Technical Principles and Practices of Fire Prevention

Module Institutions

MODULE OBJECTIVES

The students will be able to:

- *Classify occupancies as institutions and identify subclasses.*
- *Identify and classify the major hazards found in institutions.*
- *Given various examples of potential hazards in institutions, describe the hazard and suggest the proper method(s) for solving or abating the problem.*
- *Given a list of conditions found in institutional occupancies, determine code requirements using the local code.*

DEFINITION OF INSTITUTIONS

A basic definition of an institution is the following: "something that is instituted: as an established society or corporation; an establishment or foundation especially of a public character; a building or the buildings occupied or used by such an organization." However, from the angle of fire prevention, this is far too generic. We need to pinpoint a more specific classification.

Building Codes

The Building Officials & Code Administrators International, Inc. (BOCA) building code defines institutions as "all structures in which people who suffer from physical limitations because of health or age are harbored for medical or other care or treatment, or in which people are detained for penal or correctional purposes, or in which the liberty of the inmates is restricted."

The definition will vary with each model code. Each will have groups and subclasses that add complexity to identifying which buildings are institutions. As stated frequently, the code official must refer to the code adopted for the jurisdiction.

NFPA 101, *Life Safety Code* Definition

This National Fire Protection Association (NFPA) standard defines health-care occupancies as those used for purposes such as medical or other treatment, or care of persons suffering from physical or mental illness, disease, or infirmity, and for the care of infants, convalescents, or aged persons. Health-care occupancies provide sleeping facilities for four or more occupants and mostly house persons who are incapable of self-care because of age, physical or mental disability, or because of security measures not under the occupants' control.

Detention and correctional occupancies normally house individuals under varied degrees of restraint or security. While these persons can care for themselves, they are nonetheless subject to varying levels of security and control.

The NFPA defines a health-care occupancy as a building, or any portion thereof, used on a 24-hour basis to house or treat four or more people who cannot escape from fire without assistance. The same source describes detention and correctional occupancies as facilities in which occupants are confined or housed under some degree of restraint or security.

In summary, an institution is a facility for individuals who, because of physical limitations, are considered confined. Thus there are defined requirements for that occupancy, such as exits, smoke compartmentalization, etc. The major differences in different code definitions arise from factors such as the number of occupants, sleeping versus nonsleeping conditions, age of occupants, staffing ratio, physical/mental condition, and varied degrees of restraint or security.

TYPES OF INSTITUTIONS

As suggested above, health-care institutions include hospitals, limited-care facilities, nursing homes, and residential (single-family) care homes.

Detention occupancies include as broad a range:

- adult and juvenile substance abuse centers;
- adult and juvenile work camps;
- adult community residential centers;
- adult correctional institutions;
- adult local detention facilities;
- juvenile community residential centers;
- juvenile detention facilities;
- juvenile training schools; and
- local law enforcement facilities with short-time detention capability.

HAZARDS IN INSTITUTIONS

Institutions have most of the same hazards found in any other occupancy type, i.e., electrical hazards, cooking hazards, heating hazards, and housekeeping hazards. Health-care facilities will have several types of electrical systems with different voltages, safeguards, etc., to protect patients and employees. The code official always must consider the area of the facility, its function, and the specific hazards of that area. Examples include the potential hazard(s) in a nonflammable anesthetizing location versus a flammable anesthetizing location, and the potential hazard(s) of an emergency room versus an operating room or patient care room.

Resources

There are many resource materials for dealing with institutions. These include

- Building codes;
- Fire prevention codes;
- NFPA 101, *Life Safety Code;*
- NFPA *Inspection Manual*;
- NFPA 99, *Standard for Health Care Facilities*;
- NFPA 30, *Flammable and Combustible Liquids Code*;
- NFPA 50, *Standard for Bulk Oxygen Systems at Consumer Sites*; and
- NFPA 58, *Standard for the Storage & Handling of Liquefied Petroleum Gases.*

Maintenance of building services such as heating, ventilating, and air conditioning (HVAC) equipment, electrical control and distribution equipment, laundry operations, and shop operations is critical to the life safety of occupants. Detention facilities could have educational/ vocational areas such as those needed for carpentry, metalworking, painting, or electrical or auto body shops. There may be areas in institutions in which the occupants use flammable liquids and store others. Let's take a moment to talk about compressed gases.

