Norfolk Fire-Rescue Carbon Monoxide Monitoring Program

Captain Nick Nelson
Norfolk Fire-Rescue
VA OEMS Symposium
November 13, 2015
“Don’t get in the way of outcomes you can’t change”

Dr. Richard B. Gasaway
NFR New Recruit Class
Norfolk Fire Rescue

- 1871-paid fire department
- 4th oldest paid fire department in America?
- Merged with PRS in 1991
- 500 employees
- 12 ALS ambulances
- 14 ALS fire engines
- 7 ALS ladder companies
- 2 ALS heavy rescue trucks
- 14 fire stations
Fire-Rescue continued

- 66 square mile urban city
- 350,000 during the workday
- Average of 40,000+ emergency incidents a year
- FY15 Budget $39,890,700

- Typically, a fire response consists of 3 engine companies, 1 ladder company, 1 rescue company, 1 battalion chief, and 1 ambulance. The ambulance crew can commit to fire suppression at working incidents.
Overview

• Introduction
• Possible sources of CO
• Carbon Monoxide (CO) properties
• CO health hazards
• CO levels and what they mean
• Response procedures
• Atmospheric monitoring
• Case studies
Objectives

• Familiarize personnel with the dangers and properties associated with CO
• Provide a frame-work on which to base initial response considerations
• Familiarize personnel with equipment used in the detection/monitoring of CO
FDNY Firefighters responding to a medical emergency in the Bronx Monday night entered what turned out to be a CO leak -- and fortunately equipment on an EMS crew coming behind them averted what would have been a really bad situation. The firefighters were reportedly unaware they had walked into a building that was literally filled with CO. It wasn't until the FDNY EMS crew from Station 15 got on the scene that an alarm was sounded.

Some 10 residents and the Firefighters evacuated from the building at E. 217th St. Four people, including the initial patient who called 911 with difficulty breathing, were taken to Jacobi Hospital for treatment of minor injuries related to the CO exposure, according to FDNY. The call that came in just before 0100 hours was for a cardiac arrest and Firefighters were the first on the scene for the emergency call, taking care of the patient, who was actually having an asthma attack.

But when FDNY EMS members from Station 15 stepped into the building, they immediately knew there was trouble. The carbon monoxide meters the units carry with them began to go off, alerting them to the potential deadly danger.

The first readings showed a level of 600 parts per million, which can cause nausea and headaches and can be deadly with extended exposure of three hours or more. The EMS monitors will spike at 35 parts. As the crew worked to evacuate the building residents, their alarms kept climbing, and by the time the building was emptied, the monitors were registering 1000 parts over 1 million.

None of the Firefighters or EMT's were harmed. The residents taken to Jacobi Hospital with CO-related injuries included a woman in her 40s and a man in his 60s, according to FDNY.
Introduction

• CO is one of the leading cause of poisoning deaths
• CO is responsible for half the poisonings world wide
• During 1999–2010, a total of 5,149 deaths from unintentional carbon monoxide poisoning occurred in the United States, an average of 430 deaths per year. (CDC)
Introduction

Most deaths are due to:

1. House fires
2. Auto exhaust
3. Indoor heating systems
4. Stoves and other appliances
5. Gas powered generators
6. Charcoal grills
7. Water heaters
Introduction

- CO deaths increase during disasters due to the use of generators and portable heaters.
- The winter months also see increased death rates due to the use of heating systems and closed windows.
Norfolk Fire-Rescue Response

Calls with actual CO findings

2013: 64
2014: 75
2015 to date: 57
State of VA CO Calls

- 2015 371 through July
- 2014 986
- 2013 1,047

- VDFP Annual Report
CO and CO2

**Carbon Monoxide**
Carbon monoxide is a highly poisonous, odorless, colorless, and tasteless gas. It is very flammable in air.

