



Eight-Alarm Fire in a 27-Story High-Rise Apartment Building for the Elderly Nearly Claims the Life of One Fire Fighter—Missouri

SUMMARY

On October 12, 1998, while attempting a rescue, two fire fighters became disoriented in a smoke charged hallway on the 21st floor of a high-rise apartment building, ran out of air, and one of the two fire fighters (Captain on Engine 17, the victim) came close to death in this incident. The fire started in the apartment of an elderly woman, and was reported as originating from an electrical cause or smoking in bed. The fire started shortly after 0900 hours, and the resident unsuccessfully attempted to extinguish the fire with glasses of water for a period of time. She then called the front desk, reported the fire and exited the apartment, leaving the door open, and took the elevator to the lobby. By the time the fire department arrived, the entire hallway on the 21st floor was fully charged with thick black smoke, and the fire had escalated, breaking out the apartment

windows and allowing the wind to blow the apartment door shut. Three oxygen bottles in the apartment, for the resident's use, accelerated the fire growth when they exploded. NIOSH investigators conclude that, to minimize the risk of similar occurrences, fire departments should:

- *ensure that all standard operating procedures (SOPs) regarding high-rise fire fighting operations are followed*
- *ensure that incident command always maintains close accountability to monitor the location of all fire fighters on the fireground*
- *ensure that all officers and fire fighters wear and use a personal alert safety system (PASS) device that are involved in fire fighting, rescue, or other hazardous duty*
- *ensure that a Rapid Intervention Team be in place before conditions become unsafe*



Incident Scene

The **Fire Fighter Fatality Investigation and Prevention Program** is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at:

<http://www.cdc.gov/niosh/firehome.html>

or call toll free **1-800-35-NIOSH**

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- *develop and implement a written respirator maintenance program for all respiratory protective equipment used by fire fighters*
- *ensure that fire fighters entering immediately dangerous to life and health atmospheres have fully charged air tanks on their self-contained breathing apparatus*
- *ensure that at least four fire fighters be on the scene before initiating interior fire fighting operations at a structural fire - two in, two out*

Additional Safety Recommendations

- *consider using a rope attached to a permanent object or placing a bright, narrow-beamed light (e.g., laser) at the entry portal to a structural fire to assist lost or disoriented fire fighters in emergency escape.*
- *ensure that procedures are established to record fireground radio communications*

NIOSH also concluded that municipalities should require all high-rise apartments for the elderly have sprinkler systems installed and operable wherever feasible.

INTRODUCTION

On October 12, 1998, one fire fighter came close to death during a rescue attempt on the 21st floor of a 27-story high-rise apartment complex for the elderly, and eleven civilians were also treated as a result of smoke inhalation. A report was transmitted on the fireground frequency at 0956 hours that a civilian was hanging out of the building on the 21st floor (fire floor). A Captain and a fire fighter who had just exited the fire floor into the stairwell decided to

attempt a rescue from the opposite stairwell (nearest to the reported person in trouble). Both the Captain and the fire fighter knew they were low on air (alarm stage <500 pounds), however, they descended the stairs to the 20th floor, walked through the hall to the opposite stairwell, and ascended the stairs to the 21st floor. They opened the exit door and entered the smoke-filled hall in an attempt to locate the civilian. However, within a few minutes, the Captain and the fire fighter were out of air. The fire fighter managed to find the exit door and escape to the landing in the stairwell; however, the Captain became disoriented and was found approximately 13 minutes later in a trash room closet, 2 feet from the exit door. On October 18-21, 1998, the Chief of the Trauma Investigations Section and a Safety and Occupational Health Specialist traveled to Missouri to investigate the circumstances surrounding the near fatal injury of the Captain on Engine 17 at the request of the Chief from the Fire Department. On December 2, 1998, the Chief of the Trauma Investigations Section returned to Missouri to complete the investigation (work with the Chief Fire Investigator with the Fire Department and interview the Captain on Engine 17 (victim). The Chief of the Fire Department also requested participation from the National Fire Protection Association (NFPA), the International Association of Fire Chiefs (IAFC), and the International Association of Fire Fighters (IAFF). An opening conference was convened at the Fire Department Headquarters by the Fire Commissioner and Chief of the Fire Department with the following: the Chief that was representing the IAFC, the Chief Fire Investigator with the NFPA, and the two NIOSH investigators (technical assistance request from the IAFF). After the opening conference, the investigation team conducted a site visit to the incident scene, the 21st floor of a 27-story masonry high-rise apartment building for the elderly. Each floor contained 12 separate apartments, and the building had approximately 190 occupants at the time of the fire. Five apartments were occupied on the 21st floor.



