FIREGROUND
Search & Rescue in Today's Fire Environment
Objectives

- Identify how current fire behavior research may affect search and rescue operations.
- Perform a 360° size up.
- Determine survivability profile.
- Demonstrate decision making based on current and predicted conditions.
- Perform primary search techniques.
Part 1

Search and rescue decision making and current fire behavior research
Part 2

Basic primary search techniques

More advanced search techniques will be covered in future lessons.
It is impossible for this lesson to address every possible fireground situation.

TSS is simply providing current information so you can make sound tactical decisions.
Part 1

Search and Rescue

Decision Making
Your company is first on scene of this fire. Upon arrival, it is unknown if the structure is occupied.
• What information do you need to gather?
• Based on this information, what tactics should you consider?
Prior to engaging, the following actions should be considered.

- Size up
- Locate the fire
- Identify and isolate existing or potential flow paths
360° Size up
NIOSH firefighter fatality reports repeatedly cite lack of a complete size-up as a contributing factor in firefighter deaths.
SIZE UP

360
Known or potential rescue problem?

Active or potential flow paths?

Location and extent of the fire?

Structural stability?

Other hazards (electrical, exposures, access)?

Size, age and construction type of building?
If available, utilize a TIC during your size up.
The following slides compare a visual size up with a TIC size up.
Where is the fire?
Let’s see the same view with a TIC.
With the TIC view, one can clearly see fire involving the room at the Alpha/Delta corner with heat signatures in an adjacent room on the Delta side.
Portions of your 360 Size Up may have to be delegated due to access issues.
Other factors to consider during size up
Time of day?

Weather (WIND)?

Savable lives and/or property?

Resources on scene or en route?

Water supply?
Size up is done continuously by EACH member of the crew.

What temperatures am I seeing with the TIC?

What is the smoke volume, velocity, density & color?

How is my water reacting with the upper atmosphere (turning to steam or falling to the floor?)
Locate the Fire
Determine the location and extent of the fire.

Where is the fire?
Determine the location and extent of the fire.

Where is the fire going?
Locating the fire can usually be accomplished during the 360 size up.

Again, a TIC can be very useful in determining the location and extent of the fire.
Reading Smoke

VOLUME
VELOCITY
- The faster smoke is closer to the fire.
- Compare velocities from equal size openings.
Reading Smoke

DENSITY
• Smoke = fuel, thicker smoke = more fuel.

COLOR
• Black smoke that is high velocity and very thin (low density) is indicative of flame-pushed smoke indicating the fire is nearby.
Identify and Control Flow Paths
If a flow path is identified, attempt to control it by closing doors or windows.
Check for victims within close proximity of the door or window prior to closing.
Controlling flow paths will limit fire growth, helping protect potential victims.
Controlling the flow path continues after entry. Compartmentalizing a structure by closing doors and windows limits fire growth and gives potential victims more time to escape or be rescued.
During UL/NIST experiments, closing an interior door took ceiling temperatures from 450° F to 150° F.
UL Experiment

Fire allowed to burn for 20 minutes in a 1 and 2 story home.

First time listed is predicted time to incapacitation by CO.

Second time listed is predicted time to incapacitation due to high temperatures.
Decision time
Do I attempt search and rescue, or control the fire and then make the search? Or, can I do both at the same time?
It all comes down to the incident priorities.
Open Volume 10 & 11. What is the #1 priority for every incident?
This includes civilian AND firefighter lives.
Incident Priorities

• Protection of life
• Incident stabilization through fire control
• Property/environment protection and conservation

In today’s fire environment, there will be times when incident stabilization may provide for the protection of life.
Rescue vs. Fire Control

it’s a

Risk vs. Gain Decision
Can you make a quick save without the fire threatening more lives...including yours?
Or, will forgoing fire control contribute to worsening fire conditions, and possibly jeopardizing more lives...including yours?
Search and rescue principles from the IAFC’s Rules of Engagement
“Our goal as firefighters is to save lives. The fire service has a long history of aggressive search and rescue operations as an initial priority of first arriving fire companies. History (and firefighter fatalities) also reflects that firefighters are exposed to the greatest risk of injury and death during primary search and rescue operations.”

Rules of Engagement for Structural Firefighting
Increasing Firefighter Survival
Developed by the Safety, Health and Survival Section
International Association of Fire Chiefs
If life is our first priority, what are the numbers telling us about our risk vs. gain decisions?
Let’s take a look at the research.
The Boston Globe

U.S. Fire Administration
Working for a Fire-Safe America

Executive Fire Officer Program

National Fire Academy
Emmitsburg, MD

2005 Boston Globe report of 52 FF Fatality Fires, 1997-2004

- **FF Deaths in structure fires**: 80
- **Fires w/suspicion of people trapped**: 14
- **Fires w/victims inside upon FD arrival**: 6
- **Civilian Deaths**: 0
Source: Can They Be Saved? Utilizing Civilian Survivability Profiling to Enhance Size-Up and Reduce Firefighter Fatalities in the Fire Department, City of New York
“Search efforts must be based on the potential to save lives. A safe and appropriate action plan cannot be accurately developed until we first determine if any occupants are trapped and can survive the fire conditions during the entire rescue event (find AND then remove them).”

