



# Design Standards and Operating Guidelines for Laboratory Facilities

## INTRODUCTION:

**Laboratory facilities** have architectural, space planning, HVAC, environmental control, and fire/life safety requirements not found in most other types of construction. Sound laboratory facility design standards, construction document standards, and equipment standards in the hands of qualified engineers and contractors are the foundation on which successful laboratories are built. Sound operating guidelines in the hands and hearts of skilled facility operators and laboratory personnel are the tools that will keep the facility operating smoothly and efficiently. Writing these design documents is the job of the project team.

## PROJECT MANAGEMENT PLAN AND SCOPE:

The **project manager** should write a plan outlining the project management goals and methods before the project gets underway. This plan should also include a list of project team members and the criteria for choosing them. A project team should consist of at least one person from each of the following categories:

- Project Manager
- Owner/Occupant
- Construction Manager
- Facility Manager/Operator
- Lab Consultant
- Engineer
- Architect
- Safety/Loss Prevention Professional
- Industrial Hygienist
- Construction Contractor
- Commissioning Contractor(s)
- Controls Contractor(s)

**Assemble the full project team** as early as possible. This can help avoid many design and construction headaches and delays. Define the project scope with input from the *everyone* on the design team. The use of Total Quality Management (TQM) or other project management philosophy for creating high performance teams, improving meeting management, and decision making is highly recommended.

## FACILITY DESIGN DOCUMENTS

A set of design documents should be developed by the project team and may include the following:

### **Facility Site Location Guide-lines:**

This should include information about local codes, ordinances and regulations that affect the construction or operation of the facility. It should include information for making logistical decisions regarding location with respect to customers, suppliers and employees. It should include *soft* information about the local population and public opinion regarding the company and the type of work being done in the facility and the perceived risks to the community. Environmental considerations such as availability of hazardous waste treatment/storage services including landfills and municipal wastewater treatment facilities should be evaluated.

**Facility Planning Guidelines:** This document defines the relationship of offices, labs, corridors, and hazardous material receiving, storage, and transport areas. Risk/Hazard assessment tools should be used when drafting these guidelines to produce a facility plan guideline which will reduce

the effects of spills, chemical/biological releases, fires and explosions on the building occupants. Space pressurization planning should be done at this time to determine the relative pressure level of each space classification in the building.

**Lab Planning Guidelines:** Defining the size and possible configurations of laboratory modules is the purpose of this document. Special attention should be given to defining where fume hoods are placed with respect to doors, aisles and supply diffusers. Safety shower, sink and floor drain placement should be included. Placement, density, and type of electrical services, liquids and gases should be defined here as well.

**Environmental Guidelines:** This document specifies the type of air pollution controls, wastewater pre-treatment/post-treatment and hazardous waste collection and storage requirements for the facility.

**Engineering Guidelines:** This document should include the following sections and related information: safety & loss prevention, civil/architectural, electrical, and mechanical. This document represents the specifications that the engineer/architect should follow when designing the facility and writing the construction specifications.

**Equipment Selection/Design Guidelines:** This document includes information regarding purchased equipment. It should include a list of acceptable manufacturers or specifications for standard purchased items and custom fabricated equipment. It can also include decision making trees and selection criteria when the actual equipment models and manufacturers are to be chosen by the

engineer/architect or by the contractor. Included should be information about: fume hoods, hood face velocity controls, space pressurization controls, building automation systems, emergency power systems, exhaust fans, air handling equipment, chillers, pumps, cooling towers, etc.

**Indoor Air Quality Guidelines:** This document includes information about the design, construction, and operation of the facility that will affect the indoor air quality. The following issues/items are a brief list of the type of information in an IAQ guideline: ventilation rates, fume hood face velocities, and hazardous material storage and handling procedures. Exhaust stack and air intake design and location, cooling tower air discharge locations, truck/vehicle exhaust considerations, construction materials (carpet, adhesives, insulation, wallpaper, etc.), office equipment (copiers, blueprint machines, etc.), and maintenance materials (cleaners, etc.) should also be addressed.

### **CONSTRUCTION DOCUMENT STANDARDS:**

**These are not the construction documents** themselves but a set of standards and practices that define the creation, maintenance and approval processes for the construction documents.

**Drawing Standards:** This standard should contain information the owner wishes to specify regarding the form of the drawings for the project.

**Construction Specification Standards:** This is a set of specifications for writing the specifications. It should include the desired format of the spec (CSI, etc.), any required boilerplate, and special safety, security, or site specific information which needs to be included in the construction specification.

**Document Check/Change Process Procedures:** This document details the process by which design and construction documents are checked, changed, approved, and communicated to the project team and those in the

field. Special chains of command should be created to handle these important aspects of the project. Changes to the design and construction documents should receive proper review by knowledgeable project personnel and be adequately communicated to all project entities before implementation to avoid serious safety and operational problems. A technique borrowed from the chemical industry, implemented after the Union Carbide chemical plant disaster in Bhopal, India in 1984 to track changes to chemical plant processes, involves the use of a form attached to the document being changed and is called a *Process Change Request* or *Design Change Request*. This form usually has routing information so that all project principles may approve the request and make other necessary second-order changes to the design to accommodate the desired change. Frequently a change will be requested which adversely affects the safety of another part of the design and will precipitate a whole series of other changes. These additional changes may be overlooked without this Check/Change process in place. The Kansas City Hyatt Regency Hotel skywalk collapse of 1981 probably would never have happened if an effective Check/Change process had been in place for that project.

### **BUILDING COMMISSIONING GUIDELINES:**

**These guidelines cover** the verification and startup of the building systems and include information about submittals, construction verification, as-built drawings and acceptance criteria during the construction phase. Equipment testing, air and fluid flow balancing, system functionality and verification, documentation and approval processes should be included during the startup phase. Operator training, creation of the S.O.P.'s and operating discipline manuals, maintenance schedules and a process to handle post-startup alterations and modifications should be covered for the post-startup/occupancy phase of the project. ASHRAE Guideline 1-1989 *Building Commissioning* is a helpful reference for this document.

### **BUILDING OPERATIONS GUIDELINES:**

**Operator qualification and training** procedures, facility scheduling (time of day) criteria for use by the building automation controls programmers, and normal operating parameters such as temperature, humidity, etc. should be documented for both the design team and the operating personnel. Emergency procedures covering events such as fire/explosion, internal/external chemical releases, emergency shutdown and restart of the facility should also be a part of this document.

### **LABORATORY OPERATIONS GUIDELINES**

**Standard operating and safety procedures** for laboratories should be documented for a new facility. These guidelines should include fume hood use, chemical storage, waste disposal, experiment design/practices/procedures, chemical/physical agent inventories, industrial hygiene guidelines, reactive chemistry reviews, pressure vessel and relief design standards, laboratory equipment standards (especially for equipment used in hoods and hazardous locations), personal protective equipment, and health surveillance.

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