NFPA® 440

Guide for Aircraft Rescue and Firefighting Operations and Airport/ Community Emergency Planning

2024 Edition

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An International Codes and Standards Organization

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NFPA® 440

Guide for

Aircraft Rescue and Firefighting Operations and Airport/Community Emergency Planning

2024 Edition

This edition of NFPA 440, *Guide for Aircraft Rescue and Firefighting Operations and Airport/Community Emergency Planning*, was prepared by the Technical Committee on Aircraft Rescue and Firefighting. It was issued by the Standards Council on October 7, 2022, with an effective date of October 27, 2022.

This edition of NFPA 440 was approved as an American National Standard on October 27, 2022.

Origin and Development of NFPA 440

This first edition of NFPA 440, *Guide for Aircraft Rescue and Firefighting Operations and Airport/Community Emergency Planning*, is a consolidation of NFPA 402 and NFPA 424, as part of a document consolidation plan that was approved during the April 2019 Standards Council meeting. This plan affects all documents in the Emergency Response and Responder Safety (ERRS) project.

Many of the revisions for this edition are related to the consolidation of the legacy documents NFPA 402 and NFPA 424 into NFPA 440. The technical committee has revised several definitions for the purpose of clarification and to reflect current use and practices. Guidance has been provided on the presence and use of alternative fuel vehicles and how they are more commonly used at airports, as well as considerations regarding suppression as it relates to lithium-ion battery fires. Necessary considerations also have been provided for aircraft to reflect that most aircraft now are constructed of composite materials rather than aluminum. Another revision for this first edition of NFPA 440 includes replacing the term *halogenated agents* with *clean agents* to reflect current use and practice.

For more information about the ERRS consolidation project, see nfpa.org/errs.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for aircraft rescue and firefighting (ARFF) documents used by organizations providing ARFF services for operational procedures; training; foam testing and application; specialized equipment; and planning for aircraft emergencies.

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex L.

Chapter 1 Administration

1.1 Scope. This guide provides information relative to aircraft rescue and firefighting (ARFF) operations and procedures for airport and structural fire departments and describes the elements of an airport/community emergency plan that require consideration before, during, and after an emergency has occurred. Throughout this document, the airport/community emergency plan is referred to as the "AEP."

1.1.1 Statistics indicate that approximately 80 percent of all major commercial aircraft accidents occur in the critical rescue and firefighting access area. This is the primary response area for airport-based ARFF services. Approximately 15 percent of the accidents occur in the approach areas. In such instances the community/mutual services could be the prime responders.

1.1.2 Some airport fire departments have the total fire prevention and fire protection responsibility for the entire airport, including structural firefighting responsibilities in terminal buildings, aircraft hangars, airport hotels, cargo buildings, and other facilities. Procedures for these fire prevention and protection operations are not covered in this guide.

1.1.3 The scope of the AEP should include command, communication, and coordination functions for executing the AEP.

1.2 Purpose.

1.2.1 This guide has been prepared for the use and guidance of those charged with the responsibility of providing and maintaining ARFF services on airports.

1.2.2 This guide was written to inform airport and adjacent community authorities of current emergency planning techniques and procedures that result in the efficient utilization of personnel from all involved organizations and agencies to provide effective delivery of emergency services in the event of an aircraft-related emergency. Jurisdictional problems previously identified in actual emergencies or emergency plan exercises point out the necessity of resolving the conflicts as part of the development of the AEP. Recommendations contained herein are not intended to conflict with any local or state regulations. One of the principal purposes of this document is to alert all participants to conflicts that can exist due to multijurisdictional factors, such as conflicts between state and local regulations. Additional criteria for assessing the AEP can be found in *NFPA 1600*.

1.2.2.1 This guide's content is also intended for the use of structural fire departments to assist them in developing methods to effectively handle aircraft incidents that might occur within their jurisdiction. It also provides for a basis of understanding, relative to emergencies on airports, that would enhance structural fire departments' effectiveness when called to assist airport fire departments.

1.3 Application. This guide can be applied as follows:

(1) Chapters 1 through 3, 4 through 13, and Annexes A, B, C, D, and L constitute NFPA 402.
(2) Chapters 1 through 3, 14 through 25, and Annexes A, E, F, G, H, I, J, and L constitute NFPA 424.

1.4 General.

1.4.1 Providing protection for the occupants of an aircraft takes precedence over all other operations. Fire control is frequently an essential condition to ensure such survival. The objectives of the airport fire department should be to respond to any aircraft emergency as expeditiously and safely as possible and to employ rescue and firefighting techniques effectively. These objectives can be accomplished when properly trained personnel work together as a team and apply the operational procedures presented in this guide.

1.4.2 Governmental and organizational publications frequently referenced in this guide can be found in Annex L.

1.5 Units and Formulas.

1.5.1 If a value for measurement as given in this guide is followed by an equivalent value in other units, the first stated is to be regarded as the requirement. A given equivalent value might be approximate.

1.5.2 Metric units of measurement in this guide are in accordance with the modernized metric systems known as the International System of Units (SI). One unit (liter), outside of, but recognized by, SI is commonly used in international fire protection.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this guide and should be considered part of the recommendations of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems,* 2022 edition.

NFPA 402, *Guide for Aircraft Rescue and Fire-Fighting Operations,* 2019 edition.

NFPA 407, *Standard for Aircraft Fuel Servicing,* 2022 edition.

NFPA 408, *Standard for Aircraft Hand Portable Fire Extinguishers,* 2022 edition.

NFPA 424, *Guide for Airport/Community Emergency Planning,* 2018 edition.

NFPA 460, *Standard for Aircraft Rescue and Firefighting Services at Airports,* 2024 edition.

NFPA 1003, *Standard for Airport Fire Fighter Professional Qualifications,* 2019 edition.

NFPA 1600®, Standard on Continuity, Emergency, and Crisis Management, 2019 edition.

NFPA 1900, *Standard for Aircraft Rescue and Firefighting Vehicles, Automotive Fire Apparatus, Wildland Fire Apparatus, and Automotive Ambulances,* 2024 edition.

NFPA 2500, *Standard for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services,* 2022 edition.

Fire Protection Research Foundation, "Best Practices for Emergency Response to Incidents Involving Electric Vehicles Battery Hazards: A Report on Full-Scale Testing Results," 2013 edition.

2.3 Other Publications.

2.3.1 FAA Publications. Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591.

DOT/FAA/TC-14/22, *Impact of Alternative Fuels Present in Airports on Aircraft Rescue and Firefighting Response,* 2014.

FAA National Part 139 CertAlert 13-04, *Additional Precautions for Approaching Aircraft with Ballistic Parachutes, Ejection Seats, and Airbags*, 2013.

FAA AC 150/5210-7D, *Aircraft Rescue and Firefighting Communications*, 2008.

2.3.2 ICAO Publications. International Standards and Recommended Practices promulgated by the International Civil Aviation Organization, 999 Robert-Bourassa Boulevard, Montréal, Quebec H3C 5H7, Canada.

Airport Services Manual, Part 7: Airport Emergency Planning, second edition, 1991.

2.3.3 PHMSA Publications. Pipeline and Hazard Materials Safety Administration, Office of Pipeline Safety, East Building, 2nd Floor, 1200 New Jersey Avenue, SE, Mail Stop: E24-455, Washington, DC 20590.

Emergency Response Guidebook, US Department of Transportation, 2020.

2.3.4 US Government Publications. US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 29, Code of Federal Regulations, Part 1910.165, "Employee Alarm Systems."

2.3.5 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Advisory Sections.

NFPA 10, *Standard for Portable Fire Extinguishers,* 2022 edition.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam,* 2021 edition.

NFPA 17, *Standard for Dry Chemical Extinguishing Systems,* 2021 edition.

NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft,* 2020 edition.

NFPA 460, *Standard for Aircraft Rescue and Firefighting Services at Airports,* 2024 edition.

NFPA 470, *Hazardous Materials/Weapons of Mass Destruction (WMD) Standard for Responders,* 2022 edition.

NFPA 600, *Standard on Facility Fire Brigades,* 2020 edition.

NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems,* 2020 edition.

NFPA 921, *Guide for Fire and Explosion Investigations,* 2021 edition.

NFPA 1051, *Standard for Wildland Firefighting Personnel Professional Qualifications,* 2020 edition.

NFPA 1145, *Guide for the Use of Class A Foams in Fire Fighting,* 2022 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2019 edition.

NFPA 2500, *Standard for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services,* 2022 edition.

Chapter 3 Definitions

3.1* General. The definitions contained in this chapter apply to the terms used in this guide. Where terms are not defined in this chapter or within another chapter, they should be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, is the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Guide. An NFPA standard that is advisory or informative in nature and that contains only nonmandatory provisions. A

guide may contain mandatory statements such as when a guide can be used, but the NFPA standard as a whole is not suitable for adoption into law.

3.2.4 Should. Indicates a recommendation or that which is advised but not required.

3.3 General Definitions.

3.3.1 Air Accident Investigations Branch (AAIB). A UK agency that is responsible for investigating and determining the probable cause of all British aircraft accidents.

3.3.2* Airborne Emergency. Those emergencies that affect the operational integrity of an aircraft while in flight.

3.3.3 Aircraft.

3.3.3.1 ***Pressurized Aircraft.*** Sealed, modern-type aircraft within which the internal atmospheric pressure can be regulated.

3.3.3.2 ***Turboprop Aircraft.*** An aircraft powered by one or more turbine engines each of which drives a propeller.

3.3.4 Aircraft Accident. An occurrence associated with the operation of an aircraft that takes place between the time any person boards the aircraft with the intention of flight and until all such persons have disembarked and in which any person suffers death or serious injury or in which the aircraft receives substantial damage. [**460,** 2024]

3.3.5* Aircraft Accident Pre-Incident Planning. The process of forecasting all factors that could possibly exist involving an aircraft accident that could bear upon the existing emergency resources.

3.3.6 Aircraft Defueling. See 3.3.62, Fuel Servicing.

3.3.7 Aircraft Emergency Exercise. Testing of the emergency plan and review of the results in order to improve the effectiveness of the AEP.

3.3.8 Aircraft Familiarization. Refers to the knowledge of vital information that rescue and firefighting personnel should learn and retain with regard to the specific types of aircraft that normally use the airport and other aircraft that might use the airport due to weather conditions at scheduled destinations.

3.3.9* Aircraft Firefighting. The control or extinguishment of fire adjacent to or involving an aircraft following ground accidents/incidents.

3.3.10* Aircraft Incident. An occurrence, other than an accident associated with the operation of an aircraft, that affects or could affect continued safe operation if not corrected.

3.3.11 Aircraft Operator. A person, organization, or enterprise engaged in, or offering to engage in, aircraft operation.

3.3.12* Aircraft Rescue and Firefighting (ARFF). The firefighting action taken to prevent, control, or extinguish fire involved or adjacent to an aircraft for the purpose of maintaining maximum escape routes for occupants using normal and emergency routes for egress.

3.3.13 Aircraft Rescue and Firefighting Vehicle. A vehicle intended to carry rescue and firefighting equipment for rescuing occupants and combating fires in aircraft at or in the vicinity of airports.

3.3.14 Aircraft Skin. The outer covering of an aircraft fuselage, wings, and empennage.

3.3.15 Aircraft Undercarriage. All components of an aircraft landing gear assembly.

3.3.16 Air-Cushioned Vehicle (ACV). A vehicle that can travel on land and water.

3.3.17 Airline Coordinator. A representative authority delegated by an airline to represent its interests during an emergency covered by this guide.

3.3.18 Airport (Aerodrome). An area on land or water that is used or intended to be used for the landing and takeoff of aircraft and includes buildings and facilities.

3.3.19 Airport/Community Emergency Plan (AEP). Established procedures for coordinating the response of airport services with other agencies in the surrounding community that could be of assistance in responding to an emergency occurring on, or in the vicinity of, the airport.

3.3.20 Airport Familiarization. Refers to the knowledge that rescue and firefighting personnel must maintain relative to locations, routes, and conditions that will enable them to respond quickly and efficiently to emergencies on the airport and those areas surrounding the airport.

3.3.21* Airport Manager. The individual having managerial responsibility for the operation and safety of an airport.

3.3.22 Airside. The part of an airport, including terminal buildings past security checks and passport and customs control, used for the loading, unloading, takeoff, and landing of aircraft.

3.3.23 Air Traffic Control (ATC). A service established to provide air and ground traffic control for airports.

3.3.24 Air Traffic Control Provider. A service established to provide air and ground traffic control for airports. (This includes airport control tower and airport flight information services.)

3.3.25 Aluminum. A lightweight metal used extensively in the construction of aircraft airframes and aircraft skin sections.

3.3.26 Area.

3.3.26.1 ***Care Area.*** Location where initial medical care is given to injured.

3.3.26.2 ***Casualty Collection Point.*** The location where the seriously injured are initially collected.

3.3.26.3 ***Critical Rescue and Firefighting Access Area.*** The rectangular area surrounding any runway within which most aircraft accidents can be expected to occur on airports. Its width extends 150 m (500 ft) from each side of the runway centerline, and its length is 1000 m (3300 ft) beyond each runway threshold.

3.3.26.4 ***Holding Area.*** Location where the apparently uninjured aircraft occupants are transported.

3.3.26.5 ***Medical Transportation Area.*** That portion of the triage area where injured persons are staged for transportation to medical facilities under the direct supervision of a medical transportation officer.

3.3.26.6 ***Practical Critical Fire Area (PCA).*** This area is two-thirds of the theoretical critical fire area (TCA). *[See also 3.3.26.8, Theoretical Critical Fire Area (TCA).]*

3.3.26.7 ***Staging Area.*** A location established for the temporary location of available resources, such as personnel, supplies, and equipment, while awaiting operational assignment.

