



NIOSH
Fire Fighter Fatality Investigation
and Prevention Program

Death in the line of duty...

A Summary of a NIOSH fire fighter fatality investigation

February 28, 2002

Career Fire Fighter Dies After Falling Through the Floor Fighting a Structure Fire at a Local Residence - Ohio

SUMMARY

On March 8, 2001, a 38-year-old male career fire fighter (the victim) fell through the floor while fighting a structure fire, and died 12 days later from his injuries. At 1231 hours, Central Dispatch notified the career department of a structure fire with reports of the occupants still inside. The Assistant Chief arrived on the scene along with Engine 70 and assumed Incident Command (IC). The IC immediately called for the second alarm, began conducting the initial size-up of the structure, and confirmed heavy fire in the left front section. At that time, the neighbors approached the IC and informed him that the occupants were trapped inside. The IC ordered the fire fighters on scene to commence search and rescue efforts, and then verified the stability of the structure through radio and face-to-face communications.

Engine 68 arrived on the scene at approximately 1250 hours with an Assistant Chief and the victim. The Assistant Chief provided tactical command of the fire ground, and along with the victim,

conducted search and rescue operations. Other crews conducted searches with a thermal imaging camera of the first floor and basement level of the residence with no sign of any occupants. During these searches the stability of the structure was diminishing due to the intense fire that was now venting through the roof.

Fire fighter #3 and the victim were at the front entrance conducting a defensive attack as the third emergency evacuation signal was sounded. The neighbors were still insisting to the IC and fire fighters that the occupants were trapped inside, and one of the occupants was handicapped. The victim and one other fire fighter conducted another search of the structure. The heat and flames were now extending from the basement level to the first floor when the fire fighter's low air alarm sounded. The victim and the fire fighter were backing out of the structure when the floor beneath the victim gave way, causing him to fall through the floor and become trapped in the basement. Attempts were made from the first floor to rescue the victim by utilizing a handline



Picture courtesy of Steve Claytor,
Special County Arson Team

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. The program does not seek to determine fault or place blame on fire departments or individual fire fighters. 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

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and an attic ladder, but they were unsuccessful due to the intense heat and flames. Two Rapid Intervention Teams (RIT #1 & RIT #2) were deployed simultaneously from separate entrances into the basement to perform a search and rescue operation for the downed fire fighter. The RITs were able to locate and remove the victim on their initial entry. He sustained third degree burns to over half of his body and died 12 days later.

NIOSH investigators concluded that to minimize the risk of similar occurrences, fire departments should

- *ensure that Incident Command continually evaluates the risk versus gain during operations at an incident*
- *ensure that a separate Incident Safety Officer independent from the Incident Commander is appointed*
- *ensure that fire fighters are trained in the tactics of defensive search*
- *ensure that fire fighters performing fire fighting operations under or above trusses are evacuated as soon as it is determined that the trusses are exposed to fire*
- *ensure consistent use of Personal Alert Safety System (PASS) devices at all incidents and consider providing fire fighters with a PASS integrated into their Self-Contained Breathing Apparatus which provides for automatic operation*
- *ensure that personnel equipped with a radio, position the radio to receive and respond to radio transmissions*

INTRODUCTION

On March 8, 2001, a 38-year-old male career fire fighter responded to a structure fire at a local residence with a report from the neighbors that the occupants were still inside. After several search and rescue attempts the occupants could not be located. The victim, who was operating the nozzle, entered the first floor of the structure with a fire fighter to conduct a search for the occupants. The floor beneath the victim gave way, causing him to fall through the floor and become trapped in the basement. The victim was removed from the structure approximately 1 hour and 10 minutes from the time the department was notified of the incident. The victim died 12 days later as a result of his injuries. On March 21, 2001, the United States Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of the incident. On March 23-26, 2001, two Safety and Occupational Health Specialists from NIOSH, Division of Safety Research, investigated the incident. Interviews were conducted with the Chief, the Assistant Chiefs, and members of the departments who responded to the fire. The incident site was visited, and photographs were obtained. Copies of the standard operating procedures, training records, dispatch records and the notes of the county arson team's investigation were reviewed. The site was a single-family home built in 1991, consisting of a one-story brick ranch structure with a finished walk-out basement and an attached two-stall garage. The roof was constructed of layered asphalt shingles over plywood sheathing.

