U.S. Department of Transportation

Federal Aviation Administration

Advisory Circular

Subject: AIRCRAFT RESCUE AND FIREFIGHTING STATION BUILDING DESIGN

Date: 9/10/2008

Initiated by: AAS-100

AC No.: 150/5210-15A

Change:

1. PURPOSE. This advisory circular (AC) contains information, references and guidelines for Aircraft Rescue and Fire Fighting (ARFF) station building design. This AC sets the policy for federally funded fire stations that meet Federal Aviation Regulations, Title 14 Code of Federal Regulations (CFR) Part 139, *Certification of Airports,* requirements for airport facilities.

2. CANCELLATION. AC 150/5210-15, *Aircraft Rescue and Firefighting Station Building Design*, dated July 30, 1987, is canceled.

3. APPLICATION. The Federal Aviation Administration (FAA) recommends the guidance and specifications in this Advisory Circular for Aircraft Rescue and Firefighting Building Design. In general, use of this AC is not mandatory. However, use of this AC is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and with revenue from the Passenger Facility Charges (PFC) Program. See Grant Assistance No. 34, "Policies, Standards, and Specifications," and PFC Assurances No.9, "Standards and Specifications."

4. PRINCIPAL CHANGES.

a. Updated accident site distribution.

b. Incorporated specific NFPA standards.

c. Expanded phases of ARFF station projects.

d. Further defined site selection criteria.

e. Expanded station elements and facility requirements to align with public law, national standards, revised ACs, and design criteria.

f. Clarified and updated station facility systems requirements.

g. Expanded and incorporated detailed hazard and safety features.

h. Updated references.

i. Provided new table on ARFF vehicle dimensions and thresholds in Appendix A.

j. Revised typical station equipment furnishings and requirements in Appendix B.

k. Revised station design checklist in Appendix C.

l. Updated all appendices to incorporate current data.

5. METRIC UNITS. To promote an orderly transition to metric units, this AC contains both English and metric dimensions. The metric conversions may not be exact metric equivalents and, until there is an official changeover to the metric system, the English dimensions will govern.

6. COMMENTS OR SUGGESTIONS for improvements to this AC should be sent to:

Manager, Airport Engineering Division
Federal Aviation Administration
ATTN: AAS-100
800 Independence Ave. S.W.
Washington, DC 20591

7. COPIES OF THIS AC. The Office of Airport Safety and Standards makes ACs available to the public through the Internet. These ACs may be found through the FAA home page (www.faa.gov). A printed copy of this and other ACs can be ordered from the U.S. Department of Transportation, Subsequent Business Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, Maryland 20785.

MICHAEL J. O'DONNELL
Director of Airport Safety and Standards

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CHAPTER 1. INTRODUCTION

1-1. OVERVIEW. This Advisory Circular (AC) establishes and identifies requirements and operational features for the design and layout of aircraft rescue and fire fighting (ARFF) facilities that support the various indexes of Federal Aviation Administration (FAA) airports, as defined by Federal Aviation Regulation (FAR) Title 14 *Aeronautics and Space*, Part 139 – *Certification of Airports*, Subpart D – *Operations*, throughout the United States. The paragraphs include:

a. Paragraph 139.315, *Aircraft Rescue and Fire Fighting: Index Determination*

b. Paragraph 139.317, *Aircraft Rescue and Fire Fighting: Equipment and Agents*

c. Paragraph 139.319, *Aircraft Rescue and Fire Fighting: Operational Requirements*.

1-2. SCOPE. The primary responsibility and objective of an ARFF and emergency service organization is to provide a timely response, protect life and property, and minimize the effects of an aircraft accident, incident, or catastrophic event occurring primarily on airport property. The key to successful execution of this role can be achieved by optimizing the location of the airport fire station(s) and designing the station to enhance the effectiveness and efficiency of emergency services personnel. Essential to operational efficiency is fire station site selection. This critical element is paramount in reducing emergency response times to an aircraft related incident. Response times can be further reduced by ensuring that the facility's layout and floor plan provide a smooth and unimpeded flow of personnel traffic to reach emergency response vehicles in the shortest period of time possible. Fire station operations can be more efficient and cost-effective by incorporating an overall station systematic design to preclude operational shortcomings. A systematic design approach will result in a process flow relationship of facility subsystems, e.g., mechanical, electrical, and piping systems. Human factors engineering will promote personnel safety.

1-3. TYPES OF ARFF STATIONS. ARFF stations may be designed to provide single, or several types of, services and may also house multiple functions. These include:

a. Headquarters stations that generally house the airport fire chief and administrative staff, administrative functions, and emergency response vehicles (ARFF, structural, or both).

b. Combination stations that house and provide both ARFF and structural fire fighting response capability from a single or multiple facility.

c. Multiple function/dual use stations that house other services which support airport operations, e.g., snow removal equipment, maintenance terminals, medical treatment, security offices, emergency operations center, etc.

d. Single (satellite) stations that house and provide either ARFF or structural (facility protection) fire fighting response vehicles.

1-4. PHASES OF ARFF STATION PROJECTS. There are four phases associated with fire station projects: planning, design, construction, and occupancy. Each project phase may vary in detail according to the specific needs of each individual airport. However, the basic foundation with its own sub-steps will lead to a functional and cost-effective facility that meets the intended needs of the airport and emergency responders.

a. Planning Phase: The planning phase consists of determining initial planning decisions relative to the type and functional use of the facility that is required; the types and number of vehicles to be housed; expertise, advice, and counsel rendered by a licensed architect and engineer (A/E); an integrated project team of diverse professionals; and the collection of data relating to existing airport inventory and/or airport requirements projected out to twenty-five years or to the master plan time frame.

(1) Initial Planning Decisions.

(a) Expansion of an Existing Station or Construction of a New ARFF Station. The airport operator or sponsor should perform an analysis to determine the feasibility of whether it is more cost-effective to expand an existing station or to construct a new one in meeting ARFF emergency service requirements. Upon decision resolution, the specific requirements of the expanded or new station should be defined in precise detail. The defined list of unique requirements will influence all aspects of planning, designing, construction, and occupancy. The airport master plan as prescribed by AC 150/5070-6, *Airport Master Plans*, integrates all aspects of airport planning including short-term and, more importantly, long-term development needs, and can assist in this determination.

(b) Single (Satellite) or Dual Station Functions. The airport operator or sponsor should decide whether the station will have the sole function of ARFF services or multiple functions to house other airport services. To achieve facility efficiency, it may be a common practice to house ARFF vehicles with airport snow removal equipment or structural firefighting vehicles. Should snow removal equipment be housed in the same facility, consult AC 150/5220-18, *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials*. These stations may also include permanent or temporary medical treatment facilities, security offices, and maintenance terminals. Precautions should be taken, though, that the ARFF vehicle apparatus bays are separated from the facilities of other airport departmental functions to avoid delayed emergency vehicle responses and internal agency operational conflicts.

(c) Single or Multiple ARFF Stations. For larger airports with several runways, a zonal coverage by multiple stations is often preferred, not only to meet vehicle response times, but to shorten response times to high risk areas. Aircraft accident studies show that a large number of aircraft mishaps occur on or near the runways and are addressed in Chapter 2 of this AC. The more serious accidents, in terms of casualties and fire control conditions, occur in or beyond the runway end safety areas. Where more than one station is provided, one station should be designated as the headquarters station and the other(s) as satellite(s). Usually, the range and extent of the facilities vary between those which are more appropriate for the headquarters station and those at a satellite.

(d) ARFF Vehicle Fleet Requirements/Airport Index. Title 14 Code of Federal Regulations (CFR) Part 139, Subpart D paragraphs 139.315,

ARFF Index Determination and 139.317 ARFF Equipment and Agents, establishes the minimum amount of fire extinguishing agent required for each certificated airport together with the minimum number of ARFF vehicles required to transport the agent. There are a myriad of combinations of ARFF vehicles and agents used to comply with these requirements. The number and type of existing ARFF vehicles to be in the fleet are the starting point for ARFF vehicle apparatus bay space allocations. Designers should also consider the potential procurement of future replacement vehicles (**NOTE:** *Current vehicle manufacturers are increasing ARFF vehicle footprints and widths*). The number of vehicles will impact the design for the majority of the remaining station rooms and other station elements. The number of vehicles governs the design and space designated for administrative offices, training rooms, sleeping quarters, lavatories, dining areas and kitchen, watch/alarm rooms or communications centers, storage and maintenance areas, and other key station elements. Refer to Chapter 3 of this AC.

(2) Selection of an Architect and Engineer (A/E). The expertise, advice, and counsel rendered by a licensed A/E are essential to the airport sponsor. AC 150/5100-14, *Architectural, Engineering, and Planning Consultant Services for Airport Grant Projects*, provides sponsors with guidance in the selection and employment of architectural, engineering, and planning consultants. Additionally, it provides guidance on contract format and provisions, methods of contracting, and allowable costs. It should be noted that if the station is to be constructed as a part of a Federal airport grant project, the selection of the A/E should conform to OMB Circular A-102. The selected individual should know or learn the needs of ARFF service personnel and their specific operations. Basic A/E services in addition to design responsibilities include overseeing construction, assisting in negotiations between the contractor and the airport sponsor, and ensuring that all contractual obligations are met in accordance with the plans and specifications.

(3) Selection of a Project Team. The project team should consist of a closely integrated group of multi-disciplined professionals that is formally organized to plan and monitor the entire project from initial conception to final acceptance by the end user. The team should include design consultants such as the A/E, airport planners, non-Federal authorities funding the project, and at least one person from airport operations and ARFF service. It is recommended to consult AC 150/5300-9, *Predesign, Prebid, and Preconstruction Conferences for Airport Grant Projects*. Where formal ARFF services do not exist at the airport, a representative from the organization that will provide emergency services personnel and equipment should be a member of the team. Firefighter participation in the design of the station serves as a dependable and experienced source of determining valid operational requirements; their firsthand knowledge of fire fighting technology, existing station design, and functional shortcomings and assets can be a vast resource of useful information. When deemed necessary by the airport operator, others should be assigned to the team to provide additional related expertise. With such a diversity of team skills, potential ramifications of decisions are normally considered and chances for mistakes and omissions reduced.

(4) Data Collection. Data relating to existing airport inventory and/or airport requirements projected out to twenty five years should be collected. The data collection should, as a minimum, include the following:

(a) Planned near and long-term airport development and/or expansion.

(b) Current and forecasted airport operations by aircraft type.

(c) ARFF service requirements to meet the airport's present and future airport indices.

(d) Projected life-cycle costs (consider both initial and long-term costs of ownership).

(e) Existing fire station(s) and support building(s) used by ARFF personnel.

(f) Airport service personnel requirements.

(g) Existing and future equipment requirements. These requirements should include new technologies for computerized control systems for communications, fire control, energy management, environmental, and building systems operation.

(h) Need for special equipment and practices for solving specific problems (e.g., standardized hose fitting sizes which can be shared by non-airport ARFF support units and quick disconnect fittings for use with older ARFF vehicles that require constant air pressure and have no on-board compressor).

(i) Requirements for notification of proper authorities, e.g., AC 150/5370-2, *Operational Safety on Airports During Construction*.

(j) Requirements for the handling/storing of hazardous materials. Refer to 29 CFR, *Hazardous Waste Operations and Emergency Response*, Section 1910.120.

(k) Projects that support utility infrastructure.

b. The Design Phase. It is essential to integrate the airport's requirements with the projected facility cost, schedule of time line constraints, and the preparation of plans and specifications. This requires the airport sponsor's and the project team's involvement at team meetings from the earliest decisions through the completion of schematic designs. AC 150/5300-9 describes the purpose, timing, participants, and agenda items for each of these project team meetings. Approval by the sponsor and the project team should precede the initiation of subsequent stages. Sponsor approval should include any necessary adjustment of the airport master plan to reflect the proposed location of the station(s) and the modification of building restriction lines to preclude future airport construction from interfering with the station surveillance of the movement area. Activities encountered to accomplish a completed project design include the following:

(1) Schematic Designs. Upon completion of preliminary schematic design, the sponsor and the A/E should identify estimated cost, construction materials and equipment needs, items to be included in the contract documents, and other items of operational importance.

(2) Cost. After the A/E develops a station outline from the list of requirements, a cost approximation of a conceptualized station should be established.

(3) Design Development. This stage should emphasize station constructability. Any uncertainties in the station subsystems such as structural, electrical, and construction material details should be worked out and accordingly reflected on the schematics.

(4) Plans and Specifications. This stage should focus on establishing construction drawings, plans, and specifications. Specific construction materials, workmanship, and special construction conditions need to be identified. Prior to bidding, the sponsor should perform a final project design review and incorporate any modifications necessitated by changes that may have occurred after the planning phase, such as in personnel requirements, technology, or building and safety regulations.

(5) Approvals. Station designs must comply with local and state building codes and other Federal requirements where appropriate. If these requirements exceed or are more stringent than those contained in this AC, they will take precedence. Administrating agencies may require station drawing approval and issuance of a building permit prior to construction. In areas subjected to earthquakes, hurricanes, heavy snow loads, heavy driving rain, hail or high winds, stations should use materials designed to withstand such phenomena.

c. Construction Phase. The construction phase includes all activities required after the award of a construction contract.

(1) Resident Engineer. Periodic inspection by a resident engineer of the work in progress may be part of the basic services offered by the contracted A/E. If the sponsor desires such an inspection service, it must be addressed within the contract. Full-time inspection may be provided by either the sponsor or the A/E firm. The presence of a resident engineer provides a high level of confidence and assurance that the contractors are complying with the terms of the contract through acceptable workmanship and materials. The individual should have experience in fire station construction and knowledge of proper installation and operation of fire service systems. AC 150/5370-12, *Quality Control of Construction for Airport Grant Projects*, provides a list of primary duties and responsibilities of a resident engineer. Also see AC 150/5300-9.

(2) Airport Operations. The construction of an expanded or a new station should not interfere with normal airport operations or ARFF services. During construction, careful observation should be maintained to ensure that airport operational safety is not degraded by construction hazards. AC 150/5370-2 provides guidance on the sponsor's responsibilities to ensure operational safety, construction vehicle activity, and special safety requirements during construction. Also see AC 150/5300-9.

d. The Occupancy Phase. After a station has been completed, the airport sponsor and a team from selected disciplines should perform a detailed acceptance inspection to ensure all facility, utility, and support systems are properly installed and functioning as designed. ARFF service personnel should check the facilities and related ARFF equipment. This should incorporate the testing of systems and equipment for proper installation and operation prior to station occupancy. All deficiencies should be documented and reported to the A/E for correction. A "certificate of occupancy" will be issued by the airport operator prior to the facility becoming occupied and/or placed into service for its intended use.

CHAPTER 2. SITE SELECTION

2-1. OBJECTIVE. The primary objective for siting an ARFF station is that a site (or sites) be located to meet, or exceed, FAR Part 139.319 ARFF vehicle response time requirements for certification purposes.

2-2. RESPONSE TIME ANALYSIS. During the planning phase a qualified team will undertake a comprehensive analysis to determine which potential sites not only comply with FAR Part 139.319, but can provide the fastest response time. Because of their superior accuracy, the use of computer models is greatly encouraged. There are a number of computer software programs available that can be used for a response time analysis. The method used in the past, involving a simple mathematical approach and ruler, is not totally reliable. For example, in a straight run ARFF apparatus may attain speeds of 50 miles (80 kilometers) per hour or more. However, the use of only a mathematical approach does not provide a means to reflect deceleration distance at that speed when approaching the scene.

A computer analysis uses a geo-based program that displays the airfield configuration, including airfield service roads, and simulates actual travel routes and times of emergency vehicles within the airfield network. The network reflects the actual centerlines of each element, and computer mapping accurately reflects distances. A critical input to these computer programs is to ascertain from the airport's ARFF department what travel speeds are normally used for each link, or segment, including turn segments of 45, 60 and 90 degrees.

Another important step to utilize in this analysis is calibration, where the speed for each link is adjusted to accurately reflect actual speeds by type of apparatus, by route, by sharp turns and straight runs. Actual time trials can be used as well; however, these should be kept to a minimum to mitigate wear and tear on the ARFF vehicles.

A key aspect of this analysis includes the turn-out time (activation time) from when the alarm is struck to when the first ARFF apparatus begins to move. The time for this phase should come from the ARFF department and should be added to the travel time for a total response time.

These computer programs can produce accurate colored graphics for each site being considered and by specific route.

2-3. SITE SELECTION PARAMETERS. The analysis of each candidate site for a new ARFF station involves a number of parameters that need to be addressed, recognizing that these can vary from airport to airport. These parameters are in addition to the response time analysis.

a. Operational Factors. The site should allow for:

(1) Immediate, straight access to the airfield network.

(2) Unimpeded access routes with a minimum of turns to the airfield network and aircraft aprons.

(3) Direct access to the terminal aprons minimizing the crossing of active runways, taxiways, or difficult terrain. This parameter is critical because of the need for a timely safe response to emergencies on the ramps, aprons, or terminal areas. Response routes that do not require ARFF vehicles to enter the aircraft movement area will reduce the risk of airfield incursions.

(4) Non-interference with the air traffic control tower's (ATCT) line of sight.

(5) Maximum surveillance of the airfield.

(6) Adherence to the Building Restriction Line (BRL) as determined using AC 150/5300-13, *Airport Design*.

(7) Future expansion of the ARFF station without:

(a) Limiting or reducing airport surveillance.

(b) Blocking fire traffic lanes.

(c) Impacting adjacent roads, buildings, aircraft pavement and parking areas, and ATCT's line of sight unless the structure or paved area is to be eliminated for other reasons.

(d) Requiring significant structural changes to the ARFF station itself.

(8) Planned airfield improvements that will not create emergency response runs that will negatively impact FAR Part 139 response time requirements. However, in this event, an additional (satellite) ARFF station(s) may provide an alternative.

(9) Non-interference by ARFF vehicles or the ARFF station's communications equipment or with navigational facilities.

(10) Close proximity to a rescue boat launch facility for those airports with an aircraft water rescue program. This need is particularly important if the rescue boat is stored at the ARFF station, thus requiring a tow for launching.

(11) Adherence to FAR Part 77.25, *Civil Airport Imaginary Surfaces*.

(12) Minimum obstructions or interference from existing facilities or uses such as:

(a) Access roads.

(b) Aircraft fuel storage areas.

(c) Aircraft taxiing operations or parking areas.

(13) Ease of connection to and integration with the airport's security system.

b. Site Size. The site should allow for:

(1) The accommodation of the ARFF station and future expansion(s) such as increasing the apparatus bays for larger ARFF apparatus or an increase in ARFF Index (as defined in FAR Part 139, Sub-part D) and/or personnel requiring larger living quarters, employee parking, etc.

(2) Exterior amenities, such as employee parking, exterior patio, and ARFF vehicle resupply (water and/or foam) operation and servicing area.

(3) ARFF apparatus apron to accommodate the largest current or anticipated vehicle.

(4) Removal of trash.

c. Proximity to Utilities and Roads. The site should offer reasonable access to:

(1) Electrical power and, if any, alternate energy sources, e.g., gas.

(2) Essential communication and telecommunication networks, including proximity to fiber optic and copper network backbones. This is particularly critical for the ARFF station's security design components and integration with the airport's security system.

(3) Existing and future airport access and airfield service roads.

(4) Existing and future water supply system and sanitary sewer hookups.

d. Topography and Station Orientation.

(1) A level site is preferred, however, an irregular un-level site can at times be used if it is superior in other aspects (response times, etc.) and construction costs are reasonable.

(2) Proper station orientation can help to reduce yearly energy operating costs by moderating the effects of the wind and the sun's rays. The design team should strive to earn Leadership in Energy and Environmental Design (LEED) certification from the U.S. Green Building Council (http://www.usgbc.org/), which is a voluntary national standard for designing high-performance and sustainable buildings.

(3) Proper station orientation can help to mitigate exterior noise levels and associated costs for acoustical treatment.