3.3.26.8 ***Theoretical Critical Fire Area (TCA).*** The theoretical critical fire area (TCA) is a rectangular area, the longitudinal dimension of which is the overall length of the aircraft and the width includes the fuselage and extends beyond it by a predetermined set distance that is dependent on the overall width. Therefore, the aircraft length multiplied by the calculated width equals the size of the TCA.

3.3.27 Auxiliary Power Unit (APU). A self-contained power source, provided as a component of an aircraft, that is used to energize aircraft systems when power plants are not operating or when external power is not available.

3.3.28 Clean Agents. Liquefied gas extinguishing agents that extinguish fire by chemically interrupting the combustion reaction between fuel and oxygen. Clean agents leave no residue.

3.3.29 Cockpit Voice Recorder (CVR). A device that monitors flight deck crew communications through a pickup on the flight deck connected to a recorder that is usually mounted in the tail area of the aircraft and that is designed to withstand certain impact forces and a degree of fire.

3.3.30 COMBI. An aircraft designed to transport both passengers and cargo on the same level within the fuselage.

3.3.31 Command Post (CP). The location at the scene of an emergency where the incident commander is located and where command, coordination, control, and communications are centralized.

3.3.32* Composite Materials. Lightweight materials having great structural strength. They are made of fine fibers embedded in carbon/epoxy materials. The fibers are usually boron, fiberglass, aramid, or carbon in the form of graphite.

3.3.33 Dangerous Goods. This term is synonymous with the terms *hazardous materials* and *restricted articles*. The term is used internationally in the transportation industry and includes explosives and any other article defined as combustible liquids, corrosive materials, infectious substances, flammable compressed gases, oxidizing materials, poisonous articles, radioactive materials, and other restrictive articles.

3.3.34 Deck Gun (Deluge Set). See 3.3.117, Turret.

3.3.35 Departure. An aircraft taking off from an airport.

3.3.36 Dry Chemical. A powder composed of very small particles, usually sodium bicarbonate–, potassium bicarbonate–, or ammonium phosphate–based with added particulate material supplemented by special treatment to provide resistance to packing, resistance to moisture absorption (caking), and the proper flow capabilities. [**17,** 2021]

3.3.37 Dry Powder. Solid materials in powder or granular form designed to extinguish Class D combustible metal fires by crusting, smothering, or heat-transferring means. [**10,** 2018]

3.3.38 Emergency Medical Technician. A person trained and certified to appraise and initiate the administration of emergency care for victims of trauma or acute illness before or during transportation of victims to a health care facility.

3.3.39 Emergency Operations Center. A temporary or established facility where the coordination of information and resources to support incident management activities (i.e., on-scene operations) takes place.

3.3.40 Empennage. The tail assembly of an aircraft, which includes the horizontal and vertical stabilizers.

3.3.41 Evacuee. An aircraft occupant who has exited the aircraft following an accident/incident.

3.3.42 Exposure. Any person or property that could be endangered by fire, smoke, gases, runoff, or other hazardous conditions.

3.3.43 Extinguishing Agent.

3.3.43.1 ***Complementary Extinguishing Agent.*** An agent that provides unique extinguishing capability beyond the primary chosen agent.

3.3.43.2 ***Primary Extinguishing Agent.*** Agents that have the capability of suppressing and preventing the reignition of fires in liquid hydrocarbon fuels.

3.3.44 Extinguishing Agent Compatibility. Related to the requirement that the chemical composition of each agent be such that one will not adversely affect the performance of other agents that might be used on a common fire.

3.3.45 Extrication. The removal of trapped victims from a vehicle or machinery. [**2500,** 2022]

3.3.46 Federal Aviation Administration (FAA). An agency of the United States federal government charged with the primary responsibility of regulating aviation activities.

3.3.47 Fire Classifications.

3.3.47.1 ***Class A.*** A fire in ordinary combustible materials such as wood, cloth, paper, rubber, and many plastics.

3.3.47.2 ***Class B.*** A fire in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

3.3.47.3 ***Class C.*** A fire that involves energized equipment where the electrical resistivity of the extinguishing media is of importance.

3.3.47.4 ***Class D.*** Combustible metals.

3.3.48 Fire Wall. A bulkhead designed to stop the lateral spread of fire in a fuselage or engine nacelle.

3.3.49 Flashback. The tendency of flammable liquid fires to reignite from any source of ignition after the fire has once been extinguished.

3.3.50 Flashover. A transition phase in the development of a compartment fire in which surfaces exposed to thermal radiation reach ignition temperature more or less simultaneously and fire spreads rapidly throughout the space, resulting in full room involvement or total involvement of the compartment or enclosed space. [**921,** 2021]

3.3.51 Flight Attendants. Those members of the flight deck crew whose responsibility includes the management of activities within the passenger cabin.

3.3.52* Flight Data Recorder (FDR). An instrument that monitors performance characteristics of an aircraft in flight.

3.3.53 Flight Deck Crew. Those members of the crew whose responsibility includes the management of the aircraft's flight control and ground movements.

3.3.54 Foam.

3.3.54.1* *Aqueous Film Forming Foam (AFFF) Concentrate.* A concentrate based on fluorinated surfactants plus foam stabilizers to produce a fluid aqueous film for suppressing hydrocarbon fuel vapors and usually diluted with water.

3.3.54.2 *Film-Forming Fluoroprotein Foam Concentrate (FFFP).* A protein-foam concentrate that uses fluorinated surfactants to produce a fluid aqueous film for suppressing hydrocarbon fuel vapors. [**11,** 2021]

3.3.54.3* *Fluoroprotein Foam Concentrate.* A concentrate very similar to protein-based foam concentrate but with a synthetic fluorinated surfactant additive. [**11,** 2021]

3.3.54.4 *Protein Foam Concentrate.* A concentrate consisting primarily of products from a protein hydrolysate, plus stabilizing additives and inhibitors to protect against freezing, to prevent corrosion of equipment and containers, to resist bacterial decomposition, to control viscosity, and to otherwise ensure readiness for use under emergency conditions. [**11,** 2021]

3.3.55 Foam Application Rate. The amount of foam solution in liters or gallons per minute expressed as a relationship with a unit of area, usually square meter or square foot.

3.3.56 Foam Blanket. A covering of foam over a surface to insulate, prevent ignition, or extinguish the fire. [**1145,** 2017]

3.3.57 Foam Burnback Resistance. The ability of a foam blanket to retain aerated moisture and resist destruction by heat and flame.

3.3.58 Foam Drain Time. The 25 percent drainage time (or ¼ drainage time) required for 25 percent of the original foam solution (foam concentrate plus water) to drain out of the foam.

3.3.59 Forcible Entry. Techniques used by fire personnel to gain entry into buildings, vehicles, aircraft, or other areas of confinement when normal means of entry are locked or blocked.

3.3.60 Forward Looking Infrared (FLIR). The detection of heat energy radiated by objects to produce a "thermal image." This thermal image is converted by electronics and signal processing into a visual image that can be viewed by the operator.

3.3.61 Frangible Gate/Fence. Gates or fence sections designed to open, break away, or collapse when struck with the bumper of an ARFF vehicle responding to an emergency.

3.3.62 Fuel Servicing. Fueling and defueling of aircraft fuel tanks, not including aircraft fuel transfer operations and design of aircraft fuel systems during aircraft maintenance or manufacturing operations.

3.3.63 Fuselage. The main body of an aircraft.

3.3.64 Gear.

3.3.64.1 *Main Gear.* Refers to the two or more larger landing gear structures of an aircraft, as opposed to wing, nose, or tail gear assemblies.

3.3.64.2 *Nose Gear.* That mechanical part of a landing gear system mounted under the nose of an aircraft. It can be designed either as a stationary component or one that retracts into the fuselage.

3.3.65 Grid Map. A plan view of an area superimposed with a system of numbered and lettered squares that provide a fixed reference to any point in the area.

3.3.66 Halon 1211. A clean agent whose chemical name is bromochlorodifluoromethane (CF_2BrCl).

3.3.67 Halon 1301. A clean agent whose chemical name is bromotrifluoromethane ($CBrF_3$).

3.3.68 Hazardous Materials. Substances (solid, liquid, or gas) that when released are capable of creating harm to people, the environment, and property.

3.3.69 Hot Brakes. A condition in which the aircraft's brake and wheel components have become overheated, usually due to excessive braking during landing.

3.3.70* Ignition Temperature. Minimum temperature a substance should attain in order to ignite under specific test conditions. [**921,** 2021]

3.3.71* Incident Commander (IC). The individual responsible for all incident activities, including the development of strategies and tactics and the ordering and the release of resources. [**470,** 2022]

3.3.72 Incident Command Post (ICP). The field location where the primary functions are performed, which may be co-located with the incident base or other incident facilities.

3.3.73 Incident Command System (ICS). The combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure that has responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident or training exercise. [**2500,** 2022]

3.3.74 International Air Transport Association (IATA). An international group composed of the major airlines of the world that reviews aviation policy, including safety items.

3.3.75 International Civil Aviation Organization (ICAO). An international body charged with matters dealing with the development, coordination, and preservation of international civil aviation.

3.3.76 Investigation. A systematic inquiry or examination.

3.3.77 Jet Blast. The thrust-producing exhaust from a jet engine.

3.3.78 Joint Aviation Authority (JAA). An agency in Europe charged with the responsibility of regulating safety in civil aviation.

3.3.79 Knockdown. The reduction of flame and heat to a point where further extension of a fire has been abated and the overhaul stage can begin.

3.3.80 Magnesium. Refers to either pure metal or alloys having the generally recognized properties of magnesium marketed under different trade names and designations.

3.3.81 Master Stream. A portable or fixed firefighting appliance supplied by either hose lines or fixed piping and that has the capability of flowing in excess of 1140 L/min (300 gpm) of water or water-based extinguishing agent. [**600,** 2020]

3.3.82 Mobile Emergency Hospital (MEH). A specialized, self-contained vehicle that can provide a clinical environment that enables a physician to provide definitive treatment for serious injuries at the accident scene.

3.3.83 Moulage. A reproduction of a skin lesion, tumor, wound, or other pathological state. Applied for realism to simulate injuries in emergency exercises.

3.3.84 Mutual Aid. Reciprocal assistance from emergency services based on a prearranged plan.

3.3.85 National Incident Management System (NIMS). A consistent nationwide template that enables all government, private-sector, and nongovernmental organizations to work together during domestic incidents.

3.3.86 National Transportation and Safety Board (NTSB). A US federal agency that is responsible for investigating and determining the probable cause of aircraft accidents.

3.3.87 Ordnance. Explosives, chemicals, pyrotechnics, and similar stores (e.g., bombs, guns, ammunition, flares, smoke, or napalm).

3.3.88 Overhaul. The final stages of fire extinguishment, following knockdown of the main body of fire, during which pockets of fire are sought out to complete extinguishment.

3.3.89 Paramedic. A medical technician who has received extensive training in advanced life support and emergency medicine.

3.3.90 Penetrating Nozzle. An appliance designed to penetrate the skin of an aircraft and inject extinguishing agent.

3.3.91 Perimeter.

3.3.91.1 ***Inner Perimeter.*** That area that is secured to allow effective command, communication, and coordination control and to allow for safe operations to deal with an emergency, including the immediate ingress and egress needs of emergency response personnel and vehicles.

3.3.91.2 ***Outer Perimeter.*** That area outside of the inner perimeter that is secured for immediate-support operational requirements, free of unauthorized or uncontrolled interference.

3.3.92 Post Aircraft Accident. The specific time when all fires have been extinguished, persons have been accounted for, survivors have been removed, and the hazards have been identified.

3.3.93 Preservation of Evidence. After an aircraft accident/incident, it is imperative that investigative evidence be preserved after life safety and rescue operations have been concluded.

3.3.94* Protective Clothing. Equipment designed to protect the wearer from thermal hazards, hazardous materials, or from the hazardous component of a weapon of mass destruction contacting the skin or eyes. [**470,** 2022]

3.3.95 Rendezvous Point/Staging Area. A prearranged reference point, that is, a road junction, a crossroad, or other specified place, where personnel/vehicles responding to an emergency situation initially proceed to receive directions to staging areas or the accident/incident site or both.

3.3.96 Rescue. Those activities directed at locating endangered persons at an emergency incident, removing those persons from danger, treating the injured, and providing for transport to an appropriate health care facility.

3.3.97 Rescue Path. A fire-free path from an aircraft accident site to a safe area. This path, normally selected by evacuees, must be maintained by firefighters during the evacuation process.

3.3.98 Resources. All personnel and major items of equipment that are available, or potentially available, for assignment to incidents. [**1051,** 2020]

3.3.99 Response Time. See 3.3.112.2, Response Time.

3.3.100 Restricted Articles. See 3.3.33, Dangerous Goods.

3.3.101 Runoff. Liquids that flow by gravity away from an aircraft accident and might include aviation fuel (ignited or not), water/foam from firefighting streams, liquid cargo, or a combination of these liquids.

3.3.102 Runway. A defined rectangular area on a land airport prepared for the landing and taking off of aircraft along its length. Runways are normally numbered relative to their magnetic direction.

3.3.103 Salvage. A firefighting procedure for protecting property from further loss following an aircraft accident or fire.

3.3.104* Self-Contained Breathing Apparatus (SCBA). An atmosphere-supplying respirator that supplies a respirable air atmosphere to the user from a breathing air source that is independent of the ambient environment and designed to be carried by the user. [**1981,** 2019]

3.3.105 Size-Up (Risk Assessment). A mental process of evaluating the influencing factors at an incident prior to committing resources to a course of action. [**2500,** 2022]

3.3.106 Smoke Ejector. A mechanical device, similar to a large fan, that can be used to force heat, smoke, and gases from a post-fire environment and draw in fresh air.