**Carbon Dioxide**
Carbon dioxide (chemical formula CO2) is a colorless, odorless gas vital to life on Earth.
Carbon Monoxide Properties

- Odorless, colorless, tasteless, non-irritating gas
- CO is a Poison and can be deadly at high levels
- CO can compound pre-existing illnesses and is often blamed on pre-mature deaths
- CO is Virtually undetectable without specialized equipment
Carbon Monoxide Properties

- Flammable Range: 12.8% to 74%
- Vapor Density: 0.968
- Vapor can rise or fall depending on temperature
Carbon Monoxide Production

- A natural by-product of incomplete combustion from burning carbon based fuels such as:
  - Gasoline
  - Oil
  - Propane
  - Methane
  - Coal
  - Wood
Carbon Monoxide Sources

- Attached garages with running automobiles
- Gas powered tools
- CO from sources outside
- Cooking and heating appliances
  - Improperly vented
  - Not serviced
  - Inefficient/improper operation

- Blocked Chimney
- Portable Heater
- Back Drafting
- Cracked Heat Exchanger
- Ranges
- Running Auto
- Leaky Flue
- Barbecues
- Dryers
Carbon Monoxide Sources

• Appliances
  – Vented: appliances that are designed to be used with a duct, chimney, pipe or other device that carry the combustion pollutants outside the home
  – Un-vented: appliances that do not vent to the outside, so they release combustion pollutants directly into the home
Health Hazards

- Silent Killer: CO will kill before its presence is known
- No early warning signs
- Displaces O2 in the bloodstream
- Victims die from asphyxiation
Health Hazards

- Reduced O2 reduces functions of the brain, cardiac muscle, and respiratory system.
- CO has a greater affinity for hemoglobin than O2 at 210 times to 1.
- COHb limits the ability of the blood to carry oxygen and effects all major organs and muscles.
Health Hazards

- High Risk Groups
  - Infants/Children
  - Pregnancies (Fetus)
  - Elderly
  - People with Heart Conditions
  - People with Respiratory Conditions
  - Persons who are anemic
Pulse Oximetry

Is it a reliable tool in patient assessment?????????
Carbon Monoxide Action Levels

- 9 ppm (Max Residential) EPA

- 35 ppm (Max Industry) and the Max limit per NFR SOP

- 50 ppm (OSHA PEL) Per NFR SOP’s
<table>
<thead>
<tr>
<th>Concentration</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 ppm</td>
<td>Headache/dizziness within 6 to 8 hours</td>
</tr>
<tr>
<td>100 ppm</td>
<td>Mild headache within 2 to 3 hours</td>
</tr>
<tr>
<td>200 ppm</td>
<td>Mild headache within 2 to 3 hours and loss of judgment</td>
</tr>
<tr>
<td>400 ppm</td>
<td>Frontal type of headache in 1 to 2 hours</td>
</tr>
<tr>
<td>800 ppm</td>
<td>Nausea, dizziness, and convulsions within 45 minutes</td>
</tr>
<tr>
<td>1,600 ppm</td>
<td>Headache, dizziness, and nausea within 20 minutes. Death in less than 2 hours</td>
</tr>
<tr>
<td>3,200 ppm</td>
<td>Headache, dizziness, and nausea within 5 to 10 minutes. Death within 30 minutes</td>
</tr>
<tr>
<td>6,400 ppm</td>
<td>Headache and dizziness in only 1 to 2 minutes. Death in less than 20 minutes</td>
</tr>
<tr>
<td>12,800 ppm</td>
<td>Unconsciousness with only 2 to 3 breaths and death in less than 3 minutes</td>
</tr>
</tbody>
</table>
Response Procedures

- Medic Units, Ladder Companies and Rescues Companies will carry single gas CO Detection equipment and Tubes.
- Rescues also carry 4 – gas meters
- Fire Prevention Inspectors carry single gas CO meters for follow-up operations
Response Procedures

- Establish Command
- Account for all occupants
- If occupants are still in a suspect atmosphere, remove all occupants
- If occupants are missing or reported trapped, request additional resources and initiate search & rescue operations
Response Procedures

• Triage all occupants for signs and symptoms of CO exposure. Treat and Transport all suspected CO patients

