Ensuring Mission Critical Data Center Reliability With Aspirating Fire Detection

By Steven Joseph

Whether data centers are on-premise for enterprises, colocation (colo) arrangements or hyperscale facilities run by the largest Internet-based companies in the world, ensuring 24/7 reliability and avoiding service disruptions due to fire is essential because of the mission-critical nature of the information and services involved.

Although much of the focus has been on data center cyber security and power utilization effectiveness, fire is the second leading cause of failure (after power issues), according to a 2015 Capitoline survey regarding causes of data center failures.

Few in the industry publicly admit to data center fires, but they do occur as evidenced by a quick Google search of "data center fire." And the risk of fire hazard is increasing as the industry pursues ever-greater power densities (potentially 20 or more kW per rack) in more confined space to maximize available real estate.

When a fire does occur, vital business services that rely on information to generate profits can come to a screeching halt. The downtime can be catastrophically expensive in terms of damage to operations, facilities, reputation, as well as lost data and customers.

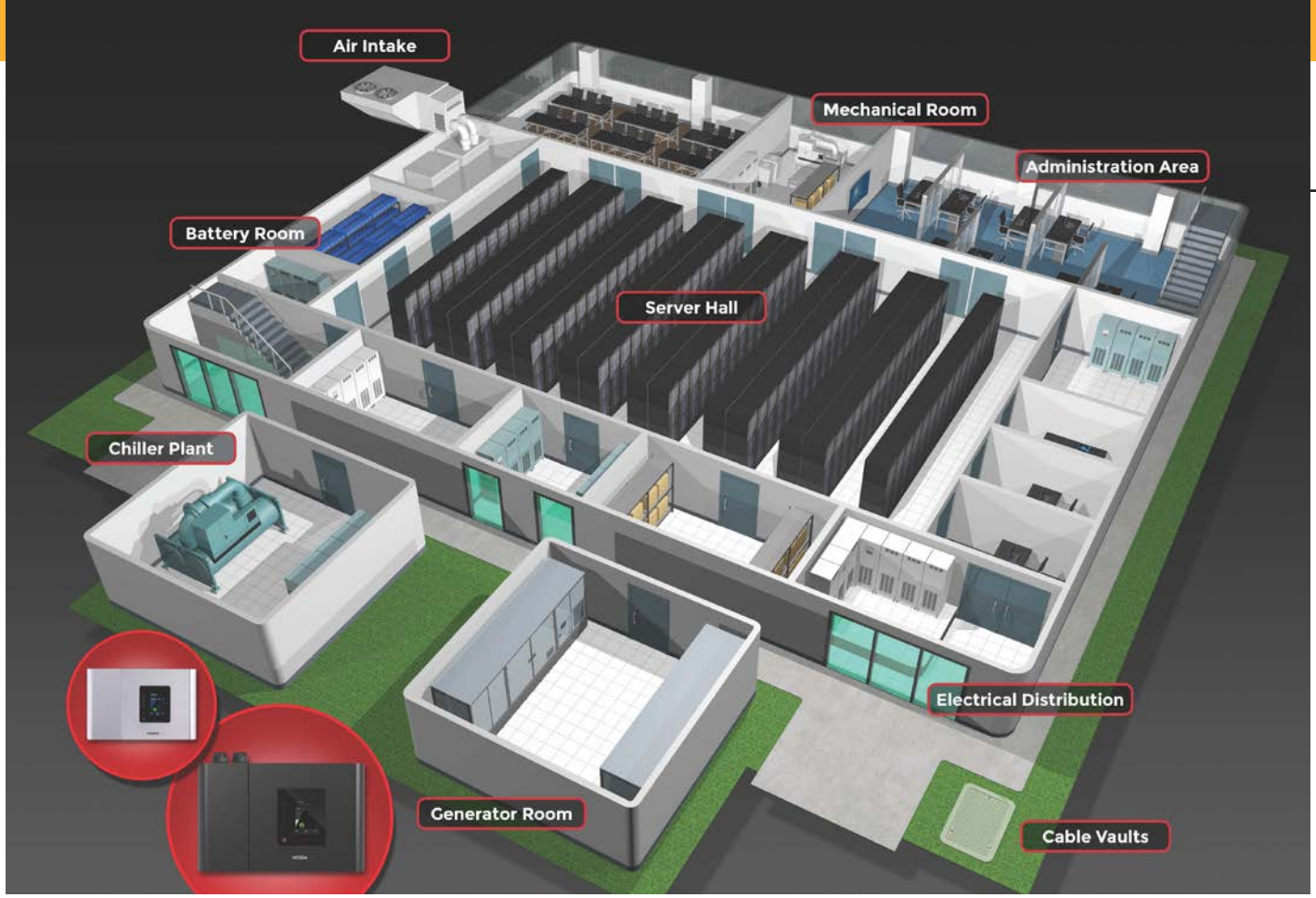
Because data centers are so critical to business operations today and so costly in terms of service disruption and reputational damage when there is downtime, the goal is to detect fires as early as possible at the incipient stage before it becomes a fire fighting exercise.

