews 31, 55, and 57, winter 2004.

level. On September 11, 2001, the initial “size-up” indicated that the buildings’ sprinkler systems were not working or controlling the fires and that the standpipe systems were inoperable at the impact zones.¹⁹¹

The following information concerning firefighting water supply systems at the WTC are based on a first-person interview:¹⁹²

It was understood that the WTC fire pump system was functional, at least until the collapse of WTC 2. The damage to the standpipe systems in each building meant that significant work would be needed to reestablish a functional water supply that could have been used for firefighting. In addition, since both towers shared the same reserve water tank system and both towers sustained damage to their standpipe systems, a person who worked at the WTC would have to go to and manually close an isolation valve located between the buildings in order to get the fire pump system prepared for operation. Also, several WTC employees would have to go with FDNY up into the building to assist with sealing the broken standpipe system and to operate the various fire pumps, hand valves, gravity water tanks, and booster pumps needed for firefighting operations on the upper floors. At the point in time when WTC 2 collapsed, WTC personnel had not accomplished tasks required for operating the building’s fire pump systems, and WTC personnel had not given orders for starting the building’s fire pump system.

The discussion below provides some insight into firefighting operations that may have been carried out if the WTC towers had not collapsed.

In Section 5.2 of this report, it was estimated that it would take a water flow rate of approximately 4,700 l/min (1,250 gal/min) to extinguish one-half of a floor that would be burning inside one of the WTC towers. This amounted to approximately five 63.5 mm (2.5 in) diameter hoselines using nozzles with a 28.5 mm (1.125 in) tip diameter. For a full size floor on fire in one of the WTC towers, it would take approximately twice this flow rate, 9,400 l/min (2,500 gal/min), with a total of approximately 10 hoselines to extinguish the fire. This type of operation would likely involve a minimum of 15 to 20 Engine companies that would typically be able to work for periods of between 15 to 20 minutes before they would have to be relieved. This estimate for the extinguishment of a full floor fire at the WTC is based on operations under ideal conditions where the building’s fire pumps would be supplying adequate water supplies for firefighting. If a building’s fire pumps are not functioning, the fire department must rely upon its own resources. Special high-rise pumper apparatus would have to be coupled with the building’s standpipe system to provide water supply for the upper floors.

5.6.3 Elevator Access and Evacuation

Elevators often are an integral part of high-rise building firefighting. They are relied upon by fire departments for transporting personnel and equipment up inside tall buildings. Over the years, elevator companies have improved the technology of high-rise building lift systems, but many fire departments still do not trust elevators to carry out critical tasks in high-rise buildings when human safety is the highest priority.(Klaene 2001) Also, building code developers have been attempting to address the difficult issues of making elevator usage safe for emergency responders during firefighting operations

¹⁹¹ FDNY Interviews 2, 7, and 20, fall 2003 and winter 2004.

¹⁹² Other Interview 7, fall 2004.

through the consensus process. (Winslow 2003) Many elevator components are susceptible to damage from fires, smoke, water, and earthquakes. (NFPA 2003) Emergency responders will not use systems with limited safety margins when lives are at stake. (Klaene 2001) FDNY recognized these issues and discussed them in their training bulletin, FDNY DCN: 3.02.17 Training Bulletin Emergencies 1, entitled, Elevator Operations, dated March 15, 1997¹⁹³. In addition, the following general procedures taken from the bulletin describe FDNY procedures for elevator operations during fires:

General Procedures for Elevator Operations during Fire Operations

- Account for all elevators serving the fire floor, checking them for victims.
- When it is confirmed that the fire is on the 7th floor or below units should avoid the use of elevators. It is safer to utilize the stairway to reach the fire floor.
- Do not use an elevator in a bank which services the fire floor if a lower bank of elevators reaches within five floors of the fire floor.
- When it is necessary to use an elevator in a bank which serves the fire floor:

If Firemen Service is available, use a car with the Firemen Service feature. (Note: This feature is required in many elevators which enables the fire department personnel to gain exclusive control of the elevators.)

Select a floor at least two floors below the fire floor or two floors below the lower level of an access stair in the fire area, whichever is lowest.

- A service elevator shall not be used until it is declared safe for use by the officer in command of the fire. Be aware that in many high rise office buildings the service elevators have been converted for Firemen Service. Use of such an elevator must be avoided until declared safe by the officer in command.
- There must be a member equipped with a handie-talkie in each car whenever the elevator is in use.
- Not more than six members are to be permitted in any elevator car. This precaution is required to prevent overloading.
- Forcible entry tools must be carried aboard each elevator car.
- Elevator should be stopped every five floors (precautionary stops) to confirm that the elevator will respond to the selected floor. At each stop a new selection must be made.

The complete FDNY DCN: 3.02.17 Training Bulletin Emergencies 1, entitled, Elevator Operations, dated March 15, 1997, is reproduced in Appendix D.

¹⁹³ FDNY DCN: 3.02.17 Training Bulletin Emergencies 1, entitled, Elevator Operations, dated March 15, 1997.

The following is drawn from Port Authority and FDNY first-person interviews, and FDNY high-rise radio repeater communications:

There were 99 elevators inside each of the WTC towers for a total of 198 elevators.¹⁹⁴ Port Authority vertical transportation personnel began an evaluation of elevator operations immediately after the aircraft hit the towers. This was done by checking the elevator operations panels at the Fire Command Desk and calling the elevators using the elevator intercom phones.¹⁹⁵ Their initial analysis indicated that no elevators were operating in either building, and this was reported to the FDNY Chiefs running the building Operations Posts in the lobbies.^{196 197} Therefore, the fire department did not direct any personnel to use any elevators for operations inside of WTC 1. Some FDNY personnel went to the elevator banks in the building and personally checked the elevators.¹⁹⁸ Out of the 99 elevators that were located inside each of the two buildings, FDNY personnel found that only one elevator in WTC 1 and one elevator in WTC 2 appeared to be working.^{199 200} The Port Authority vertical transportation personnel and FDNY Command Post staff were unaware of the elevator that was operating inside of WTC 1.²⁰¹ This elevator was staffed by a WTC building Elevator Starter. The Elevator Starter took a small number of FDNY personnel up to the 16th floor using this elevator.²⁰² It does not appear that information about this operating elevator was ever reported to the FDNY Operations Post or the PA vertical transportation personnel that were operating in the lobby. Other emergency responders who saw that the elevator was operating did not trust it and chose to climb the stairs. The following is a statement made during a first-person interview by a PAPD Officer concerning the use of elevators inside of WTC 1:

- We were in a situation that was so desperate that I was not comfortable taking the elevator from the 1st to the 44th floor. There is no way I would use it, I know the dangers of a dead elevator.²⁰³

Under normal circumstances, the 50 Car elevator would be used by FDNY for access to the upper floors inside WTC 1.²⁰⁴ The 50 Car elevator had access to all floors in WTC 1 and was a large capacity utility elevator.²⁰⁵ During an interview, a contract employee at the WTC described what happened with the 50 Car elevator and why it was not available for use by the fire department. The following information is drawn from the first-person interview:

- The employee was working on the 7th floor of WTC 1 when the aircraft hit the building. The building shook and continued to shake. The interviewee said that the 50 Car elevator shaft was located just beyond

¹⁹⁴ PA Interview 5, fall 2003.

¹⁹⁵ PA Interview 5, fall 2003.

¹⁹⁶ PA Interview 5, fall 2003.

¹⁹⁷ PA Interview 13, fall 2003.

¹⁹⁸ FDNY Interview 25, winter 2004.

¹⁹⁹ FDNY Interview 25, winter 2004.

²⁰⁰ FDNY Channel 7 / PA, WTC Channel 30 radio repeater communications recording.

²⁰¹ PA Interview 5, fall 2003.

²⁰² FDNY Interview 25, winter 2004.

²⁰³ PA Interview 10, fall 2003.

²⁰⁴ FDNY Interview 42, winter 2004 and Other Interview 3, spring 2004.

²⁰⁵ PA Interview 5, fall 2004.

the room's wall where he was working. He heard the elevator falling and fly past his location. He heard people inside the elevator when it went past him. Then he heard the elevator crash to the bottom of the shaft, and he heard the elevator cables falling down the shaft after the 50 Car fell. A second explosion followed, and something came through the wall of the room. A fireball came into the room from the elevator shaft. The building had moved, and the room's door became jammed. Fire gasses that came into the room took his breath away, and when the interviewee finally got out of the room he collapsed on the corridor floor. Building occupants helped him up and helped to carry him out of the building. Two of the interviewee's associates were injured by flying concrete block on the B2 and/or B4 levels when the 50 Car elevator crashed to the bottom of WTC 1.²⁰⁶

In addition to the loss of lives and injuries caused when the 50 Car elevator fell, the loss of this elevator seriously hindered FDNY operations inside WTC 1. The primary means of transportation to the upper part of WTC 1 was no longer available.

Inside WTC 2, Port Authority vertical transportation personnel also evaluated elevator operations.²⁰⁷ An FDNY firefighter found that one elevator was working from the lobby and that it would go up to the 40th floor.²⁰⁸ Information about this elevator was reported back to the WTC 2 Operations Post located at the building's Fire Command Desk. This elevator was put into use and was used to shuttle personnel and equipment up to the 40th floor. The elevator operated until just prior to the collapse of WTC 2.²⁰⁹ A firefighter who was operating the elevator became trapped in it just prior to the building collapse. At approximately 9:57 a.m., a FDNY radio communication over the high-rise repeater channel reported that firefighters were trapped inside the elevator that was being used to carry personnel and equipment up the 40th floor inside WTC 2. FDNY also used the elevator to carry injured building occupants to the lobby.²¹⁰ The radio message also stated that they were chopping through the wall to get out. WTC 2 collapsed about two minutes later. This radio communication may also have been heard by a FDNY Chief Officer who was working inside of WTC 1. The following was extracted from a first-person interview related to the emergency response:

- Another I remember, I believe I heard over the radio that a Truck Company was stuck in an elevator. There was a lot of traffic going on, on the radio, but you key into companies you know. I tried to contact the one guy who was trapped in the elevator and I couldn't get to him, but I could hear him calling for help. Sometimes you can transmit or you can just receive.²¹¹

The following information is based on first-person interviews with Port Authority personnel:

²⁰⁶ Other Interview 7, fall 2004.

²⁰⁷ PA Interview 5, fall 2003.

²⁰⁸ FDNY Channel 7 / PA, WTC Channel 30 radio repeater communications recording.

²⁰⁹ FDNY Channel 7 / PA, WTC Channel 30 radio repeater communications recording.

²¹⁰ FDNY Channel 7 / PA, WTC Channel 30 radio repeater communications recording.

²¹¹ FDNY Interview 25, winter 2004.

Port Authority personnel indicated that they were able to identify three elevators in WTC 1 that contained people.²¹² One elevator had 4 people, one elevator had 1 person, and one elevator had 9 people. FDNY personnel were directed to each of the elevators. The elevator with 9 people in it was located on the ground floor. It is believed that the people in this elevator were rescued. Port Authority employees on the upper floors of WTC 1 found two men trapped in an elevator on the 71st floor.²¹³ (NIST 2004) The elevator doors were jammed, and they had no tools to get the men out. Two of the rescuers went up to the 73rd floor to get tools that could help. After returning with the tools the two men were rescued from the elevator.²¹⁴ The status of the other elevators containing people is unknown.

Elevator checks were made on all Zone 1 and Zone 2 elevators inside WTC 1 before WTC 2 collapsed.²¹⁵ Elevator checks had started on Zone 3 at the point of building collapse. In Zone 3, banks B, C, and D did not show any signals on the elevator panel at the Fire Command Desk in the lobby of WTC 1 and were assumed to be inoperable.²¹⁶ (Note: Each of the WTC towers was divided into three vertical zones. Zone 1 reached to the 43rd floor. Zone 2 reached from the 44th floor to the 77th floor, and Zone 3 went from the 78th floor to the top of the building.)

Inside WTC 2, it was reported that when the aircraft struck the building one elevator with 18 people in it became stuck in the shaft.²¹⁷ It is unknown if this was the elevator that was reported to be stuck near the 78th floor. The final status of this elevator and its occupants is unknown. This radio report was received by a PA technical specialist located inside WTC 1 at the lobby elevator panel and was received from his PA counterpart in WTC 2.²¹⁸ No further information is known.

Based on the first-person interviews with FDNY personnel and the high-rise radio repeater recording, FDNY personnel who used each of the single elevator cars inside each of the towers basically followed fire department protocol.^{219, 220} However, the elevator operation to the 16th floor of WTC 1 was never reported to the building's FDNY Command Post.²²¹

5.6.4 Stairways, Access and Egress

Stairs were the primary means of access to and egress from the World Trade Center towers after the aircraft impact. Elevator service, practically speaking, did not exist in either of the buildings. As stated earlier, only one elevator functioned in each of the towers, and they only functioned in a limited capacity to the lower third of each building. This lack of available elevators forced emergency responders to use the stairways for building access. The effect of building evacuees and emergency responders using the same stairways for egress and access (counterflow) was studied by NIST's Project 7 investigators

²¹² PA Interview 5, fall 2003.

²¹³ Building Occupant Interview 1000118.

²¹⁴ Building Occupant Interview 1000118.

²¹⁵ PA Interview 5, fall 2003.

²¹⁶ PA Interview 5, fall 2003.

²¹⁷ Port Authority, WTC Security radio channel X, communications recording.

²¹⁸ PA Interview 5, fall 2003 and PA Interview 13, fall 2003.

²¹⁹ FDNY Interview 25, winter 2004.

²²⁰ FDNY Channel 7 / PA, WTC Channel 30 radio repeater communications recording.

²²¹ FDNY Interview 25, winter 2004.

(Averill 2005). This study is reported by Averill *et al*, in NIST NCSTAR 1-7, Federal Building and Fire Safety Investigation of the World Trade Center Disaster, Occupant Behavior, Egress, and Emergency Communications, 2005. This document states that few building occupants felt that counter flow on the stairways had much effect on their evacuation. In contrast, many emergency responders suggested that counter flow on the stairways in WTC 1 generally had a negative impact on the emergency responder operations. Emergency responders reported difficulties negotiating the stairways as occupants were coming down. A sample of emergency responder comments concerning stairways and counter flow is located below.

Some of the problems experienced by emergency responders are as follows:

- Difficulty accessing the stairways at the lobby and mezzanine levels because of building occupant flow out of the stairway doors,
- Firefighter company personnel and police officer team personnel became separated from their colleagues by the counter flow as building occupants moved down the stairs and the emergency responders attempted to move up, and
- Emergency responders experienced difficulty moving equipment up the stairs as building occupants were coming down the stairs.

The following are supporting statements made by emergency responders about the stairs and problems with counter flow on the stairs:

- You could fit two people abreast on the stairs, one going down and one going up. It was just slow going up because of the lack of room. In my opinion, they should have had wider staircases. I do not think anyone anticipated this.²²²
- It was a single file up and a single file down, I am not an architect but this was not sufficient.²²³
- The building intercom system was not working after the plane hit. Normally, announcements over the intercom would tell people to use a different stairway when they were going down.²²⁴
- With all the people going the other way on the stairs, even if you were a marathon runner, you are not going to get very far.²²⁵
- We didn't know how long it would take us to get up to the 70th floor. You never know with the people coming down and if you had to fight the crowds. That takes a lot out of you sometimes.²²⁶

²²² FDNY Interview 43, winter 2004.

²²³ FDNY Interview 52, winter 2004.

²²⁴ FDNY Interview 43, winter 2004.

²²⁵ FDNY Interview 29, winter 2004.

Figures 5–7 through 5–10 show an occupant and a firefighter carrying a length of hose passing on a 1,118 mm (44 in) wide stairway. The Figures also show a firefighter and occupant passing at the landing. Note that the stair width does not provide adequate space for the individuals to pass without hitting each other. This occurs on the stairway as well as on the landing when the firefighter makes the turn to start climbing the next flight of stairs.



Source: NIST.

Figure 5–7. Top view of occupant and firefighter passing on stairs.



Source: NIST.

Figure 5–8. Front view of occupant and firefighter passing on stairs.



Source: NIST.

Figure 5–9. Front view of occupant and firefighter passing on landing.



Source: NIST.

Figure 5–10. View from above of occupant and firefighter passing on landing.

It was stated during the emergency responder interviews that the 1.12 m (44 in) wide stairways could be easily blocked by one person as they attempted to walk down the stairs.²²⁷ An average-sized person could walk down the center of the stairway and place one hand on each of the staircase hand rails. This posture would successfully block the stairway for other people who were moving faster down the staircase.²²⁸

²²⁶ FDNY Interview 37, winter 2004.

²²⁷ FDNY Interview 42, winter 2004.

²²⁸ FDNY Interviews 41 and 42, winter 2004.

This posture was identified as being used by mobility impaired people who were only able to step down to the next step one foot at a time, which resulted in both feet standing on the same step, instead of the unimpaired gait where one foot is placed onto a step and the other foot is placed on the next step down.²²⁹

Emergency responders also reported that the stairways became plugged and traffic was stopped as individuals with other physical disabilities or significantly overweight occupants blocked the stairs as they were attempting to evacuate. A building occupant reported that as he went down the stairs between the 50th and 43rd floors there was a steady flow of firefighters going up the stairs spaced about two feet apart vertically on the stairs.(NIST 2004) At about the 45th floor, the occupant encountered a group of slow moving elderly people who were mobility challenged.²³⁰ (NIST 2004)

The following is a sample of statements from FDNY and PAPD emergency responder personnel concerning people who were mobility challenged:

- At the 27th floor I ran into a guy in a wheel chair with his friend. He was waiting for the crowds to clear so that he could make it down the stairs.²³¹
- Inside the stairway in WTC 1, it was strange, people were still coming down as we were evacuating. More incapacitated people, they were holding people up. How were we going to move these people? We didn't want to hold people up. That is how I got separated. We were letting people go by us.²³²

After WTC 2 collapsed, FDNY personnel inside WTC 1 attempted to exit the building by going down the various stairways. On the way down, some of the emergency responders stopped and checked each floor to be sure that it was clear before they proceeded down. On about the 12th floor, FDNY personnel found approximately 40 to 60 people who had been removed from the stairway by others and placed onto the floor because the mobility impaired individuals had been blocking the stairway evacuation routes. These people were mostly physically challenged building occupants and significantly overweight occupants who were having trouble going down the stairs.²³³ The emergency responders stopped and began to assist these people with their evacuation. Depending on the disability or size of the mobility challenged person, it took from one to four emergency responders to assist one person with the evacuation. If the individual being provided aid required a lot of assistance or was significantly overweight, emergency responders had to change teams with those assisting as fatigue set in.²³⁴ The evacuation pace while assisting the mobility challenged occupants was often described by the emergency responders as very slow.²³⁵ One well-publicized case involved a mobility challenged occupant, several firefighters, and a PAPD officer who were trapped inside a staircase when WTC 1 collapsed. These emergency responders were able to extract themselves from the collapsed staircase and were assisted by other firefighters as they crossed the rubble

²²⁹ FDNY Interview 39, winter 2004.

²³⁰ Building Occupant Interview 1000118.

²³¹ PA Interview 10, fall 2003.

²³² FDNY Interview 41, winter 2004.

²³³ FDNY Interview 25, winter 2004.

²³⁴ PA Interviews 7 and 8, fall 2003.

²³⁵ FDNY Interview 56, winter 2004.

pile.^{236, 237, 238} The occupant was taken from the rubble pile by firefighters that came to the person's aid. From the FDNY and PAPD interviews, it was not clear how many of the 40 to 60 occupants were safely evacuated from the building before WTC 1 collapsed. It is known from the interviews that a group of about 20 of these individuals were being moved out of WTC 1 just before the building collapsed.

Another problem reported with the stairways in WTC 1 and to a slightly lesser degree in WTC 2 during the evacuation was that the stairways in the impact zone were damaged, and the stairways above the impact zone were typically filled with smoke and hot gases. (NIST NCSTAR 1-7) The stairways were functioning as chimneys for the fire gases and smoke that blocked the evacuation routes for the occupants above the impact zones. Several occupants inside WTC 2 above the impact zone found that stairway A, for a period of time, had a smoke level low enough for them to successfully escape from the upper floors. For additional information see NIST NCSTAR 1-7, section 8.1 and Fahy and Proulx, NIST NCSTAR 1-7B, 2005. (NIST NCSTAR 1-7B, 2005) Also inside WTC 2, FDNY personnel reported over the radio that stairway walls were breached from the aircraft impact on the 68th, 73rd, and 74th, floors.²³⁹ It should be pointed out that the aircraft struck WTC 2 between the 77th and 85th floors. (NIST NCSTAR 1-5A, 2005)

Another problem with the stairways occurred when WTC 2 collapsed. As WTC 2 collapsed, the stairways in WTC 1 became filled with dust and smoke, reducing visibility to near zero.²⁴⁰ It was reported that emergency responders with flashlights could get near the floor and see the steps and floor that were painted with photo-luminescent paint, marking the stairway routes. They could also see the reflective exit signs.^{241, 242} Figure 5–11 shows an identical staircase with painted floor markings that was located in the sub-grade level of WTC 4. This photograph was taken in one of the WTC 4 stairways several months after the WTC attack, in 2001.

The following first-person interview statements provide insight into how emergency markings and exit signs helped to save lives:

- One piece of equipment that I carried was a small Mag-Light. It was enough to illuminate the reflective markings on the stairs.²⁴³
- My flashlight saved my life with the reflective exit signs leading to the outside.²⁴⁴

It also was noted that on about the 3rd floor of WTC 1, where water had entered the stairway from broken pipes or discharged sprinklers, the water mixed with the dust and the floors became very slippery, causing emergency responders to fall as they went down the stairs.²⁴⁵

²³⁶ PA Interview 10, fall 2003.

²³⁷ FDNY Interview 25, winter 2004.

²³⁸ FDNY Interview 56, winter 2004.

²³⁹ FDNY Channel 7 / PA, WTC Channel 30 radio repeater communications recording.

²⁴⁰ PA Interviews 6, 7, and 8, fall 2003.

²⁴¹ PA Interview 6, fall 2003.

²⁴² PA Interview 1, fall 2003.

²⁴³ PA Interview 6, fall 2003.

²⁴⁴ PA Interview 1, fall 2003.



Source: NIST.

Figure 5–11. Photograph of a typical World Trade Center staircase, sub-grade level of WTC 4.

As the emergency responders approached the lobby level on several of the stairs they found them blocked by debris generated when WTC 2 collapsed.²⁴⁶ Some of the emergency responders were able to move debris and get past it, and others tried to find different routes out of the building.²⁴⁷ Interviews with FDNY and PAPD personnel indicated that a firefighter with an axe cut a hole in a wall to allow them to escape out of the stairway.²⁴⁸ Two PAPD personnel reported that they were trapped inside WTC 1 and used their service pistols to shoot windows out so that they could get out of the building.²⁴⁹ A NYPD officer also used a service pistol to shoot a window out in an attempt to escape the collapse.²⁵⁰ This was done when an NYPD Special Operations Unit team was trapped near the front of WTC 7 and a window was shot out in an attempt to form an exit route through the WTC 7 building.

²⁴⁵ PA Interview 9, fall 2003.

²⁴⁶ PA Interview 7, fall 2003.

²⁴⁷ PA Interview 6, fall 2003.

²⁴⁸ PA Interview 7, fall 2003.

²⁴⁹ PA Interview 9, fall 2003.

²⁵⁰ NYPD Interview 8, winter 2004.

5.6.5 Physiological Impact on Emergency Responders and the Effectiveness of Conducting Operations

Since the elevators were not functioning or safe to use, firefighters had to climb the stairs in order to assist with the evacuation and rescue building occupants. Many of these firefighters were carrying additional equipment with them that would be needed for conducting rescues and firefighting.

A normally outfitted FDNY firefighter wearing a full protective clothing ensemble (coat, pants, helmet, hood, boots, and gloves) and a SCBA (self-contained breathing apparatus) carries approximately 23 kg (50 lbs) of gear (Lawson 2000). This does not include any additional tools, radios, lights, extra air bottles, medical kits, or hose packs that may be carried by a firefighter. This additional equipment that may be carried by a firefighter may add another 23 kg (50 lbs) or more to the work load. It is not unusual for firefighters to be carrying loads in excess of 46 kg (100 lbs) into a building when fighting a fire.

On September 11, 2001, firefighters who responded to the World Trade Center carried these loads as they ascended the stairways in the buildings. At a minimum, firefighters with only their protective clothing ensemble and SCBA carried approximately 23 kg (50 lbs) of equipment up the stairways. This extra weight has a serious impact on the physical capabilities of firefighters or any emergency responder trying to climb stairs. The following first-person interview statements address the issue of equipment weight:

- I'm surprised I made it up to the 30 floors. It's heavy, bulky, hot and sweaty. The most that we could do was 10 floors at a time. I think that we were taking about 100 extra pounds of weight: heavy boots, bunker pants, tanks on your back and tools in your hands and a heavy helmet on your head.²⁵¹
- We were all carrying one roll up. I needed a little more time to recuperate. We figured that if two guys carried one roll up, we would make better time so we left two fire hoses on the 31st floor. The guys were so fatigued carrying all the stuff. It took about an hour to get to the 31st floor.²⁵²
- It is tiring climbing the stairs. I carried about 105 lbs with bunker pants, tools and water can. You have got to keep things light.²⁵³

The Figure 5–12 shows FDNY firefighters in the lobby of WTC 1 and the equipment they carried.

²⁵¹ FDNY Interview 17, winter 2004

²⁵² FDNY Interview 39, winter 2004

²⁵³ FDNY Interview 42, winter 2004



Figure 5–12. Video image showing FDNY firefighters inside the lobby of WTC 1 with protective clothing and extra equipment carried for operations inside the building.

A basic rule of high-rise firefighting mentioned by emergency responders during the investigation indicates that, a fully equipped firefighter can climb approximately one floor per minute.²⁵⁴ This means that it would take a firefighter approximately one hour to climb to the 60th floor. However, some firefighters estimated that it would have taken them as long as two hours to climb to the 70th floor where FDNY was planning to establish an Operations Post.²⁵⁵ Some FDNY personnel that were interviewed by NIST and were inside WTC 1 had heard that a small number of FDNY rescue personnel had climbed to about the 50th floor in WTC 1 before WTC 2 collapsed.²⁵⁶ This was also reported by a building occupant who stated that as they evacuated down the stairs, “We saw distressed firemen around the 50th floor.”²⁵⁷ (NIST NCSTAR 1-7, 2004) Inside WTC 2, a FDNY Chief Officer reached the 78th floor just before the building collapsed. This climb included a trip on an elevator up to the 40th floor before the FDNY Chief began to climb the remaining 38 floors using the stairs.²⁵⁸ This officer was noted to be a marathon runner, and during his climb up the stairs he was likely wearing an SCBA breathing apparatus but was not carrying extra firefighting equipment. For additional information on the locations of interviewed personnel inside WTC 1, see Section 5.7, Table 5–1.

²⁵⁴ FDNY Interview 29, winter 2004.

²⁵⁵ FDNY Interview 16, winter 2004.

²⁵⁶ FDNY Interviews 20 and 54 winter 2004.

²⁵⁷ Building Occupant Interview 1000118.

²⁵⁸ FDNY Channel 7 / PA, WTC Channel 30 radio repeater communications recording.

Interviews with FDNY, PAPD, and NYPD personnel identified the following concerning climbing the stairs inside WTC 1 on September 11, 2001:

Initial Climbing Period

- Firefighters were able to climb the first 10 to 12 stories in 2 to 5 minutes. The climbing rate depended upon the individual's physical condition and the amount of equipment being carried.
- After the first 10 to 12 floors the firefighters had to stop and rest.

Supporting First-Person Interview Comments:

- We started taking breaks around the 9th floor, and then started marching up again. One of our guys had some chest pain. We made another few flights and he got worse.²⁵⁹
- Climbing was tough but orderly. Carrying equipment was a strain. The first 12 floors felt like I had climbed 100 floors²⁶⁰

Repetitive Climbing and Rest Periods

- After the rest period that may last several minutes the firefighters would climb again, but this time they would usually complete only 5 to 6 floors before they would have to stop and rest again.
- After resting again the firefighters would again climb another 5 to 6 floors and rest again. Some individuals would only make about 3 to 4 floors before having to stop for a rest.

Supporting First-Person Interview Comments:

- A lot of companies had taken rests at about every 4th or 5th floor because we kept passing one another. It was very hot in the stairway, especially with all your gear and hood on, with no ventilation. I ended up going up to the 19th floor.²⁶¹
- Our crew made it up to 21 or 22. I was not exhausted, but it was taking a toll. If we had to go another 20 flights we would have to take longer rest breaks. With us going up about five flights of stairs at a time it would have taken us about two hours to get to the 70th floor.²⁶²

²⁵⁹ FDNY Interview 35, winter 2004.

²⁶⁰ PA Interview 6, fall 2003.

²⁶¹ FDNY Interview 27, winter 2004.

²⁶² FDNY Interview 16, winter 2004.

Physical Impact of Climbing: Fatigue, Heat Stress, and Dehydration

- As a result of the climb, the human body becomes fatigued and thermally stressed. Many of the emergency responders indicated that they were also dehydrating and needed water to drink.
- During rest periods, the firefighters would usually take off their helmets and open their coats in order to cool off. The firefighter protective clothing is designed to be a thermal barrier during firefighting operations, and as a result it is a thermal insulator. Human body temperature rises rapidly under work conditions while clothed in insulating apparel. Many firefighters interviewed indicated that they also removed their SCBA's and coats while they were trying to cool down and rest.

Supporting First-Person Interview Comments:

- You go up about 10 flights and take a rest. You have to because you will be tired if you don't. If you run up to the 20th floor and you are tired, you can't work. You have to rest before you get up there.²⁶³
- Before the other building collapsed, firefighters were out of the stairway in the office area, laying on the floor, masks on the floor, and coats off or open, and resting.²⁶⁴
- We stopped every 10 floors to see the conditions. When we got up to the 20th floor we were really huffing and puffing so we broke a couple of vending machines and took the water out and started distributing it to those who were in need and then continued up.²⁶⁵
- I saw those firemen on the 27th floor. They were totally exhausted. They basically crawled onto the floor. That's why I ran and got them the water.²⁶⁶

There were several cases of firefighters suffering from chest pains or heart attacks.^{267, 268} Other emergency responders were called to their aid, and at a minimum, oxygen was administered to the chest pain patients.²⁶⁹ No other data were found related to these cases except that some of the emergency responders were assisted down the stairs to ambulances. FDNY interviews indicated that at least one of the chest pain cases was associated with strained chest muscles.²⁷⁰

²⁶³ FDNY Interview 42, winter 2004.

²⁶⁴ FDNY Interview 11, winter 2004.

²⁶⁵ FDNY Interview 17, winter 2004.

²⁶⁶ PA Interview 10, fall 2003.

²⁶⁷ FDNY Interview 35, winter 2004.

²⁶⁸ FDNY Interview 16, winter 2004.

²⁶⁹ PA Interview 7, fall 2003.

²⁷⁰ FDNY Interview 29, winter 2004.

Many additional interviewees provided information similar to that reported above. With the information gathered, NIST attempted to estimate the climbing times for the emergency responders who were interviewed. There was no accurate starting time, and there was no precise ending time for the estimates. The starting times are based on the known arrival time for a person or a unit at the WTC, an estimated time to get equipment off of an apparatus, and the estimated time it took to arrive at the Lobby Command Post and get an assignment. It is estimated that it took approximately three to five minutes for firefighters to get to the Lobby Command Post and get an assignment after arriving at the WTC. The ending times for all of the calculations for personnel inside WTC 1 are based on the floor they were on at the time when WTC 2 collapsed. Of the 26 emergency responders interviewed who were inside WTC 1, the following represents the maximum floor heights that they achieved:

- One police officer carrying no extra equipment and wearing a patrolman's uniform climbed to the 44th floor.²⁷¹
- Seven emergency responders including personnel from FDNY and NYPD climbed to the 30's. Two of these FDNY personnel took an elevator to the 16th floor.²⁷²
- Sixteen emergency responders (FDNY, PAPD, and Port Authority Security) climbed to floors in the 20's.²⁷³
- Two emergency responders, FDNY and NYPD, climbed to the teens.²⁷⁴

Based on the data gathered, it is estimated that climbing rates varied between approximately 1.4 minutes per floor for personnel not carrying extra equipment to approximately 2.0 minutes per floor for personnel wearing firefighters' protective clothing and carrying extra equipment. These estimates have an error of approximately ± 0.5 minutes per floor.

The consequence of firefighters and other emergency responders having to climb many tens of floors to get to a fire in a high-rise building can be summarized as follows:

- The climbing rate will be approximately one to two minutes per floor for emergency responders attempting to access a fire zone 30 floors or more high.
- The ability to get both personnel and needed equipment to the desired location becomes limited by building height.
- Emergency response time factors related to the rate of fire growth, the ability to rescue building occupants, and the ability to bring a fire under control becomes more critical with every additional floor in building height.

²⁷¹ PA Interview 10, fall 2003.

²⁷² FDNY Interviews 12, 13, 17, 25, and 39 winter 2004; NYPD Interviews 5 and 6, winter 2004.

²⁷³ FDNY Interviews 9, 11, 16, 29, 33, 35, 37, 41, 42, 43, 52, and 56; PA Interviews 4, 6, 7, and 8, falls 2003.

²⁷⁴ FDNY Interview 27, winter 2004 and NYPD Interview 22, winter 2004.

- The ability of emergency responders to climb the stairs with equipment and remain physically fit to conduct rescue and firefighting operations is diminished with every additional floor in building height that must be climbed.

5.6.6 Situational Awareness

Situational awareness is one of the overriding factors associated with understanding the operational environment, decision making, and operations command and control during periods where large amounts of information are needed and are critical to the successful outcome of a task.

Endsley defined situational awareness as follows: “the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future” (Endsley 1988). In simpler terms, situational awareness refers to the degree of accuracy by which one’s perception of his current environment mirrors reality (Naval Aviation Schools Command 2004). The U.S. Navy website also lists two sets of factors that affect situational awareness:

Perception versus Reality

- View of the Situation
- Incoming Information
- Expectations & Biases
- Incoming Information versus Expectations

Factors that Reduce Situational Awareness

- Insufficient Communication
- Fatigue / Stress
- Task Overload
- Task Underload
- Group Mindset
- “Press on Regardless” Philosophy
- Degraded Operating Conditions

On September 11, 2001, many emergency response personnel who conducted operations at command posts within the WTC towers indicated that they received large quantities of information related to the event, and other individuals indicated that they did not receive enough information about the situation. Both too much information and lack of information prevented responders from having adequate, accurate, and timely information for decisions that were critical to operations and may have been critical to life safety, whether it was their personal safety or the safety of others. All of the factors listed above that

reduce situational awareness, except underload, came into play during WTC operations, and as a result, many of the emergency responders struggled with their perception of what was happening compared to what was really happening.

Situational awareness was an overriding issue with all emergency responders during the WTC operations. First-person interviews with emergency responders from all agencies highlight the importance of situational awareness during this complex emergency response. Results from the interviews show that emergency responders had one of two levels of situational awareness: First, emergency responders working outside the buildings with the ability to observe site conditions as they changed felt that they had good situational awareness.²⁷⁵ In addition, emergency responders who worked inside the buildings and had reliable radio communications with people outside the building felt that their situational awareness also was good. Second, emergency responders who worked inside the buildings and had no reliable means of communication other than face-to-face felt that they had poor situational awareness.²⁷⁶

Many of the emergency responders who did not see the aircraft impact into WTC 1 and reported to the scene before the second aircraft struck WTC 2 did not understand that a large commercial aircraft had struck WTC 1.²⁷⁷ Many thought that a small private or commuter aircraft had hit the building. Emergency responders who could see WTC 1 and then later saw WTC 2 as they approached the towers could tell that the buildings were seriously damaged and that large fires were burning in the buildings.²⁷⁸ Many thought that what had happened to WTC 1 was caused by an accident.²⁷⁹ These original ideas may be related to insufficient information associated with the initial situational cues and were based on their understanding of the event as it related to past experience. However, the situation became much clearer to all that it was a terrorist attack as they either saw or received reports that a second aircraft had crashed into WTC 2.²⁸⁰

Some senior officers inside WTC 1 felt that their situational awareness was poor even though they were in radio contact with other senior officers outside the building.²⁸¹ One of these senior officers stated that *he would have known more about what was going on during the incident if he had been home watching it on TV.*²⁸² It took time to confirm that a second aircraft had actually hit WTC 2. A large number of emergency responders who were working inside WTC 1 realized that something had happened but did not know what had occurred when the second aircraft struck WTC 2.²⁸³ Some firefighters who were going up in the stairways inside WTC 1 did not know that anything had happened when the second aircraft struck WTC 2.²⁸⁴

²⁷⁵ FDNY Interviews 1 – 68, fall 2003 and winter 2004.

²⁷⁶ FDNY Interviews 1 – 68, fall 2003 and winter 2004.

²⁷⁷ FDNY Interview 1, fall 2003 and FDNY Interview 4, winter 2004.

²⁷⁸ FDNY Interview 4, winter 2004.

²⁷⁹ FDNY Interview 4, winter 2004.

²⁸⁰ FDNY Interviews 12, 21, and 29, winter 2004 and NYPD Interview 6, winter 2004.

²⁸¹ FDNY Interview 20, winter 2004.

²⁸² FDNY Interview 7, winter 2004.

²⁸³ FDNY Interviews 11 and 12, winter 2004.

²⁸⁴ FDNY Interview 42, winter 2004.

The situation was somewhat different when WTC 2 collapsed. Many emergency responders inside WTC 1 felt the building shake violently and thought that another aircraft had flown into WTC 1 or that a portion of WTC 1 had collapsed above them.²⁸⁵ All emergency responders interviewed knew that something significant had occurred, but they didn't know exactly what had happened. This lack of situational awareness clearly had a negative impact on some emergency responders who did not understand what had happened when WTC 2 collapsed. It may have been responsible to some degree for the slow evacuation pace that some emergency responders observed after the responders themselves were ordered to evacuate from WTC 1. The following quote describes situational awareness for a small group of firefighters inside WTC 1 shortly after WTC 2 collapsed:

“We were trapped in the interior space, deaf and blind to the rest of the world, to the devastation outside our windows – probably the only group of people in the civilized world who hadn't seen what had happened to the south tower. We might as well have been in a cave, for all we could tell about what was unfolding on the plaza below.”(Picciotto 2002)

The following statements concerning situational awareness were extracted from FDNY and PAPD first-person interview notes:

- We are in the forest here and we are talking about various trees in the forest; we are really just talking about communications. Everybody, my wife and the people in California knew more about the situation than me. It was ridiculous. I didn't know what was going on out there.²⁸⁶
- In between the 21st and 22nd there were some firefighters coming down who said they were told to evacuate. At that time, we still did not know the other tower had collapsed.²⁸⁷

Situational awareness is influenced by the amount and quality of information available (Endsley 1988). The following statement provides information concerning communications capabilities related to the ability to share critical information inside WTC 1:

- It was found that FDNY didn't have effective radio communications with the floors above the lobby. Mostly, their handie-talkie radio communications were ineffective. The interviewee instructed one of his associate Chiefs to activate the building repeater. The repeater didn't seem to work and they thought that the airplane impact destroyed the repeater system. In order to establish some type of communications in the building they tried the standpipe phones and they tried intercom systems. Nothing worked.²⁸⁸

Many of the emergency responders who narrowly escaped the collapse of WTC 1 never understood that WTC 2 and WTC 1 had fully collapsed until the dust and smoke began to clear almost an hour after

²⁸⁵ FDNY Interview 25, winter 2004.

²⁸⁶ FDNY Interview 11, winter 2004.

²⁸⁷ FDNY Interview 16, winter 2004.

²⁸⁸ FDNY Interview 20, winter 2004.

WTC 1 had collapsed.²⁸⁹ Some responders indicated that they did not understand the magnitude of what happened that morning at the WTC until the next day.²⁹⁰

5.7 INFORMATION, COMMUNICATIONS, AND EMERGENCY RESPONDER EVACUATION FROM THE WORLD TRADE CENTER

Information coming into several of the New York City emergency response communications centers indicated that building conditions for the two WTC towers were steadily degrading. At approximately 9:36 a.m., a New York City 9-1-1 telephone operator received a call from inside of WTC 2 stating that a floor had collapsed somewhere in the 90s.²⁹¹ This information was then transferred to a NYPD dispatcher who communicated at about 9:51 a.m. that the 106th floor inside WTC 2 was crumbling. According to a NYPD document, this report appears to have misidentified the floor that had collapsed.²⁹² However, this information concerning the floor collapse was still important as it related to the seriousness of the degrading conditions. Just prior to this message, at approximately 9:49 a.m., one of the NYPD helicopter units reported over the Special Operations Division radio channel that “large pieces” were falling from WTC 2. Each of these messages suggested that the top floors of WTC 2 were experiencing significant degradation; however, none of the emergency responders interviewed believed that there would be total collapse of the building. Also, emergency responders reported during their interviews that around the same time period that these radio messages were being collected and distributed, a runner was sent from OEM to the FDNY Incident Command Post (ICP) to inform them that an engineer believed the WTC towers were nearing conditions that would cause a collapse.²⁹³ The runner got to the FDNY Incident Command Post located in the front of World Financial Center 2 just before WTC 2 collapsed and was in the process of delivering the message when WTC 2 collapsed.²⁹⁴ Figure 5–13 shows the FDNY ICP located in the garage driveway of WFC 2.

With the collapse of WTC 2, each emergency responder department sent out radio messages calling for the immediate evacuation of WTC 1.^{295, 296} At least three FDNY Chief Officers at ground level transmitted urgent radio messages over their handie-talkie radios calling for the evacuation of WTC 1 following the collapse of WTC 2.^{297, 298} Additionally, one FDNY Chief Officer located upstairs inside WTC 1 called over his radio for emergency responders to evacuate the building.²⁹⁹ Interview data from emergency responders who were located upstairs inside WTC 1 provide some insight into how orders to

²⁸⁹ FDNY Interview 10, winter 2004.

²⁹⁰ FDNY Interview 5, winter 2004.

²⁹¹ McKinsey & Company, NYPD call-routing and message dispatch, “106th floor is collapsing,” draft summary report July 23, 2002.

²⁹² McKinsey & Company, NYPD call-routing and message dispatch, “106th floor is collapsing,” draft summary report July 23, 2002.

²⁹³ FDNY Interview 46, winter 2004.

²⁹⁴ FDNY Interview 46, winter 2004.

²⁹⁵ NYPD Interview 24, spring 2004.

²⁹⁶ PA Interview 10, fall 2003.

²⁹⁷ FDNY Interview 7, winter 2004.

²⁹⁸ FDNY Interview 20, winter 2004.

²⁹⁹ FDNY Interview 25, winter 2004.

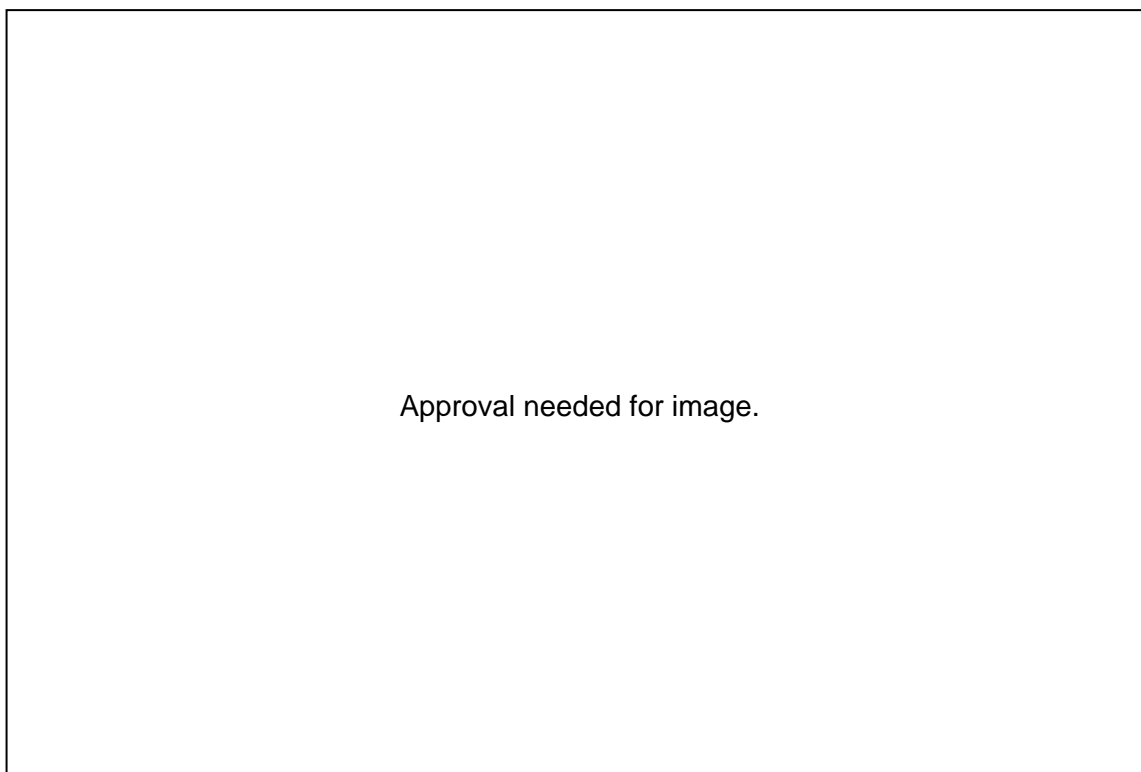


Figure 5–13. Video image of the FDNY Incident Command Post in front of World Financial Center 2.

evacuate the building were received following the collapse of WTC 2. Several firefighters and FDNY officers heard the evacuation orders on their radios while others did not hear the orders. (Table 5–1) One firefighter received the information to evacuate from a FBI employee³⁰⁰, and the remaining firefighters received their evacuation information from other FDNY personnel.³⁰¹

NYPD ESU personnel inside of WTC 1 received their orders to evacuate from an ESU Mobilization Point staff person located at Church and Vesey Streets.³⁰² These radio communications came over a point-to-point radio channel that was being used to communicate with the ESU teams inside the buildings.