The fire department involved in this incident operates from four stations, and is comprised of 65 uniformed fire fighters. The department serves a population of 13, 000 in a geographic area of 30 square miles. The victim was certified through the State of Ohio as Fire Fighter Level II, Engine



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Operator, Para-Medic, Haz-Mat and First Responder. The victim had over 20 years of experience and received additional training through the department on first aid, search and rescue, apparatus operation, live fire training and cardiopulmonary resuscitation.

INVESTIGATION

On March 8, 2001, at 1230 hours, Central Dispatch received a call from a local resident about a structure fire with the occupants trapped inside. Central Dispatch notified the department at 1231 hours and dispatched Engine 70 with a fire fighter acting as the officer in charge (E70 OIC), Engine Operator, and Fire fighter #1. The Assistant Chief responded in Car 02 to the scene. As Car 02 was en route to the structure, heavy black smoke could be seen from over 3 miles away. Car 02 and Engine 70 arrived on the scene at approximately 1239 hours, and the Assistant Chief assumed Incident Command (IC). The IC immediately ordered the second alarm for mutual aid due to the involvement of the structure. The structure was located at the end of a private drive that extended approximately 2000 feet from the county road and the nearest hydrant (See Drawing #1). Engine 70 stopped on the driveway for Fire fighter #1 to pull approximately 700 feet of 5-inch supply line off the back of the Engine. Fire fighter #1 staged the 5-inch supply line on the driveway to be attached by Engine 105 for water relay. Fire fighter #1 then proceeded to the structure to assist the E-70 OIC on stretching a 1 3/4 inch handline to the front door. Engine 105 was the first to arrive on the scene at approximately 1244 hours for mutual aid and responded with a Lieutenant, Engine Operator and Fire fighter #2. Fire fighter #3 responded via a privately owned vehicle (POV) at approximately 1245 hours. Engine 69 also arrived at approximately 1245 hours with a Lieutenant and Fire fighter #4. Engine 105 obtained assignments from the IC to set up water relay. Engine 69 stopped

at the hydrant and pumped to Engine 105, which in turned hooked up to the 5-inch supply line and relayed water to Engine 70. Engine 68 arrived on the scene at approximately 1250 hours with an Assistant Chief and the victim. They picked up the Lieutenant from Engine 69 and proceeded to drive up the driveway to the structure.

The IC did an initial size-up of the structure and noticed heavy fire in the left front of the structure. Neighbors approached the fire fighters and the IC stating that two or three people were trapped inside the structure. One of the residents was reported to be confined to a wheelchair. The IC conducted another size-up, determining that all the windows were intact and that fire was venting through the roof. He then ordered a crew from Engine 70 to conduct a search of the structure to locate and remove any occupants. The front and side entrances were locked so the E-70 OIC made forced entry through the front door. The E-70 OIC (equipped with a thermal imaging camera), Fire fighter #1 (Nozzleman) and Fire fighter #3 (backup) advanced a 1 3/4 inch handline through the front door. The E-70 OIC took the thermal imaging camera inside the structure to assist in the search. The crew turned to the left and proceeded through the foyer and conducted a search of the living room and dining room. They then proceeded back through the foyer and down a hallway to the bedrooms located in the back of the structure. Heavy smoke was encountered in the hallway, making visibility near zero. At the end of the hallway they searched the bathroom and ventilated the bathroom window. The E-70 OIC, Fire fighter #1 and Fire fighter #3 then conducted a left-hand search of the bedrooms and located a hospital bed and wheelchair, but found no occupants. They became low on air and exited the structure to refill their air bottles. The second crew to enter the structure was from Engine 105 and consisted of a Lieutenant operating the nozzle



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and Fire fighter #2 providing back-up on the 1 3/4 inch handline. They too entered and turned left, proceeding through the foyer. The dining room and living room were fully involved and the fire had vented through the roof at this time. The Lieutenant and Fire fighter #2 proceeded back through the foyer and began an aggressive suppression effort by pulling the ceiling and attacking the fire in the kitchen (See Drawing #2). They then moved back through the hallway, into the back bedrooms and bathroom, conducting aggressive suppression efforts.