However, a dilemma occurs when data center owners try to meet prescriptive fire safety regulations designed to protect human life — and not assets. After all, most data centers are staffed by very few people.

Given the sheer size (which can encompass hundreds of thousands of square feet) and how densely packed with hot, power-intensive electronics these environments can be, the focus needs to be on achieving high-performance 24/7 uptime, along with asset preservation.

On top of this, data center environments are becoming more challenging in terms of smoke detection. This is due to structural and environmental conditions present, such as obstructions, turbulence in a predominantly air-cooled environment,

(Continued on page 14)



With fire a leading cause of serious disruption, aspirating technology can provide very early smoke detection as well as streamline testing and maintenance, even in challenging colocation environments.

and the need to avoid disruptions during mandated maintenance and testing.

Fortunately, advances in aspirating smoke detection technology, which has proven itself in data center environments for decades, are not only providing very early warning and greater reliability than traditional options, but also ease testing and maintenance.

The approach, which works by continuously drawing in small samples of air through holes in piping or tubing and tests it at a central unit, can be used to protect critical data center assets with very early detection even before smoke becomes visible, and prior to flame, in conjunction with performance based systems built to exceed life safety codes.

Data Center Smoke Detection Challenges

As a result of maximizing server power in the smallest available space, present day data centers often have unusually high heat densities of more than 300 watts per square foot. Data centers contain ample sources of fuel, such as plastics, circuit boards, and insulated jacketing of wire — and that mechanical equipment such as HVAC systems with moving parts, fans, bearings or belts can start a fire with the friction generated.

However, the traditional method of mounting spot smoke detectors on ceilings is increasingly insufficient to alert data centers of a fire risk before an outage or serious service disruption is triggered for a number of reasons. One significant reason is that most data centers still typically direct large volumes of air to cool equipment, but this can be problematic for spot detectors that passively wait for smoke to accumulate at their sensing chamber.

In the beginning stages of a fire, smoke has very little buoyancy because it doesn't have much heat. Combined with the strong airflow for cooling, it will not have the thermal lift needed to reach the ceiling. Air mixing from cooling also dilutes any smoke accumulation in the space. So, the smoke migrates with the airstream away from the ceiling, where spot detectors are traditionally mounted.

Structural barriers near the ceiling such as HVAC ducts and fully loaded cable trays can also obstruct smoke from reaching traditional ceiling mounted detectors.

The industry's practice to contain server aisles — which directs air to cool equipment within a designated aisle, rather than cool the entire space — is also complicating traditional spot type smoke detection.

When traditional smoke detectors are installed within contained hot aisles, the high heat temperatures reached in the hot aisle can in some cases exceed the listed range of traditional smoke detectors, which renders them unsuitable.

Because of these challenges, traditional prescriptive codes and standards that focus on life safety rather than asset protection may not necessarily meet data center business continuity and performance goals.

In traditional prescriptive based designs, building codes usually require specific, measurable design criteria that are

meant to govern typical building situations, based on past loss history and standard construction methods. While this works well in most cases, the approach can lack flexibility when data centers have unusual design parameters.

The problem is that our codes and standards are written to predominantly address life safety, not necessarily asset protection. But from a data center owner's perspective, asset and business continuity protection is a key goal, because they operate such an expensive technical asset that is so critical to the community relying on their services.