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Meetings and interviews were also conducted with the Chief Fire Investigator for the Fire Department, Battalion Chiefs, first responding officers, fire fighters responding to the incident, the fire fighter personnel at the respirator maintenance shop, and representatives of the local IAFF. The fire department provided pictures, diagrams of the building, and a video of this incident.

The fire department involved in the incident serves a metropolitan population of 385,000 in a geographic area of 62.5 square miles. The fire department is comprised of approximately 832 employees, of whom 692 are fire fighters and officers, 130 are emergency medical service personnel, and 10 are civilians. The fire department provides all new fire fighters with an extensive 12-week training program at their fire department training academy, which covers all aspects of Level I and Level II fire fighter training as recommended by the NFPA. Upon completing academy training and passing final examinations, a fire fighter is assigned to a fire station. The department requires the continuation of training on each shift for a minimum of 1 hour per shift, plus additional training at the academy in live and planned events, e.g., live fire training, apparatus operations, and fire rescue. The Captain who required extensive hospitalization for smoke inhalation had 20 years of experience with the fire department. The fire fighter involved in the rescue attempt did not require any hospitalization. Three other fire fighters were transported to the hospital, treated and released. Also, eleven civilians were transported to the hospital, treated for smoke inhalation, and released the same day.

Although eight-alarms responded to this high-rise incident, only those directly involved up to the time of the incident are cited in this report.

INVESTIGATION

On October 12, 1998, at 0934 hours, the manager of A 27-story apartment complex (see floor diagram) for the elderly called the fire department to report a fire in apartment 2103. Note: From all the information obtained during this investigation, it is estimated the fire started around 0900 hours (**approximately 30 minutes before it was reported to the fire department**) in apartment 2103 as a result of an electrical short near the bed or from a burning cigarette. The elderly woman who lived in the apartment attempted unsuccessfully to extinguish the fire with glasses of water. It was reported that many bags of polyester clothing were stored in the bedroom, which could have intensified the fire and smoke conditions. In addition, the occupant was using supplemental oxygen, so there were three oxygen bottles in the apartment. When the occupant of the apartment was unsuccessful in extinguishing the fire, she called the front desk and reported the fire, exited the burning apartment, leaving her apartment door open, which charged the hallway with thick black smoke. The fire accelerated, breaking out the large windows, and the apartment door blew shut. One of the residents on the 21st floor stated he heard the fire alarm sounding at approximately 0910 hours and opened the door to his apartment but did not see any smoke or fire.

The first alarm responded at 0935 hours: Engine 29 (Captain and two fire fighters), Engine 17 (Captain [victim], and three fire fighters), Engine 2 (Captain and three fire fighters), Engine 28 (Captain and three fire fighters), Truck 6 (Captain and two fire fighters), Rescue Squad 2 (Captain and four fighters), and Battalion Chief 802 (BC- 802), Battalion Chief 805 (BC-805) and Deputy Chief 810 (DC-810). Engine 29 was the first to arrive on the scene at 0937 hours and reported to Fire Alarm (central dispatch) that heavy smoke was showing. At 0938 hours, Engine 29 requested that Fire Alarm strike a second alarm due to the conditions upon arrival.



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At 0939 hours the second alarm was dispatched: Engine 5 (Captain and three fire fighters), Engine 32 (Captain and three fire fighters), Engine 1 (Captain and two fire fighters), Truck 15 (Captain and three fire fighters), Battalion Chief 801 (BC-801), the Fire Commissioner and Chief (CFD) along with support staff, Captain on 819, Captain on 824, Captain on 826, Captain on 816, Captain on 827, fire fighter on 823, and fire fighter on 825.

At 0939 hours, BC-805 and BC-802 reported to Fire Alarm that they were on the scene.

At 0941 hours, BC-805 requested that Fire Alarm direct all companies go to Channel 3 (fireground channel).

