



Minimizing the Risks and Effects of Accidents in Laboratory Facilities

Laboratory facilities should be designed to contain chemical or biological releases, fires, and explosions in as small an area as possible and be operated to minimize the risk of these events. Accomplishing this requires:

- Hazard Assessment.
- Proper facility space planning and layout.
- Functional space pressurization controls.
- Specific safety systems to address specific risks.
- Operating and emergency procedure creation and training.

FACTS:

A **hazard assessment** is often one of the first steps taken in the process of building a new laboratory facility. A thorough hazard assessment requires participation of the laboratory director, the researchers, the laboratory safety and chemical hygiene officers, the industrial hygienist, the engineer and architect. Topics covered in the assessment should include: a complete Chemical/Physical Agent Inventory, the quantities of hazardous materials which will be handled; the methods to be used to dispense these materials, especially if is to be from bulk containers; the containers and equipment used to hold these materials during storage, transport and use; reactive chemistry considerations, biohazard and radiation hazard evaluations. Once the risks are known, the

next step is the development of a conceptual design which incorporates the necessary features to address the type and level of risks which will be encountered in the facility. □

One of these features is the proper planning and layout of the spaces in the building. There are three major classifications of laboratory facility space: office and administrative areas; laboratories; and hazardous material receiving, shipping, storage, dispensing and transport areas. These areas can be separated by firewalls, fire-doors and airlock arrangements to help prevent the migration of fires, explosions and chemical, biological, or radioactive releases. □

Since it is not advisable to transport or handle hazardous materials in the office areas, a

separate corridor system may be designed to connect the shipping, receiving, storage, handling and laboratory areas together through the building core without passing through the more populated spaces. Separate elevators can also be a part of this core. □

Simply separating these areas physically may not be enough. Other types of barriers may also be employed to protect adjoining areas. One of these barriers is *space pressurization*. The NFPA¹ Code 45 requires that a laboratory containing flammable material be negatively pressurized with reference to adjoining areas such as offices or hallways. Under most conditions, fire or airborne contaminants will move *with* an airstream rather than *against* it. A differential pressure assures that air will flow into the laboratory from the adjoining

area and form a secondary protective barrier between them. □

Once a new laboratory facility is operating, even the best building design and safety systems can't make up for poor or inadequate operating procedures. These design features and systems only take affect *after* an accident occurs. It is the operating procedures which can *prevent* the accidents and aid in minimizing their effect. A complete and detailed operating procedure for each potentially hazardous activity, coupled with adequate training and frequent review will do more to protect your personnel and capital investments than all the engineered safety systems combined. □

Unfortunately, even under ideal conditions and with the best procedures and safeguards, accidents can occur. A comprehensive emergency plan should be developed by the design team *before* the facility is started-up and occupied. This emergency plan should include hazard communication, evacuation procedures, the operation of the building safety systems and shutdown procedures for experiments and dangerous equipment. Several scenarios should be covered including: fire/explosion, chemical/biological release, power failure, tornado, earthquake, etc. These procedures should be rehearsed frequently, reviewed periodically and modified as necessary to meet the changing needs and programs in the facility. Activities in a research facility

change rapidly. The operating and emergency procedures and sometimes even the mechanical and control systems need to evolve simultaneously to assure that all hazards are minimized and the facility is as safe as it can be *at all times*. □

CONTROVERSIES:

There are two schools of thought regarding space pressurization. The oldest method is to measure the actual differential static pressure between the laboratory and the adjoining space. More recently, however, a technique called *flow-tracking* has become increasingly popular. Flow-tracking involves the measurement of the exhaust flowrate and the supply flowrate and controlling the supply volume to produce the desired pressure difference. □

The idea of providing a central corridor system for the transportation and storage of hazardous materials itself does not seem to be controversial, but the building space and cost required to provide this feature often is. The final decision should be based on the hazard assessment on a building by building basis. □

CONCLUSION:

Building a laboratory facility is much more than an engineering task. It requires a specialist who can help you see the big picture as well as zoom in on all the important details. A laboratory consultant can assist your organization with the *entire* laboratory construction or renovation process: from the definition of

the scope to the hazard assessment; from the conceptual design to interviewing and choosing an engineering firm; from developing the operating and emergency procedures to commissioning the facility. Most people who need surgery seek a surgeon or other specialist rather than a general practitioner. Similarly, a laboratory facility requires more specialized expertise than most other types of buildings. Choose a consultant who specializes in the field of laboratory facility design and operation. □

References:

¹National Fire Protection Association

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