3.3.107 Stabilization. The medical measures used to restore basic physiologic equilibrium to a patient, to facilitate future definitive care, in order to ensure survival.

3.3.108 Stabilizer.

3.3.108.1 ***Horizontal Stabilizer.*** That portion of an aircraft's structure that contains the elevators.

3.3.108.2 ***Vertical Stabilizer.*** That portion of the aircraft's empennage that contains the rudder.

3.3.109 Surface Movement Guidance and Control System (SMGCS). A process or plan used by airports conducting operations in visibility conditions less than 366 m (1200 ft) runway visual range (RVR).

3.3.110 Tabletop Training. A workshop style of training involving a realistic emergency scenario and requiring problem-solving participation by personnel responsible for management and support at emergencies.

3.3.111 Threshold. The beginning of that portion of the runway usable for landing.

3.3.112 Time.

3.3.112.1 ***Evacuation Time.*** The elapsed time between an aircraft accident/incident and the removal of all surviving occupants.

3.3.112.2 ***Response Time.*** The total period of time measured from the time of an alarm until the first ARFF vehicle arrives at the scene of an aircraft accident/incident and is in position to apply agent.

3.3.113 Titanium. Refers to either pure metal or alloys having the generally recognized properties of titanium metal, including the fire or explosion characteristics of titanium in its various forms.

3.3.114 Triage. The sorting of casualties at an emergency according to the nature and severity of their injuries.

3.3.115 Triage Tag. A tag used in the classification of casualties according to the nature and severity of their injuries.

3.3.116 Triage Tape. Color-coded tape used in the classification of casualties according to the nature and severity of their injuries.

3.3.117 Turret. A vehicle-mounted master stream appliance.

3.3.118 United Kingdom Civil Aviation Authority (CAA). A UK agency charged with the responsibility of regulating safety in civil aviation.

3.3.119 US National Grid. A standard area and point grid reference system that quickly enables multidiscipline and multijurisdictional emergency service agencies to precisely locate incidents and universally communicate locations using paper maps and/or electronic applications.

3.3.120* Ventilation. The changing of air within a compartment by natural or powered means. [**302,** 2020]

3.3.120.1 ***Mechanical Ventilation.*** A process of removing heat, smoke, and gases from a fire area by using exhaust fans, blowers, air-conditioning systems, or smoke ejectors.

Chapter 4 Pre-Incident Planning for Aircraft Emergencies (NFPA 402)

4.1 General.

4.1.1 Many accidents within the critical rescue and firefighting access area involve undershoots, overshoots, and rejected takeoffs, and are generally survivable. Accidents occurring outside of the critical rescue and firefighting access area might involve impact with adverse terrain, resulting in the rupture of the aircraft structure. Rapid response to these areas is crucial for saving lives.

4.1.2 In addition to routine training programs, airport aircraft rescue and firefighting (ARFF) services and all structural fire departments and community emergency services with jurisdictions adjacent to an airport or its traffic patterns are encouraged to frequently schedule and participate in multiagency training sessions based on the material in this guide. The objective of these sessions should be to focus on achieving maximum unity, compatibility, and effectiveness during aircraft emergencies on or off the airport property. *(See Section 4.5.)*

4.1.3 Throughout the year, all ARFF personnel should participate in regular exercises involving simulated aircraft accidents. Frequent command-level training for those persons assigned to major roles in the airport/community emergency plan is also essential. Command training can be presented as workshops or tabletop exercises designed to develop effective emergency management techniques. Guidance for emergency plan exercises is provided in Chapters 14 –25.

4.1.4 Command authority at any accident site should be predetermined according to the jurisdictional responsibilities of the agencies involved and as designated in the airport/community mutual aid agreement.

4.2 Emergency Response Preplanning.

4.2.1 All ARFF vehicles in use at an airport should be able to meet the provisions of Chapters 1 through 3; 4 through 6; and Annexes A, B, C, D, and I of NFPA 1900 upon acceptance from the manufacturer. They should also be maintained to ensure such levels of performance. Special training should be provided to enhance the skills of all vehicle operators, as their performance is critical to successful vehicle utilization, particularly under unfavorable conditions. ARFF drivers should drive all the service roads and be familiar with any gates.

4.2.2* Operators assigned to each ARFF vehicle should make trial runs to all the areas of the airport in all weather conditions during which flight operations take place. Particular emphasis should be placed on the ability to respond to the critical rescue and firefighting access areas, as these are where most accidents occur. These runs will demonstrate each vehicle's operational capability and the time required to reach each site.

4.2.2.1 Because many aircraft accidents occur in the overrun areas of runways, it is important to provide suitable routes for the vehicles to enable them to reach these areas. Bridges spanning gullies, streams, ditches, cattle grids, or other ground surface appurtenances should be capable of supporting at least 120 percent of the weight of the heaviest emergency vehicle.

4.2.2.2 Some airports have installed engineered material arresting systems (EMAS) at runway ends. These passive systems are designed to bring overrunning aircraft to a safe stop.

4.2.2.3 ARFF equipment can safely traverse these installations, but ARFF crews should understand the specific maneuverability precautions and evacuation issues. *(See 9.4.3.1.)*

4.2.3 Where construction work of any kind is likely to affect the response capability or operational performance of the ARFF service, prior notification of the work should be provided so that amendments can be made to operational procedures to overcome or minimize any effect. This is particularly important where work on airport water mains is likely to close down one or more fire hydrants.

4.2.4 In order to provide multi-vehicle access to an accident site, service roads should be constructed so that one vehicle cannot block ingress or egress of other emergency vehicles. This can be accomplished with roads of sufficient width or suitable passing and turnaround areas. Access to service roads

should also be strategically placed and maintained near the ends of runways or key taxiways so ARFF crews can have all-weather access. Where gates are secured using locks, they should all be capable of being opened using the same key. Where the gates are remotely controlled, each ARFF vehicle should have the ability to perform the unlocking function.

4.2.5 Gates should be located at strategic locations to allow rapid access for ARFF vehicles to areas outside the airport boundary. Keys to gate locks should be carried in each authorized emergency vehicle, and by airport security personnel and designated local emergency services.

4.2.6 Grid maps should be provided for each airport and its environs. They should be ruled with numbered and lettered grids, as shown in Figure 4.2.6, to permit rapid identification of any response area. The area covered by a grid map should be a distance of 8 km (5 mi) from the center of the airport. This distance might vary depending on the type of terrain or location of the airport in relation to other emergency facilities. The map nomenclature should be compatible with that used by off-airport public safety authorities.

4.2.7 Two or more maps might be required where the area exceeds an 8 km (5 mi) radius. One map should display the locations of medical facilities, heliports, and other features according to the airport/community emergency plan. Where more than one grid map is used, the grids should differ by color and scale to assist in their identification.

4.2.8 Prominent local features, access routes, staging areas, and compass headings should be shown to facilitate locating accident and medical facility sites. Copies of grid maps should be prominently displayed at air traffic control, the airport operations office, each airport and community fire station, and all mutual aid service sites, and they should be carried on all the appropriate emergency vehicles.

4.2.9 Emergency backup power systems meeting the requirements of NFPA 111 Level 1 system(s) should be provided in airport fire stations to allow for the rapid operation of vehicle bay doors, the efficient reception/transmission of vital communications, and the provision of emergency lighting.

4.2.10 A communication system from the airport to the community or regional emergency services should be provided. The system should be tested daily.

4.2.11 Any off-airport emergency services authorized to respond to an on-airport incident should have a pre-incident plan for access to the various areas of the airport, particularly the designated staging areas. Personnel should also be trained in the special procedures to be followed once at the airport.

4.2.12 Sufficient ARFF vehicles, personnel, and equipment should be provided to meet the required level of protection specified in Chapters 1 through 3, 4 through 10, and Annex A through E and G of NFPA 460 for the airport during flight operations. When this protection level is reduced for any reason (e.g., off-airport response, mechanical breakdown, lack

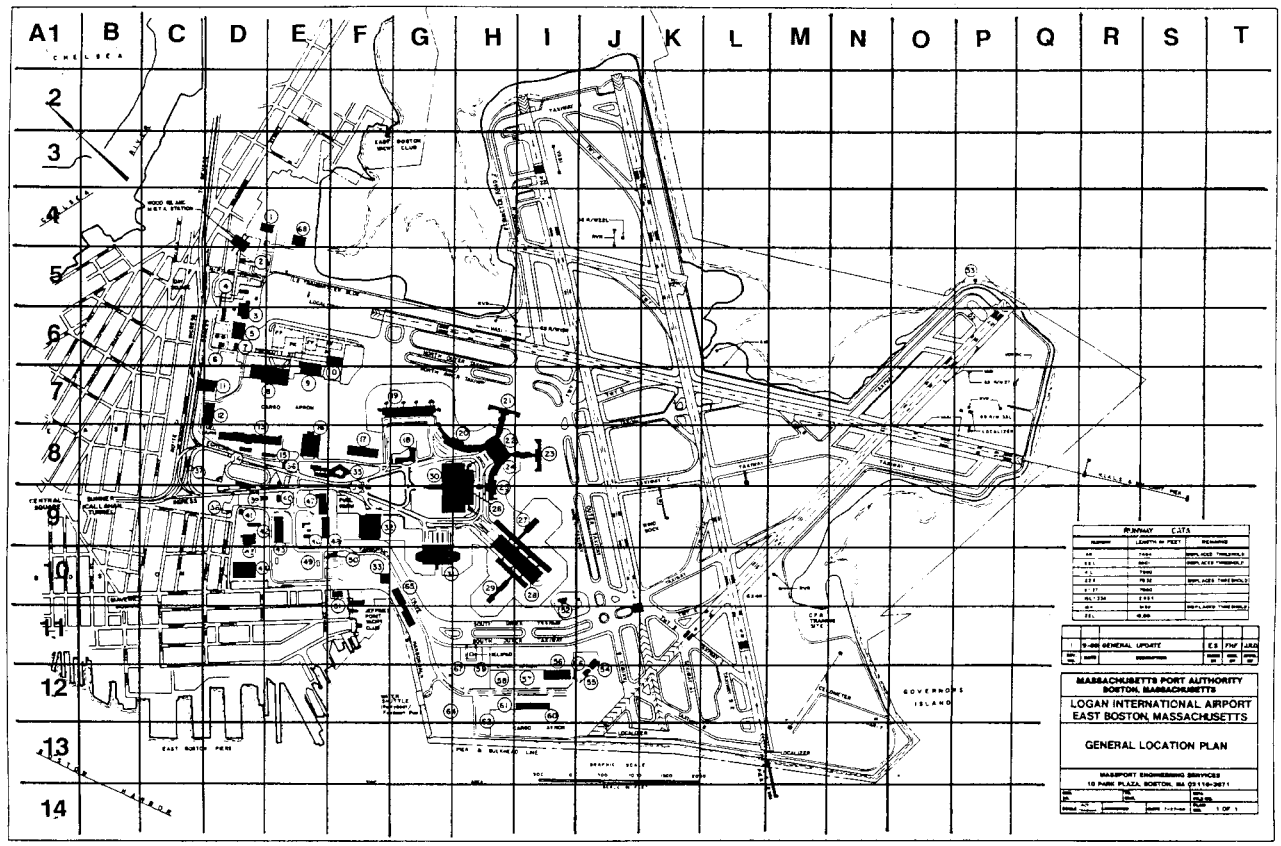


FIGURE 4.2.6 Typical Airport Grid Map.

of qualified personnel), all incoming and departing aircraft should be notified of the change in ARFF capability.

4.2.13 It is important that pre-incident planning include the response of additional pumping vehicles, ladder trucks, elevated platform vehicles, portable lighting equipment, hoisting and lifting equipment, medical supplies, and any other specialized equipment or vehicle that might be required. It is extremely important that the pre-incident plan also ensures the immediate availability of the special vehicles and equipment, qualified drivers/operators, and an approving authority at all times.

4.3 Airport Firefighter Basic Knowledge.

4.3.1 To ensure that airport firefighters have a suitable degree of skill, basic training should be provided in accordance with NFPA 1003.

4.3.2 Comprehensive, continuous in-service training in accordance with Chapters 1 through 3, 11 through 26, and Annex A and G of NFPA 460 should be provided to maintain each firefighter's proficiency. For further information on training subjects, see the references listed in Chapter 2 and Annex L.

4.3.3 The complexity of modern aircraft and the variety of types in service make it difficult to train ARFF personnel in all the important design features of each model. However, personnel should become as familiar as possible with each type of aircraft that normally operates at an airport. Particular emphasis should be placed on all of the following:

(1) Location and operation of normal and emergency exits, cargo doors, equipment, and galley access doors
(2) Seating configurations
(3) Type of fuel and location of fuel tanks
(4) Location of ejection seats and armament (military aircraft)
(5) Locations of batteries, hydraulics, and oxygen systems
(6) Positions of break-in points on the aircraft
(7) Location of rapidly activated standby generators or turbines
(8) Location of fire access panels
(9) Location of aircraft construction materials (carbon fibers, composite materials, etc.) that are subject to releasing hazardous/toxic substances when burning
(10) Location of hazard areas (e.g., collapse zones)
(11) Use and application of new and emerging technologies for aircraft and alternative energy sources

4.3.4 Airports are large commercial complexes that contain many potential life and fire hazards. These hazards vary relative to aircraft operations, time of day, weather conditions, construction, or a combination of these factors. It is, therefore, vital that ARFF personnel become extensively knowledgeable about their airport and any changes that could adversely affect immediate response or the efficient performance of their rescue and firefighting responsibilities. Minimum requirements should include knowledge of all of the following:

(1) Water supply locations (hydrants)
(2) Runway identifications and locations
(3) Taxiway identifications and locations
(4) Airport lighting systems
(5) Most effective response routes and alternatives
(6) Fuel handling and storage areas
(7) Key airport locations
(8) Airport service roads
(9) Gates and fences
(10) Airport drainage systems
(11) Fire protection systems and components within airport hangars and facilities

4.4 Communications.

4.4.1 All airport emergency vehicles should be provided with multi-channel two-way radios that operate on the airport's assigned ground control frequency and other airport emergency frequencies.

