CLEAN AGENT SYSTEMS

From Drafting Board to Post-Incident

Introduction

Clean agent systems are waterless fire suppression systems that protect high value property found in specific occupancies. The purpose of this article is to help educate firefighters on how to operate at a fire scene where a clean agent discharge has occurred. It is meant for any firefighter that has a clean agent system in their response area. For over 20 years I have worked as a fire protection engineering and design consultant, which has provided me the opportunity to understand and document multiple clean agent systems. This article will address the most common system types including the clean agent material, system components and operation, and the strategy and tactics for dealing with a clean agent system both before, and after, an incident.

Definition

A clean agent system is a waterless fire suppression system that uses an inert gas to extinguish a fire. They are regulated by the NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems. A clean agent is defined as an “electrically nonconducting, volatile, or gaseous fire extinguishant that does not leave a residue upon evaporation.'' These systems are most commonly found protecting spaces where a fire incident would have a high value consequence. They could protect items that have significant worth or equipment critical to business continuity. Common spaces include data centers, data storage areas, document storage areas (banks, insurance companies), imaging suites (CT, MRI), and telecommunication centers. Less common spaces include power plant control rooms and turbines, air traffic control towers, 911 call centers, maritime vessels, museums, and libraries. Simply put, they are located anywhere there is a sensitivity to water damage. They can extinguish fires that would otherwise be obstructed from a standard sprinkler. They also greatly reduce damage from smoke and water.

There are various types of clean agents available. Halon is considered a “legacy” agent and is no longer allowed to be installed due to its ozone depleting qualities. Novec 1230, a fluoroketone, has a very low global warming potential with a short atmospheric lifetime. Inert gas systems (Inergen, Argonnite) are 100% green with “0” ozone depletion, global warming, and atmospheric lifetime as they come from the air that we breathe. The other two commonly installed agents are FM-200 and FE-25, both of which are hydrofluorocarbons. FM-200 was the first “clean agent” to the market in 1994 and is the leading agent in the market. These two agents have zero ozone depletion potential but many environmental groups are critical of them because they have high global warming and atmospheric lifetimes. All have pros and cons based on the hazard protected, environmental impact, clean-up required after a discharge, and human contact.

Clean agents suppress fires in three ways: 1) Inert agents smother fires by depleting the oxygen; 2) FM-200/FE-25 extinguishes a fire primarily through heat absorption that occurs as the agent changes from a liquid to a vapor during discharge. In addition, these also disrupt the combustion reaction which aids in the extinguishment of a fire; 3) Novec 1230 fluid extinguishes fire primarily through heat absorption.

Figure 1

(1) Storage Cylinder; (2) Discharge Nozzle; (3) Smoke Detector

Operation

An oversimplified description of a clean agent system is that it's an extinguisher with an automated discharge. The source of the system is a storage cylinder (Figure 1) which contains the agent at a high pressure (typically 360 psi). This cylinder is piped using carbon steel pipe to nozzles (Figure 2) that discharge the agent into the space. Piping to multiple nozzles is installed symmetrically which matches pressure loss throughout the system to achieve equal discharge pressure at the nozzles ensuring a balanced dispersion. Smoke detectors (Figure 3) are provided inside the space and are used to recognize a fire condition and initiate an agent discharge. A horn/strobe unit (Figure 4) is provided inside the room above the door to alert the occupants of the space to system activation and a strobe is provided outside the room above the door to indicate that a discharge has occurred. An abort button and manual pull station (Figure 5) are provided inside the room adjacent to the door and a keyed maintenance switch is provided outside the room to take the system out of service. All of these items are wired to a control panel (Figure 6) that is typically located outside the space adjacent to the door. Signs are provided to identify the various appurtenances and explain the audio/visual device warnings.

Figure 2

Figure 3

If a smoke detector is activated it will be indicated on the control panel, the horn and strobe in the room will be activated, and the building fire alarm system will be alerted. If a second smoke detector is activated it will be indicated on the control panel, the HVAC equipment will shut down or dampers will be closed to isolate the space, the horn/strobe unit will pulse faster, and a delay sequence (10 to 60 seconds) begins to allow occupants to exit. Once the time delay sequence is complete the agent is discharged and strobe outside the room will be activated. The abort switch may be used to stop the agent discharge by holding the button during the delay sequence. The manual release will start the sequence as if the second detector initiated and will override the abort switch or it will activate an immediate discharge

Figure 4

Figure 5

(4) Horn/Strobe; (5) Abort Button / Manual Pull; (6) Control Panel

of the agent. The keyed maintenance switch can be used to prevent the system from discharging, but the detection system will remain active.