(4) The primary objective in locating and orienting an ARFF station is "to provide a timely response, protect life and property, and minimize the effects of an aircraft accident or incident or catastrophic event occurring primarily on airport property." (See Scope 1.2.) The factors identified in 2.3 Site Selection A through C should be the operational priorities of the Site Selection phase. Section D provides important considerations but must be evaluated carefully against any impact with critical operational and performance issues that might add delays in response, compromise safety or affect any mission critical objectives.

2-4. OTHER PLANNING TOOLS. A good planning tool that can be used to assist airport operators and their design team in the siting for a new ARFF station is an FAA document entitled *Location of Commercial Aircraft Accidents and Incidents Relative to Runways*, dated 1 July 1990.

The documentation used in this study was based upon commercial aircraft accidents and incidents that occurred between 1978 and 1987. It was limited to aircraft operating under FAR Part 121, Part 129 and scheduled Part 135 operations. Over 500 accidents and incidents were categorized as "undershoots,

landing off the runway, veers, overruns and others in the airport vicinity". Not all the events had an exact location of where the aircraft came to rest. Therefore, Figure 1 graphically depicts only some of those events where the exact location of the aircraft came to rest was known.

Figure 1 shows that a large number of aircraft accidents and incidents occurred on or within the runway regime. The more serious accidents, in terms of casualties and severity of the event, occurred in or beyond the runways and safety areas. **NOTE:** *Users of this information are cautioned that it not be interpreted in any other fashion than for airport planning purposes.*

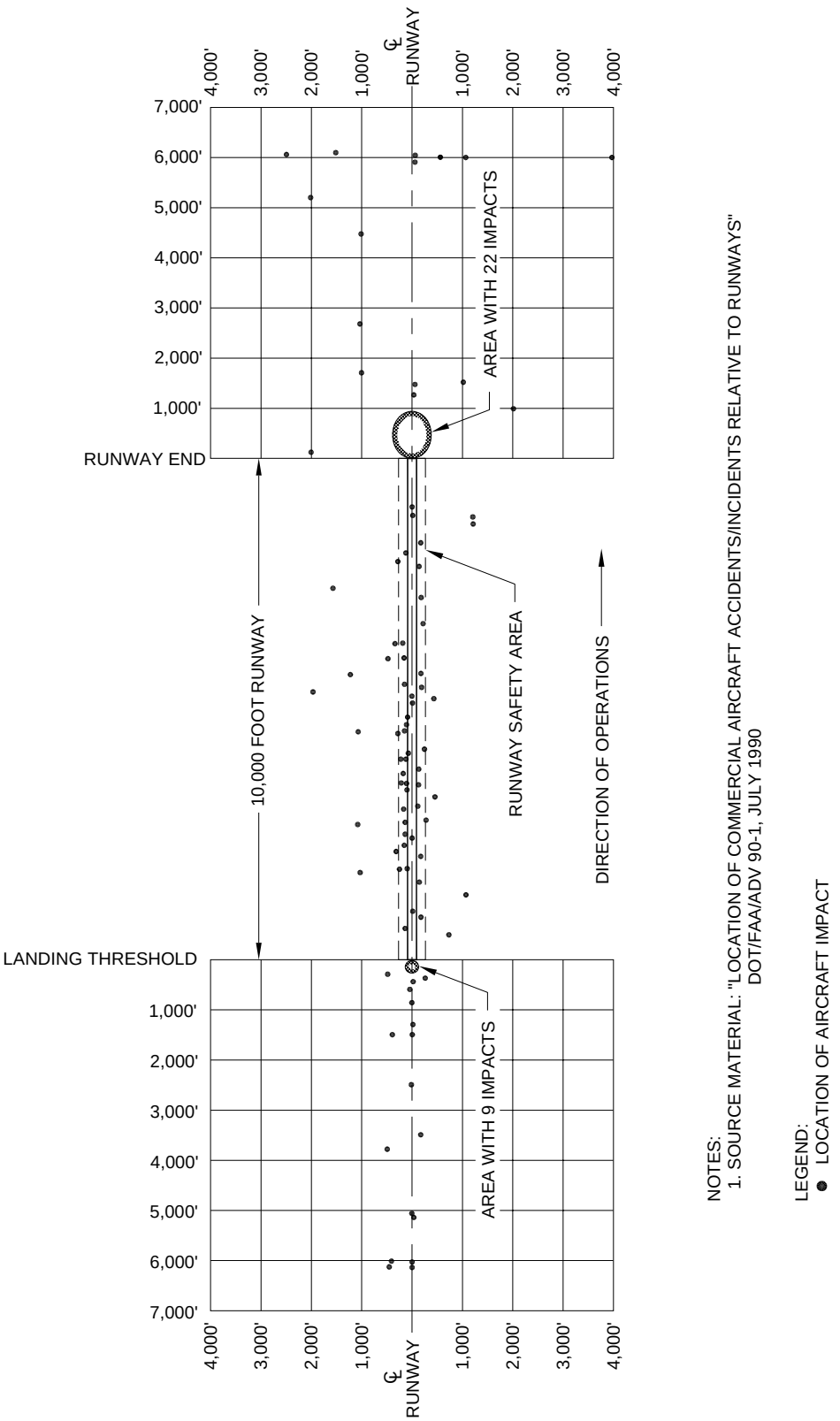

Figure 1. Accident Site Distribution in Relation to Runway Regime

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CHAPTER 3. STATION ELEMENTS.

3-1. INTRODUCTION. FAA airport certification requirements establish the payload size and the required minimum number of ARFF vehicles per FAR Part 139.317. The number of vehicles and their characteristics help to drive the operational design requirements of the station's apparatus bays. The number of vehicles relates in part to the number of personnel. Consequently, living and working space allocations for most of the station's rooms will be based on the number of personnel (current and future). The watch/alarm room, mechanical room, and the apron design, for example, will also be affected by the overall design and operational requirements of the apparatus bays. To assist in assessing these needs, the following appendices have been included in this AC: Appendix A, dimensions, minimum crew requirements, and other characteristics of sample ARFF vehicles; Appendix B, typical items purchased and installed as part of the construction and furnishing of a station; and Appendix C, a list of questions that should be answered for equipment purchases.

NOTE: *It is very important that the user of this AC understand that the sizes of many of the functional spaces will vary greatly depending upon the size of the ARFF department and its' mission. In many instances, smaller airports will not require the total square footages shown (where a space is described as a minimum, that number can be increased by 20%; the resulting figure is then considered a maximum and would need FAA approval if larger) or functions shown, but they should use the UNIT sizes where shown for each functional space that applies to their needs. For these reasons, total and/or unit square footages are NOT provided for many functions, recognizing the wide variances from airport to airport.*

Users of this AC should keep in mind that potential changes to FAR Part 139, Subpart D, are currently being considered by the FAA that, if enacted, will have an impact on ARFF station location and design. Check with the appropriate Airport District Office (ADO) before starting the planning and design phases for the status of these potential changes.

3-2. ARFF APPARATUS BAYS. The ARFF apparatus bays are the primary station functional space. The apparatus bays govern the layout and structural design of the majority of other station elements and directly influence the successful operation of the ARFF service. The question of how many bays are eligible is often predicated on the airport's ARFF Index plus one bay for light maintenance and washing; however, there are other considerations that can impact this question.

a. Justification for additional bays being eligible can be based upon other factors as well, including:

(1) The vast majority of responses by most ARFF departments are for Emergency Medical Service (EMS) calls, for which there could be a separate vehicle from the required Index vehicles, but would be available for responding to an aircraft emergency.

(2) There should always be a reserve ARFF truck in case of the scheduled maintenance of an on-line truck or repairs which take an ARFF vehicle out of service. If a reserve ARFF vehicle is not available to replace an Index-required vehicle, an airport must drop down to the next lower ARFF Index until rectified.

(3) Bays can be used for the re-supply of foam and water during an incident or accident.

(4) The potential need for ARFF departments to be prepared for a terrorist attack. At the very least, the need for a Hazardous Material (HAZMAT) vehicle is now a consideration to meet new environmental regulations. This facet should be considered in light of the new Safety Management System (SMS) for airport operators and is presented as a concept in AC 150/5200-37, *Introduction to Safety Management Systems (SMS) for Airport Operators*. SMS is intended to become, ultimately, a regulatory requirement at certificated airports. As noted in AC 150/5200-37, "a key indicator of management's commitment to safety is the adequacy of resources".

Recognizing that each airport is unique, it will be incumbent upon the airport operator to justify to the FAA the number of eligible apparatus bays, which will be considered on a case by case basis. Further, as previously underscored, the total square footage for a functional space, where shown in this AC, can be increased by up to 20% to reflect local conditions. An increase of over 20% requires FAA approval.

(5) Training is a critical component of ARFF readiness. When justified, an additional apparatus bay may be required for a vehicle that performs training, water rescue, or hazardous material response functions. Training evolutions require ARFF firefighters to operate all components of the vehicle during simulated tactical operations and during mandatory live fire evolutions. During these training evolutions, agent quantities are reduced and not immediately available for response. Dedicated training vehicles allow for departments to train members without compromising agent quantities. Training vehicles can also be deployed to incidents as additional manpower arrives and helps to restore an airports index required agent following an event, helpful in reopening an airport.

b. Apparatus bay dimensions depend on the vehicle parking concept and the physical characteristics and number of ARFF and other non-ARFF vehicles to be housed. There have been significant changes in ARFF vehicle designs in terms of size, foam/water capacities and operational characteristics. Appendix A provides data on the more common ARFF vehicles currently available. Be certain to include the side-view mirror dimensions to the vehicle width as well. There are a number of issues that determine the size and number of ARFF apparatus bays. It is not just a question of meeting the airport's ARFF Index, because this would not reflect the total mission of a modern ARFF department.

c. Configuration (length, width and height) of apparatus bays is established by using the dimensions of the largest existing or anticipated new truck together with the minimum parking clearances. Proper sizing of the ARFF vehicle bays will provide operational flexibility, a clear margin of safety and space to undertake minor maintenance tasks for each truck. Note that the standard clearances provided in paragraph (c) 4 below are categorized as "at least", meaning they are viewed as minimums. Further, these dimensions are "standards", which means they are required minimum clearances. Lastly, when necessary to meet local conditions, clearances may be increased up to 20% of these minimums. Configuration of the bays is further impacted by factors such as side or back hook-ups for air and power, clearance for side-view mirrors (which impacts door width), new truck designs with extendable turrets and multi-position high performance bumper turrets.

(1) ARFF PERSONNEL MUST HAVE OBSTACLE FREE ACCESS FROM ALL INTERIOR AND EXTERIOR (PATIO) STATION POINTS TO THE APPARATUS BAYS.

(2) Side-by-side parking of vehicles versus tandem parking (more than one vehicle deep to a bay) should be carefully considered. Some airports do not prefer tandem parking since, if a mechanical failure in the lead tandem parked vehicle occurs, it will hinder or negate the response of the rear vehicle. If tandem parking is unavoidable, limit it to structural firefighting and other secondary vehicles. Whenever practical, long and short vehicles should be parked side by side for more efficient use of vehicle room space.

(3) The use of drive-thru bays should be considered to facilitate parking of vehicles and to increase the operational safety and flexibility of the station. This type of parking, also, facilitates the operation of re-supplying the ARFF trucks with either foam and/or water in a bay so designated for this purpose. The time required for the re-service of foam concentrate and water can be reduced with drive-through bays since the vehicle can pull straight through rather than having to back-in. Drive-thru bays also provide the opportunity for bi-directional use.

(4) THE ARFF VEHICLE STANDARD CLEARANCES WILL BE AT LEAST: 6 FEET (1.8 M) BETWEEN THE VEHICLE AND WALLS/STORAGE AREAS; 8 FEET (2.4 M) BETWEEN VEHICLES PARKED SIDE BY SIDE; 5 FEET (1.5 M) BETWEEN VEHICLES PARKED END TO END; AND 5 FEET (1.5 M) BETWEEN THE VEHICLE AND STALL BAY DOORS. More clearance may be required for folding bay doors. Dimensions should accommodate the present vehicle fleet and newer replacement vehicle models. Additional consideration should be given to larger future vehicle additions which may be a result of an increase in the airport's index and/or mission.

(5) The ceiling height should allow service personnel to stand erect on top of vehicles and still clear any overhead obstructions, such as pipes, a hoist, storage tanks, bay door mechanisms, etc. THE STANDARD CLEARANCE BETWEEN THE CEILING HEIGHT AND THE ARFF VEHICLE WORK PLATFORM IS 7 FEET (2.1 M). New ARFF truck designs need to be considered, which, in relation to bay heights, need to consider an extendable turret or other appliances or technology located on top of the vehicle. In addition, the standard clearance above the vehicle may be impacted by station-mounted tracks or equipment used to provide positive attachment to vehicle exhaust pipes to prevent vehicle exhaust from contaminating station air.

(6) Storage for turnout gear Personal Protective Equipment (PPE) is required at or near the vehicles. Storage may be in either lockers or open racks. THE STANDARD FOR STORAGE IS AT LEAST 10 SQUARE FEET (0.9 SQUARE METER) PER FIREFIGHTER. Locker sizes are typically 2-1/2 feet (0.7 M) deep by 3 foot (0.9 M) wide with space in front of the locker approximately 2 feet (0.6 M) deep by 3 feet (0.9 M) wide. The storage area should receive sufficient natural or forced ventilation to completely air-dry clothing between shifts and where possible recessed into a wall to keep clear of personnel movement. PPE in lockers should not be exposed to direct sources of

ultra-violet (UV) light, which degrades the protective qualities of PPE and reduces its' life-span.

(7) There will always be items in need of storage that were not anticipated, or that require additional space as an ARFF department grows. It is recommended that the amount of storage for the apparatus bays should be approximately 10% of the total area. Storage for hoses, mechanical hose drying equipment or devices (refer to paragraph 3.12 of this chapter), tools and equipment, as well as medical and first aid supplies are part of this area, while storage for vehicle equipment parts and foam/dry chemicals is separate.

d. Electrical Details.

(1) Recommended lighting levels are discussed in Paragraph 4-5, *Lighting*.

(2) Convenient electrical outlets on usable walls should be approximately 18 to 24 inches (46 to 61 cm) above the floor with 8-foot (2.4 M) centers. Outlets should not be recessed into the vehicle bay floor.

(3) Appropriate electrical supplies should be provided for vehicles fitted with engine heaters, battery charging/conditioning devices, 110 volt air compressors, or other protective equipment. All such connections should be designed for quick and safe disconnection. All power cords that are to be attached to the apparatus should be mounted in such a way so as to not create an obstacle or hazard to firefighters running to their trucks. Retractable reels and automatic disconnects should be considered.

e. Interior Environment.

(1) A means of exhausting vehicle exhaust fumes to the external environment is recommended to avoid air contamination within the vehicle room (Paragraph 4-12, *Ventilation*). The ARFF station will prevent exposure to firefighters and contamination of living and sleeping areas from exhaust emissions.

(2) A separate heating control is recommended to maintain a vehicle room temperature of at least 55°F (13°C). Paragraph 4-14, *Room Temperatures*, provides recommended station room temperatures. In stations where high ambient temperatures and humidity are prevalent, some form of climate control may also be necessary.

(3) Carbon monoxide detectors must be used to detect excess exhaust fumes in the living quarters per Occupational Safety and Health Act (OSHA) standards.

(4) Wall surface materials should have easy-to-clean and maintenance-free qualities. Wall finishes should be selected for long-term maintenance-free characteristics rather than initial low cost.

f. Vehicle Support Equipment.

(1) One overhead hoist with a minimum working capacity of one ton is recommended for the lifting of foam drums, nitrogen tanks, and other equipment onto the vehicles.

(2) A water connection(s) for the refilling of a vehicle's water tank is recommended for each apparatus bay (AC 150/5220-4, *Water Supply Systems for Aircraft Fire and Rescue Protection*).

(3) A nearby utility room or designated area within the vehicle room with a hot and cold water source, a deep slop sink, and mop ringer should be provided. This utility room should be from 64 square feet (6.0 square meters) to 100 square feet (9.3 square meters), depending upon station size, to include storage space for cleaning equipment and supplies. An additional utility room, when justified, may be required based on the station floor plan. This closet is separate from the janitor's closet for the living and administrative areas.

(4) Hose bibs and retractable hose reels must be conveniently located for washing apparatus and equipment. All service lines, air, water, and foam will be equipped with isolation valves easily accessible to firefighters. These isolation valves are critical to minimize disruption to all bays, due to a failure in one. For example, a broken air line without individual isolation valves would eliminate all air service to the Apparatus Bays.

(5) A compressed air supply capable of providing an operating pressure of at least 120 psi (825 kPa) at the end of a run should be provided for maintenance, vehicle readiness (air supply), painting, and cleaning. A retractable air line should be available for connection to each ARFF vehicle to supplement vehicle air systems. Each air line should be equipped with an auto-disconnect type fitting matched with the apparatus' air inlet. Apparatus that have 110-volt air compressors will only use the air lines as a back up, while those without 110-volt air compressors will use it as a primary source of air. The air compressor should be of sufficient size to operate the ARFF bay exhaust system as well.

(6) A SOURCE FOR FOAM AGENT RECHARGE MUST BE PROVIDED. ALTERNATIVES ARE EITHER A SINGLE COMMON OR INDIVIDUAL BAY FOAM STORAGE TANKS OR A STORAGE AREA WITH A PUMPING SYSTEM THAT HOUSES FOAM CONCENTRATE CONTAINERS ABOVE 32°F (0°C). CAPACITY MUST BE SUFFICIENT TO FILL ALL VEHICLES WITH AT LEAST TWICE THEIR ASSIGNED CAPACITY (i.e. if the total aggregate foam capacity of all assigned ARFF vehicles is 500 gallons, then the amount required for storage to reservice all vehicles is twice the assigned vehicle capacities, or 1000 gallons). For built-in supply facilities, an overflow system to capture excess foam should be provided. The size of a pump room is related to the airport's ARFF Index and can range from 200 square feet (18.6 square meters) (Index A) to 500 square feet (46.5 square meters) (Index E). In bays designed for rapid re-service, the foam concentrate must be delivered to the truck through a hard rubber hose which can be attached to the ARFF vehicles' 1-1/2 inch (6 cm) National Standard Thread (NST) connection, which fills the ARFF vehicle foam tank from the bottom of

the foam concentrate reservoir. Filling by this method reduces the amount of agitation to the foam concentrate and reducing "suds", allowing for a complete filling of the foam concentrate reservoir.

Foam re-service in bays not designed for rapid re-service, but rather to "top off" foam concentrate reservoirs, can be done from the top of the vehicle. Overhead reels and a ¾-inch (2 cm) rubber hose can deliver foam pumped from the station foam concentrate storage tank(s). The delivery end of the hose should be equipped with a shut-off and a 12-16 inch (30-40 cm) extension pipe, or probe, to reduce turbulence of the concentrate caused by the valve and, when possible, to penetrate below the level of the concentrate during the filling of the reservoir to reduce "suds".

The foam room should be equipped with a foam storage tank(s) of sufficient capacity to refill all vehicles twice with the full capacity of their foam capacity reservoirs. In addition to the fixed tank(s), this room should be equipped with pumps to draw the foam concentrate out of 55 gallon (208.2 liter) drums or smaller "totes". The tank(s) could also be refilled through direct connection fills to allow tanker deliveries. The tank(s) should also be equipped with a redundant pump system for foam concentrate being pumped to the ARFF vehicle re-supply hose reel(s) in the apparatus bays. The foam room should be heated (if appropriate) and designed with a floor drain(s) at a low point. The doors to this room should be large enough to remove and replace the foam tank(s), or pumps, as needed.

g. Vehicle Bay Doors.

(1) THE STANDARDS FOR THE SMALLEST INSTALLED VEHICLE BAY DOOR ARE 18 FEET (5.48 M) IN WIDTH AND 18 FEET (5.48 M) IN HEIGHT. However, smaller doors, no less that 16 feet (4.87 m) in width and 16 feet (4.87 m) in height, may be considered and used as appropriate.

(2) THE STANDARD FOR THE MAXIMUM TIME TO FULLY OPEN ANY VEHICLE BAY DOOR IS 16 SECONDS, or approximately 1 foot (0.3 M) per second. This can be achieved by manual remote control from the alarm/watch room or from the side(s) of each vehicle bay door, manually from a door pull chain, or automatically by the alarm system. Manual door pull chain should be placed on the driver's side. For vehicles with center consoles, pull chain placement should be on the left side.