Compressed Gases

The fire prevention codes have sections on gases and liquefied petroleum gases (LPG). Some of the model codes have a section for cryogenic gases. Here, we will consider only compressed gases in the occupancy, not gases stored outside.

The fire prevention codes address requirements for gases in three sections:

- compressed gases;
- LPG; and
- cryogenics.

NFPA also has a code for liquefied natural gas, NFPA 59A, *Standard for the Production, Storage & Handling of Liquefied Natural Gas (LNG).*

Principles of controlling fire hazards involve storage of compressed gases in the proper type of container, minimizing the gas/air mixture, and knowing the chemical and physical properties. Requirements for permits depend on the amount stored. If the amounts are stored in greater quantities than recommended in the following tables, then the occupancy classification changes to high hazard. Refer to your local code.

Examples taken from the National (BOCA) Fire Prevention Code.

Table F-2701.3 (1)
Compressed Gas Occupancy Classifications

Compressed Gas	Use Group
All flammable gases	H-2
Highly toxic and toxic gases	H-4
Other nonflammable gases	Use group it most closely resembles

Table F-2701.3 (2)
Exempt Amounts of Highly Toxic or Toxic Compressed Gases[a]

Condition	Exempt amounts (cubic feet at normal temperature pressure)[b]	
	Highly toxic	Toxic
Inside storage		
Unprotected by sprinklers, gas cabinets, exhausted enclosures or separate gas storage rooms	0	810
Within gas cabinets or exhausted enclosures in an unsprinklered structure or separate gas storage rooms	20	1,620
In sprinklered structures, not in gas cabinets, exhausted enclosures or separate gas storage rooms	20	1,620
In sprinklered structures, within gas cabinets, exhausted enclosures or separate gas storage rooms	40	3,240
Outside storage	20	1,620

Note a. Except for lecture halls occupied for educational purposes and laboratories and classrooms in occupancies in Use Group B, highly toxic or toxic compressed gases shall not be permitted in occupancies in Use Groups A, B, E, I, M and R.

Note b. 1 cubic foot=0.028m^3.

Table F-2701.3 (3)
Exempt Amounts of Flammable Gases

Condition	Exempt amounts (cubic feet at normal temperature pressure)[a]
Unprotected by sprinklers, gas cabinets, exhausted enclosures or separate gas storage rooms	750
Within gas cabinets or exhausted enclosures in unsprinklered structures or separate gas storage rooms	1,500
In sprinklered structures, not in gas cabinets, exhausted enclosures or separate gas storage rooms	1,500
In sprinklered structures, within gas cabinets, exhausted enclosures or separate gas storage rooms	3,000
Outside storage	1,500

Note a. 1 cubic foot = 0.028 m^3.

Compressed gases may be stored in cylinders or pressure vessels marked with the name of the gas and secured to prevent falling or being knocked over. Flammable anesthetics and nonflammable medical gases are to be stored and handled in a safe manner relative to persons and property. Piping systems are **not** to distribute flammable medical gases in any hospital; only nonflammable gases may be piped in distribution systems.

As you inspect for gases, also look for the proper storage and use of biological matters and chemicals.

LIFE SAFETY ISSUES

Traditionally, life safety inspection is an evaluation of the number, arrangement, and capacity of a building's exit system. In fact, NFPA 101, *Life Safety Code*, originally was titled the *Building Exits Code*. More recently, however, we have come to realize that life safety involves much more than just exits. In simple terms, life safety involves avoiding exposure to the harmful effects of the products of combustion. The exposure may be to personnel who are in the process of evacuating a building, to persons who are within the building in an area considered to be an area of refuge, or to persons who are not aware of the fire.