4.4.2 Preferably, airport ARFF vehicles should be able to monitor or be in direct voice communication with an aircraft during an emergency situation. This procedure is especially important when airport control towers are not in operation. A discrete emergency frequency (DEF), where available, should be used for communication between the aircraft crew and the ARFF incident commander.

4.4.3 At an aircraft accident site, power megaphones can be used to coordinate flight deck crew/ARFF activities, direct evacuating aircraft occupants to safe locations, and so forth.

4.4.4 Portable radios can be utilized at an accident site to communicate with the command post, airport emergency dispatcher, airport management, arriving back-up units, and so forth. Where personnel and vehicles from more than one agency operate in mutual support, common radio frequencies or other interoperable solutions should be available. If common frequencies or other interoperable solutions are not used, pre-incident planning procedures should be enacted so that portable radios can be exchanged, the use of messengers can be employed, or methods of relaying messages through the command post can be utilized. When portable radios are exchanged, consideration should be given to avoiding channel saturation and the maintenance of communication discipline.

4.4.5 Experience from recent accidents has shown that the use of automated voice notification systems greatly facilitates emergency response/mutual aid notification.

4.4.6 The use of cellular telephones in ambulances, supervisory vehicles, and command post vehicles can provide significant benefits for command and control functions.

4.5 Mutual Aid Considerations.

4.5.1 It is essential to have mutual firefighting assistance agreements with community and regional off-airport fire departments. Successful rescue operations and handling of aircraft accident fires both on- and off- airport depend on pre-incident planning for the effective use of mutual aid *(see also Annex D)*. The following considerations are significant:

(1) Special attention should be given to ensuring compatibility in equipment design (e.g., fire hose threads, communications equipment, etc.) and fire control operational techniques.
(2) It is important to familiarize structural fire department personnel with the special problems related to aircraft rescue and firefighting, including methods of access to aircraft operating areas and how to operate vehicles while at the airport.

4.5.2 Airport orientation visits should be arranged by fire departments bordering airports for consultation with the airport fire department, airlines, military services, and others as appropriate. Their training in airport/aircraft familiarization should include those items listed in 4.3.3 and 4.3.4, as well as grid maps of the airport and surrounding area.

4.5.3 Structural firefighting vehicles normally carry small amounts of water compared to the amounts usually carried on major airport ARFF vehicles. However, they can be useful in relaying water from hydrants, reservoirs, or other sources to maintain ARFF vehicle supplies.

4.5.4 Structural firefighters can assist airport ARFF personnel by handling hose lines, operating tools and equipment, assisting in rescue operations, and protecting against exposure.

Chapter 5 Flight Deck Crew and ARFF Personnel Responsibilities (NFPA 402)

5.1 Areas of Responsibility.

5.1.1 The flight deck crew, flight attendants, and ARFF personnel should have the skills to deal with aircraft emergencies and should be familiar with each others' responsibilities to ensure that all their efforts are clearly directed toward the common goals of life safety and fire protection.

5.1.2 The prime mission of all concerned is the safety of all persons aboard the aircraft and any others involved in the emergency. Duties and responsibilities can generally be defined as follows:

(1) Flight deck crews and flight attendants are responsible for the aircraft and for the safety of its occupants. The final decision to evacuate an aircraft, and how to do so, is made by the flight deck crew.
(2) It is the duty of responding ARFF personnel to create conditions in which survival is possible and evacuation or rescue can be conducted. As visibility from within an aircraft is limited, any external features or situations likely to be of significance in the evacuation process should be communicated to the aircraft's crew. Should it become apparent that crew incapacitation precludes their initiation of evacuation, the incident commander of the ARFF personnel should take the initiative to do so.
(3) In some cases, evacuation and passenger-assisted rescues might have already commenced prior to the arrival of ARFF crews.
(4) Care should be taken by ARFF operators to avoid causing further injury or death to evacuating occupants.

5.1.3 To prevent injury when an emergency aircraft evacuation takes place, consideration should be given to assisting occupants in using the aircraft slides.

5.2 Communications.

5.2.1 Effective communications between flight deck crew and ARFF personnel is very important during emergencies. Contact should be established at the earliest possible time between persons in charge of each group. Exchange of pertinent information can assist in developing better decisions and plans of action. Several methods of direct communication are generally available, such as aircraft interphone, tower relay, direct radio communication via approved DEF, or visual signals.

5.2.2 Where aircraft engines are operating, radio communications near the aircraft can be very difficult. Most aircraft are equipped with intercom systems and provided with plug-in jacks normally located under the forward portion of the aircraft near the nose gear. ARFF personnel should be aware of this means of communication and carry the necessary headset and microphone to plug into these facilities. Even with the engines operating, direct communications with the flight deck crew can be established by use of this system as long as the power is on.

5.2.3 Where a more direct means of communication cannot be established, a designated ARFF individual should go to the left side (pilot's left) of the aircraft nose and establish direct eye contact and voice communication with the captain of the flight deck crew. It might be necessary to resort to hand signals to communicate. Figure 5.2.3 depicts standard international ground-to-aircraft hand signals that should be used by ARFF personnel to communicate with the captain during emergencies. These hand signals are established for emergency communication between the ARFF incident commander and/or ARFF firefighters and the cockpit and/or cabin crews of the incident aircraft. ARFF emergency hand signals should be given from the left front side of the aircraft for the cockpit crew. (Note: In order to communicate more effectively with the cabin crew, emergency hand signals may be given by ARFF firefighters from other positions.) With helicopters and aircraft with different seating configurations, ARFF individuals should establish communication from the other side of the aircraft.

5.2.4 If aircraft engines are operating, ARFF personnel should use extreme caution when approaching an aircraft for communications purposes as described in 5.2.2 and 5.2.3. The aircraft should be approached only from the front and well ahead of the nose and, if possible, in full view of the captain. Vehicle and hand-held lights should be used in periods of darkness and poor visibility. See Table 5.2.4 for light-gun signals.

Recommend Evacuation — Evacuation recommended based on ARFF incident commander's assessment of external situation.

Arm extended from body and held horizontal with hand upraised at eye level. Execute beckoning arm motion angled backward. Nonbeckoning arm held against body.

Night — same with wands.

Recommend Stop — Recommend evacuation in progress be halted. Stop aircraft movement or other activity in progress.

Arms in front of head, crossed at wrists.

Night — same with wands.

Emergency Contained — No outside evidence of dangerous condition or "all clear."

Arms extended outward and down at a 45-degree angle. Arms moved inward below waistline simultaneously until wrists crossed, then extended outward to starting position (umpire's "safe" signal).

Night — same with wands.

FIGURE 5.2.3 Standard International Ground-to-Aircraft Signals. ***(Photos courtesy of the Air Line Pilots Association.)***

Table 5.2.4 Standard Air Traffic Control Tower Light-Gun Signals

	Meaning		
Color and Type of Signal	**Movement of Vehicles, Equipment, and Personnel**	**Aircraft on the Ground**	**Aircraft in Flight**
Steady green	Cleared to cross, proceed, or go	Cleared for takeoff	Cleared to land
Flashing green	Not applicable	Cleared for taxi	Return for landing (to be followed by steady green at the proper time)
Steady red	STOP	STOP	Give way to other aircraft and continue circling
Flashing red	Clear the taxiway/ runway	Taxi clear of runway in use	Airport unsafe do not land
Flashing white	Return to starting point on airport	Return to starting point on airport	Not applicable
Alternating red and green	Exercise extreme caution	Exercise extreme caution	Exercise extreme caution

Chapter 6 Emergency Response (NFPA 402)

6.1 General.

6.1.1 The survivable atmosphere inside an aircraft fuselage involved in an exterior fuel fire is limited to approximately 3 minutes if the integrity of the airframe is maintained during the impact. This time could be substantially reduced if the fuselage is fractured. When the aluminum aircraft skin is directly exposed to flame, burn through will occur within 60 seconds or less, while the windows and insulation may withstand penetration for up to 3 minutes. Because of this serious life hazard to occupants, rapid fire control is critical. Therefore, whenever flight operations are in progress, ARFF vehicles and personnel should be located so that optimum response and fire control can be achieved within this time frame.

6.1.2 At many airports portions of the critical rescue and firefighting access areas, as shown in Figure 6.1.2, might be outside the airport boundaries. There also can be obstructions created by natural features, highways, or railroad right-of-ways that would delay or preclude access by ARFF vehicles. In these instances, consideration should be given to providing specialized vehicles where conventional vehicles can be restricted due to unusual terrain characteristics. Any delay in response time is critical, and mutual assistance agreements with off-airport agencies should be established to provide optimum response in problem areas.

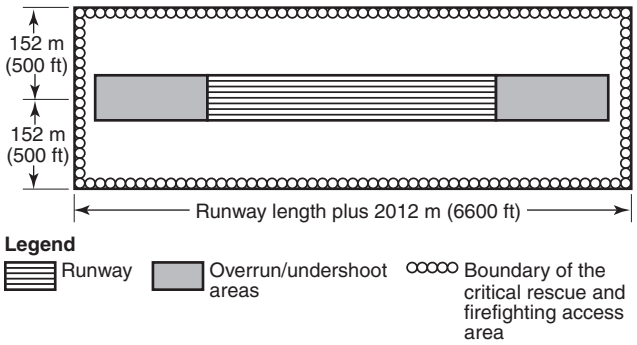


FIGURE 6.1.2 Critical Rescue and Firefighting Access Area.

6.1.3 To obtain the desired response, pre-incident planning should include a wide range of factors such as adequate alarm systems, fire station locations (or prepositioning of resources), vehicle operator training, airport familiarization, and staging areas for outside assistance.

6.1.4 Fire stations should be located to allow rapid direct access to the operational runway(s) so that maximum acceleration rate and top speed of the vehicles can be utilized to enable them to reach any point on the runway(s). The access road to the runway(s) should be as direct as possible.

6.1.5 All-weather access routes to the critical rescue and firefighting access area suitable for ARFF vehicles should be designated and should be maintained in usable condition while flight operations are in progress.

6.1.6 To minimize response times, operational procedures should exist through which ATC would stop or divert all aircraft and nonessential traffic that would conflict with responding emergency vehicles.

6.1.7 Airports updating their master plan for airport development should consider the location of obstructions in the critical rescue and firefighting access area, such as ditches, mounds, vegetation, or nonfrangible structures that could cause extensive damage to any overrunning aircraft or obstruct the positioning of emergency vehicles.

6.2 Low-Visibility Operations.

6.2.1 New and improved techniques for instrument takeoff and landing permit flight operations to continue under adverse weather conditions. Low-visibility operations criteria vary from one airport to another depending upon the type of instrument landing system available, the level of natural and manmade obstructions in the surrounding terrain, the type of runway lighting, and the capability of the onboard instrument systems of the aircraft using the airport. Such operational minimums can vary from 5 km (3 mi) visibility to 100 m (300 ft) for landings, with similar restrictions for takeoff. ARFF personnel should ascertain operational restriction levels from the local ATC agency or airfield operations, or both, in order to establish response capability under low-visibility conditions.

6.2.2* Although aircraft operational navigational weather minimums might not be in effect, fully staffed Local Standby Alert procedures should be initiated when flight operations are in progress and surface visibility and conditions are less than 800 m (½ mi). Whenever operational or environmental conditions exist that have the potential to impede a timely ARFF response, an assessment should be made regarding ARFF personnel and equipment or repositioning of resources or both. *(See also Section 10.2.)*

6.2.3 Standbys during low-visibility operations and adverse weather conditions should have at least one major ARFF vehicle located at a distance no closer than the taxiway hold line adjacent to the midpoint of the active runway, unless the fire station(s) location(s), as shown in Figure 6.2.3, permits effective response times. When on standby, vehicle operators should keep engines running and such lights operating as needed to effectively mark the position of the vehicle. If the vehicle is equipped with a Forward Looking Infrared (FLIR) system, it should be fully operational with an in-cab display.

6.2.4 ARFF personnel assigned to any standby should monitor all applicable radio frequencies.

6.2.5 ATC should be made aware of the exact location of the ARFF vehicles assigned to standby duty. Where available, surface navigational aids, such as ground radar (ASDE), should be fully utilized through coordination between ARFF personnel and the control tower.

6.2.6 ARFF vehicles can be equipped with an infrared vision system to help the crew of the vehicles locate and respond to emergencies in low-visibility conditions.

6.2.7 Positioning equipment such as the driver's enhanced vision system (DEVS) can be installed on ARFF vehicles so drivers know their position on the airport at all times.

6.3 Considerations for Airports Adjacent to Water.

6.3.1 Where airports are situated adjacent to large bodies of water such as rivers or lakes, or where they are located on coastlines, provisions should be made for the availability of specialized water rescue vessels or helicopters, or both, and equipment should be in place.

6.3.2 Inclined ramps or docking facilities should be considered by airports located adjacent to large bodies of water to allow rapid response to aircraft accidents. Launch ramps should be located adjacent to the overrun areas of the critical rescue and firefighting areas. Where appropriate, ARFF crews should have navigational maps available.