After changing their air bottles, the E-70 OIC reentered the structure with Fire fighter #1, who was on the nozzle of the 1 3/4 inch handline. They proceeded to the left of the foyer where they could see the exposed brick wall of the west side of the structure. The roof trusses that were not yet consumed by the fire were also exposed. Down the hallway and to the east side of the structure, where the kitchen was located, the ceiling was falling and they could see the fire venting through the roof. As they pulled the ceiling to expose and suppress the fire, the roof trusses were breaking due to their fire exposure. At this time, the IC determined the structure to be unsafe due to intense heat and the possibility of a collapse. The IC gave the order for an emergency evacuation over the radio and also sounded the engine's air horn for emergency evacuation per the department's standard operating procedures (SOPs). *Note: Each crew had a radio to relay pertinent interior information to the IC. Information was also given to the IC through face-to-face communications as the crews exited the structure to exchange air bottles.* After the evacuation the neighbors were still insisting that the owners were trapped inside. The IC ordered a search of the basement area, and assigned the Assistant Chief from Engine 68 to oversee the technical operations of the fireground. The

Assistant Chief assembled a crew consisting of himself, the E-70 OIC, a Lieutenant from a mutual aid company and Fire fighter #6 to conduct the search of the basement. The rear entrance to the basement was unlocked and did not show any fire (See Drawing #3). Since there was light smoke, the Assistant Chief did not don his SCBA and was able to see across the basement. The search was completed very quickly and an "All Clear" was radioed to the IC. The IC, unaware of the clear visibility, ordered a second search. The Assistant Chief and his crew entered again, taking a thermal imaging camera to conduct a more thorough search. The "All Clear" was given for the basement a second time and the crew exited. The Assistant Chief directed his crew to the garage to look for fire extension and provide suppression. The IC gave the second order for an emergency evacuation over the radio and sounded several long blasts on the air horn to signal the evacuation. A full personnel accountability report (PAR) was received at this time and the operation was to be strictly defensive. Neighbors were still approaching the fire fighters and screaming that there were occupants inside the structure. The IC ordered another search of the structure, but instructed the crews not to commit too far. The Assistant Chief assembled a crew consisting of E-70 OIC, a Lieutenant from Engine 105 and Fire fighter #3 to enter the basement and conduct a search for the occupants with the thermal imaging camera. At this time, visibility for the crew in the basement was very poor and the intense heat was limiting the effectiveness of the thermal imaging camera, causing the screen to "white out." The crew radioed an "All Clear" to the IC and exited the structure. The third emergency evacuation signal was sounded. At this time, Fire fighter #2 and the Lieutenant from Engine 69 were taking turns operating the nozzle of a 1 3/4 inch handline on an exterior attack through the front windows. The Lieutenant and Fire fighter #2 came to the



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front door to make entry just as the third evacuation signal was sounded. The victim, who was at the front entrance, informed Fire fighter #2 and the Lieutenant of heavy fire in the garage area. A crew consisting of Captain #2 and the Engine Operator from Engine 95 were also at the front door receiving instructions from the IC and E-70's OIC to conduct a search of the first floor with a thermal imaging camera for possible entrapments. *Note: No civilians were ever located in the residence.* The Lieutenant and Fire fighter #2 began to make entry when the Lieutenant became low on air and went to exchange bottles. The victim assisted the Lieutenant with his bottle then returned to man the nozzle with Fire fighter #2. Fire fighter #2 and the victim made entry through the front door to attack the fire in the garage area. They then conducted another search of the living room area. In the hallway leading to the living room the fire was in the wall, extending through the switch covers and wall registers. The heat and flames were rolling from the basement area when Fire fighter #2's low air alarm sounded. The victim and Fire fighter #2 were backing out of the living room when the floor in the hallway beneath the victim gave way, causing him to fall through the floor into the basement with the handline. Fire fighter #2 immediately lay prone and tried to pull the victim through the hole but could not. He then ran outside screaming "Fire fighter down!"