Chapter 2 of the NFPA *Life Safety Code* lists ten fundamental requirements for life safety. These requirements provide some basic life safety principles which are the basis of many life safety code requirements:

- **To provide for adequate exits without dependence on any single safeguard.** The exits must have sufficient capacity for the number of occupants, and a single failure shall not result in an unacceptable level of life safety.

- **To ensure that construction is sufficient to provide structural integrity during a fire while the occupants are exiting or in an area of refuge.** Note that from an occupant life safety perspective, the structural integrity need only be sufficient for safe egress time. Additional protection would be necessary for the safety of firefighters during interior fire suppression activities.

- **To provide exits that match the size, shape, and nature of the occupancy.** The use of the space or building determines the design requirements for the exits. A 10,000-square-foot storage building requires neither the same number or capacity of exits as a 10,000-square-foot place of assembly, because of the number and characteristics of the occupants. Because of the nature of the fire, a building that stores bricks does not have the same exit requirements as a building that stores flammable liquids.

- **To ensure that the exits are clear, unobstructed, and unlocked.** The occupants of the building should have a clear path of travel to the exits and control over any component of the egress system. The occupants should be able to exit a building easily without the use of any special knowledge, effort, keys, or tools, It should be noted that in certain instances, codes will allow some deviation from this fundamental principle, provided the occupants have the necessary knowledge to effect safe egress.

- **To ensure that the exits and routes of escape are marked clearly so that there is no confusion in reaching an exit.** While the need for exit marking does vary from occupancy to occupancy, depending on the occupants' familiarity with the building, the codes generally require some degree of exit marking in case occupants become confused or disoriented.

- **To provide adequate lighting.** Adequate lighting is essential to the safe use of the egress system, especially for components such as stairs.

- **To ensure early warning of fire.** This does not necessarily mean that automatic detection is required in all buildings. Depending on the awareness of the occupants and their ability to detect changes in their environment, automatic detection may not be necessary.

It also should be noted that from a life safety standpoint, when automatic detection is required, it usually involves smoke detection, and not heat detection, unless the space is not occupied and is separated from occupied areas.

- **To provide for backup or redundant exit arrangements.** With a few limited exceptions, the codes require that every area have at least two accessible exits.

- **To ensure the suitable enclosure of vertical openings.** Many large-life-loss fires have occurred in buildings with unprotected vertical openings. The vertical openings allow smoke and fire to spread easily to adjacent floors with little advance warning for the occupants on the adjacent floors.

- **To make allowances for those design criteria that are tailored to the normal use and needs of the occupancy.** While adequate fire protection and life safety are critical, they are not the primary purpose for constructing a building. Therefore, it is critical that codes provide an acceptable level of safety without creating an undue hardship or inconvenience. This is not to say that the needs of the operation or use should compromise life safety, but rather, that attempts should be made to provide life safety without interfering with the operation or use of the building. For example, it is obvious that locks must be permitted in correctional facilities. The codes recognize this and provide acceptable life safety by addressing the operation and reliability of the locking system without compromising security.

Life Safety Factors

It is important to remember that life safety factors are only one set of considerations in the development of the occupancy classifications contained in the codes. The following life safety factors also must figure in developing the code requirements for an acceptable level of life safety in health-care facilities.

- Fatal fires in health-care facilities typically have been rapidly developing fires detected early in the fire's development.

- Patients may be of different ages, but are considered to be incapable of self-preservation.

- The staff is considered to be alert, aware of changes to the environment, and trained in fire emergency procedures.

- Occupant density is considered to be relatively low.
- Visitors who will not be familiar with the surroundings and most likely will respond to the direction of the health-care staff.
- The fuel load is considered to be relatively low. However, fire experience has demonstrated that some furnishings and mattresses used in health-care facilities will have high heat-release rates.
- Health-care facilities usually are well compartmentalized to restrict the spread of smoke and fire. However, this same compartmentalization is what results in short times-to-hazard thresholds of fires in small rooms, such as patient sleeping rooms.
- Interior finishes generally are limited to materials that have low flame spread ratings.
- Cubicle curtains, draperies, and decorations usually are flame retardant.
- Smoking usually is restricted to certain areas. Recently, many facilities have instituted "smoke-free" environments.

