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Lab Works

Specialized equipment leads trends in laboratory and technical facility design. BY DAVID SKINNER AND MELANIE TUNGET

The latest trends in laboratory and technical facility design and construction can be seen in the evolution of the HVAC, electrical, plumbing and process piping systems, and the specialized furniture and fume hoods utilized in these facilities. Determining optimal trend choices to implement in a particular facility takes early planning and a team with knowledge and understanding of laboratories and technical facilities. With proper planning, systems and components, substantial efficiencies and cost savings can be realized.

HVAC systems are one of the most significant systems within a laboratory or technical facility; labs and cleanrooms generally require significant air changes per hour and certain processes require once-through, or 100 percent outside air. These exhaust demands require significant conditioned make-up air, and costs can additionally be driven by the potential need for system redundancy for mission critical tasks. Today, typical room air change rates are being re-evaluated as they are dependent on several key factors including room use, room arrangement and the hazards involved.

In some facilities, operational trends are allowing for more direct control of HVAC by end-users depending on the processes conducted. However, this is an option that is still being studied.

Electrical systems in laboratories and technical facilities can be complex and demanding as significant power is required for mechanical systems and facility equipment and/or instrumentation. Many users will require clean and dedicated circuits, and mission critical operations may require back-up generators or explosion proof (Class 1, division 1 or 2) electrical systems in some work areas.

Labs are generally major users of power and mechanical system resources. However, there are solutions to mitigate this mass use of energy such as variable air volume (VAV) systems, low flow and high efficiency fume hoods and energy-efficient lighting. Energy efficiency in laboratories is a critical issue as more and more facilities are realizing there can be considerable savings realized over the life of the building and as laboratories will no longer be exempted from the energy recovery calculations required by the ASHRAE 90.1 standards.

Plumbing and process piping systems are

another complex component of the laboratory or technical facility. It is imperative that all piping materials are selected based on the unique environment and processes of each laboratory, keeping in mind the importance of flexible design that allows for easy renovation and modifications when necessary.

Plumbing systems in these facilities are usually much more complex than general sanitary/domestic plumbing systems and can include complex carrier gas distribution systems, ultra-pure and DI water systems, and separate industrial waste systems – some of which require clarifiers and neutralization systems. Today, the emphasis is on installing appropriate plumbing systems vital to each individual facility's efficiency, flexibility and safe operations.

Trends in laboratory casework and fume hoods include modular and mobile workstations, low flow and high efficiency fume hoods, and moveable tables and cabinets. And, some specialized casework and fume hoods are dictated by lab processes. Heavy chemistry laboratories demand a high linear footage of fume hoods while laboratory instruments require more laboratory bench space. Also, sufficient storage and cabinetry can provide solutions to reduce workspace clutter common in the lab environment. Regardless of type or style, having the ability to modify and relocate casework is a key element to the ever-changing lab environment. In today's world, it's all about flexibility and adaptability.

Popular Concepts

When it comes to facility layout, three concepts are gaining popularity. The first concept is the flexible lab, which offers tremendous options for future uses. The flexible lab offers efficient ways to modify and reconfigure workstations. Flexible labs utilize centrally located utility chases for all major services that are positioned for easy reconfiguration, while some labs provide for overhead utility services, even liquid waste, to allow for fast changes in facility operations. The flexible lab design concept results in a functional, efficient and easy to reconfigure space.

The second concept is the open lab where large open spaces with dedicated sections are utilized; this is different from some of the closed or compartmentalized lab concepts employed in the past. The open lab keeps all functions in one open and undivided space to promote teamwork and communication, as well as the sharing of equipment, work space and support staff.

The third concept is collaborative space, which offers ample and easily accessible meeting areas for sharing information and cultivating a team approach to research. These spaces can include team-based research areas, writing areas, work areas and other meeting spaces such as break rooms or atriums. Collaborative labs move away from the concept of "specific" areas where only one person works or one process occurs – this concept is all about working together, and of course, collaboration.

Each of these concepts support common goals, including creating functional efficient work areas that are easy to modify and reconfigure, as well as encouraging a team approach to lab processes and research. The key to these concepts is to invest in the front-end of the project, during the design phase, particularly for the MEP elements to reduce future costs. If planned early, each of these concepts can be incorporated in early design and equipment specifications, and offer a facility capable of enduring frequent advances and changes in the laboratory and technical facility environment.

In the past, employing green solutions in the design of technical facilities has many times taken a secondary role in project planning. But it's important to keep in mind the big picture and review the lifecycle cost analysis as a basis for energy investment decisions. While lower-cost solutions may initially be more cost effective over shorter periods of time, say less than five years, it is not uncommon for VAV systems to have a lower lifecycle cost when considered at life cycles in excess of 10 years. Note that payout is based on current energy costs and does not even consider the new ASHRAE 90.1 guidelines that will most certainly impact existing building codes.

One Final Point

A final point about trends in laboratory and technical facility design and construction is the importance of building commissioning and re-commissioning. In new construction, commissioning a building ensures all the subsystems – HVAC, plumbing, electrical, fire and life safety, building envelopes, interior systems (such as a laboratory unit), cogeneration, utility plants, sustainable systems, lighting, wastewater, controls, and building security – achieve the owner's project requirements as intended by the building owner and as designed by architects and engineers.

Even the most carefully designed and constructed facility can fall short of reaching its energy performance goals if it is not properly commissioned, maintained and operated.

For existing buildings, re-commissioning is a systematic process applied to identify and implement operational and maintenance improvements, and to ensure continued performance over time and assure system functionality.

Re-commissioning optimizes the way equipment and systems operate as well as how systems function together, and recent studies have shown that over time, significant performance shortfalls in existing systems can occur if the systems are not properly maintained and a process is not in place to verify that design benchmarks are being met. Commissioning and re-commissioning are critical to the environmental performance of laboratories and technical facilities. ◆

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