PAPD command personnel also called for the evacuation of WTC 1. One PAPD Police Officer heard the order to evacuate over his handie-talkie radio.³⁰³ One of the PAPD Police Officers was told to evacuate by a FDNY Company Officer.³⁰⁴ Another PAPD Police Officer was told to evacuate by a FDNY firefighter, and one was told to evacuate by another PAPD Police Officer.³⁰⁵

³⁰⁰ FDNY Interview 12, winter 2004.

³⁰¹ FDNY Interviews 11, 12, 13, 16, 33, 35, 41, 43, and 52, winter 2004.

³⁰² NYPD Interview 5, winter 2004.

³⁰³ PA Interview 6, fall 2003.

³⁰⁴ PA Interview 8, fall 2003.

³⁰⁵ PA Interview 7, fall 2003.

Table 5–1 summarizes information gathered concerning how evacuation messages were distributed to the surviving WTC 1 emergency responders who were interviewed. In the table a floor height is given for each emergency responder indicating what floor they were on when they received the message to evacuate WTC 1. The emergency responders were located at various places inside the building. They may have been inside any of the three stairways or out on the building's floors when the evacuation message was received.

As demonstrated in Table 5–1, radio communications associated with the order to evacuate WTC 1 had mixed results. The data shows that different personnel located on the same floors of the building either heard the evacuation orders or did not hear the orders over the radio. This failure to receive the evacuation messages may be attributed to a number of factors, including:

- the person's location inside the building and their relative position to building materials or structures that attenuated radio signals,
- the operational condition of their radio,
- their radio volume may have been turned down,
- they or someone nearby was transmitting on the same radio channel at the time when evacuation orders were given, and/or
- noise levels around the person, etc.

Also, the interview information gathered demonstrates that individuals who had the evacuation information actively told others that the building was being evacuated.

After receiving the order to evacuate, some FDNY personnel indicated that there were people in the building who needed medical attention and assistance in evacuating. Several FDNY personnel told the survivors that were interviewed by NIST that they were going to stay behind to help the people who needed them.³⁰⁶ The following interview statements made by FDNY firefighters relate to personnel staying behind:

- One firefighter got the order to evacuate, but he refused because he was helping injured people. He was in the WTC 1 Sky Lobby, on the 44th floor. Another firefighter the interviewee saw was standing in a doorway. The interviewee told him "Let's go, we have to evacuate." The firefighter told him okay, but he was waiting for his chief. The interviewee said that these guys were much like him and the others that were evacuating while helping a lady out of the building. It was the nature of the beast. A firefighter could not just walk out and leave these people who needed help. Other firefighters

³⁰⁶ FDNY Interview 56, winter 2004.

wanted to be sure that their company members were accounted for and also out safe, and they didn't want to leave without them.³⁰⁷

- The interviewee was evacuating down the stairway inside WTC 1 and came across two PAPD officers. They were heading up the stairs. He told them that they had to evacuate, but they said that they had to get to the other Port Authority officers in the building.³⁰⁸
- After realizing that WTC 2 had collapsed we started our evacuation. We then heard the order on the radio to evacuate. From the 27th floor, as we were going down the stairs, I could hear radio reports from a Captain who was around the 40th floor. One FDNY Captain reported on the radio that there were too many burned people with him and that he was not going to leave them.³⁰⁹

Table 5–1. WTC 1 evacuation data from emergency responder interviews.

	FDNY^a	NYPD^b ESU	PAPD^c
Personnel interviewed that went up stairways inside WTC 1	18	3	5
Personnel with handie-talkie radios	15	3	3
Personnel with handie-talkies radios that <u>heard the evacuation order for WTC 1 on their radio</u>	8	3	2
Floors responders were on when message was received to evacuate WTC 1	19, 22, 23, 27, 27, 31, 35, 36	11, 31, 31	22, 35
Personnel with handie-talkie radios who <u>did not hear the evacuation order for WTC 1 on their radio</u> , but were told to evacuate by other personnel	7	0	1
Floors responders were on when message was received to evacuate WTC 1	21, 23, 27, 27 ^d , 28, 34, 25	n/a	24
Personnel without handie-talkie radios	3	0	2
Personnel <u>without handie-talkies radios that heard the evacuation order for WTC 1 over someone else's radio</u>	1	0	0
Floor responder was on when he heard the order to evacuate WTC 1.	23	n/a	n/a
Personnel <u>without handie-talkie radios that were told to evacuate by other personnel</u>	2	0	2
Floors that responders were on when told to evacuate WTC 1	22, 31	n/a	24, 25

a. FDNY Interviews # 9, 11, 12, 13, 16, 17, 25, 27, 29, 33, 35, 37, 39, 41, 42, 43, 52, and 56

b. NYPD Interviews # 5, 6, and 22

c. PAPD/PA Security Interviews # 4, 6, 7, 8, and 10

d. This emergency responder had made an independent decision to leave WTC 1 before the collapse of WTC 2 because one of his members was experiencing medical problems. The responder received a verbal evacuation order as they were in the process of evacuating the building.

³⁰⁷ FDNY Interview 56, winter 2004.

³⁰⁸ FDNY Interview 25, winter 2004.

³⁰⁹ FDNY Interview 56, winter 2004.

Many of the emergency responders who were interviewed indicated that as they came down the stairs they stopped on each floor to check for occupants or called out that everyone should leave the building.³¹⁰ The emergency responders also reported that there were still a few civilians still going down the stairs as they went down the staircases.³¹¹ Several of the civilians were building occupants who were mobility impaired and needed assistance.³¹² Emergency responders provided assistance to these individuals as needed.³¹³ As the responders went down through the building, they found approximately 40 to 60 mobility impaired people sitting inside offices on the 12th floor.³¹⁴ These individuals had been placed on the floor in order to clear the staircases since they had been causing the evacuation to slow. The emergency responders got approximately 20 of these people up and began assisting them down the stairs as they were attempting to evacuate the building.³¹⁵ Other firefighters stayed behind to assist others who needed help.³¹⁶ WTC 1 collapsed as firefighters and police officers were getting this first group of mobility impaired people outside.³¹⁷ It is not known how many mobility impaired building occupants or emergency responders died during this part of the operation. Additionally, a building occupant who was able to exit WTC 1 just in time to save his life reported that as he went through the lobby, “there were firefighters who did not leave the building, they were milling around the fire desk in the lobby.”³¹⁸ (NIST 2004)

5.8 EFFECT OF WTC 2 COLLAPSE ON EMERGENCY OPERATIONS

With the collapse of WTC 2, all emergency responder operations at the WTC were disrupted. This included operations being carried out by FDNY, NYPD, PAPD, PANYNJ, and OEM. When WTC 2 collapsed, it resulted in fatalities and injury of many emergency responders at the scene. Also, all operations at emergency responder command posts and mobilizations points at and near the WTC complex were disrupted. Falling debris destroyed command posts and critical equipment being used by emergency responders during the ongoing operations.³¹⁹ The wind and dust cloud generated during the collapse also hampered operations. Emergency responders reported being blown into the air and tumbling down the street as WTC 2 collapsed.³²⁰ Some police officers reported that the wind was so strong that it ripped equipment from their gun belts and blew it away.³²¹ With these high winds, some emergency responders felt intense heat as the wind blew past them, and they were hit by flying debris.³²² All of the emergency responders interviewed who were near street level when WTC 2 collapsed reported

³¹⁰ FDNY Interview 25, winter 2004.

³¹¹ FDNY Interviews 11, 13, and 16, winter 2004.

³¹² PA Interviews 8 and 10, fall 2003.

³¹³ FDNY Interview 25, winter 2004.

³¹⁴ FDNY Interview 25, winter 2004.

³¹⁵ NYPD Interview 22, spring 2004 and PA Interviews 7 and 8, fall 2003.

³¹⁶ FDNY Interview 25, winter 2004.

³¹⁷ FDNY Interview 25, winter 2004.

³¹⁸ Building Occupant Interview 1000118.

³¹⁹ FDNY Interviews 20, 51, and 65, winter and spring 2004.

³²⁰ NYPD Interviews 8 and 16, winter 2004 and FDNY Interview 67, spring 2004.

³²¹ PA Interview 9, fall 2003.

³²² FDNY Interviews 64 and 65, spring 2004.

that the dust cloud and smoke was so thick and black that they could not see anything or breathe. The dust in the air was so thick that it filled their eyes and mouths.³²³

Immediately following the collapse, emergency responders reported that there was a period where they heard no radio communications.³²⁴ They did not know whether it was caused by the thick dust cloud preventing radio signals from getting through or if no one was able to communicate on the radio. As the dust and smoke began to clear, many of the emergency responders found that their radio microphones and speakers were filled with dust and debris.³²⁵ Also, police officers' firearms were clogged with dust and debris.³²⁶ The emergency responders generally indicated that they immediately attempted to clear their critical equipment to get it working again.³²⁷ As the radio systems came back on line, emergency responders indicated that the radios became filled with Mayday distress messages, and surviving personnel began to respond to these calls for help.³²⁸

As the dust and smoke continued to clear, emergency responders also began to assess their operational situation. The FDNY Incident Command Post located in front of World Financial Center 2 (WFC 2) on West Street was destroyed and many of its personnel were missing. The FDNY Field Com unit that was located at the Incident Command Post also was lost, and the personnel operating the system evacuated toward the Hudson River.³²⁹ Therefore, all FDNY command communications at the site were lost except those that could be carried out using the low output power handie-talkie radios carried by the command officers. It soon became apparent that WTC 2 had fully collapsed, and that the Lobby Command Post there was destroyed, and the FDNY personnel operating the command post were missing. The FDNY Command Post located on the corner of Liberty Street and West Street was destroyed, and personnel were missing, and the Lobby Command Post inside of WTC 1 had been abandoned as personnel evacuated in an attempt to save their lives.³³⁰ When WTC 2 collapsed, it fell into the Marriott Hotel killing, injuring, and trapping many firefighters inside the damaged structure. This also ended the Command Post operations inside the hotel.³³¹ The primary NYPD mobilization point located at Church Street and Vesey was abandoned as WTC 2 collapsed, and operations at the NYPD mobilization point on West Street and Vesey Street were ended.³³² The PAPD police desk inside WTC 5 also was abandoned following the collapse of WTC 2.³³³ Although the OEM command center inside WTC 7 had already been evacuated, OEM personnel working around the site and stationed with the Mayor also had to evacuate from the WTC site, which had a negative impact on effective operations at the highest command level.³³⁴ Loss of the various critical personnel and the emergency responder command posts seriously disrupted emergency operations at the WTC. In addition, all records associated with emergency responder personnel

³²³ FDNY Interview 64, spring 2004.

³²⁴ FDNY Interview 22, winter 2004.

³²⁵ FDNY Interview 45, winter 2004.

³²⁶ PA Interview 9, fall 2003.

³²⁷ PA Interview 9, fall 2003.

³²⁸ FDNY Interviews 30 and 31, winter 2004.

³²⁹ FDNY Interviews 58 and 61, winter 2004 and spring 2004.

³³⁰ FDNY Interviews 2 and 7, fall 2003 and winter 2004.

³³¹ FDNY Interview 62, spring 2004.

³³² NYPD Interview 24, spring 2004.

³³³ PA Interview 3, fall 2003.

³³⁴ NYPD Interview 2, winter 2004 and FDNY Interview 46, winter 2004.

accountability and operations were lost, and vital equipment for carrying out the emergency operations was destroyed by debris and fire.

5.8.1 Emergency Responder Apparatus at the WTC

During emergency operations, it is important that a fire department assigns and dispatches the appropriate types and numbers of apparatus and personnel needed to accomplish the mission. As fire department personnel arrived at the WTC scene, they positioned their apparatus in a fashion that would allow them to quickly access their equipment and bring it into use to control the fire and protect lives.³³⁵ Firefighters knew that they would have to be at the WTC for many hours and that they would need a significant amount of equipment to conduct operations inside the WTC towers.³³⁶ Figure 5–14 and Figure 5–15 show the locations of parked emergency vehicles at the WTC before the towers collapsed.

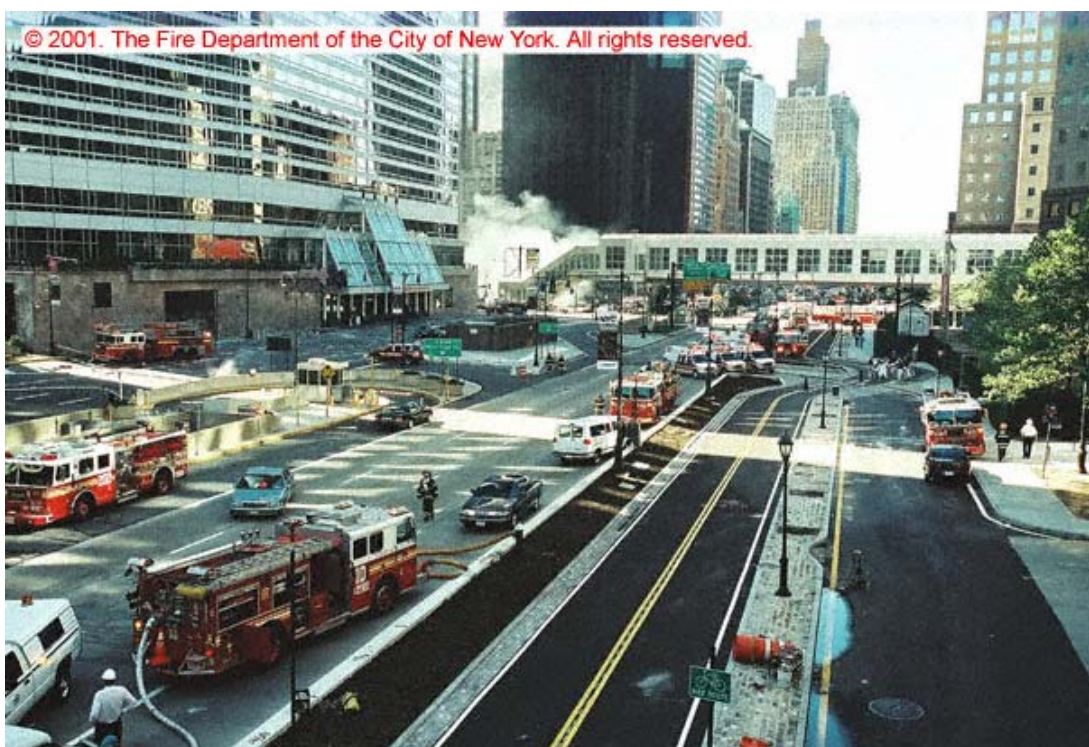


Figure 5–14. Photograph taken from near the corners of West and Vesey Streets looking south before the collapse of WTC 2.

³³⁵ FDNY Interviews 16, 32, 39, and 44, winter 2004.

³³⁶ FDNY Interviews 18 and 30, winter 2004.



Figure 5–15. Photograph taken from West Street looking towards (right to left) Liberty Street, WTC 2, and the Marriott Hotel before the collapse of WTC 2.

Firefighters had never experienced the total collapse of a tall high-rise building and did not believe that the towers would fully collapse during their operations.³³⁷ Therefore, many FDNY vehicles and other emergency apparatus were parked within the collapse zone of the towers. The total number of emergency response apparatus near the WTC towers ranges from approximately 100 to 170 vehicles.³³⁸ As a result of the collapse, 91 FDNY vehicles and apparatus were destroyed when the buildings collapsed.³³⁹ Table 5–2 contains a list of vehicles destroyed:

Each of the vehicles and firefighting apparatus listed in Table 5–2 carried equipment vital for conducting firefighting and rescue operations. The loss of the 343 firefighters coupled with the loss of the valuable equipment listed above created a significant reduction in FDNY’s capabilities. This loss of human life and the capital assets makes it imperative that emergency operations protocols for tall buildings be critically reassessed. Figures 5–16, 5–17, and 5–18 show some of the emergency response apparatus destroyed during the collapse of the WTC towers.

³³⁷ FDNY Interviews 1, 2, 6, 7, 11 – 15, 17, 19, and 20, fall 2003 and winter 2004.

³³⁸ FDNY, Vehicles Missing or Destroyed at WTC Disaster, 2002.

³³⁹ FDNY, Vehicles Missing or Destroyed at WTC Disaster, 2002.

Table 5–2. FDNY vehicles and apparatus destroyed by collapse of WTC towers.

Vehicles or Apparatus Destroyed	Number Destroyed
Ambulances	5
Ladders or Trucks	15
Engines or Pumpers	18
Satellite Pumper	1
Rescue Vehicle, Primary	2
Rescue Vehicle, Secondary	1
Squad Vehicle, Secondary	3
High-Rise Vehicle	2
Emergency Crew Vehicle	2
Field Comm (Spare)	1
Mask Service Unit	1
Tac (Tactical Equipment Unit)	1
Sedans	23
Staff Utility Vehicles	16
Total	91

**Figure 5–16. Destroyed fire apparatus following the collapse of WTC 1 and 2.**



Figure 5–17. Damaged emergency apparatus at the corners of West and Vesey Street after the collapse WTC 1 and 2.



Figure 5–18. Burned out fire apparatus on West Broadway next to WTC 7 following the collapse of WTC 1 and 2.

5.8.2 Emergency Responder Equipment

Generally, before the towers collapsed equipment used by emergency responders at the WTC was adequate for the operations being carried out.³⁴⁰ However, there are some points related to equipment that need consideration.

Thousands of pounds of emergency equipment are typically needed for operations where people are seriously injured, buildings are damaged with the possibility of structural collapse, and large fires are burning. All of these conditions existed at the WTC on September 11, 2001. As a result of the elevators being unsafe or inoperable, emergency responders hand carried almost all equipment needed with them up the stairs. This emergency equipment included rescue equipment, medical equipment, and some firefighting equipment. The equipment locker on the 44th floor of WTC 1 that was opened by a Port Authority employee did not have the equipment necessary for conducting large scale operations that were required in the building.³⁴¹ Also, tenants on the upper floors of WTC 1 who attempted to provide medical aid to the injured and rescue people trapped in elevators indicated that they did not have the equipment needed to carryout those tasks.³⁴² Additionally, protective clothing systems produced heat stress and added to the firefighters' fatigue as they climbed the stairs.³⁴³ From these observations, it is apparent that the issue of pre-positioned equipment is vitally important for emergency response in high-rise buildings, and there should be a means for the emergency responder agencies and high-rise building owners to ensure that the pre-positioned equipment is adequately inspected, maintained, and certified for use.

The emergency responder first-person interviews highlighted three pieces of equipment that made a difference in their operations that day; in fact, they are credited with saving the lives of many emergency responders. These items were: radios, flashlights, and SCBA's (Self Contained Breathing Apparatus) carried by the emergency responders.

Radios

Although significant problems were reported with the use of handie-talkie radios at the WTC site, many emergency responder personnel, from each of the emergency response organizations, reported that their radios played a part in saving their lives. Some statements extracted from first-person interviews related to hearing the calls for evacuating WTC 1 follow:

- Later on my handie-talkie I heard an order to evacuate. Then there was a lot of handie-talkie communications. I believe there was a PAPD officer with an air-pack, and he had a radio and he told us there was an order to evacuate the building, WTC 1.³⁴⁴

³⁴⁰ FDNY Interview 37, winter 2004 and NYPD Interview 19, spring 2004.

³⁴¹ PA Interview 10, fall 2003.

³⁴² Building Occupant Interview 1000118.

³⁴³ FDNY Interviews 17, 28, and 33, winter 2004.

³⁴⁴ FDNY Interview 39, winter 2004.

- When I got to the 22nd floor there was a lot of debris, everything was pushed to the center of the building. The windows were knocked out and I could feel the wind. I could not see. I got a radio transmission that said everyone in Tower 1, get out.³⁴⁵
- Firehouse 10 located across the street from the WTC gave us the information that we needed. Lucky for us, those items were all relevant to Tower 1. House 10 was monitoring Tower 1 radio transmissions.³⁴⁶
- I heard my boss calling for help on the radio. He was trapped and calling for help. I knew that I had to go find him so I started talking to him on the radio. He was found by another fireman buried in rubble and he was rescued.³⁴⁷
- I heard a muffled message on my radio that there was a mayday, get out of the building. The south tower has come down.... I had an older radio; I didn't have the new radio that they were phasing in. I had the old antique MX 330, it was twice the size of a normal radio, but it picked up everything.³⁴⁸

Flashlights

During the response on September 11, 2001, emergency responders found that flashlights were an extremely important piece of equipment. In the darkness, smoke, and debris throughout the WTC complex, flashlights enabled emergency responders to find other emergency responders, occupants, and identify hazards.³⁴⁹ Emergency responders used flashlights to find and navigate routes of evacuation for themselves and others.³⁵⁰ In addition, flashlights provided a source of hope and comfort in the darkness. Emergency responders and others gathered around those who had flashlights as they evaluated their situation and developed evacuation strategies. There were cases where as many as 25 to 30 people would gather around a single flashlight in the darkness.³⁵¹ Numerous emergency responders credited flashlights with saving their lives.

The following statements concerning flashlights were extracted from the emergency responder first-person interview notes:

- I was in the super heated gases in the epicenter, which was sort of hellish. A fellow responder took his flashlight and pointed me in a direction. I hobbled and crawled. I finally hit WFC 2.³⁵²

³⁴⁵ FDNY Interview 42, winter 2004.

³⁴⁶ FDNY Interview 47, winter 2004.

³⁴⁷ FDNY Interview 54, winter 2004.

³⁴⁸ FDNY Interview 9, winter 2004.

³⁴⁹ FDNY Interview 45, winter 2004.

³⁵⁰ FDNY Interview 32, winter 2004.

³⁵¹ NYPD Interview 19, spring 2004.

³⁵² FDNY Interview 12, winter 2004.

- I told everyone, don't move, and stay where you are. I didn't want to cause a secondary collapse. Just look, we were able to find flashlights... I said, just look around you, and see if you can see a way out.³⁵³
- It was dark in the stairwell. If I didn't have a flashlight, I'd be on night vision. It was dark. Plus, with the smoke and soot and there's no windows. I think the emergency light was working, but it wasn't very bright.³⁵⁴
- The interviewee began to hear the beeping and chirping of the firefighters pass devices. The interviewee didn't have a flashlight and it was pitch black inside the building, but someone did have their flashlight and turned it on. He could see the light and he then knew that he was not blind. That gave him hope. They had light. Others gathered around the light. Soon there was a large group of people only a few around the light could see.... Others got close and made physical contact in the darkness. The little flashlight helped. The people in the front of the line with the light could see where they were going. The people at the other end of the line away from the light could not see and held on following the lead of the rest.³⁵⁵
- The firefighter chopped a hole through the wall. The police and the Port Authority personnel went through the same hole to exit. He was using his flashlight to help people walking through the hole to see.³⁵⁶
- He also gave the medical oxygen bottle to a firefighter that needed help. His flashlight saved his life by lighting his way out.³⁵⁷
- People were in sneakers and they had flashlights and masks and the only thing I could assume right there is that these people knew what they were doing because of 1993. I'm quite sure that they had some kind of fire drills because of the bombing in 1993.³⁵⁸

These comments from emergency responders point out the importance of having a reliable flashlight during a serious incident. The comments are only a small sample of statements made by emergency responders concerning their flashlights and how they played an important roll in life saving that day. When considering the issue of flashlight usage, it should not be forgotten that on September 11, 2001, it was a clear, blue sky day with no clouds. By the time WTC 2 collapsed, the sun had risen to a relatively high angle in the sky, and the WTC site was well illuminated. However, with the collapse of WTC 2, this pristine day suddenly became so black that people literally could not see their hands in front of their

³⁵³ FDNY Interview 25, winter 2004.

³⁵⁴ FDNY Interview 29, winter 2004.

³⁵⁵ NYPD Interview 3, winter 2004.

³⁵⁶ PA Interview 2, fall 2003.

³⁵⁷ PA Interview 6, fall 2003.

³⁵⁸ PA Interview 9, fall 2003.

faces, even outside of the buildings in the open space of the streets.³⁵⁹ Inside the buildings, emergency responders not only had to deal with dust and smoke, but also were located in areas where the loss of electrical power made the area pitch black. This condition was described particularly by people who were trapped in the Concourse level of the WTC and people in the lower floors of the WTC 1 staircases.

Breathing Apparatus (SCBA)

The third piece of equipment reported as being extremely valuable by emergency responders was the air-pack or SCBA. Numerous emergency responders indicated that they used their SCBAs to breathe after the WTC towers fell. The air was thick with debris, dust, and smoke and most people found it difficult to breathe.³⁶⁰ Personnel with SCBAs were able to place the mask over their faces and breathe fresh air from the air bottle even though the outside air was thick with dust and smoke. Many of the emergency responders with SCBAs shared their air supply with others around them. The following is a sample of statements made by emergency responders during first-person interviews related to the use of their SCBA's:

- One of the men near him had a SCBA air-pack and they were able to buddy breathe as they made their way out of the building.³⁶¹
- One of them had an air-pack. They were all vomiting; breathing was difficult. They shared the air-pack so that they could breathe fresh air. They were able to exit the building in about ten minutes and ended up on South End Avenue.³⁶²
- My air-pack was great; it saved my life and I am glad I was trained with it.³⁶³
- My air-pack and my flashlight saved my life.³⁶⁴
- If we didn't have our air-packs, we wouldn't have made it.³⁶⁵

5.9 EMERGENCY RESPONSE OPERATIONS AT WORLD TRADE CENTER 7

World Trade Center 7 (WTC 7) was an important building with regard to the attack on the World Trade Center. The New York City Office of Emergency Management (OEM) was located on the 3rd and 23rd floors of WTC 7.³⁶⁶ The OEM office on the 23rd floor contained the emergency operations post for OEM and was designed to function as a command center to help coordinate multi-agency operations at

³⁵⁹ FDNY Interview 12, winter 2004.

³⁶⁰ FDNY Interview 67, spring 2004.

³⁶¹ FDNY Interview 67, spring 2004.

³⁶² FDNY Interview 64, spring 2004.

³⁶³ NYPD Interview 8, winter 2004.

³⁶⁴ NYPD Interview 19, winter 2004.

³⁶⁵ PA Interview 8, fall 2003.

³⁶⁶ FDNY Interview 54, winter 2004.

incidents in the city.³⁶⁷ (Sheirer 2004) On September 11, 2001, WTC 7 became threatened as the WTC complex was attacked.

When the first aircraft struck WTC 1, the electrical power went out for several seconds inside WTC 7.³⁶⁸ Many people immediately began leaving the building, and the OEM operations center began receiving calls related to the emergency.³⁶⁹ As the second aircraft struck WTC 2, a decision was made to evacuate WTC 7.³⁷⁰ By the time WTC 2 was struck by the second aircraft at 9:03 a.m., many WTC 7 occupants had already left the building and others had begun a self-evacuation of the building. Shortly after WTC 2 was struck, a firefighter entered WTC 7 from the Washington and Vesey Streets side, connected a hose line onto the “A” stairwell sprinkler riser and started the Engines pumps.³⁷¹ At approximately 9:30 a.m., FDNY, EMS established a Division for assisting victims at WTC 7.³⁷² An EMS triage center was established in the lobby of WTC 7 as occupants from WTC 1 and WTC 6 evacuated through WTC 7.³⁷³ At approximately 9:44 a.m., after the report of a third aircraft heading into the city and news that the Pentagon had been attacked, a Deputy OEM Commissioner ordered the complete evacuation of WTC 7. (Sheirer 2004) This order included the evacuation of the OEM operations center on the 23rd floor. The loss of the OEM operations center created difficulties related to the coordination of emergency responder operations and resources.³⁷⁴ Before the OEM operations center was evacuated, OEM had assigned personnel to work with each of the emergency responder command posts. This reduced the impact of the loss of the WTC 7 OEM office. (See Chapter 8.) Occupants evacuating from WTC 7 used both the elevators and stairways as they left the building.³⁷⁵ Shortly after WTC 7 was evacuated, the FDNY Fire Commissioner arrived, looking for the Mayor who he believed to be at the OEM center on the 23rd floor. A guard met the Commissioner in the lobby and ordered him and his staff out of the building. The guard told him, “This building has been evacuated.” and that “OEM, the mayor, they’re all gone.” (Von Essen 2002)

At 9:59 a.m., WTC 2 collapsed, and debris from the collapse struck the south face of WTC 7.³⁷⁶ At 10:28 a.m., WTC 1 collapsed and a significant amount of damage was done to WTC 7.³⁷⁷ A large amount of debris crashed through the front center of the building from approximately the 10th floor down to ground level, and debris ripped a part of the southwest corner off from approximately the 8th floor up to the 18th floor.³⁷⁸ The collapse of WTC 1 also appears to be responsible for starting fires inside of WTC 7.³⁷⁹ With the collapse of the two towers, a New York City employee and a WTC 7 building staff person became trapped inside of WTC 7.³⁸⁰ The two had gone to the OEM center on the 23rd floor and

³⁶⁷ FDNY Interview 54, winter 2004.

³⁶⁸ FDNY Interview 54, winter 2004.

³⁶⁹ FDNY Interview 54, winter 2004.

³⁷⁰ WTC 7 Interview 1110402, fall 2002.

³⁷¹ WTC 7 Interview 2110402, fall 2002.

³⁷² McKinsey & Company, *Increasing FDNY's Preparedness*, New York, August 2002.

³⁷³ FDNY Interview 45, winter 2004.

³⁷⁴ FDNY Interview 45, winter 2004.

³⁷⁵ WTC7 Interviews 1110402 and 2110402, fall 2002.

³⁷⁶ FDNY Interview 45, winter 2004.

³⁷⁷ PAPD Interview 1, fall 2003.

³⁷⁸ FDNY Interview 3, winter 2004.

³⁷⁹ FDNY Interview 19, winter 2004.

³⁸⁰ WTC 7 Interviews 2041604 and 1041704, spring 2004.

found no one there. As they went to get into an elevator to go downstairs the lights inside of WTC 7 flickered as WTC 2 collapsed. At this point, the elevator they were attempting to catch no longer worked, so they started down the staircase. When they got to the 6th floor, WTC 1 collapsed, the lights went out in the staircase, the sprinklers came on briefly, and the staircase filled with smoke and debris. The two men went back to the 8th floor broke out a window and called for help. Firefighters on the ground saw them and went up the stairs. In addition, a security officer for one of the businesses in the building was also trapped on the 7th floor by the smoke in the stairway. As the firefighters went up, they vented the stairway and cleared some of the smoke. They first met the security officer on the 7th floor and firefighters escorted him down the stairs. Other firefighters from the group continued up the stairs, shined their flashlight through the staircase smoke and called out. The two trapped men on the 8th floor saw the flashlight beam and heard the firefighters calling and went down the stairway. The firefighters took the men outside and directed them away from the building.³⁸¹

At approximately 11:30 a.m., FDNY assigned a Chief Officer to take charge of operations at WTC 7. The Chief was initially given orders to put the fires out in WTC 7.³⁸² From the Chief's assigned location at WTC 7, he reported that looking south toward WTC 7, they could not see the building because of the large smoke and dust cloud. The Chief Officer was able to negotiate the debris fields, get to the building, and see the WTC 7 logo on the side. There were numerous burned out FDNY vehicles around WTC 7. At the corner of Vesey and West Broadway, a FDNY Engine was connected to a hydrant at the corner of WTC 7. Hose lines were stretched, and the Engine's pump was still running even though the Engine was on fire and was almost burned out. There was no water coming out of the hydrant system.³⁸³ One FDNY Chief Officer that entered WTC 7 indicated that he opened a standpipe on the 4th floor of one stairway and found no water in the standpipe system.³⁸⁴ A FDNY fire boat and the retired FDNY fire boat "Harvey" were located at the shore on the Hudson River near the site. They were starting to stretch lines up to the WTC.³⁸⁵ According to the FDNY first-person interviews, water was never an issue at WTC 7 since firefighting was never started in the building.³⁸⁶ When the Chief Officer in charge of WTC 7 got to Barclay Street and West Broadway, numerous firefighters and officers were coming out of WTC 7. These firefighters indicated that several blocks needed to be cleared around WTC 7 because they thought that the building was going to collapse.³⁸⁷

Con Edison personnel arrived at the scene and consulted with FDNY. They wanted to know if they should cut the power off at the WTC 7 power station. It was decided to leave the power on and not allow Con Edison personnel to enter WTC 7 because it was not safe.³⁸⁸ The Con Edison personnel also indicated that fuel tanks were located in the lower level of WTC 7. However, they could not determine if the fuel tanks were involved with the fires burning in the building. FDNY personnel reported that they did not see any indication of burning liquid fuels before the building collapsed.³⁸⁹ No accurate time is

³⁸¹ WTC 7 Interviews 2041604 and 1041704, spring 2004.

³⁸² FDNY Interview 3, winter 2004.

³⁸³ FDNY Interview 3, winter 2004.

³⁸⁴ FDNY Interview 3, winter 2004.

³⁸⁵ FDNY Interview 3, winter 2004.

³⁸⁶ FDNY Interview 3, winter 2003.

³⁸⁷ FDNY Interview 3, winter 2004.

³⁸⁸ FDNY Interview 3, winter 2004.

³⁸⁹ FDNY Interview 3, winter 2004.

available for this event during the operations; however, the sequence of events indicates that it occurred between approximately 12:00 noon and 2:00 p.m.

One Battalion Chief coming from the building indicated that they had searched floors 1 through 9 and found that the building was clear.³⁹⁰ In the process of the search, the Battalion Chief met the building's Fire Safety Director and Deputy Fire Safety Director on the ninth floor. The Fire Safety Director reported that the building's floors had been cleared from the top down. By this time, the Chief Officer responsible for WTC 7 reassessed the building again and determined that fires were burning on the following floors: 6, 7, 8, 17, 21, and 30.³⁹¹ No accurate time is available for these actions during the WTC 7 operations; however, the sequence of event indicates that it occurred during a time period from 12:30 p.m. to approximately 2:00 p.m.

The Chief Officer then met with his command officer to discuss the building's condition and FDNY's capabilities for controlling the building fires. A Deputy Chief who had just returned from inside the building reported that he had conducted an inspection up to the 7th or 8th floor.³⁹² He indicated that the stairway was filling with smoke and that there was a lot of fire inside the building. The chiefs discussed the situation and the following conditions were identified:^{393, 394}

- The building had sustained damage from debris falling into the building, and they were not sure about the structural stability of the building.
- The building had large fires burning on at least six floors. Any one of these six fires would have been considered a large incident during normal FDNY operations.
- There was no water immediately available for fighting the fires.
- They didn't have equipment, hose, standpipe kits, tools, and enough handie talkies for conducting operations inside the building.

At approximately, 2:30 p.m., FDNY officers decided to completely abandon WTC 7, and the final order was given to evacuate the site around the building.^{395, 396} The order terminated the ongoing rescue operations at WTC 6 and on the rubble pile of WTC 1. Firefighters and other emergency responders were withdrawn from the WTC 7 area, and the building continued to burn. At approximately 5:20 p.m., some three hours after WTC 7 was abandoned the building experienced a catastrophic failure and collapsed.

³⁹⁰ FDNY Interview 26, winter 2004.

³⁹¹ FDNY Interview 3, winter 2004.

³⁹² FDNY interview 14, winter 2004.

³⁹³ FDNY Interview 3, winter 2004.

³⁹⁴ FDNY Interview 14, winter 2004.

³⁹⁵ FDNY Interview 3, winter 2004.

³⁹⁶ FDNY interview 14, winter 2004.

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Chapter 6

PLANNING FOR MAJOR OPERATIONS IN TALL BUILDINGS

6.1 FIRE AND EMERGENCY RESPONSE PROTOCOLS FOR TALL BUILDINGS

On September 11, 2001, FDNY was conducting high-rise firefighting procedures based on their document, FDNY DCN: 3.02.01, Fire Fighting Procedures High-Rise Office Buildings, Volume 1, Book 5, January 1, 1997.¹ A complete copy of this document is located in Appendix I. The purpose of this documents as stated in the introduction is:

- To describe High-Rise Class “E” office buildings. Over 800 of these structures can be found in New York City.
- To point out the problems and features of such buildings with regard to fire.
- To establish methods of operating at fires in such buildings, and recommend precautions that should be taken.

According to this document there were three types of high-rise office buildings in New York City: 1) Class “E” built before 1945, 2) Class “E” built between 1945 and 1968, and 3) Class “E” built after 1968.¹ The WTC towers were built after 1968 and were in the third class. Construction characteristics of the post 1968 buildings are found in section 2.4 of the FDNY procedure. The following lists several construction details of a Class “E” high-rise building that are important to fire department operations:

- The construction techniques used in these buildings resulted in a "lightweight" building
- They were constructed with a lack of compartmentation.
- The protection of the structural steel component is usually done by spraying on a fireproofing material.
- Exterior walls or curtain walls constructed of a combination of glass and metal.
- The ceiling plenums of these buildings are extensive and lack fire stopping. They are used to return the air to the air-conditioning system and for electrical, communications and other building support equipment.
- Exterior windows usually can not be opened.
- Fire towers are not required.

¹ FDNY DCN: 3.02.01, Firefighting Procedures, High-Rise Office Buildings, Volume 1, Book 5, January 1, 1997.

- Floors are light in weight usually consisting of lightweight concrete
- Core construction techniques are used extensively.

The FDNY strategic operating plan for evacuation and firefighting for the first alarm Battalion Chief is presented in section 6.1 of the FDNY High-Rise Building document.¹ The following provides a brief summary of the FDNY Strategic Operating Plan. See the complete Strategic Operations Plan in Appendix I.

Strategic Operating Plan:

- Determine the specific fire floor or the floors on which smoke is reported from any information that is available to you in the building lobby.
- Verify the fire floor. Analyze information received from responsible occupant/building management personnel and/or the first arriving Ladder company. Determine the fire floor location as rapidly as possible. All future actions hinge on this vital information.
- Simultaneously, or as soon as possible, begin the process of controlling evacuation. Occupants of numerous floors may have self-initiated evacuation. Due to large floor areas or maze like corridors, occupants on the fire floor may be unaware of the fire until it is too late to evacuate. Search of large areas will be required. Search and evacuation of the floor above the fire will also be required.
- Gain control of the building systems: elevators, HVAC (Heat, Ventilation, and Air Conditioning system), communications, and fire pumps, confine and extinguish the fire.
- Experience indicates any serious fire will require a large commitment of units and equipment because of extensive logistic problems and a need for frequent relief of members.

In addition to these tasks listed above a Lobby Command Post is to be established and the Incident Command System is to be activated. The following FDNY procedure details information concerning the Lobby Command Post.¹

Lobby Command Post:

The lobby command post is established by the arriving units inside the building and manned by each succeeding officer in command. From this post operations conducted in the building by Fire Department units are coordinated and controlled.

- The early establishment of a lobby command post will enable the chief in charge to exert central control over: evacuation, building systems, and the Fire Department units being deployed to locate, confine and extinguish the fire.
- To assist the lobby command post, it may be necessary to establish areas of command as follows: operations post, search and evacuation post, and staging areas.

- The lobby command post should provide the officer in command access to the following: the fire safety director, the fire safety plan, floor plans, the class "E" communications system, outside telephone lines, in-house telephone lines if available, building, elevator and window keys.
- The lobby command post shall be established at a location that provides the following: accessibility to incoming units, control of the elevators, control of the building fire command station, facilities for communications with all needed fire department communications and established operations posts and staging areas, the fire pump room, the HVAC control center, and the building occupants.

In addition to the establishment of the Lobby Command Post, Operations Posts are to be established within the high-rise building. The following procedure located in section 6.5 describes the Operations Post: ¹

Operations Post:

- It shall be established on the first floor below the fire, where conditions permit, and its location shall insure reliable communications with the operating units and the lobby command post.
- The chief in charge of the operations post shall be responsible for control, communications with, and coordination of the in building staging areas, and units operating on the fire floor and the floor above.
- Communications between the operations post and the lobby command post and the implementation of tactical procedures received from the lobby command post.
- Advising the lobby command post of conditions, problems and the need for additional units, and consult with the lobby command post about tactical procedures.
- Keeping in reserve an adequate number of units at the operations post for the orderly relief of units operating on the fire floor and the floor above.

As the Command Posts are established the FDNY Incident Command System also became established. The FDNY Incident Command System Manual, ICS Manual, Part 1, May 1997 ² describes policies and the structure of the system. The following is extracted from the manual: FDNY INCIDENT COMMAND SYSTEM. The complete document is located in Appendix A.

FDNY Incident Command System Policy:

The FDNY Incident Command System policy provided guidelines and concepts to manage an incident in an efficient organized manner; the document describes the components, operating capabilities and functions of the New York City Fire Department Incident Command System (ICS). The Incident

² FDNY Incident Command System Manual, ICS Manual, Part 1, May 1997.

Command System was designed to improve firefighter safety by providing better accountability of personnel and improved use of resources and tactical effectiveness.

The policy provides a general description of the ICS organizational structure and describes the duties and responsibilities for each position at various types of incidents. The FDNY-ICS breaks down the system elements for managing an incident into 5 main functions: COMMAND, PLANNING, OPERATIONS, LOGISTICS, and FINANCE. It was the function of the initial Incident Commander, to implement the necessary parts of the ICS based on the needs of the incident. As the incident grows in complexity, the Command function is transferred to succeeding officers.

The FDNY Incident Command System described in this document was the official policy for the management of all incidents and the development of standard operating procedures that were in effect during the World Trade Center attack on September 11, 2001. The New York City Fire Department Incident Command System provided for the following kinds of operations:

- Single jurisdiction and single agency.
- Single jurisdiction and multi-agency.
- Multi-jurisdiction and multi-agency involvement.

This FDNY document stated that characteristic components of the Incident Command System policy interact to create a system that ensures optimum information management and control under normal or crisis conditions. Characteristics attributed to ensuring optimum information management and control are: common terminology, manageable span of control, modular organization, integrated communications, unified command structure, incident action planning, designated incident facilities, and resource management. During the WTC attack and operations, all of these Incident Command System procedures and policies were seriously challenged and experienced various degrees of performance.

The above procedures and policies represent the basis for FDNY operations at the WTC associated with the 2001 attack. Review of the procedures and policies and comparing them with the actions taken by FDNY at the WTC shows that the procedures and policies were, to a great extent, being followed with this extremely large and complex operation.

- In less than one hour FDNY had established three Lobby Command Posts, the original Lobby Command Post that was set up inside WTC 1, the second Lobby Command Post was set up inside of WTC 2, the third Lobby Command Post was set up inside the Marriott Hotel, a fourth FDNY Command Post was established on the street at the corner of West and Liberty Streets, and the Incident Command Post was set up near West and Vesey Streets in front of World Financial Center building two (WFC 2).^{3,4}

³ FDNY Interview 7, winter 2004.

⁴ FDNY Interview 62, winter 2004.

- The FDNY Field Communications unit had arrived and was functioning at the Incident Command Post in front of WFC 2.⁵
- FDNY had also set up an EMS Operations Post and they sectorized the WTC area into four zones for operations regarding patient triage and treatment.⁶
- FDNY had also established staging areas for firefighting and EMS units, and EMS had called in a Mobile Emergency Response Vehicle (MERV) that established operations on Vesey Street between West Street and North End Avenue.^{7, 8}

First-person interview data, FDNY documents, and media video support the premise that FDNY had established a functional Incident Command System when WTC 2 collapsed, and FDNY had the human and equipment resources committed for conducting high-rise operations at the WTC. However, the FDNY Incident Command System was hampered by the loss of the OEM Command Center, the lack of a fully functional Field Comm unit, poor radio communications, and limited access to shared information critical to operations.^{9, 10} The collapse of WTC 2 not only caused the death of numerous citizens and emergency responders, but it totally disrupted the ongoing Incident Command System Operations being carried out by the Fire Department. The Lobby Command Post inside WTC 2 was destroyed and all of its personnel died in the collapse. Orders were issued to evacuate WTC 1, and the WTC 1 Lobby Command Post was abandoned. The Incident Command Post in front of World Financial Center 2 (WFC 2) was mostly destroyed by the collapse of WTC 2, and robust operations ended at that location. The FDNY Incident Command Post in front of WFC 2 was completely destroyed with the collapse of WTC 1, and several of the commanding officers, including the FDNY Chief of Department, died at this time.