Upon arrival, the Captain and a fire fighter on Engine 29 took the elevator to the 19th floor with the hotel pack (two 50-foot lengths of 1 3/4 inch line) and then they took the west stairwell to the 21st floor (fire floor). Opening the door to the hallway on the 21st floor, which was charged with thick black smoke, they connected the 1 3/4-line to the standpipe located just to the left inside the door. The Captain on Engine 29 took the tip of the hoseline down the hallway on the 21st floor in search of the fire, and 2 fire fighters on Squad 2 followed the charged line; however, they could not locate the fire. The fire fighters on Squad 2 returned to the west stairwell, and the Captain (victim) and two fire fighters on Engine 17 went to the 19th and 20th floors, and observed no fire or smoke on these floors. They then took the west stairwell to the 21st floor and observed heavy smoke in the hallway of the 21st floor. The Captain on Squad 2 and several fire fighters went to the 22nd floor, connected a 1 3/4 inch line to the standpipe, and observed a light haze of smoke in the hallway. Heavy smoke was observed in the apartment directly above the involved apartment on the 21st floor because the flames leaping up from below were breaking the windows. All the residents

on the 22nd floor were gathered into one apartment at the east end of the building. A fire fighter on Squad 2 on the 21st floor stairwell landing re-entered the smoke-filled hallway in an attempt to locate the fire. Following the line to the tip, he could not locate the fire. The fire fighter was running low on air, so he returned to the stairwell and shut off his air. He encountered BC-805, the Captain (victim) on Engine 17, and other fire fighters who were also in the landing. At 0956 hours, a report was transmitted over the radio that a civilian was hanging out the window on the 21st floor apartment.

The Captain (victim) on Engine 17 decided to attempt a rescue although he knew he was low on air. A fire fighter on Squad 2 who was also low on air, stated he would go with him. Both fire fighters descended the steps to the 20th floor, walked down the hallway to the east stairwell landing, and ascended to the 21st floor. They turned on their SCBAs, opened the stairwell door and entered the smoke-laden hallway on the 21st floor, in an attempt to rescue the person who was reported to be hanging out of the window. Low on air and in a dark-hot-heavy smoke environment, both became disoriented, and they attempted to return to the door from which they had just entered. The fire fighter on Squad 2 stated he thought the Captain was right behind him; however, when he found the door and escaped into the landing of the stairwell, he discovered the Captain was not behind him. He pulled off his face piece, opened the door again and yelled for the Captain; however, there was no response from the Captain. The fire fighter stated he opened the door two or three times and yelled for the Captain, but he received no response.

At approximately 0957 hours, an explosion occurred in Apartment 2103, escalating the fire and causing the flames to leap-frog up the exterior of the building.

At approximately 1000 hours, the fire fighter on Engine 17, who just exited the fire floor, went down



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the east stairwell to the 19th floor and changed her air bottle. At the same time, a fire fighter on Squad 2 was changing his empty bottle. Both fire fighters returned to the 21st floor via the west stairwell. Upon arrival at the 21st floor stairwell landing, the door to the hallway opened, and they encountered a fire fighter on Ladder 2 helping a resident out of the hallway. The fire fighter on Engine 17 entered the hallway and relieved the fire fighter at the tip, while the fire fighter on Squad 2 assisted in helping the resident down to the 19th floor, and then down the elevator to the lobby.

0938 hours - Engine 29 requested 2nd alarm
0939 hours - 2nd alarm - BC-805 & BC-802 on the scene
0941 hours - Rescue 1 dispatched
0942 hours - 810 on scene
0945 hours - 3rd alarm - CFD on scene
0946 hours - 3rd alarm dispatched

At 1009 hours, DC-810, BC-805 and BC-801 were in the landing of east stairwell on the 21st floor. They opened the door to the hallway and discovered a fire fighter's helmet just inside the door. The Captain on Ladder 15, a fire fighter on Engine 14, and a fire fighter on Engine 28 were trying to pull a second line to the hallway on the 21st floor from the floor below. The effort to pull the second line was hampered by other fire fighters trying to move elderly residents down the stairs. Every time the door to the 21st floor was opened, the stairwell became charged with thick black smoke. A fire fighter on Engine 14 was advancing a line down the hallway, and within a few feet from the door, found the Captain on Engine 17 (victim) face down and unresponsive (see diagram). The Captain was removed by fire fighters to the 19th floor, and then to the lobby area. He was transported to a local hospital. The Captain was hospitalized for several weeks for smoke inhalation, and to date, has not returned to the fire department.