(3) EACH ELECTRIC VEHICLE BAY DOOR MUST HAVE A MANUAL OVERRIDE THAT IS OPERABLE BY ONE PERSON AND MUST FULLY OPEN ANY VEHICLE BAY DOOR WITHIN THE MAXIMUM 16 SECOND OPENING STANDARD. A separate master door override that is capable of opening all apparatus bay doors must be located in apparatus bay areas, and/or watch alarm room or dispatch room.

(4) Vehicle bay doors should be equipped with adjustable timers so that the energy lost in the bays when the doors are open can be minimized. Stations that do not have a staffed watch/alarm room when vehicles are out may utilize remote door openers that can be carried in the vehicle(s) to open the doors when returning.

(5) An automatic vehicle bay door retractor should be installed to reverse the downward motion of a door upon contact with an individual or equipment. Pneumatically-operated sensing devices are not reliable in areas subject to sustained cold weather.

(6) Electric eyes should be installed wherein if the beam is broken it will reverse the direction of a closing door. The electric eyes should be mounted at a height that will protect personnel and, also, so that the beam will see the portion of the ARFF vehicle that is most forward, such as a bumper turret, bumper or crash bar.

(7) A vehicle bay door window should be placed to enable one to see the apron from both the vehicle bay floor and the vehicle's driver seat.

(8) For energy conservation and noise attenuation, vehicle bay doors should be insulated and weather-stripped.

(9) In addition to the above, a red warning light inside the bay doors must be used that will automatically deploy whenever the bay doors are in use. The location of this red light must be such that it is clearly visible to ARFF personnel.

h. Vehicle Room Floor.

(1) Vehicle room floor design should not only support the current heaviest loaded vehicle but make allowances for an increase in future vehicle weights. To minimize injury to personnel, floors adjacent to the apparatus bays should be the same elevation as the bay floor. In cold climates, vehicle room floors should have in-floor heating units. There are a number of benefits to heated floors. Heated floors provide consistent heat across the entire space and trucks returning to quarters after sustained exposure to extreme cold are heated from the bottom, which is where the greatest exposure has occurred. Standing water on heated floors dries quickly removing slippery hazards. For locations where the mean average temperature is at or below 32°F or 0°C, for extended periods, consideration should be provided for in-floor heating systems.

(2) Floor surface finishes should be resistant to hydrocarbon fuels, foam concentrates, antifreeze, battery acid, etc., and be smooth and easy to clean. There are a number of products designed for fire apparatus floors that provide color options, protection from the penetration of foam concentrates and fuel products which can leak from a vehicle. These products are available with varying levels of non-skid texture and are easy to maintain.

(3) The recommended slope of the vehicle room floor to the drain(s) is 1 inch to 10 feet (2.5 cm to 3 M).

(4) One transverse drain with heavy gauge covers should be located at the vehicle bay door(s) to receive surface water from the bay(s) and the forecourt. It is further recommended that each bay have either a shallow trough or catch basin floor drain equipped with a sediment/grease trap. Troughs are preferable in cold climates because of the greater ease in handling ice and snow that may be brought into the station by vehicles during winter.

(5) Some floor configurations may call for full length trough drains located in the centerline of each bay. This design removes another potential tripping hazard in the vehicle bay. The slope of the floor is critical to ensure no standing water.

i. Sliding Poles. Because of the concern for potential injury to personnel the use of sliding poles should be avoided. When used, they should be located to minimize the time to reach a vehicle from an upper floor. To reduce the potential for sliding down into obstructions, e.g., vehicle doors left open, sliding poles should be installed near the walls of the vehicle room or in recessed alcoves. Modern ARFF stations typically locate living quarters, etc., on the ground floor to expedite response time and mitigate personnel injuries.

3-3. STATION APRON.

a. General Design.

(1) An apron/driveway design should provide responding ARFF vehicles with a straight access from the vehicle room floor to the movement area without any curves or other encumbrances that will increase the response time.

(2) Exterior hose bibs with garden hose connections must be provided. For cold climate areas, hose bibs must be provided freeze protection.

(3) Fire hydrants must be installed for use in protecting the ARFF station and any adjacent structures. They will, also, be available for apparatus re-service, as well as for training and testing of hose with apparatus. Hydrants must be equipped with the size discharges and thread type consistent with other airport hydrants and the inlet on an ARFF vehicle.

(4) As an alternative wall hydrants may, also, be provided for apparatus re-servicing as well as for training and testing of hose and apparatus. The hydrants must be equipped with the size discharges and thread type consistent with other airport hydrants and the inlet on the ARFF vehicle. Wall hydrants must be labeled as such, so as not to be confused with Fire Department connections.

(5) A warning light should be provided if the station has pedestrian or vehicle traffic crossing the apron/driveway. It should be activated automatically whenever a station vehicle bay door is opened during an emergency.

b. Apron Standards and Recommendations. THE APRON OPERATING SURFACE MUST BE LARGE ENOUGH TO ALLOW THE LONGEST VEHICLE OR THE ONE THAT HAS THE GREATEST OPERATING CIRCLE[1] TO BACK INTO ANY BAY OF THE STATION.

(1) Apron Width. THE WIDTH OF AN APRON FOR MULTI-BAY STATIONS AND SINGLE BAY SINGLE VEHICLE STATIONS MUST BE AT LEAST EQUAL TO THE DISTANCE BETWEEN THE OUTERMOST LEFT AND RIGHT VEHICLE BAY DOOR OPENING(S) PLUS 3 FEET (1 M) ADDED

[1] The operating circle is the circle circumscribed by the outermost point on a vehicle (e.g., a bumper or mirrors). This circle can be significantly larger than that circumscribed by the vehicle's wheels.

TO EACH SIDE OF THIS DISTANCE. FOR SINGLE BAY TANDEM VEHICLE STATIONS, THE WIDTH OF AN APRON MUST BE AT LEAST 28 FEET (8.5 M) WIDE FOR ITS FULL LENGTH, ORIENTED ASYMMETRICALLY TO THE LEFT OR RIGHT.

(2) Apron Length. THE APRON MUST EXTEND FROM THE VEHICLE BAY DOOR(S) AT FULL-WIDTH FOR AT LEAST 1½ VEHICLE LENGTHS OF THE LONGEST VEHICLE. APRONS LONGER THAN 1-1/2 VEHICLE LENGTHS ARE TO BE GRADUALLY TAPERED DOWN TO A WIDTH NOT LESS THAN 28 FEET (8.5 M) FOR MULTI-VEHICLE STATIONS. The 28-foot (8.5 M) standard allows two vehicles to operate side by side in case one malfunctions while responding to an emergency by furnishing a disabled vehicle pad. SINGLE VEHICLE STATION APRONS MAY BE GRADUALLY TAPERED DOWN TO A WIDTH NOT LESS THAN 12 FEET (3.7 M).

(3) Apron Strength. THE APRON OPERATING SURFACE FOR AT LEAST ONE VEHICLE LENGTH FROM THE VEHICLE BAY DOOR MUST BE THE SAME STRENGTH SPECIFICATION AS THE VEHICLE ROOM FLOOR.

(4) Gradient. THE APRON MUST SLOPE AWAY FROM THE STATION AND VEHICLE ROOM FLOOR FOR EFFECTIVE DRAINAGE. Recommended apron slopes are from 2% to 4%. THERE MUST BE A SMOOTH TRANSITION BETWEEN THE APRON AND THE VEHICLE ROOM FLOOR WHICH MAY INCLUDE A DRAINAGE CHANNEL ALONG AND OUTSIDE ALL OF THE BAY DOORS AS DETERMINED BY THE A/E.

(5) Marking. An apron alignment stripe should extend from the back of the vehicle room floor out onto the apron a distance equal to the length of the longest vehicle in the fleet. The recommended alignment stripe is a 3-inch (7.6 cm) wide paint stripe on the left side of each vehicle lane.

(6) Lighting. Apron lights should be mounted so as not to interfere either with the drivers' vision when leaving or returning to the station or with other airport operations, e.g., the air traffic control tower's line of sight. Special care should be given to ensure that apron lights do not reflect from vehicle mirrors when vehicles are being backed into the station.

(7) Apron Canopy. A canopy mounted above the bay door(s) will provide a place for apron lighting, as well as serving as a shelter from weather for firefighters directing ARFF vehicles as they back in. A canopy will also provide shelter from the sun on the vehicle side view mirrors while the vehicle is backing in. Reducing sun glare increases safety by keeping the line and any obstacle(s) visible in the mirror.

(8) Bollards. Concrete bollards should be placed outside on each side of each bay to prevent vehicles from accidentally hitting the ARFF station wall while backing in.

(9) Apron Heating. In cold climates consideration should be given to apron heating to prevent slippery surfaces on the apron thereby allowing maximum response times. The heated apron should extend out the length of the longest vehicle from the bay doors. This keeps airport snow removal equipment away from the bay doors, thereby reducing the possibility of damage. Also, a heated apron provides an area free of ice and snow for firefighters to walk as they get off the apparatus in order to direct it while backing into the station. It, also, keeps the seals at the bottom of the overhead doors from freezing to the ground, which could prevent or delay a door from opening, cause damage to the seal and potentially delay a response.

3-4. WATCH/ALARM ROOM. AIRPORT ARFF STATIONS MUST HAVE A CENTRAL POINT FOR RECEIVING EMERGENCY CALLS, DISPATCHING ARFF VEHICLES, AND MOBILIZING AND DIRECTING OTHER SUPPORT RESOURCES. This central point, called the watch/alarm room, depends on the reliability and effectiveness of its alarm(s) and communication systems. Attendants should receive, evaluate, and act on requests for assistance with a minimum of room activity and outside consultation.

a. General Design. The watch/alarm room should provide for maximum surveillance to the extent possible of the airfield and control and observation of vehicle room activities. If necessary for airfield surveillance, the watch/alarm room may be elevated. At airports where a separate Communications Center serves as the dispatch center and emergency call receiving point, the watch/alarm room might have a reduced function. Other design items follow:

(1) THE STANDARD ROOM SIZE FOR THE WATCH/ALARM ROOM IS AT LEAST 130 SQUARE FEET (12.1 SQUARE METERS) FOR ALL AIRPORT INDICES EXCEPT AIRPORT INDEX A WHICH CAN COMBINE THIS ROOM WITH THE FIRE DEPARTMENT OFFICE. This space is required for recording emergency information and maintaining the ARFF station's logbook. Also, there should be an accessible storage space for maps and charts of the surrounding airport area, as well as sufficient wall space for same.

(2) New ARFF station design may incorporate Closed Circuit Television (CCTV) cameras – and other security devices consistent with the airport’s approved Airport Security Plan (ASP) – to monitor key points around the station not visible from the watch/alarm room.

(3) ALTERNATE EMERGENCY (BACKUP) POWER AND UNINTERRUPTABLE POWER SUPPLY (UPS) MUST BE PROVIDED FOR THE ALARM SYSTEM AND ESSENTIAL COMMUNICATIONS EQUIPMENT.

(4) All electronic equipment and wiring should be conveniently accessible for maintenance and repair. Raised flooring and removable panels on a suspended ceiling should be used to ease access to wiring and/or electrical equipment for maintenance purposes or improvements.

(5) The room should be equipped with a computer that provides access to the ARFF Department Local Area Network (LAN) for Incident Reports, accessing

electronic logs, pre-fire plan information, standard operating guide training media, etc.

(6) The room should be equipped with a minimum of two radios: an ARFF radio(s) and a tunable radio capable of monitoring Air Traffic Information Service (ATIS), tower frequencies, and any Discrete Emergency Frequency (DEF) as assigned.

(7) External night surveillance can be improved by the installation of a dimmer to reduce the intensity of the room's interior lighting. Red night lighting is also effective in providing interior lighting without creating glare that restricts seeing outside.

(8) Tinted glass with retractable sun screens or shades should be provided to maintain visibility. Areas subject to freezing temperatures, ice and snow should have a heater installed in such a way as to keep the windows defrosted in order to maintain a clear view of the airfield.

(9) A lavatory should be conveniently accessible.

(10) A backlit clock with both 12 and 24-hour display formats is recommended. Clocks will be synchronized to provide accurate and identical times between CAD systems, report generation, radio recordings and CCTVs where equipped.

(11) There should be adequate room sound suppression measures to offset generated high noise levels by ARFF vehicles and aircraft (Paragraph 4-6, *Acoustics*).

b. Alarms. AC 150/5210-7, *Aircraft Rescue and Fire Fighting Communications*, provides guidance for planning and implementing ARFF station alarm systems. Other recommendations follow:

(1) The alarm may be sounded by chimes or gongs located throughout the entire station and any satellite stations. Chimes are recommended since they usually cause less stress than gongs.

(2) An audible alarm anywhere auxiliary firefighters may be employed is recommended, especially at airports with "dual function" personnel or auxiliary firefighters. Alarm sounds should be different from any other bell or alarm that auxiliary firefighters might hear and loud enough to be heard above normal workplace noise levels and wind conditions.

(3) Functional alarm room controls, such as signals and alarms, should be compact, orderly, labeled and conveniently located. All personnel, including personnel confined to a wheelchair, should have no trouble reaching and operating all alarm room controls.

c. Communications. AC 150/5210-7 provides guidance for planning airport communication systems for ARFF services. One important factor that affects the design of station communication systems is whether there is to be one or a series of airport ARFF stations. If more than one, a designation of one as the main station and the

other(s) as the satellite(s) should be made. It is essential to differentiate between the minimum requirements needed at each station and those commonly needed at both.

3-5. MEDICAL DECON ROOM. A room dedicated to the cleanup and medical decontamination of ARFF personnel, or a ramp worker who arrives at the ARFF station soaked in fuel or other contaminant. This room needs to have double sinks, shower and drying area and should be at least 150 square feet (14.0 square meters) to include space for cleaning equipment and supplies. It should be located so the firefighter(s) (person) being treated does not have to walk beyond the apparatus bay area.

3-6. GEAR WASH/DRYING ROOM. Wet gear takes a long time to dry so a room with a commercial washer and heated drying rack, storage for 5 gallon (18.9 liter) washer material and circulation is needed. It is recommended this room should have at least 200 square feet (18.6 square meters). The gear wash/drying room will vent dryer heating exhaust to the exterior of the building through a duct system.

3-7. FIRST AID AND MEDICAL STORAGE. A clean environment is needed for the treatment of minor first aid to ARFF and other personnel who walk in requesting medical assistance, as well as storage for medical supplies. This room will need cabinets and a sink. This room should be a minimum of 120 square feet (11.1 square meters) and have a lockable door.

3-8. COMPLEMENTARY AGENT STORAGE. A room is needed for the storage of dry chemicals and firefighting powder, which should be stacked on 4’ × 4’ pallets in a room ranging in size from 225 to 350 square feet (21.0 – 32.5 square meters) depending upon the number of ARFF vehicles. In addition, this room should be available for the storage of re-supply tanks of halogenated fire extinguishing agents, or other approved clean streaming agent, as well as storage for Nitrogen or Argon cylinders used as propellants for vehicle mounted complimentary agent fire fighting systems. Pressurized cylinders must be stored in cages, or chained to the wall in accordance with local code. This room should have doors wide enough to move pallets and tanks from a receiving area to this room, which can also accommodate the storage of spare fire extinguishers as well as extinguishers waiting to be re-serviced.

3-9. SELF-CONTAINED BREATHING APPARATUS (SCBA). A room is needed for the storage of fire extinguishers and self-contained breathing apparatus (SCBA), working space to refill and repair SCBA bottles, and a compressor. If the latter is needed, this room should be located on an outside wall for ease of access as well as for safety reasons. This room should be 200 square feet (32.5 square meters). Further, the area should have:

a. Access to a source of air that has a degree of air purity that meets or exceeds the standards of the Compressed Gas Association Specification G-7.1 for Grade D Breathing Air of the OSHA.

b. An air compressor specifically designed to provide breathing quality compressed air for filling SCBAs. The SCBA compressor should be a complete unit with cooling tanks and/or fragmentation cages.

c. A 230-volt alternating current (VAC) 1-phase or 230-VAC/ 460-VAC 3-phase receptacle, depending upon the type of compressor.

d. Storage tanks that meet or exceed section VIII of the American Society of Mechanical Engineers (ASME) Code for Unfired Pressure vessels if a cascade system is used. It

should be noted that storage vessels rated by the U.S. Department of Transportation and the Interstate Commerce Commission do not meet those standards and are unacceptable.

e. All major components and accessories clearly identified with permanent name plates stating the make, model, serial number, capacities, pressures, voltages, currents and other pertinent information.

f. Tags and warning labels affixed to equipment for safety and ease in the operation and adjustment of valves, switches and controls.

3-10. ARFF ADMINISTRATIVE OFFICES. A modern ARFF station should have office space for the ARFF Chief, Deputy Chief and/or Shift Commander, while other officers (Captain and Lieutenants) can share office space. The Chief's office should be large enough to accommodate a small conference table and personal storage space. In some case, a shower stall and private restroom may be provided. The Chief's room should be 200 square feet (32.5 square meters). The Deputy Chief's office should be 160 square feet (14.9 square meters), while the Lieutenant's/Captain's offices should be 200 square feet (18.6 square meters) each since these rooms would also include dormitories. The Shift Commander/ Captains/ Lieutenants rooms should be located as near as possible to the Watch Room and apparatus bays.

If there is a need for an entry, lobby and reception area, these can be combined into one overall space keeping in mind that this space is for the public and, thus, should have a seating area as well as restrooms that are compliant with the Americans with Disabilities Act (ADA). If there is a secretary for the Chief and Deputy Chief, this person can "double" as a receptionist.

Consideration for a small conference room of 100 square feet (9.3 square meters) for use by officers' (other than the Chief) should be planned. If the ARFF department is for a large airport, office space is often needed for a Fire Inspector's room 160 square feet (14.9 square meters) complete with a plan review room 200 square feet (18.6 square meters), as well as space for a Fire Marshal if applicable.

If the ARFF department has a Training Officer separate from the other officers, an office and storage space for that position as well as for training equipment and supplies should be provided. The office space needs to be large enough for at least one visitor, as well as space for file cabinets, book shelves and computer desk. The size of the office should be 250 square feet (23.2 square meters). At some airports, one of the officers sometimes "doubles" as the Training Officer. In this case, space should be added to their office to accommodate training supplies, etc.

A conference room should be provided for meetings too large for individual offices to accommodate anywhere from 8 to 16 persons depending upon the department's needs. This room should be equipped with visual aids and be sized at 30 square feet (2.8 square meters) per person.

Insufficient space for ARFF department files could result in disruption to other spaces. Thus, depending upon the department's size, a separate room of 250 to 500 square feet (23.2 – 46.5 square meters) should be considered.

A separate janitor's closet of 60 square feet (5.6 square meters) is needed for the apparatus bays and one for the administrative/living quarters. See paragraph 3-36 as well.

Finally, a small kitchenette should be considered for the administrative offices to include cabinetry, sink, coffee maker, microwave and small refrigerator.

3-11. WORKSHOP. The workshop is an area for performing routine maintenance on the ARFF vehicles and other station equipment.

a. Location. The workshop may be located either in a separate room adjacent to the vehicle room or a space designated in the vehicle room for a workbench and tool storage. The storage area should be a minimum of 100 square feet (9.3 square meters), while the work area itself should be 300 square feet (27.9 square meters) for larger airports.

b. Features. The workshop should have:

(1) An intercom and alarm speaker which are easily accessible.

(2) Electrical outlets, one of which is at least 30 amps.

(3) Hot and cold water sources nearby for cleanup.

(4) A source of compressed air.

(5) An approved receptacle for disposal of greasy rags.

(6) A cabinet, designed in accordance with the National Board of Fire Underwriters Code 30 and in compliance with OSHA regulation 1910.106, for storing paints, greases, oils, and solvents.

(7) An adequate complement of mechanics tools (e.g., wrenches, socket sets, screwdrivers, pliers, hammers, chisels, rulers, and reamer).

