Alarm and Detection/Suppression
American Fire Technologies

- To provide special hazard services worldwide to the industrial market through the integration of components and services.
Clean Agent

- What are our goals today?
  - How does a Clean Agent extinguish a fire
  - Types of Clean Agents systems
  - Halon?
  - Design Considerations of a Clean Agent System
  - System Components
  - Sequence of Operation
How Does a Clean Agent System Work?

- Most clean agent’s work by chemically extinguishing a fire at the molecular level.
  - In order to extinguish a fire, the agent decomposes.
  - When a Clean Agent decomposes, toxic gases are released. (Does not apply to inert gasses: CO2, Inergen)
  - To avoid high levels of decomposed gasses, systems are designed for quick discharges (UL requires <10 seconds).
How Does a Clean Agent System Work? (cont)

- Agent Storage
  - Agent is a liquid, stored in cylinders, pressurized with N2.
  - Agent is super pressurized with N2 to a pressure of 360 psi.
  - Agent is distributed to discharge nozzles, drilled to allow a specific flow rate.
  - Discharge nozzles are located in the room area and below under floors.
  - Cylinders are furnished with low-pressure switches to monitor agent pressure.
How Does a Clean Agent System Work? (cont)

- Oxygen Depletion: Halon
- Heat Absorption: HFC’s
- Reaction Interruption: Inert Gas
  - Primary: Halon
  - Secondary: HFC’s

Chemical Reaction

- Heat
- Oxygen
- Fuel
How Does a Clean Agent System Work? (cont)

- **Physical**
  - Heat absorption - remove heat faster than generated
  - Reduces flame temperature below that necessary to maintain combustion

- **Chemical**
  - Interruption of chemical chain reactions of combustion process by halogenated atoms (Fl, Cl, Br)
### Physical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Halon 1301</th>
<th>FE-25™</th>
<th>HFC-227ea</th>
<th>Novec</th>
<th>Inergin</th>
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<tbody>
<tr>
<td>Chemical Formula</td>
<td>CF3Br</td>
<td>CHF2CF3</td>
<td>CF3CHFCF3</td>
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<td></td>
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<tr>
<td>Molecular Weight</td>
<td>148.9</td>
<td>120.02</td>
<td>170.0</td>
<td>316.4</td>
<td>34</td>
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<td>Boiling Point</td>
<td>-72º F</td>
<td>-55º F</td>
<td>3º F</td>
<td>120º F</td>
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<tr>
<td>Vapor Pressure</td>
<td>200 psi</td>
<td>195 psi</td>
<td>66 psi</td>
<td>5.87 psi</td>
<td>2175</td>
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<tr>
<td>ODP</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>GWP</td>
<td>6900</td>
<td>2800</td>
<td>2900</td>
<td>1</td>
<td>0</td>
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</table>

- **Zero Ozone Depletion Potential (ODP)**
- **Very low Global Warming Potential (GWP)**
  - GWP is calculated over a 100 year time horizon and represents mass of CO2 equivalent to emission of one unit of this compound.
Different Types of Fire Suppression Systems

- FM-200 (HFC-227ea) CF$_3$CHFCF$_3$
  - Most common agent used.
  - Works by chemically inhibiting fire propagation.
  - Poor flow characteristics.
  - Supports 12 nozzles max
Different Types of Fire Suppression Systems (cont)

- **Novec 1230 (Sapphire)** \(\text{CF}_3\text{CF}_2\text{C}(\text{o})\text{CF}(\text{CF}_3)_2\)
  - Fairly new agent.
  - Works the same as FM-200.
  - Short after life in the atmosphere (days).
  - Poor flow characteristics.
  - Pressurized with Nitrogen
Different Types of Fire Suppression Systems (cont)

- Ecaro 25 (Dupont FE-25) \textbf{CHF2CF3}
  - Closest to replacing Halon 1301
  - Works by removing O2 at the molecular level.
  - Superior flow characteristics.
  - Required 25% less agent than FM-200.
  - Most economical of Clean Agents.
  - No pressurization concerns
  - No venting required
  - Support 30 to 40 Nozzles
Different Types of Fire Suppression Systems (cont)

- Inergen (Argonite. Same as Inergen without any CO2)
  - Inert gas (52% nitrogen, 40% argon, and 8% carbon dioxide)
  - Lowers the oxygen in the room to a level that won’t support a fire, but still enough oxygen to breath.
  - Design is critical.
  - Must vent room due to pressure build up.
  - Doesn’t leak from the room because of low density.
  - Economical to recharge (Hard to find recharge locations).
Different Types of Fire Suppression Systems (cont)

- Water Mist (Micro Mist)
  - Non-Chemical.
  - Micron size water droplets.
  - Best used for generator rooms or areas with high leakage.
  - Very economical to recharge.
Different Types of Fire Suppression Systems (cont)

