CHAPTER 3

Laboratory, Personnel, Maintenance Facilities and Safety Design

LABORATORY, PERSONNEL, MAINTENANCE FACILITIES & SAFETY DESIGN

3.1 General

Suggested considerations are presented in this chapter for laboratory, personnel, maintenance facilities, and safety. If testing is contracted out (particularly for lagoon systems) minimal maintenance facilities will only be required.

3.2 Laboratory Facilities

3.2.1 General

A guide to provision of laboratory facilities is the EPA publication Estimating Laboratory Needs for Municipal Wastewater Treatment Facilities, EPA-430/9-74-002.

Lab work involves a significant portion of a small facility's work tasks. Each facility should estimate work tasks by obtaining the following documents:

a. "Minimum sampling schedule" should be obtained from the Permit Section of the Division of Water Pollution Control, containing compliance parameters from NPDES Permit as well as operation test.

b. List of Approved Analytical Procedures. See Code of Federal Regulations (CFR), June 30, 1986, pp. 23693-23700 for lab methods and preservation procedures for NPDES data.

c. Tennessee "Lab Manual" 1986. Contact the Julian Fleming Training Center in Murfreesboro.

d. Tennessee "Laboratory Equipment and Supplies for Wastewater Treatment Plants." Contact the Julian Fleming Training Center in Murfreesboro.

3.2.2 Space Requirements

Specific laboratory facilities should be based on the needs of the treatment plant. Minimum suggested space for one MGD facilities is:

- Floor space of 200 sq. ft.
- Percent of floor space required for bench area is 40%
- Cabinet volume of 200 cubic foot.

These figures apply to a typical treatment plant monitoring program. If laboratory testing will be performed for other sources, such as industrial discharges, receiving waters, and sewer overflows, appropriate space increases should be provided. If some of the plant monitoring tests are performed at other facilities, the space required could be significantly less.

3.2.3. Design

The following factors should be key considerations in design of plant laboratories:

- Flexibility, which provides for changes in use requirements
- Adaptability, for changes in occupancy requirements
- Expandability, for changes in space requirements

3.2.3.1 Location

The laboratory should be located at ground level and easily accessible to all sampling points. To assure sufficient environmental control, the laboratory should be located away from vibrating machinery, corrosive atmospheres, or equipment which might have adverse effects on the performance of laboratory instruments or the analyst.

3.2.3.2 Layout

New lab layouts should be modeled after proven exemplary layouts. Efficient laboratory operation depends largely on the physical layout of the laboratory. The physical layout includes items such as working area arrangement, the number and location of sinks and electrical outlets, the arrangement of laboratory equipment, materials of construction, and lighting. The details of the layout can affect the accuracy of the laboratory tests. For example, tests that include identification of a colorimetric end point, as in heavy metals determinations, can be drastically affected by the type of lighting and the finishes on laboratory facilities.

The following factors should be considered when laying out a laboratory:

a. A northern exposure is preferred for colorimetric analysis.

b. Adequate lighting should be provided. Color-corrected fluorescent lighting is suggested.

c. Wall and floor finishes should be nonglare-type and light in color. Flat-finish wall paint is suggested.

Floor finishes should be of a single color for ease of locating small items that have been dropped.

d. Floor covering, in addition to being nonglare, should be easy to clean and comfortable.

e. Doors shall have large glass windows for visibility into and out of the laboratory. There should be no obstructions near the doors.

f. Aisle width between work benches should be at least 4 feet. Adequate spacing should be provided around free-standing equipment, workbenches, and file cabinets to facilitate cleaning.

g. Storage space for reagent stock should be under workbenches. Reagent containers removed from storage areas under workbenches are less likely to be dropped than reagent containers removed from storage in the inconvenient and hard-to-reach areas above the workbenches. Only items that are infrequently used or chemicals of a nonhazardous nature should be stored above workbenches. Strong acids or bases should be stored within convenient reach of the laboratory personnel, preferably beneath or adjacent to the fume hood.