0949 hours - CFD requested 4th alarm
0950 hours - 4th alarm
0952 hours - DC-810 requested 5th alarm
0954 hours - 5th alarm
0956 hours - CFD reported man at window on 21st floor
0957 hours - explosion of oxygen bottles - apartment 2103
0959 hours - 6th alarm
1003 hours - 7th alarm - CFD requested
1004 hours - 7th alarm
1007 hours - bringing elderly residents down east stairwell from 22nd floor - can't open door to 21st floor because stairwell becomes charged with smoke

SYNOPSIS TIME LINE

0935 hours - 1st alarm - front desk from high-rise reported possible bed fire on 21st floor
0937 hours - Engine 29 on the scene - reported heavy smoke showing

1009 hours - CFD reported a fireman at the window on 21st floor
1011 hours - 8th alarm

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1013 hours - CFD reported most of the fire knocked down

1016 hours - Captain (victim) being transported to hospital

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Fire departments should ensure that all standard operating (SOPs) regarding high-rise fire fighting operations are followed on the fireground. ^[1-3]

Discussion: High-rise fires present a complex set of circumstances and it is important that all standard operating procedures be followed to minimize the risk of serious injury to fire fighters and occupants. The fire department should review the high-rise procedures and evaluate the performance on this incident for compliance and deviation from the standard.

Recommendation #2: Fire departments should ensure that incident command always maintains close accountability to monitor the location of all fire fighters on the fireground. ^[3-5]

Discussion: Accountability for all fire fighters on the fireground is paramount, and one of the fire commands' most important duties. The fire department has SOPs on fire ground accountability, however, at this incident, there appeared to be a breakdown in accountability. The lack of fireground accountability system on the fire floor may have contributed to free lancing among fire fighters.

Recommendation #3: Fire departments should ensure that all officers and fire fighters wear and use a personal alert safety system (PASS) device that are involved in fire fighting, rescue, or other hazardous duty. ^[2, 6]

Discussion: The PASS device is a small electrical device worn by the fire fighter which will emit a distinctive audible alarm if the fire fighter becomes motionless for more than 30 seconds. However, neither the Captain or the fire fighter who was attempting a rescue on the 21st floor had activated their PASS devices before entering the smoke-charged hallway.

Recommendation #4: Fire departments should ensure that a Rapid Intervention Team be in place before conditions become unsafe. ^[6, 7]

Discussion: A Rapid Intervention Team should be positioned to respond to every major fire. The team should report to the officer in command and remain at the command post until an intervention is required to rescue a fire fighter(s). The Rapid Intervention team should have all the tools necessary to complete the job, e.g., a search rope, first aid kit, and a resuscitator to use if a fire fighter is injured. Many fire fighters who die from smoke inhalation, or a from a flashover, or are caught or trapped by fire, actually become disoriented and run out of air. The Rapid Intervention Team should be positioned on the floor below the fire floor, and ready to respond when a fire fighter(s) is down or in trouble. NOTE: If freelancing is practiced, it is difficult for a Rapid Intervention Team or Incident Command to know when a fire fighter is in trouble.

Recommendation #5: Fire departments should develop and implement a written respirator maintenance program for all respiratory protective equipment used by fire fighters. ^[7-11]

Discussion: Fire Departments should establish service and maintenance procedures and rigidly enforce them to provide respirators that are dependable and are constantly evaluated, tested, and maintained. Equally important is recordkeeping, a critical element of any respirator maintenance protection program.

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In review of the SCBA SOPs the following recommendations are offered: the Morning Check SOP should cover the basics of cylinder pressure (NIOSH recommendations require that a cylinder be taken out of service if the pressure falls below 90% of the rated pressure), regulator function, audible alarm, facepiece and harness. References: OSHA 1910.134(h)(3)(iii) (inspection of cylinders); NFPA 1404, Chapter 7-2.1 (recharging air cylinders). Also, the fire department should be keeping a written record showing the morning check has been conducted each day and by whom.