6.2 PRE-PLANNING, TRAINING, AND STANDARD OPERATING PROCEDURES APPLIED AT THE WTC

High-rise buildings, such as the WTC towers, are complex structures that house many thousands of people. Detailed emergency planning for these types of buildings is needed to enhance the safety of building occupants and emergency responders. Building owners and operators, fire departments, emergency medical services, and police departments need well-developed pre-plans that address safety issues associated with these unique and potentially high-risk properties. Not only do these groups need to develop pre-plans for emergencies in high-rise buildings, they must be sure that each of the pre-plans appropriately link to form a cohesive and functional unified plan that will be successful when it is challenged by an emergency situation.

On September 11, 2001, the initial responding fire department companies were familiar with operations within the WTC and were familiar with the emergency plans for the towers. Many of the firefighters had been inside the towers before on previous operations. The Port Authority had conducted pre-planning for

⁵ FDNY Interview 61, winter 2004.

⁶ FDNY Interview 49, winter 2004.

⁷ McKinsey & Company, *Increasing FDNY's Preparedness*, New York, August 2002.

⁸ FDNT Interview 55, winter 2004.

⁹ FDNY Interview 45, winter 2004.

¹⁰ FDNY Interview 58, winter 2004.

building emergencies in the towers and had worked with FDNY, particularly after the 1993 bombing, to enhance safety at the buildings. As part of FDNY's document "Firefighting Procedures, High-Rise Office Building,"¹ a section refers to the "Strategic Operations Plan" for high-rise operations. This plan established operations practices that were designed to link with the building owner's high-rise emergency plan.

Some key elements of FDNY pre-planning for high-rise building operations relate to:

- planning for operations with the high-rise building's safety personnel
- planning for operations with building security personnel
- planning for operations with the local police department
- knowing the construction and physical layout of the building,
- understanding the building's fire alarm and protections systems,
- understanding the building's standpipe systems, fire pumps, hookup points, in-house firefighting resources, and the overall firefighting water supply,
- understanding the design and operations of the building's emergency communications system,
- understanding the building's evacuation plan, elevators, stairways, and other building egress ways
- plan for the safe use of fire department controlled elevators
- knowing the capabilities of fire department radios and other means of communication as it relates to building design and locations where radio signals become lost or attenuated, and
- information on the building's HVAC system, its function, and means of building ventilation.

Procedures for Implementing the Strategic Operating Plan

The FDNY document "Firefighting Procedures, High-Rise Office Buildings" has a detailed description of how the Strategic Operating Plan was to be implemented. Listed below are some of the key factors for how the fire department was to put the plan into operation. The following was extracted from the FDNY document entitled "Firefighting Procedures, High-Rise Office Buildings," January 1997.¹ Also see section 6.1 that lists details of the strategic operations plan and Appendix I.

- The first arriving Battalion Chief was responsible for implementing the strategic operating plan, and the Battalion Chief was to position operations at the lobby command post. From this post, there would be control over all building systems through the fire safety director or a surrogate. The Battalion Chief would receive first-hand information about other problems that might develop on floors above the fire through the building communications networks.

The Chief would have liaison with the Police Department for control of the lobby and the streets in the vicinity of the fire building.

- The first arriving Battalion Chief would be required to make an initial size up to determine the adequacy of the response and the need for additional response.

A 10-76 signal would be transmitted when a report of fire is confirmed. Any fire in a high-rise office building which requires the stretching and operating of one hose line would necessitate the use of "All Hands."

A second alarm would be warranted for any visible fire or smoke emanating through the exterior skin of the building or when a serious fire had been verified.

Because of the large number of occupants in high-rise office buildings, even fires of a minor nature might require additional units to prevent unnecessary evacuation and panic.

- The first arriving Battalion Chief would be also required to establish liaison with the fire safety director if present, or a surrogate to determine the following:

Has the fire floor definitely been determined?

What is the extent of the evacuation that has been implemented?

Have there been any reports of severe life hazards?

What is the status of the elevators and the HVAC system?

Are there any access stairs in the vicinity of the reported fire floor?

What communications have been established between the fire floor and the lobby command post?

What communications have been established between the lobby command post and the occupants of the building?

- Under normal fire situations in high-rise buildings, the Battalion Chief would arrange for the fire safety director or the evacuation supervisor to make an announcement over the PA system or the intercom system. "This is your Fire Safety Director, Dr. John Doe. The New York City Fire Department has just arrived to extinguish a fire on the floor. As they obtain information, we will pass it along to you. If your assistance is required, I will make such an announcement. In the meantime, please remain calm at your place of employment." In WTC 1, the intercom system was not functioning, and therefore, an announcement of this type could not have been communicated. In fact, there is no evidence that this type of message was delivered. In WTC 2, there is no evidence from the several announcements made from the Fire Command Desk in the building that a message containing this content was communicated.

- The fire department also had a high-rise operations check list that would be used for obtaining additional information critical for operations in the fire building. The first arriving Battalion Chief would make use of this check list as soon as possible to advance the collection of additional information needed for operations.

The Port Authority had prepared an extensive pre-plan manual for emergency procedures at the WTC. The original manual was prepared in 1988 and had been updated annually. The manual had already been updated during 2001 and this revised plan was in effect on September 11, 2001. The manual was entitled, “World Trade Center Emergency Procedures Manual 2001,”¹¹ it contained plans for natural disasters and a full range of other threats to the buildings. A copy of this Port Authority emergency procedures manual are contained in Appendix J. In addition, the plan highlighted cooperation between PAPD, FDNY, and NYPD.

Firefighter Training

At the time of the 2001 WTC attack, FDNY had several training programs to prepare its members for operations inside high-rise buildings. The basic Probationary Firefighter School curriculum gave new personnel a minimum of 25 weeks of training. This training provided basic skills that were needed by a firefighter for operating under the direction of a Company Officer in a high-rise firefighting environment. A second level of training consisted of the “First Line Supervisors Training Program” which was directed at training company officers. In this program, the officers received approximately eight hours in training that focused on high-rise firefighting. The third level of training on high-rise operations was for Battalion Chiefs and consisted of training associated with the department’s 40-plus page document on high-rise firefighting. A copy of this document is located in Appendix I. The Battalion Chief training dealt with building design and construction, working with building fire safety directors, communications, incident command, use of fireman service elevators, stairways, evacuation, Ladder company operations, and firefighting operations.

¹¹ Port Authority of New York and New Jersey, *World Trade Center Emergency Procedures Manual 2001*, New York, NY.

Chapter 7

EMERGENCY COMMUNICATIONS AND ANALYSIS

7.1 INTRODUCTION

On September 11, 2001, radio and telephone communications played a significant role in the operations of emergency responders at the World Trade Center (WTC). Radio and telephone communications were a primary means of communicating information to emergency responders. These forms of communication were also used by emergency responders to communicate with people trapped in the WTC buildings and people attempting to evacuate from the buildings. They were used to communicate between members of the same emergency responder departments for planning and operations at the WTC, and they were used to communicate between different departments or responding organizations.

Each of the governmental departments that had emergency responders at the WTC—New York City Fire Department (FDNY), New York City Police Department (NYPD), and the Port Authority Police Department (PAPD)—depended on their ability to communicate to accomplish their mission and to obtain information related to operations safety during the attack. Personnel from each of the departments used radios, cellular phones, and wired or landline telephones for communications during the WTC operations. Other forms of communication at the WTC included the warden telephone system, and the use of Blackberry communications systems. In addition, the emergency responders relied on the most basic form of communication, direct face-to-face communications.

As a normal practice during a typical emergency response many radio and telephone communications are recorded by the respective departments that respond to an incident. These recordings are normally made by the departments to provide an accurate record of operations during an incident. These records are often used by departments during review of department operations. They are also used for investigative purposes and are sometimes used as evidence in legal cases. During the attack on the WTC, many of the emergency responder communications were recorded and preserved. This study is based on these recordings. In addition, information gathered by personnel from the NIST, during first-person interviews with more than 100 emergency responders has contributed to the report.

7.1.1 Objectives

The objective of this section is to develop a better understanding of the role that emergency communications played during the response to the WTC attack, and to quantify information related to communications effectiveness.

Many factors are associated with the ability of emergency communications to be successful. The following objectives were set in this report:

- To document radio and telephone communications operations,
- To document radio communications readability or understandability,

- To quantify radio communications traffic volume,
- To understand the impact of traffic volume on communications readability and the transfer of information,
- To identify communications associated with dispatch and arrival of responders,
- To identify communications related to evacuation and emergency response operations, and
- To identify communications related to building conditions at the WTC and the impact of this information on the emergency response.

7.1.2 Telephone and Radio Communications Recordings

Both the Port Authority of New York and New Jersey (PANYNJ) and the NYPD supplied copies of audio recordings from the emergency response operations at the WTC. The PANYNJ provided digital copies of the audio communications tapes recorded by them during operations on September 11. These recordings included communications from emergency response personnel, maintenance personnel, PAPD personnel, and a recording of the FDNY Channel 7 / PA, WTC Channel 30 radio repeater that was located at the WTC. The FDNY Channel 7 and PA, WTC Channel 30 radio frequencies are the same radio communications frequencies. The FDNY Channel 7 designation represents the actual tuning knob switch location on the fire department's handie-talkie radios. The Port Authority identified this same repeater channel as Channel 30 as a result of the PA radio communications system architecture. The FDNY Channel 7 / PA, WTC Channel 30 repeater frequency was a FDNY city-wide channel designated for use in high-rise building operations. This repeater was installed because FDNY handie-talkie radio communications within the WTC towers was relatively poor, and the radio repeater would increase transmission power improving the radio signal. The combination of increased radio transmission power and the location of the repeater antenna outside of the WTC buildings on top of WTC 5 provided better radio coverage for the complex and increase the likelihood that FDNY personnel working inside the towers would be able to communicate with others while using their handie-talkie radios. The Port Authority had installed this radio repeater system at the WTC for use by FDNY after the 1993 bombing.^{1,2}

Because telephone communication (both landline and cellular phone) was a contributing part of the emergency communications process during the WTC attack, NIST received copies of telephone emergency response communications from the PANYNJ. Identification information for these recordings is listed in Attachment 3.

The NYPD submitted their communications to NIST in the form of audio tapes copied from the original tapes recorded on September 11, 2001. These tapes included radio communications from NYPD Special Operations, Division One, and city-wide operations.

¹ PA Interview 2, fall 2003.

² PA Interview 11, fall 2003.

FDNY communications recordings were not available from the WTC location on September 11, 2001, because the primary Field Communications truck was in the shop for repairs and a backup Field Communications van was used in its place. The backup Field Communications van did not have the capability to record the on-scene incident command or tactical communications. Also, the backup van was destroyed when the towers collapsed. Therefore, the best record of radio communications available to NIST on FDNY operations at the WTC came from the FDNY Channel 7 high-rise repeater / PA, WTC Radio Channel 30 tape and accounts provided by FDNY personnel during their interviews. The Channel 7 / Channel 30 tape provides a limited amount of information on FDNY communications and operations at the WTC, but it does provide insight into FDNY operations inside WTC 2. NIST also received the FDNY Manhattan radio dispatch channel recordings for the period just prior to the WTC attack until the time when WTC 1 collapsed.

Each audio communications file was received from the source with the starting and ending times marked on the media jacket or the surface of the media. A list of all communications recordings acquired from the various departments is found in Attachment 3 at the end of the report.

The City of New York provided NIST with opportunities to review their telephone recordings for 9-1-1 Emergency Operators and FDNY fire dispatchers in their New York City offices.

7.2 TELEPHONE COMMUNICATIONS

7.2.1 Accounts of Telephone Communications

There were 116 first-person interviews conducted with emergency responders who reported to the WTC on the morning of September 11, 2001. The following information was drawn from these interviews:

- Before the attack occurred on the WTC, both the landline and cellular systems appeared to be working normally.
- Only moments after the first aircraft impacted WTC 1, the landline and cellular telephone systems were stressed by increased caller volume making it difficult to get messages through. This condition continued for many hours following the attack.
- Telephone calls from the WTC to the 9-1-1 emergency operators and statements from various individuals being interviewed show that even though WTC 1 and WTC 2 were severely damaged by the aircraft impact and fires, many of the landline telephones in the buildings continued to work up until the collapse of WTC 2.

The following is from emergency responder first-person interviews and deals with telephone communications from inside WTC 1:

- One of my guys called up on the warden phone. There was one on every floor in the building and you can call the Lobby Command Post with it. He called but he couldn't get through and we went to the Verizon

Company on the 23rd floor and he called the Manhattan dispatcher on the phone and told them to pass a message to the Lobby Command Post.³

- I didn't have a dial tone. So I went into another office there and I called the fire dispatcher and got through on a regular telephone. This was around the 18th floor. We could not get through on the radio, and I am sure they had their hands full down there at the Lobby Command Post.⁴
- After the collapse of WTC 2, a number of cellular phone systems were not functional in the area of lower Manhattan. A number of emergency responders attempted to use their cellular phones to make calls since they were unable to communicate using their radios. Many of these attempts were unsuccessful either due to failure of the cellular phone system or the high communications traffic volume that occurred.
- After the collapse of WTC 2, there were still some landline telephones working within the city block areas adjacent to the WTC site.

7.2.2 PAPD Police Desk Telephone Calls

Throughout the operations, while the PAPD Police Desk in WTC 5 was staffed and just before the collapse of WTC 2, the police desk was receiving radio and telephone calls concerning building occupants, building conditions, and operations. Most of the telephone calls related to operations and the location of people in the buildings. However, there was another category of telephone calls coming in that distracted the Police Desk operators from their efforts to save lives: calls from the news media. These included calls from news organizations in the immediate area and other locations on the east coast of the United States. In addition, there was a telephone call from a radio talk show on the West Coast and another telephone call from a news service in Europe. The PAPD Police Desk personnel tried to be helpful but also attempted to transfer the callers to another telephone number for assistance. These efforts took valuable time and potentially delayed critical communications with the emergency responders at the scene.

7.2.3 New York City 9-1-1 Emergency Telephone System

The New York City 9-1-1 Emergency Telephone System also was flooded with telephone calls and experienced periods where the system was stressed by the number of incoming calls.^{5,6} The New York City 9-1-1 Emergency Telephone Center was staffed as usual with dozens of telephone operators who received incoming calls and determined if the calls were for NYPD, FDNY, or EMS. Each 9-1-1 operator had a computer for logging in calls, transferring written information, and the ability to switch telephone

³ FDNY Interview 29, winter 2004.

⁴ FDNY Interview 35, winter 2004.

⁵ NYPD Interview 13, winter 2004.

⁶ NIST review of 9-1-1 tapes, 2004.

calls to the appropriate city department.⁷ As emergency calls were being switched, the 9-1-1 operators would monitor the call to insure that it was responded to by the assigned department.

On the morning of September 11, 2001, telephone calls received from people trapped inside the WTC towers were transferred to the FDNY dispatchers. Information concerning injured and trapped people was collected by the FDNY dispatchers, the information would be evaluated, and then the dispatcher would attempt to transmit the information to the FDNY Incident Command Post or to the Field Comm unit located at the Incident Command Post in front of WFC 2. Since the radio communications system also was experiencing problems with a large volume of radio traffic, all information did not get through to the people who needed it. Additionally, the large amount of incoming data presented a problem for FDNY dispatchers related to evaluating and retransmitting the information to all individuals needing it. Once information was transmitted by the FDNY dispatchers and received by the FDNY WTC Incident Commander, FDNY units were assigned to go to a specific location and assist the trapped or injured occupant (s).

7.3 RADIO COMMUNICATIONS

In general, emergency responders felt that their equipment was adequate for the operations they were carrying out before the WTC towers collapsed. There was one notable exception: this was the FDNY handie-talkies used throughout the department by Chief Officers down to the first line firefighter.

7.3.1 Handie-Talkie (HT) Radios Used by FDNY on September 11, 2001

FDNY personnel knew from years of experience - including their communications experience during the 1993 bombing of the WTC - that the handie-talkies used by the department did not work well inside high-rise buildings. (Fusco 1993) Buildings containing large amounts of steel and reinforced concrete are known to attenuate radio communications signals. Radio signals also may be attenuated by electromagnetic interference and radio signal reflections, and each of these attenuation modes can be found in large cities with high-rise buildings. The radios used by FDNY during the 1993 bombing and until March 14, 2001, were Motorola Saber 1 and Saber 1E models. These radios had the following attributes:

- Operating frequency - 150 MHz, VHF band
- Type of operation - analog with 1 Watt of output power
- The radios had seven radio channels distributed as follows: Six channels were simplex or point-to-point operation channels; one channel was a duplex or repeater channel which used a 153 MHz transmitter frequency and a 154 MHz receiver frequency.

Table 7-1 shows the HT operating channels and radio frequencies as specified in FDNY A.U.C. 179 Utilization of Company Handie Talkie⁸. The complete document is located in Appendix K. It should be noted that this document was in abeyance as the result of a March 22, 2001, FDNY order. However,

⁷ NYPD Interview 15, winter 2004.

⁸ Fire Department City of New York, DCN 4.0306, Utilization of Company Handie Talkie, A.C.U. 179, July 1996.

the document was the basis for Company handie-talkie radio usage during the WTC attack on September 11, 2001.

Table 7–1. HT radio frequency allocation and use.

	Channel	Frequency
1	Universal Handie - Talkie	153.83 MHz
2	City Wide Base	154.43 MHz
3	Queens Mobile	154.40 MHz
4	Manhattan Mobile	154.01 MHz
5	Brooklyn Mobile	153.95 MHz
6	Staten Island Mobile	154.07 MHz
7	Hi - Rise Repeater	TX 153.89 MHz RX 154.43 MHz

Note: In the table above, TX refers to the transmit frequency and RX refers to the receive frequency.

The radio channel is set on the handie-talkie radio by rotating a control knob at the top of the radio.

In addition to these VHF band HT frequencies FDNY was using the following communications frequencies on September 11, 2001: Manhattan Fire 154.25 MHz, Brooklyn Fire 154.37 MHz, Bronx Fire 154.19 MHz, and Staten Island Fire 154.19 MHz.

On March 14, 2001, FDNY began to field new 800 MHz handie-talkie radios. They were Motorola model XTS 3500 R radios with the following attributes:

- Operating frequency - 800 MHz, UHF band.
- Type of operation - digital operation through a trunking system (Trunking systems process and route communications messages.)
- Transmitter output power - 2 Watts and 5 Watts.
- The radios had 16 communications channels of which channels 15 and 16 were not assigned. The remaining channels were assigned as follows: channels 1 through 3 were all Borough fireground tactical and command channels; channel 4 through 8 were assigned as specific Borough fireground channels; channel 9 was the future high-rise in-building repeater channel; channel 10 was the Battalion mobile repeater channel; channels 11 and 12 were subway repeater channels; channel 13 was EMS/fire fireground; and channel 14 was the railroad repeater channel.

On March 19, 2001, a FDNY firefighter using the new 800 MHz digital radio became trapped during firefighting operations. The firefighter used his radio and called Mayday several times but was not heard. The firefighter was rescued, but the failure of this Mayday to get through raised questions about the new

radio's capabilities.⁹ On March 21, 2001, the new 800 MHz radios were recalled by FDNY and were replaced by the Saber radios previously used by the department for a period of about 10 years.¹⁰ These were the radios used by FDNY during emergency operations at the 1993 WTC bombing. These Saber handie-talkie radios were used by FDNY during the September 11, 2001, attack on the WTC. The poor operating performance of these older radios in high-rise buildings was well known to firefighters and chiefs, and raised concerns by many personnel that the radios would not perform well during the WTC operations. Their concerns were proven to be valid.

The following is a statement drawn from the emergency responder first-person interviews and concerns communications in high-rise firefighting environments:

- It was stated that communications in high-rise fires had been a problem as long as the interviewee had been on the department, so it was not a surprise that they had problems at the WTC on the morning of September 11, 2001.¹¹

In addition, FDNY management, selected chiefs, and Field Comm were using some Motorola UHF, 800 MHz, analog radios for command communications.¹² These radios were used on a trunking system that processes the radio communication and then routes the message as it is being retransmitted by the system. These 800 MHz radios were not used by FDNY fire and rescue companies operating inside the WTC complex. However, it was being used by FDNY command personnel for communications during WTC operations. FDNY informed NIST that the FDNY 800 MHz command radio traffic was not recorded during the WTC operations on September 11, 2001.

As mentioned earlier, another component of the FDNY radio communications system used on September 11, 2001, at the WTC was the high-rise repeater system located in WTC 5. Communications through the WTC high-rise repeater were carried out with the use of the Saber handie-talkie radios discussed above. The handie-talkie radio's channel selector switch would be set on Channel 7, which would allow communications through the high-rise repeater system.

7.3.2 Radio Repeater Systems Used by FDNY at the WTC

FDNY had instituted several efforts to improve communications inside high-rise buildings. They worked with building owners and encouraged them to install building/complex repeater systems that would assist with building radio communications. The PANYNJ installed a building/complex repeater system for FDNY following the 1993 bombing. In addition, FDNY developed what they referred to as the "battalion car cross-band repeater" that also could be used to enhance radio communications inside of high-rise buildings. In a 1998 article, Battalion Chief Orio J. Palmer of FDNY wrote about the use of repeater

⁹ Written Communication from New York City, October 6, 2004.

¹⁰ Written Communication from New York City, October 6, 2004.

¹¹ FDNY Interview 34, winter 2004.

¹² Written Communication from New York City, October 6, 2004.

systems to improve radio communications during high-rise operations. The following is a quote from his WNYF article:¹³

“The primary use of the battalion car repeater was to assist the Incident Commander in the lobby of a high-rise building in communicating with members on the upper floors when transmissions were affected adversely by the building. If the battalion car with the installed cross-band repeater is positioned approximately 60 feet from the building, there is a much greater chance of the battalion car repeater receiving a one-watt signal from a handie-talkie transmitting from an upper floor than any handie talkies located within the building at the lobby command post (LCP). The signal does not have to pass through numerous floors of steel and steel-reinforced concrete.”

“The battalion car cross-band repeater is not a cure-all for communications in high-rise buildings or large complexes, but the UHF radio may provide a link between the lobby command post and remote members where no link exists.”

Two different radio repeater systems were used at the WTC during the 2001 operations. One was the building/complex radio repeater system installed at the site by the PA, and the second was the battalion car cross-band repeater (Figures 7-1, 7-2, and 7-3). The following are descriptions of the two systems.

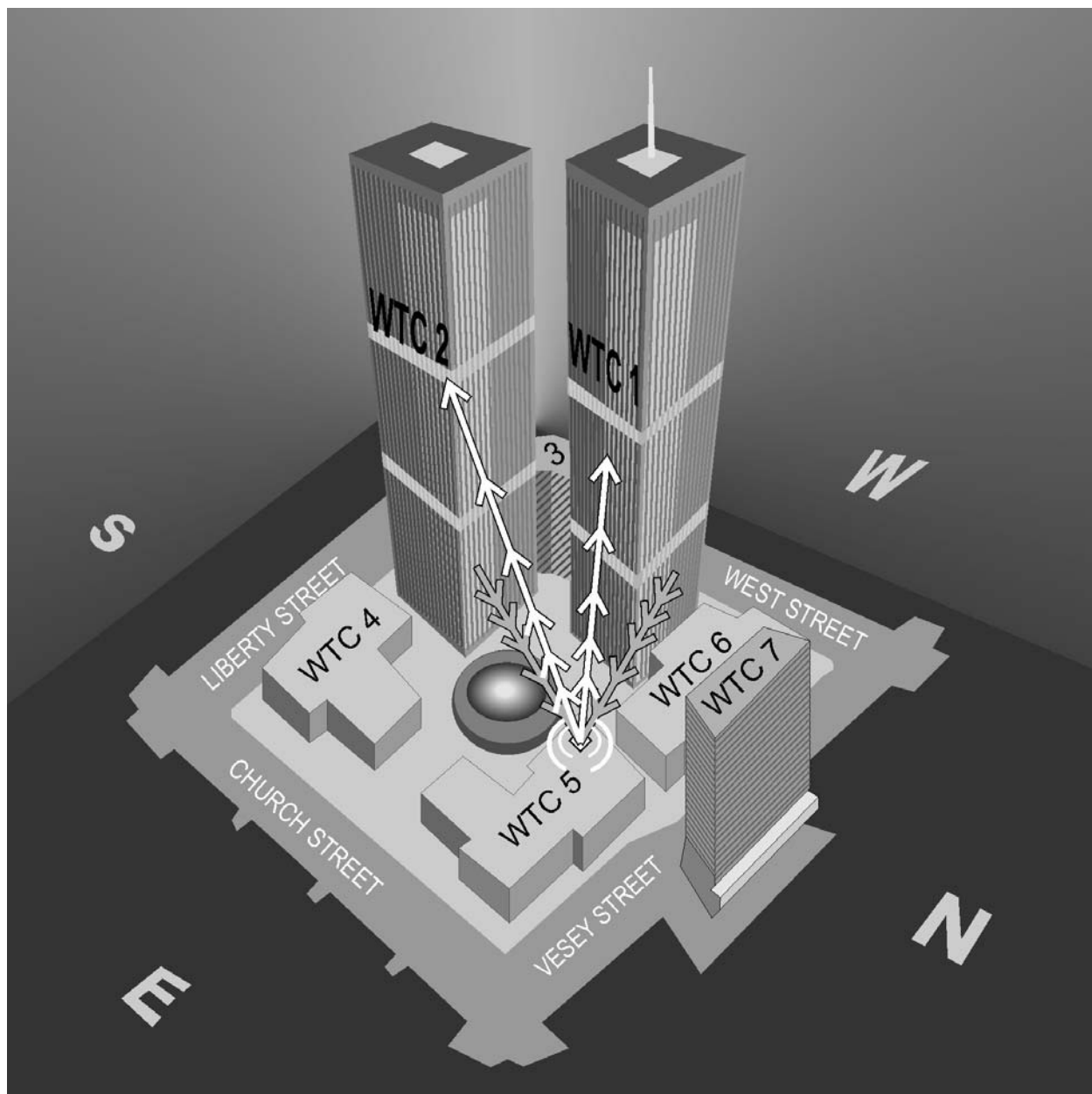
7.3.3 Building/Complex FDNY Radio Repeater

The WTC/FDNY high-rise repeater was located inside WTC 5 and the antenna for the repeater was located on roof of WTC 5 and was aimed up and directly at WTC 1 and 2.¹⁴ With this antenna configuration, the repeater provided coverage for both towers. The repeater was a Motorola base station model MSR 2000. It had an output power of approximately 50 watts. The radio repeater was a duplex design having an input receive frequency of 154.430 MHz and an output transmit frequency of 153.890 MHz. Note that the receive frequency was exactly the same as that of the FDNY Channel 2 command frequency and the FDNY City Wide base frequency. This repeater had three different locations where it could be turned on and operated.¹⁵ Two were located at the tower's Fire Command Desks, one in the lobby of WTC 1 and one in the lobby of WTC 2. The third repeater control point was located at the PAPD Police Desk inside WTC 5.

¹³ Palmer, Orio J., Battalion Chief, *Repeater Systems*, WNYF, 3rd edition, FDNY, New York, 1998.

¹⁴ PA Interview 2, fall 2003.

¹⁵ PA Interview 2, fall 2003.



Source: Original artwork by Marco Crupi. Enhancement by NIST.

Figure 7–1. Illustration showing the location of the FDNY WTC high-rise repeater antenna at the site.

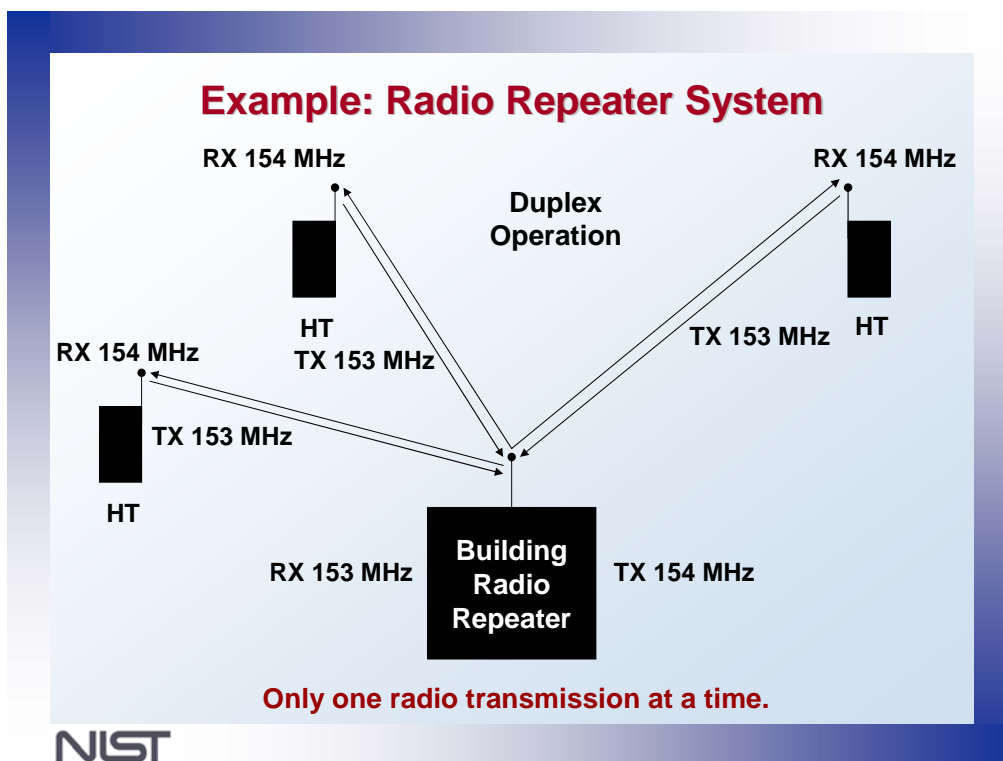


Figure 7–2. Example of a FDNY high-rise repeater.

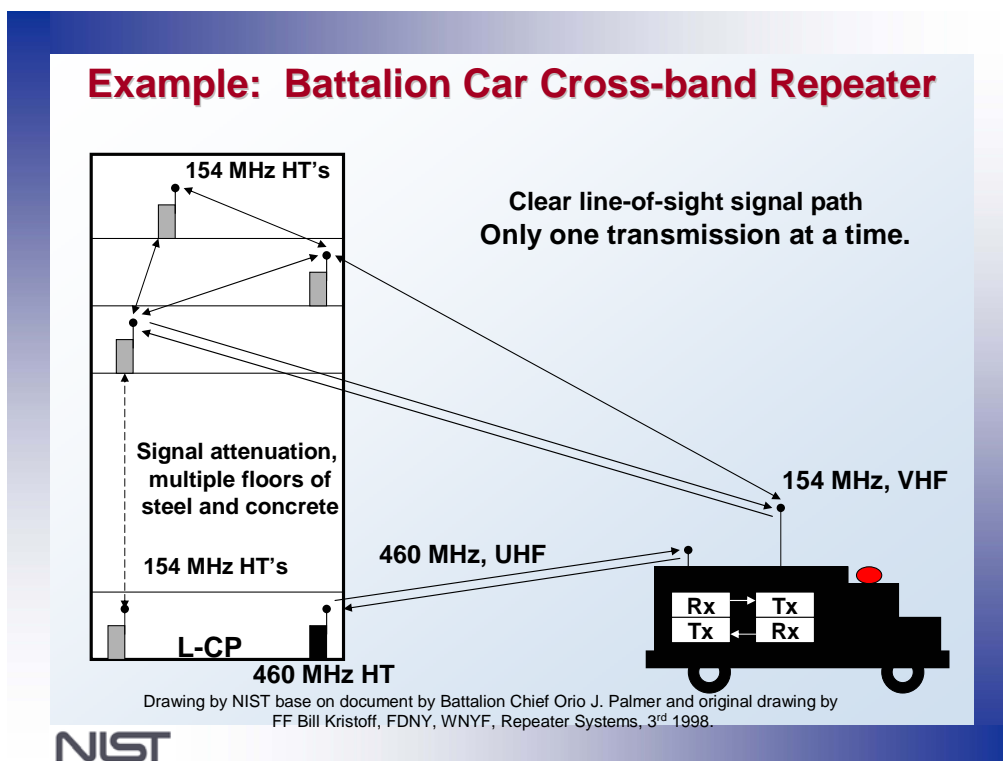


Figure 7–3. Example of a Battalion car cross-band repeater.

7.3.4 FDNY Battalion Car Cross-Band Repeater

The FDNY Battalion car cross-band repeaters operated on the VHF band input or receive frequency of 154.430 MHz and an UHF output or transmit frequency of 460.625. The car repeater system consisted of two units the receiver/transmitter and band/frequency conversion part and a UHF handie-talkie that could be removed from the vehicle and carried into the building's Lobby Command Post.¹³ The most important feature of the Battalion car cross-band repeater was not that it amplified the radio signals from the Lobby Command Post to the upper floors of a high-rise building, but that it could receive a one watt radio signal from the upper floors of a high-rise building and retransmit it to the Lobby Command Post that normally would not be able to receive the signal. This would allow for two-way communications.¹³ Battalion Chief Orio Palmer pointed out the following critical issue when comparing the operations of the two different repeater systems:

“The crucial difference between the battalion car repeater and a building/complex repeater is that the battalion car repeater- - even if not operating properly or if improperly positioned - -will not affect communications adversely. This is not the case when using channel 7 and a building/complex repeater system. If the building/complex repeater system malfunctions, all communications on channel 7 cease.”
(Palmer 1998)

The above provides necessary basic information for understanding the function of radio systems used by FDNY during the attack on September 11, 2001, and helps in understanding issues related to questions concerning the function of the WTC/FDNY high-rise radio repeater.

7.3.5 Function of FDNY Radio Repeater Systems

After the towers had collapsed and 2,749 people were killed (including approximately 421 emergency responders and building security personnel), the questions raised were as follows: (1) whether the WTC/FDNY repeater was actually working, (2) if the repeater had been working would radio communications have been better, and (3) would emergency communications made using the repeater have saved the lives of WTC occupants and FDNY personnel inside WTC 1?

Based on the information gathered throughout this investigation - both documentary and first-person interview data - and the repeater's radio operations recording recovered from the WTC 5 rubble, the following is an assessment of what occurred concerning operation of the WTC/FDNY repeater system:

Question (1) Was the WTC/FDNY repeater actually working?

- Prior to the WTC attack on the morning of September 11, 2001, and before the WTC/FDNY repeater was activated inside WTC 1, the Port Authority repeater recording system was recording radio communications made by the FDNY City Wide radio channel, 154.43 MHz. It also recorded radio transmissions coming from the Monmouth County, New Jersey Fire Department.¹⁶ This indicates that the repeater recorder was collecting communications from these other sources for the period after the repeater was activated inside WTC 1 by FDNY. This is supported by the repeater's recording. The fact that these other communications were being recorded by the WTC/FDNY repeater's recording system complicates the analysis of the repeater's operation. Another complicating factor is that the FDNY Battalion Car Cross-Band repeater also used the 154.43 MHz frequency as its receiving frequency.
- When the first FDNY personnel entered WTC 1, a Chief Officer, believed that there would be communications problems at the WTC towers and requested that the repeater system be turned on.¹⁷
- A FDNY member went to see that the repeater was turned on.
- Radio transmission analysis conducted by NIST and the Port Authority communications personnel showed that at approximately 8:53 a.m., a 1450 Hz audio tone was transmitted indicating that the F4 button on the repeater's phone console had been pressed to activate the repeater. (Note: The repeater's phone console was designed to transmit a series of audio tones that were received and transmitted by the repeater. These tones identified operational functions of the repeater and the console.)
- At approximately 8:55 a.m., 8:56 a.m., and 9:04 a.m., the repeater console phone's handset was operated and sent out a 2175 Hz audio tone.¹⁸
- At approximately 9:05 a.m., two FDNY Battalion Chiefs using the Fire Command Desk's Vega, Model C-514B Four-Frequency Tone-Remote Control Console and their FDNY handie-talkies checked the repeater's operation.¹⁹ See the photograph in Figure 7-4 that shows the speaker phone and handset assembly sitting on top of the Fire Command Desk console.
- The repeater check was carried out inside the lobby of WTC 1 with the two Battalion Chiefs standing only a short distance from each other.²⁰ As this radio check was started, the WTC/FDNY high-rise repeater recorded the 2175 Hz tone generated by pressing the hand set button followed by another 1450 Hz audio tone indicating that the F4 button that activates the repeater had been pressed again. Following these tones, one Battalion Chief attempted to call

¹⁶ Other Interview 2, winter 2004.

¹⁷ FDNY Interview 7, winter 2004.

¹⁸ FDNY Channel 7 / PA, WTC Channel 30 radio communications recording.

¹⁹ FDNY Channel 7 / PA, WTC Channel 30 radio communications recording.

²⁰ FDNY Interview 7, winter 2004.

the other Battalion Chief who was listening on his handie-talkie. During this exchange of radio calls (that were recorded by the repeater's recording device), another Chief Officer who identified himself as being in a WTC lobby said that he could hear the radio transmissions. This was followed by the second Battalion Chief attempting to call the first Battalion Chief. This exchange was repeated approximately three additional times.



Figure 7–4. Video image of the WTC 1 Fire Command Desk and the FDNY repeater speaker phone, at left, sitting on top of the console.

- After multiple attempts to establish communications using the WTC/FDNY high-rise repeater console's handset, the first Battalion Chief called to the second Battalion Chief using his handie-talkie and indicated that he didn't think the repeater was working:

"I don't think we have the repeater. I picked you up on my radio but not on the hard wire."²¹

This indicates that the listening part of the repeater hand set may not have been functioning or was not adjusted to provide adequate volume to hear the communication. However, if each of the Battalion Chiefs had their handie-talkie radios set to channel 7 and the first Battalion Chief heard the transmissions over his handie-talkie, this indicates that the repeater was working. During this exchange of radio communications, the two Chiefs established that FDNY Channel 2 would be the command channel for operations inside WTC 1 and that the Battalion Car Cross-Band repeater would be taken to WTC 2. Channel 2 on the FDNY handie-talkies was the city-wide base channel that was being recorded by the repeater's recorder prior to the attack, and it also was the repeater's receive or input frequency.

²¹ FDNY Channel 7 / PA, WTC Channel 30 radio communications recording.

- This plan to take the Battalion Car Cross-Band repeater to WTC 2 left the Lobby Command Post inside WTC 1 with no repeater to use for communicating with personnel on the upper floors of the building. The only evidence that the Battalion Car Cross-Band repeater may have been used came from a radio message at 08:56 a.m. made by the second Battalion Chief over the 154.25 MHz channel to the Manhattan dispatcher that stated the following:

“I am going to stay on the Cross-Band repeater of the Battalion Car as a back-up to the building repeater.”²²

- Based on interviews with FDNY personnel, WTC 1 established its communications in the following fashion: FDNY Channel 1 became the tactical channel and Channel 6 became the command channel in WTC 1.²³ FDNY Channel 2 became the tactical channel and Channel 4 or 5 was the command channel for WTC 2.^{24, 25} FDNY Channel 7 was not used again inside WTC 1 but appears to have been used inside WTC 2. In addition, FDNY Channel 3 or 6 was used for the tactical channel inside the Marriott.²⁶
- The second Battalion Chief was dispatched to operate inside of WTC 2 and he left to assist with operations in that building.
- At approximately 9:17 a.m., radio communications were established inside WTC 2 by the second Battalion Chief and his aide using the WTC/FDNY high-rise repeater input frequency and the FDNY Channel 2 frequency 154.43 MHz.²⁷ The clear exchange of radio communications from the Battalion Chief located on the 40th floor to his aide located somewhere below shows that the repeater was working or exceptional point-to-point communications inside WTC 2 were occurring. The repeater communications recording system recorded a complete communications exchange between the two FDNY personnel. No 2175 Hz tones were recorded indicating that the officer and the aide were both using their handie-talkies for communications. This communication was followed by many additional radio communications that were recorded by the repeater’s recording system between personnel on the upper floors of WTC 2, other locations in the building, and the lobby of WTC 2. These communications continued until seconds before the collapse of WTC 2 when the repeater system went silent.

The following is a statement extracted from emergency responder first-person interviews concerning WTC/FDNY high-rise repeater operations: (Note: The firefighter was operating inside WTC 1.)

- Usually when you get the repeater it’s supposed to be on channel 7, but we were never told. They said that the repeater system was not working,

²² FDNY Channel 7 / PA, WTC Channel 30 radio communications recording.

²³ FDNY Interview 20, winter 2004.

²⁴ FDNY Interview 20, winter 2004.

²⁵ FDNY Interview 62, winter 2004.

²⁶ FDNY Interview 31, winter 2004.

²⁷ FDNY Channel 7 / PA, WTC Channel 30 radio communications recording.

but I was not sure. I got clear messages from handie-talkies, and I'm assuming the repeater was on.²⁸

NIST studied three suggested theories as to why the repeater system did not seem to function correctly that morning:

- The antenna system was damaged when the aircraft struck the towers, and communications were not possible inside of WTC 1.
- The repeater console handset was broken
- The volume on the repeater console handset was turned down.

From the above data, it can be stated that the repeater was operating inside of WTC 1 when the repeater check was underway. The first Battalion Chief transmitted radio communications using the console handset, which was recorded, and that another Chief Officer called to the two Battalion Chiefs and stated that he could hear the radio transmissions. The first Battalion Chief could not hear communications over the repeater console handset that he was using inside WTC 1.²⁹

Since (1) the radio communications were being heard by others, (2) the repeater system was recording the exchange of calls between the two Battalion Chiefs, and (3) the operating tones were being transmitted and recorded by the repeater recording system, there is strong evidence that the repeater was working and that the communications difficulties were associated with the repeater console handset. However, with the information available, there is no way to conclusively determine the exact performance of the WTC/FDNY building radio repeater system that was used on the morning of September 11, 2001. Also, it is not possible to determine whether the handset was broken or if the volume was turned down since the repeater's handset was destroyed by the building collapse. It is likely that the handset either had a malfunction and/or the handset listening volume was not turned up high enough to allow the user to hear the returning radio transmissions.

Related to the possibility of radio antenna damage causing a problem, one should note that radio communications using the WTC/FDNY repeater system were carried out on the inside of WTC 1 and inside of WTC 2. These radio communications were recorded by the repeater's recording system from each location. Therefore, it is likely that the antenna and repeater system was functional and not disabled as a result of damage from debris produced by the impact of aircraft.

Question (2) If the repeater had been working would radio communications have been better?

The recording of radio communications by the WTC/FDNY repeater system suggests that communications for operations inside of WTC 2 were assisted by the repeater. Also, the radio recordings show that communications readability using the repeater was generally good with readability often reaching levels of 3 to 5. (See section 7.4 concerning the assessment of radio communications quality.) Where readability levels were lower, it was generally caused by doubling or multiple people attempting to

²⁸ FDNY Interview 17, winter 2004.

²⁹ FDNY Interview 7, winter 2004.

communicate over the repeater at one time. If FDNY personnel in both of the towers attempted to use the WTC/FDNY repeater for operations, there likely would have been additional radio traffic resulting in more unreadable communications. (Note: The term “unreadable” is used in this document to identify radio or other forms of telecommunications that could not be understood by persons receiving the message.) However, it would have been likely that the Lobby Command Post located in WTC 1 might have had somewhat improved communications with personnel operating up inside the building until the time when WTC 2 collapsed. The radio repeater recording suggests that the WTC/FDNY high-rise repeater failed during the collapse of WTC 2. Additionally, if personnel inside both towers had been attempting the use the same repeater at the same time, firefighters might have become confused as to which communication related to operations inside which tower. During the first-person interviews, several firefighters indicated that at times they were unsure as to which tower they were really working in. This difficulty with identifying which tower was which is also demonstrated by a series of radio transmissions recorded by the WTC/FDNY high-rise repeater where a Chief Officer and his Aide attempted to communicate which tower they were in to the WTC 2 Lobby Command Post.

Question (3) Would emergency communications made using the repeater have saved the lives of WTC occupants and FDNY personnel inside WTC 1?

With the collapse of WTC 2 and failure of the WTC/FDNY repeater system, the Lobby Command Post inside WTC 1 would have lost its primary means of communicating with personnel operating inside of WTC 1. This loss of the WTC/FDNY radio repeater would have produced communications capabilities equivalent to the actual radio communications situation at the Lobby Command Post inside WTC 1 on the morning of September 11 since it was not operating through any repeater system. Therefore, since the WTC/FDNY repeater appeared to fail with the collapse of WTC 2, it would have had no effect on saving lives of occupants or FDNY personnel located inside WTC 1. Additionally, if the repeater system had been in use inside WTC 1 when WTC 2 collapsed, it would have taken time to establish that the repeater system had failed, and FDNY personnel inside WTC 1 would have had to change radio channels to continue radio communications. This need to change radio channels may have complicated the transmission and reception of emergency evacuation orders given over the radio for personnel inside WTC 1.

