Clean Agents

Mission Critical Data Center and Telecommunications Switching Facility Applications

By Tom Simms

[Back to Article Index](#)

Image courtesy of The RJA Group, Inc.
(click to enlarge)

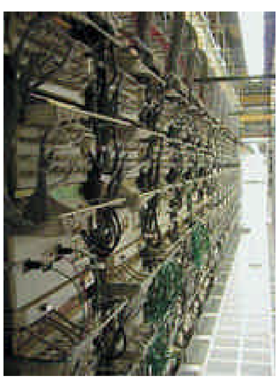

Image courtesy of The RJA Group, Inc.
(click to enlarge)

Feature Article

PROTECTING THE SPECIAL HAZARD of a computer room data center or a telecommunications switching facility against fire requires an integrated fire model. This article focuses on the gaseous suppression agent as a key element of a mission critical facility fire protection model.

By definition, mission critical environments support operations that are often unique and disruption is detrimental to the business function they serve. Avoidance of an extended business interruption from a fire requires an immediate response that addresses the fire situation without sustained disruption or the necessity for involved post-fire remediation.

Of the various client sites I have reviewed over my tenure, most facilities incorporated a gaseous suppression system on the basis of industry standard or even industry trends. Application of a gaseous suppression agent is sometimes a directive from the client while otherwise a decision of the design professional.

Design professionals should consider what is intended to go right as well as what may go wrong. This article discusses both.

When selecting and applying a gaseous suppression system to protect a mission critical environment, one should consider the following questions:

WHAT ARE THE CLIENT'S EXPECTATIONS OF THE GASEOUS SUPPRESSION SYSTEM?

It is important to understand the clients expectations for the gaseous suppression agent. After spending a significant amount of capital budget on this protection system, the client will experience a peace of mind knowing additional protection is provided. The actual benefit of the suppression system may or may not occur during the lifetime of the facility.

Client's expectations of the gaseous suppression system performance should be discussed with the fire protection design professional. These discussions should explain the suppression system's capabilities, limitations, operation requirements, maintenance requirements, potential for failure, and the side affects of any potential failure to suppress.

A very important aspect to discuss with the client is that some gaseous suppression system manufacturers provide warranties for the system components, but disclaim any warranty that the system and it's agent will extinguish a fire.

WHAT IS THE FACILITY'S FIRE PROTECTION MODEL REQUIREMENTS?

In a majority of the applications, the fire protection engineer or party responsible for design of a mission critical facility chooses to protect the critical operation with a gaseous suppression system. In addition to the decision to incorporate this protection, consider how the gaseous suppression system will interact with a fire scenario as part of the facilities fire protection model.

A mission critical facility fire protection model should consider - What is the likely fire scenario? In most mission critical environments, the highest probability will be that the source of the fire is an electrically energized circuit or power supply. With this assumption, a gaseous suppression system applied to suppress an electrical fire (Class C) must have the capability to both extinguish the combustion of materials and inert the ignition source. One must also consider if the gaseous suppression system will extinguish the fire successfully on the first attempt. Extinguishing the fire on the first attempt of agent discharge minimizes the fire's capacity to disrupt or destroy the mission critical operation.

Failure to extinguish a fire on the first attempt introduces several undesirable conditions. The obvious result of a failed suppression attempt is the fire continues to propagate disrupting the mission critical operation, destroying data and/or capital equipment while further reducing the opportunity for rapid recovery from the incident.

GASEOUS AGENTS FOR MISSION CRITICAL APPLICATIONS

During a majority of my tenure consulting in mission critical facility design, the Halon 1301 agent has afforded me the proven confidence that this gaseous agent would address the suppression system requirements of valuable technology spaces and their operations.

Numerous Halon articles were published, extensive and comprehensive application research was performed, that included both laboratory and empirical field testing. Possibly due to the newness of the NFPA 2001, Standard on Clean Agents Fire extinguishing Systems, comparable documentation and testing appears to be in limited supply.

Of the documentation available, bench mark testing of the NFPA 2001 recognized Clean Agents, in comparison to Halon 1301, describe lesser results. These new halocarbon Clean Agents are not generally equivalent in their overall effectiveness, require higher concentrations and result in higher decomposition percentages.