Code does not allow a clean agent suppression system to act as the sole defense against a fire because it is a finite source. The cylinder will discharge the agent until it is empty which typically lasts for a duration of 10 to 60 seconds depending on the agent. If the fire is not controlled by the agent, it will continue to develop. For this reason, an automatic sprinkler system is required as a secondary back-up. There are exceptions to this rule, but they are rare and require approval from the local fire code official. Preaction systems are usually provided in addition to the clean agent because they are well suited to critical spaces as well.

Figure 6

Tactics

Firefighters should perform pre-incident planning for spaces protected by clean agent systems and develop a set of tactics for a response. We need to know what's being protected before we respond to an incident.

Tactics for an event in a server room will be different than a rare books library. How the space is protected is also critical. The detectors and discharge nozzles may not only be located at the ceiling. Many data centers have a raised floor and the area below the floor may also be protected. The presence of a raised floor is typically evident from walking up a ramp to enter the space. Detection could be accomplished with an air sampling system that constantly monitors the air in the space for the presence of smoke. I liken it to a 5-gas meter with a wand but on a larger scale. The location of the control panel is critical as this will be your source of information as to what's going on

inside the space. You should know if there is a pre-action back-up system in place and where its components are located. Although not necessarily critical, it would be good to know where the agent storage cylinder is located. You should also have an understanding of how the HVAC system operates under normal conditions and the options available for using the system to assist with ventilation if needed.

If you are dispatched to an event, go to the space and determine if the clean agent has in fact been discharged. The presence of a haze could be smoke or could be the agent. Pay attention to the exterior strobe which indicates system discharge. Locate the control panel to determine which detectors have been activated. There may be a drawing at the panel with a layout of the room, so you know where the detectors are based on the identifier listed on the panel. Try to determine if the pre-action system has discharged if one is present. If the clean agent hasn't contained the fire and you are making entry, be prepared for sprinklers to activate. Enter the space wearing SCBA. The agent is not toxic, but you're in there because of a fire so protect yourself as you would any other fire. Locate the source of the event and determine if the fire was extinguished. If it wasn't, complete the extinguishment with an extinguisher or handline. Firefighters must be cognizant of the methods used at this point. The extinguisher must be compatible with the hazard in the room to work adequately. The incorrect choice or the use a handline could create more damage to contents.

Once the fire is placed under control the room will need to be restored to operation as quickly as possible. This will probably not be the responsibility of the fire department, but you may be asked to assist. If ventilation of the space cannot be performed by facilities personnel manipulating the building HVAC system, you may be required to use fans. Many modern buildings have fixed sash windows that cannot be opened for ventilation which will complicate the task. Even if you ventilate the space into the surrounding areas there won't be a problem. The agents are non-toxic and work at small concentrations within a confined space so there's no risk to the occupants. But firefighters should be prepared to explain this to put the occupant's mind at rest.

Conclusion

Clean agent systems are a complex network of fire suppression components used to protect critical contents or spaces. Discharges are low frequency but high consequence events. Even a minor fire in this type of space can be a major event to a building owner. Firefighters must understand the components and operation of these systems. Not only to be safe, but to mitigate the situation in a timely manner while protecting the space and its contents. There may be delicate or expensive items that are irreplaceable. There may also be equipment that is critical to business operations which will need to be brought back online and the space returned to operation quickly. Identify areas with clean agent during the plan review process. Once the system is installed, attend the commissioning process. That will be the best time to have all the parties to coordinate with together. The engineer and installer will be there to discuss the system operation. The building Owner will be there to discuss the contents and nature of the space. And the facilities personnel will be there to discuss your response efforts. There are many ways these systems can function. This article only describes what I feel is most commonly installed. Firefighters must ensure they have an accurate understanding of the systems in their response area.