Captain #2, the Engine Operator from Engine 95 and Fire fighter #2 rushed back inside, followed by the Assistant Chief from Engine 68. Fire fighter #2 and the Engine Operator from Engine 95 both had their hands on the victim and were trying to hoist him up through the floor. The victim's glove was pulled off in the process. The handline was caught on the hole in the floor and could not be used to extricate him. The Assistant Chief could see and hear the victim through the floor. He ordered a back-up line and attic ladder for the

first floor, and for rapid intervention teams (RIT) to enter the basement through the back door (RIT #1) and kitchen stairwell (RIT #2). The flames were extending up and beyond the attic ladder, restricting its use and any rescue efforts through the hole in the first floor.

The Captain from Engine 95 was in charge of the rear sector and staged Fire fighter #1 and a Lieutenant from a mutual aid company as a RIT for rescue operations of the rear sector. Entry for rescue was then made through the rear entry into the basement by Captain #1, who operated the nozzle on a 1 3/4 inch handline, followed by Fire fighter #8, the Captain from Quint 33, Fire fighter #5, the Lieutenant from Engine 105 and Fire fighter #3 with a thermal imaging camera (RIT #1). The crew moved straight into the structure to the front wall and proceeded to conduct a right hand search, which led them into the south hallway. The Lieutenant from Engine 105 was unaware that his air tank was not turned on forcing him to exit within a minute. He reentered with E-70's OIC. They met up with the RIT #2 and proceeded down the north hallway. Fire fighter #6 and Fire fighter #7 entered the front door and were instructed by the Assistant Chief to be RIT #2. He instructed them to take the stairwell in the kitchen to the basement and conduct a search for the victim. When they entered the basement they proceeded straight back and passed another crew (RIT #1) to their left, also searching for the victim. The west side of the basement consisted of two separate parallel hallways leading to bedrooms (See Drawing #3). They entered the hallway to the north and encountered intense heat from the bedroom areas which were fully involved.

RIT #1 was experiencing extreme heat with zero visibility. Fire fighter #3 exited the structure to request positive pressure ventilation (PPV). The PPV fan was set in place and provided improved



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visibility. RIT #1 found the victim in the furnace room between the two hallways. RIT #2 breached a wall to reach the victim and assisted in removal. The victim was found between a wall and the hot water heater, sitting on his hands in the upright position. The victim's portable radio was in the off position and located in the pants pocket of his turnout. His hood, turnouts, SCBA and face-piece were on with air remaining in his tank. His helmet and his gloves were not on at this time. Neither his low air alarm nor his personal alert safety system (PASS) was sounding. The victim became semi-responsive while in transit to the emergency transport helicopter. He sustained third-degree burns to over half of his body and died 12 days later from the injuries.

CAUSE OF DEATH

The cause of death was listed as complications of thermal burns to 60% of total body surface.

RECOMMENDATIONS AND DISCUSSION

Recommendation #1: Fire departments should ensure that Incident Command continually evaluates the risk versus gain during operations at an incident.¹⁻⁶

Discussion: Considerations for rescue operations of occupants include information such as time of incident, time fire was burning before arrival, time fire was burning after arrival, time occupants have for rescue (risk vs. gain) and type of attack are some of the most important pieces of information the Incident Commander should have. After it has been determined that the time frame for rescue has expired, the operation should become a recovery and all tactical efforts should be defensive.