Protect-in-Place Theory

When occupants cannot be moved, they need protection in place. Sometimes occupants cannot be moved because of surgery or isolation, or because of security issues. If the occupancy may require protecting in place, a detection system must exist. In some classifications within detention occupancies there are special exceptions as to activation. The presence of a suppression system may allow other exceptions to be made with regard to travel distance to exits, discharge from exits, length of common paths, and protection of hazards. Smoke barriers subdivide the building and provide areas of refuge for occupants. Openings must be protected and doors must be self-closing.

Evacuation

Facilities must have an evacuation plan and employees need training on the plan. The evacuation plan needs evaluation in terms of whether it is clear, posted, and explained to new employees. Further factors to consider include time of day and staffing.

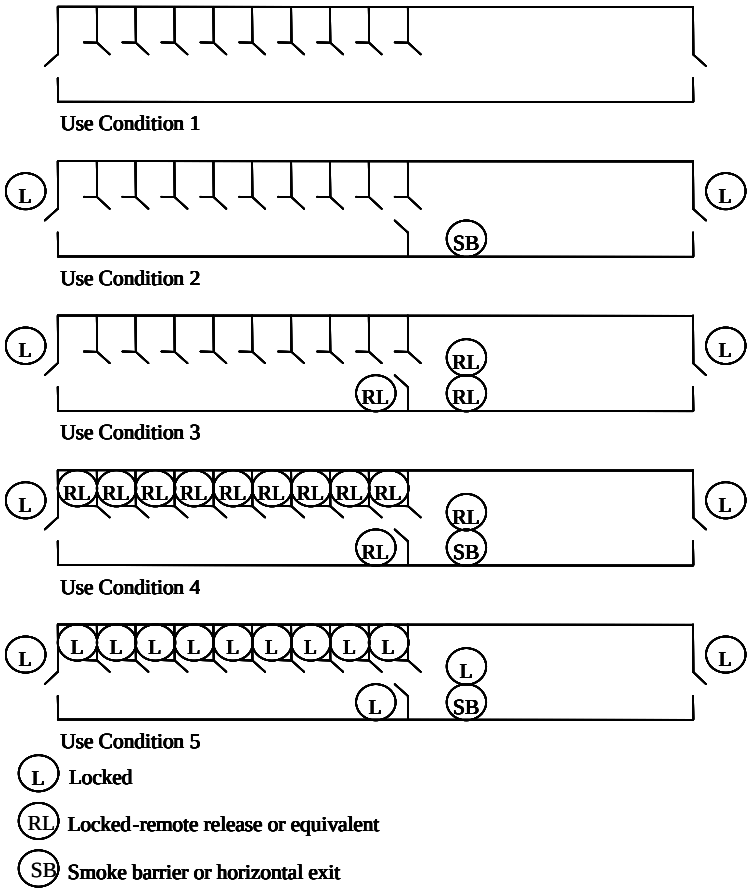
INSPECTION CONSIDERATIONS

Detention Occupancies

There are five degrees of restraint in detention occupancies that determine the arrangement and management of the locking systems. Inspectors always must use the condition that reflects the most restricted movement:

- Condition I--free egress;
- Condition II--zoned egress;
- Condition III--zoned impeded egress;
- Condition IV--impeded egress; and
- Condition V--locked.

Levels of Restraint in Detention Facilities



When inspecting detention occupancies, inspectors must consider fire department accessibility, occupant load, and other considerations used in mixed occupancies.

Means of egress considerations include minimum number of exits of adequate capacity, travel distance, proper doors, etc.

Hazardous areas must be separated by one-hour construction or be sprinklered. Padded cells must be separated by one-hour construction or be sprinklered.

Health-Care Occupancies

The following are considerations for inspecting health-care facilities. New fire inspectors and company inspectors typically will not perform hospital inspections. Generally hospitals are required to adhere to the NFPA *Life Safety Code* to maintain their accreditation.