h. Sufficient cabinet and drawer space should be provided for the storage of equipment and supplies. Wall cabinets should be no more than 30 inches above the workbench top so that the contents of the top shelving can be reached. The base cabinets under the workbenches should contain a combination of drawers and storage spaces for large items. All cabinets and drawers should be acid resistant.

i. One sink with a large gooseneck faucet, large enough to wash laboratory equipment, should be provided for every 25 to 30 feet of bench length. One sink should be sufficient when total bench length is less than 25 feet. The sink should be made of chemical-resistant material.

   Cup sinks, also of chemical-resistant material, should be provided at strategic locations on the bench surface to facilitate laboratory testing. The number of cup sinks depends largely on the type of tests that will be run;
   the general rule is one cup sink for every 25 to 30 feet of bench length. Cup sinks should be alternated with the wash sinks at 12- to 15-foot intervals.

Where workbench assemblies are provided in the center of the laboratory, a trough-type sink down the center of the workbench may be provided in lieu of cup sinks. A hot and cold water tap should be placed at approximately every 5 to 10 feet along the trough.

The use of an automatic dishwasher should be considered. Where dishwashers are provided, some of the sinks can be replaced by cup sinks.

j. Electrical receptacles should be provided at strategic points for convenient and efficient operation of the laboratory. Duplex-type receptacles should be spaced at intervals along benches used for laboratory tests. Strip molding receptacles may be used. All receptacles must be elevated to prevent spills from entering the receptacles.

k. Gas and vacuum fixtures should be provided at convenient locations.

l. Bench tops should be suitable for heavy-duty work and resistant to chemical attack. Resin-impregnated natural stone and other manmade materials provide such a surface and should be used.

m. Bench surfaces should be approximately 36 inches high for work done from a standing position and 30 inches high for work done while sitting.

n. Bench surfaces should be approximately 30 inches wide.

o. Equipment arrangement should be given special consideration in laying out the laboratory facility in conjunction with the facility's owner and operators. Plumbing, and/or electrical connections should be provided for units such as the distillation apparatus, drying ovens or other wall-mounted equipment. Pieces of equipment used for making common tests should be in proximity.

For example, the drying oven used in making total, suspended, and dissolved solids tests should be close to the muffle furnace for use in determining total volatile solids and volatile suspended solids from the samples dried in the drying oven. The drying oven and the muffle furnace should be near the

balance table because the balance is used in the weight determinations for the various solids tests.

p. Safety is a prime consideration of a laboratory. The first aid kit, fire extinguisher, eye wash, and emergency shower should be near the main working area of the laboratory. If the safety shower is not provided in a separate shower stall, a floor drain should be nearby.

q. Sources of loud or startling noises, such as alarms or composite sampling equipment,should be located at sites remote or otherwise isolated from the laboratory.

r. The analytical balance should be on a separate table at least 30 inches long and 24 inches deep. The table should not transmit vibrations that would adversely affect the operation of the balance.

s. A separate table is desirable for microscopes. This table should be about 30 inches long, 24 inches deep, and 27 inches high.

t. Fume hoods, if provided, should be near the area where most laboratory tests are made.

u. All labs which run BOD_5 require air-conditioning to achieve a sufficiently high, stable D.O. in the dilution water.

   Laboratories should be separately air-conditioned, with external air supply for 100-percent makeup volume. Separate exhaust ventilation should be provided. Window air-conditioning should not blow directly on the analytical balance or furnaces.

v. Panic hardware should be provided for doors opening to the outside to allow for rapid exiting in an emergency.

3.3 Personnel Facilities

Personnel facilities are generally located in the administration building. This building serves the needs of the supervisory staff, the operation and maintenance personnel, and often the laboratory staff.

Sewer maintenance personnel may also share the administration building. However, facilities for the laboratory and operations and maintenance staff need not be provided in the administration building, even though this is customary.