Evidence supporting these findings concerning the FDNY radio repeater systems at the WTC also suggests radio communications options that may have advanced the ability of FDNY to communicate. This raises the question: What basic radio system would have assisted FDNY personnel inside each tower to successfully communicate during operations at the WTC?

The magnitude of events on September 11, 2001, was greater than anything experienced previously by emergency responders in New York City. Emergency response operations were focused on multiple and parallel tasks, WTC 1 and WTC 2. This suggests that FDNY needed a capability for handling a large amount of communications traffic, requiring a minimum of two separated radio repeater systems functioning on a minimum of two different pairs of radio frequencies. The separate repeaters would double the capability of FDNY to communicate with personnel inside the buildings, and the different pairs of radio frequencies would prevent radio interference between the two repeater systems. One of these repeater systems would have been operated at WTC 1, and the second would have operated at WTC 2. In addition, the Incident Command Post would need to be able to monitor radio traffic on each of these repeater systems and be able to transmit emergency messages to all personnel by overriding fire

ground radio traffic. The radio used for overriding radio communications on the fireground would have a higher output power than the handie-talkies and the repeaters in use at the site. This radio that would have been located outside the WTC buildings could have been used to transmit emergency messages and evacuation orders to firefighters inside the buildings. The options discussed here provide one basic approach to improving communications for multiple operations during a large emergency response operation.

7.3.6 Communications, Command and Control

Communications in a high-rise building emergency is a critical part of command and control and is a key element of the Incident Command System.

The following statement was extracted from an emergency responder first-person interview and relates to the issue of communications and command and control:

- Control is always a big issue with operations, but if we have communications, we will be able to control any operation.³⁰

High-rise buildings are known to create problems with radio communications. The vast amount of metal and reinforced concrete in high-rise buildings is known to attenuate and block radio signals. This is often a problem with low output power emergency responder handie-talkies. Various documents including information from the 1993 WTC bombing highlighted the problems that FDNY experienced with radio communications in high-rise buildings. (Fusco 1993) (Palmer 1998) On September 11, 2001, FDNY again experienced poor handie-talkie radio communications within the towers. This had a major impact on FDNY operations particularly inside of WTC 1 where no one used the WTC radio repeater system. At WTC 2, the FDNY/WTC radio repeater system was successfully being used for operations.

Emergency responders reported that they had difficulties with the communications systems from the time they arrived at the WTC, and the difficulties became progressively worse.³¹ There were problems communicating with firefighters as they climbed higher in WTC 1. There were no communications with the elevators, and attempts to use the wire line phones to call upstairs were unsuccessful.³² Radios worked when communicating with other emergency responders in close proximity, only a few floors apart. As FDNY personnel attempted to communicate with others located more than about five floors from them, they would have to move around inside the building to find locations where radio signals could get through.³³ They needed areas with line-of-sight without reinforced concrete and steel between them. At times, they tried to set up line-of-sight communications relays.³⁴ Some of the locations where radio communications appeared to work were inside stairways and next to windows.³⁵

³⁰ FDNY Interview 14, winter 2004.

³¹ FDNY Interview 43, winter 2004.

³² FDNY Interview 2, fall 2003.

³³ FDNY Interview 7, winter 2004.

³⁴ FDNY Interview 30, winter 2004.

³⁵ FDNY Interview 33, winter 2004.

The following statements were extracted from emergency responder first-person interviews and relate to radio communications inside the WTC towers:

- The interviewee stated that he never had good radio nor telephone or any other form of communication in the building to the floors above the lobby of WTC 1. At best, radio communications were poor. Throughout the time of operations in the building, handie-talkie radio communications was a negative factor. If communications were better, more firefighters would have been saved... People went between Command Posts with messages to determine conditions and deliver orders. The best form of communications was face-to-face between the Command Post and the other building, WTC 2.³⁶
- The interviewee had trouble inside WTC 1 with handie-talkie radio communications. He could not talk with this commanding officer or anyone at the command post. His radio did work with people working near him since they used a different tactical channel and established radio calls or IDs unique to their operations.³⁷
- Inside WTC 1, I heard a muffled message on my radio that there was a mayday, get out of the building, the south tower has come down. The guys standing around me, said, what was that? I said, I think they were saying, get out of the building and the other guys said they didn't get it on their radios, and I said that I got it. There were Brooklyn units stationed on the floors below and were waiting orders to proceed and they never heard the radio transmission to exit the building as far as one of the officers told me.³⁸
- There was no effective form of communication that day. First of all, when you work for a FDNY company near by and you go into the WTC buildings for a sprinkler discharge, as soon as you walk into the lobby, the first companies get one of their Port Authority radios. So right away you know when you walk in there your radio is no good. Right there in the lobby, they have seven of their radios. They are attached to the building repeater. So those radios were compatible with the Port Authority's building repeater, and our FDNY WTC site repeater wasn't compatible with the Port Authority radios. You know if you have a fire in the building, you can't communicate with the FDNY radios. With the FDNY radios, you can communicate from floor to floor, but not lobby to wherever the fire is. It's out of our range. Say you have a small fire in WTC 1 on an upper floor that would be a 2nd alarm and you have 60 people with 7 radios. What good is that?³⁹

³⁶ FDNY Interview 2, fall 2003.

³⁷ FDNY Interview 3, winter 2004.

³⁸ FDNY Interview 9, winter 2004.

³⁹ FDNY Interview 29, winter 2004.

Radio Traffic

In addition to the poor operating characteristics of the handie-talkie radios inside of high-rise buildings, emergency responders also were struggling with the high volume of radio traffic. This was due in part to the design of the FDNY radio system. Figure 7–5 below shows an example how radio communications may be structured by the Fire Department during a two-alarm firefighting operation. When evaluating this figure, it should be remembered that there were many more people attempting to use the radio system than shown in the example. There were firefighters at the WTC complex representing three five-alarms and one two-alarm. All of these firefighters were attempting to communicate over the FDNY radio system before WTC 2 collapsed. An example of staffing for a single five-alarm fire would be approximately four battalions dispatched to yield a total of 20 Engine companies and 8 Ladder companies at the scene. Each tower was assigned one tactical radio channel and one command radio channel. At minimum, there were about 40 FDNY companies trying to communicate over each of the tactical radio channels during the WTC operations, and only one person could talk at a time.

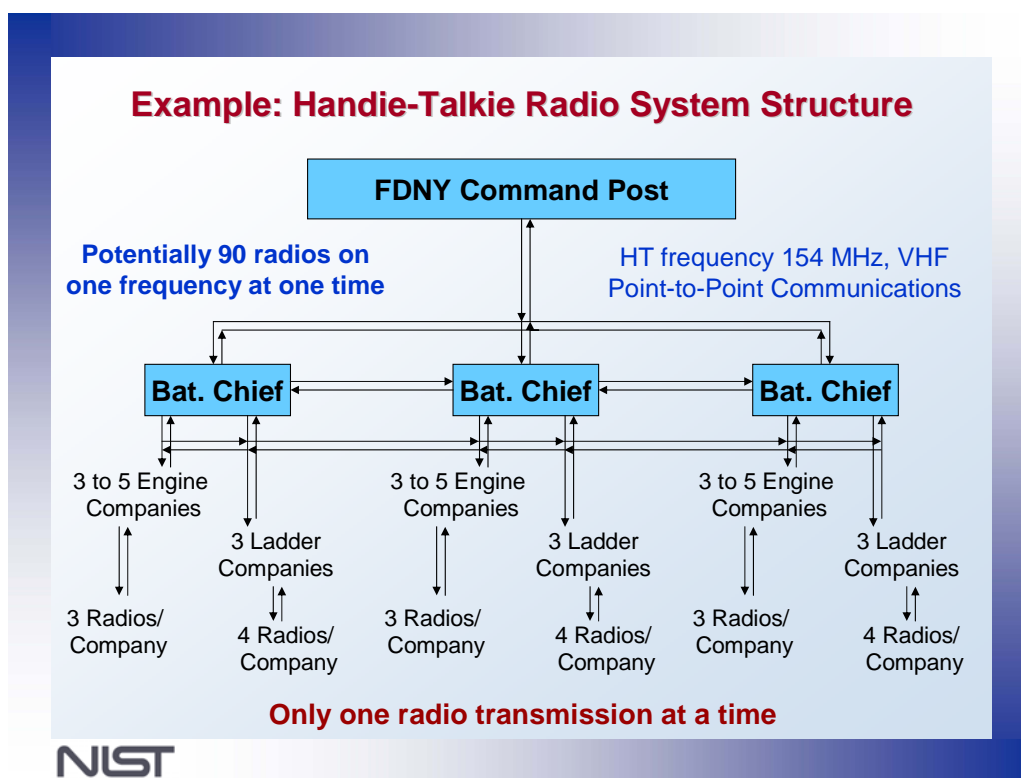


Figure 7–5. Example of handie-talkie radio communications for a two-alarm fire.

Emergency responders reported that they experienced extreme radio traffic on September 11, 2001. Too many people were trying to communicate at once, and the handie-talkie channels were overwhelmed.⁴⁰ People were stepping on other people's radio transmissions, and feedback was a problem, making those transmissions that did get through incomplete.^{41, 42}

⁴⁰ FDNY Interview 19, winter 2004

⁴¹ FDNY Interview 38, winter 2004

The following statements were extracted from emergency responder first-person interviews concerning the level of radio traffic they experienced during their WTC operations: (Also see section 7.5 that follows and provides quantitative data on radio traffic.)

- I never saw him again. I couldn't get him on the radio. There were too many people trying to talk at once. Radio communications were almost non-existent.⁴³
- Radio communications that day were terrible; you couldn't get a word in. There were so many people talking on the radio and everything was jammed up. Radio reception was really bad, also.⁴⁴
- Radio traffic was unbearable at that point. I was trying to call headquarters to ask for portable handie-talkies and flashlights and some uniformed firefighters to set up a much larger Command Post somewhere outside in the immediate area. I had a lot of trouble trying to call headquarters.⁴⁵
- On the radio I heard, "Evacuate the building." Then everyone around me was like, did you hear that, "evacuate the building?" Then you couldn't get on the radio because everyone was calling everyone. It was like radio gridlock.⁴⁶

Radio Communications and Incident Command and Control

The poor radio communications at the WTC had a serious impact on the Lobby Command Post's attempts to maintain command and control. The following statement extracted from an emergency responder first-person interview addresses this issue:

- The radio communications from up inside the building were sporadic and ineffective. Any direction the Lobby Command Post gave over the radio was sporadic and a lot of the information transmitted was not acknowledged. So they didn't know whether the messages got through, and it was frustrating.⁴⁷

The Lobby Command Post inside WTC1 repeatedly tried to call the different Battalion Chiefs that were up in the building. Neither the interviewee nor the other two FDNY Chief Officers at the Lobby Command Post ever got an acknowledgement for the calls.⁴⁸ During the call to evacuate WTC 1, some units did respond over the radio to the call to evacuate.⁴⁹ The photograph Figure 7-6 shows an

⁴² FDNY Interview 58, winter 2004

⁴³ FDNY Interview 29, winter 2004

⁴⁴ FDNY Interview 30, winter 2004

⁴⁵ FDNY Interview 60, winter 2004

⁴⁶ FDNY Interview 39, winter 2004

⁴⁷ FDNY Interview 20, winter 2004

⁴⁸ FDNY Interview 20, winter 2004

⁴⁹ FDNY Interview 7, winter 2004

FDNY/EMS member attempting to communicate from the lobby of WTC 1 by holding his radio high in the air.



Figure 7–6. Video image of a FDNY/EMS member attempting to communicate using his handie-talkie radio inside the lobby of WTC 1.

In Figure 7–6, note that the FDNY/EMS member is holding the radio’s microphone that is attached to an extension wire in his right hand at mouth level as he attempts the communication.

7.4 ASSESSMENT OF RADIO COMMUNICATIONS QUALITY

The Readability, Signal Strength, and Tone system for rating the quality of radio communications is used widely throughout the field of radio communications and is described in *The ARRL Handbook for Radio Communications* (ARRL 2003). This system is broken into three distinctive groups that can be rated: Readability, Signal Strength, and Tone. The rating for “Tone” is only used to identify the quality of radio communications for “Continuous Wave” transmissions, and it does not apply to this analysis as “Tone” does not relate to voice communications. For voice radio communications, only “Readability” and “Signal Strength” are used. “Signal Strength” is usually read from a signal strength meter at the time of the actual radio communication and is not available on the audio recordings.

Thus, in this study, “Readability” was used for rating the primary emergency responder radio communications channel recordings. It is recognized that this form of analysis is subjective, and it relates to the ability of an individual to hear and understand the radio communications. In an attempt to minimize the influence of the subjective rating system, individuals with extensive experience using radio communications and project staff trained by the experienced personnel were used to conduct the analysis. In addition, communication periods from the various recorded data sets were reviewed by more than one person where radio communications readability was difficult.

The rating table for communications readability is listed below (ARRL 2003):

Readability (the term “readable” means “understandable”):

- 1 – Unreadable (A term meaning the communication is not understood.)
- 2 – Barely readable, occasional words distinguishable
- 3 – Readable with considerable difficulty
- 4 – Readable with practically no difficulty
- 5 – Perfectly readable

7.4.1 Training of Transcribers

Four NIST personnel were used to transcribe the emergency responder communications files. This included the project leader and three other staff personnel. The transcription protocol listed above was planned and tested by the two senior NIST personnel, including the project leader. When the protocol was found to be acceptable, the two other NIST personnel were trained by the senior members of the group. After the basic transcription training was completed, each of the new transcribers was given a communications file to transcribe. This communications file had previously been transcribed by the two senior personnel. After the file was transcribed by the new transcriber, their results were compared to that transcribed by the senior personnel. When it was demonstrated that the new transcriber had a full understanding of the transcription process, they were then assigned communications files to transcribe.

7.4.2 Radio Communications Concepts

Currently, the only way for most emergency responder radio systems to produce a totally clear communication (one can be received and understood) is for one communications signal to be transmitted at a time on a given radio frequency. This means only one person can transmit a radio message at a time to avoid communications interference on that radio frequency. If two or more radio transmissions are made on the same radio frequency at the same time using these systems, signal mixing may occur and the communications may not be understandable. This difficulty with radio communications often is referred to as doubling. Under these conditions, usually the radio with the highest transmitting power will override transmissions from the lower-power radios and only the highest-power radio signal will be heard. This is often the case where an emergency response radio system uses a higher-power base station for dispatch communications or where a repeater is used to amplify a radio system’s signal output. Where multiple radio communications are received by a radio repeater, signal mixing is likely to occur and the communications will not be understandable (ARRL 2003).

Over the last several years, radio communications technology has undergone some significant advancement, particularly with cellular phones. These new systems can increase the effective use of the radio frequency/time factors related to radio communications (ARRL 2003)], and are now beginning to be applied to emergency responder communications equipment.

7.4.3 Communications Data Analysis

This analysis of communications addresses four major areas: (1) radio traffic volume, (2) transmission time periods, (3) readability of communications, and (4) the development of a chronology of radio communications from the emergency responders conducting operations related to the WTC attack.

The first two factors, radio traffic volume and communications duty cycle, are directly related. Each has an impact on readability as well as the ability to understand and deal with the information being communicated. Generally, as radio traffic rate increases, the operations duty cycle approaches overloaded conditions. With very high traffic volumes, it becomes more difficult for personnel at central communications facilities and personnel in the field to respond to the volume of traffic. Human operators of communications equipment become overloaded with work. Not only do the operators have to verbally communicate with personnel over the radio, but they must often transfer the information gained to other locations. The transfer of information also may be done verbally using other communications systems, by hand through keyboard inputs, or simply face to face. Analysis of the radio traffic for each of the departments shows periods where radio traffic rates during the surge conditions potentially resulted in situations where base station radio operators were unable to relay important information.

7.4.4 Emergency Response Communications Chronology

This chronology provides information on communications difficulties experienced by NYPD, PAPD, PA Security, PA Operations, and PA Vertical Transportation units following the attack on the WTC. Much has been published concerning the communications difficulties experienced by FDNY at the WTC, and first-person interviews with FDNY personnel confirm some of these difficulties. However, this chronology shows that FDNY was not the only emergency responder department that experienced radio equipment and communications difficulties. There are reports of radios not working well and communications showing that some personnel were not being heard or responded to. Also, some of the radio transmissions demonstrate the failure to communicate as a result of radio traffic surge conditions.

The chronology provides examples of numerous cases where radio transmissions were not understood because of “crossing or doubling” of radio signals when too many people are trying to talk at one time.

- 8:45 a.m. PAPD police desk: requests a radio check to locate an open microphone on a handie-talkie radio. [Note: This occurred just before the aircraft struck WTC 1.] (PAPD Radio Channel W)
- 8:49 a.m. WTC Security requests, as a result of the surge in radio traffic volume, that police officers stay off the air. (PA/WTC Security Radio Channel X)

 PAPD police desk Channel W: extended period with an open microphone, lots of background noise and people talking. (PAPD Radio Channel W)
- 8:50 a.m. PAPD police desk receives a message that the officer did not copy the previous transmission and asks what is going on. (PAPD Radio Channel W)

- 8:51 a.m. NYPD Special Operations Division: a dispatcher advises a police lieutenant that his message was crossed and to repeat it. A message came through that he can't get a hold of someone on the cell phone. (NYPD SOD Radio Channel)
- 8:53 a.m. NYPD Special Operations Division: a dispatcher advises a police department truck that their radio message is cutting off and all that the dispatcher got was something about the upper floors. (NYPD SOD Radio Channel)
- 8:54 a.m. WTC Security is reporting that it is having trouble reading incoming radio transmissions. (PA/WTC Security Radio Channel X)
- WTC Security receives a message that an officer is having trouble reading radio messages because of so much commotion on the floor. (PA/WTC Security Radio Channel X)
- 8:55 a.m. A Battalion Chief says, I am going to stay on the Cross-Band repeater of the Battalion Car as a back-up to the building repeater. (FDNY channel 7 / PA/WTC Channel 30)
- 8:59 a.m. NYPD Special Operations Division: a dispatcher advises a police truck that their radio message is breaking up, and the dispatcher asks what units he wants to respond. (NYPD SOD Radio Channel)
- 9:00 a.m. NYPD Special Operations Division: dispatcher advises that various units are crossing each other and that the dispatcher cannot understand them. (NYPD SOD Radio Channel)
- 9:01 a.m. WTC Operations: a microphone is stuck open, interfering with communications. (PA/WTC Operations Radio Channel Y)
- 9:02 a.m. NYPD Special Operations Division: a police officer asks the dispatcher if the last transmission was heard. The police office asks twice. There is no answer. (NYPD SOD Radio Channel)
- 9:03 a.m. WTC Operations receives a report that someone has found a supervisor's radio that has been lost. (PA/WTC Operations Radio Channel Y)
- NYPD Special Operations Division: an officer in an NYPD car requests that units give their messages slowly. (NYPD SOD Radio Channel)
- 9:05 a.m. FDNY chief officers conduct tests of the City-wide, high-rise repeater located at the WTC. (PA/WTC Channel 30 radio recording)
- 9:07 a.m. NYPD Special Operations Division: a police officer requests that the air be cleared for emergency vehicles and personnel unimpeded. (NYPD SOD Radio Channel)
- 9:08 a.m. NYPD Special Operations Division: a dispatcher advises officers directing traffic that they are coming over the air. Approximately 30 seconds later the dispatcher advises a second time that the officers directing traffic are coming over the air and requests that they stop. (NYPD SOD Radio Channel)

- 9:09 a.m. NYPD Special Operations Division: a Special Operations Division officer requests that the dispatcher designate two channels for this emergency, one for units on the scene and one for units that are responding. (NYPD SOD Radio Channel)
- 9:11 a.m. NYPD: a backup transmitter for City-wide communications is put into service in anticipation of potential problems with the primary transmitter. (NYPD McKinsey & Company, 2002)
- 9:12 a.m. NYPD City-wide: a dispatcher advises that “We need to keep this frequency clear unless it is in regards to the level four mobilization.” (NYPD City-wide Radio Channel)
- NYPD Special Operations Division: dispatcher states “Only emergency transmissions are to be made on this frequency.” (NYPD SOD Radio Channel)
- FDNY Chief begins using the FDNY channel 7 repeater while working inside WTC2. (PA/WTC Channel 30 radio recording)
- WTC Security receives a radio report from the Fire Command Desk in the lobby of WTC 2 that they cannot pick up the Warden phones and that they are making announcements telling people not to stay at the Warden phones. Note: This communication indicates that the Warden phones in WTC 2 were not working. (PA/WTC Security Radio Channel X)
- 9:15 a.m. PAPD police desk: a radio microphone is stuck open. (PAPD Radio Channel W)
- 9:19 a.m. NYPD Special Operations Division: a dispatcher advises a police officer that his message was being cut off and that only part of the message was copied. (NYPD SOD Radio Channel)
- 9:20 a.m. NYPD Special Operations Division: a dispatcher advises that there is an open carrier and the units should check their radios. (NYPD SOD Radio Channel)
- 9:22 a.m. NYPD Special Operations Division: a dispatcher advises a police truck that his radio message was unreadable. (NYPD SOD Radio Channel)
- NYPD Special Operations Division: the dispatcher advises a second time that there is an open carrier and that messages are not being understood. (NYPD SOD Radio Channel)
- 9:23 a.m. NYPD Special Operations Division: the dispatcher advises that the two frequencies are the Manhattan IO (Interoperability Channel) and the City-wide. The dispatcher also advises that the various units are crossing. (NYPD SOD Radio Channel)
- 9:25 a.m. PAPD police desk: a radio microphone is stuck open and interfering with communications. Radio signals are garbled and broken, and there is a high level of background noise. (PAPD Radio Channel W)
- 9:30 a.m. WTC Security Radio Channel X has a communication indicating that everybody should turn their phone off.

- 9:31 a.m. WTC Security: a Port Authority officer is questioned as to whether they have brought any red bags with radios for the fire department. The answer is no, and is it safe to go into the building. (PA/WTC Security Radio Channel X)
- 9:32 a.m. NYPD City-wide channel: a unit advises that he cannot communicate, his radio is going in and out and the cell phone is not working. (NYPD City-wide Radio Channel)
- 9:36 a.m. NYPD Special Operations Division: a police officer reports that the telephones at his location are not working. Note: Location not identified. (NYPD SOD Radio Channel)
- 9:43 a.m. NYPD Special Operations Division: a police officer advises that he heard over an AM radio that a plane had crashed into the Pentagon. (NYPD SOD Radio Channel)
- 9:49 a.m. PAPD police desk instructs officer that he was speaking too fast and that he must slow down so that he could be understood. (PAPD Radio Channel W)
- 9:53 a.m. NYPD Special Operations Division: the dispatcher advises all units to check their portable radios for an open carrier. (NYPD SOD Radio Channel)
- 9:54 a.m. NYPD City-wide channel: a dispatcher requests “Keep the air clear. We have problems in the City. Keep the air clear right now.” NYPD City-wide Radio Channel)
- 9:55 a.m. WTC Vertical Transportation: personnel are having trouble reading communications over the radio and indicate that they will try to call on the telephone. PA/WTC Vertical Transportation Radio Channel Z)
- 9:57 a.m. WTC Security: a report is received that an officer is responding to WTC 1 Fire Command and that he had been trying to contact the Command Center on floor 22, but they didn’t know how to operate the other set of communications equipment. (PA/WTC Security Radio Channel X)
- 9:59 a.m. WTC 2 collapsed. (FEMA 403)
- 9:59 a.m. NYPD Special Operations Division: an Emergency Service Unit police officer calls several times for the dispatcher. The dispatcher answers each time and apparently was not heard by the calling unit. (NYPD SOD Radio Channel)
- 10:03 a.m. NYPD Special Operations Division: a dispatcher requests that some units standby while the needs of other units are addressed. (NYPD SOD Radio Channel)
- 10:05 a.m. NYPD Special Operations Division: the dispatcher advises that all units need to talk one by one. The dispatcher further advises that units are cutting each other off. (NYPD SOD Radio Channel)
- 10:09 a.m. NYPD Special Operations Division: an Emergency Service Unit advises the dispatcher that he can hear the dispatcher but is not sure if the dispatcher is hearing him. (NYPD SOD Radio Channel)

10:10 a.m. NYPD Special Operations Division: the dispatcher advises that there are three units trying to talk at the same time and requests, “One at a time.” (NYPD SOD Radio Channel)

7.4.5 PAPD Radio Communications

All radio communications evaluated for this report experienced traffic volume surge conditions as a result of the WTC attack. The traffic volume surge greatly exceeded the traffic volume experienced under normal operating conditions.

PAPD Channel 26/W was used to demonstrate typical radio communications and operational conditions that occurred with the PAPD minutes before the terrorist attack, during the attack, and during operations that followed the WTC attack. This radio channel is used by PAPD police officers, NYPD supervisors and FDNY Engine 10 and Ladder 10 for communications at the WTC site. Table 7–2 and Table 7–3 compare the number of transmissions and their length of time before and after the first aircraft impacted WTC 1. The percent of radio transmissions versus time is in Figure 7–7. This figure and others give the rate of radio transmissions over a 40 minute period, 20 minutes prior to the first airplane impact and 20 minutes after the impact. This percent of radio transmission, as well as others discussed in this report, was calculated as the sum of transmission time and no transmission time over the total period of time. These data show that there was an approximately 13 percent rate of radio transmissions on the PAPD police desk channel for the 20 minutes prior to the aircraft impact. After the first aircraft impact on WTC 1, the radio communications were occurring 80 percent of the time. This surge in communications significantly impacted the functional capability of the radio system. After approximately 10 minutes, communications dropped to a steady operating level of approximately 48 percent capacity.

7.4.6 FDNY Radio Communications

The communications for the FDNY City-wide high-rise building radio Channel 7 was recorded by PAPD on their Channel 30. The Port Authority installed this high-rise repeater at the WTC for FDNY following the 1993 bombing. This FDNY channel was used primarily by FDNY personnel during operations in WTC 2. Personnel using this channel were FDNY chief officers, company officers, aides, and firefighters.

While looking at these data, it is important to keep in mind that several FDNY personnel at the WTC did not think that the WTC complex high-rise channel radio repeater was working. This is based on radio communications tests that were conducted by two Chief Officers working inside WTC 1 when the first Command Post was being set up in that lobby. A record of this radio communications test was recorded on the PA/WTC Radio Channel 30 tape. Following this radio test, a Chief Officer involved in the test chose to use different channels for command and tactical communications. However, as FDNY operations increased in WTC 2, it was determined by members of the FDNY that the high-rise channel was functioning and use of the channel developed.

Traffic load for this FDNY channel is summarized in Table 7–2 and Table 7–3. The percent of radio transmissions versus time is shown in Figure 7–8. The radio communications on the repeater channel prior to the first airplane impact could have been operations at other high rises in the city or radio transmissions from the Monmouth County, New Jersey Fire Department that shared the radio frequency.

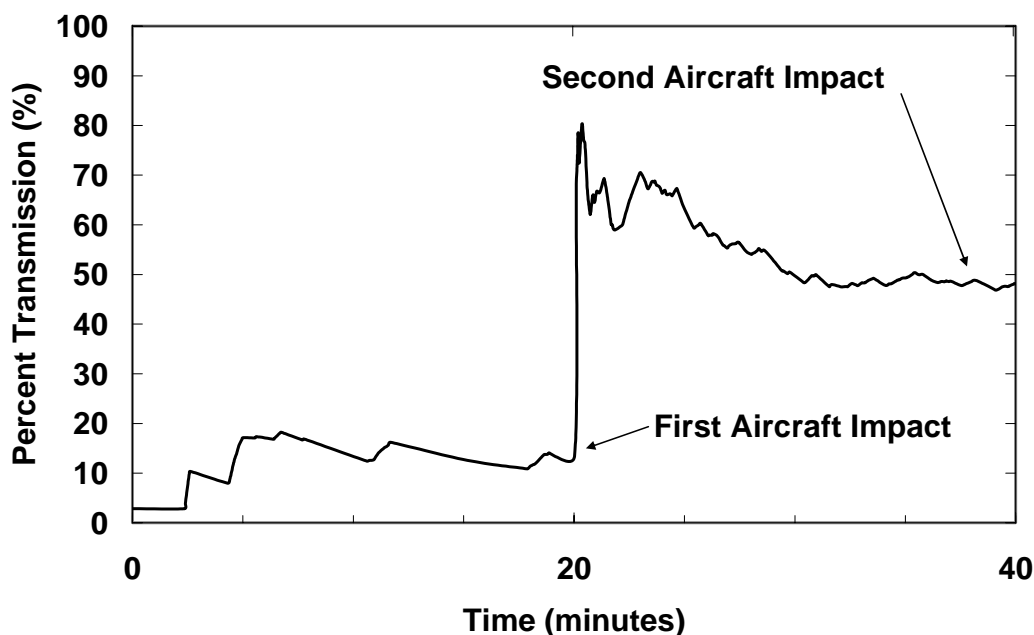
Table 7–2. Comparison of radio transmissions before and after the first aircraft impact.

Department	Number of transmissions before first aircraft impact (20 min period)	Number of transmissions after first aircraft impact (20 min period)
PAPD, Ch. 26/W	42	176
FDNY, Ch. 7 high-rise	39	134
FDNY, Manhattan Dispatch	25	258
NYPD Division 1	171	225
NYPD Special Operations Division	72	192

Table 7–3. Comparison of average and maximum radio transmission times before and after first aircraft impact.

Department	Average time per transmission before first aircraft impact (s)	Average time per transmission after first aircraft impact (s)
PAPD, Ch. 26/W	3.8 (maximum 21.8)	3.3 (maximum 19.7)
FDNY, Ch. 7 high-rise	3.8 (maximum 50.9)	3.1 (maximum 19.5)
FDNY Manhattan Dispatch	4.9 (maximum 21.7)	3.1 (maximum 22.6)
NYPD Division 1	5.3 (maximum 19.0)	3.4 (maximum 12.6)
NYPD Special Operations Division	2.8 (maximum 22.3)	5.7 (maximum 31.5)

Note: All minimum transmission times were typically less than 1 s and were often related to the keying of a microphone.

**Figure 7–7. PAPD Police Desk channel 26/W plot of percent transmission versus time.**

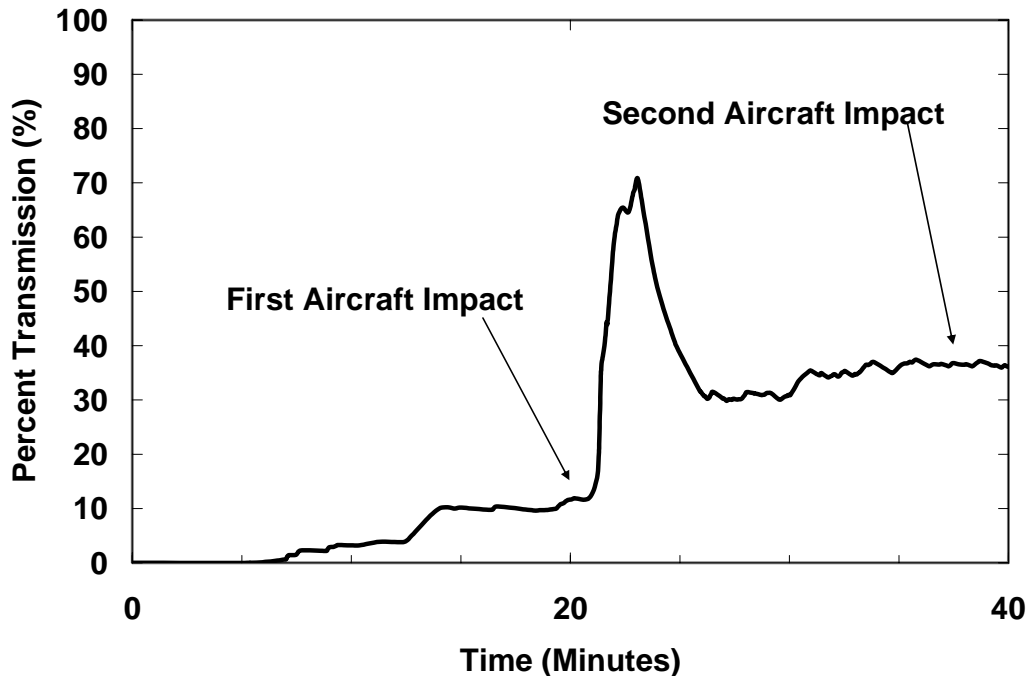


Figure 7-8. FDNY City-Wide High-Rise channel 7 (PA/WTC Radio Channel 30) plot of percent transmission versus time.

The following is from a first-person interview that dealt with fire department communications:

- High-Rise firefighting operations are transmitted on 154.430 MHz. This is the frequency that is used by the high-rise repeaters and one of the frequencies used by the Battalion Chiefs Car Repeater. This high-rise frequency is not used very often because it will interfere with other local area fire departments that are also using the frequency. This is the primary turnout frequency for the Monmouth County, New Jersey Fire Department that is located about 25 to 35 miles from here.⁵⁰

In the analysis of the 20 minutes after the first airplane impact there appears to be several instances where the communications recorded on this channel originated from other fire departments.

7.4.7 NYPD Radio Communications

The third example illustrates radio communications for the NYPD Division 1 channel and the NYPD Special Operations Division channel. The Division 1 channel was used by police officers and supervisory police officers. The Special Operations Division channel was used by senior level NYPD management, supervisory police officers, Emergency Service Unit personnel, and aviation unit personnel.

⁵⁰ Other Interview 2, winter 2004

Table 7–2 and Table 7–3 compare the number of transmissions and their length of time before and after the first aircraft impacted WTC 1 for both of the NYPD channels. Figure 7–9 and Figure 7–10 give the percent transmissions versus time for the NYPD Division 1 and NYPD SOD channels, respectively.

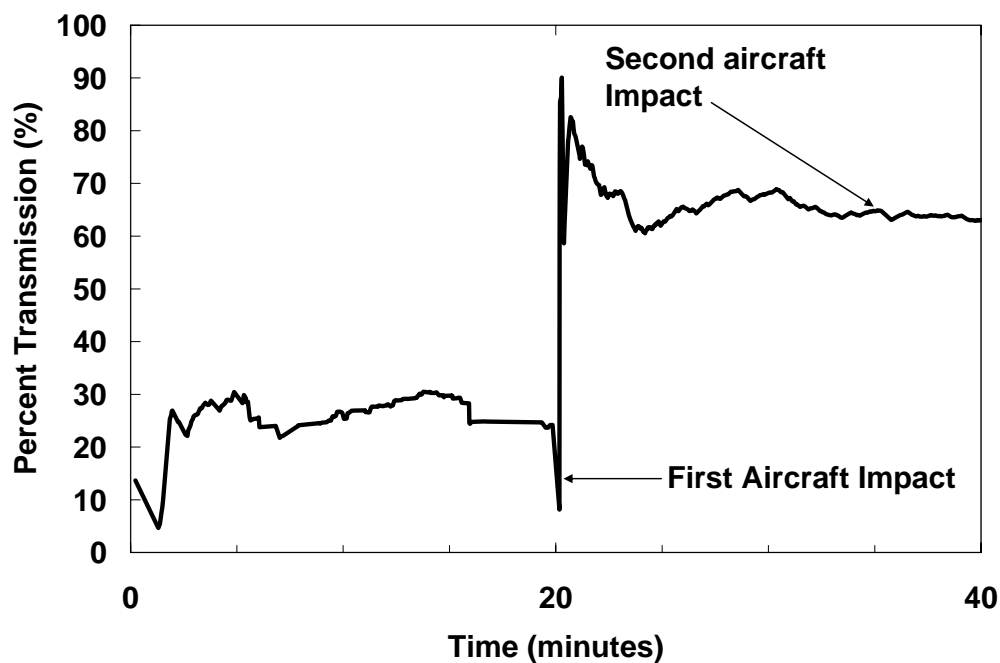


Figure 7–9. NYPD Division 1 channel plot of percent transmission versus time.

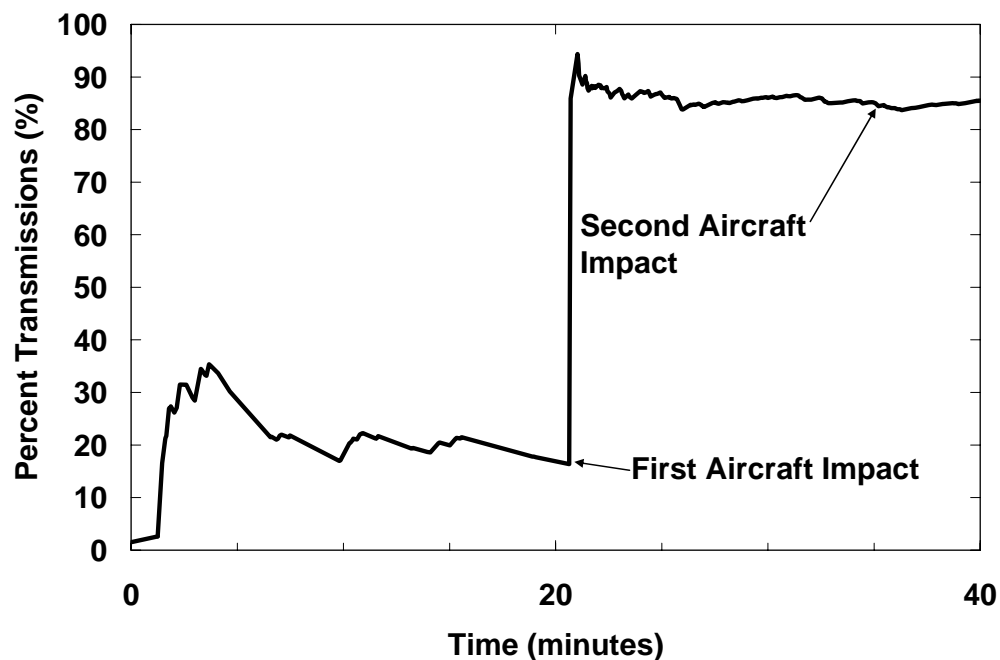


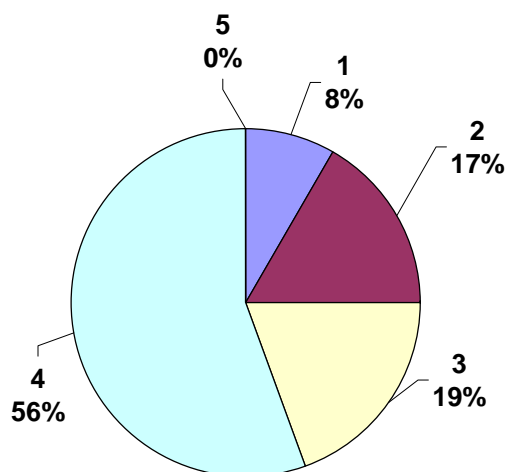
Figure 7–10. NYPD Special Operations Division channel plot of percent transmission versus time.

7.5 RADIO COMMUNICATIONS READABILITY ANALYSIS

As each of the communications files was transcribed, a readability value was assigned for each attempt to communicate. Results of this analysis are shown in Figure 7–11 through Figure 7–17. Analysis of these data showed that the ability to transmit a complete message was difficult during the communications surge. Data showed that approximately one-third to one-half of the radio communications for each of the three departments did not exceed a readability level of 2. These emergency communications were not complete and may have not been fully understood. The largest fraction of readability for all radio communications analyzed was recorded at a readability level of 3. This means that this fraction of communications was readable, but audio and radio transmission problems were being experienced. Some conditions that will cause poor communications quality are:

- Background noise either at the transmission point or receiving point or both,
- Operating health of transmitting and receiving radios and antenna systems,
- Doubling or crossing of radio signals caused by multiple transmissions at the same time on the same radio frequency, and
- Radio transmissions that may be affected by attenuating materials or electromagnetic interference.

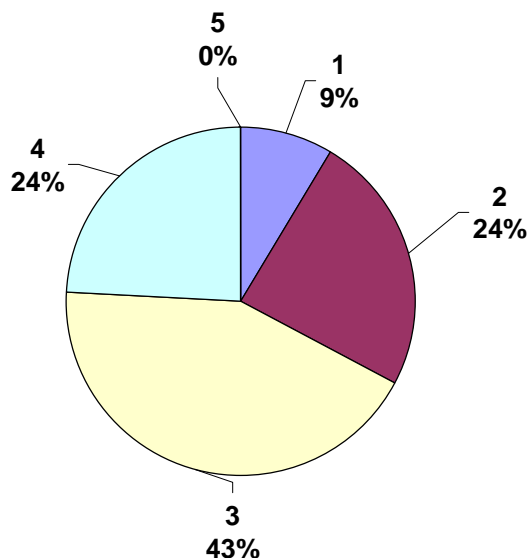
In addition, approximately 25 percent of the radio communications had readability levels 4 or above. Typically, the higher readability levels were produced by the various department base stations that operate at a higher radio transmission output power than the hand held radios. However, there is one exception: several of the radio communications on the FDNY City-wide high-rise radio channel, the PAPD recording of Channel 30. It appears that the repeater was operating at the WTC site. Several of the radio communications on this channel were assigned readability values of four and five as the FDNY began its operations in WTC 2. In addition, some of these 4 and 5 readability value radio communications were occurring between FDNY personnel in the lobby of WTC 2 and FDNY personnel some 40 or more floors up inside the same building.



Note: Readability scale:

- | | |
|---|--|
| 1 – Unreadable | 4. – Readable with practically no difficulty |
| 2 – Barely readable, occasional words distinguishable | 5. – Perfectly readable |
| 3 – Readable with considerable difficulty | |

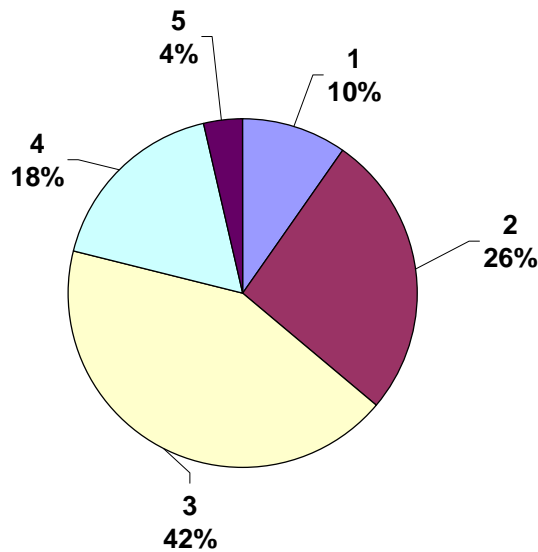
Figure 7–11. PAPD Police Desk channel 26/W radio communications readability for the time period 20 minutes before first plane impact.



Note: Readability scale:

- | | |
|---|--|
| 1 – Unreadable | 4. – Readable with practically no difficulty |
| 2 – Barely readable, occasional words distinguishable | 5. – Perfectly readable |
| 3 – Readable with considerable difficulty | |

Figure 7–12. PAPD Police Desk channel 26/W radio communications readability for time period 20 minutes after first plane impact.



Note: Readability scale:

1 – Unreadable

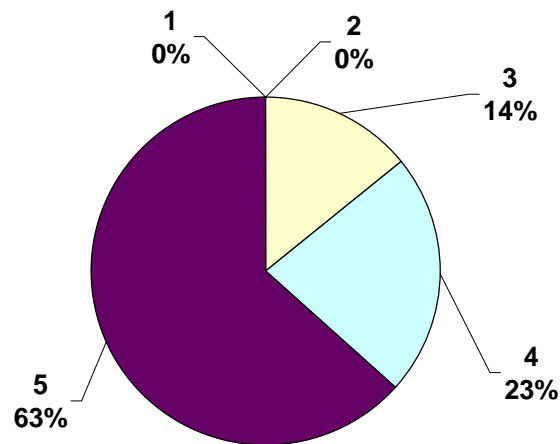
2 – Barely readable, occasional words distinguishable

3 – Readable with considerable difficulty

4. – Readable with practically no difficulty

5. – Perfectly readable

Figure 7–13. FDNY City-Wide High-Rise channel 7 (PA/WTC Radio Channel 30) radio communications readability for time period 20 minutes after first plane impact.



Note: Readability scale:

1 – Unreadable

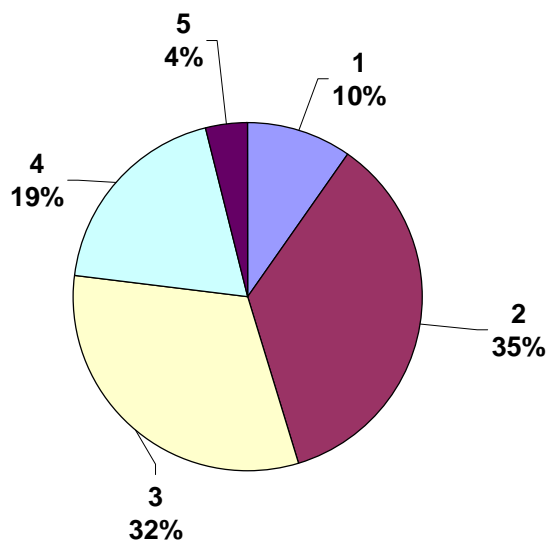
2 – Barely readable, occasional words distinguishable

3 – Readable with considerable difficulty

4. – Readable with practically no difficulty

5. – Perfectly readable

Figure 7–14. NYPD Special Operations Division channel communications readability for time period 20 minutes before first plane impact.