Of the most common 2001 Clean Agents being utilized today, HFC-227ea (Commercially known as FM -200) shares

Image courtesy of The RJA Group, Inc.
(click to enlarge)

ABOUT THE AUTHOR

Mr. Tom Simms, P.E. is Associate Manager for the Chicago, USA office of Rolf Jensen & Associates, Inc. (RJA). Mr. Simms has over twenty-five years of experience providing consulting services in the protection of mission critical facilities. To learn more about RJA, visit their website at www.rjainc.com

the largest installed base of gaseous suppression agents. Clean Agent IG-541 (Commercially known as Inergen) shares a lesser presence in the mission critical facility environment.

The most recent NFPA 2001 recognized Clean Agent C-6 (Commercially known as Novec) has been introduced as a viable mission critical facility agent. As this agent has been recently released to the market, performance analysis by independent testing for mission critical applications is hopefully forthcoming.

ENERGIZED CIRCUITS OR EQUIPMENT - DECISION TO DEPOWER

Inerting the fire's electrically energized ignition source is key factor to successful extinguishment and preventing the re-ignition of the combustible materials.

Depowering of the mission critical equipment operation is not without its consequences. Depowering the data center operation equipment will result in the loss of time and may result in the unrecoverable loss of data and temporary disruption of the business operations. Depowering telecommunications switching equipment may disrupt not only voice conversations, but critical data, and life saving 911 communications. Therefore, the decision to depower must be well thought-out and a risk assessment made on the impact to depower or not.

Depowering was often performed with Halon 1301, but proven through testing not always to be a requirement. Testing of the Halon 1301 agent included several decades of performance in the fire protection market, extensive independent research and testing, and empirical experience has been plentiful. One key attribute of the Halon 1301 agent is it's effectiveness to suppress live, energized circuitry synonymous with mission critical equipment. Thus reducing the reliance on the need to depower.

Some independent lab testing is available pertaining to the performance testing of energized circuits with the newer halocarbon Clean Agents. Laboratory testing for HFC-227ea (commonly known as FM200) indicates the agent's extinguishment capabilities of energized circuits may have mixed results.

A Hughes Associates, Inc study "Final Report - Extinguishment Tests of Continuously Energized Class C Fires" prepared for the Great Lakes Chemical Corporation (Manufacturer of FM-200 Clean Agent) rendered results indicating FM-200 could extinguish a energized circuit fire and inert the energized source. A portion of this test protocol utilized segments of conductors energized with a common electric welder as a power source. Extinguishing performance of the Class C tests were obtained with normal concentrations for an energized duration of 5-minutes.

Conversely, the National Institute of Standards and Technology (NIST) performed similar, but more extensive testing of FM-200's capabilities to extinguish energized circuits. This NIST Test "Clean Extinguishing Agents and Continuously Energized Circuits" utilized a more extensive and comprehensive testing protocol. Their testing results indicated the need for higher than permissible (NFPA 2001) concentration levels of the agent to extinguish an energized circuit fire with lower energy sources than the Hughes Associates protocol test. The NIST tests further documented a significant increase in thermal decomposition of the agent, especially with the increased concentration levels required to extinguish their testing protocol. One important conclusion of the NIST Testing is the need for further testing of full scale (actual data center/telecommunications equipment application) higher energy level fires involving electrically power equipment.

The term "Clean Agent" of the NFPA 2001 Standard refers to the application of the agent in reference to the protected hazard. The Clean Agent when discharged is compatible with mission critical equipment and personnel without any detrimental effects. Should however, a halocarbon agent fail to extinguish and suppress the energized fire source, one must consider decomposition of the agent. This form of contamination is detrimental to most mission critical equipment's continued performance integrity, not to understate this exposure to personnel responding to a fire. With the gaseous suppression agent as the primary active element of the mission critical fire protection model, an automatic depowering scheme may be most appropriate for use with Halon replacement Clean Agents.

AGENT RETENTION TIME

When utilizing gaseous suppression in the mission critical fire model, the facility's enclosure capability to "hold" the agent's concentration level is strategic. This design and construction detail of the protected hazard's enclosure to retain the agent's minimum concentration level is a key factor to the effectiveness of this portion of the fire protection model.

NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems 2004 Edition does not stipulate a required hold time. Agent hold time must be a consideration of the fire protection model and stipulated in the design criteria. In prior related Standard, the typical hold time was 10-minutes from the time of complete discharge. This time duration is fine for a fire protection model that utilized Halon 1301 as the agent, involved depowering, and included response personnel that could intervene manually with the fire scenario to prevent re-ignition or continued propagation of the fire. One must consider the agent's capabilities, response time by intervening personnel and the respondent's qualifications once the agent has released and is suppressing the fire.

This is especially true for remote, unoccupied or "lights out" mission critical facilities. In a fire scenario where a gaseous agent releases in response to a detected fire, the agent hold time duration is critical to both the extinguishing process and time to permit the responding personnel to determine what action may be required. Without adequate hold time, responding personnel may arrive just in time to see the fire re-ignite.

MISSION CRITICAL RELEASING DETECTION

Detecting the incipient stage of a mission critical fire is imperative to the timely release of the gaseous suppression agent. Traditionally, thermal, ionization or photo-electric spot detectors have been utilized with releasing panel sequences to automatically discharge gaseous suppression agents.

With the advent of the high density equipment information technology platforms, equipment cooling requirements are demanding higher air flows in the mission critical spaces. Traditional spot detector sensitivities are affected at locations including ceilings due to the heat stratification and high air flows. This scenario introduces a dilemma to achieve responsive detection for both notification and timely release of the gaseous agent.

The newer very early warning detection technologies offer some advantages to this traditional detection dilemma. Very early warning detectors with their acute sensitivity permit incipient detection of the early stages of a fire for alert and provide additional levels of detection for timely detection for release of the agent. Their sensitivity however, can also introduce undesirable premature discharges of the gaseous suppression agent. Care must be employed in the application of very early warning detectors serving as releasing detection.

OVERPRESSURIZATION OF THE HAZARD ENCLOSURE

A gaseous suppressed fire protected zone must be designed and constructed to retain the specified design "hold" time of the agent. In addition, a common element of this fire protection model includes smoke control from external sources that would otherwise contaminate the mission critical equipment. Monolithic wall construction combined with vapor barriers, fire caulking of construction joints and enclosure penetrations are instituted to achieve high levels of smoke barriers. Furthermore, air conditioning ductwork entering the protected mission critical zone should be equipped with low leakage dampers to limit smoke infiltration. All these design elements contribute to a well designed and constructed chamber to retain the gaseous agent.

With a low leakage enclosure designed and constructed, overpressurization of this enclosure upon releasing the gaseous agent into this space must be considered. All gaseous agents propelled into these spaces to meet the NFPA Standards for discharge times will produce pressures and impose these pressures on the structural aspects of the enclosure. This includes Halon 1301, and the NFPA 2001 Clean Agents. It is especially pronounced with the inert clean agent due to the significant volume of gas introduced.

Therefore, a venting design to address the pressurization of the enclosure is a key element in the mission critical fire protection model. Failure to coordinate the enclosure strengths with a venting design can result in a breach of the protected enclosure, a loss of agent concentration, and detrimental structural damage to the enclosure and/or facility.

Close consultation is in order with the gaseous suppression manufacturer, the system designer, and the designers of the facility enclosure to assure proper venting is achieved.

AGENT/SMOKE EVACUATION

Means to evacuate the discharged agent from the protected enclosure once it has either extinguished the fire or failed should be consider a part of the fire protection model. This system should be operated by qualified personnel on their determination the agent was successful or has failed and may be decomposing along with any fire byproducts causing further damage to the mission critical operation. Optimally this evacuation system is a powered mechanical ventilation system capably designed and dedicated to this function.

CONCLUSION

Creation of a mission critical fire protection model must consider many application, design, and operational aspects in selecting a suppression agent.

ENDNOTES

NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems 2004 Edition, NFPA, One Batterymarch Park, Quincy, MA.

Hughes Associates, Inc Baltimore MD. "Final Report - Extinguishment Tests of Continuously Energized Class C Fires" prepared for the Great Lakes Chemical Corporation"

National Institute of Standards and Technology (NIST) Mark R. Driscoll, Paul E. Rivers of the 3M Company, St. Paul, MN.

"Clean Extinguishing Agents and Continuously Energized Circuits"

IFP

Top