A wastewater treatment plant staffed for 8 hours or more each day should contain support facilities for the staff. Toilets shall be provided in conformance with applicable building codes. The following should be provided:

a. **Wash-up and changing facilities:** Showers, lockers, sinks, and toilets sufficient for the entire staff at design conditions. A heated and ventilated mudroom is desirable for changing and storage of boots, jackets, gloves, and other outdoor garments worn on the job. Each staff member should have separate lockers for street clothes and plant clothes. Separate wash-up and changing facilities should be available for men and women, with the exception of the mudroom.

b. **Eating Facilities:** A clean, quiet area with facilities for storage and eating of light meals.

c. **Meeting facilities:** A place to assemble the plant staff and visitors. In many cases, meeting facilities and the eating facilities will be the same.

d. **Supervisors' facilities:** A place where discussion and writing can be carried out in private. A desk station should be provided for data entry.

Facilities should be provided for the storage of analytical methods and records, catalogs, as-built plans, operation and maintenance manual(s), etc.

Small mechanical treatment plants that are not manned 8 hours per day need not contain all of the personnel facilities required for larger plants, but shall contain a lavatory, and a storage area.

3.4 Maintenance Facilities

To assure adequate maintenance of equipment, convenient maintenance facilities should be available. Such facilities generally include a maintenance shop, a garage, storage space, and yard maintenance facilities.

Access to nearby municipal garages and other maintenance centers should be considered. Duplication of facilities should be avoided where possible.

3.4.1 Maintenance Shop

A separate maintenance shop should be designated where treatment plant equipment and vehicles can be repaired. The maintenance shop should be provided with the following facilities:

a. Work space with adequate area and lighting, including a workbench with vise.

b. Conveyances to move heavy items from the point of delivery to the appropriate work space.

c. Storage for small tools and commonly used spare parts.

d. Adequate power outlets and ratings for the equipment.

3.4.2 Storage Requirements

Storage space should be provided for paints, fuels, oils and lubricants, grounds maintenance equipment, spare parts, and collection system equipment.

In larger facilities, it may be desirable to have a separate storage building for things such as paints, fuel, oils and lubricants, spare parts, and yard supplies. For storage of flammable materials, the requirements of the uniform building code shall be met. In smaller facilities, it might be desirable to combine storage with the shop or garage so that the stored material can be protected against unauthorized use.

Where underground tanks are to be used to store controlled substances, the Division of Ground Water Protection shall be contacted regarding Underground Storage Tank (UST) requirements.

3.4.3 Yard Requirements

A landscaped yard helps to soften the visual impact of a treatment facility. Shrubs and treees judiciously located can screen unsightly areas from public view. Care must be taken that the plantings do not become a hindrance to operation. Deciduous leaves falling in clarifiers can hinder skimming and add unnecessarily to the digester loading. Roots from trees too close to pipes can cause clogging. Fencing should be adequate to prevent unauthorized or unattended entry.

3.5 Safety Design

The field of wastewater treatment has always been one of the most hazardous fields of employment.
This fact is accented by job-related deaths and accidents which happen each year. Safety designs are needed which should be supplemented by yearly inspections to gain awareness.

Adequate provisions shall be included in the design of all wastewater treatment facilities to minimize exposure of facility personnel and visitors to safety hazards.

Treatment facilities shall be designed in full compliance with the Occupational Safety and Health Standards of the State of Tennessee, Division of Occupational Safety and Health (TOSHA).

Pertinent safety design requirements as well as safety design practices are included in the attached on-site checklist for wastewater treatment plants (Appendix 3-A).

To gain awareness each operator should have other safety resources such as:

1.) Safety & Health in Wastewater Systems (MOP-1 by WPCF)
2.) Individual safety manual adopted by each plant's safety committee.
3.) Safety meetings with city.

Any unsafe practices or incidents should be reported to TOSHA and each facility's safety committee. As a last resort, complaints can be made anonymously by the operator or any other concerned citizen.