Areas for special consideration include operating rooms, anesthesia storage rooms, and oxygen storage rooms. Operating rooms must not have nonconductive equipment. Electrical equipment below the five-foot level of the room must be explosion-proof. Anesthesia storage rooms may not store nitrous oxide or oxygen with flammable anesthesia. No combustibles are allowed. Only a one-day supply of flammable anesthesia may be stored.

Each floor or fire section of the building must have at least two means of egress. Travel distances and exit capacities can be greater if the building is fully sprinklered. Corridors should be clear and wide, and discharges to the outside must remain unobstructed. Exterior areas must be clear of ice and snow, and the building must be accessible. Any locks must be of approved types.

SUMMARY

This module has covered only major hazards and inspection considerations in institutions. There are many more which only experience can reveal. The code official needs to remember that an institution is a facility that is occupied by individuals who are considered confined. The inspection of institutional occupancies and their associated hazard considerations are important to ensure the life safety of the occupants who are confined or cannot escape from fire without assistance.

Activity INS.1

Identify Institutional Occupancies

Purpose

To identify institutional occupancies in your home areas.

Directions

1. Individually, generate a list of institutional occupancies in your home area.

2. As a large group, identify the common types of these institutional occupancies, the activities they host, and the ages of the people involved.

Activity INS.2

Hazards in Institutional Occupancies

Purpose

To identify fire and life safety hazards in institutional occupancies.

Directions

1. You will work in small groups.

2. Your group will choose two institutional occupancies from the list generated in Activity INS.1.

3. Develop a list of hazards you would expect to find in these institutional occupancies.

4. Select a spokesperson to report the group's list.

Activity INS.3

Hazard Correction

Purpose

Given a list of potential hazards in institutional occupancies, describe the hazards and suggest proper methods for solving the problems.

Directions

1. Review this list and note any deficiencies you discover.

   a. The exit door is blocked with a "crash cart."

   b. A patient room corridor is crowded with two hospital beds and a large supply cart.

   c. An extension cord is running from a typewriter at the nurses' station under the carpet to an electrical receptacle.

   d. The trash can in the "family room" is overflowing with trash.

   e. In the kitchen, the filter for the hood system above the deep fryer is dirty.

2. Look up the suspected deficiency in your code and develop solutions. List the problem, the solution, and the code reference.

3. Be prepared to discuss your solutions.

Activity INS.4

Report Writing

Purpose

To formulate code-based findings from an inspection into a properly formatted report document.

Directions

1. Working individually and using the code applicable to your jurisdiction, review the inspection scenario.

2. Complete the attached inspection report form or an inspection report form from your jurisdiction, citing the hazards identified in the scenario.

3. Write a report on the occupancy. Be sure to cite specific code references.

4. You have 60 minutes for this activity. You will turn in all completed forms to the instructor.

Scenario

On Thursday, September 25, 1996, my supervisor, John D. Smith, assigned me to inspect the Elder Nursing Home. This inspection was to be completed by Tuesday, September 30, 1996.

On Thursday, September 25, 1996, 1134 hours, I contacted the Elder Nursing Home by telephone and spoke with Robert P. Jones, the safety director. We arranged for my inspection on Friday, September 26, 1996, 0900 hours.

I reviewed the previous file of the Elder Nursing Home on the afternoon of Thursday, September 25, 1996. I noted the address as:

Elder Nursing Home
1234 Old Road
Bowie, AZ 21587

I also noted that it was a small home, with 32 beds. No major concerns during the last inspection, conducted on May 18, 1990.

Upon arrival at the above-noted address, I met with the facility's business manager, Mr. R.B. Swartz. He is present during business hours daily and may be reached at 303-484-2222. He was not employed with Elder Nursing Home during the last inspection. The safety director appears to have resigned since I spoke with him on Thursday, September 25, 1996.

The weather on Friday, September 26, 1996, 0915 hours, was warm with low humidity (72°F).

