TACTICAL INTEGRATION WORKSHEET

Horizontal Ventilation Study

Stages of Fire Development: Today, fires can quickly become ventilation controlled, transitioning from growth to decay until additional ventilation is provided due to fire effects (e.g., failure of window glass) or fire department action.

Gaining Access is Ventilation: Opening a door to gain entry for firefighting operations is ventilation. This is of particular concern due to intake of air that increases heat release rate (HRR) and fire growth.

No Smoke Showing: The drop in temperature when the fire becomes ventilation controlled reduces pressure inside the building that pushes smoke through gaps such as those around windows and doors. As the fire becomes more ventilation controlled, smoke discharge is significantly diminished or may cease entirely.

Coordination: The window of time for coordination of ventilation and fire attack in the modern fire environment is much smaller than in the past. In the one story experiments, the average time from ventilation (absent fire control) to untenable conditions for firefighters was 100 seconds. In the two story experiments, the time was slightly longer at 200 seconds, but still quite short.

Smoke Tunneling and Rapid Air Movement: Opening a door for entry, rapid air intake that creates a tunnel through the smoke inside the door may be a strong indication of a ventilation controlled fire.

Vent Enter Search (VES): When entering a room through a window for vent, enter, search operations, it is essential to close the interior door to take that room out of a flow path from the fire to an exhaust opening.

Flow Paths: Every new ventilation opening creates a flow path. Flow paths are the volume between inlets, the fire, and exhaust openings. Under ventilation limited conditions, additional flow paths can create dangerous conditions.

You Cannot Vent Enough: Even with creation of a large number and size of horizontal ventilation openings, it was not possible to return the fire to a fuel controlled burning regime. Each additional opening (absent fire control) resulted in an increased HRR, higher temperature, and worsening conditions.

C**losed Doors Maintain Tenable Conditions:** In each experiment a closed interior door maintained tenable conditions in one of the bedrooms. Closed interior doors provide a potentially survivable space for occupants or place of refuge for firefighters who have become trapped.

Open Vents Decrease Time to Flashover: Ventilation openings made prior to fire department arrival (e.g., by exiting occupants or fire effects) will likely reduce the time required for the fire to return from ventilation controlled decay to growth and transition through flashover to a fully developed fire.

You Can't Push Fire with Water: None of the experiments provided evidence that water applied from the exterior pushed fire from the involved room into adjacent compartments or other areas of the building.

Lack of Oxygen Limits Flaming Combustion: In most experiments, there was little or no flaming combustion in compartments adjacent to the fire compartment. Lack of oxygen precluded flaming combustion in these areas.

Vertical Ventilation Study

The Fire Environment Has Changed: Today's fire environment is fueled by synthetic materials with rapid fire development and ventilation limited fire conditions. Decades ago the fire environment was predominantly fueled by natural materials; fires had a lower potential heat release rate, and remained fuel controlled much longer. Changes in the fire environment require reevaluation and shift of tactics to meet these changes.

Control the Access Door: Controlling the door slows fire development and limits heat release rate. Once water is on the fire and is limiting heat release by cooling the door can and should be opened as part of planned, systematic, and coordinated tactical ventilation.

Coordinated Attack Includes Vertical Ventilation: While vertical ventilation is the most efficient type of natural ventilation, it not only removes a large amount of smoke, it also introduces a large amount of air into the building (the mass of smoke and air out must equal the mass of air introduced). If uncoordinated with fire attack, the increase in oxygen will result in increased fire development and heat release.

Large Vertical Vents are Good, But…. A 4' x 8' ventilation opening removed a large amount of hot smoke and fire gases. However, without water on the fire, the increased air supply caused more products of combustion to be released than could be removed through the opening, overpowering the vertical vent and worsening conditions on the interior. Once fire attack returned the fire to a fuel controlled regime, the large opening was effective and conditions improved.

Location of the Vertical Vent? It Depends! If ventilation and fire attack are coordinated, venting over the fire provides the most efficient flow of hot smoke, fire gases, and air. One of the important lessons in this tactical implication is that the effects of vertical ventilation are not only dependent on the location of the exhaust opening, but also on the location of the inlet and resulting flow paths created within the building.

Operations in the Flow Path Present Significant Risk: Operations in the downstream segment of the flow path are hazardous due to the flow of hot gases and smoke, increasing convective heat transfer and potential for fire spread in this space.

Timing is (Almost) Everything: When effective tactical ventilation is coordinated with fire attack, the fire environment becomes cooler, visibility is increased, and useful flow paths are created that remove hot smoke, fire gases, and steam ahead of hoselines. However, tactical ventilation completed significantly before fire attack is having an effect on the fire can result in increased heat release rate and fire growth.

Reading Smoke: While smoke is a critical category of fire behavior indicators, firefighters must consider all of the B-SAHF indicators (Building, Smoke, Air Track, Heat, and Flame) when reading the fire. The key point made in the UL vertical and horizontal ventilation reports is that nothing showing means exactly that. Nothing!

Closed Doors Increase Potential for Survival: As with UL's horizontal ventilation experiments, the vertical ventilation experiments further demonstrated that closed doors increase victim survivability. In the bedrooms with open doors, potential victims would be unconscious if not deceased prior to fire department arrival or as a result of fire ventilation actions.

Softening the Target: Data on the effects of water application from the exterior during the vertical ventilation experiments reinforced the conclusions drawn from those conducted during the horizontal ventilation study. Regardless of the point of application, water quickly applied into the fire compartment improved conditions throughout the entire building. In the vertical ventilation experiments water applied from the exterior for approximately 15 seconds had a significant impact on interior conditions increasing potential for victim survivability and firefighter safety.

You Can't Push Fire with Water: Data from this study continues to support the position that application of water does not push fire. However, discussion during the study pointed to several situations that may give the appearance of fire being pushed including changes in flow path, saturation of turnout gear with heat, or changes in oxygen concentration in spaces where flaming combustion was not previously occurring.

Direct Attack is Important on Fires in Large Spaces: While large open floor plans in many modern homes presents a fire suppression challenge, open floor plans also permit application of water to burning fuel from a distance. It is not necessary to be in the fire compartment to begin effective suppression. If an involved room is in line of sight, water can be applied to burning fuel with good effect.