

Fire Rescue 1

Study proves firefighter crew size impacts responses

Report issued by NIST is the first to quantify the effects of crew sizes and arrival times

By Jamie Thompson
FireRescue1 Senior Editor

WASHINGTON — A landmark study issued Wednesday proves the size of firefighting crews does have a substantial effect on the ability to protect lives and property.

The report, released by the National Institute of Standards and Technology, is the first to quantify the effects of crew sizes and arrival times on the fire service's lifesaving and firefighting operations for residential fires. Until now, little scientific data has been available.

Four-person firefighting crews were able to complete 22 essential firefighting and rescue tasks in a typical residential structure 30 percent faster than two-person crews and 25 percent faster than three-person crews, according to the study.

The results of the study will allow the fire service to prove to community officials the impacts of reduced staffing with solid, scientific data for the first time.

"The results from this rigorous scientific study on the most common and deadly fires in the country — those in single-family residences — provide quantitative data to fire chiefs and public officials responsible for determining safe staffing levels, station locations and appropriate funding for community and firefighter safety," said NIST's Jason Averill, one of the study's principal investigators.

The four-person crews were able to deliver water to a similar-sized fire 15 percent faster than the two-person crews and 6 percent faster than three-person crews.

Broad coalition

Performed by a broad coalition in the scientific, firefighting and public-safety communities, more than 60 controlled fire experiments were conducted in the study to determine the relative effects of crew size, the arrival time of the first fire crews, and the "stagger" or spacing between the arrivals of successive waves of firefighting apparatus.

The stagger time simulates the typically later arrival of crews from more distant stations as compared to crews from more nearby firehouses.

"Our experiments directly address two primary objectives of the fire service: extinguishing the fire and rescuing occupants," Lori Moore-Merrell, of the IAFF and a principal investigator on the study, said.

The study is extremely significant because academics, science and fire service providers were all brought to the table to conduct the research, she added.

In addition, the results were collated and delivered by independent statisticians to offer an unbiased perspective on the impacts different staffing levels have. The study provides the science to be able to say to local governments that reducing firefighting staffing levels does have major impacts, according to Moore-Merrell.

Researchers also performed simulations using NIST's Fire Dynamic Simulator to examine how the interior conditions change for trapped occupants and the firefighters if the fire develops more slowly or more rapidly than observed in the actual experiments. The fire modeling simulations demonstrated that two-person, late-arriving crews can face a fire that is twice the intensity of the fire faced by five-person, early arriving crews.

It also demonstrated that trapped occupants receive less exposure to toxic combustion products — such as carbon monoxide and carbon dioxide — if the firefighters arrive earlier and involve three or more persons per crew.

Test facility

For the study, researchers built a "low-hazard" structure as described in NFPA 1710, the standard that provides guidance on the deployment of career firefighters. The two-story, 2,000-square-foot test facility was constructed at the Montgomery County Public Safety Training

Academy in Rockville, Md. Fire crews from Montgomery County, Md., and Fairfax County, Va., responded to live fires within the facility.

Crews of two, three, four and five firefighters were timed as they performed 22 standard firefighting and rescue tasks to extinguish a live fire in the test facility. Tasks included occupant search and rescue, time to put water on fire, and laddering and ventilation. Apparatus arrival time, the stagger between apparatus, and crew sizes were varied.

With the study completed, the research team will now develop a training package for firefighters and public officials that would enable them to have both quantitative and qualitative understanding of the research.

The United States Fire Administration reported that 403,000 residential structure fires killed close to 3,000 people in 2008 — accounting for approximately 84 percent of all fire deaths — and injured about 13,500.

The study's principal investigators were Averill, Moore-Merrell and Kathy Notarianni of Worcester Polytechnic Institute. Other organizations participating in this research included the IAFC, the Commission on Fire Accreditation International-RISK and the Urban Institute.

"The results of the field experiments apply only to fires in low-hazard residential structures as described in the NFPA Standard 1710, but it provides a strong starting point," said Moore-Merrell. Future research could extend the findings of the report to quantify the effects of crew size and apparatus arrival times in medium- and high-hazard structures, she added.