6.3.3 For rescue purposes, the vessel(s) should be equipped with flotation platforms, rafts and/or personal flotation devices, or a combination of these for the maximum number of occupants carried on the largest aircraft regularly scheduled into the airport.

6.3.4 Rescue vessels should be capable of rapid response to the accident site.

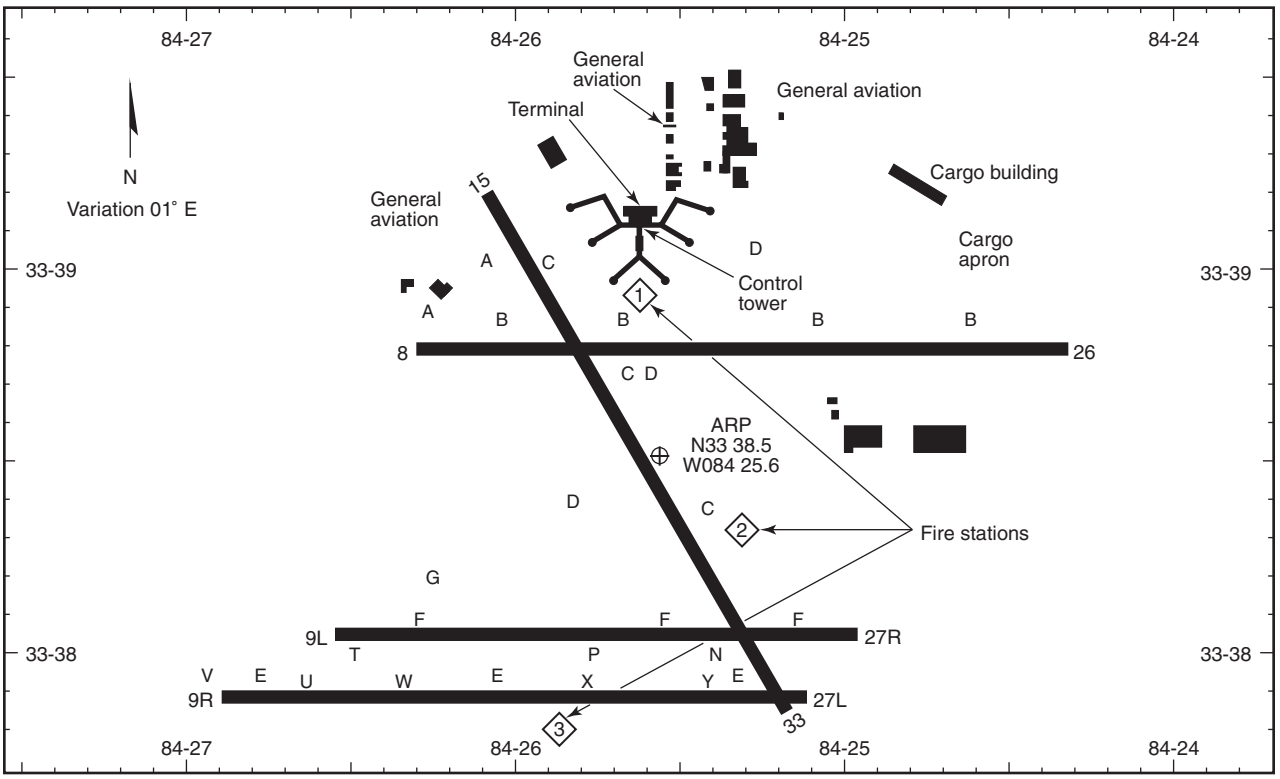


FIGURE 6.2.3 Example of Airport Fire Station Locations.

Chapter 7 Factors Common to Airport Emergencies (NFPA 402)

7.1 General.

7.1.1 The primary hazard associated with aircraft accidents is liquid fuels that are likely to be released and ignited during the accident sequence. A secondary hazard is fuels released but not ignited that could subsequently be ignited prior to or during the egress of occupants. In addition, fires can occur involving combustible materials such as interior furnishings, stored goods, and aircraft system components. Further complications could result if the aircraft comes to rest in such an attitude that forcible fuselage entry or shoring for stabilization might be required. (See also Annex K for information related to electrical and hydrogen powered aircraft hazards).

7.1.2 During all aircraft emergencies, all persons not directly involved in the ARFF phase of the incident, including the news media, should be required to stay well clear of the site until evacuation, occupant care, full fire control, and site safety security are completed. Responsibility for site security should be preassigned to the law enforcement agency of primary jurisdiction and could be augmented by other law enforcement agencies, guards, military personnel, and volunteers as needed.

7.1.3 The various emergencies that can be anticipated include emergencies involving aircraft in flight *(see Section 7.2)*, as well as emergencies that occur on the ground. The emergency declarations associated with pre-flight and post-flight aircraft operations, maintenance, and servicing are generally referred to as aircraft ground emergencies. Information on aircraft ground emergencies can be found in Sections 12.1 through 12.10 of this document.

7.2 Types of Alerts.

7.2.1 The terms used to describe categories of emergency alerts are not standardized. *Local standby alert, full emergency alert,* and *aircraft accident alert* and the International Civil Aviation Organization (ICAO) terms *local standby, full emergency*, and *aircraft accident* are equivalent. Individual airports might have adopted their own nomenclature for the terms *local standby alert, full emergency alert,* or *aircraft accident alert.* This must be coordinated with the appropriate authority.

7.2.2 Local Standby Alert (Local Standby). When an aircraft has or is suspected to have an operational defect, the incident should be considered a Local Standby Alert. The defect should not normally cause serious difficulty for the aircraft to achieve a safe landing.

7.2.2.1 Under Local Standby Alert conditions, at least one ARFF vehicle should be staffed and positioned to permit immediate use in the event of an accident.

7.2.2.1.1 If time and conditions permit, ARFF personnel should be advised of the following:

(1) Aircraft type
(2) Number of passengers and crew
(3) Amount of fuel remaining
(4) Nature of the emergency
(5) Type, amount, and location of dangerous goods aboard
(6) Number and location of nonambulatory passengers on board, if any

7.2.2.1.2 All other in-service ARFF vehicles should remain available for immediate response.

7.2.2.2 Whenever operational or environmental conditions exist that have the potential to impede a timely ARFF response, an assessment should be made regarding ARFF personnel and equipment or repositioning of resources or both.

7.2.2.3 Operational policies should be in effect for aircraft movements not normally encountered by the airport.

7.2.2.4* A Local Standby Alert should also be initiated when an aircraft is involved in an operation that could present an additional life hazard risk.

7.2.3 Full Emergency Alert (Full Emergency). When an aircraft has or is suspected to have an operational defect that affects normal flight operations to the extent that there is danger of an accident, the incident should be considered to be a Full Emergency Alert, or a Full Emergency.

7.2.3.1 When a Full Emergency Alert emergency is declared, ARFF personnel should be provided with detailed information that allows preparation for likely contingencies. A full response should be made with the ARFF vehicles staffed and in position with engines running and all emergency lights operating so that the fastest response to the accident/incident site can be accomplished.

7.2.3.2 It is important that appropriate radio frequencies be continuously monitored by ARFF personnel. One or more major ARFF vehicles should be able to initiate fire suppression within the briefest period of time after the aircraft comes to rest. Standby positions for ARFF vehicles should be established for the type of emergency and aircraft involved.

7.2.3.3 ARFF personnel should be informed of any changes in a distressed aircraft's emergency situation.

7.2.4 Aircraft Accident Alert (Aircraft Accident). This alert denotes that an aircraft accident has occurred on or in the vicinity of the airport.

7.2.4.1 Regardless of the source of an Aircraft Accident Alert alarm, full ARFF response should be put into effect. When possible, all known pertinent information should be relayed via radio by ATC to responding units and include, as accurately as possible, the accident location using landmarks and grid map coordinates.

7.2.4.2 When an accurate accident location is not available, ARFF personnel should anticipate the worst situation and stand by until signs of an accident are evident or better information is received. Mutual aid assistance should be initiated in accordance with the airport/community emergency plan. *(See also Chapter 14 and ICAO Airport Services Manual, Part 7.)* During all Aircraft Accident Alerts, ARFF crews should always assume there are survivors.

7.3 Vehicle Response to Aircraft Accidents.

7.3.1 ARFF vehicles should approach any aircraft accident by the route that provides the most expeditious and safest possible response. This might not necessarily be the shortest distance to the scene. Traversing unimproved areas can take longer than traveling a greater distance on paved surfaces such as taxiways, ramps, and roads. Total response time is vital. Preferred routes, especially those within the critical rescue and firefighting access area, should be preselected. Practice response runs should be made under both ideal and inclement weather conditions.

7.3.2 In some cases, runways and taxiways are blocked by aircraft awaiting taxi clearance or takeoff. Vehicle operators should be aware of alternate routes that can be used so as not to delay response.

7.3.3 The load-bearing characteristics of the airport soil structure under various weather conditions should be known, and vehicle operators should be trained to deal with off-road driving conditions.

7.3.3.1 When responding in rough terrain conditions, ARFF responders should consider alternate routes.

7.3.3.2 For those airports that have Engineered Material Arresting Systems (EMAS) installed at runway ends, ARFF personnel should be mindful of the following:

(1) While vehicles may depress the material, the material should not cause the vehicles to become bogged down.
(2) While material is inherently noncombustible, it could absorb fuel.

7.3.4 When nearing the accident scene, vehicle operators should be alert to avoid all persons in the area, especially those who might be injured, unconscious, or wandering about in a dazed condition. In darkness, periods of low visibility, or when operating in areas of tall vegetation, extra caution and effective use of lighting equipment, audible warnings, FLIR systems, or a combination of these might be needed.

7.4 Positioning of ARFF Vehicles.

7.4.1 Information from the flight deck crew relative to the nature of the emergency will assist the ARFF personnel to better determine the most advantageous positioning of the vehicles upon arrival at the scene of an aircraft emergency.

7.4.2 Piston-type engine aircraft provide different options for initial positioning of ARFF vehicles than do turbojet aircraft that have swept-back wings and produce a jet blast hazard. ARFF personnel should therefore consider an approach from the nose of jet aircraft. However, this should not become a standard procedure as wind conditions, terrain, type of aircraft, location of engines, cabin configurations, and other factors can dictate the optimum approach in a given circumstance.

7.4.3 Propellers turning on turboprop or piston-type engine aircraft present a hazard to evacuees and ARFF personnel.

7.4.3.1 Turbojet engines present different problems, as the areas directly ahead of and for a considerable distance behind the engines should be avoided because of the intake and jet blast hazards.

7.4.3.2 Turbojet engines will rotate for a considerable time after they have been shut down, as shown in Figure 7.5.6.

7.4.4 When combination cargo/passenger (COMBI) aircraft have declared an emergency, ARFF personnel should be informed of cabin configurations prior to the landing. Because some cargo areas extend over the wings, the overwing exits could be unavailable for use as emergency exits.

7.4.5 The mission of the first-arriving ARFF vehicle and crew is to assist in the evacuation of occupants, prevent the outbreak or spread of fire, and perform any rescue operations required. The vehicle should be positioned to protect the principal evacuation route being used by the occupants. Caution must be exercised to avoid placing evacuees, ARFF personnel, or vehi-

cles in locations that could become hazardous in the event of a sudden extension of fire.

7.4.5.1 Vehicle position should never obstruct aircraft evacuation or interfere with the deployment of evacuation slides. *(See also Chapter 9.)*

7.4.5.2 Vehicles should be positioned to allow for optimal application of extinguishing agents and deployment of handlines.

7.4.5.3 Consideration should be given to the apparatus operator applying an extinguishing agent to the maximum amount of surface area around and under the aircraft in a minimum amount of time.

7.4.5.4 Additional consideration should be given to the rapid deployment of handlines around and into the aircraft.

7.5 Hazards to ARFF Personnel.

7.5.1 ARFF personnel should always remain alert to the presence of flammable vapors. Elimination of ignition sources and the maintenance of a foam blanket are the best procedures for preventing ignition.

7.5.2 All ARFF personnel should be provided with and be required to wear proper protective clothing and equipment (PPE). Personnel should be fully trained in the use limitations and value of such protective clothing and equipment by utilizing them in frequent firefighting drills.

7.5.3 Aircraft structures damaged by fire or impact forces are often very unstable and subject to collapse or rollover. If these conditions are suspected to exist, precautions in the form of blocking or shoring should take place as soon as practicable to ensure the safety of ARFF personnel working in the area.

7.5.4 If dangerous goods are believed to be involved in an emergency, procedures should be carried out as prescribed in the US Department of Transportation *Emergency Response Guidebook*. This also includes incidents involving agricultural spraying aircraft and the associated pesticides.

7.5.5 An aircraft undercarriage fire creates a potential for aircraft collapse or explosive disintegration of affected components from wheel assemblies. Personnel should not cross the possible fragmentation area, which covers a 45-degree angle from the side of the wheel assemblies to a distance of at least 90 m (289 ft), as shown in Figure 7.5.5.