Note: Readability scale:

1 – Unreadable

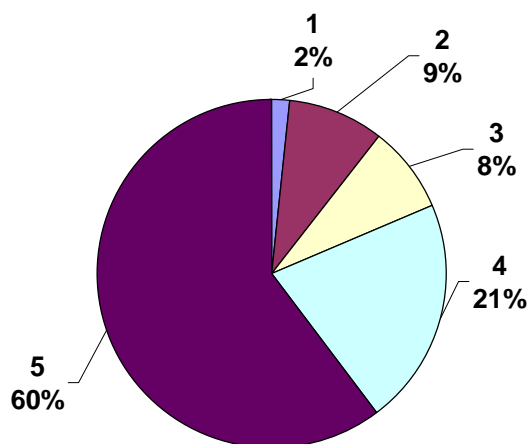
2 – Barely readable, occasional words distinguishable

3 – Readable with considerable difficulty

4 – Readable with practically no difficulty

5 – Perfectly readable

Figure 7–15. NYPD Special Operations Division channel communications readability for time period 20 minutes after first plane impact.



Note: Readability scale:

1 – Unreadable

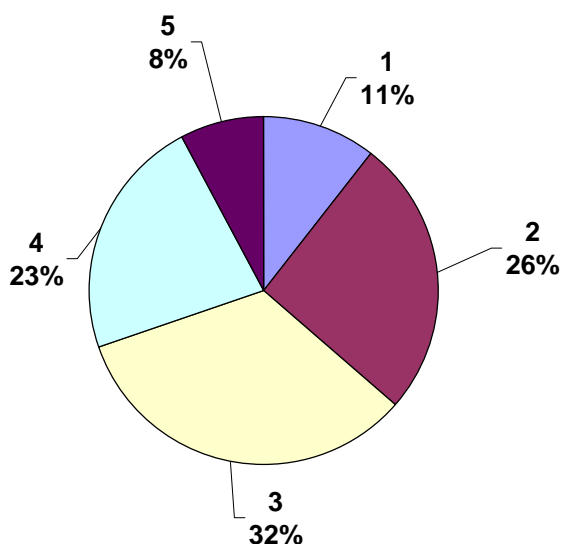
2 – Barely readable, occasional words distinguishable

3 – Readable with considerable difficulty

4 – Readable with practically no difficulty

5 – Perfectly readable

Figure 7–16. NYPD Division 1 channel communications readability for time period 20 minutes before first plane impact.



Note: Readability scale:

1 – Unreadable

2 – Barely readable, occasional words distinguishable

3 – Readable with considerable difficulty

4 – Readable with practically no difficulty

5 – Perfectly readable

Figure 7–17. NYPD Division 1 channel communications readability for time period 20 minutes after first plane impact.

7.6 GENERAL COMMENTS ON RADIO COMMUNICATIONS

NIST's analysis of PA and NYPD radio systems indicated that they were working during the period of normal operations one half hour before the attack on the WTC. Also, the FDNY Manhattan Dispatch channel was functioning normally prior to the attack on the WTC. No other radio communications recordings relevant to the attack were available from FDNY. However, it was noted that Channel W of the PAPD was experiencing some difficulty with a handie-talkie radio transmitting a carrier wave as a result of an open or keyed microphone which disrupted communications on that channel. PAPD personnel recognized the problem and were busy trying to correct it just before the first plane struck WTC 1. The keyed microphone problem continued after the attack occurred. NYPD also had a problem with an open or keyed microphone after the attack began; it occurred on the Special Operations Division (SOD) channel. The problem was recognized and efforts were also made by the NYPD desk operator to get the problem cleared up. Initial attempts to correct the open microphone problem appeared to be successful.

Also, the data above for the various departments demonstrate the significant changes that occurred in radio communications traffic during the WTC operations. It is evident that PAPD, FDNY, and NYPD all experienced similar surges in radio traffic volume following the first aircraft impact into WTC 1. It is noteworthy that when the second aircraft struck WTC 2, 17 minutes later, there was no major surge in radio communications. This may be attributed to the fact that the initial emergency response assignments had already been made and that operations had already begun at the WTC, so an additional surge in radio communications was not needed. In addition, it is observed from the communications recordings and from first-person interviews that the emergency responders were trying to limit their use of the radios to reduce interference on their operating frequencies.

7.7 REFERENCES

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Palmer, Orio J. 1998. *Repeater Systems*, WNYF, 3rd, The Fire Department of the City of New York.

Chapter 8

COORDINATION OF RESPONSE ACTIVITIES WITH OTHER AGENCIES AT THE WORLD TRADE CENTER

The issue of coordination of emergency response activities among the different authorities (the New York City Fire Department [FDNY], the New York City Police Department [NYPD], The Port Authority Police Department [PAPD], and the New York City Office of Emergency Management [OEM]) at the World Trade Center (WTC) has implications for each of the emergency response departments. The attack on the WTC created a large and complex emergency response challenge for each responding organization. It is apparent that in general on the morning of September 11, 2001, all departments attempted to work together to save as many lives as possible and protect the citizens of New York City. It is also apparent that there were difficulties associated with inter-department operations. This is demonstrated by statements extracted from first-person interviews with NYPD Emergency Service Unit (ESU) officers and FDNY personnel.

The following statement describes interactions between NYPD ESU personnel and FDNY Rescue One personnel who were operating together up inside WTC 1 as they heard radio messages ordering the evacuation of the tower:

- The firefighters were contacting their command post as we were contacting ours. I asked the firefighter, did you hear the same thing and he said yes. The interviewee said we are getting out and the firefighter said yes. The firefighter from Rescue One that the interviewee was talking to perished that day. The interviewee thought that the firefighter was a hero. He kept all of the guys calm that were there. He also worked well with the interviewee in communicating back and forth what FDNY had and what NYPD ESU had. The interviewee told the firefighter that they would be exiting the building and the firefighter wanted to confirm that all NYPD ESU members were evacuating the building so he could inform his command post. The firefighter said that he was going to inform his guys and that they would be coming down right behind the ESU team.¹

First-person interviews with FDNY and NYPD personnel also showed that at times some issues related to operational responsibility and the competitive nature of departments' did exist during the WTC operations. The following information was extracted from first-person emergency responder interviews:

- A team of ESU police officers went into WTC 1 and the fire department and Port Authority were there. They stopped at the FDNY Command Post. A Sergeant and a Lieutenant from the team approached the fire

¹ NYPD Interview 6, winter 2004.

department to let them know they were there. The fire department did not acknowledge. There was no response. Since they got no response from the fire department they decided to go up the stairway to the upper floors.²

- A team of ESU police officers received instructions from an OEM staff member to report to the FDNY Lobby Command Post inside of WTC 2. The OEM member indicated that the ESU officers reluctantly followed his directions. The ESU team did report to the FDNY Command Post and they were given an assignment to assist a FDNY Chief many stories up in the building.³

The two interview statements above highlight issues related to departmental operational responsibility and the function of the operations command structure during the emergency response at the WTC. In general, emergency responder interviews suggest that inter-agency competition had minimal effect on operations at the WTC before the towers collapsed.

8.1 DEPARTMENT OPERATIONAL RESPONSIBILITY

The issue of which emergency responder department, police or fire, has command authority of a given operation has been a subject of discussion throughout the emergency response community for many years. In an attempt to reduce the uncertainty associated with this issue, the New York City Mayor's Office established an operations protocol. In April of 1994, FDNY and NYPD published a document entitled "Police/Fire Protocol."⁴ The complete document is located in Appendix B. The introduction of this document stated that the protocol was "established to put and end to the confusion concerning the roles and responsibilities of the Police and Fire Departments at emergencies." In section 2.2 it states:

"At the scene of a fire, the ranking Fire Department officer will assume command. The ranking member of the Police Department will report to the fire officer in charge and offer any assistance that may be required. The police supervisor will request the Fire Department commander to inform Fire Department subordinates that evidence, especially in suspected arson or explosive cases MUST be preserved and safeguarded."⁴

The following section, 2.3, stated that the Police Department would assume command at the scene of a non-fire emergency, and that the Fire Department would provide assistance for the Police Department as required. In addition to these two sections (that clearly specify the roles and responsibilities of the Police and Fire Departments at emergencies), section 2.5 addresses the protocol for how emergency responders would receive their directions and orders during an incident. This section stated the following:

"During a joint operation, specific direction to members of both departments will be issued through their department's chain of

² FDNY Interview 5, winter 2004.

³ FDNY Interview 54, winter 2004.

⁴ New York City, *Police/Fire Protocol*, April 1994.

command. Ranking police and fire commanders will confer frequently concerning orders and directions to be issued. The ranking officers of the Police and Fire Departments MUST be aware of the need for mutual cooperation. All police and fire personnel MUST understand that they will be held strictly accountable for their conduct during joint operations.”⁴

The sections discussed above make it clear that FDNY was responsible for incident command at the WTC site since both of the WTC towers were on fire. As mentioned earlier, NYPD was in charge of aviation and roof operations since this was a criminal act. Relative to building collapse, section 3.4 of the protocol states that FDNY would be in command of rescue operations during a structural collapse. This issue saw intense debate by some personnel after the buildings collapsed and rescue operations were begun in the rubble field. Additionally from above, section 2.5 addressed the issue of how members of each department received directions during joint operations. Generally, this protocol was followed by the departments. FDNY was providing direction for its members and NYPD was providing direction for its members. This protocol potentially assisted in creating a conflict relative to operations inside the WTC towers. The protocol may have been associated with the response of FDNY Lobby Command Post personnel when NYPD personnel arrived, or it may also be associated with the reluctance of NYPD ESU personnel to report to the WTC 2 Lobby Command Post before going to work inside the tower. Also, section 2.5 indicated that ranking police and fire department commanders were to confer frequently concerning orders and directions to be issued. Information gathered related to the origination of unified orders and directions for FDNY and NYPD shows the process took place only at the department commissioner level. Evidence shows that FDNY and NYPD department chiefs were not working together at the same command post or that they formulated unified orders and directions for their departments.^{5,6}

8.2 OFFICE OF EMERGENCY MANAGEMENT AND MULTI-AGENCY OPERATIONS

The OEM was created in New York City after the 1993 bombing in part, to promote unified operations between and among the various city emergency responders. OEM was basically a support organization for expediting emergency response operations within the city. An analysis of the overall city emergency response structure indicates that New York City did not have a formalized Incident Command System that encompassed city wide emergency response operations. However, FDNY documents and first-person interviews show that FDNY was working under an established Incident Command System that was updated by the department in May of 1997.⁷ A description of the Mayor’s Office of Emergency Management (OEM) and its functions is provided in Appendix L.

On the morning of September 11, 2001, OEM operations were disrupted with the evacuation of the city’s OEM operations center located inside WTC 7.⁸ The FDNY Fire Commissioner stated the following

⁵ NYPD Interview 12, winter 2004.

⁶ FDNY Interview 65, spring 2004.

⁷ FDNY Interviews 2, 7, and 20, winter 2004.

⁸ FDNY Interview 45, winter 2004.

concerning the loss of the OEM center when he was turned away from WTC 7 shortly after it had been evacuated:

“How ridiculous, I thought. We’ve got a thirteen-million-dollar command center and we can’t even use it.” (Von Essen 2002)

Since the OEM center was not available for operations, NYPD, FDNY, and OEM Commissioners met the Mayor on the street with the group initially assembling at Barclay Street. At the same time, NYPD was establishing an alternate command center for the Mayor and his staff at 75 Barclay Street so that he and his staff could oversee operations. However, their operations from 75 Barclay Street were disrupted by the collapse of the towers, and they had to quickly evacuate from that site. Data show that there was no formal structure of unified command between departments below the Mayor and Commissioner level of operations. Also data indicates that FDNY and NYPD department chiefs were not working together at the same command post, and that they did not formulate unified orders and directions for their departments.

Unified command for the emergency response also was hampered by FDNY and NYPD setting up separate command posts for operations at the WTC. FDNY established its Incident Command Post (ICP) in the driveway of the parking garage at World Financial Center 2 (WFC 2), and there is no record that the ICP had any senior NYPD personnel assigned to it to provide liaison or assist with operations. One armed ESU team did provide a security sweep for the FDNY ICP, and it provided security for the ICP as operations were being established. However, NYPD set up its own separate command posts at Church and Vesey Streets and at West and Vesey Streets. It should be noted that the NYPD post at West and Vesey was only a short distance from the FDNY Incident Command Post at WFC 2. Figure 8–1 shows an armed NYPD ESU team member at the FDNY ICP location in front of WFC 2.

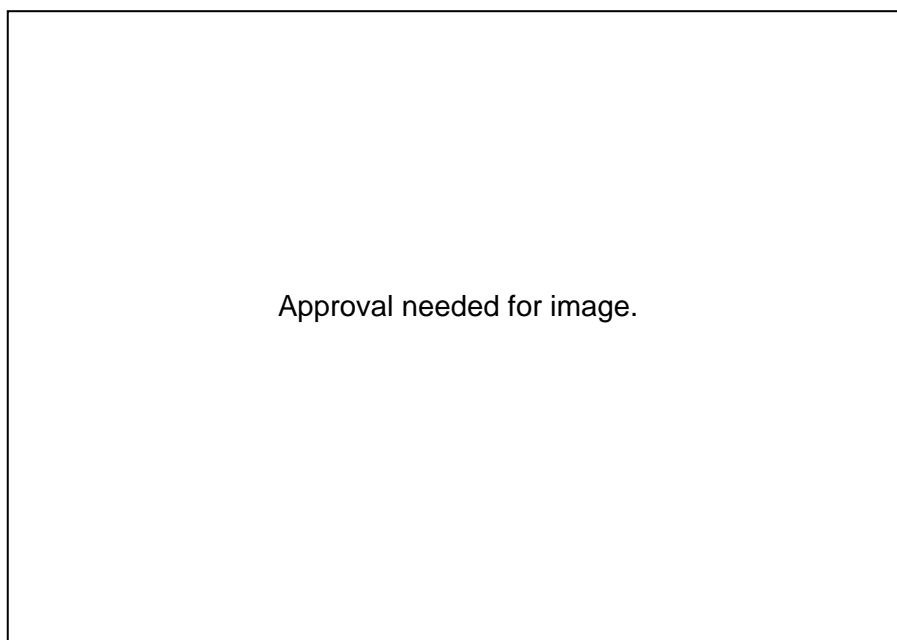


Figure 8–1. Video image of an NYPD Emergency Service Unit member providing security at the FDNY Incident Command Post in front of WFC 2.

It is recognized that NYPD generally has different responsibilities from FDNY that relate to security, traffic control, protection of the public, and the crime scene. However, there were overlapping functions associated with ESU rescue team operations inside and around the WTC towers and FDNY operations. Although ESU rescue teams did eventually meet up with and work with FDNY personnel, functional unified operations were diminished as a result of the two departments' command posts being separated. It is also apparent from the emergency responder interviews that the separate command posts could not communicate with each other on their different radio systems. Additionally, neither department had liaison officers working with either the FDNY or NYPD command posts until after WTC 1 collapsed. With the collapse of the towers, a FDNY Chief was assigned to work at the newly established command center at One Police Plaza.

The following information is extracted from FDNY Circular, A.U.C. 319, Office of Emergency Management, April 1996.⁹

Purpose of the Mayor's Office of Emergency Management (OEM):

- Emergency management requires inter-agency and inter-governmental coordination as well as communication with the public and the press. The performance of these functions by the City is best coordinated by the Office of the Mayor. The Mayor's Office of Emergency Management has been established for this purpose.

Relevant Functions of OEM:

- Coordinate the City's response to all emergency conditions and potential incidents which require a multi-agency response, including but not limited to severe weather, threats from natural hazards and natural disasters, power and other public service outages, labor unrest other than the keeping of the peace, water main breaks, transportation and transit incidents, hazardous substance discharges, building collapses, and acts of terrorism.
- Monitor all potential emergency conditions and potential incidents which may require a multi-agency response.
- Coordinate and implement training programs, including emergency response drills, to prepare for emergency conditions and potential incidents which may require a multi-agency response.
- Increase public awareness as to the appropriate responses by members of the public to emergency conditions and potential incidents, and review the City's systems for disseminating information to the public.
- Operate an emergency operations center to assist the City in managing emergency conditions and potential incidents which may require a multi-agency response.

⁹ FDNY Circular, A.U.C. 319, Office of Emergency Management, April 1996.

- Coordinate with the Police Department to ensure that the City agencies develop and implement emergency response plans in connection with planning for major City events.
- Coordinate with state, federal and other governmental bodies to effectuate the purposes of OEM.

On September 11, 2001, the OEM Operations Center located inside WTC 7 on the 23rd floor was disrupted when the building underwent an emergency evacuation after the second hijacked aircraft struck WTC 2. As a result, this center became unusable and the operations of the OEM office became less than totally effective until after WTC 1 and 2 collapsed. This loss of OEM operations had a negative impact on interagency operations during WTC operations. As the Mayor learned of OEM's evacuation, he immediately devised two priorities: 1) set up a new OEM Command Center, and 2) find a way to communicate with the people of New York City (Giuliani 2002). The following concerning unified emergency operations for the WTC event was extracted from the book by Mayor Giuliani:

- It was felt that this attack on the World Trade Center placed the city "*in uncharted waters*" and it was also felt that they would have to make up their response to the attack.
- It was also reported by the Mayor that early in the emergency operations a decision was made to establish two command posts: one for the Fire Department and one for the Police Department.

It was stated that two different command posts were needed because the departments were going to perform different tasks and had different requirements. The following direct quotes are from Mayor Giuliani's book:

"The Fire Department had to lead the rescue and evacuation. The Police Department had to protect the rest of the city. As the team leading the rescue, the Fire Department immediately became the incident commander. They set up their command post so that they had the buildings in their line of sight. The Police Department had already begun setting up at 75 Barclay.

Had the Police Department established its command post on West Street with the Fire Department, it would have been impossible for them to access the hardlines and necessary communications for the defense of the city. Had the Fire Department put its command post with the Police Department at 75 Barclay, it would have been impossible to observe the buildings and fight the fire. It was absolutely necessary to have two command posts – one to observe the fire and the other to permit communication via hardline. Having the police commissioner, the fire commissioner and Director of OEM together with me ensured coordination of the emergency rescue recovery and provided for the security of both the site and the city."

The different standard operating procedures of the agencies address cooperation between departments. However, the agencies have found it difficult in practice to operate under command of another group. This is especially true during large complex incidents.

The coordination of communications and operations between the responding authorities at the WTC was a challenge for all emergency responders working that morning. The short time frame related to the attack and emergency responder operations coupled with successive significant threats (an aircraft hitting WTC 2 after WTC 1 was hit, the threat of a third aircraft coming in, the collapse of WTC 2, etc.) that had to be responded too by the different agencies compounded the difficulty for establishing a unified operation. The challenges related to the establishment of unified operations were made significantly worse when the OEM facility located inside WTC 7 had to be evacuated. Although there was merit to having the FDNY and NYPD Command Posts separated related to the different types of operations, there was no uniform means for communicating between the two Command Posts by the time that WTC 2 collapsed. FDNY and NYPD were primarily operating as independent organizations based on their operational responsibilities. Consequently, functional unified operations were diminished as a result of the two department's command posts being separated, coupled with their inability to directly communicate with each other. It has been demonstrated in earlier parts of this report, however, that FDNY, EMS, NYPD, PAPD, PANYNJ, and OEM were attempting to work together at the WTC complex.

8.3 REFERENCES

Giuliani, Rudolph, W., with Kurson, Ken. 2002. *Leadership*, First Edition, Hyperion, Talk Miramax Books, New York.

Von Essen, Thomas. 2002. *Strong of Heart Life and Death in the Fire Department of New York*, Regan Books, Harper Collins Publishers, New York.

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Chapter 9

FINDINGS

The emergency response to the World Trade Center (WTC) was complex and of unprecedented scale. Although New York's emergency responders had never experienced an operation of the size presented by the attack on the WTC, National Institute of Standards and Technology (NIST) has determined that they typically followed their department policies and procedures for the operations they were required to carry out. The WTC attack and its results presented unprecedented challenges to emergency responder practices and equipment. The following addresses the findings of this investigation.

9.1 ACCESS AND FIREFIGHTING

Building Access and Evacuation

The ability of occupants to evacuate from a building and the ability of emergency responders to access a building is largely a function of the building's design. During the attack on the WTC, the elevators and stairways were the primary means for moving through and out of the buildings. The following findings highlight the conditions and difficulties related to these building components:

- It was reported to the FDNY Battalion Chief who established the WTC 1 Lobby Command Post that the elevators were not working and/or were not generally safe for use during the WTC operations; however one elevator was used briefly by FDNY.
- People were trapped inside many of the elevators.
- Firefighters had to gain access to the injured and trapped occupants by climbing the stairs and carrying the equipment needed up the stairs.
- FDNY command personnel learned from 9-1-1 dispatch operators that smoke, fire, and structural damage in the buildings prevented many building occupants from evacuating floors above the impact zones.
- Mobility impaired individuals blocked stairway evacuation routes in WTC 1, and approximately 40 to 60 of these individuals were temporarily placed on the 12th floor to clear the stairways so others could evacuate.
- It is estimated that emergency responder climbing rates varied between approximately 1.4 minutes per floor for personnel not carrying extra equipment to approximately 2.0 minutes per floor for personnel wearing protective clothing and carrying extra equipment.
- Communications records and interviews indicate that smoke and heat conditions on the top of the two WTC buildings prevented the NYPD helicopters from conducting safe roof evacuation operations.

- NYPD aviation unit personnel reported critical information about the impending collapse of the WTC towers several minutes prior to their collapse. No evidence has been found to suggest that the information was further communicated to all emergency responders at the scene.

Emergency Response Operations

The magnitude of the attack and the results were far greater than anything that the city's emergency responders had ever experienced. The facts below provide a brief summary of emergency response operations that were critical to how operations were carried out before the collapse of WTC 2:

- A review of procedures and policies compared to the actions taken by FDNY at the WTC shows that the procedures and policies were being followed to a great extent at the WTC.
- The initial fire department size-up of the event was that a large aircraft had hit WTC 1, and that large fires were burning on multiple floors at and above the impact zone.
- It was likely that the water supply on the upper floors was damaged and that firefighting would not be an option until a reliable water supply was established and equipment was carried up.
- It appeared that the sprinkler and standpipe systems were compromised at the impact zone.
- FDNY command personnel knew that jet fuel had flowed into the elevator shafts and into other parts of the buildings and presented a danger to building occupants and emergency responder personnel.
- The known extent of the impact damage, fires in the buildings, and the height of the impact zones indicated that many of the people trapped above the impact zones were already dead or would likely die before emergency responders could reach them,
- The impact zones were located at heights in the buildings that would require hours for the emergency responders to accumulate appropriate equipment and personnel to carry out the large scale operations needed to successfully access the upper floors,
- Structural damage and fires caused by the aircraft impact would likely result in localized collapses in and above the impact and fire zones.
- The fact that the impact zone and fires were so high in the building and that the building's water supply was compromised brought the fire chiefs to the conclusion that fire department efforts should be directed toward evacuation and rescue of building occupants.
- At the point when WTC 2 collapsed, WTC personnel had not yet accomplished tasks required for operating the building's fire pump systems, and WTC personnel had not given orders for starting the building's fire pump system.

- The consequence of firefighters and other emergency responders having to climb many tens of floors to get to a fire in a high-rise building can be summarized as follows:
 - The climbing rate is approximately one to two minutes per floor for emergency responders attempting to access a fire zone 30 floors or more high.
 - The ability to get both personnel and needed equipment to the desired location becomes limited by building height.
 - The time factors related to fire growth, the ability to rescue building occupants, and the ability to bring a fire under control becomes more critical with every additional floor in building height.
 - The ability of emergency responders to climb the stairs with equipment and remain physically fit to conduct rescue and firefighting operations is diminished with every additional floor in building height that must be climbed.
- The private ambulances or EMS teams that responded to the WTC had no equipment and no protective clothing at all. They also did not have the same radios so it was not possible to communicate with them by radio.

9.2 EMERGENCY RESPONDER EQUIPMENT

Generally, the equipment used by the emergency responders was adequate for the operations being carried out. However, there are some points related to equipment that need consideration.

For high-rise buildings, fire departments should work with building owners to establish caches of equipment that can be assessed at different locations inside the buildings. Firefighters should not be expected to carry heavy equipment up dozens of flights of stairs. Firefighters and other emergency responders who are forced to climb stairs to access a fire or other emergency should not have to wear or carry equipment that can be secured and maintained on the upper floors of high-rise buildings. Within the agreements developed between emergency responders and high-rise building owners, there should be a means for the emergency responder agencies to insure that the pre-positioned equipment is adequately inspected, maintained, and certified ready for use.

Equipment That Facilitated Operations

The emergency responder first-person interviews did highlight three pieces of equipment that made a difference in their operations that day; in fact, they are credited with saving the lives of many emergency responders. These items were: radios, flashlights, and SCBA's (Self Contained Breathing Apparatus).

Radios

Chapter 7 discussed the significant problems reported with the use of handie-talkie radios during the WTC operations on September 11, 2001. However, it is shown that numerous emergency responders felt

that their radios played a critical role in saving their lives. As seen in section 5.8.2, this viewpoint was expressed by personnel from each of the emergency responder departments.

Flashlights

A second piece of equipment credited with assisting operations and saving lives was the flashlight. Although the WTC attack took place on a clear and sunny day, flashlights became critical to emergency responders and occupants at the WTC complex when electrical power was lost and when the towers collapsed. Flashlights provided the light needed to evacuate from dark, smoky, and dust filled environments. (Section 5.8.2)

Breathing Apparatus (SCBA)

The third piece of equipment given high marks by emergency responders was the air-pack or SCBA. Numerous emergency responders indicated that they used their SCBAs to breathe after the WTC towers fell. The air was thick with debris, dust, and smoke and everyone found it difficult to breathe. Personnel with SCBAs were able to place the mask over their face and breathe fresh air from the air bottle even through the outside air was thick with dust and smoke. Many of the emergency responders with SCBAs shared their air supply with others around them. (Section 5.8.2)

9.3 EMERGENCY COMMUNICATIONS

Building Emergency Communications

- It was found through building occupant and emergency responder interviews that the emergency communications system used to make the emergency announcements inside WTC 1 was inoperable as a result of the aircraft impact.
- It also was learned by FDNY personnel up inside of WTC 1 that the warden phone system was damaged and the standpipe phone system was not operating.

Emergency Responder Radio Communications

- After the first aircraft struck the WTC, there was a peak increase in emergency responder radio communications by approximately a factor of 5, followed by an approximate factor of 3 steady level of radio communications.
- Analysis of the radio traffic for each of the departments shows periods where radio traffic rates during the surge conditions potentially resulted in situations where base station radio operators were unable to relay important information.
- During the surge in emergency responder radio traffic that occurred as a result of the attack on the WTC, approximately 1/3 to 1/2 of the emergency radio communications were not complete messages nor understandable.

- For the number of people at the WTC, the FDNY radio system was inadequate for locating and tracking personnel.

Repeater

- Radio communications recordings from the Port Authority radio communications system for their channel 30, which was the same as the FDNY channel 7 high-rise repeater channel, demonstrates that the FDNY high-rise repeater was operating.
- Some of the 4 and 5 readability value radio communications occurred between FDNY personnel in the lobby of WTC 2 and FDNY personnel some 40 or more floors up inside the same building.

9.4 COMMAND AND CONTROL

Even though the footprint of the WTC was small compared to the large areas that can be destroyed by earthquakes, hurricanes, tornados, wildfires, and urban conflagrations, the height and size of the buildings, the concentration of large numbers of occupants, and the large number of emergency responders needed to conduct operations created significant difficulties for emergency responder command and control. The vertical volume associated with the towers and the effects of tall building design and construction had an overall negative influence on emergency operations: firefighting, evacuation, rescue, and communications. The following addresses the findings associated with emergency responder command and control during these attacks.

- A FDNY interviewee indicated that on September 11, 2001, the Command Board approach to managing operations at the WTC became overwhelmed with the number of units and personnel reporting in for operations. In addition, an interviewee indicated that not all personnel that arrived at the WTC site were logged in on the Command Board. This is partially due to the size and complexity of operations at the WTC, but it also relates to personnel not always following department policies on reporting to the Command Post for assignment.
- FDNY had established a functional Incident Command System when WTC 2 collapsed, and FDNY had the human and equipment resources committed for conducting high-rise operations at the WTC.
- The FDNY Incident Command System was hampered by the loss of the OEM Command Center, the lack of a fully functional Field Comm unit, poor radio communications, and limited access to shared information critical to operations.
- The collapse of WTC 2 not only caused the death of numerous citizens and emergency responders but it totally disrupted the ongoing Incident Command System Operations being carried out by FDNY, NYPD, and PAPD.

Command Posts

The emergency responder operations associated with the WTC attack exhibited a situation where almost all emergency responder departments established their command posts within the potential collapse zone of the buildings. This approach had been a standard operating procedure for years since there had been no prior history of collapsing high-rise buildings. However, on September 11, 2001, it suddenly became apparent to all Command Post personnel that the posts were located too close to the buildings.

Personnel Accountability and Tracking

With any large emergency response, personnel accountability and tracking are vital part of command and control.

- In general, responding FDNY units to the WTC followed good practices as related to accountability. However, there were some cases where individuals did not report to the Command Post and became freelancers. Interviews with FDNY personnel showed that some fire department personnel came to WTC facilities without unit approval. In addition, there were various emergency responders from NYPD and PAPD that entered the towers without reporting into the FDNY Command Posts.
- Several obstacles with regard to accountability of EMS personnel added to operations difficulties. They were first, the size of the event as it unfolded and the difficulty that EMS Chiefs had in determining who was at the scene. Second, “self dispatch” and “freelancing” of some non FDNY ambulances. Finally, there was an inability of FDNY EMS supervisors to communicate with some of the non FDNY ambulances.
- Within the individual triage and treatment areas that were set up by EMS, it appears that efforts were made to keep track of patients. This was done with pencil and paper. All the data on patients were lost when the buildings collapsed. The loss of WTC 7 which housed the OEM hampered the ability to track patients within the system.
- Because of the self dispatch of non 9-1-1 resources, there were patients being removed from the location by those units and the EMS officers did not have any knowledge or records of these patients, or even knew if or where they had been transported.
- Once responders reported to a Command Post at the WTC, received their assignments, and departed to accomplish their tasks, there was no positive means to locate or track the activities of the units or individuals.

Communications and Information Sharing

All three of the emergency responder departments, FDNY, NYPD, and PAPD experienced difficulties with radio communications during the attack that occurred on the WTC. Each of the different departments was well aware of the shortfalls of their radio communications systems as it related to operations in the city and in high-rise building operations. They all knew not to expect perfect radio communications. There were two basic issues related to the quality of radio communications on September 11, 2001. One was the function of the radio equipment in the manner that it was being used

during the high-rise operations, and the other was the volume of radio traffic. For NYPD and PAPD, radio equipment did not appear to be a major problem during the operations.

Within the WTC site, the PAPD maintained a reasonable quality of radio communications as it related to the capabilities of the radio and antenna systems in the buildings and site. The Port Authority had added an extensive radio antenna system for Port Authority and PAPD operations at the site, and it worked well until WTC 2 collapsed. With the collapse of WTC 2, the abandonment of the Police Desk at WTC 5, and the PAPD repeater being lost, personnel were forced to switch to point-to-point communications.

NYPD also experienced successful operations with its radio equipment during communications at the WTC site. This may be attributed to the fact that only a small number of NYPD personnel entered and operated inside the WTC towers and that the mobilization points for the NYPD personnel were located outside of the WTC towers (roughly a city block or more away from the towers). This location provided an unobstructed line of sight route for radio signals to travel to and from the towers allowing the radio signals to enter and exit the building's windows. The radio signals did not have to pass through floors of steel or steel-reinforced concrete.

It was well known by FDNY that handie-talkie radios did not work well in high-rise buildings that contain large amounts of metal and steel reinforced concrete. FDNY made attempts to overcome this challenge by developing the Battalion Car Cross-Band Repeater, and working with building owners to have building/complex repeaters put into areas where poor radio communications existed. FDNY also was attempting to improve the radio communications shortfall by the purchase of new handie-talkies. Even with all of this effort, FDNY radio communications suffered. One of the main contributing factors to poor FDNY communications at the WTC was that its primary Command Posts for conducting operations inside the buildings were located inside the lobby of each of the towers. This arrangement put the Chiefs managing operations inside the buildings at a location where radio signals would be attenuated by the building's structure and did not allow a clear path for radio signals from the lobby to propagate up through the building. This arrangement also blocked radio signals coming down to the lobby from upstairs. A solution to this problem was the use of the WTC/FDNY high-rise building repeater or the use of the Battalion Car Cross-band Repeater. Since the WTC/FDNY high-rise repeater appeared to have a communications handset malfunction and it was not understood, that repeater became ineffective in WTC 1. However, the WTC/FDNY high-rise repeater was apparently used by personnel inside WTC 2. The radio transmission record indicated that the Battalion Car Cross-band Repeater was taken over to the lobby of WTC 2. Only one radio message from the Battalion Chief who activated the cross-band repeater provides evidence that it was being used as a backup to the WTC site repeater. No other record has been located concerning the use of that repeater at the WTC. Also, the rules for using a Battalion Car Cross-band Repeater states that only one of these repeaters can be used at a time at one incident. With this, WTC 1 was apparently left without any capability of getting a radio signal outside of the building so that it could be retransmitted up with a clear propagation path. Therefore, radio communications to personnel working inside WTC 1 were seriously limited.

The lack of information sharing that resulted from poor radio and telephone communications, and the information overload conditions resulted in serious operational difficulties. Emergency responder communications systems are the critical link for command and control and personnel safety. The incoming data and other information were not being pooled and analyzed in real time during operations, were not being distributed to all emergency responders who needed it; and were not being delivered to

emergency personnel and the public (WTC occupants) in a timely fashion. As a result, many emergency responders were not getting the critical information they needed for conducting operations and for maintaining the safety of their personnel. This had a significant impact on many of the emergency responders' attempts to maintain good *situational awareness*. In addition, some occupants inside the WTC were not getting information that potentially could have saved their lives. An example is that there was one staircase inside WTC 2 that was passable for a period of time to the area above the impact zone. Information on this escape route was not acquired from the evacuating occupants and not passed on to others trapped above the impact zone. The gathering, analysis, and distribution of critical emergency information by responders and government agencies not only affect them and their operations but also affect citizens at the scene and citizens within the community where a large emergency occurs.

There was a large amount of critical data gathered and transmitted through the various communications routes during the approximate two hours following the first aircraft impact. It has been learned that a sizable fraction of this information was either not acted upon or was not transmitted to all appropriate parties. As a result, the emergency responder's information matrix was left with holes where these critical data should have been available for decision making and promoting safe operations. An example of this is where a senior level PAPD officer - with the authority to call for a total evacuation - immediately called for the evacuation of WTC 1 just after it was hit and again called for the evacuation of the entire complex before the WTC 2 building was hit. There is no record of any action being taken related to these instructions. These communications are found in the Evacuation Chronology section of this document.

Finally, a preponderance of evidence indicates that emergency responder lives were likely lost at the WTC resulting from the lack of timely information sharing and inadequate communications capabilities.

Emergency Responder Evacuation of the WTC

- Radio communications associated with the order to evacuate WTC 1 had mixed results. Data shows that different personnel located on the same floors of the building either heard the evacuation orders or did not hear the orders.
- Based on emergency responder interviews approximately one half of the personnel located up inside WTC 1 heard radio messages calling for the immediate evacuation of the building.
- Individuals who had the evacuation information were actively telling others that the building was being evacuated.

Emergency Responder/News Media Communications

- Emergency responder/news media communications were less than totally effective during the WTC operations on the morning of September 11, 2001.
- Critical information related to life safety and evacuation from the WTC towers was not communicated to the news media so that it could be broadcast to people trapped inside the WTC towers above the building fires.

- Some news media contacts with emergency responder agencies interfered with the emergency response and life saving operations. Appropriate emergency response agency contact points were bypassed or not used by some news media for gathering information.
- It appears that emergency response agencies were overwhelmed by news media requests for information.

Inter-agency Operations and Unified Command

During the WTC operations, there were many cases where FDNY, NYPD, and PAPD worked together to provide aid or to rescue people. There were cases where personnel from one agency needed to report to the Command Post of a different agency and get a job assignment. At times, fire or police departments may be compelled to conduct operations that can be dangerous to other emergency responders. In this event the locations of all emergency responders must be known at the event and all emergency responders must receive timely information from a unified command in order to maintain their safety.

- It is apparent that in general on the morning of September 11, 2001, all departments attempted to work together to save as many lives as possible and protect the citizens of New York City.
- On the morning of September 11, 2001, OEM operations were disrupted with the loss of the city's OEM operations center that was located inside WTC 7.
- There was no formal structure of unified command between departments below the Commissioner level of operations.
- Data indicate that FDNY and NYPD department chiefs were not working together at the same command post, and that they did not formulate unified orders and directions for their departments.
- Functional unified operations were diminished as a result of the FDNY and NYPD department command posts being separated. Emergency responder interviews show that the separate command posts could not directly communicate with each other using their handie-talkie radios.
- There were overlapping functions associated with ESU rescue team operations inside and around the WTC towers and FDNY operations.
- Neither FDNY nor NYPD had liaison officers working with the other department's command post until after WTC 1 collapsed.

Many of the items listed above highlight areas where the WTC emergency response had difficulties. These items include command and control, command post locations, staging, assignments, personnel accountability, information overload, inter-agency operations, communications, information sharing, situational awareness, and equipment for operations in high-rise buildings. Most of these areas of concern are associated with emergency response operations that occur daily throughout the United States. It points out the importance of emergency responders and governments having the capability to greatly

advance operations beyond the normal scale of business while maintaining the above items under control. Additionally, it is imperative that emergency responders and governments are prepared for high risk operations by planning, equipping, training, and testing of emergency response capabilities so that all will function effectively when they are needed.

Chapter 10

POST-SEPTEMBER 11, 2001, EFFORTS

Following the attack on the World Trade Center (WTC), New York City has actively analyzed the events of September 11, 2001. During the period following the attack up until present, New York City Fire Department (FDNY) and other city agencies have been making progress toward enhancing preparedness.¹ The Office of Emergency Management has been reestablished and is operating. The city has developed new policies and procedures related to city-wide emergency operations. In addition, the city is studying the National Incident Management System (NIMS) as a potential means for operating a city-wide incident command system. FDNY has replaced all lost firefighting apparatus and has re-staffed the department to its pre-September 11th levels. Additionally, FDNY has concentrated on developing the following areas:

- training of firefighters related to complex operations,
- comprehensive training of personnel related to the Incident Command System (ICS),
- training of multiple teams as Incident Management Teams (IMT),
- increasing capabilities related to HazMat operations,
- helping to establish and participate in a City-wide Incident Management System (CIMS),
- developing an updated Strategic Plan for the department,
- developing an improved communications system incorporating new radio technologies with a focus on interoperability with other agencies they would be expected to work with,
- establishing an intelligence sharing and needs effort with other agencies,
- establishing a new Fire Department Operations Center,
- developing an advanced Electronic Command Board for incident command operations,
- developing specific emergency response plans that take into account updated practices on recall, staging, and multi-agency operations,
- conducting internal and multi-agency drills and exercises to train personnel,
- ongoing preparedness planning effort to deal with new threats and long-term challenges, and

¹ New York City Fire Department, Written Statement of the FDNY Before the National Institute of Standards and Technology, November 22, 2004

- as related to prevention, FDNY has also been working on the revision of the building code and fire codes in New York City.

The above efforts represent some of the areas where FDNY identified needs related to their capabilities as they addressed the lessons learned following the September 11, 2001, attack on the WTC. Many of these efforts are ongoing and will take commitment, time, and funds to complete. FDNY is making progress with their efforts. However, it is noted that many of the areas addressed above also reflect on the needs of other fire departments and emergency responders located across the United States. Serious efforts are needed to insure that our nation's emergency responders are ready to safely operate at unexpected and complex events where large numbers of personnel are needed and where multi-agency operations are required for saving lives and minimizing the impact of the incident.