Recommendation #2: Fire departments should appoint an Incident Safety Officer.^{1,4,7}

Discussion: According to NFPA 1561, paragraph 4-1.1, "The Incident Commander shall be responsible

for the overall coordination and direction of all activities at an incident. This shall include overall responsibility for the safety and health of all personnel and for other persons operating within the incident management system." While the Incident Commander (IC) is in overall command at the scene, certain functions must be delegated to ensure adequate scene management is accomplished. According to NFPA 1500, paragraph 6-1.3, "As incidents escalate in size and complexity, the incident commander shall divide the incident into tactical-level management units and assign an incident safety officer to assess the incident scene for hazards or potential hazards. "The incident safety officer (ISO), by definition is "An individual appointed to respond to or assigned at an incident scene by the incident commander to perform the duties and responsibilities specified in this standard. This individual can be the health and safety officer or it can be a separate function. "According to NFPA 1521, paragraph 2-1.4.1, "An incident safety officer shall be appointed when activities, size, or need occurs." On-scene fire fighter health and safety is best preserved by delegating the function of safety and health oversight to the ISO. The ISO is appointed by the Incident Commander at each emergency scene. The duties of the ISO are to monitor the scene and report the status of conditions, hazards, and risks to the incident commander, ensure that fire fighter rehabilitation occurs, that the personnel accountability system is being utilized, and to monitor radio communications to ensure all areas of the scene are capable of communicating to incident command.

Recommendation #3: Fire departments should ensure fire fighters are trained to recognize the danger of searching above a fire.⁸

The danger of being trapped above a fire is greatly influenced by the construction of the burning building. Of the five basic building construction types (fire resistive, noncombustible, ordinary



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construction, heavy timber, and wood-frame) the greatest danger to a fire fighter who must search above the fire is posed by wood frame construction. Vertical fire spread is more rapid in this type of structure. Flames may spread vertically and trap fire fighters searching above the fire, in four ways: up the interior stairs, through windows (autoexposure), within concealed spaces, or up the combustible exterior siding. Extreme caution must be used to determine if the structural stability of the flooring system is adequate to facilitate the search.

Recommendation #4: Fire departments should ensure that fire fighters performing fire fighting operations under or above trusses are evacuated as soon as it is determined that the trusses are exposed to fire.⁹

Discussion: There is no specific time limit on how long fire fighters should operate under or on truss roofs that are exposed to fire. A time limit is often used by fire departments as a guide for operation under or on truss roofs. Even though standard fire engineering calculations show that lightweight trusses may be expected to collapse after about 10 minutes in a fully developed fire, it is not recommended to set a time limit. As stated in *Building Construction For the Fire Service*,¹³ “under fire conditions, truss failure is unpredictable.” When fire fighters arrive on the scene of a building with trusses exposed to fire, it is virtually impossible to identify how long the trusses have been exposed to fire and set a time limit for fire suppression. When it is determined that the building’s trusses have been exposed to fire, any fire fighters operating under or above them should be immediately evacuated. If it is not clear that the building’s trusses have been exposed to fire, a defensive attack should take place until the conditions can be verified. In this incident, the decision was made early to evacuate

the structure due to the roof trusses collapsing. After the fire vented through the roof, the fire expanded in the basement. The direct heat and flame impingement on the floor joists resulted in the same type of failure as in the roof trusses.

Recommendation #5: Fire departments should ensure consistent use of Personal Alert Safety System (PASS) devices at all incidents and consider providing fire fighters with a PASS integrated into their Self-Contained Breathing Apparatus which provides for automatic activation.¹⁰

Discussion: PASS devices are electronic devices worn by the fire fighter, which will emit a loud and distinctive alarm if the fire fighter becomes motionless for more than 30 seconds. Fire fighters entering hazardous areas should be equipped with a PASS device. There are several types of PASS devices available. One device that could be used is a PASS that is integrated into the SCBA. “*Such automatic activation shall be permitted to be, but not limited to, linked to activation of SCBA, linked to removal from storage or transportation positions, by pull-away tether to a fixed position, or by remote activation.*” Manual PASS devices are also used throughout the fire service. These devices require fire fighters to manually turn on the device each time they use it.

Recommendation #6: Fire departments should ensure that personnel equipped with a radio, position the radio to receive and respond to radio transmissions.¹¹

Discussion: The fireground communications process combines electronic communication equipment, a set of Standard Operating Procedures, and the fire personnel who will use the equipment. To be effective, the communications network must integrate the equipment and



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procedures with the dynamic situation at the incident site, especially in terms of the human factors affecting its use. The ease of use and operation may well determine how consistently fire fighters monitor and report over the radio while fighting fires. Fire departments should review both operating procedures and human factors issues to determine the ease of use of radio equipment on the fireground to ensure that fire fighters consistently monitor radio transmissions from the IC and respond to radio calls.