An acceptable maintenance and inspection SOP should address and ensure the following:

- disassembly into each major sub-assembly, regulator flow testing, regulator disassembly and cleaning (according to manufacturer's recommendations), replacement of all worn or broken parts as well as those recommended by the manufacturer (for all sub-assembly components and not just regulator)
- disassembly, cleaning and repair of audible alarm following manufacturers recommendations
- disassembly, cleaning, and repair of the facepiece and harness assemblies following manufacturer's recommendations, and reassembly of major subassemblies into the complete SCBA followed by the appropriate functional tests (alarm, bypass valve, main-line valve, etc.)
- proper record keeping - records should be kept for each individual SCBA in the department which would include SCBA identification number, date of maintenance actions, detailed list of maintenance actions including identification by part number of all parts replaced, flow test results of both before and after readings, and name of person performing maintenance actions. These records should be kept

for the life of the SCBA and can be used to show maintenance trends over time as well as identify problem areas needing additional preventive maintenance actions in the future.

ANSI Z88.2, Respiratory Protection, Section 6, describes what information should be contained in written SOPs for respirator programs. Written records are required by NFPA 1404, Chapter 2, 2-2.2 thru 2-2.5; OSHA 1910.134(h)(3)(iv)(A) and (B) and NIOSH recommendations.

Recommendation #6: Fire departments should ensure that fire fighters entering immediately dangerous to life and health atmospheres have fully charged air tanks on their self-contained breathing apparatus (SCBA).

Discussion: The Captain and a fire fighter, whose tanks were both extremely low on air, attempted to rescue of a person in one of the apartments on the 21st floor, when both fire fighters ran out of air in a smoke-charged hallway and became disoriented. The SCBA that was sent to the NIOSH laboratory for testing failed the positive pressure test, and the alarm activation was set to low (less time than normal to escape). See attached test report.

Recommendation #7: Fire departments should ensure that at least four fire fighters are on the scene before initiating interior fire fighting operations at a structural fire - two in, two out.^[8]

Discussion: The Captain and a fire fighter, entered the hallway to the 21st floor (heavy smoke - no visibility) without anyone knowing they were attempting a rescue. The National Fire Protection Association (NFPA) recommends that four persons (two in and two out), each with protective clothing and respiratory protection, is the minimum number essential for the safety of those performing work inside a structure. The team members should be in

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communication with each other through visual, audible, or electronic means to coordinate all activities and to determine if emergency rescue is needed. Also, the recently promulgated standard by the Occupational Safety and Health Administration (29 CFR 1910.134) states that when at least two enter an IDLH atmosphere, e.g., structural fire fighting, two will remain on the outside and maintain visual or voice contact to assist in emergency rescue activities.

Additional Safety Recommendations

Recommendation #8: Fire departments should consider using a rope attached to a permanent object or placing a bright, narrow-beamed light (e.g., laser) at the entry portal to structural fires to assist lost or disoriented fire fighters in emergency escape.^[12]

Discussion: In a dark, smoky environment, fire fighters often become lost or disoriented, and too often they are unable to escape. The use of a rope attached to a permanent object and held by a fire fighter as they enter the a smoke filled environment, can become a lifeline for emergency escape. Another approach would be the use of a bright, narrow-beamed light, e.g., a laser light at the entry point which could possibly assist fire fighters in emergency escape situations, i.e., when lost or disoriented.

Recommendation #9: Fire departments should ensure that procedures be established to record fireground communications.^[2]

Discussion: The fire department has experienced timeline difficulties in the area of post-incident fire investigation because all fireground communications were not available for review. Unless a record is kept and compiled of major incidents, it is difficult to establish a time-line on critical situations on the fireground.

Recommendation #10: Municipalities should require all high-rise apartments for the elderly have sprinkler systems installed and operable wherever feasible.^[13]

Discussion: Fire detection and automatic suppression are extremely important in the control of aggressive fires in buildings, especially high-rise apartments that house the elderly and disabled. If the high-rise apartment building had been equipped with an automatic sprinkler system, they may have controlled the spread of the fire and therefore prevented injuries to fire fighters and residents.

