Atmospheric Monitoring at Structure Fires

I. POLICY

The purpose of this policy is to provide a policy for safe practices for all individuals working in and around the fire scene and during overhaul of the fire ground.

II. RESPONSIBILITY

A. All Chief and Company Officers have the responsibility to comply with and ensure that the personnel under their command are adequately trained, fully understand, and comply with this policy.

B. All firefighters have the responsibility to learn and follow this policy. .

III. PROCEDURE

1. Information

A. Hydrogen cyanide (HCN) is produced when materials such as insulation or synthetic materials are burned or heated. The symptoms closely mirror those of carbon monoxide (CO) exposure; therefore personnel must be cognizant of its presence.

B. Vehicle fires and trash fires also generate high levels of HCN and CO, but because they normally occur in an open environment the products of combustion dissipate quickly into the atmosphere. However, when smoke is present the need for SCBA is vital for responder protection.

C. The “5 gas monitor” shall be utilized to perform atmospheric monitoring on incidents and shall be carried in the on duty Battalion Chief’s vehicle. The monitor shall be removed and placed into the oncoming Battalion Chief’s vehicle at the time of shift change.

2. Personal Protective Equipment

A. Self-Contained Breathing Apparatus

1. SCBAs are required on **all** structure fires that present a smoke condition, to include kitchen and cooking fires, until air monitoring has taken place.

2. SCBAs are required on **all** vehicle fires until completely extinguished and all smoke has dissipated, or monitoring has taken place.

3. SCBAs are required on **all** large trash receptacle fires until completely extinguished and all smoke has dissipated.

B. Structural Turnout Gear

1. Turnout gear helps protect personnel from absorbing smoke, including HCN and CO through the skin, which is a secondary route of exposure.

2. Personnel are to wash turnout gear following structure fires that heavily soil and saturate gear with products of combustion.

3. If a second set of turnout gear is available personnel should switch gear as soon as possible.

3. Air Monitoring

A. All structure fires are to be monitored after the fire is deemed "under control", prior to beginning overhaul.

B. The incident commander shall assign personnel to performing the monitoring at structure fires.

C. SCBAs are **not** to be removed until the atmosphere can be monitored and deemed safe.

D. Monitoring specifically for HCN and CO shall be performed in the areas where crews will be operating.

E. HCN and CO levels are to be communicated to the Incident Commander who will record the readings on the Structure Fire Atmospheric Monitoring Form. (See attached)

F. If the readings are below the safe levels listed on the form, the Incident Commander will announce that overhaul may proceed without SCBAs.

G. At any time an Officer inside the structure feels conditions warrant the wearing of the SCBA, the Officer will order a member working inside to don their SCBA's and inform the IC.

4. Action Levels

A. Hydrogen Cyanide is twenty-four times more dangerous than carbon monoxide. Because of this, the action level for HCN is lower than CO.

B. The action level in order to operate without SCBA in an environment where HCN is

detected at **5ppm** (4.7ppm). This is the Short Term Exposure Limit (STEL) for HCN as recommended by NIOSH. The action level for carbon monoxide is **35ppm**.

1. STEL as defined by NIOSH is a 15-minute TWA (Time-Weighted Average)
   exposure that should not be exceeded at any time during a workday.

2. Immediately Dangerous to Life and Health (IDLH) for HCN is 50 ppm.

3. The atmosphere must meet both the action level for HCN and CO in order for personnel to operate without SCBA.

5. Decontamination

A. Personnel shall wash their hands prior to drinking and eating in rehab.

B. Once an incident is placed under control a random selection of personnel known to have been operating in the structure should have their PPE monitored.

C. If turnout gear has a reading higher than 5 ppm (Toxic sensor) within 2 inches of soiled turnout gear the soiled turnout gear shall be decontaminated following the procedure outlined below.

1. A hose line shall be used to decontaminate equipment. Briefly rinse with a soft fog pattern to prevent saturation.

2. Gear should be washed as soon as possible in an approved gear extractor.
   a. Turnout gear, flash hood, and helmet ear flaps should be washed in accordance with NFPA 1851 *(Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting).*
   b. Gloves should be washed by hand with hose or in sink.

2. Reporting

A. The officer completing the fire report shall be responsible for recording any significant exposures during a structure fire.

B. The following information will be supplied in the narrative:
   1. The HCN and CO levels during the time of operation.

   2. Areas monitored with corresponding reading.

   3. How long personnel operated in the atmosphere.

   4. The personnel operating in the hazardous atmosphere (listed on unit report).

   5. Specifics concerning the call i.e. major materials that burned.

3. Exposure

A. Hydrogen Cyanide can cause rapid death due to metabolic asphyxiation. Death can occur within seconds or minutes of the inhalation of high concentrations of Hydrogen Cyanide. Sources report that 270 ppm is fatal after 6 to 8 minutes, 181 ppm after 10 minutes and 135 ppm after 30 minutes [Hathaway et al. 1991]. These levels are not uncommon during routine structure fires as documented in a recent Columbia Fire Department study.

B. Acute exposure symptoms including weakness, headache, confusion, vertigo, fatigue, anxiety, dyspnea, and occasionally nausea and vomiting. Respiratory rate and depth are usually increased initially and at later stages become slow and gasping. Coma and convulsions occur in some cases. If cyanosis is present, it usually indicates that respiration has either ceased or has been inadequate for a few minutes. If large amounts of Cyanide have been absorbed, collapse is usually instantaneous; unconsciousness; often with convulsions, is followed almost immediately by death.

C. If personnel are found to have been operating in an IDLH atmosphere or experiencing severe health effects it is strongly recommended they be transported for advanced medical evaluation.

1. HCN has a half-life of one hour, therefore it is imperative that the exposed personnel be given immediate medical attention to include a blood work and tested for HCN levels in the blood.

2. Because this is somewhat new information it is likely test results will be delayed, but personnel will still be treated and monitored by advanced medical personnel.

3. It is important that when transported to the hospital, advise medical personnel that the firefighter was operating in a known hazardous environment containing Hydrogen Cyanide.