(8) A first aid kit and any necessary protective gear, such as goggles, earplugs, etc.

3-12. HOSE-DRYING FACILITIES. If hose-drying facilities are needed to support in service ARFF vehicles, they should be constructed near the rear of the hose carrying vehicle to facilitate removal and replacement. Mechanical hose-drying machines are frequently the most efficient means of drying hoses. A hose table and a rack near the dryer should be included to load, unload and store hoses. A room that is 150 square feet (14.0 square meters) should be sufficient for this function. For those facilities desiring a hose tower to suspend hose for drying purposes, it will be provided with open grating, railings, hose pulleys, and adequate safe guards to prevent personnel injuries from falls. The tower must be of sufficient height to accommodate hose of 50 feet in vertical length.

3-13. VEHICLE FUELING AREA. Unless vehicle fuel service is provided elsewhere on the airport, an area adjacent to the apron where vehicles can be easily positioned next to a fuel pump should be provided. The vehicle fueling area should be located to one side of the apron. Fueling hoses should be long enough to reach a vehicle's fueling connection. The dispensing pump(s) should be adequately protected against physical damage. One means of protecting fueling pumps is by placing them on a raised platform and protecting them with bollards. For operational safety, the pumps should be fitted with remote shut-offs and be color coded to distinguish different types and grades of fuel. Fuel storage tanks must meet specific OSHA and Environmental Protection Agency (EPA) requirements. Installation of both underground and above-ground storage tanks should observe approved design, fabrication, and installation practices; for example, API Publication 1615-79, *Installation of Underground Petroleum Storage Systems*; API Standard 2000-82, Venting Atmospheric and Low Pressure Storage Tanks; API Specification 12B, *Specification for Bolted Tanks for Storage of Petroleum Liquids*; ASME, *Boiler and*

Pressure Vessel Code, 1983 edition; Underwriters Laboratories Incorporated (UL) 58-76, *Standards for Steel Underground Tanks for Flammable and Combustible Liquids*; UL 142-81, *Standards for Steel Aboveground Tanks for Flammable and Combustible Liquids*; UL 1316-83, *Standards for Glass-Fiber Reinforced Plastic Underground Storage Tanks for Petroleum Products*, etc.

3-14. DAY ROOM. This is a multi-purpose room used by the firefighters for socializing, casual meetings and, possibly watching television although newer stations have a separate TV room so as not to bother other activities. The size of the Day Room is directly related to the number of firefighters on during a shift. In addition, allowance should be made for ARFF personnel held over from the previous shift, as well as for visitors. Thus, a unit of 20 square feet (1.9 square meters) per occupant should be used, which includes space for circulation, a table, chairs and sofa.

3-15. TV ROOM. Due to changes in providing more home-like surroundings, a separate TV room can be considered so as not to disturb others, although the Day Room could be used as an alternative. The space for this activity should include space for a large screen TV and lounge chairs and be based upon 20 square feet (1.9 square meters) per occupant.

3-16. TELEPHONE ROOM. For private conversations, there should be at least two telephone rooms, despite the predominance of cell phones as some firefighters might prefer at times a land line phone. The design team should determine if this room is in fact needed.

3-17. DORMITORIES. At airport ARFF stations that operate "overnight" shifts, dormitory accommodations should be provided for firefighters to sleep. Sleeping quarter configurations for firefighters vary greatly; however, many now provide individual rooms which should be large enough for a 6’ 6” (2 M) bed, nightstand, small study desk with chair and three lockable storage units for personal belongings for each shift. As a space saver, pillow cases and linens can be stored in a drawer beneath the bed. The number of rooms is directly related to the number of firefighters per shift, but allowing for future increases to minimize disruption to the building during construction. Furthermore, approximately 20% of the total should be set aside for female firefighters. If individual rooms are used, 140 square feet (13.0 square meters) should be used.

a. Location and Capacity. Whatever their configuration, dormitories should be located on the ground floor, adjacent to the locker and lavatory area, and have direct access to the vehicle room.

b. Features:

(1) The dormitory should be designed to minimize the stress personnel experience upon waking up from a sound sleep when responding to an emergency. For example, station and dormitory lights are often designed to turn on instantly to full intensity when an alarm goes off. Instant activation of such dormitory lights creates unnecessary stress. A better alternative is to use night lights placed approximately 12-18 inches (30-46 cm) above the floor. They may be controlled by a dimmer connected to the alarm circuit which gradually increases intensity during an alarm. Another alternative for dormitories and other areas normally occupied at night, or areas used to travel to the apparatus bays are red night lights. These lights should be on a separate circuit controlled by a timer. Red night lights provide enough illumination for firefighters to respond to their apparatus, yet not so bright to fully constrict pupils, which leaves the eyes in a better adjustment to operate on the dark airfield.

(2) Wall, floor, and locker materials should be chosen for noise attenuation.

(3) There should be a dormitory clock and at least one extension of the intercom installed in each dormitory. Speakers which provide emergency announcements (either public address (PA) or radio) should be in every space including dormitories. If a crash phone method is employed, an extension of a highly visible and easily accessible crash phone should be available in both the crew's and officer's quarters.

(4) Bunk placement should be away from heating and cooling drafts.

(5) Each dormitory area should have fire exit(s) as specified by the appropriate building code. If acceptable, fire escape windows that can be opened only from the inside may serve as exits for individual dorm rooms at the ground level.

(6) Another dormitory arrangement that offers privacy and bed ownership is 2-bed private sleeping areas where beds are assigned to different shifts. If this approach is used, the size of the room should be increased accordingly from that shown in Paragraph 3-17.

3-18. MALE'S LOCKER ROOM. Lockers should be part of the shower room and lavatories and be located near the dormitories. The locker room should provide easy access to the lockers with at least 9 square feet (1 square meter) of clear area centered in front of the locker for each firefighter. Since clearance is a function of the total number of firefighters, it is recommended that the locker be equipped with a half-shelf and hooks or a coat hanger rod and have dimensions of at least 18 inches (46 cm) wide, 24 inches (0.6 M) deep, and 78 inches (198 cm) high. The total space for each locker and space in front is 15 square feet (1.4 square meters) and each firefighter would be assigned their own locker. Additional lockers should be planned for at the outset so as to avoid any unnecessary construction as personnel are added.

3-19. FEMALE'S LOCKER ROOM. Similar to the functions in the men's locker room, as well as the area per locker.

3-20. LAVATORIES.

a. Accommodations. Separate, well-heated and ventilated facilities for male and female service personnel should be provided. At least one lavatory facility should accommodate handicapped individuals.

b. Features:

(1) The number of toilets, urinals, sinks, and showers for each lavatory is based on applicable building codes and the total number of facility occupants. Partitions should be placed between urinals and toilets for privacy. Any lavatory intended for use by women should have a dispenser and a receptacle for sanitary napkins. Ensure lavatories meet ADA requirements addressed in Chapter 5.

(2) Individual shower stall dimensions should be at least 3.5 feet by 3.5 feet (107 cm by 107 cm).

(3) Hooks for articles of clothing and towels should be located near showers and sinks, but far enough away so articles remain dry.

(4) Each sink should have an electrical outlet that is protected by a ground fault interrupter circuit device.

(5) Ceilings should be of water-resistant materials, such as gypsum board or plaster, walls of ceramic tile, and floors of non-slip surfaces.

(6) Extra items should include a wall clock and an installed mirror on the wall that is large enough to be used simultaneously by two or three individuals.

(7) Lockers/Lavatories/Showers should have speakers for the station's alarm system. Speakers which provide emergency announcements (either PA or radio) should be in every space including dormitories. If a crash phone is employed it should be installed in each space.

3-21. LAUNDRY ROOM. A laundry room needs to be 100 square feet (9.3 square meters) for a washer and dryer, ironing board, a counter for folding and shelves for storage.

3-22. KITCHEN/DINING ROOM.

a. Design:

(1) The kitchen needs to be large enough to accommodate a commercially sized stove with 4-6 tops, 2 ovens and a griddle, a commercial refrigerator/freezer for each shift, a microwave unit, food preparation area, pots/pans storage and shelving. In addition, there must be space for a double sink and a commercial dishwasher. For a large ARFF department the total space for this function should be a minimum of 400 square feet (37.1 square meters).

NOTE: *It is very important that a shut off button (mushroom type) be located conspicuously so that when the alarm is sounded during the use of the kitchen/dining areas the power, or gas source, to the stove(s) can be shut off as personnel are vacating the area responding to the alarm. See paragraph c (1) below.*

(2) Emergency Exit. THE KITCHEN MUST HAVE A DOORWAY LEADING OUT OF THE STATION.

(3) Modes of Use. The design should consider the different modes of use. For example, one shift may rotate kitchen duties among the firefighters, one or two individuals responsible for each meal; another shift may require each firefighter to prepare his/her own meal.

b. Size. THE STANDARD DINING AREA IS EQUAL TO THE NUMBER OF PLACE SETTINGS TO SEAT ONE FULL SHIFT OF FIREFIGHTING PERSONNEL, plus allowance for personnel held over from the previous shift and visitors. ALLOW AT LEAST 20 SQUARE FEET (1.9 SQUARE METERS) PER PERSON.

c. Facilities:

(1) Stove. As previously noted, all stoves should be provided with a manual or automatic energy shut-off device that is connected to the alarm or can be activated by a person assigned to that function. For gas stoves, a manual reset should be located near the stove; thus whoever restarts the stove will first have to check it. For conservation and safety, gas ovens, broilers, and burners should have pilotless electric ignitions with an automatic gas valve. Gas stoves should be placed far enough away from doors and windows or be shielded to reduce the likelihood of drafts blowing out a gas jet. The space between the heating elements or burners should accommodate a large 3-gallon (11.5-liter) pot on one burner without interfering with a pot on the adjacent one. Sufficient space is particularly important at stations using "community" cooking. The installation of a hood and duct fire suppression system will be determined by local fire codes.

(2) Sink. A stainless double bowl steel sink fitted with a heavy-duty garbage disposal is recommended, if appropriate for the locations sewage system.

(3) Cabinets. Built-in cabinets or a pantry for storing canned and dry goods and other normal kitchen staples should be part of the kitchen design.

(4) Pantries. A pantry or closet for each shift with shelves and locking doors will be provided for storage of goods purchased by the shift.

(5) Ice Makers. If the kitchen or station design includes a commercial ice maker, a water drain that is connected to the station wastewater system should be located underneath.

3-23. TRAINING ROOM. A specific area should serve for training purposes. The training area need not be a separate or enclosed room; it may be part of a conference room. Regardless of location, the training room should provide sufficient space to accommodate training capability and equipment where justified (such as, multimedia projection, wall and floor space/room for a smart board, chalkboard, airport maps, training aids, large screen projection surface, fixed and portable video projectors, internet access, and Interactive Computer teaching testing systems, and other necessary training devices, etc.). The room should also have adequate secured storage space for instructional materials, audio-visual training aids, equipment, and supplies. Electrical services to support such equipment should be identified during the planning phase. IF A SEPARATE TRAINING ROOM IS BUILT, THE STANDARD IS AT LEAST 48 SQUARE FEET (2.8 SQUARE METERS) PER FIREFIGHTER PER SHIFT WHICH INCLUDES SPACE FOR A DESK FOR EACH FIREFIGHTER OR TABLES (TWO FIREFIGHTERS PER TABLE).

3-24. COMPUTER TRAINING ROOM. More and more ARFF training curricula utilize computerized training programs. A study room should be quiet and have space for at least two stations (more in larger stations) as well as storage shelving for video programs. This room should be a minimum of 24 square feet (2.3 square meters) per station, which unit figure also allows for circulation.

3-25. MECHANICAL ROOM. The mechanical room usually houses the major components of the heating, ventilating, and air conditioning systems, including sprinkler control systems. The room itself should be heated and cooled. Sufficient space should be provided around each system for convenient, safe access for servicing. Floor finishes should be resistant to water, oil, and grease. Acoustic

attenuation measures should be incorporated in the room's structure (Paragraph 4-9, *Sound Control Solutions*). Doors leading into this room should be large enough to accommodate the removal of large equipment and for maneuverability. The mechanical room will have floor drains in the low points to accommodate the needs of servicing mechanical systems and sprinklers.

3-26. STORAGE ROOM. The storage room provides space for storing department supplies. Its preferred location is adjacent to the administrative area and should be equipped with shelves, cabinets, etc., and should be large enough to anticipate future needs.

3-27. ELECTRICAL ROOM. This room is for power distribution and panel boards and should be separate from the Emergency Generator Room. Panels in the electrical room should have sufficient space for future expansion and have space for the mounting of additional panels, controls, switches and timers.

3-28. EMERGENCY GENERATOR. This room should be large enough to accommodate an emergency generator of sufficient size to carry the entire ARFF station electrical load. Doors leading to the room need to be large enough to accommodate a new generator. The generator should be fed from an underground (preferably) fuel tank of sufficient capacity to run the generator at full load (100%), plus 20% for a reasonable minimum of time to be determined by the airport, but at an absolute minimum for 72 hours. The 20% factor is intended to allow for additional (new) electrical loads placed on the system in future years. The design of the generator system, including the fuel storage installation and its' monitoring system should be in compliance with all local and manufacturer's requirements. The size of the room will be dependent upon the size of the generator, amount of support equipment, as well as for ease of maintenance of equipment, etc. Should the emergency generator be located on the outside of the building and not in an enclosed room, it will be secured to a concrete pad of sufficient density to accommodate the weight of the generator and if appropriate – the fuel supply tank. It should be noted that an underground fuel tank for the generator is preferred for safety reasons and will require a monitoring system to detect underground leakage. The generator should be exercised on a weekly basis to ensure proper operation. A permanent load bank must be included for generator testing purposes.

3-29. TELECOMMUNICATIONS AND ELECTRONICS ROOM. This is a room for telecommunications and electronic equipment, including an Uninterruptible Power Supply (UPS), telephone racks, LAN or information technology (IT) requirements, PA system, security system racks, etc. Space should be allowed for working inside this room by technicians. Consideration should be given to specialized fire protection systems in this space as recommended or required by local code. The size of this room is dependent upon the number of racks and ease of access for maintenance, etc., however a minimum area of 80 square feet (7.4 square meters) should be planned for.

3-30. TRASH AND RECYCLING ROOM. A room of 150 square feet (7.4 square meters) for trash and recycled materials in receptacles. This room should be in close proximity to where a trash truck will be servicing the station. At some airports, a trash compactor or dumpster may be used based upon local choice.

3-31. PARKING (PUBLIC AND EMPLOYEE) AREAS. The recommended minimum employee parking area is one space per person per duty shift. Transportation Security Administration (TSA) security requirements will dictate that the employee parking area be access controlled. In addition, a parking area for visitors should be provided. The employee parking area should accommodate two duty shifts, thereby eliminating delays-when shifts change or when all firefighters are summoned during an airport emergency. The area should be located so not to obstruct firefighting operations; for instance, located away from the apron area, vehicle room doors, and any firefighting equipment stored outside the station. HANDICAPPED REQUIREMENTS SUCH AS CURB CUTS, SIDEWALK RAMPS, AND DESIGNATED PARKING SPACES MUST BE PROVIDED IN THE PUBLIC AREA. The public

parking area should include one or two spaces for school buses. Furthermore, the employee parking area should be secured and located to protect against vandalism after normal business hours.

3-32. DELIVERY TRUCK ACCESS. Space must be allowed for delivery truck access to the ARFF station, which could include the need for a truck dock. Thus, maneuvering space for a semi-trailer needs to be provided. This space could, also, include the area for trash pick-up.

3-33. EXERCISE FACILITIES. Proper exercise encourages physical fitness and mental alertness. Firefighter professional development standards and many employment criteria specify minimum physical fitness standards for emergency personnel. Thus, an exercise area may be included. Such an area should be large enough to accommodate 50% of a shift and equipment.

a. Interior Exercise Room. A typical exercise facility may include the following items: multi-station pin gym unit, ergometer bike(s), rowing machine(s), mats for sit-ups, aerobics, free weights, abdominal board, Roman chair for the abdominal board and lower back exercises, treadmill, and jump ropes.

3-34. PATIO. Some airport sponsors consider a patio a cost-effective station accessory that contributes significantly to employee morale. If provided, a patio should be protected from wind, excessive noise, aircraft backwash, airborne debris, and located to offer privacy. If enclosed, a brick or concrete wall of 7 to 8 feet (2.1 to 2.4 M) high surrounding the area will suffice. ALL ALARMS, PHONES, AND INTERCOM ARE REQUIRED TO BE AUDIBLE BY THE FIREFIGHTERS ON A PATIO. ALSO, A PATIO MUST HAVE EASY ACCESS TO THE VEHICLE ROOM.

3-35. STATION STORE. A station store is a convenience that personnel appreciate, a place where they can buy provisions like candy, soft drinks, coffee, and hot and cold snacks. The "store" can take several forms: a counter, a locker, or a small commercial freezer where provisions are stored, or vending machines. Some stations combine forms; for example, a station might have vending machines and a counter. Designers should consider setting aside space for the station store, either as an alcove or in a corner of a room. They should also provide storage containers with locks.

3-36. JANITOR CLOSET. For the living area and administrative offices, THE STANDARD JANITOR CLOSET AREA IS AT LEAST 30 SQUARE FEET (2.8 SQUARE METERS) WITH THE CEILING AT LEAST 8 FEET HIGH (2.4 M) HIGH. There should be space for storage racks, shelves, cabinets, mop rack, and a janitor’s sink. See section 3-10, paragraph 7 for apparatus bay closet.

3-37. CONSTRUCTION. Selected materials should be non-hazardous, durable and easy to clean. The ceiling finish may be exposed construction; walls may be gypsum board with ceramic tile, masonry, or concrete. Fabric-covered gypsum or other material can easily accommodate postings. Floors may be concrete or tile, but with carpeting in offices and dormitories.

CHAPTER 4. STATION SYSTEMS

4-1. ARFF STATION FACILITY SYSTEMS consists of several major components and areas of consideration. These include design safety; personnel circulation through corridors and doors and use of windows for lighting sources; electrical, acoustic, mechanical; sound transmission; heating, ventilation and air conditioning; heating plants; and energy conservation.

4-2. FACILITY FIRE SAFETY. Fire safety in building design can only be achievable when the proper selection and use of fire resistive materials, application of fire safety technology, and the adherence to NFPA 101, *Life Safety Code*, is strictly enforced. All construction materials should be as fire-protected and fire-resistant as possible, preferably noncombustible. Second floor dormitories, if designed and constructed, should receive special emphasis. Where ARFF stations are built of concrete masonry, designers should consult the following National Concrete Masonry Association (NCMA) practices.

a. NCMA-TEK 46, *Fire Safe Concrete Masonry Construction*

b. NCMA-TEK 80, *Fire Safe Apartment Construction with Concrete Masonry*

c. NCMA-TEK 35, *Fire Safety With Concrete Masonry*

d. NCMA-TEK 128, *Steel Column Fire Protection*.

All pipe passages through fire-resistant construction should not exceed ½-inch (1.25 cm) gaps between the pipe and sleeve. The remaining interior gap can be filled with an appropriate noncombustible filler and sealed on both sides of the wall by metal escutcheons. Materials enclosing the apparatus vehicle bays/room must have a minimum of a 2-hour fire resistance rating. Openings between the vehicle apparatus bays/vehicle room and dormitories should be provided with either a vestibule or double acting rated double fire doors. These doors should not be equipped with knobs as they may impede emergency personnel flow to vehicles. Stations located in isolated areas should have an accessible fire hydrant. Other fire safety requirements include: carbon monoxide/smoke/fire detectors; location and illumination of exit signs; fire doors; sprinkler system in accordance with NFPA 13, *Standards for the Installation of Sprinkler Systems*; fire escape stairs (where applicable); emergency exit windows; and a sufficient number of strategically located cabinet-mounted fire extinguishers that contain the appropriate extinguishing agent for the type of materials found in the area in accordance with NFPA 10, *Standards for Portable Fire Extinguishers*.