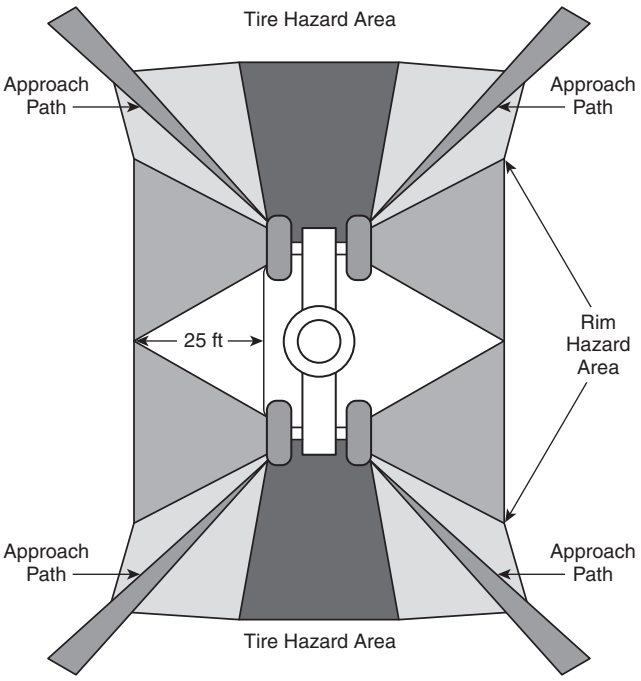
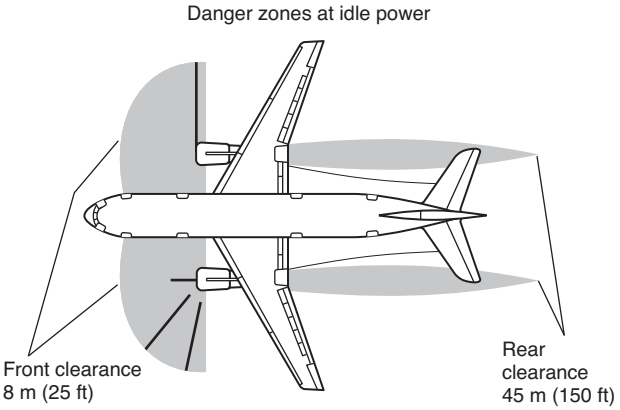


FIGURE 7.5.5 Wheel Fragmentation Area.



Note: Crosswinds will have considerable effect on contours.

FIGURE 7.5.6 Engine Run Danger Areas.

7.5.6 ARFF personnel should stay well clear of an operating jet engine to avoid intake and exhaust hazards. The danger zones at idle power are shown in Figure 7.5.6. Before ARFF personnel approach an aircraft, the incident commander should request that the captain shut down appropriate engine(s) to ensure that there is a safe area of work.

7.5.7 The propellers of piston-type engine aircraft should never be moved when at rest as any movement could, under certain conditions, restart the engine. ARFF crews should be aware of the various prop arcs of aircraft and make it standard operating procedure to never pass under or through a prop arc.

7.5.8 Some modern jet aircraft are equipped with ram air turbines (RAT) or air driven generators (ADG), as shown in Figure 7.5.8, designed to provide back-up electrical and hydraulic power in the event of in-flight failures of primary systems. These devices are often designed to deploy from flush fuselage or engine-mounted storages, and some can deploy with considerable force. ARFF personnel should be aware of aircraft employing these systems and their locations. Serious injury could result should the RAT accidentally deploy and strike a person during emergency operations.

7.5.9 On some aircraft if the ground spoilers are deployed and an overwing exit is opened, the ground spoilers will rapidly retract down. This is done so that exiting passengers will not be hampered in evacuation. The slide also deploys from the side of the fuselage.

FIGURE 7.5.8 Ram Air Turbine.

7.5.10 When approaching a helicopter while the pilot is conscious, approach in full view and follow the pilot's instruction (pilot normally sits in the right-hand seat); avoid blind areas where the pilot cannot be seen. Figure 7.5.10(a) shows the danger areas around a helicopter. Under crash conditions where the pilot is incapacitated and the rotors are still operating, it may be advisable to approach in a crouching position from the side opposite the tail stabilizing rotor at a position slightly to the rear of the main rotor head, remaining as close to the fuselage as possible, because the main rotors are designed to rise clear above the tail [remember that main rotors tend to lower at the front of the helicopter, as shown in Figure 7.5.10(b)].

7.5.11 The use of composite materials in aircraft construction necessitates the use of appropriate PPE and respiratory protection. The problem areas are as follows:

(1) Emission of toxic gases from the decomposition of resins and bonding agents.
(2) Airborne sharp particles of composite materials that can be ingested into the respiratory system and cause skin injuries and traumatic dermatitis.
(3) In post-fire conditions composite materials are capable of absorbing all of the products of a post-crash fire, potentially acting as a carrier if fibers enter the body by skin injection or inhalation.
(4) Composite materials exhibit different characteristics for firefighting and extrication.

7.5.11.1 A size-up of whether or not composite materials are involved with the accident/incident should be undertaken, and the appropriate level of personnel protection for site management should be established. Factors to be considered should include the following:

(1) Whether composite materials, carbon, aramid, boron, fiberglass, or other synthetics are involved
(2) The scale of involvement
(3) Whether the composite material components in the internal airframe structure (e.g., flooring, seating) (internal containment if fuselage is intact) or external airframe structure (e.g., skin panel control surfaces, rotor blades) are free to atmosphere
(4) The prevailing wind and weather conditions
(5) Whether there is a fire or immediate risk of fire

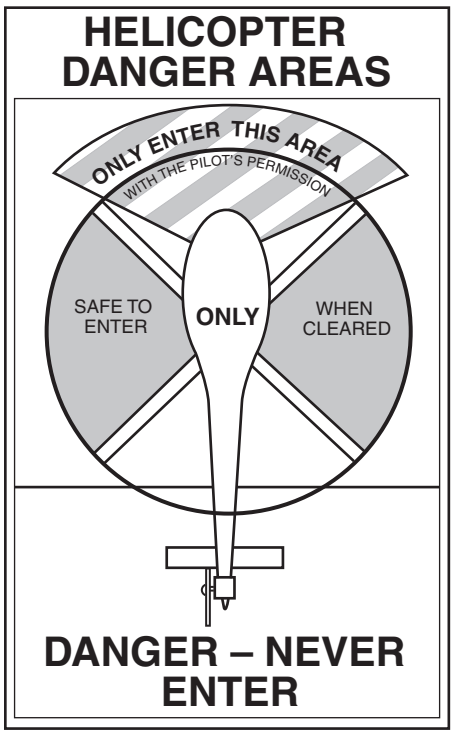


FIGURE 7.5.10(a) Helicopter Danger Areas.

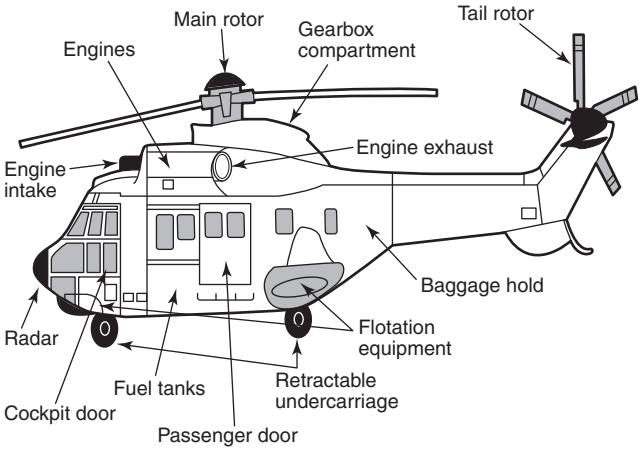


FIGURE 7.5.10(b) Helicopter Showing Main Rotor Lower in Front.

7.5.11.2 ARFF vehicles should be positioned on the upwind side whenever possible.

7.5.11.3 In post-fire conditions when composite materials such as carbon, aramid, boron, fiberglass, and other synthetics are involved, the fibers may initially be suppressed within the accident site by the application of aspirated foam or fine water spray, or by covering the immediate wreckage with salvage sheets, which will assist in the control of airborne fibers materials. When resources are available, the above can be achieved by the application of water-based suppressants or mixtures similar to a domestic-based floor wax.

7.5.11.4 Control of access and egress from the scene is essential for successful decontamination. ARFF personnel should undergo formal decontamination based on likely hazards and levels of exposure.

7.5.11.5 Ballistic Parachute Recovery System (BPRS).

7.5.11.5.1 An increasing number of certified general aviation, amateur built, light sport, and ultralight aircraft are now being fitted with a ballistic parachute recovery system (BPRS). In the event of an aircraft structural failure or loss of flight control, the pilot can activate the BPRS. The BPRS is designed to recover control and lower the aircraft and occupants to the ground at a survivable rate. A typical BPRS consists of a parachute, attachment cables, and a propellant system for deployment.

7.5.11.5.2 The components of the propellant system will contain detonators, small explosive charges, and solid-fuel rocket motors, which cannot be rendered safe by emergency response personnel.

7.5.11.5.3 Inadvertent operation of a BPRS may result in serious injury or death. When approaching a general aviation accident, an early assessment should be made to determine if a BPRS is installed. A robust emergency plan should be developed for dealing with a BPRS that safeguards emergency responding personnel and the aircraft occupants against inadvertent operation during extrication activities and wreckage movement. Further information can be found on the FAA web site (www.faa.gov) under ARFF and first responder training. Also see Certification Alert 13-04, *Additional Precautions for Approaching Aircraft with Ballistic Parachutes, Ejection Seats, and Airbags*, under ARFF related CertAlerts on the FAA website.

7.5.11.6 Lithium-Ion Main Battery Events.

7.5.11.6.1 Some airplanes, both commercial and military, are being equipped with lithium-ion batteries. These batteries store energy that can generate intense heat in the event of a short circuit or other failures. Lithium-ion batteries can short circuit if they are improperly packaged, dropped, damaged, or have manufacturing defects.

7.5.11.6.2 Each lithium-ion cell contains a flammable electrolyte. If the cell has a short circuit or is exposed to high temperatures, it can swell and the electrolyte may begin to vaporize, creating internal pressure resulting in a thermal runaway.

7.5.11.6.3 For example, on the Boeing 787 the lithium-ion batteries are secured inside a reinforced stainless-steel enclosure that is capable of containing a lithium-ion battery event. Venting of vapor during a battery failure event may be visible from an exterior vent on the bottom of the airplane under the forward or aft electrical and electronic (E&E) bay. During active venting, there is no reason to make access to the E&E bay.

7.5.11.6.4 Suppression Considerations. Water is considered the preferred agent for suppressing lithium-ion battery fires. Water has superior cooling capacity, is plentiful (in many areas), and is easy to transport to the seat of the fire. While water might be the agent of choice, the module/cabinet configuration could make penetration of water difficult for cooling the area of origin, but might still be effective for containment. Water spray has been deemed safe as an agent for use on high-voltage systems. The possibility of current leakage back to the nozzle, and ultimately the firefighter, is insignificant based on testing data published in the Fire Protection Research Foundation report *Best Practices for Emergency Response to Incidents Involving Electric Vehicles Battery Hazards: A Report on Full-Scale Testing Results*. Firefighting foams are not considered to be effective for these chemistries because they lack the ability to cool sufficiently and can conduct electricity. There is also some evidence that foams might actually encourage thermal runaway progression by insulating the burning materials and exacerbating heat rise. [**855:**C.5.1]

Firefighting dry chemical powders can eliminate visible flame. However, they also lack the ability to cool burning battery components. Quite often, even if visible flame is removed, the thermal runaway inside the battery will continue resulting in re-ignition. Carbon dioxide and inert gas suppressing agents will also eliminate visible flame but will likely not provide sufficient cooling to interrupt the thermal runaway process. ESS with clean agent suppression systems installed have ventilation systems that are tied in with the fire detection and control panel so that the HVAC shuts down and dampers close to ensure the agents have sufficient hold times at the proper concentration levels to be effective suppressants. In some fire suppression systems, the HVAC recirculates and does not shut down and provides a means of dispersing the clean agents. Responders must ensure adequate hold time has occurred prior to accessing battery room/container. Manufacturer-recommended times should be made clear. These agents might also reduce flammability by suppressing oxygen levels, but data has identified that flammable gases will continue to be produced due to the continued heating and could create an environment ripe for flashover or backdraft when oxygen is reintroduced into the system. [**855:**C.5.1]

Chapter 8 Aircraft Construction and Materials (NFPA 402)

8.1 Aircraft Construction.

8.1.1 It is fundamental that ARFF personnel have a working knowledge of named parts and construction of an aircraft to ensure commonality in terms used and recognition of potential difficulties and hazards when gaining access or extricating casualties. Aircraft are manufactured in many sizes. However, the terms used in respect to identification of structural features are common to most sizes of aircraft. These are identified in Figure 8.1.1.

8.1.2 The structure of the fuselage consists of the following components, as shown in Figure 8.1.2:

(1) The tapering shape of the fuselage is formed by a series of vertical frames (formers) placed transversely from nose to tail.

(2) Metal struts (stringers) run horizontally along the length of the fuselage, positioned around the circumference of the formers.
(3) The cabin floor is supported by horizontal weight-bearing struts (longerons).
(4) The rigidity of the airframe is achieved by an aircraft skin (stressed aircraft skin), which is riveted or bonded to the formers and stringers.

8.1.3 The structure of the wings (main plane), as shown in Figure 8.1.3, consists of tapering spars (main and secondary spars), which can run either from the center section of the fuselage or from wing tip to wing tip. The number of spars depends on the wing design. Struts (ribs) are placed at right angles to the spars to form a profile of the wing design. Struts (stringers) run across the ribs, on which a stressed aircraft skin is riveted or bonded.