Attachment 1

EMERGENCY RESPONDER LIST OF FATALITIES AND MISSING

Fire Department City of New York/Paramedics

List of Dead and Missing:

September 11, 2001

Name	Rank	Unit
Angello, Joseph	Firefighter	Ladder 118
Ahearn, Brian	Lieutenant	Engine 230
Allen, Eric	Firefighter	Squad 18
Allen, Richard	Firefighter	Ladder 15
Amato, James	Captain	Squad 1
Anaya, Jr., Calixto	Firefighter	Engine 4
Angelini, Joseph	Firefighter	Rescue 1
Angelini, Jr., Joseph	Firefighter	Ladder 4
Apostol, Jr., Faustino	Firefighter	Battalion 2
Arce, David	Firefighter	Engine 33
Arena, Louis	Firefighter	Ladder 5
Asaro, Carl	Firefighter	Battalion 9
Atlas, Gregg	Lieutenant	Engine 10
Atwood, Gerald	Firefighter	Ladder 21
Baptiste, Gerard	Firefighter	Ladder 9
Barbara, Gerard	Assistant Chief	City Wide Tour
Barnes, Matthew	Firefighter	Ladder 25
Barry, Arthur	Firefighter	Ladder 15
Bates, Steven	Lieutenant	Engine 235
Bedigian, Carl	Lieutenant	Engine 214
Belson, Stephen	Firefighter	Ladder 24
Bergin, John	Firefighter	Rescue 5
Beyer, Paul	Firefighter	Engine 6
Biefeld, Peter	Firefighter	Ladder 42
Bilcher, Brian	Firefighter	Squad 1
Bini, Carl	Firefighter	Rescue 5
Blackwell, Christopher	Firefighter	Rescue 3
Bocchino, Michael	Firefighter	Battalion 48
Bonomo, Frank	Firefighter	Engine 230
Box, Gary	Firefighter	Squad 1

Fire Department City of New York/Paramedics

List of Dead and Missing:

September 11, 2001

Name	Rank	Unit
Boyle, Michael	Firefighter	Engine 33
Bracken, Kevin	Firefighter	Engine 40
Breman, Michael	Firefighter	Ladder 4
Brennan, Peter	Firefighter	Rescue 4
Brethel, Daniel	Captain	Ladder 24
Brown, Patrick	Captain	Ladder 3
Brunn, Andrew	Firefighter	Ladder 5
Brunton, Vincent	Captain	Ladder 105
Bucca, Ronald	Fire Marshal	
Buck, Greg	Firefighter	Engine 201
Burke, Jr., William	Captain	Engine 21
Burns, Donald	Assistant Chief	City Wide Tour
Burnside, John	Firefighter	Ladder 20
Butler, Thomas	Firefighter	Squad 1
Byrne, Patrick	Firefighter	Ladder 101
Cain, George	Firefighter	Ladder 7
Calabro, Salvatore	Firefighter	Ladder 101
Callahan, Frank	Captain	Ladder 35
Cammarata, Michael	Firefighter	Ladder 11
Cannizzaro, Brian	Firefighter	Ladder 101
Carey, Dennis	Firefighter	Haz-Mat Co. 1
Carlo, Michael	Firefighter	Engine 230
Carroll, Michael	Firefighter	Ladder 3
Carroll, Peter	Firefighter	Squad 1
Casoria, Thomas	Firefighter	Engine 22
Cawley, Michael	Firefighter	Ladder 136
Cherry, Vernon	Firefighter	Ladder 118
Chiofalo, Nicholas	Firefighter	Engine 235
Chipura, John	Firefighter	Engine 219
Clarke, Michael	Firefighter	Ladder 2
Coakley, Steven	Firefighter	Engine 217
Coleman, Tarel	Firefighter	Squad 252
Collins, John	Firefighter	Ladder 25
Cordice, Robert	Firefighter	Squad 1
Correa, Ruben	Firefighter	Engine 74
Corrigan, James	Captain	Engine 320
Coyle, James	Firefighter	Ladder 3

Fire Department City of New York/Paramedics

List of Dead and Missing:

September 11, 2001

Name	Rank	Unit
Crawford, Robert	Firefighter	Safety Battalion 1
Crisci, John	Lieutenant	Haz-Mat Co. 1
Cross, Dennis	Battalion Chief	Battalion 57
Cullen, III, Thomas	Firefighter	Squad 41
Curatolo, Robert	Firefighter	Ladder 16
D'Auria, Michael	Firefighter	Engine 40
Datri, Edward	Lieutenant	Squad 1
Davidson, Scott	Firefighter	Ladder 118
Day, Edward	Firefighter	Ladder 11
DeRubbio, David	Firefighter	Engine 226
Deangelis, Thomas	Battalion Chief	Battalion 8
Delvalle, Manuel	Firefighter	Engine 5
Demeo, Martin	Firefighter	Haz-Mat Co. 1
Desperito, Andrew	Lieutenant	Engine 1
Devlin, Dennis	Battalion Chief	Battalion 9
Dewan, Gerard	Firefighter	Ladder 3
Dipasquale, George	Firefighter	Ladder 2
Donnelly, Kevin	Lieutenant	Ladder 3
Dowdell, Kevin	Lieutenant	Rescue 4
Downey, Raymond	Battalion Chief	Special Operations
Duffy, Gerard	Firefighter	Ladder 21
Egan, Jr., Martin	Captain	Division 15
Elferis, Michael	Firefighter	Engine 22
Esposito, Francis	Firefighter	Engine 235
Esposito, Michael	Lieutenant	Squad 1
Evans, Robert	Firefighter	Engine 33
Fanning, John	Battalion Chief	Haz-Mat Ops
Farino, Thomas	Captain	Engine 26
Farrell, Terrence	Firefighter	Rescue 4
Farrelly, Joseph	Captain	Division 1
Feehan, William	Chief	1st Deputy Comm.
Fehling, Lee	Firefighter	Engine 235
Feinberg, Alan	Firefighter	Battalion 9
Fiore, Michael	Firefighter	Rescue 5
Fischer, John	Captain	Ladder 20
Fletcher, Andre	Firefighter	Rescue 5
Florio, John	Firefighter	Engine 214

Fire Department City of New York/Paramedics

List of Dead and Missing:

September 11, 2001

Name	Rank	Unit
Fodor, Michael	Lieutenant	Squad 1
Foley, Thomas	Firefighter	Rescue 3
Fontana, David	Firefighter	Squad 1
Foti, Robert	Firefighter	Ladder 7
Fredericks, Andrew	Firefighter	Squad 18
Freund, Peter	Lieutenant	Engine 55
Gambino, Jr., Thomas	Firefighter	Rescue 3
Ganci, Jr., Peter	Chief of Department	Chief of Department
Garbarini, Charles	Lieutenant	Battalion 9
Gardner, Thomas	Firefighter	Haz-Mat Co. 1
Garvey, Matthew	Firefighter	Squad 1
Gary, Bruce	Firefighter	Engine 40
Geidel, Gary	Firefighter	Rescue 1
Geraghty, Edward	Battalion Chief	Battalion 9
Germain, Denis	Firefighter	Ladder 2
Giammona, Vincent	Lieutenant	Ladder 5
Giberson, James	Firefighter	Ladder 35
Gies, Ronnie	Lieutenant	Squad 288
Gill, Paul	Firefighter	Engine 54
Ginley, John	Lieutenant	Engine 40
Giordano, Jeffrey	Firefighter	Ladder 3
Giordano, John	Firefighter	Engine 37
Glascoe, Keith	Firefighter	Ladder 21
Gray, James	Firefighter	Ladder 20
Grzelak, Joseph	Battalion Chief	Battalion 48
Guadalupe, Jose	Firefighter	Engine 54
Guja, Geoffrey	Lieutenant	Battalion 43
Gullickson, Joseph	Lieutenant	Ladder 101
Halderman, David	Firefighter	Squad 18
Halloran, Vincent	Lieutenant	Ladder 8
Hamilton, Robert	Firefighter	Squad 41
Hanley, Sean	Firefighter	Ladder 20
Hannafin, Thomas	Firefighter	Ladder 5
Hannon, Dana	Firefighter	Engine 26
Harlin, Daniel	Firefighter	Ladder 2
Harrell, Harvey	Lieutenant	Rescue 5
Harrell, Stephen	Lieutenant	Battalion 7

Fire Department City of New York/Paramedics

List of Dead and Missing:

September 11, 2001

Name	Rank	Unit
Haskell, Jr., Thomas	Battalion Chief	Division 15
Haskell, Timothy	Firefighter	Squad 18
Hatton, Terence	Captain	Rescue 1
Haub, Michael	Firefighter	Ladder 4
Hayes, Philip	Firefighter	Engine 217
Healey, Michael	Lieutenant	Squad 41
Heffernan, John	Firefighter	Ladder 11
Henderson, Ronnie	Firefighter	Engine 279
Henry, Joseph	Firefighter	Ladder 21
Henry, William	Firefighter	Rescue 1
Hetzel, Thomas	Firefighter	Ladder 13
Hickey, Brian	Captain	Rescue 4
Higgins, Timothy	Lieutenant	Special Operations
Hohmann, Jonathon	Firefighter	Haz-Mat Co. 1
Holohan, Thomas	Firefighter	Engine 6
Hunter, Joseph	Firefighter	Squad 288
Hynes, Walter	Captain	Ladder 13
Ielpi, Jonathon	Firefighter	Squad 288
Ill, Jr., Frederick	Captain	Ladder 2
Johnston, William	Firefighter	Engine 6
Jordan, Andrew	Firefighter	Ladder 132
Joseph, Karl	Firefighter	Engine 207
Jovic, Anthony	Lieutenant	Battalion 47
Juarbe, Jr., Angel	Firefighter	Ladder 12
Judge, Mychal	Chaplain	Chaplain
Kane, Vincent	Firefighter	Engine 22
Kasper, Charles	Battalion Chief	SOC Battalion
Keating, Paul	Firefighter	Ladder 5
Kelly, Thomas	Firefighter	Ladder 105
Kelly, Thomas	Firefighter	Ladder 15
Kelly, Jr., Richard	Firefighter	Ladder 11
Kennedy, Thomas	Firefighter	Ladder 101
Kerwin, Ronald	Lieutenant	Squad 288
Kiefer, Michael	Firefighter	Ladder 132
King, Jr., Robert	Firefighter	Engine 33
Kopytko, Scott	Firefighter	Ladder 15
Krukowski, William	Firefighter	Ladder 21

Fire Department City of New York/Paramedics**List of Dead and Missing:**

September 11, 2001

Name	Rank	Unit
Kumpel, Kenneth	Firefighter	Ladder 25
Kuveikis, Thomas	Firefighter	Squad 252
Laforge, David	Firefighter	Ladder 20
Lake, William	Firefighter	Rescue 2
Lane, Robert	Firefighter	Engine 55
Langone, Peter	Firefighter	Squad 252
Larsen, Scott	Firefighter	Ladder 15
Leavey, Joseph	Lieutenant	Ladder 15
Leavy, Neil	Firefighter	Engine 217
Libretti, Daniel	Firefighter	Rescue 2
Lillo, Carlos	Paramedic	Battalion 49
Linnane, Robert	Firefighter	Ladder 20
Lynch, Michael	Firefighter	Engine 40
Lynch, Michael	Firefighter	Ladder 4
Lyons, Michael	Firefighter	Squad 41
Lyons, Patrick	Firefighter	Squad 252
Maffeo, Joseph	Firefighter	Ladder 101
Mahoney, William	Firefighter	Rescue 4
Maloney, Joseph	Firefighter	Ladder 3
Marchbanks, Jr., Joseph	Battalion Chief	Battalion 57
Margiotta, Charles	Lieutenant	Battalion 22
Marino, Kenneth	Firefighter	Rescue 1
Marshall, John	Firefighter	Ladder 27
Martin, Peter	Lieutenant	Rescue 2
Martini, Paul	Lieutenant	Engine 201
Mascali, Joseph	Firefighter	Tactical Support 2
Maynard, Keithroy	Firefighter	Engine 33
McAleese, Brian	Firefighter	Engine 226
McAvoy, John	Firefighter	Ladder 3
McCann, Thomas	Firefighter	Battalion 8
McGinn, William	Lieutenant	Squad 18
McGovern, William	Battalion Chief	Battalion 2
McHugh, Dennis	Firefighter	Ladder 13
McMahon, Robert	Firefighter	Ladder 20
McPadden, Robert	Firefighter	Engine 23
McShane, Terence	Firefighter	Ladder 101
McSweeney, Timothy	Firefighter	Ladder 3

Fire Department City of New York/Paramedics

List of Dead and Missing:

September 11, 2001

Name	Rank	Unit
McWilliams, Martin	Firefighter	Engine 22
Meisenheimer, Raymond	Firefighter	Rescue 3
Mendez, Charles	Firefighter	Ladder 7
Mercado, Steve	Firefighter	Engine 40
Miller, Douglas	Firefighter	Rescue 5
Miller, Jr., Henry	Firefighter	Ladder 105
Minara, Robert	Firefighter	Ladder 25
Mingione, Thomas	Firefighter	Ladder 132
Mitchell, Paul	Lieutenant	Battalion 1
Modafferi, Louis	Captain	Rescue 5
Mojica, Dennis	Lieutenant	Rescue 1
Mojica, Manuel	Firefighter	Squad 18
Molinaro, Carl	Firefighter	Ladder 2
Montesi, Michael	Firefighter	Rescue 1
Moody, Thomas	Captain	Division 1
Moran, John	Battalion Chief	Battalion 49
Morello, Vincent	Firefighter	Ladder 35
Mozzillo, Christopher	Firefighter	Engine 55
Muldowney, Jr., Richard	Firefighter	Ladder 7
Mullan, Michael	Firefighter	Ladder 12
Mulligan, Dennis	Firefighter	Ladder 2
Murphy, Raymond	Lieutenant	Ladder 16
Nagel, Robert	Lieutenant	Engine 58
Napolitano, John	Firefighter	Rescue 2
Nelson, Peter	Firefighter	Rescue 4
Nevins, Gerard	Firefighter	Rescue 1
Oberg, Dennis	Firefighter	Ladder 105
O'Callaghan, Daniel	Lieutenant	Ladder 4
Oelschlager, Douglas	Firefighter	Ladder 15
Ogren, Joseph	Firefighter	Ladder 3
O'Hagan, Thomas	Lieutenant	Battalion 4
O'Keefe, William	Captain	Division 15
O'Keefe, Patrick	Firefighter	Rescue 1
Oitice, Samuel	Firefighter	Ladder 4
Olsen, Eric	Firefighter	Ladder 15
Olsen, Jeffery	Firefighter	Engine 10
Olsen, Steven	Firefighter	Ladder 3

Fire Department City of New York/Paramedics

List of Dead and Missing:

September 11, 2001

Name	Rank	Unit
O'Rourke, Kevin	Firefighter	Rescue 2
Otten, Michael	Firefighter	Ladder 35
Palazzo, Jeffery	Firefighter	Rescue 5
Palmer, Orio	Battalion Chief	Battalion 7
Palombo, Frank	Firefighter	Ladder 105
Pansini, Paul	Firefighter	Engine 10
Paolillo, John	Battalion Chief	Battalion 11
Pappageorge, James	Firefighter	Engine 23
Parro, Robert	Firefighter	Engine 8
Pearsall, Durrell	Firefighter	Rescue 4
Perry, Gleen	Lieutenant	Ladder 25
Petti, Philip	Lieutenant	Battalion 7
Pfeifer, Kevin	Lieutenant	Engine 33
Phelan, Kenneth	Lieutenant	Engine 217
Pickford, Christopher	Firefighter	Engine 201
Powell, Shawn	Firefighter	Engine 207
Princiotta, Vincent	Firefighter	Ladder 7
Prior, Kevin	Firefighter	Squad 252
Prunty, Richard	Battalion Chief	Battalion 2
Quappe, Lincoln	Firefighter	Rescue 2
Quilty, Michael	Lieutenant	Ladder 11
Quinn, Ricardo	Paramedic	Battalion 57
Ragaglia, Leonard	Firefighter	Engine 54
Ragusa, Michael	Firefighter	Engine 279
Rall, Edward	Firefighter	Rescue 2
Rand, Adam	Firefighter	Squad 288
Regan, Donald	Firefighter	Rescue 3
Regan, Robert	Lieutenant	Ladder 118
Regenhard, Christian	Firefighter	Engine 279/Ladder 131
Reilly, Kevin	Firefighter	Engine 207
Richard, Vernon	Captain	Ladder 7
Riches, James	Firefighter	Engine 4
Rivelli, Jr., Joseph	Firefighter	Ladder 25
Roberts, Michael	Firefighter	Ladder 35
Roberts, Michael	Firefighter	Engine 214
Rodriguez, Anthony	Firefighter	Engine 279
Rogan, Matthew	Firefighter	Ladder 11

Fire Department City of New York/Paramedics

List of Dead and Missing:

September 11, 2001

Name	Rank	Unit
Rossomando, Nicholas	Firefighter	Rescue 5
Rubach, Paul	Firefighter	Ladder 25
Russell, Stephen	Firefighter	Engine 55
Russo, Michael	Lieutenant	Special Operations
Ryan, Matthew	Battalion Chief	Battalion 1
Sabella, Thomas	Firefighter	Ladder 13
Santora, Christopher	Firefighter	Engine 54
Santore, John	Firefighter	Ladder 5
Saucedo, Gregory	Firefighter	Ladder 5
Scauso, Dennis	Firefighter	Haz-Mat Co. 1
Schardt, John	Firefighter	Engine 201
Scheffold, Fred	Battalion Chief	Battalion 12
Schoales, Thomas	Firefighter	Engine 4
Schrang, Gerard	Firefighter	Rescue 3
Sikorsky, Gregory	Firefighter	Squad 41
Siller, Stephen	Firefighter	Squad 1
Smagala, Jr., Stanley	Firefighter	Engine 226
Smith, Kevin	Firefighter	Haz-Mat Co. 1
Smith, Jr., Leon	Firefighter	Ladder 118
Spear, Jr., Robert	Firefighter	Engine 26
Spor, Joseph	Firefighter	Ladder 38
Stack, Lawrence	Battalion Chief	Battalion 50
Stackpole, Timothy	Captain	Division 11
Stajk, Gregory	Firefighter	Ladder 13
Stark, Jeffery	Firefighter	Engine 230
Suarez, Benjamin	Firefighter	Ladder 21
Suhr, Daniel	Firefighter	Engine 216
Sullivan, Christopher	Lieutenant	Ladder 111
Sweeney, Brian	Firefighter	Rescue 1
Tallon, Sean	Firefighter	Ladder 10
Tarasiewicz, Allan	Firefighter	Rescue 5
Tegtmeier, Paul	Firefighter	Engine 4
Tierney, John	Firefighter	Ladder 9
Tipping, II, John	Firefighter	Ladder 4
Tirado, Jr., Hector	Firefighter	Engine 23
VanHine, Richard	Firefighter	Squad 41
Vega, Peter	Firefighter	Ladder 118

Fire Department City of New York/Paramedics

List of Dead and Missing:

September 11, 2001

Name	Rank	Unit
Veling, Lawrence	Firefighter	Engine 235
Vigiano, II, John	Firefighter	Ladder 132
Villanueva, Sergio	Firefighter	Ladder 132
Virgilio, Lawrence	Firefighter	Squad 18
Wallace, Robert	Lieutenant	Engine 205
Walz, Jeffery	Firefighter	Ladder 9
Warchola, Michael	Lieutenant	Ladder 5
Waters, Partick	Captain	Special Operations
Watson, Kenneth	Firefighter	Engine 214
Weinberg, Michael	Firefighter	Engine 1
Weiss, David	Firefighter	Rescue 1
Welty, Timothy	Firefighter	Squad 288
Whelan, Eugene	Firefighter	Engine 230
White, Edward	Firefighter	Engine 230
Whitford, Mark	Firefighter	Engine 23
Wilkinson, Glenn	Lieutenant	Engine 238
Williamson, John	Battalion Chief	Battalion 6
Wooley, David	Captain	Ladder 4
Wren, William X.	Firefighter	Ladder 166
York, Raymond	Firefighter	Engine 285
Roma, Keith	Fire Patrolman	Fire Patrol 2, New York Board of Fire Underwriters

Other Fire/EMS, Emergency Responders

Fire Service

Lovero, Joseph	Fire Dispatcher	Jersey City, NJ
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Paramedic/EMS

Fairben, Keith	Paramedic/Lieutenant	Hospital EMS, New York Presbyterian Hospital / Floral Park, NY Volunteer Fire Department
Hamdani, Mohammed S.	Ambulance Driver	Howard Hughs Medical Institute
Merino, Yamel J.	Paramedic/EMT	Hospital EMS, Metro Care Ambulance
Pearlman, Richard A.	Paramedic/EMT	Hospital EMS, Forest Hills Volunteer Ambulance Corp.
Santoro, Mario L.	Paramedic/EMT	Hospital EMS, New York Presbyterian Hospital
Schwartz, Mark	Paramedic/EMT	Hospital EMS, EMT 7981, Hunter Ambulance
Simpson, Jeff	Paramedic/EMT	Triangle Rescue Squad, Inc., Dumfries, VA
Sullins, David Marc	Paramedic/EMT	Hospital EMS, Cabrini Hospital
Winuk, Glenn J.	Firefighter	Volunteer Firefighter

New York City Police Department

List of Dead and Missing

Name	Rank	Unit/Command
Coughlin, John	Sergeant	ESU Truck 4
Curtin, Michael	Sergeant	ESU Truck 2
Gillis, Rodney	Sergeant	ESU Truck 8
Roy, Timothy	Sergeant	Bus Squad
Richards, Claude	Detective	Bomb Squad
Vigiano, Joseph	Detective	ESU Truck 2
D'Allara, John	Police Officer	ESU Truck 2
Danz, Vincent	Police Officer	ESU Truck 3
Dominguez, Jerome	Police Officer	ESU Truck 3
Driscoll, Stephen	Police Officer	ESU Truck 4
Ellis, Mark	Police Officer	Transit District 4
Fazio, Robert	Police Officer	13th Precinct
Kloepfer, Ronald	Police Officer	ESU Truck 7
Langone, Thomas	Police Officer	ESU Truck 10
Leahy, James	Police Officer	6th Precinct
McDonnell, Brian	Police Officer	ESU Truck 10
Perry, John	Police Officer	40th Precinct
Pettit, Glen	Police Officer	Police Academy
Smith, Moira	Police Officer	13th Precinct
Suarez, Ramon	Police Officer	Transit District 4
Talty, Paul	Police Officer	ESU Truck 10
Valentin, Santos	Police Officer	ESU Truck 7
Weaver, Walter	Police Officer	ESU Truck 3

Port Authority Police Department PAPD/PANYNJ

List of Dead and Missing

Name	Rank	Unit/Command
Morrone, Fred V.	Superintendent of Police	Headquarters Command
Romito, James A.	Chief of Police	Headquarters Command
Mazza, Kathy N.	Captain, CO	PAPD Academy
Infante, Anthony P. Jr.	Police Inspector, CO	JFK International Airport
Cirri, Robert D.	Lieutenant	Executive Officer
Kaulfers, Robert M.	Sergeant	PATH ESU
Amoroso, Christopher	Police Officer	Tactical Response Unit
Barry, Maurice V.	Police Officer	PATH ESU
Callahan, Liam	Police Officer	PATH ESU
Davis, Clinton	Police Officer	WTC Command
Foreman, Donald A.	Police Officer	Holland Tunnel Command
Froehner, Gregg J.	Police Officer	PATH ESU
Gorman, Thomas E.	Police Officer	PATH ESU
Houston, Uhuru Gongu	Police Officer	WTC Command
Howard, George G.	Police Officer	JFK ESU
Huczko, Stephen	Police Officer	Newark Int'l Airport Command
Jurgens, Paul W.	Police Officer	PAPD Academy
Laszezynski, Paul	Police Officer	PATH ESU
Lemagne, David P.	Police Officer	PATH Command
Lennon, John J.	Police Officer	PATH ESU
Levi, John D.	Police Officer	Port Authority Bus Terminal
Lynch, James F.	Police Officer	WTC Command
McIntyre, Donald J.	Police Officer	PATH Command
McNeil, Walter A.	Police Officer	Holland Tunnel Command
Navas, Joseph M.	Police Officer	PATH ESU
Nelson, James	Police Officer	PAPD Academy
Niedermeyer, Alphonse J.	Police Officer	Commercial Vehicle Inspection Unit
Parham, James W.	Police Officer	PAPD Academy
Pezzulo, Dominick A.	Police Officer	Port Authority Bus Terminal
Reynolds, Bruce A.	Police Officer	George Washington Bridge
Rodrigues, Antonio J.	Police Officer	Port Authority Bus Terminal
Rodriguez, Richard	Police Officer	PAPD Academy
Skala, John P.	Police Officer	Lincoln Tunnel Command
Stuart, Walwyn W.	Police Officer	PATH Command
Tietjen, Kenneth	Police Officer	PATH Command

Webb, Nathaniel	Police Officer	Holland Tunnel Command
Wholey, Michael T.	Police Officer	PATH Command
Sirius	Police K-9	Explosives Detection Team

Volunteer Responders

Bourdier, Francisco	Security at Deutsche Bank Building
Costello, Charles G	Elevator Technician
Jurgens, Thomas E.	Volunteer Responder
Lovero, Joseph	Volunteer Responder
Thompson, Capt. Harry W.	Volunteer Responder
Wallace, Mitchel S.	Volunteer Responder

United States Government Personnel

Hatton, Leonard W.	Federal Bureau of Investigation
Miller, Craig James	U. S. Secret Service

Attachment 2

CHRONOLOGY OF EMERGENCY RESPONDER OPERATIONS, WORLD TRADE CENTER ATTACK, SEPTEMBER 11, 2001

Note: (E) indicates that time is an estimate from the original source or has been estimated by the authors based on the available data. All other times listed are based on time recordings or clock readings. These data are compiled from many different sources. The authors of this chronology have included the time based on the best possible data, and the detailed times showing hour, minute, and second are given to represent the exact sequence of events during a given minute or block of time from the same set of recorded data. Based on the variations of recorded and clock times or different time stamps on different sets of recorded data, it is estimated that the error in time for this chronology is on the order of ± 2 minutes.

- 8:46 a.m. Aircraft strikes WTC 1 on north side causing serious building damage and starting fires on floors 94 through 98. (FEMA 403)
The aircraft impact is observed by FDNY personnel assigned to Engine 7 and Ladder 1 as they investigate a gas odor at street level at the intersection of Church Street and Lispenard Street. Ladder 8 is also located at this scene. (FDNY interviews; New York Times; CBS Television documentary)
Battalion 1 Chief (at the intersection of Church Street and Lispenard Street) calls in aircraft impact to the communications center. Personnel and apparatus at the gas odor immediately respond to WTC 1 about fourteen blocks away. The Chief is located at the intersection of Church Street and Lispenard Street.
2nd and 3rd alarms (Note: For FDNY a first alarm requires that the following apparatus be dispatched:
- 8:46 a.m. PAPD Police Desk radio report, Channel W – A unit reports by radio to the Police Desk at the World Trade Center that there has been an explosion at the World Trade Center. A PAPD unit reports that there are major injuries at the Plaza.
- 8:46 a.m. WTC Elevator operations radio report, PA Channel Z – (Note: Significant static on the following transmissions.) "...?... the building. Evacuate the building" "Evacuate the building." "...?... debris ...?..." "...?... some kind of explosion."
- 8:46 a.m. WTC Security radio report, PA Channel X – There is an open microphone transmission with a lot of people yelling.
- 8:47 a.m. NYPD – Level 1 mobilization called; Level 3 mobilization called 8 seconds later (NYPD, McKinsey & Company, 2002)
- 8:47 a.m. Box 8087-2, location of alarm box - Fire Command Desk in WTC 2, location of alarm box in the lobby at Command Desk via Liberty Street Note: Each "Box" record represents the formal dispatch of a unit to the incident location of the "Box.". (FDNY Box Alarm data sheets)
Battalion 1 (WTC 1)
Battalion 2 (WTC 1 Command Post, fatalities)

- Engine 4 (WTC 1, hydrant hookup, upper floors operations, fatalities)
 Engine 6 (WTC 1, hydrant hookup, upper floors operations, fatalities)
 Engine 7 (WTC 1, hydrant hookup, upper floors operations)
 Engine 10 (1WTC, hydrant hookup, upper floors operations, fatality)
 Engine 24 (WTC 1, upper floors operations)
 Engine 263 (post collapse operations)
 Ladder 1, (WTC 1, upper floors operations)
 Ladder 8 (WTC 1, upper floors operations, evacuation of West St., fatality)
 Ladder 10 (WTC 1, upper floors operations, fatalities)
 Ladder 15 (WTC 2, search and evacuation, fatalities)
 Rescue 1 (WTC 1, operation on upper floors, fatalities)
 Marine 1 (evacuated injured to Jersey City, drafted water)
 Marine 6 (operated fire boats Kane and Smoke, evacuated injured to Jersey City, drafted water)
- 8:47 a.m. WTC Security radio report, PA Channel X – "...?... There is a fire on 22."
- 8:47 a.m. WTC Elevator operations radio report, PA Channel Z – "A4 to ...?... hook up" "Roger, evacuate the building, evacuate the building. Head out towards Building 5."
- 8:47 a.m. WTC Elevator operations radio report, PA Channel Z – "B6 ...?... employees, avoid the Concourse, avoid the Concourse."
- 8:47 a.m. WTC Security radio report, PA Channel X – "...?... on the 22nd floor a lot of debris."
- 8:47 a.m. PAPD Police Desk radio report, PA Channel W – "The top ten floors of the Trade Center are on fire, possible aircraft."
- 8:48 a.m. EMS confirms incident (FDNY, McKinsey & company, 2002)
- 8:48 a.m. Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm data sheets)
 SOC Battalion 1 (WTC 1, operations on upper floors, fatality)
 Battalion 4 (WTC 1, fatality)
 Battalion 6 (WTC 1, fatalities)
 Battalion 7 (WTC 2, operation on upper floors, fatalities)
 Engine 5 (WTC 1, hydrant hookup, upper floors operations, relayed water to E 247 & E 41, 5 WTC, fatality)
 Engine 9 & Sat 1 (WTC 1, hydrant hookup, upper floors operations)
 Engine 15 (WTC 1, upper floors operations)
 Engine 28 (WTC 1, hydrant hookup, upper floors operations)
 Engine 33 (WTC 1, hydrant hookup, upper floors operations, post collapse – relayed water from fire boat to manifold, fatalities)
 Ladder 6 (WTC 1, upper floors operations, trapped in B stairway upon collapse)
 Ladder 20, (WTC 1, upper floors operations, fatalities)
- 8:48 a.m. WTC Security radio report, PA Channel X – ".....Be advised I have two (ATM ?) workers down here on B2 between the red and the yellow lot. Be advised, I got two...workers hurt. I need a, ah, EMT down here ASAP." "Where do you need assistance for the (ATM?) workers?" "...?... between a the red lot and yellow lot where the walkway where the (ATM?) office is"

- 8:49 a.m. PAPD Police Desk radio report, PA Channel W – “..... (garbled).....but start doing the evac, the upper levels. Have the units put on the Scot air-packs...apparatus.”
- 8:49 a.m. WTC Security radio report, PA Channel X – “10-4, S4, I understand there may have been an explosion on Liberty Street.”
- 8:49 a.m. WTC Security radio report, PA Channel X – “Stay off the air.”
- 8:49 a.m. WTC Security radio report, PA Channel X – “...?... I need EMS by ...?... I got a security guard that’s hurt.”
- 8:50 a.m. 5th alarm called for WTC 1 (FDNY, McKinsey & Company, 2002)
Command Post established at WTC 1 lobby by Battalion 1
- 8:50 a.m. Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm data sheets)
Engine 1 (WTC 1, fatality)
Engine 3 (WTC 2, WTC 7, WFC 3)
High Rise 1 (WTC 2, WTC 7, WFC 3)
Engine 16 (WTC 1, upper floors operations)
Engine 55 (WTC 1, Siamese connections, upper floors operations, fatalities)
Ladder 5 (WTC 1, upper floors operations, fatalities)
Rescue 2 (WTC 1, operations on upper floors, fatalities)
Rescue 4 (operations unknown, fatalities)
HAZMAT 1 (WTC 2, operations unknown, fatalities)
- 8:50:04 PAPD Police Desk radio, PA Channel W – FDNY Ladder 10 calls to identify which World Trade Center building was involved. “Ladder One Oh, WTC, Go ahead Ladder One Oh. Is it Two World Trade or One World Trade? (response PAPD) One World Trade, on the upper ten floors. (FDNY) Two or One? (response PAPD) Building One.
- 8:50:38 10-84, Engine 55, Note: This transmission was by error. FDNY, World Trade Center Incident Summary (WTC 1, Siamese connections, upper floors operations, fatalities. (FDNY CD12/CD15)
- Note: Code 10-84 denotes that the unit has arrived at the scene.
- 8:50 – 8:59 Incident Command Post established in WTC 1 lobby (FDNY, McKinsey & Company, 2002)
- 14 units responding to WTC 1, all from lower Manhattan. Three of the 14 units reporting are dispatched from stations that have already sent other units to the WTC. (New York Times, website, timeline)
- 8:50:35 PAPD Police Desk radio report, PA Channel W – An Officer calls for chemical mobilization.
- 8:50:48 WTC Security radio report, PA Channel X – “...?... Be advised, I have two.... workers down here on B2 between the red and ...Be advised I got two...workers I need an EMT down here ASAP.” “Where do you need assistance for theworkers?” “B2 between the red...walkway...”

8:51 EMS - 10-40 transmitted Note: Code 10-40 denotes a gas or electrical condition.

8:51:12 PAPD Police Desk radio report, PA Channel W – “Four One to WTC” “Go ahead.” “B1 Level ..(garbled).. We had a minor explosion or major explosion. Something happened down here.” (Response) “There was an explosion on the upper floors.”

8:51:25 WTC Elevator operations radio report, PA Channel Z – “Everybody head over to the B Tower escalators. I’ll set up over here.”

8:51:35 10-84, Ladder 1, (WTC 1, upper floors operations)

8:51 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm data sheets)
Squad 18 (WTC 1 operate on upper floors, fatalities)

8:51:43 Box 9031, location of Alarm Box, West and Liberty Streets (FDNY Box Alarm data sheets)
Battalion 31 (Command Post at WFC 3, Command Post at Marriott)
Engine 205 (Command Post at West and Liberty Streets)
Ladder 110 (WTC 1, up to 21st floor)

8:52 (E) 10-60 alarm for WTC 1 Note: Code 10-60 denotes a Major Emergency (FDNY, McKinsey & Company, 2002)

8:52 NYPD – ESU responds to WTC, five ESU teams deployed into WTC buildings and plaza, one additional ESU team prepares for helicopter rescue that was canceled for safety reasons. (NYPD, McKinsey & Company, 2002)
Aviation unit arrives at scene and examines possibility for roof rescue (NYPD, McKinsey & Company, 2002)
Truck 1 establishes ESU Command Post at Church and Vesey Streets
30 extra staff members assigned to take 9-1-1 calls (NYPD, McKinsey & Company, 2002)

8:52 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm data sheets)
Engine 39 (WTC 1, upper floors operations, trapped in B stairway at collapse)
High Rise 2 (WTC 1, upper floors operations)
Rescue 3/RCO 1 (WTC 2, operations on upper floors, fatalities)

8:52:01 10-84, Engine 18 (FDNY Box Alarm data sheets)

8:52:09 PAPD Police Desk radio report, PA Channel W – “Eight One to TC” “CBD’s aware; they’re mobilizing at this time.”

8:52:17 WTC Elevator operations radio report, PA Channel Z – “Seven Two Six Mark.” “Go John” “Elevator in A Tower is stuck right now...?...in the elevator.” “Alright, John try to try to calm them down. There’s nothing we can do right now. Stand by ...?...” “OK”

8:52:49 PAPD Police Desk radio report, PA Channel W – “People are jumping out the windows.” (response) “What location?” “Tower 1.”

- 8:52:59 FDNY, Police Precinct 76. (FDNY Box Alarm Dispatch log)
- 8:53 EMS - 042 arrives and establishes EMS Command. (FDNY, McKinsey & Company, 2002)
- 8:53 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log)
Ladder 3 (WTC 1, upper floors operations, fatalities)
- 8:53:23 WTC Security radio report, PA Channel X – "...?... Please let me get through the PATH train. Something is going on at the PATH train. Can you ask somebody...?... make announcement 310B...people running out of the PATH train. Copy?"
- 8:54 Battalion 2 assigned as Comcord. (FDNY, McKinsey & Company, 2002)
- 8:54 NYPD – PAPD is notified to shut down all PATH tunnels and trains
All ESU teams advised to respond to Church and Vesey Streets. (NYPD, McKinsey & Company, 2002)
- 8:54 Almost 50 percent of special operations units deployed (FDNY Box Alarm Dispatch log)
- 8:54 EMS – Task forces are staging at Manhattan bridges. (FDNY, McKinsey & Company, 2002)
- 8:54 Box 1377, location of Alarm Box, Columbia and Woodhull Streets (FDNY Box Alarm Dispatch log)
Battalion 40 (Command Post at Marriott),
Battalion 48 (Operations unknown, fatalities),
Engine 202 (Command Post at WFC 3 on West Street)
Engine 204 (Command Post at WFC 3 on West Street)
Engine 210 (Command Post at West and Liberty Streets, hydrant hookup at West and Liberty, at WTC 1 Command Post when WTC 2 collapsed)
Engine 224 Command Post on West Street, relayed water to WTC 2, supplied hoselines for firefighting)
Engine 235 (WTC 2)
Engine 239 (Command Post at West and Vesey Streets, relayed water to E 24)
Ladder 101 (Command Post at West and Liberty Streets, operations in WTC 2, fatalities)
Ladder 105 (WTC 2, operations unknown, fatalities)
Ladder 131 (Command Post at West and Liberty Streets, while in Marriott WTC 2 collapsed, when exiting Marriott WTC 1 collapsed, all injured)
Ladder 132 (WTC 2, rescue work on upper floors, fatalities)
- 8:54:02 WTC Elevator operations radio report, PA Channel Z – "OS6, OS4 Bryan" "Go ...?... we're on 33, C staircase. We're heading down." "All right hurry up Bryan. The lobby is a ... mess Bryan. There's ...?... on the way down. You come out of the building, there is ... falling down from the side of the building, OK. Be very careful...?... a mess."
- 8:54:22 WTC Security radio report, PA Channel X – "... (?)... Do you know basically where the plane hit the building?" (Note: Two unreadable transmissions follow.) "... (?)... By the side right over the ... (?)..." "Come back, I didn't read your transmission. It is on the

side of Building Six Tower One.” “...(?)... One hundred One floor you said?” “ ... (?)... I got too much... (?)... Here, if you can hear me ... (?)... Can you hear me with so much commotion?” “What floor? ...(?)... Building Seven. ...(?)... Hit Building Seven.” “No it hit World Trade Center One but ... (?)... Building Seven. Copy?” “What floor did it hit?” “...(?)... All the way at the top ... (?) ... and above.”
(FDNY Box Alarm Dispatch log)

- 8:54:31 10-84, Ladder 20, (WTC 1, upper floors operations, fatalities)
- 8:54:39 10-84, Battalion Chief 2, (WTC 1 Command Post, fatalities)
- 8:54:41 WTC Security radio report, PA Channel X – “...?... by the side right over the ...?...” “Come back, I didn’t read your transmission.” “It is on the side of Building 6, Tower 1,” “101st floor you said?” “I got too muchhear if you can hear me...” “Can you hear me with so much commotion?” “What floor?”
- 8:54:42 10-84, Ladder 6, (WTC 1, upper floors operations, trapped in B stairway upon collapse) (FDNY Box Alarm Dispatch log)
- 8:54:49 WTC Elevator operations radio report, PA Channel Z – “...?...B to all ACE employees report down to 310B lobby.”
- 8:54:57 FDNY report of people trapped on 106th floor of World Trade Center 1. (FDNY, World Trade Center Incident Summery, 2001)
- 8:55 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log)
Squad 1 (operations unknown, fatalities)
- 8:55 a.m. The first fire companies are arrive at WTC 1. Some firefighters start up stairs.
(New York Times, website, timeline)
- Chiefs set up command post in lobby of WTC 1.
- 8:55 EMS – Initial staging area established on West Street across from WTC 1. (FDNY, McKinsey & Company, 2002)
- 8:55:02 FDNY report of people trapped on 87th floor of World Trade Center 1. (FDNY, World Trade Center Incident Summery, 2001)
(FDNY Box Alarm Dispatch log and CD12/CD15)
- 8:55:12 10-84, Engine 15 (WTC 1, upper floors operations)
- 8:55:18 10-60, Called by Division Chief 1
- 8:55:21 10-84, Rescue Squad 1 (operations on upper floors, fatalities)
- 8:55: 37 10-84, Engine 24 (WTC 1, upper floors operations)
- 8:55:48 FDNY radio dispatcher relays that people are trapped on the 106th floor and Division Chief 1 (DC01) states he has units on the way up. He has unconfirmed reports of fire on

- the 78th floor. He also requests Police Department for security. (FDNY World Trade Center Incident Summary notes, 2001)
- 8:55:49 10-84, Engine 4 (WTC 1, hydrant hookup, upper floors operations fatalities) (FDNY Box Alarm Dispatch log)
- 8:56 NYPD – ESU sends team to meet helicopters for possible roof rescue. (NYPD, McKinsey & Company, 2002)
(FDNY Box Alarm Dispatch log and CD12/CD15)
- 8:56:11 10-84, Ladder 5 (WTC 1, upper floors operations, fatalities)
- 8:56:22 10-47, from FDNY Note: Code 10-47 denotes request for police response.
- 8:56:24 PAPD Police Desk radio report, PA Channel W – “Plaza, be advised through our contact?.... We still have trains coming into the Trade Center.”
- 8:56:30 10-84, Battalion Chief 7 (WTC 2, operation on upper floors, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 8:56:30 WTC Security radio report, PA Channel X - ...(?)... Go. Need an ambulance immediately at Building Four. Have a person injured here. Building Four. That’s a copy.
- 8:56:32 WTC Security radio report, PA Channel X – “Need and ambulance immediately at Building 4. Have a person injured here.” “Building 4, that’s a copy.”
- 8:56:44 WTC Security radio report, PA Channel X – “...?... security dispatch on the side of Building 4 and 2. We have people trying to exit out of the building. Need some assistance...on keeping the people inside.” “That’s a copy.”
- 8:56:51 WTC Security radio report, PA Channel X - ... (?)... security officer dispatch on the side of Building Four and Two. We have people trying to exit out of the building. Need some assistance... (?)... on keeping the people inside. That’s a copy
- 8:57 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)
Squad 288 (operations unknown, fatalities)
- 8:57:20 10-84, Engine 5, (WTC 1, hydrant hookup, upper floors operations, relayed water to E 247 & E 41, 5 WTC, fatality) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 8:57:27 PAPD Police Desk radio reports, PA Channel W – Unit reports broken water pipes at the P4 Level.
- 8:57:30 WTC Security radio report, PA Channel X – “Don’t let anyone in the building.”
“Evacuate the Plaza at this time.”
- 8:57:33 WTC Security radio report, PA Channel X – Evacuate the Plaza at this time.

8:57:49 WTC Elevator operations radio report, PA Channel Z – “Seven, Seven, all ACE mechanics respond down to 310 fire command. Seven, seven, all ACE mechanics respond down to 310 fire command.”

8:57:52 FDNY Battalion Chief 2 (BC02) advises there are jumpers and confirms for Division Chief 1 (DC01) that the jumpers have already jumped. (FDNY World Trade Center Incident Summary notes, 2001)

8:58 NYPD – Chief of Department calls Level 4 mobilization. (NYPD, McKinsey & Company, 2002)

8:58 EMS – Staging established at Church and Fulton Streets. (FDNY, McKinsey & Company, 2002)

8:58:04 WTC Security radio report, PA Channel X – “What elevators are running in Building number One?” ... (?)... OCC... (?)... “S2 to all security guards, hold your posts. Don’t allow people in ... (?)... Do not allow anyone into the courtyard or any ... (?)... leading into the ... (?)... copy?”

8:58:09 10-84, Battalion Chief 6, (WTC 1, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)

8:58:26 WTC Security radio report, PA Channel X – “S2 to all security guards, hold your posts. Don’t allow people in the Plaza...Do not allow anyone onto the Courtyard or any ... leading into the ...” “Copy?”

8:58:29 10-84, Engine 3, (WTC 2, WTC 7, WFC 3) (FDNY Box Alarm Dispatch log and CD12/CD15)

8:58:48 PAPD Police Desk radio report, PA Channel W – “Seventy Ninth floor. We have various people trapped at that location.”

8:59 NYPD – First ESU team enters WTC 1. (NYPD, McKinsey & Company, 2002)

8:59 Eighteen fire apparatus are parked outside of WTC 1. (New York Times website)

8:59:08 Dispatch 5th alarm (FDNY Box Alarm Dispatch log)

8:59:12 WTC Security radio report, PA Channel X – “...?... the Plaza. Evacuate the people.” (FDNY Box Alarm Dispatch log and CD12/CD15)

8:59:26 10-84, Engine 28, (WTC 1, hydrant hookup, upper floors operations)

8:59:32 10-84, Engine 202, (Command Post at WFC 3 on West Street)

8:59:32 PAPD Police Desk radio report, PA Channel W – “Eight One, TC” “Go One.” “As soon as we’re able, I want to start a building evacuation, building one and building two, till we find out what caused this.”

8:59:41 10-84, Ladder 101, (Command Post at West and Liberty Streets, operations in WTC 2, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)

- 8:59:47 WTC Security radio report, PA Channel X – “Sir, be advised on forty-four, Building One, I have people upstairs... (?)... Copy?” “We are aware ... (?)...EMS... (?)... emergency people in route. ...(?)...up there. You all right?”
- 8:59:54 PAPD Police Desk radio report, PA Channel W – “Let’s begin an evacuation of the entire complex.” “All buildings, copy?” “Roger 8.”
- 9:00 second 5th alarm for WTC 1
- 9:00 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)
 Engine 21 (WTC 1, hydrant hookup, upper floors operations, fatality)
 Engine 34 (WTC 1, operated at Command Post and Field Comm Unit)
 Engine 54 (WTC 1, operations unknown, fatalities)
 Engine 65 (WTC 1, upper floors operations)
 Engine 207/Sat. 6 (WTC 1, hydrant hookup, Siamese to 90 West Street, upper floors operations WTC 1, fatalities)
 Engine 226 (Command Post on West Street, provided water from hydrant, operations unknown, fatalities)
 Ladder 9 (WTC 1, upper floors operations, fatalities)
 Ladder 18 (WTC 1, lower floors operations)
 Rescue 5 (operations unknown, fatalities)
- 9:00:07 WTC Security radio report, PA Channel X – “...to S4” “Be advised suite 4711 Building 1, there is a report of glass...” “...couldn’t get outside the room. There’re stuck inside
- 9:00:26 FDNY radio dispatcher advises smoke is on 83rd, 103rd, and 104th floors, reiterates about the people trapped on the 106th floor. (FDNY World Trade Center Incident Summary notes, 2001)
- 9:00:33 WTC Security radio report, PA Channel X - “S4 to 77, K” “Be advised, you have a report of an injured person two World Trade between the 14th and 15th floor. OK”
- 9:00:51 WTC Elevator operations radio report, Channel Z – “...?...” “Go” “Yea Pete, I’m stuck in the stairway.”
- 9:00:54 PAPD Police Desk radio report, PA Channel W – “Building five, start to evacuate building five?” “Stand by on building five.” “Roger.” (Skip portion of transmission) “Go down to the B4 level” “Roger” “...Start at the B4 level for evacuation.” “Affirmative.”
- 9:00 – 9:09 Most companies arriving during this period go the WTC 1. (New York Times, website, timeline)
- 9:01 – 9:03 (E) FDNY Incident Command Post is established on West Street opposite WTC 1 (FDNY, McKinsey & Company, 2002)
- 9:01 NYPD – 1st and 5th precinct Executive Officers advise new mobilization point at Vesey and West Streets (NYPD, McKinsey & Company, 2002)

9:01 EMS - Assistant Chief of EMS arrives (FDNY, McKinsey & Company, 2002)

9:01:09 FDNY radio dispatcher advises Car 4D that there are 25 to 30 people trapped on the 104th floor back room, and 103rd floor north room. Also reports people trapped on 83rd floor. (FDNY World Trade Center Incident Summary notes, 2001)

9:01:58 PAPD Police Desk radio report, PA Channel W – “Evacuate all buildings in the complex. You copy? All buildings in the complex.” “Roger. Units evacuate all units, all tenants in the buildings, at the Trade, at the Trade Center.”