The facility itself is basically a concrete block with brick veneer consisting of a central area with three patient corridors. The bed capacity for the facility is 48. It appears that an additional patient corridor has been added since the last inspection. I questioned Mr. Swartz regarding this and he agreed, and it appears that corridor number 3 is the "new" wing. The central area contains the dining room, waiting room/lounge, kitchen, activities room(s), laundry, mechanical/storage room(s), examining room(s), and public restrooms. Today the total patient occupancy is 49, all ambulatory, with the additional patient in a bed in the hallway of corridor number 3. The facility is completely sprinklered. There is an alarm system, and smoke/heat detectors appear to be present. While meeting with Mr. Swartz, I learned that the sprinkler maintenance log/report indicated that the sprinkler maintenance contractor last inspected and flowed the system on August 19, 1995. The alarm system maintenance log/report indicated that the system is also part of a security system, and was last inspected and tested by the alarm system maintenance contractor on September 10, 1996. The evacuation plan was available and has been reviewed by the staff, with drills held what appeared to be quarterly.

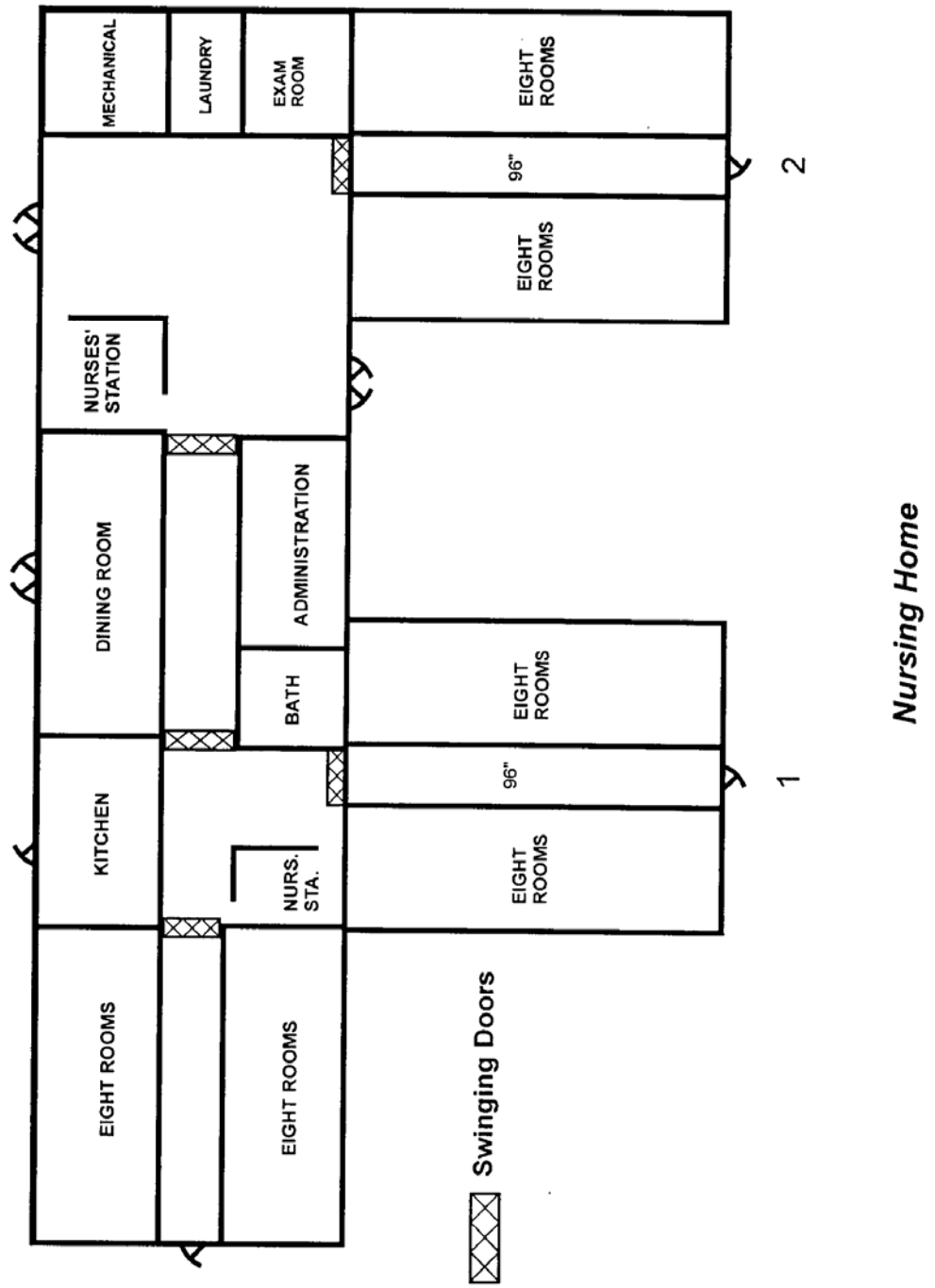
The inspection was fairly easy to conduct, as the facility is all on one level and easily accessible. I first inspected the central area and then each of the three patient corridors in order (1-2-3). In the waiting room/lounge, I noted that an extension cord was being used for a portable television set. The cord also was running under the carpet to the electrical receptacle. In the kitchen area, I noted that the log/record book for the hood system could not be located. The system indicated that it was charged. The filters appeared to be dirty in the hood system. In the laundry area, there was a large lint buildup to the rear of the gas-fired dryer. The mechanical/storage room appeared to be acceptable. An exit light was out in the dining room, and emergency lighting did not work when I attempted to test it.