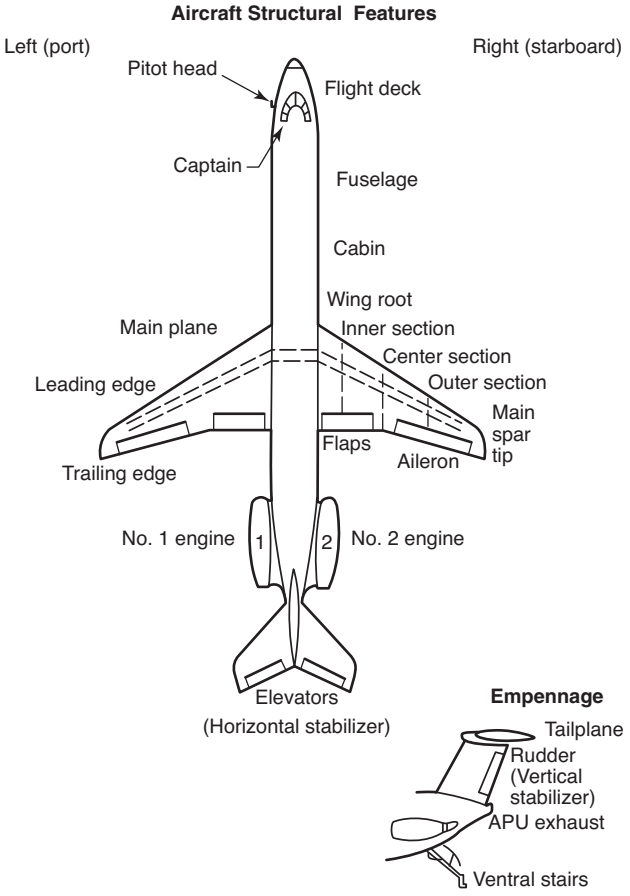


FIGURE 8.1.1 Nomenclature for Aircraft Structural Features.

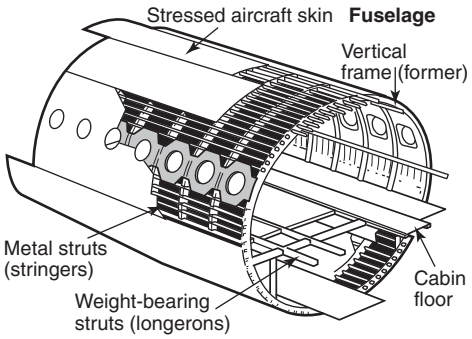


FIGURE 8.1.2 Fuselage Components.

8.1.4 The aircraft undercarriage normally consists of a nose wheel and two groups of wheels (or more) situated behind the center of gravity beneath the aircraft. The landing gear incorporates a mechanism to raise and lower the aircraft undercarriage. A shock-absorbing unit (oleo leg), wheels, and braking units are attached to the base of the oleo leg and supporting hydraulic pipe work. It is normal practice for wheels to incorporate a fusible plug that deflates the tire when excessive tire pressures develop. Hazards associated with the aircraft undercarriage are burst tires, hot brakes, ruptured hydraulic piping, and seals contained in the oleo leg rupturing and causing the oleo to drop. Braking units are not normally situated on the nose wheel.

8.1.5 The construction of the airframe of a helicopter is similar to the fuselage of a fixed-wing aircraft. However, a helicopter is not stressed to carry a main plane. The cabin is not pressurized for high altitude. Aircraft undercarriage assemblies are comparatively small and in some cases not retractable, which means that structural components are smaller and lighter.

8.2 Aircraft Materials.

8.2.1 ARFF personnel should be familiar with aircraft construction materials. Most of these materials have a low resistance to flame exposure, and their behavior under fire conditions should be understood. They have high resistance to cutting or other forcible entry methods, which can make access difficult and time consuming and can virtually impede successful rescue and firefighting operations.

8.2.2 Modern aircraft are primarily constructed of composite materials; however, many aircraft still in service are constructed of aluminum alloy. Aluminum alloy is approximately 50 percent lighter than steel, and its normal appearance is a light gray or silvery surface when polished. It is used as sheets for aircraft skin surfaces, as channels for framework, and as plates and castings for bulkheads and fittings. This metal will not contribute to a fire to any significant degree. However, it will melt under the high-temperature conditions found in aircraft fires. As a rule, aluminum will buckle and distort at 400°C (778°F) and decompose, depending on its thickness, at 600°C (1138°F).

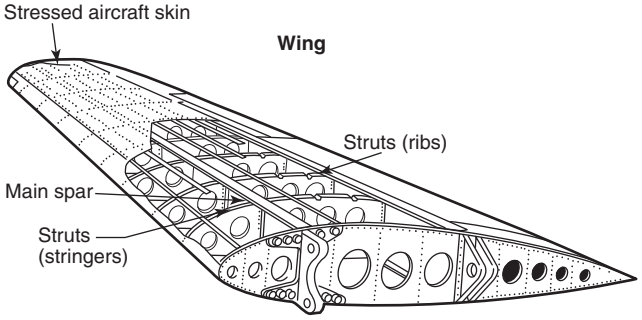


FIGURE 8.1.3 Wing Components.

8.2.3 On some aircraft, magnesium alloys are used for wheels, engine mounts, brackets, crankcase sections, cover plates, and other engine parts. The appearance of this metal is silvery-white or grayish, and it is about two-thirds the weight of aluminum. It is not easily ignited; however, when it is, it burns at 900°C (1678°F) to 1000°C (1858°F) violently and cannot be easily extinguished. It thus presents a serious reignition source. Sparks developed when the metal comes in contact with paved surfaces, as might occur in a wheels-up landing, have the capability of igniting flammable vapors.

8.2.3.1 Where special extinguishing agents are not available for magnesium fires, water in coarse, heavy streams might provide a suitable alternative fire control method.

8.2.3.2 At first, such streams will result in localized intensification of flame and considerable sparking and showering of burning magnesium. Isolated burning pieces of magnesium should be removed from flammable vapor areas.

8.2.4 Steel in various forms, including stainless steel, is used in aircraft engine parts, around engine nacelles, engine fire walls, flap gear, and tubing. This metal presents no fire hazard, nor does it contribute to a fire except that it can create friction sparks when in contact with hard surfaces during a wheels-up landing. The sparks have sufficient energy to ignite flammable vapors. In most forms used in aircraft, steel can be cut with metal cutting saws, but because of the sparks produced, this is a potentially hazardous operation in the presence of flammable vapors.

8.2.5 Titanium is used primarily in engine parts, nacelles, and for engine fire walls. It is a combustible metal, but in the forms used in aircraft, it has a high degree of heat and fire resistance. Although not easily ignited, it will burn between 1300°C (2372°F) and 1450°C (2642°F). Once ignited, titanium is difficult to extinguish. Water is ineffective. Turbine engine fires involving titanium cannot normally be extinguished by external firefighting techniques within the time period necessary to complete rescue operations. Titanium metals have a friction spark hazard similar to steel and magnesium. Surfaces of titanium are very difficult to penetrate, even with power equipment.

8.2.6 To improve the payload/vehicle-weight ratio of aircraft without compromising structural strength, increasing use is being made of composite materials. They are made of small, fine fibers embedded in carbon/epoxy materials. The fibers are usually boron, fiberglass, aramid, or carbon in the form of graphite. Composite fiber plus plastic materials have replaced metal in many aircraft components, such as engine nacelles, flaps, floor panels, struts, aircraft undercarriage doors, wing structure, tail plane, and horizontal and vertical stabilizers. Temperature-resistant composites can also be found in engine, tire, and brake components. These materials do not present any unusual fire extinguishment problems. However, when cutting composite materials firefighters should have full body protection, including positive-pressure SCBA or a suitable full-face respirator, to prevent injections from fibers into the skin or ingestion into the respiratory system.

8.2.6.1 The composite materials are bonded together in layers, forming a matrix. The types of matrices in use include diglycidyl ether of bisphenol A, and polyurethane and urea or phenol/formaldehyde. If composite materials are directly involved in a fire with a temperature of 400°C to 500°C (778°F to 958°F), the resins and bonding agents used decompose, emitting highly toxic fumes in the immediate area. Burn-through of these materials has demonstrated a greater fire resistance than conventional duraluminum aircraft construction.

8.2.6.2 The hazards associated with an aircraft incident/accident that does not involve a fire are limited to composite material being liberated through abrasion and breakage. With a combination of fire and impact, the risk is higher. Subsequent handling and disturbance of damaged components made from composite materials will liberate additional fibers into the atmosphere.

8.2.7 Many aircraft cabin materials in current and continuing use, as well as newer fire-resistive materials, can produce high concentrations of toxic gases when heated even though no open flaming is visible. Some examples of toxic gases given off by cabin materials are hydrogen cyanide (HCN), ammonia (NH_3), benzene, and sulfur dioxide (SO_2). (It is imperative that positive-pressure SCBA be worn by all firefighters engaged in rescue, firefighting, and overhauling operations.)

8.2.8 Modern aircraft use a new material in its fuselage construction called GLARE, which stands for glass-reinforced fiber metal laminate. It is more fire resistive than common aircraft duraluminum construction. Burn-through of this material has demonstrated a greater fire resistance than conventional duraluminum aircraft construction.

8.3 Aircraft Fuel Tanks.

8.3.1 In some aircraft, where the wing joins the fuselage there is no substantial separation to provide a desired fire wall. As all aircraft have wing tanks, many without separate metal or synthetic bladders within the wing cavity, vapors are seriously exposed under fire conditions. Fuel is carried in storage tanks that are structurally separate but interconnected, incorporating vent systems to ensure equalization of pressure and prevent collapse of the tank. Aircraft with a high rate of climb have fuel tanks that are pressurized to prevent the fuel from boiling off or with vapor locks.

8.3.1.1 Types of fuel tanks in use are as follows:

(1) *Rigid Tanks.* These are usually made of aluminum or Duralumin with internal baffles to brace the tank and reduce surging of fuel. These tanks are normally covered in fabric, fitted with cradles, and held by metal straps.
(2) *Integral Tanks.* These are shaped by compartments formed by the airframe structure, and are made fuel tight. The advantage to this type of tank is that it does not add weight to the structure.
(3) *Flexible/Semi-flexible Tanks.* These are bags made from plastic or other man-made material that are held in place by rubber-buttoned area press studs. The advantage to this type of tank is that it is not ruptured by shock; however, they are susceptible to rupture by piercing.
(4) *Auxiliary Tanks.* These are normally constructed of metal or fiberglass and found in the form of pods, which can be fitted under wing, wing tips, or within the fuselage. The fuel in auxiliary tanks is usually used in flight first, and in some circumstances, these tanks may be jettisoned in an emergency.

8.3.2 Some aircraft carry fuel in the center wing section, which in effect places fuel storage within the fuselage. It is thus possible, under some conditions, for fuel or vapors from tanks damaged due to an aircraft accident to enter the fuselage.

8.3.3 Wide-body aircraft have provisions for additional fuel storage within both the horizontal and vertical stabilizers. Damage to these tanks in the event of an aircraft accident poses a number of problems, including those where fuel or vapors might enter occupied sections of the aircraft and become ignited. These additional fuel storage locations can complicate the firefighting operations and will require additional agent. *(See also NFPA 460.)*

8.3.4 Wing tanks on some aircraft are located directly above or to the side of landing gear mounts. These tanks have been ruptured during hard landings or other ground accidents.

8.3.5* Aviation fuels used for civil and military aircraft include the following (Table 8.3.5 provides a summary of the aviation fuel designations and their significant fire hazard characteristics):

(1) Fuels for piston-driven aircraft are aviation gasoline (AVGAS) or motor gasoline (MOGAS).
(2) Fuels in use in turbine engines are Jet A and Jet A1 (AVTUR) kerosene; Jet B (AVTAG) 60 percent gasoline, 40 percent kerosene: and JP-5 (AVCAT) for naval carrier-borne aircraft.

8.4 Aircraft Exits and Doors.

8.4.1 Aircraft exits on transport category aircraft include doors, hatches, and windows of various sizes. These exits will vary with the age, size, and type of the aircraft. ARFF personnel should be familiar with the operation of the various exit types on all makes of aircraft normally using the airport.

8.4.2 Doors on most older, unpressurized aircraft open outward and can be opened from both outside and inside the aircraft.

8.4.3 The doors on the majority of US-built modern pressurized aircraft are called "plug-type" doors. When these doors open, they push in slightly and then pull out or retract upward into the ceiling. These doors are not operable as long as the cabin remains pressurized [as little as 103 Pa (0.015 psi)].

8.4.4 Aircraft having a door sill higher than 1.5 m (5 ft), with landing gear deployed, are normally equipped with inflatable evacuation slides mounted at the emergency exits. When the system is armed and the emergency exit is opened, the slide can inflate and extend outward in less than 5 seconds with considerable force. ARFF personnel, therefore, should consult aircraft manufacturer crash charts to be knowledgeable of the areas where those inflatable slides deploy.

8.4.5 If the cabin crew fails to open the aircraft doors, ARFF personnel can gain access by using the emergency door release mechanism situated on or adjacent to the external face of the door. ARFF personnel must be aware of the different external door operations in use. On some aircraft, doors are designed so that on operating the external door opening mechanism, the girt bar will be released automatically, preventing the evacuation slide from deploying. On aircraft where girt bars are manually housed by the cabin crew, if the girt bar is not removed, evacuation slides will deploy when the door is opened externally. However, doors should be approached and opened with caution, ensuring that the girt bar is disengaged, as the slide may deploy either by design or malfunction. ARFF personnel must be aware of emergency exits where, on operating the internal or external opening mechanism, the door will eject outward with an explosive force to deploy an inflatable slide. An example of an aircraft with this design is the B757.

8.4.6 When positioning ladders, elevated platforms, aircraft interior access vehicles (AIAV), or mobile stairways prior to opening cabin doors from the outside, care should be taken as all aircraft doors do not open in the same direction or by the same mode of operation.

