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Intelligent control of the lab environment

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Security is a feature of modern living. Protecting people and assets against a variety of influences and dangers is important in all businesses. However, in some industries the security risk is higher and protection therefore inevitable. Life science is one such industry where the potential dangers are numerous, from highly active agents, explosions and fire to the contamination of people, rooms or products. Intelligent building technology solutions are therefore commonly employed in chemical and pharmaceutical environments, with applied risk management used to recognize and eliminate potential inherent risks which might endanger safety or performance.

Few industries are as heavily regulated as the life science sector. Strict international standards are imposed in terms of research, development and production of a drug in order to ensure patient safety. In addition, pharmaceutical companies bear an enormous amount of financial risk. The timescales for developing a new drug are typically from eight to twelve years. Add to that the potential to discover up to nine years later that the active agent does not work as planned or the side effects are unacceptable and this clearly illustrates the investment in time and money in getting a drug to market. Out of 100,000 substances tested in the lab, only one may find its way into an approved drug. It is therefore imperative that the environment in which the drugs are developed is effectively and efficiently protected to minimize any outside influences which may affect the process.

Controlling and monitoring access: security plus additional benefits
Starting with raw materials, these can represent substantial value, as well as be potentially dangerous controlled substances. By integrating access control with video surveillance, tampering can be prevented, both in terms of raw materials and, ultimately, of the finished product.

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Integrated security also helps to deter piracy, theft, prevents unauthorized entry and reduces the risk of contamination. Access control is widely used in life science environments because of the need to give different levels of access to different personnel. Although primarily operating in a security context, by integrating the access control functionality within the intelligent building management system, other benefits can be realized. Conventionally occupancy detectors will be used to achieve a demand controlled approach to lighting and ventilation but by combining this with access control functionality, energy efficiency for room heating and lighting can be significantly improved. In a laboratory, for example, it is then possible to set the conditions based on the identity of the person that has entered. An access control reader identifying cleaning personnel entering will know it is for a relatively short period of time. The temperature comfort set point could therefore be lower but with an increased constant air exchange rate than say, for a chemist or technician entering for their daily work, resulting in increased energy efficiency.

Lab is the focal point

The laboratory is the hub of activity in terms of developing new drugs. Hazardous substances are routinely handled in lab environments, with fume hoods and other associated equipment that are subject to strict regulations in order to protect people and the environment. Air flow and the means to control it are also critical to maintaining the safety and security of the lab environment and there are dedicated lab solutions, based on a building automation and control system, specifically designed to do this. Such a lab solution takes the intelligent approach to building automation and introduces specific functions to protect the entire lab. Returning to the fume hood as an essential piece of safety equipment, this provides a well protected, localized zone for conducting tests and experiments. The formation of contaminated air or explosive concentrations, as well as uncontrolled reflow back into the room, is prevented by selective air flow or extraction. Fume hoods usually have a glass sash that acts as sliding protection barrier. Closing the sash protects the lab user against contamination and prevents potentially poisonous gases from escaping. However, protection from harmful gases also needs to be maintained even when the sash is open. For systems with a constant air volume flow, the fume hood is designed to continuously extract the specific air volume flow in the event the sash is open. A consequence of this approach is the increased energy required, as well as the generation of unpleasant noise levels, which is not conducive to a comfortable working environment.

A much more efficient and comfortable solution is to dynamically adjust the air volume flow based on the position of the sash. By employing sensors to detect the position, the set-point value for the air volume flow can be adjusted accordingly. By visualizing the sash positions in the building management system, technical personnel can check the status of each fume hood at a glance. They can then instruct users to close the fume hood more often in order to save energy and to reduce the risk of accidents.

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Minimizing fire and explosion risks

Due to the materials and substances used, as well as process steps where dust accumulates, dedicated explosion protection and fire safety measures are essential in life science facilities exposed to these risks. Specific solution concepts are available for controlling and regulating climate control installations in explosion zones, as well as dedicated fire safety solutions and products, such as certified smoke, heat and flame detectors for explosion-protected zones. This provides early and foolproof detection of increased fire variables.