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INVESTIGATOR INFORMATION

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(REAR OF STRUCTURE)



Photo: Courtesy of Steve Claytor, Special County Arson Team

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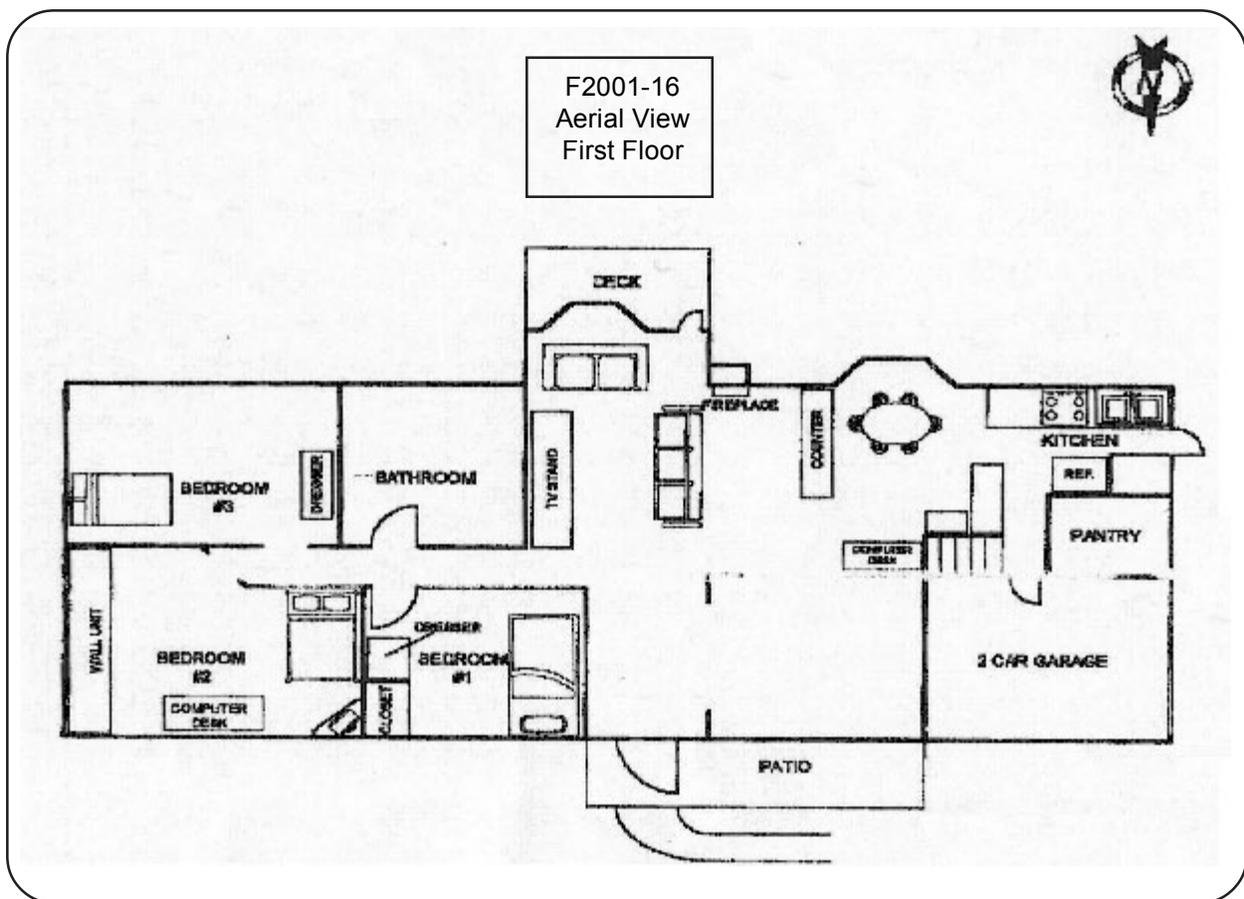
(FRONT OF STRUCTURE)



