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# Protecting your cleanroom from the threat of fire

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**By their very nature, cleanrooms are difficult environments in which to combat a fire. However, the latest technologies can help prevent a fire from even starting, let alone spreading.**

The protection of lives, property, and your business from fire requires planning, guidance and cooperation of all a building's inhabitants. Fire protection is a multistage process in which fire protection equipment must be deployed, but a strong prevention plan must be established. Education is the most important task in fire prevention and protection. However, all the fire prevention techniques and planning can not insulate an organization from a fire incident. Even though fires are rare incidents, they do occur and can be extremely devastating to the operations and profitability of an organization especially in today's global environment. One point to mention is that businesses have been experiencing increases in insurance premium costs and higher deductibles. Equipment damages or losses due to a fire that were replaced through insurance coverage in previous years, may be the responsibility of the victim company this year. Companies are attempting to search for new products and methods that will limit or mitigate their exposure to this new insurance risk.

## How a fire develops

The combustion process begins before you see smoke or fire or feel intense heat. The initial development of a potential fire will emit colourless, odorless by-products of initial combustion. Once these particles are present, the fire is said to be in its 'incipient' stage of development. This stage will eventually transform into the smoke, followed by the flame stage and finally the intense heat stage. The incipient stage causes no damage to any equipment and is not a danger to any inhabitants and the environment. In fact, the impending damage that will occur in the subsequent development stages of a fire can be prevented by removing the source of the combustion either through the removal of power or heat from the overheating source of ignition. Effectively, you potentially can turn a developing fire incident into a maintenance issue, no loss of equipment, no danger to the inhabitants, no business interruption, no insurance losses and no lost revenues. The next question that you undoubtedly have is does this type of protection exist, and how I can obtain this type of protection. These two questions will be answered in a few moments but first we need to discuss the basic requirements of protecting an advanced semiconductor manufacturing facility.

## 'Must haves' for protecting your investment

Fire protection systems encompass two functions: the detection/notification of a fire and the subsequent suppression of that fire. Detection systems use various types of detectors to sense problematic condition either being smoke, heat, flame, or the presence of products of combustion. Each type of detection device is used for specified conditions. Semi-conductor manufacturing facilities present a unique environment when referring to fire protection for such facilities. The airflow of the environment tends to inhibit the function of standard spot smoke and thermal detection devices due to the resulting smoke movement. In these facilities, smoke will follow the airflow rather than following the traditional movement towards the ceiling seen with little or no airflow conditions. Combined with the passive function and sensitivity of a standard spot detector, all types of ceiling detection will provide limited protection for the clean environment facility.

Proper protection of this type of facility calls for locating detection device within the airflow where the entire room can be monitored properly. An appropriate location is typically within the airflow immediately before the air-handling unit where the dilution of the air occurs as well as at the exit of both air-handling and re-circulation handling units. The detectors may provide passive or active detection, but are required to provide a minimum sensitivity level of .03 per foot obscuration. The National Fire Protection Association (NFPA) has published the standard 318, 'Protection of Semi-Conductor Manufacturing Facilities' (2002), which specifically indicates the location of approved detection devices within the facility as well as the sensitivity and other characteristic requirements. Other potential detection devices other than smoke detection

may include optical flame detection and gas detection as indicated by the NFPA Standard 318 to supplement the required smoke detention devices.

For advanced manufacturing sites, water sprinklers have been proven to be the most effective life safety suppression agent, and are required in accordance with NFPA Standard 318, Protection of Semiconductor Manufacturing Facilities. For minimum protection, sprinkler head locations should include the room as well as the exhaust ductwork, plenum and interstitial spaces above the room only if they are constructed of materials that are combustible. Still, assets that reside within that facility are at risk. Water by its nature is known to damage sensitive electronic circuitry. Sprinkler systems also have potentially high clean-up costs. In order to mitigate potential damage and losses due to water, a clean gaseous agent can be considered as a supplemental protection to a sprinkler system, the agent in most cases will suppress a fire without injuring the inhabitants and not damaging sensitive electronic equipment. The clean agent systems in most cases will require the deactivation of air handling units. If this does not occur, the clean agent system may not successfully suppress the fire, and the standard sprinkler system can be employed to protect the facility and the inhabitants if any are still present within the room. Remember, if the sprinkler system is employed, the assets present within the protected structure will be either damaged or lost.

## How FM-200 works

Clean gaseous agents are safe for humans and will not damage sensitive electronic equipment. The selection of preferred gaseous agents vary from country to country.

Fire-suppressing gaseous agents are typically an alternative to water for the protection of electronic equipment, and historically, Halon 1301 was the gaseous agent of choice for the applications discussed here. However, the Montreal Protocol, ratified globally over ten years ago, placed a moratorium upon the production of Halon 1301 in the majority of nations due to its ozone depleting characteristics. Since then, the USA and Europe have taken a different approach to the suppression.

In the USA, the Environmental Protection Agency accepts the use in case of fire of the next-generation halocarbon FM-200 (which has no ozone depletion effects and makes a limited contribution to the greenhouse effect). Commonly employed across the USA, the gas is safe to inhale at design concentration levels and extinguishes fires without damaging sensitive electronic equipment and other materials. In Europe, inert gases are widely used as suppressants, including carbon dioxide, nitrogen and argon. Since they are derived from the atmosphere, they have arguably no overall effect on the environment. However, they are required in much larger quantities and they must be stored under much higher pressure than HFCs such as FM-200. Typically, a 7 percent concentration for GFC-227ea will suppress a fire, while inert gases will need 30-50 percent concentrations. FM-200 is also stored as a liquid and releases into the air as a gas. Inert gases are always stored in the gaseous phase, which is why much larger volumes, logistical effort and greater storage capability are required for inert gas systems.

## A high-tech approach for high-tech business

As discussed previously, the interruption of the combustion process during the incipient stage of a fire will prevent any equipment damage as well as not affecting inhabitants or the environment. Recent technology advancements are available to provide such detection. Siemens employs the use of VESDA with its core fire alarm panel products.

VESDA is an aspiration detection system that draws in air and examines it with laser particle detectors. The unit can indicate a possible fire before smoke can be smelt or flames seen. By identifying a fire at the incipient stage, notification allows damage, if any, to be limited and personal injury to be prevented. With incipient fire detector, a system can detect overheating wire in an electrical installation before it reaches flash point. There is no need to deploy the suppression system, because the circuit can be identified and simply switched off. The fire has not yet occurred.

Such intelligent systems are the future if fire detection and can save lives and investments. With increasing insurance premiums and higher deductibles, the use of VESDA and FM-200 along with required sprinkler systems and a state-of-the-art fire alarm system can be your best insurance policy for your critical assets.

**Author**

**Laurence Grodsky is product manager with responsibility for suppression and specialized detection equipment for Siemens Fire Safety. The company's systems are installed in all types of industry from the most high-tech computer manufacturing facility to standard manufacturing plants, and from telecoms to power generation.**

**Further information**

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