Appendix 3-A

On-Site Checklist

STANDARD SAFETY

1. Personnel Protective Clothing:

    a. Safety helmets (for operators and visitors)

    b. Ear protectors for high noise areas

    c. Goggles

    d. Gloves

    e. Rubber boots with steel toes

2. Safety Devices Available for Use:

    a. Non-sparking tools in areas where flammable or explosive gases may be present

    b. Fire extinguishers readily available

    c. Oxygen deficiency/explosive gas indicator

    d. Self-contained breathing apparatus near entrance to chlorine room, away from fan discharge

    e. Safety harness

    f. First aid kits readily available

    g. Ladders to enter manholes or wetwells (fiberglass or wooden for around electrical work)

    h. Traffic control cones

    i. Safety buoy at activated sludge plants

    j. Live preservers for around lagoons

    k. Portable crane/hoist

3. General Plant Safety:
    a. Railing around all tanks, with openings chained off
    b. No uncovered pits or wells
    c. Explosion-proof fixtures, where needed
    d. Equipment guards in place
    e. Emergency telephone numbers posted
    f. Proper flammable liquid storage
    g. Covered trash cans
    h. Ladders have safety cages or equiped with safety slide rail
    i. Portable hoists for equipment removal; e.g., pumps, aeration equipment
4. Are plant personnel immunized for typhoid and tetanus?
5. No cross connections exist between a potable water supply and a non-potable source:
    a. Pump and mixer seals
    b. Digester heating system make-up water
    c. Vacuum filter water sprays
    d. Chemical mixing tank
    e. Chlorinator water source
    f. Yard hydrants
    g. Properly installed backflow preventers
6. If anaerobic digesters are used, are the following present?:
    a. Pressure/vacuum relief valves
    b. "No smoking" signs
    c. Explosimeter
    d. Drip trap
    e. Flame traps within 25' of the flame source

7. Electrical Safety:

    a. All electrical circuitry enclosed and identified

    b. Electrical test equipment available, such as a voltmeter and amperage meter

    c. Rubber mats present for electrical work

    d. The personnel are familiar with the electrical work to be performed

    e. All personnel are trained in electrical safety, such as lockout procedures

    f. Warning and/or caution signs present

    g. Rubber gloves available

    h. Ground fault interrupter used

8. Chlorine Safety:

    a. NIOSH-approved self-contained 30 minute air pack

    b. All standing chlorine cylinders are chained in place

    c. All personnel are trained in the use of chlorine

    d. Chlorine repair kit is available

    e. Chlorine leak detector tied into the plant alarm system

    f. Ammonia for checking chlorine leaks is present

    g. Ventilator fan with an outside switch is present

    h. Safety precautions posted

    i. Doors open outward and are equipped with "panic" hardware

9. Process Chemical Safety:

    a. Respirator to protect the operator against dust inhalation, when needed

    b. All personnel are trained to handle the chemicals properly

    c. Proper safety clothing for the chemical to be handled, such as rubber aprons, boots and gloves for handling ferric chloride

    d. Has complied with the Tennessee Department of Labor, Hazardous Chemical Right To Know Law, T.C.A. 50-3-2001 thru 2019.

    e. Emergency Action Plan on file with local Fire Department and appropriate Emergency Agency

    f. Containment of chemical storage areas, including curbing and floor drains to appropriate areas

10. Laboratory Safety:

    a. Eye wash and shower station is present

    b. Fume hood is present

    c. All chemicals properly labeled and stored

    d. Laboratory safety devices such as pipette suction bulbs

INNOVATIVE SAFETY

1. Warning Signs:
    a. Non-potable water
    b. Chlorine hazard
    c. No smoking
    d. High Voltage
    e. "Watch your step" signs in certain areas
    f. Exit signs
    g. Piping signs
2. Safety programs
3. Operators provided with a shower and a locker for their work clothes
4. Are the operators trained in first aid and CPR?