4-3. CIRCULATION, DOORS, AND WINDOWS.

a. Circulation. The circulation of service personnel and equipment should be safe, convenient, and rapid under both normal and emergency conditions. Careful consideration should be placed on vertical traffic circulation. THE STANDARD WIDTH OF ALL HALLS AND PATHWAYS LEADING TO AND FROM THE APPARATUS BAYS/VEHICLE ROOM MUST BE AT LEAST 4 FEET (1.2M). THE STANDARD WIDTH OF CORRIDORS THAT CONNECT AREAS SERVED BY LARGE NUMBERS OF OPERATIONS/PERSONNEL MUST BE AT LEAST 6 FEET (1.8 M). For personnel safety and quick emergency responses, avoid protruding obstructions such as water fountains and wall-mounted fire extinguishers. It is recommended that stairs leading to second floor areas be of straight-line design, without landings, of a minimum width of 6 feet (1.8 M) and provided with safety treads.

Circulation and more effective station operations are further increased by using the smallest permissible number of doors and corridors.

b. Doors. Entrances, exits, and interior doors should be selected for smooth traffic flows, safety, and for the expected traffic volumes (wear). Specific door design details are location, size, and direction of door swings. THE STANDARD FOR THE SWING OF DOORS OPENING INTO THE APPARATUS BAY/VEHICLE ROOM IS AT LEAST 175 DEGREES WITH VESTIBULE DOORS OPENING AS FAR AS POSSIBLE. All exterior doors should be low maintenance, weather-tight, and either solid-core or of a high noise reduction value.

(1) Effective doors are readily accessible, simple to locate and operate in the dark, quick opening (3 seconds or less), (44 to 133 newtons) of force, operable with 10 to 30 pounds, and are not of themselves or in operation a safety hazard.

(2) The minimum width of all doors in rooms that more than four firefighters may use at any one time, e.g., the lavatory, locker room, and kitchen, is 42 inches (107 cm) wide. All doors should accommodate wheelchairs. For wheelchair clearances see American National Standard Institute (ANSI) A117.1-1998, *Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.*

(3) All doors in rooms that more than one firefighter may occupy should open towards the apparatus bay/vehicle room.

(4) Sliding doors may only be used for storage and utility rooms.

(5) Exit doors and doors leading to exit passageways should be so designed and arranged to be clearly recognizable and readily accessible at all times. These doors must be equipped with panic hardware as prescribed by NFPA 101.

(6) Doors in all hallways will include a safety glass section (vision panel) as a safety consideration for people coming in the opposite direction.

(7) Doors to or from dining areas, locker and training rooms, lavatories, and dormitories should feature only door closers (if needed) and push-and-pull plates (no latching hardware).

c. Windows. The minimum insulated glass areas should be a minimum of 10% of the floor area of each room; 20% is recommended for energy conservation measures. Placement should be as high in the wall as possible to lengthen the depth of light penetration. Use of weather stripping and storm sash is one means of reducing heat 1oss, condensation, and particle infiltration and increasing noise attenuation.

4-4. ELECTRICAL SYSTEM. Design of the facility electrical system should be based on the current edition of the National Electrical Code (NFPA 70) or applicable local codes or ordinances. Ground fault circuit breakers must be installed where personnel use an electric outlet near a water source such as bathrooms, kitchens, or apparatus bays/vehicle rooms. AN AUXILIARY/EMERGENCY SOURCE OF STANDBY POWER MUST BE PROVIDED TO OPERATE THE ESSENTIAL AND CRITICAL COMPONENTS OF THE STATION. THESE SERVICES INCLUDE BUT ARE NOT LIMITED TO: INTERNAL FIRE ALARM CIRCUITS, WARNING BELLS, COMMUNICATION

AND DISPATCH EQUIPMENT, OVERHEAD LIGHTING, APPARATUS BAY DOORS, OVERHEAD ELECTRICAL DROP CORDS FOR VEHICLE BATTERY CHARGE MAINTENANCE, STATION SECURITY SYSTEM, AND SELECTED OUTLETS IN AT LEAST THE VEHICLE ROOM AND ALARM ROOM.

4-5. LIGHTING. Recommended levels of lighting that take into account energy conservation and functional tasks may be found in the latest edition of the Illuminating Engineering Society (IES), *IES Lighting Handbook*. This document provides recommendations for reducing existing and new lighting levels, improving the efficiency of lamps and fixtures, and avoiding energy waste in, lighting design and installation.

a. Alarm Lights. All lights that illuminate the pathways to the apparatus bays/vehicle room and the apron driveway should turn on automatically when an alarm rings. Alarm lights need not operate on a separate circuit or system; they may operate through 3-way switches. All alarm lights should be connected to a backup power source or be backed up by separate emergency lighting.

b. Parking Lot and Yard Lights. Exterior lights should:

(1) Be shielded to prevent glare in the ATCT line of sight and aircraft operation areas.

(2) Use high efficiency lamps.

(3) Use time clocks or photoelectric switches to reduce energy costs.

(4) Cover areas subject to possible vandalism (exterior open storage, fire vehicle exterior parking spaces).

(5) Comply with the latest IES recommended practices.

(6) If the station is in a remote location of the airport, exterior lighting may be utilized to facilitate site security.

4-6. ACOUSTICS. An acceptable acoustic environment is one which will not cause auditory injury, interfere with voice or any other communications, cause stress fatigue, or in any other way degrade the overall ARFF service. Designers should consult criteria developed by the International Standardization Organization (ISO) concerning indoor and outdoor acoustics. To be acceptable, workspace noise should be reduced to levels that permit necessary direct person-to-person and telephone communication. Criteria for workspaces are defined by the A-sound level decibel, dB(A). To achieve an acceptable noise level, designers should provide for the following:

a. Small Office Spaces/Special Areas. Areas requiring fast, accurate, and direct communication should not exceed 45 dB(A). Examples: watch/alarm room, offices, dormitories, conference/training room, and study rooms.

b. Large Workspaces. Areas requiring very clear and frequent telephone communications or requiring occasional direct voice communication at distances up to 15 feet (4.57 M) should not exceed 55 dB(A). Examples: kitchen, lavatories, dining rooms, personnel and equipment locker rooms.

c. Operational Areas. Areas requiring frequent telephone communications or frequent voice communication at distances up to 5 feet (1.5 M) should not exceed 65 dB(A). Examples: workshops, personal and industrial equipment laundry areas, SCBA and vehicle maintenance areas.

d. General Workspaces. Areas requiring occasional telephone communications or occasional person-to-person communication at a distances up to 5 feet (1.5 M) should not exceed 75 dB(A). Examples: apparatus bays/vehicle room, hose drying room, and mechanical rooms.

4-7. SOUND TRANSMISSIONS. The control of sound transmissions within and between rooms and workspaces needs to be analyzed for an acceptable acoustic room environment. Both areas of investigation have unique and interlinking acoustic factors that influence the sound level of a room. If the room environment is to be conducive to good hearing, the desired room sound should be uniformly distributed, sufficiently loud to be heard, and transmitted within, as much as possible, a quiet background.

4-8. SOUND TRANSMISSION WITHIN A ROOM. Several factors affect sound transmissions within a room. These factors include:

a. Reflection and Absorption. In general terms, sound reflection occurs at the boundaries of a room (e.g., ceiling, floors, walls). The amount of reflection is dependent on the amount of sound absorption by the materials and that which takes place at each boundary. As an example, a barren poured concrete and other hard surface has little absorption while fabric materials have the most absorption.

(1) Background Noise. Background noises are the combination of sound effects from many sources that either completely cover up or, at least to some extent, obscure the desired room sound (that of a lower dB(A)). Since background noise may be either above or below the desired transmitted sound's dB(A) level, room design should control the background noise level to the extent necessary through effective sound reduction or attenuation.

(2) Miscellaneous Factors. These include echoing and undesirable reflection sounds such as structure-borne, airborne, and fluttering sounds.

b. Sound Transmission Between Rooms. Several factors affect the transmission of sound between rooms. These factors include:

(1) Airborne Transmission. Airborne transmission results when impacting sound sources act directly on one side of a barrier wall, such as jet engine noise, to cause the reproduction of airborne sound transmission on the other side.

(2) Structure-Borne Transmission. Structural-borne transmission results when sound waves are transmitted within the station structure by either airborne or direct impacting sound sources. Common transmission paths are the structure itself or any continuous rigid element of the station, as piping networks, conduits, air handling systems, etc. Rigidly secured mechanical equipment can generate high level sound waves that reverberate in adjacent spaces.

(3) Background Noise. See paragraph a(2) above.

(4) Barrier Transmission Losses. Room-to-room noise reduction usually occurs between the "source" room and a "receiving" room. The existing sound intensity level difference or sound-pressure level (SPL) between rooms is dependent on the barrier's material transmission loss, common barrier surface area, receiving room absorption rate, and effects of background noise levels.

(5) Vibration Noises. These noises are often generated by mechanical equipment, air-handling systems, etc., that produce intrusive airborne and structure-borne sounds.

(6) Flanking Paths. Sound transmission will seek paths that bypass common room barriers via the connecting floor, wall, ceiling structures, or through openings around or in the barrier. These paths are termed flanking paths. Common flanking paths such as openings above walls, and poor acoustic design layouts as back-to-back light switches and electrical outlet boxes and rooms with adjacent doors separated by a common wall.

(7) Construction Leakage Paths. Closely associated to flanking paths are the unwanted sounds transmitted by common construction points of leakage, such as the crevices around doors, openings around the perimeter of piping networks, and air handling systems that penetrate wall barriers.

4-9. SOUND CONTROL SOLUTIONS. There are several acceptable solutions to sound control problems. These solutions are based on eliminating the source of the sound, protecting the receiver from the sound, and modifying or treating the transmission paths. The most effective approach is the elimination of a sound source. Other approaches include the installation of sound absorption or sound reflection materials and/or sound isolating materials, and proper station design and construction detailing.

a. Eliminating the Source of the Sound. Even though this is the most effective means of noise control, it may in some cases be unrealistic; for instance, eliminating aircraft engine noise.

b. Sound-Absorbing Materials. It is relatively easy in any room to obtain between 5 and 10 dB(A) of noise reduction by installing some type of sound-absorbing material around the sound source and receiver. Carpets, upholstered furniture, and other room furnishings assist in reducing the levels of undesirable noises. Where carpeting is not feasible, sound-absorbing materials, such as special ceiling assemblies and/or wall treatment, should be used. Acoustic materials with high sound coefficients should be provided as necessary in the construction of floors, walls, and ceiling to affect the desired sound control. Very thick layers of sound-absorbing materials are good for reducing low-frequency sounds, while thin layers are more effective at higher frequencies. The more appropriate the sound-absorbing barrier, the greater the sound transmission control. Control of reverberation, echoes, and other types of sound reflections can be achieved through the proper amount of sound-absorbing material and properly configured and proportioned rooms. It should be emphasized that the principal use of sound-absorbing materials is for the control of sounds within a room and not for the control of sound transmissions between rooms. Such material usually makes no significant differences in lowering outside sound transmissions. Precaution should be observed for interior applications of acoustic materials to assure that there are no reductions in the quality of its porous material by repeated paintings or abuse. Exterior

painting of station's concrete, block, brick surfaces, etc., is recommended as a means of noise attenuation.

c. Sound Isolating. When a greater order of magnitude of sound reduction is desired, isolating the source of the sound is a more effective approach than absorption techniques alone. Vibration and structure-borne noises are two such areas that may benefit by this noise control technique.

(1) Vibration Noises. Effective noise damping of rigidly secured mechanical equipment, supply and return ventilation ducts, etc., can be achieved by properly locating such items, using resilient materials or special damping systems. Recommended vibration noise control procedures are found in American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) *Handbook of Fundamentals*.

(2) Structure-Borne Noises. Careful structural design to isolate direct vibration-inducing noise sources and to avoid the bridging of resilient construction is extremely important in the prevention of such sound transmissions problems. Additionally, designs should consider the use of discontinuous sound transmission paths.

d. Proper Design and Construction Detailing.

(1) Flanking paths. Excessive noise can be attenuated by the physical design and layout of station rooms and workspaces. Special attention should be given to:

(a) Doors and Windows. Related doors and windows that are widely separated and properly sealed produce high-transmission losses. Separately, the sound insulation value of doors and windows can be increased as follows.

(i) Doors should be staggered in corridors or between rooms. Thick solid-core doors complete with soft, resilient, perimeter gaskets and reduction. The installation of all prefabricated door kits should be checked to ensure they are properly sealed.

(ii) Windows are the weakest acoustical barrier in the exterior wall of a station. Ordinary locked, double-hung windows generally provide an average noise reduction of about 18 dB(A). This value can be improved by installing storm windows. Triple-paned or double-paned windows of tested high acoustic attenuation value (sound transmission coefficients) (STC) range 35 - 55) can increase this value further. In all cases, proper window installation and window sealing is critical. Since the type of sealant is important, the specified sealing materials should not shrink or pull away.

(b) Ceilings. Suspended ceilings with partial partition arrangements (if used) are high transmitters of sound. Therefore, partition construction should be beyond the level of the suspended ceiling to the underside of the structure above. Another solution that retains the flexibility of this type of design is a horizontal barrier at the level of the suspended ceiling.

(c) Floors. Rooms that could be expected to have high levels of airborne and structure-borne sounds from adjacent rooms, such as those adjacent to a mechanical room or the vehicle room, should avoid lighter weight floor construction or use high-transmission loss barriers in such openings.

4-10. SELECTION OF ACOUSTICAL MATERIALS. There are several broad categories of acoustic materials available. Each acoustic material serves specific purposes. For whatever reason a particular acoustical material is selected, quality of workmanship is critical. Good materials installed with air gaps or air leaks greatly reduce acoustic attenuation values. Quality control of this type of construction and installation should be carefully observed.

4-11. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) SYSTEM. The focus of HVAC system design should be on the total system and its energy efficiency. The HVAC system design should accommodate the range of inside and outside design conditions.

a. Inside Design Conditions. The design conditions that should be determined are the dry bulb (DB) temperature, relative humidity (RH), and the rate of interior air movement. Calculations should be made for the occupied spaces under average conditions 3 to 5 feet (1 to 1.5 M) above the floor line. Refer to the latest edition of the ASHRAE *Handbook of Fundamentals* for DB values. Internal DB should be maintained at a temperature above 50°F (10°C). Sufficient capacity should be provided to maintain an effective indoor temperature not less than 65°F (18°C) unless otherwise dictated by unusual types of work. For a uniform room temperature, the air at floor level and at the head level should not differ by more than 10°F (5.5°C). Acceptable RH values should range from a minimum of 20% to a maximum of 60% where summer values are 45% to 55% and winter values (lessen the possibility of condensation) are 30% to 35%.

b. Improved HVAC Efficiency. Energy can be saved through improved HVAC operations, design of lower flow resistance duct and piping systems, and improved heating/air conditioning units.

c. Air Filters. Ventilation system air filters should be easily accessible for occupant change out. They should be of the washable and reusable type.

4-12. VENTILATION. Adequate ventilation in any personnel enclosure can be attained by the introduction of fresh air by either natural or mechanical means. Mechanical systems are preferred over natural processes because they are more reliable and permit the ability to maintain specific design air-changes per hour. Ventilation systems will include a manual system shutdown switch to turn off motors and fans to prevent the introduction of contaminated air into the facility.

a. Mechanical Ventilation. This can be achieved by a supply system, exhaust or a combination of both. The design of a mechanical ventilation system, as any vents, should consider techniques to achieve maximum noise attenuation. Both natural and mechanical methods should provide air from the outside to replace stale and vitiated air, smoke and odors, chemical and vehicle flumes, and to control humidity, temperatures, and condensation. Air intakes for ventilation systems should be located to minimize the introduction of contaminated air from sources such as exhaust pipes, exiting ventilated air, and aircraft exhaust fumes (aprons, terminal ramps).

b. Air-Changes per Hour. Numerous building codes and OSHA standards govern ventilation minimums (air-changes per hour). These values are based on the number of persons in a given space, type of activity, space volume, and generated heat and odors. If the enclosure volume is 150 ft^3 (4.25 M^3) or less per person, a recommended minimum value of 26.5 ft^3 (0.75 M^3) of ventilation air per minute per person should be introduced into the enclosure where approximately two-thirds, 17.5 ft^3 (0.50 M^3) is outside air. For larger enclosures consult the jurisdictional building code.

4-13. AIR CONDITIONING. Depending on local weather conditions, air conditioning of part or of the entire station may be necessary. Refer to the ASHRAE *Handbook of Fundamentals* for guidance on increasing the performance of an air conditioning system by changes to the mode of operation, operating conditions, and by observing routine maintenance and service procedures.

4-14. ROOM TEMPERATURES. Follow the recommended minimum temperatures for occupied and unoccupied spaces as prescribed by the ASHRAE *Handbook of Fundamentals*.

4-15. HEATING PLANTS. Properly designed heating systems provide: quick heat where needed; reduced temperature differentials between floor and ceiling; rapid circulation of air without objectionable draft; non-direct discharged air on personnel; and, uniform temperature distribution. The most common types of heating systems are:

a. Hot-Water or Steam Heating. If used, avoid air pockets within the piping system by pitching the system so air will collect at venting points.

b. Forced Warm-Air Heating. Insulated ducts should be used for cost effective heat distribution.

c. Space Radiant Heating.

d. Heat Pumps. Cost-effectiveness depends on geographic location.

e. Unit Heaters. These are best utilized for large areas such as the vehicle room or large storage areas. They should be placed at or near ceiling level.

f. Solar Heating. Solar heating systems provide both space heating and water heating. Limitations include availability of the sun's energy, its energy flux, hourly variations, and initial installation cost.

4-16. ENERGY CONSERVATION. The promotion of energy conservation while designing or remodeling a station is a primary means of "long term" energy cost savings. At some airports the central heating and cooling systems maybe able to handle the requirements of the station. The airport sponsor, to determine whether using the excess capacity of the costs of modifying the existing facilities is cost-effective, should determine the system, identify the energy source, evaluate the long-term availability of the source, and project the likely cost for several years. Normally, emergency standby equipment should be added to the station. The cost of standby equipment may offset the initial savings of using existing sources. For guidance and detailed information on promoting energy conservation in the design and operation of stations and for initiating energy conservation programs, refer to the ASHRAE Handbook, NCMA-TEK 58, *Energy Conservation with Concrete Masonry*, NCMA-TEK 82, *Energy-Conscious Design for Buildings*, and U.S. Green Building Council.

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CHAPTER 5. OTHER STATION CONSIDERATIONS

5-1. BARRIER-FREE ACCESSIBILITY.

a. Provisions for Physically Handicapped Service Personnel. An accessible ARFF station for physically handicapped or disabled service personnel should be designed by noting appropriate sections of 49 CFR Part 27, *Non-discrimination on the Basis of Disability in Programs or Activities Receiving or Benefiting from Federal Financial Assistance.* Other guidance can be found in ANSI A117.1-03, *Standard on Accessible and Useable Buildings and Facilities*. Such design allows unrestrictive performance by such employees. In addition it provides access to those areas within an ARFF Station that would be open to the general public.

b. Provisions for General Accessibility. Provide for the design, construction and alteration of buildings so that physically handicapped persons will have ready access to and use of them in accordance with the Architectural Barriers Act, 42 U.S.C. 4151-4157.

5-2. MAINTENANCE COST.

a. ARFF Station Construction and Finish Materials. The selection of quality building materials has a direct impact on the overall maintenance cost of a facility during its life cycle. Building material(s) should be selected for durability, ease of maintenance and cleaning qualities to decrease the "long-term" costs of ownership more than the purchase of less expensive materials. The front end expense outlay for quality materials will amortize during the life cycle.

b. Design. The interior design of rooms with specific functional use, work areas and spaces within an ARFF station can result in reduced annual maintenance costs. Rooms and workspaces that are designed to be easy to cleaned, such as kitchen areas with stainless steel kitchen backsplashes and plastic wall and cabinetry laminates will require less maintenance. Also, design features should exclude dust collection points (alcoves and corners), unless they have a specific functional purpose, and difficult to clean decorative objects with moldings or trims.