As we walked through the halls, I did note that the corridor doors for corridors 1 and 2 had a different closure system than the doors for the new corridor, 3. I mentioned this to Mr. Swartz and he stated, "Yes, and they don't seem to work the same." Apparently during a drill it had been noted that the doors for corridor 3 do not automatically release and close like the other corridor doors. I checked the area above the drop ceiling in corridor 3 in the first patient room adjacent to the administrative/nurses' station looking for the smoke barrier. It appeared to be open, with no barrier present. I also noted that the exit door to the outside in corridor 3 was blocked by a food services snack cart.

I reviewed the above items with Mr. Swartz and advised him that reinspection will take place on October 24, 1996.

Activity INS.4 (cont'd)

Floor Plan



FIRE-SAFETY SURVEY REPORT

FIRE PREVENTION…
FOR YOUR SAFETY

Building _____ Owner/Mgr. _____
Address _____ Phone _____
_____ Type of Occupancy _____

☐ New Occupant

The _____ Fire Department has conducted a fire safety survey of your property. The knowledge gained through this survey will enable the Fire Department to attack and extinguish fire that might occur in the building quickly and efficiently.

During this inspection, conditions affecting fire safety throughout the premises were also noted. It is requested that the items listed below be given your immediate attention in the interest of fire safety.

FIRE HAZARDS FOUND TO EXIST: ☐ NONE OBSERVED THIS INSPECTION

☐ Fire Extinguishers	☐ Housekeeping	☐ Flammable Liquids	☐ Electrical
☐ Trash	☐ Utilities	☐ Fire Protection Equip.	☐ Fire Lanes
☐ Exits	☐ Fire & Smoke Doors	☐ No Smoking Signs	☐ Other

_____

_____

_____

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_____

_____

If at any time questions regarding fire safety arise, do not hesitate to contact the Fire Department at _____. For an emergency call _____ . In case of fire in your building, call the FIRE EMERGENCY NUMBER.

_____ _____ _____
Property Representative Reporting Officer *Date*

Reinspection Due _____ Made By _____ Date _____ Notified FM # _____

WHITE – Owner/Manager
YELLOW – Station File
PINK – Fire Marshal

FIRE HAZARDS CORRECTED # _____
FIRE HAZARDS NOT CORRECTED # _____

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Notice of Violation Page _____ of _____

Building _____ Date _____

Address _____ Owner/Mgr. _____

_____ _____

PROPERTY REPRESENTATIVE REPORTING OFFICER

WHITE – Owner/Manager
YELLOW – Station File
PINK – Fire Marshal

FIRE HAZARDS CORRECTED _____
FIRE HAZARDS NOT CORRECTED _____

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