Fortunately, the International Code Council (ICC) accepts alternative, performance-based design that allows for "alternate materials and methods" that offer equivalent or superior fire safety performance. In terms of enhancing fire safety, this often involves scientific calculations and engineering as well as computer fire modeling. With this approach, a design is considered acceptable if the fire engineering calculations demonstrate that it meets the measurable performance criteria set at the start of the process.

Many data center owner-operators who rely on a design-build approach to meet the prescriptive life safety requirements are finding out the hard way that they may not get the very early detection and asset protection they require due to structural and environmental constraints. So they need to supplement this with a performance-based fire detection system that meets their asset preservation and business continuity objectives.

One way that data center owner-operators are achieving asset protection and business continuity goals is with advanced aspirating smoke detection technology. The technology enables earlier detection and a swift response by detecting very small concentrations of smoke particulate, potentially before smoke becomes visible or a fire begins to flame and burn. Newer generation aspirating technologies are better suited to discriminate against dust, which can help to minimize false alarms.

Because of the design and installation flexibility of the aspirating smoke detection technology, such smoke detection systems can provide detection throughout the data center for the fastest possible response to a developing fire threat.

As an example, Xtralis' VESDA-E VES Aspirating Smoke Detection system can also identify and monitor smoke density by individual sampling pipes that allow a single zone to be divided into four separate sectors. The technology refines the very early warning smoke detection system the company developed in the 1980s, which has been used for the most sensitive applications where early detection of smoke is critical, such as in data centers, cleanrooms, and telecommunication facilities.

In case of fire, this capability can be used to quickly distinguish which contained hot aisle(s) is affected in a data center to more accurately target a response; and a similar approach can be used in other areas such as mechanical/electrical spaces. Systems like this also provide several programmable alarm thresholds that enable a swift escalating response, which can help to stop a fire and minimize potential damage before a fire suppression release.

The system is also sophisticated enough to allow for four levels of alarm thresholds across a wide sensitivity range, which can be used to significantly reduce false alarms and allow for escalated investigation and action before fire suppression system deployment.

In sensitive data centers, avoiding unnecessary fire suppression activation is essential to business continuity since after any deployment the area and systems must be restored to full operation.

Ease of Maintenance

Even with these benefits, one of the primary advantages of an aspirating smoke detector system is its ease of maintenance, inspection and servicing.

While spot smoke detectors are relatively easy to install, NFPA regulations mandate annual inspection and testing of each unit for many facilities including data centers. This time-consuming process requires a fire alarm contractor to introduce smoke directly into the detector and verify that it functions as intended. This can require entry into secure, caged colocation areas that can potentially disrupt service during testing.

(Continued on page 16)

Furthermore, when smoke detectors are mounted on ceilings that can be 30 feet high in some data centers, mandatory testing and maintenance can also be a challenge. This can require ladders, special equipment, scaffolding — not to mention giving technicians access to detectors that may be mounted in secured locations.

Aspirating systems, however, do not require testing at each sample hole. Instead, tests can be conducted at the central unit and at benchmark test point, which can be can be conveniently located at ground level, outside of secure, caged colocation areas.

Hyperscale data center operators are essentially standardizing on aspirating detectors that provide the earliest possible fire detection, along with an ability to quickly identify an affected aisle. This is helping to more reliably maintain mission critical corporate processes on a 24/7 basis in an increasingly complex environment.

Although aspirating detection systems cost more than traditional spot smoke detectors on a one to one basis, they can actually end up costing less than conventional options overall.

A single aspirating smoke detector could take the place of 80 spot detectors, for example, as well as all the electric wiring, conduit, junction boxes, etc. that are required. When total costs, including operational expenditures like testing and maintenance are included, aspirating systems often come out ahead.

Ultimately, such a cost-effective approach provides earlier fire detection and better protection of multi-million-dollar data center assets, while helping to ensure business continuity.

For more information, contact Xtralis at 175 Bodwell Street, Avon, MA 02322, call: +1 (619) 252-2015; email: rsandler@xtralis.com or visit: www.xtralis.com/vea

Steven Joseph is Director of Market Development - Mission Critical, at Xtralis (www.xtralis.com), a global provider of aspirating fire detection equipment.