5-3. HAZARDS AND SAFETY. The workforce may be exposed to general safety hazards within the work place. These safety hazards should be eliminated wherever possible through the incorporation of accident prevention design. When this is not completely possible, personnel should be warned of a hazard by posted safety labels, signs, or audible devices. Safety features that meet established safety codes and regulations and applicable OSHA requirements should be included. Below are several considerations for designing safety features into facilities to minimize hazards and safety related issues:

a. General Hazard and Safety Preventative Design Measures:

(1) Facilities must be designed to comply with all legally applicable health, safety, building, and fire code requirements.

(2) Facilities must be provided space for disinfecting, cleaning, and storage in accordance with NFPA 1581, *Standard on Fire Department Infection Control Program.*

(3) Existing and new ARFF stations must be provided with smoke detectors in work, sleeping, and general storage areas and must sound an alarm throughout the ARFF station.

(4) Existing and new ARFF stations must have carbon monoxide detectors installed in locations in sleeping and living areas, such that any source of carbon monoxide would be detected before endangering the members.

(5) All ARFF stations must comply with NFPA 101.

(6) The fire department must prevent exposure to firefighters and contamination of living and sleeping areas to exhaust emissions.

(7) Stations utilizing poles to provide rapid access to lower floors must ensure that the area around the pole hole is secured by means of a cover, enclosure, or other means to prevent someone from accidentally falling through the pole hole.

b. Safety Labels and Signs.

(1) Labels or signs should be conspicuously placed adjacent to any equipment which presents a hazard to personnel, e.g., from high voltage, heat, toxic vapors, high pressure, or moving parts. For the type of hazard, design, color, lettering and placement of warning signs, see 29 CFR Section 1926.200, *Accident Prevention Signs and Tags,* and 29 CFR Section 1910.145, *General Environmental Controls* and ANSI Z35.1-1972, *Specifications for Accident Prevention Signs.*

(2) The safe working capacity on hoists, lifts, jacks, and similar weight-bearing equipment should be indicated.

(3) Areas of operation or maintenance where special protective clothing, tools, or equipment are necessary, e.g., insulated or safety shoes, gloves, hard hats, ear or eye protection devices, should be specifically identified.

c. General Workspace Hazards.

(1) Hazard alerting devices should be installed to provide warnings to personnel of impending or existing danger, e.g., toxic or asphyxiating gases, smoke, and fire.

(2) Stairs and treads should be provided with skid-resistant step treads.

(3) Workspaces should be designed free of obstructions which could cause injury to personnel, either through accidental contact with the obstruction or because the obstruction requires an awkward or dangerous body position. Avoid obstructions such as projecting drinking fountains, lighting fixtures, and heating devices in station corridors or other circulating areas.

(4) Warning placards, stairways, and all hazardous areas should be well Illuminated.

d. Electrical Hazards.

(1) Tools and other equipment should use plugs and receptacles designed so that a plug of one voltage rating cannot be accidentally inserted into a receptacle of a different voltage rating.

(2) The possibility of exposing personnel to dangerous voltages can be minimized by grounding, interlocks, guards, and warning placards.

e. Technical and Mechanical Hazards. Any equipment which, in normal operation, exposes personnel to potential contact with surface temperatures in excess of 140°F (60°C) or 120°F (49°C) during operations requiring handling should be appropriately guarded. Surface temperatures induced by climatic environment are exempt but should be considered in design layout.

(1) All moving parts of machinery and transmission equipment, including pulleys, belts, gears, blades, etc., on which personnel may become injured or entangled should have a guard installed.

(2) Switches or controls that initiate a hazardous operation, such as movement of a hoisting crane (which requires the prior operation of a related locking control), should be identifiable.

(3) Equipment controls should be located and mounted so that access to them can be achieved without danger from electrical charge, heat, moving parts, chemical contamination, or other hazards.

5-4. SECURITY. ARFF station facilities near industrial parks, accessible to the public or isolated from other occupied airport buildings, may require special security devices or features that increase security, particularly when firefighters are responding to a call. Security devices or features include automatic door closers, keypad entry control devices, mechanical locks for all exterior doors, exterior and interior video surveillance, and sonic or photoelectric sensors.

5-5. PROVISIONS FOR WATER RESCUE EQUIPMENT. Sponsors of airports that lie near waterway or runway approach/departure and bodies of water (lake, ocean, river, inlet, sea) may own or operate appropriate water rescue equipment. If such equipment is housed at the ARFF station, then the station design should accommodate its unique water operation and maintenance features. This may include an emergency boat ramp, space for storing spare parts and accessories, and a facility for out-of-water engine start-up. AC 150/5210-13, *Water Rescue Plans, Facilities, and Equipment*, provides additional information. Space allocated under Section 3.2 may be shared to store this requirement.

5-6. COMBINATION ARFF STATION AND MAINTENANCE BUILDING. Some airport sponsors find it cost-effective to house ARFF vehicles in a section of a building that otherwise houses maintenance equipment. This arrangement is satisfactory if the necessary personnel and facilities are available and if the choice of the site follows the conditions in this AC. The space for housing ARFF vehicles should be partitioned to safeguard against tampering with the vehicles and unauthorized use of rescue tools and equipment.

5-7. LANDSCAPING. Landscaping should be simple, easy and economical to maintain, and should enhance the exterior aesthetics of the facility, as well as conform to the general overall landscaping theme of the airport. Species indigenous to the local area are preferred. Care in the selection of

shrubbery should be exercised to avoid shrubs and trees that birds and animals find especially attractive and whose future root systems may damage the structure or underground utilities. Designers must consult AC 150/5200-33, *Hazardous Wildlife Attractants On or Near Airports* (Contact the FAA staff or an approved wildlife biologist for additional assistance.) Trees and shrubs should be planted so not to become obstacles to efficient grass-mowing and snow removal. The selected vegetation growth pattern should be considered so as avoid disruption of the line-of-sight requirements to flight line pavements or facilities. Landscapers may consider installing sprinkler systems and hose bibs to facilitate ground maintenance. An effective landscaping program is one that at least:

a. Enhances the natural beauty of the area, is hardy, and able to tolerate local conditions.

b. Provides scale and character to the station and its surroundings.

c. Provides shade and some protection against wind and snow.

d. Reduces noise, dust, and soil erosion and screens out views of undesirable sights.

e. Does not obstruct the watch/alarm room's airside view either initially or, due to growth, in the future.

f. Does not generate excessive foliage debris during annual molting periods that could result in blowing debris to the airfield or maintenance area.

APPENDIX A. SAMPLE AIRCRAFT RESCUE AND FIREFIGHTING VEHICLE DIMENSIONS AND THRESHOLDS

Vehicle Class	Vehicle Type	Length	Width	Height	GVWR Weight	Minimal Footprint of
		Feet* (Meters)	Feet* (Meters)	Feet* (Meters)	Pounds * (Kilograms)	Bay Size Feet** (Meters)
I	<120 Gallon (454 liter) ARFF	27.00 (8.1)	8.00 (2.4)	10.00 (3)	10 (4500)	12x40 (3.6X12)
II	<300 Gallon (1136 liter) ARFF	29.00 (8.7)	8.00 (2.4)	10.00 (3)	20 (9000)	12x40 (3.6X12)
III	<500 Gallon (1893 liter) ARFF	30.00 (9)	8.00 (2.4)	10.00 (3)	25 (11250)	12x40 (3.6X12)
IV	<1500 Gallon (5678 liter) ARFF	35.00 (10.5)	10.20 (3.06)	12.50 (3.75)	60 (27000)	12x50 (3.6X15)
V	>3000 Gallon (11356 liter) ARFF	40.00 (12)	10.20 (3.06)	12.50 (3.75)	90 (40500)	12x50 (3.6X15)
V	>4500 Gallon (17034 liter) ARFF	45.00 (13.5)	10.20 (3.06)	12.50 (3.75)	120 (54000)	12x50 (3.6X15)
Structural	Structural Pumper	35.00 (10.5)	10.00 (3)	12.00 (3.6)	44 (19800)	12x40 (3.6X12)
Structural	Aerial Platform >75 ft (22.9 M)	48.00 (14.4)	10.00 (3)	12.50 (3.75)	76 (34200)	12x50 (3.6X15)
Structural	Aerial Quint <75 ft (22.9 M)	40.00 (12)	10.00 (3)	12.50 (3.75)	47 (21150)	12x50 (3.6X15)
Support	Mobile Command Post	30.00 (9)	10.00 (3)	12.00 (3.6)	25 (11250)	12x40 (3.6X12)
Support	Mobile Water Tanker	37.00 (11.1)	10.00 (3)	12.00 (3.6)	64 (28800)	12x50 (3.6X15)
Support	Hazmat Vehicle	35.00 (10.5)	10.00 (3)	12.00 (3.6)	34 (15300)	12x50 (3.6X15)
Medical	Ambulance	30.00 (9)	10.00 (3)	10.00 (3)	25 (11250)	12x40 (3.6X12)

NOTE: This chart provides general information on the class, type, and minimal dimensions for various types of vehicles that may be located at an airport.
**** Design agents should use this table to assist in determining the number and size of apparatus bays required.***
***** Actual vehicle measurements and weights should be obtained by the design agent and does not include clearances between the vehicle, walls, doorways, or storage spaces.***

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APPENDIX B. TYPICAL STATION EQUIPMENT

B-1. TYPICAL STANDARD FURNISHINGS. The following list includes items typically purchased and installed as permanent fixtures or systems as part of initial construction and/or furnishings of an ARFF station. It excludes common fire fighting equipment carried on apparatus and items associated with aesthetics.

a. General Equipment (Mechanical).

(1) Facility air compressor

(2) Overhead rail mounted electric hoist

(3) Facility emergency back-up generator

(4) Vehicle washing system

(5) Vehicle exhaust system

(6) Overhead apparatus bay doors

(7) Central heat/air handling systems

(8) Hot water system

b. Electronic Equipment.

(1) Facility fire and smoke detection system

(2) Central fire alarm receiving equipment

(3) Alert dispatching system

(4) Entry doorbell

(5) Elapsed time indicator

(6) Integrated intercom system

(7) Radio monitor

(8) Recording systems

(9) Telephones

(10) Central computer terminal

c. Lights.

(1) Emergency lights

(2) General lights

(3) Night lights

(4) Exterior security lights

(5) Exit lights

d. Hardware.

(1) Doors and hardware equipment

(2) Keypad entry system

(3) Sliding partitions

e. Specialized Hardware.

(1) Doorway rollers (hose-drying room)

(2) Foam pump (permanent)

(3) Slide poles (as applicable for 2-story stations)

f. Lavatory Facilities.

(1) Drinking fountain

(2) Basin fixtures

(3) Handicapped hand and guard rails

(4) Janitor mop rack

(5) Mirrors/vanity

(6) Paper towel dispensers

(7) Sanitary napkin dispensers and disposals

(8) Sinks/wash basins

(9) Shower fixtures (doors/curtains/benches)

(10) Soap dispensers

(11) Toilets

(12) Urinals

(13) Toilet tissue dispensers

(14) Waste receptacles

g. Furnishings.

(1) Built-in cabinetry

(2) Modular office furnishings

h. Kitchen Equipment.

(1) Stove/oven

(2) Refrigerator/freezer

(3) Sink

(4) Disposal

(5) Microwave

(6) Range exhaust hood and duct

(7) Hood/duct installed dry chemical extinguishing system

i. Fire Protection.

(1) Entry control system

(2) Fire extinguishers mounted in recessed cabinets

(3) Smoke/carbon monoxide detectors

(4) Sprinkler systems

B-2. TYPICAL ARFF STATION STORAGE REQUIREMENTS. Space is warranted to store materials and equipment not carried on apparatus and is normally procured as part of day to day operating cost and is not associated with construction. Equipment carried on vehicles is addressed in AC 150/5220-10, *Guide Specification for Aircraft Rescue and Fire Fighting Vehicles.*

a. Specialized Hardware.

(1) Storage space for spare equipment (axes, ladders, nozzles, ropes, HAZMAT suits, vehicle spare tire(s))

(2) Self-contained breathing apparatus storage racks

(3) Hose storage racks

(4) Hose, washer, and dryer

(5) Portable transfer pump (foam)

(6) Vehicle refilling equipment

(7) Extinguisher refilling equipment

(8) Safety mirrors

(9) SCUBA equipment (water rescue equipment)

(10) Self-Contained Breathing Apparatus (SCBA) cylinders and maintenance equipment

(11) Spare SCBA/SCUBA cylinders

(12) Stretchers

(13) Trailer, Firefighting

(14) Trailer, hazardous materials response

(15) Hazardous material mitigation response kits

(16) Hazardous material response suits

b. Training.

(1) Mannequins, training

(2) Simulators, training

(3) Computer projection

(4) Video cassette recorder

(5) Touch screen – wall mounted

(6) Reference library

(7) Classroom furnishings (tables/chairs)

c. Other Related items.

(1) Tables/chairs/office desk/file cabinets

(2) Portable radios and charging systems

(3) Desk, sleeping quarters lamps, and wall clocks

(4) Chairs, recliner loungers

(5) Fitness/recreation equipment.

APPENDIX C. STATION DESIGN CHECKLIST

C-1. The purpose of the station design checklist is to assist end users in determining if all planning features are being and/or have been incorporated into the design and acceptance phases of ARFF station projects.

Chapter 1 Introduction (General)	**Reference***	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
1. Type of ARFF Station	AC 150/5210-15				
a. Headquarters					
b. Combination (ARFF, Structural, HAZMAT, Medical)					
c. Multiple Function/Dual Use (ARFF, Snow removal, deicing, maintenance)					
d. Single (satellite) (ARFF or structural only)					
2. Planning Phase	AC 150/5210-15				
a. Initial Planning Decisions					
(1) Type of ARFF Station Project					
(a) Expansion of Existing Station					
(b) New construction of					
(1) Headquarters					
(2) Combination (ARFF and Structural)					
(3) Multiple Function/Dual Use					
(4) Single (satellite)					
b. ARFF Fleet Requirements	Part 139 Subpart D				
(1) Part 139 – *Certification of Airports, Subpart D - Operation*s					
(a) What is the Airport Index: A/B/C/D/E					

* Web links available in Appendix D.

Chapter 1 Introduction (General)	**Reference***	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
(b) What is the quantity of firefighting agent required?					
(1) Total Water carried on vehicles					
(2) Total AFFF carried on vehicles					
(3) Total Dry Chemical carried on vehicles					
(4) Total Halogenated Agent carried on vehicles					
(c) How many vehicles are required?					
c. Selecting an Architect and Engineer (A/E)	AC 150/5210-15 AC 150/5100-14 AC 150/5300-9 AC 150/5370-2 29 CFR Part 1910				
(1) Has AC 150/5100-14, *Architectural, Engineering, and Planning Consultant Services for Airport Grant Projects* guidance been followed?					
(2) Has a project team been established?					
(3) Has AC 150/5300-9, *Pre-design, Pre-bid, and Preconstruction Conference for Airport Grant* Projects guidance been followed?					
(4) Has data relative to current and future airport operations/growth been collected?					

* Web links available in Appendix D.

Chapter 1 Introduction (General)	Reference[*]	YES	NO	NA	REMARKS/COMMENTS
(5) Have all proper authorities been notified for issues relating to operational safety and hazardous material handling.					
3. Design Phase	AC 150/5100-14 AC 150/5210-15 AC 150/5300-9				
a. Projected facility cost					
(1) Site development					
(2) Facility construction					
b. Time line schedule and constraints					
c. Specifications development and review					
d. Plans/Drawings Reviews					
e. Approvals					
4. Construction Phase	AC 150/5210-15 AC 150/5100-14 AC 150/5300-9				
a. Has a resident engineer or project inspector been assigned to the project?					
b. Does construction interfere with any airport operations?					
(1) Have notifications been made to appropriate airport authorities?					
5. Occupancy Phase	AC 150/5210-15 AC 150/5100-14 AC 150/5300-9				
a. Has a detailed acceptance inspection been scheduled and coordinated with multi-disciplined functional representatives or areas?					

[*] Web links available in Appendix D.

Chapter 1 Introduction (General)	Reference*	YES	NO	NA	REMARKS/COMMENTS
b. Have all facility installed systems and subsystems been operationally tested?					
c. Have all deficiencies been reported for correction to the project team leader for correction?					
d. Occupancy certificate					

Chapter 2 Site Selection	Reference*	YES	NO	NA	REMARKS/COMMENTS
1. Response Time					
a. Does the proposed site meet the response time requirement of FAR 139.319 for certification?	FAR 139.319				
2. Site Selection Parameters	AC 150/5300-13 AC 150/5210-15				
a. Operational Factors					
(1) Immediate and straight access					
(2) Unimpeded access routes with minimal turns					
(3) Direct access to aprons					
(4) Non-interference with ATC line of sight					
(5) Maximum surveillance of the airfield					
(6) Adherence to the BDL as prescribed by AC 150/5300-13					
(7) Future expansion without:					
(a) Limiting or reducing airfield surveillance					
(b) Blocking fire lanes					
(c) Impacting other structures					
(8) Planned airport improvements					

* Web links available in Appendix D.

Chapter 2 Site Selection	**Reference***	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
(9) Non-interference with ARFF vehicle or station communication equipment or navigational facilities.					
(10) Close proximity to boat launch facilities for airports maintaining a water rescue capability.					
(11) Adherence to FAR Part 77 Imaginary Surfaces	FAR Part 77				
(12) Minimum obstructions or interference from buildings or uses (access roads, fuel storage, taxing operations or parking areas)					
(13) Ease of integration/connection to the airports security system					
b. Site Size					
(1) Does the site allow for:					
(a) Accommodation of the station					
(b) Future expansion					
(c) Exterior features (parking, patio, storage, agent re-supply, re-servicing area)					
(d) Apparatus apron to accommodate the largest current or future ARFF vehicle					
(e) Removal of trash					
(2) Is the site accessible to:					
(a) Electrical or alternative energy sources					

* Web links available in Appendix D.

Chapter 2 Site Selection	Reference*	YES	NO	NA	REMARKS/COMMENTS
(b) Essential communication and telecommunication networks (fiber optics/copper backbones)					
(c) Existing or future airport access and airfield service roads					
(d) Existing or future water supply systems and sanitary sewer connections					
(3) Topography and Station Orientation					
(a) Is the site level					
(b) Does orientation reduce yearly energy operating cost					
(c) Does orientation mitigate exterior noise and costs of acoustical treatments					
(4) Planning Tools	AC 150/5210-15				
(5) Was historical data involving aircraft accidents/incidents considered in facility site selection	FAA Document: Location of Commercial Aircraft Accidents and Incidents Relative to Runways (Jul 1990)				

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
1. Introduction					
a. Does the proposed ARFF station provide adequate space for ARFF personnel, vehicle, equipment, and their related functions as prescribed by FAR 139.317 for certification?	FAR 139.317				
2. ARFF Apparatus Bays	AC 150/5210-15				
a. Operational Considerations to determine the number of bays					
(1) What is the Airport Index?					
(2) Does the department provide EMS?					
(3) Is a bay needed for overhead vehicle servicing?					
(4) Does the department provide a Hazardous Materials Response capability or Chemical, Biological, Radiological, and Nuclear (CBRN) threat response capability?					
b. Operational Considerations to determine the size of bays					
(1) Parking and vehicle characteristics					
(2) Vehicle Configuration (L/W/H)	AC 150/5210-15, Appendix A				
(a) Free personnel access from all interior/exterior access points					
(b) Side by side versus tandem parking					
(c) Drive through bays					
(d) Standard Clearances					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference[*]	YES	NO	NA	REMARKS/COMMENTS
(1) 6 ft btw vehicle walls and storage areas.					
(2) 8 ft between vehicles parked side by side					
(3) 5 ft between vehicles parked end to end					
(4) 5 ft between the vehicle and apparatus bay doors					
(5) 7 ft between the top of vehicle platform and ceiling					
(6) 10 sq ft of Personal Protective Equipment storage					
(7) Is 10% of space allocated for additional apparatus bay storage?					
c. Electrical Details					
(1) Are lighting levels provided per Chapter 3 of this AC?					
(2) Are electrical outlets provided 18-24” above the floor and spaced at 8 ft intervals?					
(3) Are retractable electrical reels provided that service vehicle electrical systems?					
(4) Conduit should be provided to allow for future expansion.					
d. Interior Environment					
(1) Is a vehicle exhaust extraction system provided and vented to the outside?					
(2) Is a separate apparatus bay heating system provided?					