9:01:59 10-84, Safety Battalion 1 (FDNY Box Alarm Dispatch log)

9:02:43 FDNY reports people trapped on 105th floor of World Trade Center 1. (FDNY, World Trade Center Incident Summary, 2001)

9:03 a.m. Aircraft strikes WTC 2 on the south side causing serious building damage and starting fires on floors 78 through 84. (FEMA 403)

A command post is set up in WTC 2 on the West Street side. A second fifth alarm is established to support operations in WTC 2. Sixteen firehouses from lower Manhattan have units responding to the WTC. Five of the sixteen firehouses have multiple units responding to the WTC. (New York Times, website, timeline)

9:03 Incident Command Post established on West Street across from 6 WTC (FDNY, McKinsey & Company, 2002)

9:03 NYPD – Level 4 mobilization transmitted on Citywide 1 (NYPD, McKinsey & Company, 2002)

9:03:00 10-84, Ladder 110, (WTC 1, search and evacuation up to 21st floor) (FDNY Box Alarm Dispatch log and CD12/CD15)

9:03:08 FDNY report of person trapped on 68th floor of World Trade Center, building not identified. (FDNY World Trade Center Incident Summary, 2001)

9:03:22 WTC Security radio report, PA Channel X – “S4...?... The A stair case is clear, copy, from 77 to ...?...”

9:03:33 PAPD Police Desk radio report, Channel W – “Some kind of explosion in building 2.” “Roger.”

9:03:37 WTC Security radio report, PA Channel X – “...?... Hit the building. Another plane ...?... Another plane just hit the building... (?)... Liberty Street

9:03:50 10-84, Engine 205, (Command Post at West and Liberty Streets) (FDNY Box Alarm Dispatch log and CD12/CD15)

9:03:51 FDNY radio dispatcher advises Car 4D (Car 4D is the Incident Command’s Vehicle) about the second plane hitting World Trade Center 2 and advises about people trapped on the 83rd floor in room 8311. (FDNY World Trade Center Incident Summary notes, 2001)

- 9:03:52 WTC Security radio report, PA Channel X – “S4 to FCC” Run those smoke units. They’ll clear the air up there.”
- 9:04:09 10-84, Battalion Chief 31, (Command Post at WFC 3, Command Post at Marriott) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:04:30 PAPD Police Desk radio report, PA Channel W – “Be advised that a second plane has struck the building.” (Response) “Be advised, the building has already been shut down.” (Response) Be advised, another aircraft has struck the building.”
- 9:04:50 PAPD Police Desk radio report, PA Channel W – “We have visual on that. Not known if it was a second plane, possibly a missile.”
- 9:05 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)
Battalion 8 (Command Post, operations unknown, fatality),
Battalion 9 (Command Post, operations unknown, fatalities)
- 9:05:21 FDNY radio dispatcher attempts to reach Car 4D which he is unable to contact. The dispatcher relays the information to Division Chief (DC 01). (FDNY World Trade Center Incident Summary notes, 2001)
- 9:05:51 PAPD Police Desk radio report, PA Channel W – “Eight One, TC” “Go ahead Eight One.” “The city is aware, right, that we need every ambulance that we, ah, that they can spare? Correct?” (response) I’ve notified them again, about five minutes that we have to mobilize everybody. Be advised. We still have people trapped on the upper floors. Fire crews have some units up there to evacuate.
- 9:05:51 FDNY report of a few hundred people trapped on 104th floor of the World Trade Center, building not identified. (FDNY World Trade Center Incident Summary, 2001)
- 9:05:48 FDNY radio communications, PA, WTC Channel 30 repeater – (Note: This series of communications started at 9:05:48 and ended at approximately 9:07:37.) “Battalion 1 to Battalion 7” “Battalion 1 to Battalion 7” “Battalion 7 to Battalion 1, How do you read me?” “Battalion 1 to Battalion 7” “Battalion 7 to Battalion 1, How do you read me?” “Battalion 1 to Battalion 7” “Battalion 7 to Battalion 1, How do you read me?” “Four Bravo to One” (Note: Period of mixed transmission and walkover followed by a possible female voice “20”) “Battalion 1 to Battalion 7” “Bravo to 7” “Go ahead Bravo from Battalion 7” (Note: possible female voice “...?...closed to 10 o’clock”) “I’m down in the lobby and I can read ya.” “Battalion 1 wanted a radio check.” (Note: possible female voice “...?... doing some work;”) “Battalion 1 to Battalion 7, I don’t think we have the report. I picked you up on my radio but not the hard wire.” “Alright, would you want me to remain on channel 7 or go the channel 1?” “...?... Bravo to Field Com” “...?... We’re going to have to use the car repeater. You said you have the repeater on.” “I’m going to give it to Chief Burns in the lobby of Tower 2.” “OK, we’re going to need something in this Tower 1 here.” “Alright, I’ve got the repeater on ... (walkover)... radio OK.” “Battalion 7 to Battalion 1” “Battalion 1, we ah, we’ll use this channel 2 in, ah, this building as a command channel for the Chiefs.” “Alright, you’re going to stay on channel 1 for the tactical.” “Stay on tactical, um ...?... , on the command channel 2.” “10-4”

- 9:05:53 WTC Security radio report, PA Channel X – “SS6 to anybody.” “Go” “We have a fire here and the smoke is developing and we can’t even breathe. We have eyes burning here.” “That’s a copy, sir.”
- 9:06 NYPD – (Chief of Department) orders that no aerial rescue is to be attempted. (NYPD, McKinsey & Company, 2002)
- 9:06:31 PAPD Police Desk radio report, PA Channel W – “Units on channel W, this is 8581 Sierra. There’s been a reported missile launching from the Woolworth Building. CPD, if you are monitoring, get in touch with New York City. Have them check the Woolworth Building roof top.
- 9:07 EMS – Assistant Chief of EMS Ops assumes command. EMS Ops moves into lobby and coordinates with Fire Department. (FDNY, McKinsey & Company, 2002)
- 9:07 (E) FDNY Chief and NYPD Chief receive briefing from FBI officer at Church and Vesey Streets. (NYPD, McKinsey & Company, 2002)
- 9:07 NYPD – Police Chief (PC) orders Command Post to be set up at Barclay Street. (NYPD, McKinsey & Company, 2002)
- 9:07:20 WTC Security radio report, PA Channel X – “...?... Ok, I’m still evacuating 4 World Trade, 4 World Trade Center, going to Building 5. I have people going crazy.” “Let them go out Building 4. Let them go out Building 4 to the side.” “That’s a 10-4. I’ll let them go 4 World Trade Center.”
- 9:08 Box 9998, location of Alarm Box, WTC special box assignment for the attack (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 22 (WTC 1, upper floors operations, fatalities),
Engine 40 (Reported to Command Post WTC 2, operations unknown, fatalities),
Engine 44 (West and Vesey Streets, ordered to maintain street control, assisted Marine 1 with water supply),
Engine 53 (2 WFC, street control, water supply and hose lines),
Engine 211 (hydrant hookup at Barclay and Church Streets, at Command Post at West and Vesey Streets when WTC 2 collapsed),
Ladder 11 (WTC 2, upper floors operations, fatalities),
- 9:08 – 9:13 (E) FDNY establishes a Lobby Command Post inside WTC 2 at the Fire Command Desk. (FDNY, McKinsey & Company, 2002)
- 9:08:27 WTC Security radio report, PA Channel X – “...?... Martinez to the units that are listening. Bring ...Liberty Street...5 World Trade Center.” “Debris coming down. Let em out, let em out, let em out, little by little, let em out.” “I got debris falling from 2 World Trade Center by 4 World Trade Center, Liberty.” “By Liberty, let em out. I can see, not that much debris.” “Alright 10-4.”
- 9:09 Box 9998, location of Alarm Box, WTC special box assignment for the attack (FDNY Box Alarm Dispatch log and CD12/CD15)
Battalion 10 (Command Post, West and Vesey Streets),
Battalion 12 (Marriott, supervised operations at Command Post, fatalities),
Ladder 2 (WTC 2, operations unknown, fatalities),
Ladder 13 (WTC 1, upper floors operations, fatalities)

Ladder 16 (Command Post at 2 WFC, fatalities)

- 9:09 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)
Battalion Chief 11 (WTC 1, operated with Ladder 110, used elevator to travel up to the 16th floor, operations up to the 35th floor, trapped in B stairway with Ladder 6, Engine 16, Engine 39, Battalion Chief 2, and one civilian at collapse) CD12/CD15 and “Last Man Down”
Ladder 22 (Marriott)
- 9:09:26 PAPD Police Desk radio report, PA Channel W – “Eight One, WTC, Eight One. Be advised, we have 105 people, 75 to 100 people trapped up on the Windows of the World, up on the 106th floor....garbled... starting to panic. Roger, we copy.”
- 9:09:05 10-84, Battalion Chief 4, (WTC 1 fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:09:42 WTC Security radio report, PA Channel X – “...?... OK? They are aware you can’t open that door. They’ll be up there to get the debris out of the way.
- 9:09:51 WTC Security radio report, PA Channel X – “Quartermaster WTC, Be advised the fire department is now ... going into the elevator bank L1L2. Copy?”
- 9:10 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, (FDNY, Box Alarm Dispatch log and CD12/CD15)
Engine 201 (WTC 2, operations unknown, WTC 2 post collapse, fatalities),
Engine 240 (At staging area West and Albany Streets when WTC 2 collapsed, stretch hoses, relayed water from Marine 1, extinguished fire at 90 West street.)
Engine 249 (post collapse operations, victim rescue and fires extinguished using hand extinguishers)
Engine 278 (post collapse operations)
Ladder 102 (post collapse operations, evacuated Brooklyn Battery Tunnel)
Ladder 113 (Command Post at West and Liberty Streets, on way to WTC 2 when it collapsed, then to 3 WTC)
Ladder 114 (Reported to Albany and West Streets, arrived just post collapse of WTC 2)
Ladder 119 (post collapse operations, operated Tower on 5 WTC)
Ladder 122 (Reported to Command Post on West street, in Marriott lobby when WTC 2 collapsed)
- 9:10 Box 9998, location of Alarm Box, WTC special box assignment for the attack (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 23 (Marriott, operations unknown, fatalities)
Engine 209 (Command Post at West and Vesey Streets)
Engine 212 (approaching WTC 2 from CP at collapse.)
Engine 214 (Command Post at WTC 2, operations unknown, fatalities)
Engine 216 (WTC 2 firefighter killed by human falling from Tower, fatality)
Engine 217 (WTC 2 assisted E 216 with injured firefighter, fatalities)
Engine 220 (Command Post West and Liberty Streets, approaching WTC 2 at collapse, extinguish fire on 9th floor of Gateway Plaza, assisted with water relay from Marine 1 to Vesey and West streets)

- Engine 221 (Command Post at WFC 3 West Street, approaching WTC 2 at collapse, set up water relay and hand lines)
 Engine 229 (at Command Post 1 WFC on West Street when WTC 2 collapsed, supplied Tower Ladder 146 and 58)
 Engine 230 (Command Post at West and Liberty Streets, operations unknown, fatalities)
 Engine 235 (WTC 2, operations unknown, fatalities)
 Engine 238 (WTC 2, ordered to search upper floors, building collapsed while unit was in stairway, fatality)
 Engine 279 (WTC 2 operations, hydrant hookup West and Liberty, fatalities)
 Ladder 7 (WTC 2, operations unknown, fatalities)
 Ladder 12 (Marriott, upper floors, fatalities)
 Ladder 24 (Marriott, search and evacuation)
 Ladder 118 (WTC 2, operations unknown, fatalities)
- 9:10 (E) Chief of EMS Ops arrives at WTC
- 9:10 100 percent of rescue and high rise units are deployed (FDNY Box Alarm Dispatch log)
- 9:10:01 FDNY report of people trapped in 86th floor suite 8617, World Trade Center 2. (FDNY World Trade Center Incident Summary, 2001)
- 9:10:06 WTC Security radio report, PA Channel X – “(Section Manager?) The express elevators could be in jeopardy of falling. Be prepared for that. Do you copy?” (Note: No recorded response to this transmission.)
- 9:10:19 PAPD Police Desk radio report, PA Channel W – “TC ...garbled..., Report of burning jet fuel up on five one, jet fuel on five one, eight, eight. (Response) That was 51st floor, smell of jet fuel? Negative, burning jet fuel, burning jet fuel, Roger. (Response) Ladder ten you copy that? FDNY, on the 51st floor, burning jet fuel.
- 9:10:40 10-84, Engine 34, (WTC 1, operated at Command Post and Field Comm Unit) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:10 – 9:19 Companies arriving now are mostly sent to WTC 2. A third command post is established at the Marriott Hotel, 3 WTC. 50 companies have arrived on the scene. 23 units from Manhattan (8 of 23 units represent multiple units from the same firehouse) units are from lower and central Manhattan, 4 units arrive from Brooklyn, 2 units arrive from Queens, and 1 unit arrives from The Bronx. (New York Times website, timeline)
- 9:11 FDNY - Field Com begins to maintain status (FDNY, McKinsey & Company, 2002)
- 9:11 NYPD – Back-up transmitter for Citywide channel put in service in anticipation of potential problem with primary transmitter on WTC 1 (NYPD, McKinsey & Company, 2002)
- 9:11 EMS – Staging area designated at West and Vesey Streets (FDNY, McKinsey & Company, 2002)
- 9:11 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)

- Squad 252 (Command Post WTC 1, operated on upper floors, on 20th floor worked to remove occupants from elevator, fatalities)
- 9:11:02 EMS, Trauma, need numerous EMS units (FDNY, McKinsey & Company, 2002)
- 9:11:37 FDNY reports that Engine 10 requests that all responding units stop short of the World Trade Center buildings, either North or South of Liberty and West streets due to large amount of ambulances on the scene and debris falling from the buildings. (FDNY World Trade Center Incident Summary notes, 2001)
- 9:12:21 FDNY reports people trapped on 83rd floor of World Trade Center 2. (FDNY World Trade Center Incident Summary, 2001)
- 9:12:22 WTC Security radio report, PA Channel X – “310B to any unit. Be advised that Building 2 ...Warden Phones. We can’t pick up Warden Phones. We’re just making straight announcements, telling the people not to stay at the Warden phones. We can’t pick them up.” “That’s affirm.”
- 9:13 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, (FDNY Box Alarm Dispatch log and CD12/CD15)
Battalion 41 (Staging area at Brooklyn Battery Tunnel, responded to Vesey Street Command Post)
Battalion 42/32 (Staging area at Brooklyn Battery Tunnel, responded to Command Post at Broadway and Vesey Streets, 5 WTC)
- 9:13:02 FDNY reports a second time a person trapped on the 68th floor of World Trade Center, building not identified. (FDNY World Trade Center Incident Summary, 2001)
- 9:13:11 PAPD Police Desk radio report, PA Channel W – “A1, WTC, ... A1. They want a Port Authority representative at the Fire Command A-SAP.”
- 9:13:12 WTC Security radio report, PA Channel X – “I’m locked out of 4 World Trade Center. Where do you want me to go?”
- 9:13:18 10-84, Battalion Chief 9, (Command Post, operations unknown, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:13:23 WTC Security radio report, PA Channel X – “Let them out by Building 4.” “....?...”
Let em out by Church Street, by Church Street. Let the people out to Church Street.”
- 9:13:28 10-84, Engine 65, (WTC 1, upper floors operations) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:13:39 10-84, Engine 226, (Command Post on West Street, provided water from hydrant, operations) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:13:39 PAPD Police Desk radio report, PA Channel W – “Eight to TC. Be advise I’m responding to Fire Command. Copy?”
- 9:13:39 WTC Security radio report, PA Channel X - : Building 1 is flooding. Building 1 is flooding.

- 9:13:49 WTC Security radio report, PA Channel X – “There’s a lot of water in Building 1. It’s flooding.”
- 9:14 Box 9998, location of Alarm Box, WTC special box assignment for the attack (FDNY Box Alarm Dispatch log and CD12/CD15)
 Engine 47 (WTC 1, upper floors operations),
 Engine 58 (Lobby of Marriott, fatality),
 Engine 74 (Marriott, upper floors operations, fatality),
 Engine 76 (2 WFC, hydrant hookup, Siamese connections on Vesey Street),
 Engine 91 (Command Post/West Street)
 Ladder 4 (operations unknown, fatalities)
 Ladder 21 (operations unknown, fatalities)
 Ladder 22 (Marriott, upper floors operations, in route to WTC 2 at collapse)
 Ladder 25 (WTC 2, operations unknown, fatalities),
 Ladder 35 (WTC 2, operations unknown, fatalities)
- 9:14:02 PAPD Police Desk radio report, PA Channel W – “Eight One, WTC.” “Eight One.”
 “Can we get someone up to the 105th floor, Windows of the World, 75 to 100 people. They need ...garbled... They’re losing ...garbled... options at the location.”
- 9:14:20 WTC Security radio report, PA Channel X – “Evacuate, evacuate ...?...”
- 9:14:21 PAPD Police Desk radio report, PA Channel W – “TC1,” “Head” “Alright, fourteen oh, confirmation at this time, we have no elevators working.” (response) No elevators above?” “That’s affirmative.”
- 9:15 5th alarm for WTC 2, a radio communication from the PA, WTC Channel 30 repeater recording
- NYPD calls for the evacuation of the United Nations building. (NYPD, McKinsey & Company, 2002)
- 9:15 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)
 Engine 26 (operations unknown, fatalities),
 Engine 289 (ordered to pickup air cylinders at Mask Service Unit, arrived at WTC 1 during collapse)
- 9:15:00 PAPD Police Desk radio, PA Channel W – (Note: Radio communications on channel W is very poor at this time. Static and multiple signals mixing with garbled communications)
- 9:15:28 PAPD Police Desk radio, PA Channel W – (Note: A radio mike is stuck open. There is a repeated whaling sound from a building alarm system. The mike is keyed again at, and the transmission stops.)
- 9:15:34 10-84, Special Operations Command 1, (WTC 1, operations on upper floors, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)

- 9:16 (E) FDNY Command Post and Staging area designated for WTC 2 at West and Albany Streets. (FDNY, McKinsey & Company, 2002)
- 9:16 (E) NYPD – Manhattan South begins to establish perimeter 2 blocks around WTC (NYPD, McKinsey & Company, 2002)
- 9:16:27 10-84, Engine 207/Sat. 6 (WTC 1, hydrant hookup, Siamese to 90 West Street, upper floors operations WTC 1, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:16:30 FDNY radio dispatchers advise Car 3 that there are people trapped in World Trade Center Building 1 at the following locations: 82nd floor east side, 83rd floor room 8311, 103rd floor room 103 near corner, 104th floor, and 106th floor. World Trade Center Building 2 at the following locations: 82nd floor west side, 88th floor, 89 floor. (FDNY World Trade Center Incident Summary notes, 2001)
- 9:16:53 10-84, Rescue Squad 3, (WTC 2, operations on upper floors, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:17 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 286/10 (initially out of service, back in service at 0917, relocated to E-10, arrived at WTC 1 when it collapsed, relayed water from Marine 1, fought fires from upper floors of 85 West street to 90 West street)
- 9:17:03 10-84, Rescue Squad 4, (operations unknown, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:17:20 FDNY radio communications, PA, WTC Channel 30 repeater – “Battalion 7, Battalion 7 Alpha” “Alpha” “Alright, we’re sending the elevator down to ya.” “10-4”
- 9:17:50 PAPD Police Desk radio report, PA Channel W – “Eight One from WTC.” “Eight One.” “Roger, if possible can you go with the status of the evac? I’ve got four callers losing oxygen on the 106th floor, One World Trade.” Roger, we’ve got people going up there now. “Roger, Eight One.”
- 9:17:58 10-84, Engine 21, (WTC 1, hydrant hookup, upper floors operations, fatality) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:18:01 FDNY radio communications, PA, WTC Channel 30 repeater – “This is ...?... Battalion 7 in the South Tower to lobby command post, Tower 2.” “...?... not ...?... reading you. Not picking you up.”
- 9:18:14 FDNY radio communications, Channel 30 repeater – (Note: Battalion 7 is on floor 40 in WTC 2. There is one elevator working to the 40th floor.) “This is Battalion 7 on floor 40 in Tower 2. We’ve got one elevator working up to the 40th floor staffed by a member of Latter One Five, K.”
- NYPD calls for the evacuation of the Empire State Building. (NYPD, McKinsey & Company, 2002)
- 9:18:29 10-84, Ladder 21, (operations unknown, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)

- 9:18:43 WTC Security radio report, PA Channel X – Nancy, its Salinger. The fire department tells me they’re abandoning ...?... and go across the street, copy, because there is too much stuff falling.” “Salinger abandon....” “The door is completely closed.” “That’s a copy, door is completely closed.”
- 9:18:55 10-84, Hazmat 1, (WTC 2, operations unknown, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:19 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, (FDNY Box Alarm Dispatch log and CD12/CD15)
Ladder 149 (Staging area West and Chambers Street, post collapse operations)
- 9:19:45 10-84, Ladder 12, (Marriott, upper floors, fatalities)
- 9:19:53 10-84, Ladder 24, (Marriott, search and evacuation)
- 9:20 – 9:29 WTC 2, three fire companies travel to 40th floor by work elevator and check offices to be sure civilians have evacuated. (New York Times, website, timeline)

30 Manhattan firehouses report companies dispatched. 10 of the 30 firehouses have multiple units responding. Manhattan firehouses are from lower, central, and northern parts of the borough. Brooklyn has 7 firehouses with units dispatched, 1 of the 7 houses has multiple units responding. Units from Brooklyn use the tunnel and bridges to enter Manhattan. (New York Times, website, timeline)
- 9:20 (E) EMS – Division 3 Chief in WTC 1 lobby assigned as operations chief and reports to Incident Command Post (FDNY, McKinsey & Company, 2002)
- 9:20:04 PAPD Police Desk radio report, PA Channel W – “A2Jouilie and A2, ah David ..?... Be advised that the, ah, B4 Levels a negative condition down there. No one’s down there. Also, be advised there are four additional Path Officers down stairs. Copy?” “Roger”
- 9:20:55 PAPD Police Desk radio, PA Channel W – PAPD begins a roll call for personnel accountability check.
- 9:21:48 10-84, Ladder 35, (WTC 2, operations unknown, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:22 FDNY radio communications, PA, WTC Channel 30 repeater: Battalion 7 is on 43rd floor of WTC in B stairway.
- 9:22 NYPD – ESU requests mobilization of off-duty personnel (NYPD, McKinsey & Company, 2002)
- 9:22:07 10-84, Engine 76, (2 WFC, hydrant hookup, Siamese connections on Vesey Street) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:22:15 FDNY radio communication, PA, WTC Channel 30 repeater – “Battalion 7 Chief” “Battalion 7, Go” “The emergency service cops want to back you up. Can you tell them

- where you are?” “They got a ...?... with them?” “We’re on the 43rd floor. We’re in stairway B.”
- 9:23 EMS – Tour 1 Chief arrives and establishes EMS liaison at Incident Command Post on West Street. Division 3 Chief arrives at West Street Incident Command Post. Tour 1 Chief transfers responsibility to Division 3 Chief. Assistant Chief of EMS Ops moves to Incident Command Post at West Street (FDNY, McKinsey & Company, 2002)
- 9:23 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 233 (post collapse operations)
Ladder 104 (post collapse operations, collected BF-4 riding lists from abandoned apparatus)
Ladder 161 (post collapse operations, Staging area West and Chambers Street)
- 9:23 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 274 (ordered to pick up air cylinders from Mask Service Unit, arrived at WTC 1 at time of collapse)
- 9:23:08 FDNY radio dispatcher advises Field Comm that 100 people are overcome in Building #1 on the Northwest and Southwest corners of the 103rd floor. Also the dispatcher reports that Ladder 3 reports numerous injuries in the stairwell from the 35th floor on up. (FDNY World Trade Center Incident Summary notes, 2001)
(FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:23:27 10-84, Ladder 11, (WTC 2, upper floors operations, fatalities)
- 9:23:33 10-84, Ladder 2, (WTC 2, operations unknown, fatalities)
- 9:23:51 10-84, Engine 40, (Reported to Command Post WTC 2, operations unknown, fatalities)
- 9:24 FDNY radio communication, PA, WTC Channel 30 repeater - Battalion 7 is on the 48th floor of WTC 2.
- 9:24 EMS – Second staging area is established at West and Chambers Streets
Vesey Division established at West and Vesey Streets (FDNY, McKinsey & Company, 2002)
- 9:24:17 FDNY radio communication, PA, WTC Channel 30 repeater – “59, 15” “Go ahead ...9” “Just got a report from the, ah, director of Morgan Stanley. ...?...they’ve taken the brunt of the stuff. There are a lot of bodies, said that the stairway is clear all the way up though.” “Alright 10-4 Scott. What floor are you on?” “48, right now.” “Ah, 10-4, we’re coming up behind ya.”
(FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:24:20 10-84, Ladder 114, (Reported to Albany and West Streets, arrived just post collapse of WTC 2)
- 9:24:22 10-84, Engine 278, (post collapse operations)

9:24:45 PAPD Police Desk radio report, PA Channel W – “Advise that other bodies are coming down and that people are on the street. There’s a lot of debris. If there’s a way to get the people off the street and out of the courtyard.” “Roger. What’s that location ...?” “The middle courtyard between five and one, that I came across first, and I believe it’s on, on the side of One to my left. I’m still in the building; people are coming down from 64.” (FDNY Box Alarm Dispatch log and CD12/CD15)

9:25:02 10-84, Ladder 131, (Command Post at West and Liberty Streets, while in Marriott WTC 2 collapsed, when exiting Marriott WTC 1 collapsed, all injured)

9:25:03 10-84, Engine 279, (WTC 2 operations, hydrant hookup West and Liberty, fatalities)

9:25:10 FDNY Brooklyn dispatcher advises Manhattan dispatcher that people are trapped in World Trade Center Building #5 on the 80th floor. Manhattan is unable to raise Field Comm but is able to relay message to Division Chief 11 (DC 11). FDNY World Trade Center Incident Summary notes, 2001)

9:25:38 FDNY radio communication, PA, WTC Channel 30 repeater – “7 Alpha to 7” “Go ahead Steve” “Yea Chief, I’m gonna stop on 44 K?” “Take your time.” “10-4”

9:26 NYPD – ESU units set up at Vesey and West Streets and prepare to enter towers.

9:26:27 PAPD Police Desk radio report, PA Channel W – “TC, A One” “Go ahead A One” “Have the units respond to the fire command desk immediately.” “Roger” “All units respond to the Fire Command Desk and meet up with A One, (Devona?)”

9:27 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 264 (Staging area at Brooklyn Battery Tunnel, post collapse operations)
Engine 311 (stretched lines from Marine 1 to 85 West Street, from up inside of 85 West Street extinguished fires on roof of 90 West Street)
Ladder 133 (Command Post at West and Chambers Streets, to Command Post at Broadway and Vesey Street, 3 WTC)

9:27:35 10-84, Division Chief 11 (FDNY Box Alarm Dispatch log)
(FDNY Box Alarm Dispatch log and CD12/CD15)

9:28:11 10-84, Battalion Chief 10, (Command Post, West and Vesey Streets)

9:28:12 10-84, Ladder 16, (Command Post at 2 WFC, fatalities)

9:28:16 PAPD Police Desk radio report, PA Channel W – “TC Two to TC Desk” “Go ahead Two” “Do you have EMS, and EMS unit available, an injured person who has some minor burns and , ah, injuries due to a falling elevator.” “What’s the location of that...?...A20?” (Note: The above transmissions were followed by static and mixing of radio signals.)
(FDNY Box Alarm Dispatch log and CD12/CD15)

9:28:41 10-84, Engine 44, (West and Vesey Streets, ordered to maintain street control, assisted Marine 1 with water supply)

- 9:28:48 10-84, Engine 47, (WTC 1, upper floors operations)
- 9:28:52 FDNY radio communication, PA, WTC Channel 30 repeater – “Battalion 7 Ladder One Five OV” “OV” “...?...Try to contact...The lobby, find out what bank of elevators terminates below the 75th floor. That’s the bank we’re gonna want to use.” “10-4”
- 9:28:58 PAPD Police Desk radio report, PA Channel W – “TC Two. Do you have a triage area?” “Standby let me ask. Let me find out that location.” “Roger, just advise when you find out where there will be a triage.”
- 9:29 FDNY - Recall of off-duty firefighters and officers is issued (FDNY, McKinsey & Company, 2002)
- 9:29 (E) EMS - Casualty Collection Point (CCP) established in lobby of 3 World Financial Center at West and Vesey Streets. EMS - WTC 7 Division established (FDNY, McKinsey & Company, 2002)
- 9:29:11 FDNY dispatcher advises Field Comm that people are trapped in World Trade Center Building #2 on the 82nd, 83rd, and 84th floors. (FDNY World Trade Center Incident Summary notes, 2001)
- 9:29:15 FDNY radio communication, PA, WTC Channel 30 repeater– (Note: This exchange took place over about a 3 minute period.) “Battalion 7 to Branch Commander, Tower 2, South Tower, K” “Battalion 7 to Field Comm, K” “7 Alpha ...?...Battalion 7, Orio, we’re in the North Tower, Tower 2. The North Tower.” “Correction, Battalion 7, it’s the South Tower, Tower 1, Branch Commander, K” “...?...Battalion 7, do you want me to relay?” “Yea, Steve tell, ah, the people of Palmer we got reports of there’s more planes in the area. We may have to back down here.” “10-4, 7 Alpha to 7”
- 9:29:27 WTC Security radio report, PA Channel X – “Where are you?” “B stairway.” “We’re walking down from 51. We are going to do the best we can, but we do have a medical emergency. We have on individual who cannot walk down. Has asthma.” “We are on the 11th floor working, working our way up.”
- 9:30 – 9:39 About 9:30 in WTC 1, several firefighters moving up the stairwell carrying heavy equipment report chest pain. (New York Times)
- 9:30 a.m. An Assistant Fire Chief recalled that the WTC 1 building conditions were poor and made the decision that the building was no longer safe. (FDNY interview #2, winter 2003)
- 9:30:07 WTC Security radio report, PA Channel X – “S4, 63, I’m in the B stairway. Who needs help ...?” “We are in B staircase, 51st floor heading down. We have two people with a medical emergency, elderly people that cannot walk down.” “...?... What tower?” “That’s Tower 1 staircase B.” “Tower 1 staircase B. That’s a copy.... Someone’s in route.”
- 9:30:19 10-84, Engine 22, (WTC 1, upper floors operations, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:30:24 WTC Security radio report, PA Channel X – “...?... to all, everybody turn your phones off ...Make sure they turn off their phones off.”

- 9:30:35 10-84, Ladder 119, (post collapse operations, operated Tower on 5 WTC) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:30:37 PAPD Police Desk radio report, PA Channel W – “A One, WTC.” “A One.” “Be advised EMS is setting up triage in the lobby of Building Two.” “Roger. I got that.” FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:30:49 10-84, Ladder 113, (Command Post at West and Liberty Streets, on way to WTC 2 when it collapsed, then to 3 WTC)
- 9:30:51 10-84, Battalion Chief 41 /BC 31, (Command Post at WTC 3, Command Post at Marriott)
- 9:31:00 10-84, Ladder 102, (post collapse operations, evacuated Brooklyn Battery Tunnel) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:31:28 PAPD Police Desk radio report, PA Channel W – “A One, WTC.” “A One.” “Roger. We’ve received reports of, ah, people trapped in Two World Trade Center, eighty-seventh and eighty-ninth floor.” “Roger, I copy where.”
- 9:31:29 WTC Security radio report, PA Channel X – “Did you bring any of the radios for the fire commander? Did you bring any red bags with the radios for the fire department? ... Did you bring” “No. Is it safe to go into the building?” I haven’t returned to the building. Is it safe to go inside?”
- 9:31:32 FDNY radio communication, PA, WTC Channel 30 repeater – “One Five to One Five Roof” “One Five Roof” “We’ve got reports of another incoming plane. May have take cover. Stay in the stairwell.” “10-4”
- 9:31:35 10-84, Engine 235, (WTC 2, operations unknown, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:32 FDNY radio communications, PA, WTC Channel 30 repeater: Battalion 7 is on 55th floor of WTC 2.
- 9:32 a.m. An Assistant Fire Chief is in lobby of WTC 1 makes a radio call and orders that all units come down to the lobby. (No response was received from this order, it was unheard or ignored.) (NYPD, McKinsey & Company, 2002 and FDNY Interview #2, winter 2003)
- Firefighter Danny Suhr is killed soon after his Brooklyn Engine Company 216 arrives at the scene, hit by a person that fell from WTC 2. (FDNY CD12/15) (New York Times, website)
- 9:32:01 FDNY Engine 317 states that someone from the Port Authority advises not to use the elevators on the 44th floor because they are about to come down. (FDNY World Trade Center Incident Summary notes, 2001.)
- 9:32:02 FDNY radio communication, PA, WTC Channel 30 repeater– “One Five to One Five Roof. That plane is ours. I repeat it’s ours. What floor are you on Scotty?” “54” “Alright, keep making your way up. We’re behind ya.” “10-4”

- 9:32:05 WTC Security radio report, PA Channel X – “Don’t let...Don’t let no body come down ... here. Back em up. Back em up. Back it up all the way up, everybody. Get everybody back.” “87 to 85” “Where are ... back up. ...Back up. Go back ... back up. All units back up.”
- 9:32:12 WTC Security radio report, PA Channel X – “Be advised the concourse is flooding, flooding with water. There is a lot of water in the concourse.” “We are aware of that. We are aware of that.”
- 9:32:23 FDNY radio communication, PA, WTC Channel 30 repeater – “Orio” “Go ahead” “What floor should we try to get up to, Orio?” “I’m up to five, five. We need to find a ...? ..., a stack of elevators that terminates below the ... (radio static, signal drop out)...up. K” “Below what floor?” “Below 76. The fires 78 ... (radio static, signal dropout) ...terminate below 76” “Alright.”
- 9:33:02 10-84, Engine 238, (WTC 2, ordered to search upper floors, building collapsed while unit was in stairway, fatality) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:33:15 10-84, Engine 281 (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:34:19 10-84, Engine 216, (WTC 2, first firefighter fatality at the WTC, killed by human falling from Tower 2. The only fatality for this unit.) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:34:29 PAPD Police Desk radio report, PA Channel W – “A One, WTC” “A One” “I want all responding units to come to this desk, from the various commands to report to this desk, One World Trade Center, Fire Command Desk.”
- 9:34:39 FDNY dispatcher lists to Field Comm the following floors in the World Trade Center Towers to check:
Building #1: 68, 82, 83, 88, 89, 92, 100, 103, 104, 105, 106
Building #2: 47, 73 west south side, 80 north west side, 82, 83 room 8300, 104 east south side, 105 east south side. (FDNY World Trade Center Incident Summary notes, 2001).
- 9:34:50 10-84, Engine 212, (approaching WTC 2 from CP at collapse.) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:35 FDC (NYPD, First Deputy Commissioner) orders no roof rescue to be attempted (NYPD, McKinsey & Company, 2002)
- 9:35:18 PAPD Police Desk radio report, PA Channel W, “TC One, Desk” “Ahead One.” Please be advised from the Mayor’s office. Be advised that another plane hit in this area. Copy?” (Note: There was a communication from unit 815 that immediately followed the above before the acknowledgement.) 9:35:55 – “Roger. Understand the Mayor’s office; another plane is in the area.”
- 9:37:02 PAPD Police Desk radio report, PA Channel W – “...?... AD4? World Trade Desk.” “Go ahead.” “You, ah, hear from ...?... yet?” “That’s a negative.” “Roger, ah, try to

- find out what ...?... cell phone number, beeper number is. The last I saw they were ...?... three niner ... ?... I didn't get the whole transmission." "Alright, Stand By.
- 9:37:16 10-84, Engine 214, (Command Post at WTC 2, operations unknown, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:37:36 PAPD Police Desk radio report, PA Channel W – "All World Trade Center units to the Command Post All World Trade Center units evacuate everybody over the land bridge on West Street to the Financial Center. Do not. Repeat. Do not; send people out into the Concourse on the side street, on land bridge to the Financial Center."
- 9:39 2nd alarm for Brooklyn Battery Tunnel (FDNY, McKinsey & Company, 2002)
- 9:39 FDNY radio communications, PA, WTC Channel 30 repeater - Battalion 7 ten to fifteen injured civilians are being sent down to the 40th floor to be evacuated by elevator
- 9:39 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, Squad 41 (operations unknown, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:39 (E) WTC 2, Floor 51, Two Fire Marshals headed up the stairs after the second plane hit WTC 2 and encounter a burned survivor from the 78th floor. One Fire Marshal takes the women down, and the other Fire Marshal continues up the stairs. (New York Times, website)
- 33 Manhattan firehouses responding (12 of the 33 responding with multiple units), 18 Brooklyn firehouses responding (2 of the 18 responding with multiple units) (New York Times, website, timeline)
- 9:39:06 FDNY radio communication, PA, WTC Channel 30 repeater – "One Five to One Five OV" "One Five OV" "Tommy, listen carefully, I'm sending all the injured down to you on the 40th. You're going to have to get them down to the, ah, to the elevator. There are about 10 to 15 people coming down to ya." "OK, 10 civilians coming down. One Five OV, I'm on the 40th right now, Lou." "Tommy, when you take people down to the lobby try to bring an EMS crew back." "Definitely."
- 9:39:23 10-84, Engine 201, (WTC 2, operations unknown, WTC 2 post collapse, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:40 - 9:49 Chief at WTC 7 is told that WTC buildings could collapse, and he dispatches someone to tell the chiefs on West Street. (FDNY Interviews # 45 and #46, winter 2004)
Another 5th alarm is broadcast. (FDNY, McKinsey & Company, 2002)
Four companies dispatched to WTC 2 from the Marriott 3 WTC are led to WTC 1 by mistake. (FDNY Interviews # 47 and # 53, winter 2004)
- 9:40 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 162 (post collapse operations WTC 1 and WTC 2, operations at WTC 7, hydrant at Church and Vesey Streets, stretched line to WTC 7)

9:40:12 WTC Security radio report, PA Channel X reports victims jumping from the upper floors of the buildings.

9:40:24 PAPD Police Desk radio report, PA Channel W – “Eight Hundred, World Trade” “Go ahead Eight Hundred.” “Be advised, OEM is relocating out of the lobby of Building Number One over to the World Financial Center, relocating the Fire Desk.”

9:40:40 PAPD Police Desk radio report, PA Channel W – “Base...?... We have the stage on fire at the main plaza. The stage is on fire on the ground level at the main plaza.”

9:40:43 FDNY dispatcher advises Field Comm check World Trade Center Building #2, floors 93 and 103. FDNY World Trade Center Incident Summary notes, 2001)

9:41 FDNY radio communications, PA, WTC Channel 30 repeater - Hazmat 1 on 48th floor of WTC 2 in B stairway.

9:41 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, (FDNY Box Alarm Dispatch log and CD12/CD15)
Battalion 32 (Command Post at West and Liberty Streets)
Engine 219 (post collapse operations, established water supply at West and Liberty Streets, stretched hoselines and extinguished ground level fires)
Engine 228/205 (responding through Brooklyn Battery Tunnel when WTC 2 collapsed)
Engine 280 (Ordered to Battery Tunnel staging area, conducted evacuation of tunnel)

9:42 FDNY radio communications, PA, WTC Channel 30 repeater: Battalion 7 is on 69th floor of WTC 2.

9:42:06 10-84, Engine 229, (at Command Post 1 WFC on West Street when WTC 2 collapsed, supplied Tower Ladder 146 and 58) (FDNY Box Alarm Dispatch log and CD12/CD15)

9:42:39 PAPD Police Desk radio report, PA Channel W – “WTC. Be advised the triage center, according to EMS is set up in Building ...?...” “Roger, copy that.” “...?... four, Captain Whitaker. Be advised that the triage center is at Victoria’s Secret, copy, Victoria’s Secret, Building four.” “A One copies where.”

9:42:44 FDNY radio communication, PA, WTC Channel 30 repeater – “Battalion 9 to Battalion 7” “K, Battalion 9” “Orio, I couldn’t find a bank to bring me up any higher. I’m on the 40th. What can I do for you?” “You’re going to have to hoof it up. I’m on 69 now, but we need a higher bank.” “What stairway you in Orio?” “Stairway B, Boy, Boy.”

9:42:52 WTC Security radio report, PA Channel X – “We have people out here that want to volunteer to help. Where can I send them?” “Right now, just send everybody away from the World Trade. We are not letting anybody come close to it. So, ... with that.”

9:43:04 10-84, Engine 220, (Command Post West and Liberty Streets, approaching WTC 2 at collapse, extinguish fire on 9th floor of Gateway Plaza, assisted with water relay from Marine 1 to Vesey and West streets) (FDNY Box Alarm Dispatch log and CD12/CD15)

9:43:26 WTC Security radio report, PA Channel X – “Bill, I’m at the Financial Center. I’m at the fire command station. If you want to send them over here, they have a secure hard line.” “10-4”

- 9:44 a.m. (E) The Office of Emergency Management operations center inside WTC 7 is evacuated. (FDNY, interview 24, winter 2004)
- 9:44:06 10-84, Engine 41
- 9:44:20 WTC Security radio report, PA Channel X – “FS1, go ahead Mike.” Bill have them walk across the bridge ... is at the top of the bridge. He’ll tell them exactly where to go.” “Alright. That’s a 10-4 Mike. They haven’t evacuated the fire command over here.” “In Building 2 or 1?” “Building 2.” “That was the last word so ah we have a spot here if that’s what they want to do.” “10-4”
- 9:44:24 10-84, Battalion Chief 12, (Marriott, supervised operations at Command Post, fatalities) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:44:37 Box 0050, location of Alarm Box, West and Albany Streets (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 240
Engine 201
- 9:45 NYPD – Command and Control Center activated at One Police Plaza. (NYPD, McKinsey & Company, 2002)
- 9:45 (E) Three companies are still on 40th floor of WTC 2 evacuating civilians. (New York Times, website, timeline)
- 9:45:08 WTC Security radio report, PA Channel X – “This is Troy. Tell him we’re sending people down evacuating on Stairway A, in A Tower, Stairway A.” “Stairway A, that’s a copy.”
- 9:45:39 10-84, Ladder 104, (post collapse operations, collected BF-4 riding lists from abandoned apparatus) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:45:50 FDNY radio communication, PA, WTC Channel 30 repeater – “One five to Battalion 7” “Go ahead, One Five.” “Where are ya Chief?” “74” “Ah, we’re making our way behind you we took our coats off.”
- 9:45:58 WTC Security radio report, PA Channel X – “63, this is security officer on 78 Sky Lobby” “...Where is this?” “78 Sky Lobby, 78 Sky Lobby” “That’s a copy. Are you OK?” “Yes, I am. Yes I am. What do you want me to do?” “Is it possible ... Copy” “Sector 4 to Evelyn” “Nancy, be advised, I have someone 1 World Trade Center 78th floor Sky Lobby. Do you Copy?” Sorry say it again.” “1 World Trade Center 78th floor, windows. Do you copy?” “Is that where you’re at now?” “That’s a negative. I’m at Fulton and Broadway. I need someone to respond over there toCopy.”
- 9:46:24 FDNY Field Comm Unit advises the FDNY Chief of Department at the WTC Incident Command Post that an additional 5th alarm is requested to respond to West and Vesey Streets. (FDNY World Trade Center Incident Summary notes, 2001)
- 9:46:36 Box 0050, location of Alarm Box, West and Albany Streets (FDNY Box Alarm Dispatch log and CD12/CD15)

Engine 228
 Engine 219
 Engine 280
 Ladder 114
 Ladder 113

9:47 5th alarm (FDNY, McKinsey & Company, 2002)

9:47 (FDNY Box Alarm Dispatch log and CD12/CD15)
 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk,
 Battalion 21/32 (Command Post West and Liberty Streets)

9:47:00 FDNY radio communication, PA, WTC Channel 30 repeater: - “Battalion 7 to Battalion 9” “Battalion 9 to Battalion 7” “...?... These stairway walls have been compromised on 73 and 74. No smoke or fire problems, K.” “OK, 10-4”

9:47:44 FDNY radio communications, PA, WTC Channel 30 repeater – “One Five to Battalion 7” “Go ahead, Ladder One Five” “What do ya got up there Chief?” “I’m standing in Boy stairway on the 74th floor, no smoke or fire problem. The walls are breached so be careful.” “Yea, 10-4, I saw that on 68. We’re on 71. We’re coming up behind ya.” “OK, ...? ... six more to go.” “Let me know when you see fire.”

9:47:50 Box 0050, location of Alarm Box, West and Albany Streets (FDNY Box Alarm Dispatch log and CD12/CD15)
 Battalion Chief 32

9:47:59 PAPD Police Desk radio report, PA Channel W – “TB Four, WTC. Where’s the command post? Be advised Vesey and West they can’t move to the Financial Center --- ...?... no condition on the street out there.” “Right.” “CD Four ...?... (Note: Transmission was not clear.) “A One from WTC.” “A One.” “Roger, ... ? ... That’s just a heavy traffic condition, it’s like a parking lot on Vesey and West.” “Roger, I copy.”

All five FDNY rescue companies have arrived, 1 from Staten Island. Many companies are now reporting to staging areas across from the WTC. 33 Manhattan firehouses reported at the scene (12 of the 33 responding with multiple units), 22 Brooklyn firehouses with 5 of the 22 responding with multiple units, 2 Queens firehouses, 1 Bronx firehouse, and 1 Staten Island firehouse. (New York Times, website, timeline)

9:49:27 WTC Security radio report, PA Channel X – “S2, Please convey to Doug that ... is on his way down.” “.... Could you repeat that?” “S2 to S1” “George, slow down I can’t understand you.”...”Doug or Anesto Butcher has to talk to ... Its imperative.”