Lab technicians often work with open flames and a fire in the fume hood therefore poses a significant risk. Protection systems specifically developed for fume hood applications are designed to detect fires in the working zones within seconds. They typically employ linear fire detection technology, with automatic extinguishing for the zone. Integrating this fire detection with a higher level management system allows constant visualization of the operating states of the fume hoods, any alarm conditions and any drop in the pressure of the extinguishing medium.

If the fire detection system is integrated within the overall building automation and control system, a much more comprehensive picture is provided and opportunities to automate certain processes in emergency situations are available. For example, an increase in toxic gas concentration levels can automatically increase the volume of air extracted from the room, or exterior window blinds can be raised in the event of a fire being detected. Evacuation systems can be integrated, reducing the potential for panic. Swift and efficient evacuation can be particularly significant in a life science facility, perhaps with the need for people to remain in place to avoid the potential danger being as important as getting people out of the facility. Personnel need clear and concise instructions in an emergency scenario – specific information as to what actions to take - so speech-based messaging, co-ordinated from a central control point which is receiving information from all the relevant systems, can prove invaluable.

Data protection

In addition to physical safety and security, life science is an industry in which strict requirements are in place in relation to secure protection of data. Integrated building management systems, which have in-built pharmaceutical functions, are an effective way of chemical and pharmaceutical companies meeting their compliance requirements.

All user interventions to data must be thoroughly documented, with users required to identify themselves with unique names and passwords, where needed even with biometric technology. Audit trails are also vital. All user and system activities should be automatically recorded in a seamless audit trail, with some systems allowing activation of a ‘mandatory comment’ function

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which requires users to indicate any reason for a change, therefore providing maximum transparency during layer data analysis.
Recording capability must be maintained at all times therefore requiring that the building management system has a very high level of availability. In the event of an error, fast system recovery is extremely important so regular and automated back-ups are essential, with the potential for the inclusion of business continuity modules that mirror the back-ups to an identical system and check whether it is fully ready for service.
In the event of an incident in a life science environment, traceability of each part of the process leading up to it, as well as post-event analysis, is vital to identify the exact point at which the problem occurred. Data archiving is therefore critical and it generates vast amounts of data, particularly when considering the time frames involved in developing, trialling and introducing a drug to market which means that archiving is often required for twenty years or more. It is good practice to systematically archive data, with the data no longer required in the short-term moved to secure media to free up space in the active system. Lab solutions are available which automatically show the location of data for a given period if retrieval is required at a later date. Attention also needs to be paid to ensuring that the system can read data over such prolonged periods, with the files capable of being archived in vendor-independent formats. Making sense of such a wealth of data can be difficult so implementing a system which provides useful information, such as graphic illustrations of trends or an overview of alarms or user interventions for a given period, is of significant value. Life science regulations require that systems employed in quality-relevant decisions must be validated on a project-specific basis. The capacity to do this is therefore a pre-requisite in selecting a system.

The benefits of integration

In the modern lab environment, as in many other industries, safety and security are increasingly co-ordinated through a central point. Efficient operation and rapid intervention is therefore dependent on an intelligent building management system which provides an overview based on information from thousands of data points. This includes the data upon which the safety and security protection is founded: fire detectors, access control points, video surveillance cameras, lab rooms and fume hoods, and the gas detection system. Also the data related to energy distribution and comfort provision: heating, ventilation and air conditioning, lighting, and blind control. This integrated approach offers significant benefits. It reduces complexity by providing only one user interface for the entire building infrastructure. Each subsystem operates autonomously and has a limited volume of data for a specific purpose, with the building management system only displaying the information needed for a specific task.
In the event of an alarm or a malfunction, the system helps to quickly resolve the problem since the alarm escalation and forwarding procedures are the same for all integrated systems. Any deviation

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from the normal state is immediately reported visually and acoustically. Users are guided intuitively to the cause of the fault, with intelligent algorithms used to distinguish between the initial fault and follow-up alarms.

Intelligent building management as such is about maximizing the benefits of the data presented by a facility's numerous systems. The more information is available, the better the facility operates. In the challenging work environment of the life science industry, with its strict guidelines and regulations, establishing a safe, economical and comfortable laboratory is key.

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