[*] Web links available in Appendix D.

Chapter 3 Station Elements	Reference[*]	YES	NO	NA	REMARKS/COMMENTS
(3) Are carbon monoxide detectors installed to sense CO in living quarters?					
(4) Are walls designed for easy cleaning and low-maintenance?					
e. Vehicle Support Equipment					
(1) Is an overhead hoist provided? Is the hoist a minimum 1 ton rated device?					
(2) Has a vehicle water re-supply connection been provided?	AC 150/5220-4				
(3) Is a utility room provided with a deep slop sink, hot/cold water outlets, and mop wringer? Is the room 64-100 sq ft in size?					
(4) Is a compressed air supply capable of supplying a minimum of 120 psi available to maintain vehicle air supply systems? Is a supply line provided for each stall and equipped with a drop cord on a retractable reel?					
(5) Is a foam agent recharging capability provided? Is it an overhead system or a transfer pumping system?					
f. Vehicle/Apparatus Bay Doors	AC 150/5210-15				
(1) Are apparatus bay doors a minimum 16x16 ft? **NOTE:** *Due to vehicle size, larger doors may be required based on vehicles in use or planned for procurement.*					

[*] Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
(2) Is the maximum time to raise apparatus bay doors 16 seconds?					
(3) Are does remotely operated from the alarm/watch room?					
(4) Is each door provided with a separate electrical operating control switch located adjacent to the door?					
(5) Are doors provided with a manual pull chain in the event of electrical system or switch failure?					
(6) Is each apparatus/bay door provided with a manual over-ride?					
(7) Are doors equipped with adjustable timers designed to close to prevent energy loss?					
(8) Are automatic door retractors provided on each door?					
(9) Are electric "eye beams" installed to reverse door closing? Are they correctly mounted and do they function properly to preclude equipment or personnel injury?					
(10) Are doors equipped with windows? If windows are installed, are they tempered, safety glass, and shatter proof?					
(11) Are apparatus bay doors insulated and provided with weather stripping?					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
g. Vehicle Room Floor					
(1) Are floors designed to support current and future vehicle weights and footprints?					
(2) To prevent injury are adjacent room floors on the same level plane as the apparatus floor?					
(3) In cold climates – are floors heated – if appropriate?					
(4) Are floor surfaces resilient to various liquids? Are they smooth surfaced and easy to clean?	AC 150/5210-15				
(5) Do floors have a minimum 1 inch (2.5 cm) to 10 ft (3 M) slope to a center line traverse drain collection point?					
(6) Is the apparatus floor provided with a traverse drain heavy gauge cover, a sediment/grease trap?					
h. Sliding Poles					
(1) If provided - meet safety requirements identified in NFPA 1500.	NFPA 1500				
(2) Are poles located near walls and positioned away from obstructions?					
3. Station Apron	AC 150/5210-15				
a. General Design					
(1) Does the apron/driveway have direct access to the aircraft movement area?					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference[*]	YES	NO	NA	REMARKS/COMMENTS
(2) Does the apron area have exterior hose bibs with garden hose connections?					
(3) Are fire hydrants adjacent to the ARFF station?					
(4) If wall hydrants are provided, are they correctly labeled?					
(5) Are pedestrian/vehicle traffic warning lights installed for locations where traffic crosses the apron?					
b. Apron Standards					
(1) Is the apron operating surface large enough to allow the longest vehicle access to any apparatus bay?					
(2) Apron Width					
(a) Is the apron at least 28 ft wide?					
(3) Apron Length					
(a) Is the apron length at least 1.5 times the longest vehicles length?					
(b) Are they tapered to not less that 28 ft for multi-vehicle stations?					
(c) Are they tapered to not less that 12 ft for single vehicle stations?					
(4) Apron Strength					
(a) Is the apron strength that same as the apparatus bay?					

[*] Web links available in Appendix D.

Chapter 3 Station Elements	**Reference**[*]	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
(5) Gradient – Is the apron slope a minimum of 2-4 degrees and is it directed away from the apparatus bays?					
(6) Markings – Is floor and apron striping provided? Is it at least 1.5 times the vehicle length for the apron?					
(7) Lighting – Is exterior lighting provided? Is it mounted to prevent view obstruction?					
(8) Apron Canopy – Is an apron canopy provided?					
(9) Are concrete bollards provided on each side of bay doors to prevent structural damage from backing vehicles?					
(10) Apron Heating – Has consideration been given to apron heating in locations that experience extremely low temperatures?					
4. Watch/Alarm Room	AC 150/5210-15				
a. Is a watch/alarm provided for the receipt and dissemination of alarms, dispatch of equipment, and directing support resources?					
b. General Design – Is the watch/alarm room provide for maximum surveillance of the airfield and apparatus bays? If deemed necessary, is the room elevated?					

[*] Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
(1) Is the room a minimum of 130 sq ft? Does it have sufficient storage space and wall space for maps, reference materials, and dispatch equipment?					
(2) Is the room equipped with a CCTV for security purposes?					
(3) Minimum Equipment					
(a) Alternate emergency back up power					
(b) Accessibility to controls for electronic or electrical servicing/maintenance personnel					
(c) Computer systems with LAN access					
(d) Radio equipment – ARFF and tunable radio capability					
(e) Room dimmer switches and non-glare lighting					
(f) Tinted glass, frost free windows (if warranted due to climatic conditions – windows may be heated), shades, retractable sun screens					
(g) A lavatory (Note: If watch/alarm employees are disabled – meet requirements of ADA)					
(h) Backlit clock with 12 and 24 hour display					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
(i) Sound suppression to offset ARFF and aircraft sound levels					
b. Alarms	AC 150/5210-7 AC 150/5210-15				
(1) Are chimes/alert tones provided throughout the station and satellite stations?					
(2) Is an audible alarm provided when auxiliary firefighters supplement emergency response personnel?					
(3) Are all watch/alarm room controls easily accessible and with in reach of operators?					
c. Communications	AC 150/5210-7 AC 150/5210-15				
(1) Has AC 150/5210-7 been reviewed for communications requirements?					
(2) If multiple stations are at the airport – has a central dispatch center been established?					
5. Medical Decon Room	AC 150/5210-15				
a. Is a room dedicated for medical cleanup and decontamination of ARFF personnel?					
b. Is the room equipped with double sinks, a shower, and drying area?					
c. Is the space a minimum of 150 sq ft?					

* Web links available in Appendix D.

Chapter 3 Station Elements	**Reference***	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
6. Gear Washing/Drying Room	AC 150/5210-15				
a. Is the room equipped with a commercial extractor washer and a heated drying rack?					
b. Is the space a minimum of 200 sq ft?					
7. First Aid and Medical Storage	AC 150/5210-15				
a. Is a room dedicated for medical treatment of personnel seeking medical treatment?					
b. Is the room lockable and equipped with a sink and cabinets for medical storage?					
c. Is the space a minimum of 120 sq ft?					
8. Complimentary Agent Storage	AC 150/5210-15				
a. Is a storage room dedicated for the storage of dry chemical, halogenated, powder fire fighting agents, and nitrogen cylinders?					
b. Are doors of sufficient width to accommodate a fork lift for the delivery of 4x4 pallets?					
c. Is the space a minimum of 225-350 sq ft?					
9. SCBA and Fire Extinguishers	AC 150/5210-15				
a. Is a room dedicated for the servicing and repair of SCBA and fire extinguishers?					
b. Is the room provided with storage cabinets and a workbench to perform tasks and store materials and parts?					

* Web links available in Appendix D.

Chapter 3 Station Elements	**Reference***	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
c. Is the space a minimum of 200 sq ft?					
d. Is an air filtration system available for re-servicing of SCBA	Compressed Gas Association Specification G-7.1				
e. Is an air compressor provided?					
f. Is the power supply for the compressor – 230 VAC 1-phase or 230 VAC/460 VAC 3-phase?					
g. Is a cascade system used?	ASME Code for Unfired Pressure Vessels				
h. Are all components properly marked with labels/placards or signs that identify nomenclatures?	AC 150/5210-15				
i. Are tags and warning labels affixed to equipment for safety and operation?					
10. ARFF Administrative Offices	AC 150/5210-15				
a. Is office space of sufficient size and features provided for the following:					
(1) Fire Chief – 200 sq ft					
(a) Conference table					
(b) Cabinetry and shelving					
(2) Deputy Fire Chief - 160 sq ft					
(a) Desk/Filing spaces					
(b) Cabinetry and shelving					
(3) Lieutenant/Captain – 200 sq ft					
(a) Desk/Filing spaces					
(b) Cabinetry and shelving					
(c) Sleeping space					
(4) Conference Room – 100 sq ft					
(5) Inspector Office – 160-200 sq ft					
(a) Desk/Filing spaces					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
(b) Cabinetry and shelving					
(c) Plans Review Table					
(6) Entry/Lobby/Reception Area	ADA Compliant				
(a) Administrative Assistant Space					
(1) Desk/Filing spaces					
(2) Cabinetry and shelving					
(3) Visitor Seating					
(7) Training Officer – 250 sq ft					
(a) Desk/Filing spaces					
(b) Cabinetry and shelving					
(c) Classroom Training Layout					
(d) Validate number of staff members to determine seating capacity for conducting internal training					
(e) Training aid storage space					
(8) Filing System storage space – 250-500 sq ft					
(9) Janitorial Closet					
(10) Small kitchenette to support the administrative space (microwave, coffee maker, small refrigerator, cabinetry, small sink, etc)					
11. Workshop	AC 150/5210-15				
a. Location to support maintenance 100-300 sq ft depending upon Index					
(1) Separate room adjacent to vehicle room					
(2) Space within the vehicle room					
b. Space for storage of tools and equipment					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
c. Workshop features					
(1) Intercom and alarm speaker					
(2) Electrical outlets (at least 1-30 AMP)					
(3) Hot/Cold water outlet for cleanup					
(4) Source of Compressed Air					
(5) Receptacles for disposal of soiled rags					
(6) Solvent/Waste fluid recovery					
(7) Storage cabinets for hazardous fluids	National Board of Fire Underwriters Code 30, and OSHA 1910.106				
(8) Appropriate tools for maintenance work					
(9) First Aid Kit					
(10) Personal Protective Equipment (Goggles, aprons, gloves, aural protectors/ear plugs)					
(11) Appropriate warning signs					
12. Hose Drying Facilities – 150 sq ft (7.4 M^2)	AC 150/5210-15				
a. Is a drying rack required?					
b. Is a mechanical drying machine required?					
c. Are hose storage racks provided?					
13. Vehicle Fueling Area (If required)					
a. Is an area adjacent to the apron provided for refueling?					
b. Are fuel pumps adequately protected from physical damage?					
(1) Raised platform.					
(2) Bollards.					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
c. Are automatic/remote shut offs provided? Are distinct signs provided?					
d. Do fuel storage tanks meet referenced requirements?	API Pub 161s-79 API Std 2000-82 API Spec 12B ASME Code UL 58-76 UL 142-81 UL 1316-83				
14. Day Room					
a. Is a minimum of 20 sq ft per person provided?					
b. Is it furnished to provide a relaxing atmosphere?					
c. Does it include furnishings, television, radio, tables, and other amenities for relaxation?					
15. Television Room					
a. If required, are the same amenities as for the day room provided?					
16. Telephone Room					
a. If required, is a room affixed with a minimum of 2 telephone devices for on/off airport calls provided?					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
17. Dormitories/Sleeping Rooms – 140 sq ft (13.0 M^2) per firefighter					
a. At locations where overnight crews must remain on duty – ARFF station are provided with dormitories/sleeping rooms. If required – obtain the number of rooms based on vehicle staffing requirements. **NOTE:** *A minimum of 20% additional capacity should be considered for future growth.* Once obtained – do rooms provide the following minimum features:					
(1) Bedding/Mattress/box spring/framing/headboard/ footboard					
(2) Nightstand and lamp					
(3) Small desk and chair					
(4) Lockable storage units					
b. Features					
(1) Night lights in corridors					
(2) Wall, floor, storage cabinet materials selected for noise attenuation					
(3) Clock and intercom per room					
(4) Alarm speaker per room					
(5) Crash alarm phone per room if required					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference[*]	YES	NO	NA	REMARKS/COMMENTS
(6) Fire exit for each dormitory that leads directly to the outside (windows at ground level may be considered)					
18. Male Locker Room					
a. Has the location for the male locker room been determined? Is it part of the shower room, lavatory, or dormitory space?					
b. Does the location provide for 15 sq ft (1.4 M^2) of space per firefighter to include the space used by the locker itself?					
c. Is locker space a minimum of 18 by 24 by 78 inches (0.6 – 1.9M)?					
d. Is a locker provided for each individual firefighter?					
19. Female Locker Room	Same requirements as the Male Locker Room				
a. Is a separate female locker room with the same features in 18 above provided?					
20. Lavatories					
NOTE: *Separate lavatory facilities will be provided for male and female employees.*					
a. Do separate lavatories include the following features as appropriate?					
(1) Toilets, urinals, sinks, showers as appropriate based on local building codes.					
(2) Sanitary napkin dispensers and receptacles.					

[*] Web links available in Appendix D.

Chapter 3 Station Elements	**Reference***	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
(3) Individual shower stalls – minimum of 9 sq ft					
(4) Clothing hooks, towel bars, soap dishes					
(5) Ground Fault Interrupter (GFI) outlets					
(6) Ceilings and walls of water resistant material					
(7) Flooring that is slip resistant					
(8) Vanity mirrors of sufficient size for 3 personnel to use simultaneously					
(9) Speakers for alarm notification announcements					
(10) ADA Compliance as appropriate	ADA				
21. Laundry Room – 100 sq ft (9.3 M^2)					
a. Is a personal laundry room available for the cleaning of personal garments (not to be confused with PPE)					
b. Does the room feature a washer, dryer, ironing board, table for folding of items?					
22. Kitchen/Dining Room					
a. Design – 400 sq ft (37.2 M^2) minimum					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
(1) Is the kitchen area of sufficient size to accommodate a commercial range, griddle, refrigerator/freezer (for each shift), microwave, food preparation area, storage and shelving for cooking utensils, a double sink with garbage disposal, commercial icemaker, and a commercial dishwasher?					
(2) Is an exit available that leads directly to the outside?					
(3) Do cooking appliances have a "manual shut off" button to kill power or gas supply to the cooking devices when firefighters are dispatched?					
(4) Has the mode of use been determined? Individual cooking, group cooking, assigned cooking?	Chapter 3 of this AC				
b. Facilities					
(1) Stove					
(2) Cabinetry					
(3) Icemaker					
(4) Trash compactor/disposal					
(5) Space for trash collection					
23. Training Room – 48 sq ft (4.5 M^2) per firefighter					
a. Has space been provided for the training of firefighters and, if required airport employees?					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference[*]	YES	NO	NA	REMARKS/COMMENTS
b. Does the training room provide space for a mass-media board for writing, screen projection board, projection system or computer aided display, bulletin board, charts, maps, or other training devices?					
c. Is secured storage space provided?					
d. Are desks provided/or classroom seating provided?					
24. Computer Training Room – 24 sq ft (2.2 M^2) minimum					
a. Is a computer learning center provided?					
b. Does it include at least 2 work stations?					
c. Does it provide space for the storage of computer system storage?					
25. Mechanical Room					
a. Is a separate mechanical room provided?					
b. Does it house all essential HVAC?					
c. Is the room equipped with an exterior access for maintenance and repair work?					
d. Does the room incorporate acoustic attenuation measures?					
e. Are floors resilient to water, oil, grease?					
f. Is the room enclosed by fire rated walls and ceiling?					
26. Storage Room					
a. Is space provided for the storage of department supplies?					

[*] Web links available in Appendix D.

Chapter 3 Station Elements	**Reference***	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
b. Is the space provided with cabinetry, shelving, or lockers for the storage of supplies?					
27. Electrical Room					
a. Does the electrical room contain all the panels, switches, controls, timers, power distribution boards and panels that service the facility?					
b. Are all services properly marked as to their function and provided with warning signage?					
c. Is the room equipped with an exterior access for maintenance and repair work?					
28. Emergency Generator Room					
a. Is a separate room provided for an emergency generator?					
b. Is the generator of sufficient size to support all essential services?					
c. Is the room equipped with an exterior access for maintenance and repair work?					
d. Is the fuel supply sufficient to operate the generator under maximum load for a minimum 7 day period?					
e. Is the room enclosed by fire rated walls and ceiling?					
29. Telecommunications and Electronics Room – minimum of 80 sq ft (7.4 M^2)					
a. Is space provided for telecommunications and electronic equipment?					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
b. Does the room include an UPS, telephone racks, LAN or IT requirements, PA system, security system racks, etc?					
c. Is a fire detection/suppression system required for this space per local building codes?					
30. Trash and Recycling Room – 150 sq ft (13.9 M^2)					
a. Is a room required for the collection and storage of trash and recyclable items?					
b. Are separate bins or containers provided?					
c. Is a compactor or dumpster provided? Is it accessible by delivery or removal vehicle?					
31. Parking Areas (Public and Employee)					
a. Is one space per on-duty firefighter provided?					
b. Is access to parking controlled?					
c. Is visitor parking provided?					
d. Is handicap parking provided?					
e. Is access to parking designed to comply with ADA requirements?					
32. Delivery Truck Access					
a. Is space provided to accommodate the delivery of goods, services, equipment to the station?					
b. Is a loading dock required due to station elevation?					

* Web links available in Appendix D.

Chapter 3 Station Elements	Reference*	YES	NO	NA	REMARKS/COMMENTS
33. Exercise Facilities					
a. Is space provided for exercise or physical conditioning?					
b. Is the space sufficient to accommodate exercise equipment used by department members? (multi-station gyms, ergometers, rowing machines, treadmills, ropes, barbells, etc)?					
34. Patio					
a. Is a patio is required?					
b. If so, is it protected from the wind, excess noise, aircraft backwash, and airborne debris?					
c. Is it located as to provide privacy and immediate access to the apparatus room?					
d. Is it located so that all alarms and intercom announcements are audible?					
35. Station Store					
a. Is space provided for vending machines or the internal sale of snack items?					

Chapter 4 Station Systems	Reference*	YES	NO	NA	REMARKS/COMMENTS
1. Facility Fire Safety	AC 150/5210-15 NFPA 101				
a. Are construction materials non-combustible?					

* Web links available in Appendix D.

Chapter 4 Station Systems	Reference*	YES	NO	NA	REMARKS/COMMENTS
b. If a second story dormitory is planned, has special emphasis been placed on life safety concerns?					
c. Has NCMA references for concrete masonry construction been reviewed?	NCMA-TEK 46, 80A, 35B, and 128				
d. Are all wall penetrations adequately protected?					
e. Is the apparatus room/bays separated from other areas by a 2 hr fire rated enclosure?					
f. Are doors and openings fire rated?					
g. Are carbon monoxide and smoke detection systems installed?					
h. Is a sprinkler system required?	NFPA 13				
i. Is exit lighting provided?					
j. Are recessed wall mounted fire extinguisher cabinets and extinguishers provided?	NFPA 10				
2. Circulation, Doors, and Windows	AC 150/5210-15				
a. Circulation					
(1) Is the station circulation pattern designed for personnel convenience, safety, and rapid movement					
(2) Is the standard width of hallways and pathways leading to/from the apparatus room/bays a minimum of 4 ft?					
(3) Is the standard width of hallways that connect areas served by large groups of operations personnel a minimum of 6 ft?					

* Web links available in Appendix D.