9:49:37 FDNY radio communication, PA, WTC Channel 30 repeater – “One Five to One Five OV” “One Five OV” “Tommy, have you made it back down to the lobby yet?” “The elevators screwed up.” “You can’t move it?” “I don’t want to get stuck in the shaft.” “Ah Tommy, its imperative that you try to get down to the lobby command post to get some people up to forty. We got injured people up here on 70. If you make it to the lobby command post, see if they can somehow get elevators past the 40th floor. We’ve got people injured all the way up here.” “What’s going on with this thing?” “Ah, go Chief” “Yea Chief, I’m on the 55th floor, got to rest. I’ll try to get up there as soon as possible.” “10-4”

- 9:49:49 10-84, Ladder 161, (post collapse operations, Staging area West and Chambers Street) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:50 FDNY radio communications, PA, WTC Channel 30 repeater: Firefighter reports to Chief that he is on the 55th floor and must stop to rest.
- 9:50:37 WTC Security radio report, PA Channel X – “Be advised. I’ve got L1 and Sector 1 one going to the hospital. Copy. So am I.”
- 9:50:55 WTC Security radio report, PA Channel X – “S5, Fire Department needs a resuscitator, Building 1, 19th floor B corridor. (pause) “Anybody copy?” (Note: There is no response to this call.) “S5 to Command Post” “Go from Command Post” “Building 1, 19th floor resuscitation needed.”
- 9:51:03 FDNY radio communication, PA, WTC Channel 30 repeater – “One Five to Battalion 7” “Battalion 7” “What floor you on Orio?” “Stairway on 75. Go to the South stairway and continue up.” “10-4” (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:51:14 10-84, Engine 240, (At staging area West and Albany Streets when WTC 2 collapsed, stretch hoselines, relayed water from Marine 1, extinguished fire at 90 West street.) 10-84, Ladder 114, (Box 0050, post collapse of WTC 2, West and Albany Streets)
- 9:52 NYPD radio transmission, SOD Channel, NYPD helicopters report by radio that “large pieces” are falling from WTC 2. (NYPD interviews # 21 and # 23)
- 9:52:11 FDNY radio communication, PA, WTC Channel 30 repeater – “Anybody see the Highway 1 car? Highway 1 car. We need it for an escort to the hospital for a fireman.”
- 9:52:43 FDNY radio communications, PA, WTC Channel 30 repeater – “Battalion 7 to Battalion 7 Alpha” “Freddie come on over. Freddie come on over by us.” “Battalion ...?... We got, Ladder One Five, we’ve got two to three pockets of fire. We should be able to knock it down with two lines. Rad, Radi, Radio that. 78th floor, numerous 10-45 Code Ones.” “What floor you on Orio?” “7 Alpha to lobby command post.” “One Five to Battalion 7” “Go ahead One Five” “Chief, what stair are you in?” “South stairway Adam, South Tower” “Floor 78.” “10-4, numerous civilians injured. Two engines up here.” “10-4, we’re on our way.” (Note: 10-45 code one represents civilian fatalities)
- 9:53:48 FDNY radio communication, PA, WTC Channel 30 repeater – “Battalion 6, Battalion 6 reports, there’s a sky lobby available at the 44th floor that will serve the floors above. Do you copy that? K”
- 9:53:53 WTC Security radio report, PA Channel X – “(XO ?) Martinez inside 2 World Trade Center with NYPD.” “... Advise me is everyone OK and what is your 20?” Please be advised I got eighteen passengers stuck on the 78 Sky Lobby elevator trying to get them out. We need EMS over here on the double, 2 World Trade Center.” “... Sky Lobby is that an elevator entrapment, sir.” “That’s a 10-4 the firefighter got eighteen passengers stuck. They are going to get them out, they’re burned.”

- 9:54:05 FDNY radio communications, PA, WTC Channel 30 repeater – “7 Alpha to Lobby Command Post. Chief Palmer reports on the 78th floor numerous 10-45 Code Ones. We got an isolated pocket of fire and need at least two hand lines up there. K”
- 9:54:29 Box 2033, location of Alarm Box, Vesey Street 100 feet West of West Street (FDNY Box Alarm Dispatch log and CD12/CD15)
Battalion 45 (Staging area at Queens Midtown Tunnel, to Command Post at West and Vesey Streets, 6 WTC post collapse operations)
Battalion 46 (Staging area at Queens Midtown Tunnel, to Command Post at West and Chambers Streets, operation at Verizon Building)
Battalion 49 (Staging area at Queens Midtown Tunnel, to Command Post at West and Vesey Streets)
Engine 294 (approaching WTC 1 when it collapsed, rescued people from 6 WTC)
Engine 258 (reported to West and Chambers Streets, in route to Command Post at West and Vesey Streets when WTC 1 collapsed)
Engine 259 (apparatus parked at West and Chambers street, in route to Command Post at West and Vesey street when WTC 1 collapsed)
Engine 260 (reporting to Command Post at West and Vesey streets when WTC 1 collapsed)
Engine 261 (reporting to Command Post at West and Vesey streets when WTC 1 collapsed)
Engine 262 (reporting to Command Post at West and Vesey streets when WTC 1 collapsed)
Engine 312 (Command Post at West and Vesey Streets when WTC 1 collapsed)
Engine 325 (post collapse operations)
Ladder 115 (Command Post at West and Vesey when WTC 1 collapsed)
Ladder 116 (Command Post at West and Vesey when WTC 1 collapsed)
Ladder 128 (Command Post at West and Vesey when WTC 1 collapsed)
Ladder 136 (Command Post at West and Vesey when WTC 1 collapsed)
Ladder 138 (Command Post at West and Vesey when WTC 1 collapsed)
Ladder 163 (Command Post at West and Vesey when WTC 1 collapsed)
- 9:54:40 FDNY radio communication, PA, WTC Channel 30 repeater – “Battalion 7 to Ladder One Five” “One Five” “I’m gona need your firefighters Adam stairway to knock down two fires. Get a ...?... house line stretched. We can get some water on it and knock it down. K” “Alright, 10-4, were coming up the stairs. We’re on 77 now on the B stair. We’ll be right to ya.”
- 9:55 FDNY radio communications, PA, WTC Channel 30 repeater: Ladder 15 is on 78th floor, in B stairway, WTC 2, “trapped in here, we’ve got to, ah, put some fire out to get to ya.”
- 9:55 (E) NYPD – 40 ESU officers at Command Post (NYPD, McKinsey & Company, 2002)
2 ESU Teams in WTC 1
2 ESU Teams in WTC 2
1 ESU Team in WTC Plaza
- 9:55 3rd alarm dispatch staging area (FDNY, McKinsey & Company, 2002)
- 9:55 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 241/224 (Command Post at West and Vesey Streets, extinguished fires on street)

- Engine 246/224 (post collapse operations 5 WTC, hydrant hookup on Broadway and Church Streets, water relay to E 503, operated hoseline on street level fires at Church and Liberty Streets)
Engine 284/207 (post collapse operations, hoseline stretch from Marine 1 to Vesey Street)
- 9:55:46 FDNY radio communication, PA, WTC Channel 30 repeater – “One Five OV, One Five” ‘Orio, we’re on 78, but we’re in the B stairway, trapped in here, we’ve got to, ah, put some fire out to get to ya.”
- 9:55:58 Box 2033, location of Alarm Box, Vesey Street 100 feet West of West Street, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 35 (Command Post at West and Vesey Streets, 6 WTC post collapse)
Engine 50 (post collapse operations)
Engine 64
Engine 68 (post collapse operations)
Engine 83 (post collapse operations)
Engine 94 (post collapse operations)
- 9:55:17 10-84, Engine 228, (responding through Brooklyn Battery Tunnel when WTC 2 collapsed) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 9:56:05 FDNY radio communication, PA, WTC Channel 30 repeater – “Fifteen Roof to Fifteen” “Go ahead Fifteen Roof” “Recommend that ya go to the South stairs, the A stairs.” “Ah, 10-4, we’re going to knock down some fire over here in the B stairway. We’ll meet up with ya.” “Get over to the A stair and help Chief Palmer.” “10-4, roof”
- 9:56:36 WTC Security radio report, PA Channel X – “A Tower is not completely evacuated. I think they are on the way down in each stairway. People are still coming out.”
- 9:56:55 FDNY radio communications, PA, WTC Channel 30 repeater – “Battalion 9, I need ya on the floor above 79. We have access stairs going up to 79. K” “Alright, I’m on my way up Orio.”
- 9:57 a.m. Dozens of firefighters have gathered at the WTC 2 lobby command post awaiting orders to go up in the tower. (New York Times)
- 9:57:07 FDNY radio communications, PA, WTC Channel 30 repeater – “Fifteen OV to Fifteen” “Go ahead Fifteen OV, Battalion 7 Operations, Tower 1.” (Note: these communications are actually in the South Tower, Tower 2) “Trapped in the elevator in the elevator shaft. Your gona have to get a different elevator. We’re chopping through the wall to get out.” “Radio Lobby Command with that. Tower 1.”
- 9:57:27 WTC Security radio report, PA Channel X – “...FS2 to (90 Mike?)” “If you can copy this, I’m responding to over to A Tower Fire Command.” “We are trying to get in touch with them from the 22nd floor command center, but we don’t know how to operate the other set of equipment.” “S2 to 77... Try to get up to the 22nd floor, A Tower command center.”
- 9:57:51 FDNY radio communications, PA, WTC Channel 30 repeater - Amplitude of Channel 30 repeater drops to zero.

- 9:57:57 WTC Security radio report, PA Channel X – “...?...78 Sky Lobby, 2 World Trade Center. I got people coming out the elevator banks.”
- 9:59 a.m.** WTC 2 building collapse. (FEMA 403)
- FDNY Field Com unit is destroyed (FDNY, McKinsey & Company, 2002)
- West Street Incident Command Post is destroyed. FDNY, ICP personnel take shelter in nearby structures. (FDNY, McKinsey & Company, 2002)
- Marriott Hotel, 3 WTC – Some firefighters in the lobby and directing evacuations on the upper floors are killed in 3 WTC when WTC 2 collapses. Others are trapped. (FDNY World Trade Center Incident Summary, 2001)
- WTC 1, some firefighters up inside the building as high as the 36th floor hear an urgent order over their radios to evacuate. It is heard over the command radio channel. Multiple companies start down the stairs. (FDNY interviews #16, #39, #41, winter 2004)
- 33 Manhattan firehouses (12 of the 33 multiple units assigned), 27 Brooklyn firehouses (6 of 27 multiple units assigned), 2 Queens, 1 Bronx, 1 Staten Island. (New York Time, website, timeline)
- 9:59:51 Box 2033, location of Alarm Box, Vesey Street 100 feet West of West Street, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 84/16 (Command Post West and Vesey Street, post collapse operations)
Engine 224
Engine 231/24 (Command Post at West and Vesey Streets when WTC 1 collapsed)
Engine 271/6 (left Command Post at West and Vesey streets when WTC 1 collapsed, supplied water to standpipe Siamese at Verizon Building, extinguished fires around Verizon bldg.)
Engine 305/3 (reporting to Command Post at West and Chambers Streets when WTC 1 collapsed)
Engine 307/5 (Command Post at West and Vesey Streets when WTC 1 collapsed)
Engine 310/55 (Command Post at West and Vesey Streets, evacuated Fire Department and civilians from Command Post, WTC 1 collapsed)
- 10:00 NYPD – All ESU personnel ordered out of WTC buildings. (NYPD, McKinsey & Company, 2002)
- 10:00 10-84, Battalion Chief 46, (Staging area at Queens Midtown Tunnel, to Command Post at West and Chambers Streets, operation at Verizon Building) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 10:00 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 14 (post collapse operation)
- 10:00 – 10:09 Surviving Chiefs work to recover command and additional units are arriving.

- WTC 1 - A firefighter, possibly from Ladder 3, reports over the radio a collapse on a floor in the 60's. It is the highest floor reported as being reached in the building. (New York Time, website, timeline)
- 10:00:52 Marine 6 reports collapse of south tower (FDNY, Manhattan Dispatch Radio Channel)
- 10:02:20 FDNY reports that civilian calls for assistance when he gets trapped inside a fire truck as a result of the building collapse. (FDNY World Trade Center Incident Summary notes, 2001)
- 10:03 (E) EMS – Casualty Collection Point transfers to lobby of the Embassy Suites at North End and Vesey Streets. (FDNY, McKinsey & Company, 2002)
- 10:04 (E) EMS – Primary staging area is designated at West and Chambers Streets. (FDNY, McKinsey & Company, 2002)
- 10:06 Box 0320, (FDNY Box Alarm Dispatch log and CD12/CD15)
Engine 160 (post collapse operations, supplied water to two Tower Ladders operating on WTC 7)
- 10:06 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, (FDNY Box Alarm Dispatch log and CD12/CD15)
Ladder 78 (post collapse operations, Command Post at Broadway and Vesey Streets, extinguish street level fires on Broadway, supply water to Tower Ladder 15 on Liberty Street)
- 10:06:01 10-84, Engine 271/E 6, (left Command Post at West and Vesey streets when WTC 1 collapsed, supplied water to standpipe Siamese at Verizon Building, extinguished fires around Verizon bldg.) (FDNY Box Alarm Dispatch log and CD12/CD15)
- 10:06:04 10-84, Engine 282, (stretched and operated hoselines to extinguish debris fires) (FDNY Box Alarm Dispatch log and CD 12/CD15)
- 10:06:05 Second Notification 4. Police operations 212-37 (FDNY Box Alarm Dispatch log)
- 10:07 Mutual aid requested from Westchester County. (FDNY, McKinsey & Company)
- 10:07 a.m. NYPD helicopters hovering near WTC 1 to check its condition radios, “About 15 floors down from the top, it looks like its glowing red.” Aviation 14, radioed at 10:07 a.m. “It’s inevitable.” Seconds later, another pilot (Aviation 6) reported: “I don’t think this has too much longer to go. I would evacuate all people within the area of that second building.” (New York Times)
- NYPD helicopters: Aviation 6 warns that WTC 1 collapse is likely, and advises immediate evacuation. (NYPD, McKinsey & Company)
- 34 Manhattan firehouses (12 of the 34 reporting multiple units), 28 Brooklyn firehouses (6 of 28 reporting multiple units), 5 Queens firehouses, 1 Bronx firehouse, 1 Staten Island firehouse. (New York Times, website, timeline)

10:07:39 10-84, Engine 284, (post collapse operations, hoseline stretch from Marine 1 to Vesey Street)

10:08 Box 9998, location of Alarm Box, WTC special box assignment for the attack Ladder 124/5 (post collapse operations)

10:08 NYPD – Chief of Department orders that no traffic is allowed to enter Manhattan. (NYPD, McKinsey & Company)

10:08:25 Box 0031-3, location of Alarm Box, Broad and Beaver Streets, Explosion smoke in clinic-1.
Engine 14
Ladder 17
Records show no 10-84 for these units arriving at Box. The next record for the units after they acknowledge the assignment messages are 10:58:34 for Ladder 17 and 14:40:21 for Engine 14 indicating that they are available.

10:09 Box 1377, location of Alarm Box, Columbia and Woodhull Streets,
Engine 227 (Command Post at Broadway and Vesey Streets, post collapse operations)

10:09:06 10-84, Engine 84 /E 16, (Command Post West and Vesey Street, post collapse operations)

10:09:13 10-84, Engine 249, (post collapse operations, victim rescue and fires extinguished using hand extinguishers)

10:09:16 10-84, Battalion Chief 46, (Staging area at Queen Midtown Tunnel, to Command Post at West and Chambers Streets, operations at Verizon Building)

10:09:21 10-84, Battalion Chief 45, (Staging area at Queens Midtown Tunnel, to Command Post at West and Vesey Streets, 6 WTC post collapse operations)

10:09:22 Box 0050, location of Alarm Box, West and Albany Streets
Ladder 43 (post collapse operations, WTC 1 stairway B)

10:09:29 10-84, Ladder 116, (Command Post at West and Vesey when WTC 1 collapsed)

10:10 –10:19 Fire Chiefs in front of Marriott 3 WTC work to reestablish operations. Surviving firefighters in 3 WTC try to find their way down from upper floors while others try to free people trapped in the lobby. (New York Times, website, timeline)

10:10:33 10-84, Ladder 136, (Command Post at West and Vesey when WTC 1 collapsed)

10:10:58 10-84, Engine 262, (reporting to Command Post at West and Vesey streets when WTC 1 collapsed)

10:11:38 10-84, Ladder 138, (Command Post at West and Vesey when WTC 1 collapsed)

10:11:42 10-84, Engine 35, (Command Post at West and Vesey Streets, 6 WTC post collapse)

- 10:12 NYPD – All emergency vehicles are ordered to pull back to Vesey and West Streets. (NYPD, McKinsey & Company)
- 10:12 Box 1377, location of Alarm Box, Columbia and Woodhull Streets,
Engine 518 (post collapse operations, stretched hoselines and operated in WTC 7)
Ladder 148 (post collapse Command Post operations, Broadway and Vesey streets)
- 10:12:04 Box 0019-1, location of Alarm Box, 17 Battery PL, West and Washington Streets,
Elevator Shaft Fire
Engine 202
Ladder 59
- 10:12:18 Box 8000-1, location of Alarm Box, St. George Ferry Terminal U/L Opp Pbserv Tower
Engine 164
Engine 157
Engine 156
Engine 166
Engine 155
Engine 162
Ladder 84
Ladder 83
Ladder 85
Marine 9
- 10:13:07 Box 0080-5, location of Alarm Box, Nassau and Fulton Streets, Smoke in Store
Engine 236
Ladder 47
- 10:13:14 10-84, Engine 94, (post collapse operations)
- 10:13:31 Box 0053-2, location of Alarm Box Trinity and Cedar Streets, Trapper
Engine 210
Ladder 58 /L 20
- 10:14:02 10-84, Engine 305/E3, (reporting to Command Post at West and Chambers Streets when WTC 1 collapsed)
- 10:14:55 10-84, Engine 64
- 10:15 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk,
Engine 236/15 (responding to scene when WTC 1 collapsed, stretched handlines from building standpipes and extinguished street level fires)
- 10:15 (E) WTC 1 floor 19 – Evacuating firefighters and other witnesses find a large group of firefighters in no apparent hurry to get out. (New York Times)
- Units from the outer northern boroughs arrive at the scene and escape having casualties. They are the first to search for survivors. 35 Manhattan firehouses (13 of the 35 reporting multiple units), 28 Brooklyn (6 of 28 reporting multiple units), 7 Queens firehouses, 6 Bronx firehouses (1 of the 6 reporting multiple units), 1 Staten Island firehouse. (New York Times, website, timeline)

10:15:03 10-84, Ladder 43, (post collapse operations, WTC 1 stairway B)

10:15:12 10-84, Engine 83, (post collapse operations)

10:15:13 10-84, Engine 68, (post collapse operations)

10:15:25 10-84, Engine 276 /E211,

10:18:42 10-84, Engine 50, (post collapse operations)

10:19:35 FDNY dispatcher advises Engine 228 acting that a firefighter is trapped in the Marriot, bell area. (FDNY World Trade Center Incident Summary notes)

10:19:56 Box 0064-1, location of Alarm Box, Greenwich and Liberty Streets, Deutsche Bank on 22 Floor – Floor Fell
Engine 309 /E 33
Ladder 146 /L 11

10:20 – 10:29 A few companies reach the WTC 1 lobby where they find destruction. Some companies are delayed. Firefighters climb into the Marriott Hotel 3 WTC to answer Mayday calls from trapped personnel. (New York Times, website, timeline)

10:20 NYPD – Aviation 14 states the WTC 1 is leaning. (NYPD, McKinsey & Company)

10:20 Box 9998, location of Alarm Box, WTC special box assignment for the attack
Ladder 58/20 (Arrived at Cedar and Church Streets, WTC 1 collapsed)

10:21:28 10-84, Ladder 148, (post collapse Command Post operations, Broadway and Vesey streets)

10:21:50 10-84, Ladder 47, 10-33 odor of smoke

10:22 Recalled firefighters arriving with assigned units

10:22:18 10-84, Engine 160, (post collapse operations, supplied water to two Tower Ladders operating on WTC 7)

10:23 Mutual aid request issued to Nassau County with directions on staging areas. (FDNY, McKinsey & Company)

10:23:36 10-84, Engine 246 /E235, (post collapse operations 5 WTC, hydrant hookup on Broadway and Church Streets, water relay to E 503, operated hoseline on street level fires at Church and Liberty Streets)

10:24 a.m. Dozens of people trapped in a stairway in WTC 1 on and above the third floor were directed out by a firefighter that had broken through an office wall with an ax. The firefighter opened a hole through the wall to the mezzanine and the street. He lighted the path with his flashlight. He stayed behind to direct others out of the building and did not exit with people that had been trapped. (New York Times interview with Ms. Susan Frederick. “9/11 Exposed Deadly Flaws in Rescue Plan”)

Final count of firehouse units reporting before the WTC 1 collapse:
 35 Manhattan firehouses (13 of the 35 reporting multiple units), 30 Brooklyn (6 of 30 reporting multiple units), 7 Queens firehouses, 7 Bronx firehouses (1 of the 7 reporting multiple units), 1 Staten Island firehouse. (New York Times, website, timeline)

10:24 Box 1377, location of Alarm Box, Columbia and Woodhull Streets,
 Engine 247 (Command Post at Broadway and Vesey Streets, post collapse operations, hydrant hookup and supply of hoselines to Tower Ladders)
 Engine 318/279 (post collapse operations, Staging area at West and Chambers Streets, hose stretch from Marine 1 to Vesey Street)
 Ladder 107/105 (post collapse operations)

10:24:26 Box 0063-7, Broadway and Liberty Streets, People trapped in basement.
 Engine 61 /E 18
 Ladder 3

10:26:29 Marine 9, Acknowledged MDT, (tied up at Vesey and Hudson River, drafted water, supplied numerous 3 ½ inch hoselines to relaying pumpers, tower ladders and manifolds)

10:27 Box 1377, location of Alarm Box, Columbia and Woodhull Streets,
 Battalion 58 (Coordinated staging area at Brooklyn Bridge)

10:27:11 10-84, Engine 227, (Command Post at Broadway and Vesey Streets, post collapse operations)

10:28:02 10-84, Ladder 78, (post collapse operations, Command Post at Broadway and Vesey Streets, extinguish street level fires on Broadway, supply water to Tower Ladder 15 on Liberty Street)

10:28:11 10-84, Engine 236, 10-33 odor of smoke

10:28:16 10-84, Ladder 58 /L 20, (Arrived at Cedar and Church Streets, WTC 1 collapsed)

10:29 a.m. WTC 1 building collapse. (FEMA, 403)

10:30 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk,
 Squad 61 (searched subway station at Church Street (#1Line), searched 5 WTC found one victim and removed to EMS, searched 130 Liberty Street and debris area.

10:30:08 10-84, Engine 318 /E279, (post collapse operations, Staging area at West and Chambers Streets, hose stretch from Marine 1 to Vesey Street)

10:30:30 Engine 289 reports major collapse of both towers.

10:32:12 10-84, Engine 228, (responding through Brooklyn Battery Tunnel when WTC 2 collapsed)

10:32:30 10-84, Engine 247 /E240, (Command Post at Broadway and Vesey Streets, post collapse operations, hydrant hookup and supply of hoselines to Tower Ladders)

10:33:20 10-84, Ladder 85 (post collapse operations, Command Post at Broadway and Vesey, operated Tower Ladder between 4 and 5 WTC)

10:33:56 10-84, Engine 155, (search of 5 WTC, supplied hose lines to debris pile of WTC 2, hooded up of serviceable hydrant at Church and Murray Streets and relayed water to E 229)

10:35 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, Engine 290 (search of debris piles)

10:37 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, Engine 254 (reported to Command Post at West and Chambers Streets, search collapse area)

Ladder 153 (reported to Command Post at Broadway and Vesey Streets, searched 5 WTC, buildings on Liberty Street and debris pile, setup Tower Ladder stream on fire at Bankers Trust Building)

10:38 EMS – Brooklyn Bridge Division established and Brooklyn Bridge Casualty Collection Point established. (FDNY, McKinsey & Company)

10:38:32 10-84, Engine 309 /E 33, (reported to Command Post at West and Liberty Streets, stretched 3 ½ inch hoselines from command post to Marine Companies at pier, stretched supply lines from Marine 2 to E 209 and E 279, stretched supply lines to manifolds and Tower Ladders, searched collapse area)

10:40 (E) EMS – Staging and treatment area established at Harrison and Greenwich Streets. (FDNY, McKinsey & Company)

10:42:51 10-84, Engine 157 (Command Post at West Street, stretch hoseline, fight street fires)

10:45 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, Engine 514 (hooked up to hydrant in front of 80 West Street, stretched 3 ½ inch supply line to Tower Ladder 114 in front of 90 West Street, supplied water to Tower Ladder 15 in front of 90 West Street, supplied water to standpipe of 85 West Street, searched collapse area)

10:45 (E) FDNY Chief arrives at One Police Plaza Command and Control Center. (FDNY, McKinsey & Company)

10:46:09 10-84, Battalion Chief 58, (Coordinated staging area at Brooklyn Bridge)

10:48:26 FDNY Engine 24 calls “Mayday” two members trapped in the promenade. (FDNY World Trade Center Incident Summary notes)

10:49 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, Engine 309/33 (reported to Command Post at West and Liberty Streets, stretched 3 ½ inch hoselines from command post to Marine Companies at pier, stretched supply lines from Marine 2 to E 209 and E 279, stretched supply lines to manifolds and Tower Ladders, searched collapse area)

10:50 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, Engine 206 (hooked to serviceable hydrant at Nassau and John Streets, relayed water to E 221 that was supplying a Tower Ladder, stretched and operated hoselines at Liberty Street debris fires)

10:50:50 FDNY Engine 33 advises that the water pressure is lost in lower Manhattan and requests a fireboat to augment the water supply. (FDNY World Trade Center Incident Summary notes)

10:50:56 10-84, Engine 61/E 18

10:51:36 Box 2033, location of Alarm Box, Vesey Street 100 feet West of West Street-1, Marine 4

10:52:17 Marine 4 Acknowledged RSEP

10:52:17 10-84, Engine 290

10:52:24 10-84, Ladder 83 (post collapse operations, Command Post at West and Chambers Streets, stretched hoselines at various fires, search debris piles)

10:52:02 Box 0064-8, location of Alarm Box, Greenwich and Liberty Streets, People Buried Engine 286/E 10

10:53:52 FDNY personnel request help to rescue civilians trapped, also FDNY members appear to be trapped on the West South of Tower #1. (FDNY World Trade Center Incident Summary notes)

10:54:58 10-84, Engine 166

10:55 Box 1377, location of Alarm Box, Columbia and Woodhull Streets, Engine 248 (reported to Command Post at Broadway and Vesey Streets, assisted Field communications by laying out phone lines between command posts, search of buildings)

10:59 (E) EMS – Dispatch is unable to contact chiefs. (FDNY, McKinsey & Company) Division 2 Deputy Chief prepared to assume command at Brooklyn Bridge

11:00 (E) EMS established liaison at new Incident Command Post at West and Chambers Streets. (FDNY, McKinsey & Company)

11:00 NYPD – 9-1-1 calls rerouted through backup emergency call network

11:00 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, Squad 270 (searched collapse area)

11:10:21 10-84, Engine 206, (hooked to serviceable hydrant at Nassau and John Streets, relayed water to E 221 that was supplying a Tower Ladder, stretched and operated hoselines at Liberty Street debris fires)

11:11:02 Box 0320-1, location of Alarm Box, Brooklyn Bridge Engine 227

Engine 276/E 211
Engine 241/E 224
Engine 249
Engine 282/E 204 (stretched and operated hoselines to extinguish debris fires)
Engine 284/E 207

11:11:33 10-84, Engine 276/E 211

11:12:38 10-84, Engine 248, (reported to Command Post at Broadway and Vesey Streets, assisted Field communications by laying out phone lines between command posts, search of buildings)

11:13:28 Box 0320-1, location of Alarm Box Brooklyn Bridge
Engine 515
Engine 246/E 235
Engine 519
Battalion Chief 41/BC 31
Battalion Chief 42/BC 32
Ladder 148
Ladder 119

11:13:51 10-84, Engine 515, (reported to Command Post at Broadway and Vesey Streets, stretched hoselines and conducted operations at 3 WTC, Marriott, conducted search of collapse area)

11:15 (E) Assistant Chief of EMS Ops and Tour 1 EMS Chief are in route to One Police Plaza to establish inter-agency communications.

11:16:52 Box 0320-1, location of Alarm Box, Brooklyn Bridge
Engine 152
Engine 160
Ladder 78

11:19 Box 0320,
Engine 155 (search of 5 WTC, supplied hose lines to debris pile of WTC 2, hooded up to serviceable hydrant at Church and Murray Streets and relayed water to E 229)
Engine 156 (reported to Command Post on Broadway and Vesey Streets, search building at Liberty and West Streets, supplied hoselines, and supplied water to Tower Ladder 84
Engine 164 (search of building on Liberty Street, searched debris pile)
Ladder 84 (reported to Command Post at Broadway and Vesey Streets, search of 5 WTC, operated Tower Ladder at Church and Vesey Streets on 5 WTC and WTC 7

11:21 EMS – Forward staging area established at West and Chambers Streets. (FDNY, McKinsey & Company)

11:25 Box 1377, location of Alarm Box, Columbia and Woodhull Streets,
Battalion 37 (reported to staging area at Brooklyn Bridge, operated Command Post at Broadway and Vesey Streets)

11:30 (E) NYPD – Chief of Department returns to One Police Plaza. (NYPD, McKinsey & Company)

11:30 (E) EMS presence established at One Police Plaza. (FDNY, McKinsey & Company)

11:38 Recalled firefighters on city buses awaiting deployment. (FDNY, McKinsey & Company)

11:42 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, Ladder 47/6 (search and rescue operations, standpipe hookups and stretch hoselines)

11:48 EMS – contact between One Police Plaza and dispatch established. (FDNY, McKinsey & Company)

11:50 EMS – New Jersey side ferry terminal staging and treatment area established. (FDNY, McKinsey & Company)

11:58 EMS Command conducts roll call for chief location and sector operations. (FDNY, McKinsey & Company)

12:00 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, Engine 321 (supplied building Siamese at 130 Greenwich Street, supplied and operated multiversal on debris, search operations)

12:05 NYPD – Verizon building at 140 West Street flooded

12:07 EMS – West Broadway and Chambers Street staging area is moved to Chelsea and Piers Division as a result of a gas leak. (FDNY, McKinsey & Company)

12:10 (E) EMS three new locations for Casualty Collection Points: Javits Center, Brooklyn Navy Yard, and the Yankees minor league stadium at Staten Island. (FDNY, McKinsey & Company)

12:15 (E) EMS resources staged at Broadway and Reade Streets with 100 Academy personnel. (FDNY, McKinsey & Company)

12:26:13 10-84, Ladder 7, (WTC 2, operations unknown, fatalities)

1:04:54 10-84, FDNY? FC Field Com 1

1:29 Box 9998, location of Alarm Box, WTC special box assignment for the attack Ladder 17/15 (Tower Ladder stream into 4 and 5 WTC)

1:29:53 Battalion Chief 37 reports that eight bus loads of firefighters are located at the Manhattan Bridge

1:30 NYPD – Communications Division switches to emergency control stations

1:40 Box 0300, Engine 153 (stretched and operated hoselines at fires on Liberty Street, supplied Tower Ladder 79)

1:46:25 Battalion Chief 32 reports from Manhattan Bridge that busses are over Bridge to staging area at City Hall Park

2:00 Division 3 Chief assumes EMS command at West and Chambers Streets

2:00 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, Ladder 117/3 (assisted with hoseline stretches and searched for victims)

2:02 Box 9998, location of Alarm Box, WTC special box assignment for the attack Battalion 26/7 (search and extinguish pockets of fire)

2:09:47 Box 0050, location of Alarm Box, West and Albany Streets
Engine 210
Engine 202

2:18:11 Box 2023, location of Alarm Box, Rector PL and South End Ave, Ladder 135/L 5

2:45 (E) NYPD – Verizon provides portable cellular units. (NYPD, McKinsey & Company)

2:45:36 10-84, Ladder 135/L 5, (reported to Command Post at West and Liberty Streets operated Tower Ladder on debris piles and 90 West Street)

2:49:11 Box 2023-1, location of Alarm Box, Rector PL and South End Ave
Ladder 146/L 11

2:55:44 Box 0050, location of Alarm Box, West and Albany Streets
Engine 252

3:09 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, Ladder 79/131 (operated tower Ladder at Greenwich and Liberty Streets, search of debris pile)

3:16:20 Box 2023-1, location of Alarm Box, Rector PL and South End Ave
Ladder 117/L 3

3:17:36 10-84, Engine 230, (Command Post at West and Liberty Streets, operations unknown, fatalities)

3:20:52 10-84, Engine 236/E15, (responding to scene when WTC 1 collapsed, stretched handlines from building standpipes and extinguished street level fires)

3:44:53 10-84, Ladder 117/L 3, (assisted with hoseline stretches and searched for victims)

3:53 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk, Engine 511/6 (members responded to recall and manned a reserve apparatus, stretched 3 ½ inch supply line from Liberty and Church Streets to Liberty and Nassau Streets and hooked up to hydrant and supplied water to the site, searched the collapse area)

4:00 (E) NYPD – Verizon facility at 140 West Street fails due to flooding. (NYPD, McKinsey & Company)

4:46:31 10-84, Battalion Chief 32, (Command Post at West and Liberty Streets)

5:00 Box 8087, location of Alarm Box, WTC 2 lobby at Command Desk,
Ladder 165/18 (reported to West and Vesey Street Command Post, operated at N.Y.
Telephone Building basement fire)

5:20:33 WTC 7 building begins to collapse. (FEMA 403)

5:21:10 p.m. WTC 7 building complete collapse. (FEMA 403)

5:21:11 FDNY Field Comm 1 reports major collapse of World Trade Center Building #7.
(FDNY World Trade Center Incident Summary notes)

Chronology Reference Documents:

Federal Emergency Management Agency, *World Trade Center Building Performance Study: Data Collection, Preliminary Observations, and Recommendations*, FEMA 403, Federal Insurance and Mitigation Administration, Washington, DC, May 2002.

Fire Department City of New York, List of Box Alarms for the World Trade Center on September 11, 2001. The record includes: Box Alarm Location, Unit ID and Assignment Time, Unit ID and Arrival Time.

Fire Department City of New York, Compilation of Unit CD 12/CD 15 Forms on File with FDNY, records include Unit ID, Responded to Box/Time, and Names of Deceased per Unit.

McKinsey & Company, Fire Department City of New York, *Increasing FDNY's Preparedness*, August, 2002.

McKinsey & Company, New York Police Department, *Improving NYPD Emergency Preparedness and Response*, August 2002.

Port Authority of New York and New Jersey, Tape of FDNY Channel 30 Repeater, World Trade Center (Citywide in-building) from 08:45 until 09:58.

Port Authority of New York and New Jersey, Tape of WTC Police Desk #1, Channels 002 – 039, from 07:05 until 09:56.

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Attachment 3

LISTING OF PORT AUTHORITY, NYPD, AND FDNY COMMUNICATIONS

Port Authority, NYPD and FDNY Communications

The NIST received duplicates of many radio and telephone channels. The tapes listed below cover a wide range of times. All recordings cover at least from 8:45 a.m. to 9:58 a.m. The remainder of the communications can be placed in two categories as follows; 7:05 a.m. to 9:58 a.m. and 7:05 a.m. to 6:00 p.m.

Central Police Desk - Police Command Ch 2 to 39 – Each one of these recordings is 198 minutes long.

CPD Ch. 002 - CPD.wav	Not assigned
CPD Ch. 003 - CPD.wav	Not assigned
CPD Ch. 004 - CPD.wav	Not assigned
CPD Ch. 005 - CPD.wav	Not assigned
CPD Ch. 006 - CPD.wav	Not assigned
CPD Ch. 007 - CPD.wav	Not assigned
CPD Ch. 008 - CPD.wav	Not assigned
CPD Ch. 009 - CPD.wav	Not assigned
CPD Ch. 010 - CPD.wav	Not assigned
CPD Ch. 011 - CPD.wav	Not assigned
CPD Ch. 012 - CPD.wav	Not assigned
CPD Ch. 013 - CPD.wav	Not assigned
CPD Ch. 014 - CPD.wav	Not assigned
CPD Ch. 015 - SPEN 1 State Police Emergency Network.wma	
CPD Ch. 016 - Radio SPEN 2 State Police Emergency Network.wma	
CPD Ch. 017 - Radio (Ch. A) PA Area Wide.wma	
CPD Ch. 018 - Radio (Ch. W) LT Police.wma	
CPD Ch. 019 - CPD.wav	Not assigned
CPD Ch. 020 - CPD.wav	Not assigned
CPD Ch. 021 - Phone 911 Emergency.wma (note: recording was blank)	
CPD Ch. 022 - Phone 911 Emergency.wma (note: recording was blank)	
CPD Ch. 023 - Phone SGT's Desk - 201-216-6800.wma	
CPD Ch. 024 - Phone Clerk - 201-216-6800.wma	
CPD Ch. 025 - Phone TTY NY- 201-216-6800.wma	
CPD Ch. 026 - Phone Clerk Extra - 201-216-6800.wma	
CPD Ch. 027 - Phone TTY NJ - 201-216-6800.wma	
CPD Ch. 028 - Phone Absence Control Line 1 - 201-216-6988.wma	
CPD Ch. 029 - Phone Absence Control Line 2 - 201-133-6988.wma	
CPD Ch. 030 - Phone 800 number SGT's Desk - 201-216-6858.wma	
CPD Ch. 031 - Desk TTY number 3.wma	
CPD Ch. 032 - CPD.wav	Not assigned
CPD Ch. 033 - CPD.wav	Not assigned
CPD Ch. 034 - CPD.wav	Not assigned

CPD Ch. 035 - Phone 201-963-7247 Assignment Line 800-776-8580.wma
CPD Ch. 036 - Phone 201-963-7248 Assignment Line 800-776-8580.wma
CPD Ch. 037 - Phone 201-963-7249 Assignment Line 800-776-8580.wma
CPD Ch. 038 - Phone 201-659-3028 Toll Rob 800-TOLL-ROB.wma
CPD Ch. 039 - Phone 201-216-6794 Drug Tip 800-828-PAPD.wma

PATH Police Command - Ch 02 to 31 – Recordings vary in length from 106 minutes to 193 minutes.

PATH Ch. 02 - Phone Desk Right.wma
PATH Ch. 03
PATH Ch. 04
PATH Ch. 05
PATH Ch. 06 - SGT. desk.wma
PATH Ch. 07 - Tour Commander.wma
PATH Ch. 08 - Report Room.wma
PATH Ch. 09 - Juvenile Room.wma
PATH Ch. 10 - Reserve Room 216-6078.wma
PATH Ch. 11 - Phone Desk Left.wma
PATH Ch. 12 - Jersey City Fire Department.wma
PATH Ch. 13 - Jersey City Medical Center.wma
PATH Ch. 14 - Jersey City Police.wma
PATH Ch. 15 - NYPD.wma
PATH Ch. 16
PATH Ch. 17
PATH Ch. 18
PATH Ch. 19 - Conference Room 1.wma
PATH Ch. 20 - Conference Room 2.wma
PATH Ch. 21 - Radio (R2) Train Master.wma
PATH Ch. 22 - PD Wall (Desk Area).wma
PATH Ch. 23 - Court Office 1.wma
PATH Ch. 24 - Court Office 2.wma
PATH Ch. 25 - Court Sgt.wma
PATH Ch. 26 - Radio (R1) Train Master.wma
PATH Ch. 27 - Radio (R30) Communications.wma
PATH Ch. 28
PATH Ch. 29
PATH Ch. 30
PATH Ch. 31

WTC Police Desk 1 - Ch 002 to 039 – Each one of these recordings is 171 minutes.

Ch. 00WTC 2.wav
Ch. 003 WTC.wav
Ch. 004 WTC.wav
Ch. 005 WTC phone 435-8456 clerk.wav
Ch. 006 WTC phone 435-8462 clerk.wav
Ch. 00WTC 7 phone 435-2135 TC.wav
Ch. 008 WTC phone 435-3541 desk left.wav
Ch. 009 WTC phone 435-3541 desk center.wav

Ch. 010 WTC phone 435-3541 desk right.wav
Ch. 01WTC 1 phone 435-8460 conf. room.wav
Ch. 01WTC 2.wav
Ch. 013 WTC phone 435-3519 office.wav
Ch. 014 WTC direct line FDNY.wav
Ch. 015 WTC direct line NYC EMS.wav
Ch. 016 WTC phone 435-7666 floor warden.wav
Ch. 01WTC 7 direct line fire command WTC 1.wav
Ch. 018 WTC direct line fire command WTC 2.wav
Ch. 019 WTC.wav
Ch. 020 WTC.wav
Ch. 02WTC 1 phone 435-2133 police reserve rm..wav
Ch. 02WTC 2 phone 435-2131 SHO desk.wav
Ch. 023 WTC phone 435-2948 desk.wav
Ch. 024 WTC radio Ch. A.wav
Ch. 025 WTC radio Ch. B.wav
Ch. 026 WTC radio Ch. W.wav
Ch. 02WTC 7 radio Ch. X.wav
Ch. 028 WTC radio Ch. Y.wav
Ch. 029 WTC radio Ch. Z.wav
Ch. 030 WTC FDNY radio.wav
Ch. 03WTC 1.wav
Ch. 03WTC 2.wav
Ch. 033 WTC.wav
Ch. 034 WTC.wav
Ch. 035 WTC.wav
Ch. 036 WTC.wav
Ch. 03WTC 7.wav
Ch. 038 WTC.wav
Ch. 039 WTC.wav

Newark International Airport - Police Command - Ch 02 to 39

EWR Ch. 002
EWR Ch. 003
EWR Ch. 004
EWR Ch. 005
EWR Ch. 006
EWR Ch. 007
EWR Ch. 008 - Phone 733-7525 - Newark PD.wma
EWR Ch. 009 - Phone PL234846 - Eliz PD.wma
EWR Ch. 010 - Phone PL92866- Newark FD.wma
EWR Ch. 011 - PL234881 - Eliz FD.wma
EWR Ch. 012 - Phone PL230333 - AFA.wma
EWR Ch. 013
EWR Ch. 014 - Phone PL234979 - REMCS.wma
EWR Ch. 015 - FAA Tower Crash Alarm.wma
EWR Ch. 016
EWR Ch. 017
EWR Ch. 018 - PNPd PVL - OSNA660-650.wma

EWB Ch. 019 - Phone 589-6321 - PNPB.wma
EWB Ch. 020 - Phone 589-0292 - PNPB.wma
EWB Ch. 021 - Phone 961-6666 - Line 3.wma
EWB Ch. 022 - Phone 961-6666 - Line 4.wma
EWB Ch. 023 - Radio - EWB Command - 800Mhz.wma
EWB Ch. 024 - Radio - EWB ARFF - 800Mhz.wma
EWB Ch. 025 - Radio - EWB TAC 1 - 800Mhz.wma
EWB Ch. 026 - Radio - Central Police Desk - 800Mhz.wma
EWB Ch. 027 - Radio - EWB Detectives.wma
EWB Ch. 028 - Police Desk left phone - 961-6230.wma
EWB Ch. 029 - Police desk phone center - 961-6230.wma
EWB Ch. 030 - Police CAD desk phone - 961-6230.wma
EWB Ch. 031 - Police Desk right phone - 961-6230.wma
EWB Ch. 032 - Phone 961-6666 - Line 2.wma
EWB Ch. 033 - Phone 961-6666 - Line 1.wma
EWB Ch. 034
EWB Ch. 035
EWB Ch. 036 - Radio Ch. Z - Operations & Terminals.wma
EWB Ch. 037
EWB Ch. 038 - Radio - Ch. X - Facility Maintenance.wma
EWB Ch. 039 - Radio - Ch. B - Maintenance.wma

NYPD WTC Communications

NYPD Special Operations Division (SOD), Tape 1, 08:46 – 09:33
NYPD Special Operations Division (SOD), Tape 2, 09:32 – 10:18
NYPD Special Operations Division (SOD), Tape 3, 10:18 – 11:04

NYPD City wide 1 radio, Tape 4, 08:40 – 09:27
NYPD City wide 1 radio, Tape 4b, 09:27 - 10:12
NYPD City wide 1 radio, Tape 5c, 10:12 - 11:59
NYPD City wide 1 radio, Tape 5d, 10:59 – 11:46

NYPD Division 1, Tape 6, 08:45 – 9:30
NYPD Division 1, Tape 7, 09:29 – 10:15
NYPD Division 1, Tape 8, 10:14 - 11:00

FDNY WTC Communications

FDNY Manhattan dispatch channel, 154.25 MHz