NOTE: NIOSH was notified by the fire department prior to the release of this investigation report of the following: 1) the fire department is updating the high-rise standard operating procedures, 2) the fire department is updating the self-contained breathing apparatus standard operating and maintenance procedures, 3) the fire department has purchased all necessary equipment to adequately test self-contained breathing apparatus, 4) the fire department has retested all self-contained breathing apparatus and documented test results, and 5) the fire department has made provisions to continuously record fire ground communications.

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INVESTIGATOR INFORMATION

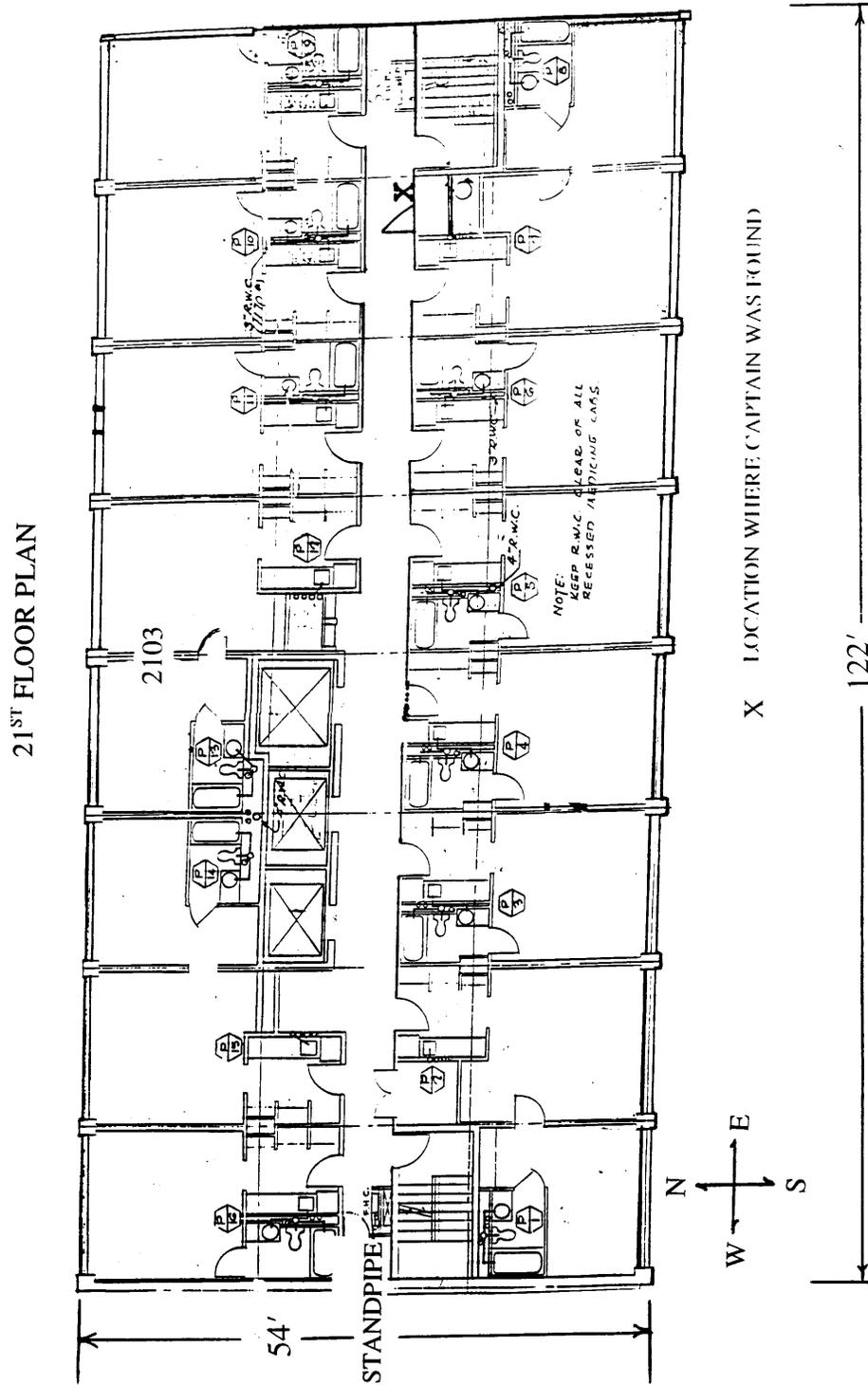
This incident was investigated by the following:
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Floor Diagram