Photo: Courtesy of Steve Claytor, Special County Arson Team

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Drawing #2

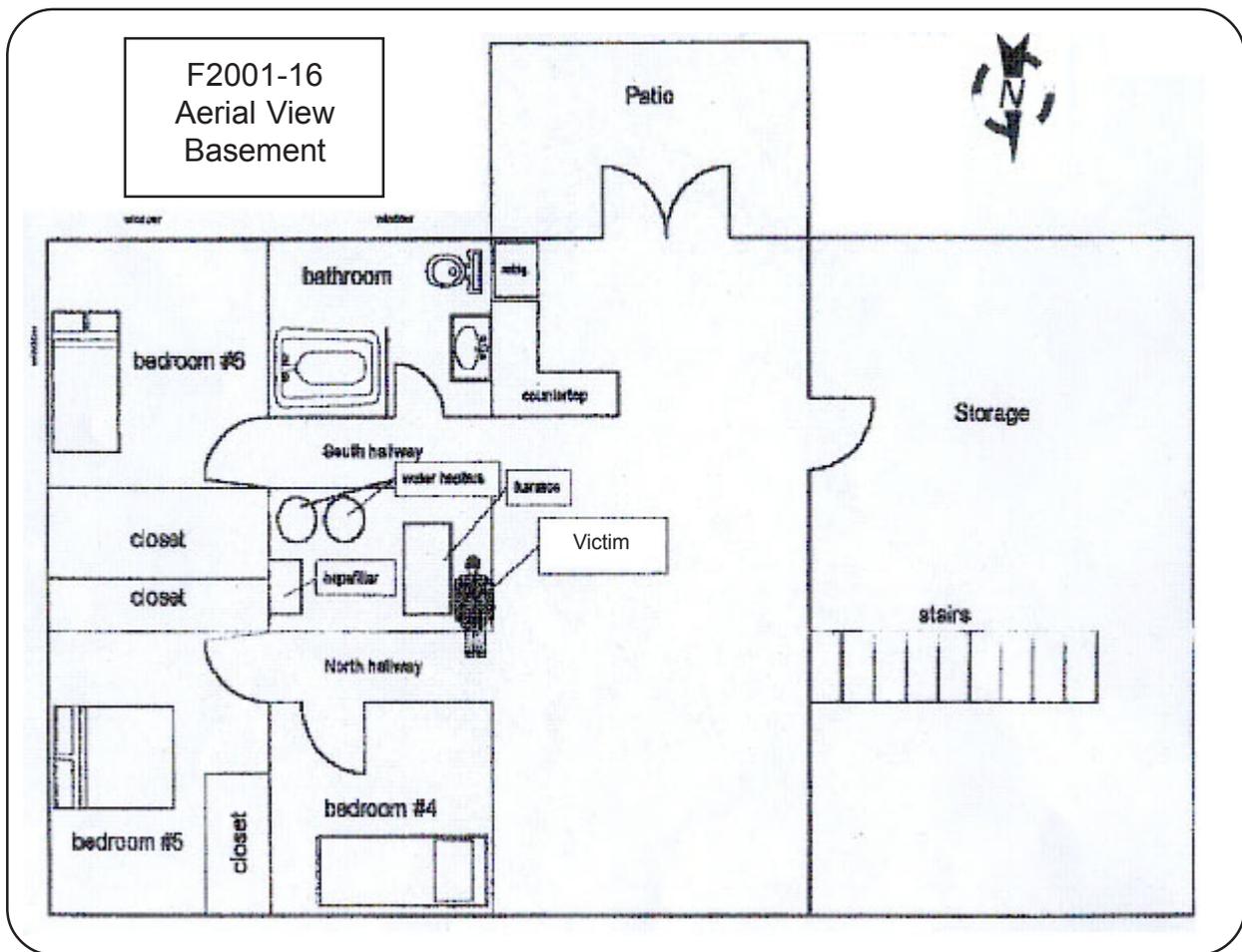


Drawing Courtesy of: Steve Claytor, Special County Arson Team



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Drawing #3



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