Chapter 4 Station Systems	Reference*	YES	NO	NA	REMARKS/COMMENTS
(4) Are corridors or hallways obstructed by protrusions (i.e. water fountains, wall exterior mounted fire extinguishers)?					
(5) If a second floor is provided, are the stairs a straight line design? Is it void of landings? Is the stair a minimum 6 ft wide and equipped with safety tread?					
b. Doors					
(1) Are entrances, exits, and interior doors placed for smooth traffic flow?					
(a) Is door swing for doors opening into the apparatus bay/room at least 175 degrees?					
(b) Are exterior doors of low maintenance quality, weather tight, and solid core or possess a high noise reduction value.					
(c) Are doors for rooms occupied by 4 or more firefighters a minimum of 42 inches (1.0 M)?					
(d) Do doors accommodate wheelchairs for impaired personnel?	ANSI A117.1				
(e) Are doors for rooms occupied by more than 1 firefighter open towards the apparatus room?					

* Web links available in Appendix D.

Chapter 4 Station Systems	Reference*	YES	NO	NA	REMARKS/COMMENTS
(f) Are sliding doors used only on storage and utility rooms?					
(g) Are exit doors and doors leading to exit pathways clearly recognizable? Are exit doors provided with panic hardware?	NFPA 101				
(h) Are doors to and from dining areas, locker and training rooms, lavatories, and dormitories equipped with closers and push-pull plates (no hardware/knobs?)					
c. Windows	AC 150/5210-15				
(1) Is a minimum of 10% insulated glass area provided throughout the facility? Is 20% provided for energy conservation? Is weather stripping and sashes used to reduce heat loss, condensation, particulate penetration, and increase noise attenuation?					
3. Electrical System	AC 150/5210-15 NFPA 70 (National Electric Code)				
a. Is the facility electrical system designed IAW NFPA 70 or local codes?					
b. Are GFI circuit breakers installed in locations where an electrical source may be in proximity to a water source?					

* Web links available in Appendix D.

Chapter 4 Station Systems	Reference*	YES	NO	NA	REMARKS/COMMENTS
c. Are circuit panels marked as to each circuit controlled by that breaker?					
d. Is an auxiliary emergency generator provided for the operation of critical facility systems?	Chapter 3 of this AC				
4. Lighting	AC 150/5210-15 IES Lighting Handbook				
a. Has the IES Lighting Handbook been consulted for recommended lighting levels?					
b. Do alarm light illuminate the pathways to the apparatus bay/room? Are all alarm lights connected to the emergency backup generator?					
c. Are parking lot and yard lights shielded to prevent glare in the ATCT line of sight and aircraft operation areas?					
d. Do parking and yard lights use high efficacy lamps?					
e. Do parking and yard lights use timers or photoelectric switches to reduce energy costs?					
f. Do parking and yard lights cover areas subject to vandalism?					
g. Do parking and yard lights comply with the latest IES recommended practices?					
h. Are parking and yard lights used to facilitate site security at satellite stations?					

* Web links available in Appendix D.

Chapter 4 Station Systems	Reference[*]	YES	NO	NA	REMARKS/COMMENTS
5. Acoustics	AC 150/5210-15 ISO Acoustics Criteria				
a. Are workplace acoustical environments and noise levels within the recommended levels of ISO and this AC?					
(1) Small offices - <45dB(A)					
(2) Large Workspaces - <55dB(A)					
(3) Operational Areas - <65bB(A)					
(4) General Workspaces - <75dB(A)					
6. Sound Transmissions	AC 150/5210-15 ISO Acoustics Criteria				
a. Has an analysis of sound transmission been accomplished to ensure an acceptable acoustic environment?					
(1) Within a room/space by					
(a) Reflection and absorption					
(b) Background noise					
(c) Echoing					
(2) Between a room/space by					
(a) Air-borne transmission					
(b) Structure borne transmission					
(c) Background noise					
(d) Barrier transmission					
(e) Vibration noises					
(f) Flanking paths					
(g) Construction leaking paths					

[*] Web links available in Appendix D.

Chapter 4 Station Systems	Reference*	YES	NO	NA	REMARKS/COMMENTS
7. Sound Control Solutions	AC 150/5210-15 ISO Acoustics Criteria				
a. Have sound control solutions been incorporated into the facility design?					
(1) Elimination					
(2) Sound absorbing materials					
(3) Sound isolation					
(4) Flanking paths					
8. Heating, Ventilation, and Air Conditioning (HVAC) Systems	AC 150/5210-15 ASHRAE *Handbook of Fundamentals*				
a. Is the system designed for energy efficiency?					
b. Does the system employ loss flow resistance ducting and piping systems?					
9. Ventilation					
a. Has a mechanical ventilation system been designed and installed?					
b. Does the system maintain specific air-changes per hour?					
c. Are system air intakes located so as to minimize the introduction of potential contaminated air sources?					
d. Have local building codes and OSHA been consulted for ventilation minimums (air changes per hour)?					

* Web links available in Appendix D.

Chapter 4 Station Systems	**Reference***	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
10. Air Conditioning (AC)	ASHRAE *Handbook of Fundamentals*				
a. Is an AC system installed? Are all critical areas provided with AC?					
b. Are minimum room temperatures for occupied and unoccupied space provided based on recommendations of the ASHRAE?					
11. Heating Plants					
a. What type of heating system is incorporated into the facility?					
(1) Hot-water/Steam					
(2) Forced warm-air					
(3) Space radiant					
(4) Heat pumps					
(5) Unit heaters					
(6) Solar					
12. Energy Conservation	ASHRAE *Handbook of Fundamentals* U.S. Green Building Council NCMA-TEK 46, 80A, 35B, and 128				
a. Has energy conservation been assessed in facility design?					
b. Are utility systems cost effective?					
c. Has the long term cost of utilities been evaluated?					

[*] Web links available in Appendix D.

Chapter 5 Other Station Considerations	Reference*	YES	NO	NA	REMARKS/COMMENTS
1. Barrier Free Accessibility	29 CFR Part 1604 49 CFR Part 127 42 USC 4151-4157 ANSI A117.1 NFPA 101				
a. Is the ARFF station accessible to physically handicapped or disabled service personnel?					
b. Does the ARFF station provide for general accessibility for physically handicapped or disabled personnel?					
2. Maintenance Cost					
a. Construction and Finish Materials?					
(1) Are quality building materials selected for durability, ease of maintenance, and cleaning qualities					
3. Hazards and Safety	NFPA 101 NFPA 1581				
a. Is accident prevention incorporated into the ARFF station design?					
b. Are hazard and safety preventative design measures incorporated into the ARFF station design? Does it include:					
(1) Compliance with all legally applicable health, safety, building, and fire code requirements?					

* Web links available in Appendix D.

Chapter 5 Other Station Considerations	Reference*	YES	NO	NA	REMARKS/COMMENTS
(2) Is space provided for disinfecting, cleaning, and storage of materials/processes that are compliant with NFPA 1581?	NFPA 1581				
(3) Are stations provided with smoke detectors?					
(4) Are stations provided with carbon monoxide detectors?					
(5) Do stations comply with NFPA 101?					
(6) Are firefighters exposed to exhaust emissions? Is a vehicle exhaust extraction system incorporated into the facility?					
(7) If a station has slide poles, are preventive measures included to prevent accidental falls?					
c. Safety Labels and Signs	29 CFR Part 1926 29 CFR Section 1910.145 ANSI Z35.1				
(1) Are safety labels and signs conspicuously posted?					
(2) Do labels and signs comply with 29 CFR Part 126, 29 CFR Part 1910.145, and ANSI Z35.1?					
(3) Are safe working capacities posted to equipment?					
(4) Are areas where specialized protective clothing, tool, or equipment identified?					
(5) Is a central MSDS binder and storage rack provided?					

* Web links available in Appendix D.

Chapter 5 Other Station Considerations	Reference*	YES	NO	NA	REMARKS/COMMENTS
d. General Workspace Hazards					
(1) Are hazard alerting devices installed to provide warnings of impending danger (smoke, fire, gases etc.)?					
(2) Are stairs provided with skid resistant step treads?					
(3) Are stations free of personnel traffic flow obstructions?					
(4) Are all warning placards, stairways, and hazardous areas well illuminated?					
e. Electrical Hazards					
(1) Are receptacles designed so that a plug of one voltage cannot be accidentally inserted into a plug of another voltage?					
(2) Are inter-locks, guards, grounding, and warning placards provided for equipment to prevent dangerous voltage?					
f. Technical and Mechanical Hazards					
(1) Is equipment which exposes personnel to high surface temperatures guarded?					
(2) Are all exposed moving parts of machinery or transmission equipment provided with protective guards?					
(3) Are all switches or controls identified?					

* Web links available in Appendix D.

Chapter 5 Other Station Considerations	**Reference**[*]	**YES**	**NO**	**NA**	**REMARKS/COMMENTS**
(4) Are all equipment controls located so as not to present a personnel hazard when operated?					
4. Security					
a. Do security systems, devices, or features include:					
(1) automatic door closers					
(2) keypad entry control devices					
(3) mechanical locks					
(4) exterior/interior video surveillance					
(5) sonic or photoelectric sensors					
5. Provisions for Water Rescue Equipment	AC 150/5210-13				
a. Does the ARFF station provide a water rescue capability? If so, has space been provided to store and maintain equipment associated with this service? Is a boat ramp required?					
6. Landscaping					
a. Is landscaping simple, easy and economical to maintain?					
b. Does it enhance exterior aesthetics?					
c. Are indigenous species employed?					
d. Will plants/trees impede flightline line of sight requirements?					

[*] Web links available in Appendix D.

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* Web links available in Appendix D.

APPENDIX D. RESOURCES AND RELATED READING MATERIAL

D-1. ORGANIZATIONS.

a. Station Design.

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
1791 Tullie Circle
NE Atlanta, Georgia 30329
(404) 636-8400
www.ashrae.org

American Petroleum Institute (API)
1220 L Street NW
Washington, DC. 20005
(202) 682-8000
www.api.org

American National Standard Institute, Inc. (ANSI)
1819 L Street NW
Washington, DC 20036
(202) 293-8020
www.ansi.org

Federal Aviation Administration (FAA)
800 Independence Avenue, SW
Washington, DC. 20591
1-866-835-5322
www.faa.gov

Illuminating Engineering Society of North America (IESNA)
120 Wall Street, 17th Floor
New York, NY 10005
(212) 248-5000
www.iesna.org

International Civil Aviation Organization (ICAO)
999 University Street
Montreal, Quebec Canada H3C 5H7
(514) 954-8219
www.icao.int

National Fire Protection Association (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
(617) 770-3000
www.nfpa.org

National Concrete Masonry Association (NCMA)
13750 Sunrise Valley Drive
Herndon, VA 20171-4662
(703) 713-1900
www.ncma.org

Association of Electrical and Medical Imaging Equipment Manufacturers (NEMA)
1300 North 17 Street
Suite 1752
Rosslyn, VA 22209
(703) 841-3200
www.nema.org

American Society of Mechanical Engineers (ASME) International
3 Park Avenue
New York, NY 10016-5390
(800) 843-2763
www.asme.org

Occupational Safety and Health Administration (OSHA)
U.S. Dept. of Labor
200 Constitution Avenue NW
Washington, DC 20210
www.osha.gov

United States Access Board
1331 F Street NW, Suite 1000
Washington, DC 20004-1111
(202) 872-2253
www.access-board.gov

International Organization for Standardization (ISO)
www.iso.org

b. Building Codes.

Building Officials and Code Administrator
4051 West Flossmoor Road
Country Club Hills, IL 60477
888-422-7233
www.bocai.org

International Code Council (ICC)
500 New Jersey Avenue NW, 6th Floor
Washington, DC 20001
888-422-7233
www.iccsafe.org

c. Kitchen Design.

Kitchen Cabinet Manufacturers Association (KCMA)
1899 Preston White Drive
Reston, VA
(703) 264-1690
www.KCMA.org

D-2. READING MATERIALS.

a. Office of Management and Budget

(1) OMB Circular A-102:

http://www.whitehouse.gov/omb/circulars/

b. United States Code

(1) 42 U.S.C. 4151-4157, Architectural Barriers Act:

www.access-board.gov

c. Code of Federal Regulations

(1) 29 CFR Part 1910, *Hazardous Waste Operations and Emergency Response:*

www.osha.gov

(2) 29 CFR Part 1604, *Guidelines as A Bona Fide Occupational Qualification:*

www.osha.gov

(3) 29 CFR Part 126, *Accident Prevention Signs and Tags:*

www.osha.gov

(4) 29 CFR Part 1910.145, *General Environmental Controls:*

www.osha.gov

(5) 49 CFR Part 27, *Non-discrimination on the Basis of Disability in Programs or Activities Receiving or Benefiting from Federal Financial Assistance:*

www.iccsafe.org

d. American National Standard Institute (ANSI)

(1) ANSI Z 35.1. 1-1972, *Specifications for Accident Prevention Signs:*

www.osha.org

(2) ANSI A117.1-03, *Standard on Accessible and Useable Buildings and Facilities*:

www.iccsafe.org

e. Federal Aviation Administration.

(1) FAA ACs can be obtained by writing to: DOT, Utilization and Storage Section, M-443.2, Washington, DC 20590 or at:

www.faa.gov

(a)	AC 150/5070-6	*Airport Master Plans*.
(b)	AC 150/5100-14	*Architectural, Engineering, and Planning Consultant Services for Airport Grant Projects*.
(c)	AC 150/5200-33	*Hazardous Wildlife Attractants On or Near Airports.*
(d)	AC 150/5200-37	*Introduction to Safety Management Systems (SMS) for Airport Operators.*
(e)	AC 150/5210-7	*Aircraft Rescue and Fire Fighting Communications.*
(f)	AC 150/5210-13	*Water Rescue Plans, Facilities, and Equipment*.
(g)	AC 150/5220-4	*Water Supply Systems for Aircraft Fire and Rescue Protection*.
(h)	AC 150/5220-10	*Guide Specification for Aircraft Rescue and Fire Fighting Vehicles.*
(i)	AC 150/5220-18	*Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials.*
(j)	AC 150/5300-13	*Airport Design.*
(k)	AC 150/5300-9	*Predesign, Prebid, and Preconstruction Conferences for Airport Grant Projects*.
(l)	AC 150/5370-2	*Operational Safety on Airports During Construction.*
(m)	AC 150/5370-12	*Quality Control of Construction for Airport Grant Projects.*

(2) Federal Aviation Regulation (FAR) Title 14 *Aeronautics and Space*, Part 139 – *Certification of Airports*, Subpart D – *Operations:*

http://ecfr.gpoaccess.gov

(3) Title 14, Aeronautics and Space, Part 77, *Objects Affecting Navigable Airspace:*

http://ecfr.gpoaccess.gov

f. Airport Master Planning.

(1) www.icivilengineer.com/Transportation_Engineering/Airport_Engineering

(2) http://eng.archinform.net

g. Station Design.

(1) *Fire Chief Magazine*, November 2006, Articles: Select Few; Quality Counts; Active Ingredients; Station Design Awards; Behind Closed Doors; and Clean and Simple:

http://firechief.com/stationstyle/

(2) www.architectureweek.com/2005/0216/design_1-1.html

(3) www.wbdg.org/design/firestation.php

(4) www.fierofirestation.com/

(5) www.afcesa.af.mil/shared/media/document/AFD-070613-099.pdf

(6) www.firestationdesign.com/

(7) www.sehinc.com/awards/award002.htm

(8) www.prarch.com/

(9) www.benham.com/Content.aspx?id=79

(10) www.usfa.fema.gov/index.shtm

(11) www.usfa.dhs.gov/downloads/pdf/publications/fa-168.pdf

(12) ANSI A117.1-1980, *Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People:*

www.iccsafe.org/cs/standards/a117/

(13) ANSI Z 35.1, *Specifications for Accident Prevention Signs:*

www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10681&p_table=STANDARDS

(14) American Petroleum Institute (API) Publication 1615-79, *Installation of Underground Petroleum Storage Systems:*

http://engineers.ihs.com/document/abstract/SHZZCAAAAAAAAAA

(15) ASHRAE *Handbook of Fundamentals*:

www.techstreet.com/cgi-bin/detail?product_id=1223925

(16) *Human Engineering Guide to Equipment Design* (rev. ed.), American Institutes for Research, Washington, DC:

http://hfetag.dtic.mil/docs-hfs/faa-hf-001_human_engineering_program_pl.rtf

(17) *Acoustical Glazing Design Guide*:

www.wbdg.org/resources/acoustic.php

h. Kitchen Design.

(1) www.kcma.org

(2) www.kitchendesignersideas.com/

i. Laundry Facilities.

(1) www.iaff.org/Comm/PDFs/NFPA1581.pdf

(2) www.laundrytoday.com/advertisers/advertising_washers.htm

(3) www.tradekey.com/ks-washer-extractor

(4) www.americanlaundrynews.com

(5) www.americandrycleaner.com

j. Physical Plant.

(1) *American Standard Safety Code for Elevators, Dumbwaiters, Escalators and Moving Stairs*. Publication No. A17.1:

www.access-board.gov/Adaag/referenced-standards.htm

(2) *Heating, Ventilating, Air Conditioning Guide:*

American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc.
1791 Tullie Circle, NE Atlanta, Georgia 30329
(404) 636-8400
www.ashrae.org

(3) Illuminating Engineering Society of North America, *IES Handbook*:

Illuminating Engineering Society
1860 Broadway, NY, NY
www.iesna.org

(4) Lightning Protection Code, NFPA-78:

National Fire Protection Association.
www.nfpa.org

(5) National Electrical Code.

National Fire Protection Association (NFPA) Standard 70:
www.nfpa.org

(6) National Fire Protection Association *Codes for Standards and Recommended Practices*.

www.nfpa.org.

(7) ASME International (National Plumbing Code)

3 Park Avenue
New York, NY 10016-5390
(800) 843-2763
www.asme.org

(8) Building Officials and Code Administrator
4051 West Flossmoor Road
Country Club Hills, IL 60477
888-422-7233
www.bocai.org

(9) International Conference of Building Officials
500 New Jersey Avenue NW, 6th Floor
Washington, DC 20001
888-422-7233
www.iccsafe.org

(10) Occupational Safety and Health Administration (OSHA)
U.S. Dept. of Labor
200 Constitution Avenue NW
Washington, DC 20210
www.osha.gov

k. Aircraft Rescue and Fire Fighting standards related to ARFF stations

(1) International Civil Aviation Organization. Airport Services Manual, Part 1: *Rescue and Fire Fighting*.

(2) FA-168, *Safety and Health Considerations for the Design of Fire and Emergency Medical Stations*:

www.usfa.dhs.gov/downloads/pdf/publications/fa-168.pdf

(3) National Fire Protection Association (NFPA).

(4) Fire Protection Reference Directory and Buyer's Guide, Annual Directory.

National Fire Protection Association (NFPA)
Batterymarch Park
Quincy, MA 02269

(5) Specific NFPA Standards are available at: www.nfpa.org

(a) NFPA 10, *Portable Fire Extinguishers*

(b) NFPA 13, *Standard for the Installation of Sprinkler Systems*

(c) NFPA 70, *National Electric Code*

(d) NFPA 96, *Ventilation Control and Fire Protection for Commercial Cooking Operations*

(e) NFPA 101, *Life Safety Code*

(f) NFPA 403, *Aircraft Fire Fighting and Rescue Services at Airports*

(g) NFPA 414, *Aircraft Rescue and Fire Fighting Vehicles*

(h) NFPA 1500, *Fire Department Occupational Safety and Health Program*

(i) NFPA 1581, *Standard on Fire Department Infection Control Program.*

APPENDIX E. KEY WORDS FOR LITERATURE SEARCH

Accident Prevention

Advisory Circular

Air Traffic Control Tower

Aircraft Rescue and Fire Fighting

Airport

Airport Emergency Equipment

Airport Index

Airport Master Planning

American National Standards Institute

Architect and Engineer

ARFF Station

ARFF Stations

Building Code

Building Restriction Line

Code of Federal Regulation

Crash Fire Rescue

Crash Trucks

Design Criteria

Disability Access

Emergency Medical Technician

Emergency Vehicle Design

Fire

Fire Detection

Fire House

Fire Houses

Fire Protection

Fire Resistance

Fire Station

Fire Stations

Fire Suppression

Government Buildings

Hazardous Materials

Infection Control

Landscaping

Life Safety

Metric Units

Municipal Buildings

Municipal Buildings

Occupational Safety

Public Buildings

Public Buildings

Response Time

Snow Removal Equipment

Water Rescue