Rules of Engagement for Structural Firefighting
Increasing Firefighter Survival
Developed by the Safety, Health and Survival Section
International Association of Fire Chiefs
Firefighters must perform an assessment of victim survivability on every fire. This is called a SURVIVALIBILITY PROFILE.
This means making a determination if interior conditions warrant a search and rescue of viable victims.
Factors to consider when determining survivability profile of potential victims.
Time to flashover

Comparison of Room Furnishings

Legacy Room

Time to Flashover
29:25

Modern Room

Time to Flashover
3:40
Higher temperatures

1 lb. of wood releases 8,000 BTU’s

1 lb. of plastic releases 19,900 BTU’s
NFPA states that the limit for human temperature tenability is 212°F.
## Heat Effects on Humans

<table>
<thead>
<tr>
<th>Degrees F</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>98.6</td>
<td>Normal body temperature</td>
</tr>
<tr>
<td>111</td>
<td>Human skin begins to feel pain</td>
</tr>
<tr>
<td>118</td>
<td>Human skin receives 1\textsuperscript{st} degree burns</td>
</tr>
<tr>
<td>131</td>
<td>Human skin receives 2\textsuperscript{nd} degree burns</td>
</tr>
<tr>
<td>140</td>
<td>Burned human tissue becomes numb</td>
</tr>
<tr>
<td>162</td>
<td>Human skin is instantly destroyed</td>
</tr>
<tr>
<td>446</td>
<td>Glass melts</td>
</tr>
<tr>
<td>482</td>
<td>Natural cotton chars</td>
</tr>
<tr>
<td>&gt;572</td>
<td>PPE’s begin to char</td>
</tr>
<tr>
<td>&gt;1112</td>
<td>Room temperature post-flashover</td>
</tr>
</tbody>
</table>

http://www.nist.gov/fire/fire\_behavior.cfm
Time for search AND rescue/removal?

[Diagram showing fire progression and survival timeline]

Fire Engineering: SURVIVABILITY PROFILING: HOW LONG CAN VICTIMS SURVIVE IN A FIRE? 07/01/2010 BY STEPHEN MARSAR
Today’s homes contain large amounts of plastics.
Thermo sets — TVs, coatings, toilets, buttons, flooring and insulation

Polypropylene — bottles, diapers and furniture

Polyurethanes — shoes and cushions

Polyvinyl chlorides (PVC) — carpet, clothes, purses, records and shower curtains

Combustibility of Plastics by Frank L. Fire. (Fire Engineering Books: 1991)
Acetyls — aerosol containers, combs, lighters and pens

Nylons — various household containers, brushes, sewing thread and fishing line

Polyvinyl chlorides (PVC) — carpet, clothes, purses, records and shower curtains

Polyesters — hair dryers, computers and kitchen appliances

Thermo sets — TVs, coatings, toilets, buttons, flooring and insulation
Nylons — various household containers, brushes, sewing thread and fishing line

Acrylics — glues, food packages and skylights

Thermo sets — TVs, coatings, toilets, buttons, flooring and insulation

Polyesters — hair dryers, computers and kitchen appliances

Combustibility of Plastics by Frank L. Fire. (Fire Engineering Books: 1991)
When plastics burn, they produce…

“The Breath From Hell.”

Combustibility of Plastics by Frank L. Fire. (Fire Engineering Books: 1991)
Today’s fire environment produces higher levels of Carbon Monoxide.
Hydrogen Cyanide

135 ppm can kill in 30 minutes.

Today’s fires routinely produce 3,400 ppm, killing in less than a minute.

Hydrogen cyanide gas used in gas chambers.
Your SCBA face piece and turnouts absorb heat/energy until they fail. Studies show this is around 500° F or sooner.
If a firefighter cannot survive in the toxic environment without SCBA, and the PPE cannot withstand prolonged exposure above 500° F, can an occupant?
“If survival is not possible for the entire extraction period, a more cautious approach to fire operations must be taken. Fire control should be obtained before proceeding with the primary and secondary search efforts.”
The bottom line…

You need to know the facts of today’s structure fires.

What are they?
Modern Structure Fire Facts

- Fire grows as it receives more air.
- Fire releases more energy as synthetic furnishings burn.
- Fire gases burn if not cooled.
- Victims have a better chance of surviving if the fire threat is minimized.
Rescue is a tactical action of opportunity. This can mean that if the fire is within seconds of flashover, and the search and rescue operation requires several minutes, you do not have the opportunity to make a rescue.
If cooling the fire is required prior to, or during the rescue, how do you do it?
Cool the Space from the Most Effective Location
If cooling from the outside is the best option...
“Hit it hard from the yard” for several seconds to take the heat out of it, and then enter to finish it off and make the rescue.
Are conditions getting better or worse for any potential occupants?
The primary goal of this step is to reduce the thermal threat to the occupants and firefighters as soon as reasonably possible.
If cooling from the inside is the best option...
Control the door(s), cool the space, get the victims out of that place!
Research by NIST and UL (Spartanburg South Carolina) saw temperatures go from over 1000° F throughout the building to below 150° F within a very short period of water flow.
The same research also saw that water application significantly increased oxygen levels near the floor and CO levels decreased.
It’s been said before, but it’s a fact - firefighters need to adapt to today’s fire environment and adjust tactics accordingly.
Once you have addressed the thermal threat, it’s time to search.

See Blackboard video for basic search techniques.
Time for hands on training.

Take the information from the PowerPoint and videos and APPLY IT!!!!