• Establish a hazard control perimeter (Hot, Warm, Cold)

• Conduct detection and monitoring to determine CO levels
Treatment of CO Patient

CARBON MONOXIDE exposure can be treated with HYPERBARIC OXYGEN
Hyperbaric Chambers in VA

Johnston Memorial Hospital | Abingdon | Southwest
Inova Mount Vernon Hospital | Alexandria | Northern
Virginia Hospital Center | Arlington | Northern
University of Virginia Hospital | Charlottesville | Thomas Jefferson
Chesapeake General Hospital | Chesapeake | Tidewater
Mary Washington Hospital | Fredericksburg | Rappahannock
Virginia Baptist Hospital | Lynchburg | Blue Ridge
Memorial Hospital of Martinsville | Martinsville | Western
Sentara Leigh | Norfolk | Tidewater
Bon Secours DePaul Hospital | Norfolk | Tidewater
Norton Community Hospital | Norton | Southwest
Capital Medical Center | Richmond | Old Dominion
Retreat Hospital | Richmond | Old Dominion
Lewis Gale Medical Center | Salem | Southwest
Halifax Regional Hospital | South Boston | Old Dominion

*Virginia's EMS Regions*
Response Procedures

- Ensure unit is turned on.
- Allow the instrument to “zero” in a clean atmosphere. “never zero the instrument in the suspected atmosphere”
Response Procedures

- Do not perform ventilation until all initial detection and monitoring is complete
- Perform detection and monitoring of all affected areas moving slowly and monitoring high and low
- Note the highest and lowest levels of concentration
Response Procedures

• Requesting assistance from a Rescue Company:
  1. Injuries or death occur
  2. Meter reading are above the action levels
  3. Unit not working
Response Procedures

• Report all findings via radio to command or the dispatcher

• Shut down all suspected equipment or appliances and “Red Tag” them for follow up by fire prevention

• Ventilate the structure
<table>
<thead>
<tr>
<th>RED TAG ISSUED BY NORFOLK FIRE-RESCUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Appliance</em> <em>Equipment</em> <em>Electrical Service</em> <em>Wiring</em> <em>Other</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATE/TIME:</th>
<th>INCIDENT #:</th>
<th>OCCUPANCY USE:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>INCIDENT ADDRESS:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>OCCUPANT/OWNER NAME (IF AVAILABLE):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>BUSINESS NAME (IF APPLICABLE):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>REASON FOR RED TAG ISSUE (BE SPECIFIC):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>APPLIANCE OR EQUIPMENT FUEL TYPE (IF APPLICABLE):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Natural Gas</th>
<th>Fuel Oil</th>
<th>Propane</th>
<th>No Fuel (Electric)</th>
<th>Other</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ISSUING NFR UNIT:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ISSUED BY (TITLE/PRINT NAME):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>OCCUPANT/OWNER SIGNATURE:</th>
<th>CONTACT NUMBER:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CLEARED BY:</th>
<th>DATE:</th>
</tr>
</thead>
</table>

White - Apply to item
Yellow Copy - Fire Marshal
Pink Copy - Building Official
Response Procedures

- Repeat atmospheric monitoring to confirm ventilation is complete and atmospheric CO is at or below:

  Residential Occupancies: 9 ppm (EPA)

  Industrial/Business: 35 ppm (NFR)
Response Procedures – No CO or Below TWA

- Leave a CO detection tube
- Brief the occupants on its use and who to call if it indicates the presence of CO
- Notify the fire prevention bureau of the placement of the CO tube
- Fire prevention will follow up with the occupants in 7 days to close out the event

Carbon Monoxide Detector Tube Cards
MSA style Mini CO Cards

Minico®
Carbon Monoxide Detector Tube
(Tubo Detector de Monóxido de Carbono)

Enter Starting
Register início
Date
(Fecha)
Time
(Horas)