- **CO2 (Carbon Dioxide)**
  - Not classified as a Clean Agent.
  - Can be lethal to humans.
  - Operates by removing the oxygen from the air.
  - Good for non-occupied hazards.
United States Position - Halon

- Montreal Protocol - ban on Halon production - 12/31/93
- No current restrictions on use of reclaimed or recycled Halon
- No current restrictions on existing installed systems
- Halon market value decreasing
Halon Retrofit Objectives

- Maintain an equivalent level of protection
- Utilize the existing Halon 1301 piping network
- Minimize business interruption
- Environmentally preferred
- Realize the most cost effective solution
- Is Green important?
Halon Replacement

- No reason to remove Halon, but difficult to recharge if dumps
- FM200/Ecaro/Inert Gases/Green Gases
- Ecaro best one for one replacement.
System Design

- Define Hazard
  - Determine volume of area(s) (L X W X H).
  - Areas may include room, under-floor, and above ceiling.
Agent/Quantity

- Determine which agent to use.
  - Try to use the same agent/mfg that is currently used in the facility.
  - Determine quantity of agent to use.
Design Concentrations Comparison

<p>| | | | |</p>
<table>
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<tr>
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<tbody>
<tr>
<td>ECARO-25</td>
<td>8.0%</td>
<td>685 lb.</td>
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</tr>
<tr>
<td>Halon 1301</td>
<td>6.0%</td>
<td>623 lb.</td>
<td>1</td>
</tr>
<tr>
<td>HFC-227ea</td>
<td>6.25%</td>
<td>765 lb.</td>
<td>1</td>
</tr>
<tr>
<td>Inergen</td>
<td>37%</td>
<td>357 m³</td>
<td>21</td>
</tr>
<tr>
<td>Novec</td>
<td>4%</td>
<td>948 lb.</td>
<td>2</td>
</tr>
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Systems Design

- Automatic and Manual Operation
  - Smoke Detectors are used for automatic operation
  - Manual release stations are used for manual operation.

- System Alarms
  - Alarm bells
  - Horn strobes
  - Strobes
Systems Design

Releasing Panels
- System controls
  - Main Control Panel (UL9th Must be listed to release specific)
    - Operates on 24 volts DC from a 120-volt AC input power source.
    - Contains batteries for DC back up.
    - Monitors and controls all input and output circuits.
    - Includes replays for connections to building alarm panels and remote monitoring
Systems Design

- Discharge Nozzles
  - Determine quantity and location for nozzles.
    - Limit nozzles to a maximum flow of 20lbs./second.
    - Locate nozzles in each protected area (Room/U/Floor).
  - Try to locate nozzles away from exit doors.
System Components

- **Main Control Panel**
  - Is “Conventional” or “Intelligent”.
  - Used to monitor and control input and output devices.
  - Supplies power to the field devices.
  - Supervises field wiring
    - INPUTS – Opens, Grounds
    - OUTPUTS – Opens, Grounds, shorts
  - Displays alarms and troubles.
  - Contains timers for time delays for agent release.
System Components (cont)

- Ionization Smoke Detector
  - Detects 1-2 micron particle size.
  - Should be used in room areas only (airflow issues)
System Components (cont)

- Photoelectric Smoke Detector
  - Detects visible particles (4+ microns) (Visible)
  - Good for under floor areas.
  - Normally not as sensitive as an ionization detector.
System Components (cont)

- Heat (Thermal Detector)
  - Operates when temperature reaches set point.
  - Not good for early warning detection
  - Best suited for harsh areas (Smokey/Dirty).
System Components (cont)

- **Air Sampling System**
  - Detects “Sub-micron” size particles.
  - Good for ultra early warning of a fire condition.
  - Detects “Thermal degradation” of the item.
  - Allows you to be “Pro-Active” to alarms. You can find the source of the problem before needing the suppression system.
  - Fairly expensive, but could save the cost of a systems recharge.
System Components (cont)

- Manual Release Station
  - Used to manually discharge the system.
  - Instant release, bypassing any time delays.
  - Normally located near exit doors.
  - Code requires every system to have a manual release.
Abort Station
- Used to bypass a pending discharge.
- Located next to the manual release station.
- Must be depressed (operated) in order to bypass a discharge.
- Must be operated prior to a system release.
System Components (cont)

- Alarm Devices
  - Alarm Bells.
    - Used for “1st” detection zone alarms.
    - Used for Air sampling system alarms.
System Components (cont)

- **Horn Strobes**
  - Can be used for “1st”/”2nd”/”Discharge” alarms
  - Normally are pulsed to indicate type of alarm.
    - Slow pulse – 1st zone alarm
    - Fast pulse – 2nd zone alarm (pre-discharge”
    - Steady – Discharge alarm.
System Components (cont)

- Strobe Lights
  - Normally used to indicate a system discharge.
  - Located outside exit doors.
  - Attached to a horn inside the hazard area, a strobe indicates a general alarm condition.
System Components (cont)