1. If stain goes beyond 11. after 1 day, or goes beyond 2. within 7 days, ventilate immediately and contact:

2. Bend test strip tube at:

Expiration Date
(Fecha de Caducidad)
JUN 2015

Phone
(Telefono)

MSA USA
Drager Pac 3500 CO Meter
Operation and Use
Drager Pac 3500

- Norfolk Fire Rescue was using the ToxiRae 3 for several years. The ToxiRae 3 parts were being phased out for a new generation of meters.
- Norfolk Fire Rescue selected the Drager Pac 3500 as its new single gas meter.
Drager Pac 3500

- Easy to use
- Will be found on Medic Units and Ladder Companies
- Compact instrument
- Virtually maintenance free
- Turn on and leave On!
- 2 year battery

**We Leave the Unit Turned ON!!!**
There are numerous models of Single gas meters available
Drager Pac 3500

- Components of the Meter
  1. OK Key
  2. + Key
  3. Alarm Buzzer
  4. Gas Inlet
  5. LED Alarm

1. [OK] Power on/off/Alarm acknowledge
2. [+ ] Key off/Bump Test
3. Horn
4. Gas Opening
5. Alarm LED
Drager

• Turning the meter on
  – Press & hold OK key for 3 seconds
Drager Pac 3500

- Remaining Life of the Device
  Once activated check the remaining life by pressing 
  while device is turned off. The remaining time in days 
  will be shown. After another press 
  “d” will be shown. Another press 
  the gas to be measured will be shown

[+] Key
Drager Pac 3500

- To turn off the Meter
  Press and hold [OK] and [+], allow the meter to count down. Screen will go blank after 3 seconds
Drager Pac 3500

- Upon Startup the device will perform a self test
- The Number of days of remaining operation are shown. Ex “750”, “d”
- The A1 alarm and A2 alarm limits are shown
- Alarm Limits are set A1 = 9PPM, A2 = 35ppm
- If Unit alarms at any time Request a Rescue Company for additional monitoring!!!!!
Case Studies

• Norfolk Fire Rescue Program

• Established June of 2014

• Within 2 days Success story

• Over 10 Documented Cases
Case #1

- June 2014
- Medic Only response for Sick Person
- Initial complaint Flu like symptoms
- Elderly subject in subsidized housing
- CO Alarm on medic bag prompted full Response
- Investigation revealed faulty gas stove
Case #2

- December 2014
- Initial response for Altered Mental Status
- Engine and Medic arrived to find elderly subject with ALOC
- Initial BLS assessment and Alarm sounded
- Rescue Company responded elevated CO readings
- Source subjects using cast iron pot with water as heat source
Case #3

- March 2015
- Commercial Structure (Restaurant)
- Dispatched as Unconscious
- Initial Pt contact EMS monitor alarmed
- Full Response
- Readings over 150 in Commercial Structure
- Utilized LUF 60 to ventilate building
Case #4

• Norfolk Fire Rescue in Station

• Alarm kept sounding on Medic bag in Medic Unit

• FIREFIGHTER Response ??????
Cases Continued

We have had over 10 confirmed cases of alarm activations on CO leaks since the inception of the program.
According to city officials, carbon monoxide detectors used by EMS crews alerted them to high levels in the home. Officials then rushed a 53-year-old female to Mary Immaculate Hospital. It’s unclear if she was suffering from a stroke or from the high levels of carbon monoxide in the home.

When firefighters went back in to ventilate the mobile home, they found 55-year-old Stephen Alexander Harris dead inside. Harris appears to have died due to carbon monoxide poisoning, according to Lee.
Newport News

http://wavy.com/2015/10/17/death-attributed-to-carbon-monoxide-poisoning/
Ever have this conversation??????
Thank you

- VDEM HMO Todd Cannon
- VDEM HMO Ray Haring
- Norfolk Fire Rescue Special Operations
- BC John Humphrey, Logistics Chief Norfolk Fire Rescue
- Dr. Richard Gasaway, PhD
  - Wavy News
- Virginia Department of Fire Programs
  - MSA America
Questions????????

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