- Agent Storage Cylinders
  - Used to store Clean Agent.
  - Is supplied with pressure gauges and low-pressure switches.
  - Are supplied with valves or bursting disc.
    - Solenoids used to actuate valves.
    - Actuators used for bursting disc type.
System Components (cont)

- Discharge nozzles.
  - Used for distribution of agent.
  - Located in protected areas.
  - Sidewall and center room type.
  - Maximum flow rate of 200 lbs (20 lbs. second)
System Components (cont)

- **Actuators**
  - GCA (Compressed Gas Actuator).
    - Triggered by small charge.
    - Requires special handling.
    - Used on cylinders with rupture disc.
  - Solenoid
    - Activated by applying voltage to coil.
    - Used on cylinders with valves.
    - Can also be used on N2 (Nitrogen Actuators)
System Components (cont)

- **Special Detection Systems**
  - **Early Warning Fire Alarms (VESDA/SAFE)**
    - Used for very early warning of a fire.
    - Monitors particle size of .01 micron (Invisible)
    - Works by taking air samples in the room and counting the particulate.
    - Allow personnel to be pro-active in finding a potential fire hazard and eliminating the need to use the suppression system.
EARLY WARNING SMOKE DETECTOR

- Particles of Combustion are Found in Air Samples
  - Control Panel Indicates “Pre/Alarm” Condition
  - Control Bar Graph Indicates Level of Particle Count
  - Control Panel “Alarm Level” Contacts Operate
  - Alarm Bells in Ground Floor Area Are Activated
Detection Devices

- Determine quantity of smoke detectors.
  - Use a spacing of 250 sq. ft. per detector.
  - In room areas use a combination of ionization and photoelectric smoke detectors.
  - In under-floor spaces, only use photoelectric smoke detectors.
  - Located a manual release and abort station at the primary room exits. Normally, these are installed inside the hazard area.
  - Locate audible and visual devices in the room so all personnel can hear/see the alarms.
  - Locate discharge strobes outside of the main exit doors.
Sequence of Operation

- Single Smoke Detector In Alarm
  - Control Panel Indicates “Alarm” Condition
  - Control Panel Alarm Contacts Operate
  - Control Panel Displays Device and Location of Alarm
  - L.E.D. On Smoke Detector Illuminates Steady “On”
  - Alarm Horn in Hazard Area Starts a Slow Pulse Signal
  - Alarm Strobe in Hazard Area is Activated
Sequence of Operation (cont)

- Two Smoke Detectors in Alarm (Same Hazard Area)
  - Control Panel Displays Device and Location of Alarm
  - L.E.D. on Smoke Detector Illuminates Steady “On”
  - Alarm Horn in Hazard Area Changes to a Fast Pulse Signal
  - Control Panel Pre-Discharge Delay Timer is Activated
  - Equipment Shutdown Contacts Are Activated
Sequence of Operation (cont)

Note:

- At the end of 30 seconds, the system is discharged into the hazard area.
- If the abort station is operated prior to the 30-time delay, the system will not discharge. The abort is a “Dead Man” type, and must be continually depressed in order to bypass a discharge. Releasing the abort station will cause the time delay to restart.
Sequence of Operation (cont)

- **System Discharge**
  - Control Panel Displays System Has Released
  - Discharge Strobe Outside Exit Door is Activated
  - Alarm Horn in Hazard Area Changes to a Steady Tone
  - Discharge Strobe Outside of Exit Door is Activated
  - Shutdown Relays are Energized
Sequence of Operation (cont)

- **System Alarms and Troubles**
  - Control Panel will Display Either “Alarm” or “Trouble”
  - Control Panel will Display Cause of the Alarm or Trouble
  - Control Panel Sonalert Will Sound
Sequence of Operation (cont)

Note:

- Depressing “Acknowledge” button on front panel can silence the control panel sounder.
- Alarm devices in the field can be silenced by depressing the “Alarm Silence” button on front panel.
- Depressing “Reset” button will return panel to “Normal” condition.
Sequence of Operation (cont)

FIRE ALARM

- Operation of Any Smoke Detector or Fire Alarm Pull Station
  - Control Panel Indicates “Alarm” Condition
  - Control Panel Alarm Contacts Operate
  - Control Panel Displays Device and Location of Alarm
  - L.E.D. on Smoke Detector Illuminates Steady “On”
  - Alarm Horns in Hazard Area Starts a Pulse Signal
  - Shutdown Contacts Operate
Sequence of Operation (cont)

NOTE:

- Depressing “Alarm Silence” button on control panel door will silence alarm bells.
- Depressing “Reset” button will reset panel to normal condition.
Clean Agent

The End

“Thanks” For Taking The Time To See This!!
We Hope This Will Help
Questions

- ?
- Leave me your card/email or email me if you would like additional information on any of the additional detail

- paulh@americanfiretech.com