8.4.7 Opening the doors of most modern-type aircraft from the exterior can be accomplished more readily and safely using an aerial platform, a mobile stairway, or an AIAV. If these units are not available, a ground ladder can be raised to a position adjacent to the door control mechanism and, if possible, on the side away from the direction the door is to be opened. Once the door is opened the ladder can then be moved into the door opening and secured at the top to prevent movement.

8.4.8 Overwing exits are part of the emergency evacuation system on several types of aircraft. They might also be useful as entry points for rescue teams and for facilitating ventilation of the cabin. Some overwing exits are equipped with slides that are similar to door exit slides when deployed. Some aircraft overwing hatches are spring loaded. Caution should be used when opening these exits to prevent injury.

8.4.9 Some aircraft have doors that incorporate stairs on the side of the fuselage or in the tail section to facilitate passenger

Table 8.3.5 Aviation Fuel Designations and Characteristics

Fuel Type	Civil Aviation Designation	UK Designation	Military Designation	Minimum Flash Point	Auto-Ignition Temp	Explosive Range (Volume %)
Kerosene	Jet A Jet A1	AVTUR	JP-8	37.8°C (100°F)	246.1°C (475°F)	0.7–5.3
Kerosene (high flash)	JP-5	AVCAT	JP-5	60°C (140°F)	246.1°C (475°F)	0.7–5.3
Kerosene and gasoline mixture	Jet B	AVTAG	JP-4	–23.3°C (–10°F)	248.9°C (480°F)	1.2–7.6
Aviation gasoline	AVGAS	AVGAS	AVGAS	–45.6°C (–50°F)	448.9°C (840°F)	1.4–7.6
Motor gasoline	MOGAS	MOGAS	MOGAS	–45.6°C (–50°F)	448.9°C (840°F)	1.4–7.6

Note: Biofuels are currently being used in commercial aviation and are generally blended with other fuels. For more information on alternative fuels, see DOT/FAA/TC-14/22, *Impact of Alternative Fuels Present in Airports on Aircraft Rescue and Firefighting Response.*

boarding and deplaning. Although in some circumstances these stairs might be used as such, they are not considered emergency exits. ARFF personnel should know which aircraft using the airport have these types of doors and should exercise proper caution when the need arises to open them.

8.4.10 Fires can occur within a cargo hold either from onboard electrically operated equipment or from the cargo carried. Doors to cargo holds have external operating devices that are manually or electrically operated. Upon failure of electrical power, doors normally have a secondary means of operation. ARFF personnel should be trained in opening the cargo doors on aircraft using their airport. This should be incorporated into recurrent training programs *(see NFPA 460)*.

8.4.11 Reinforced Flight Deck Doors. Commercial aircraft flight deck doors are secured, and in the event that the aircraft is unoccupied or occupants are incapacitated, forcible entry will be required for access in the event emergency.

Chapter 9 Evacuation and Rescue (NFPA 402)

9.1 Risk Assessment. It is imperative that before commencing rescue operations, a scene survey and risk assessment are carried out. They should consider at least the following:

(1) Stability of the aircraft and/or its wreckage
(2) Training and competence of crews
(3) Availability and suitability of equipment
(4) Hazards arising from the accident site
(5) Prevailing weather conditions
(6) Hazards that may emerge during rescue operations

9.2 Aircraft Evacuation.

9.2.1 Evacuation of occupants involved in aircraft accidents and assistance to those who cannot remove themselves should proceed with the greatest possible speed. While care is necessary in the movement of injured occupants so that their injuries are not aggravated, removal from the fire-threatened area is the primary objective.

9.2.2 Flight deck crews receive extensive training in aircraft emergency evacuation procedures. They are in the best position to make optimum decisions relative to evacuation procedures in most emergency situations. They also have immediate contact with those aboard the aircraft and therefore can direct the operations.

9.2.3 Prior to any planned emergency landing, flight deck crews normally will consider passenger relocation within the cabin. This procedure is used to expedite use of potential emergency exits. The practice of placing a crew member or a person knowledgeable in evacuation procedures at each exit to assist flight attendants in the direction and movement of occupants is common practice where time and circumstances permit. Under certain circumstances, flight attendants might have the necessary time prior to impact to more fully instruct passengers on how to survive impact and evacuate the aircraft. Training and checklists provide, among other things, for selection of able-bodied helper passengers to receive instructions pertaining to operation of exits and slides. These persons would then be more capable of assisting the flight attendants. Additionally, ARFF personnel should realize that the first passengers to leave the plane might have received instructions to remain at the bottom of a slide, wing, airstair, and so forth. ARFF personnel should direct survivors away from the aircraft and prevent survivors from obstructing the evacuation path.

9.2.4 The tendency toward forward exiting is natural; most passengers boarded the aircraft at terminals through forward doors and so will instinctively attempt to exit in the same manner. Other exit facilities are apt to be bypassed, especially if passengers are under mental strain or feel panic. Overwing and other emergency exits requiring physical agility probably will be passed up by those doubting their ability to use them effectively. Access to overwing and some other emergency exits is usually restricted by seating arrangements. Overwing exits are often smaller than door exits, and have caused passengers to become entangled just inside the exit. If visibility in the cabin is impaired due to darkness or dense smoke, orderly evacuation can be further complicated.

9.2.5 Limited evacuation options might be available to the flight deck crew due to circumstances aboard the aircraft. One or more emergency exits could be inoperable as the result of distortion caused by impact. Doors might be blocked by loose galley equipment. Aisles might be difficult to travel due to injured passengers, collapse of overhead panels and partitions, dislodged seats, and carry-on items. Although normal evacuation procedures provide for the use of all available exits, flight deck crews are trained to remain flexible and are prepared to select the best means of exit as circumstances and conditions permit.

9.2.6 Many variations of aircraft accidents are possible, and the flight deck crew can be faced with many decisions in the seconds before or after they occur. ARFF personnel, therefore, cannot expect that standard procedures will be used in all instances and should remain flexible to provide whatever protection and support evacuees require. In the event that the flight deck crew becomes incapacitated and evacuation does not begin immediately, ARFF personnel should initiate evacuation procedures.

9.2.7 If fire conditions or fuel spills initially prohibit the use of certain emergency exits, ARFF personnel are usually in a better position to make this observation. The ARFF incident commander should not hesitate to communicate this information to the flight deck crew.

9.3 Evacuation Slides.

9.3.1 Evacuation slides are provided to expedite occupant egress from aircraft that have normal door sill heights above 1.5 m (5 ft). Because passengers are not trained in proper evacuation slide use, as shown in Figure 9.3.1, there is a degree of personal injury risk (approximately 6 percent) when slides are used. ARFF personnel should expect the occurrence of sprains, bruises, friction burns, and other minor injuries whenever evacuation slides are used.

9.3.2 If the nose gear fails during landing, the aircraft might come to rest in a tail-high attitude. The failure of one or more landing gears can result in a nose-high or listing attitude. In these instances, evacuation slides become somewhat ineffective because they do not deploy at the proper angle to the ground. A high percentage of injuries can be expected when evacuation slides are used under these circumstances. ARFF personnel should be able to reduce the amount and severity of injuries and expedite evacuation by manipulating the slides and assisting evacuees.

FIGURE 9.3.1 Deployed Evacuation Slide.

9.3.3 Aircraft evacuation slides are coated with gray aluminized paint to protect them from nearby fires for up to 90 seconds; however, they remain susceptible to heat and fire exposure. They are combustible, and when exposed to radiant heat they may melt, and deflate, rendering them unusable. ARFF personnel should protect evacuation slides from heat and flame to the best of their abilities but should be extremely careful not to apply foam to the operational area of the slide. Foam on the slide makes it very slippery and increases the descent speed of evacuees, potentially causing severe injuries.

9.3.4 If time and conditions permit, aircraft interior access vehicles (AIAVs) should be used as an alternative to deploying evacuation slides. This method of evacuation, when there is no immediate danger to aircraft occupants, would prevent many injuries. Response of available nonemergency AIAVs should be prearranged between ARFF personnel and one or more of the following:

(1) Airlines
(2) Airport maintenance facilities
(3) Airport operations

9.3.4.1 AIAVs are now being used at large airports, particularly where multideck aircraft operate.

9.4 Evacuation Assistance by ARFF Personnel.

9.4.1 The need to assist in aircraft occupant evacuation depends on a variety of factors. When occupants are self-evacuating, ARFF personnel should support the operation and expedite it where possible. In other instances, actions would depend on the degree of occupant survivability, the fire situation, the condition of exits, and the status of evacuation facilities. In any event, rescue efforts should begin with fire prevention/control and should maintain a safe path from egress points. Evacuees should be directed to an upwind location.

9.4.2 Fire prevention/control during evacuation should require strategic positioning of ARFF vehicles and applying foam from turrets to establish a blanket covering the practical critical fire area (PCA). During this operation, emphasis should be placed on maintaining safe egress paths and eliminating the threat of fire extension into the fuselage. Foam handlines, which are more maneuverable than turret streams, should then be employed to protect evacuees and ARFF personnel, extinguish spot fires, and maintain the integrity of the foam blanket. *(See also Chapter 7.)*

9.4.3 If time and conditions permit, ARFF personnel should assist in the off-loading of evacuees at the base of the evacuation slides to minimize injuries. When high winds or unusual aircraft attitudes cause slides to invert or deploy in a faulty position, an attempt should be made to align them manually.

9.4.3.1 For those airports that have EMAS installed at runway ends, ARFF crews should be aware that passengers with heeled shoes can penetrate the initial layer of EMAS, which can cause difficulty in walking.

9.4.3.2 Unnecessary damage to EMAS material should be avoided.

9.4.4 Ground ladders might be needed to assist occupants who have exited onto wing surfaces and those attempting to exit from openings where evacuation slides are unusable. It is important that assistance be given to evacuees using ladders to ensure that they safely complete their exit and that any one ladder does not become overloaded.

9.5 Aircraft Forcible Entry.

9.5.1 Aircraft involved in accidents can come to rest in almost any attitude. Any abnormal landing force can jam emergency exits. The fuselage might be broken open by the impact forces, and doors, windows, and hatches dislodged. It is difficult to anticipate the various possible accident conditions, and each incident presents unique problems that must be dealt with. ARFF personnel should be thoroughly trained in forcible entry procedures and be provided with a wide variety of tools and equipment necessary to accomplish successful entry and extrication of trapped aircraft occupants. Aircraft rescue and firefighting personnel training programs should include a discussion of methods to be used for a situation that involves an aircraft in an inverted position. Such training should include crash charts that depict, in plain view, the entire underside of the various aircraft using the airport.

9.5.2 In some instances, entry into an aircraft fuselage can only be gained by cutting through the aircraft skin. Knowledge of the aircraft is required to avoid contact with wires, cables, tubing, and heavy structural members. An area of the aircraft normally clear of these features is located in the upper fuselage area above the windows, and any necessary cutting should be attempted in this area. Caution should be exercised to ensure that cutting operations do not endanger trapped occupants.

9.5.3 Turbine-powered aircraft have heavier aircraft skins and structures than the older piston aircraft. Due to this heavy construction, the only practical method of entry, other than using normal or emergency exits, is through the use of portable power tools. Power saws can be used to cut through aircraft skin and structural materials. CAUTION SHOULD BE EXERCISED WHEN USING SPARK-PRODUCING POWER TOOLS WHERE FLAMMABLE VAPORS EXIST. Claw and pry tools can be used for forcing doors and hatches that are jammed, to pull down panels and partitions, to dislodge aircraft seats, and so forth. The air chisel can be used to cut aluminum and other light metals found on aircraft. Hydraulic rescue tools are used to assist with forcible entry during aircraft accident operations. These tools take the form of electric-, pneumatic-, hydraulic-, or gasoline-powered cutting, spreading, or shifting equipment. At best, this type of entry into a modern jet aircraft fuselage is

very difficult and time consuming. Areas safe to cut or pry into should be depicted on aircraft emergency diagrams.

9.5.4 Military combat aircraft present additional hazards due to armament, jettison equipment, and ejection seats.

9.5.4.1 This type of aircraft should always be assumed to be armed.

9.5.4.2 Caution should be exercised around this type of aircraft, especially forward and aft, because it can carry ordnance.

9.5.4.3 Unlaunched rockets, when exposed to fire, are dangerous from both the front and rear.

9.5.4.4 As with any ammunition, personnel should keep the rockets cool with foam or water.

9.5.4.5 ARFF personnel should remain at a safe distance, as determined by the AHJ, from the aircraft during the ammunition cooling operation.

9.5.4.6 Further unclassified information should be obtained from the commanding officer of the nearest military installation.

9.6 Extrication and Rescue.

9.6.1 Immediately following the self-evacuation phase of an aircraft accident, a search of the fuselage interior and physical rescue of surviving occupants is crucial. Search and rescue teams should wear full protective clothing and positive-pressure SCBA. They should also be equipped with charged hose lines for their protection and the extinguishment of any fire that might have entered the fuselage. A THOROUGH SEARCH OF THE FUSELAGE INTERIOR AT THIS TIME IS EXTREMELY IMPORTANT. PERSONS, PARTICULARLY INFANTS, CAN BE EASILY OVERLOOKED OR HIDDEN BY DEBRIS.

9.6.2 Rescue operations should be carried out using normal aircraft openings wherever possible. Occasionally, openings caused by airframe separations can be utilized when it is more convenient and safe to do so.

9.6.3 ARFF personnel should have a general knowledge of the occupant capacity of the various types of aircraft that use the airport. Initial rescue plans should be based on the assumption that occupant load is at maximum.

9.6.4 The location of occupants in military aircraft can generally be determined by the aircraft type and sometimes by exterior design features such as canopies, gun positions, and so forth.

9.6.5 Even in survivable aircraft accidents, disruption of the fuselage can be severe, necessitating the improvisation of rescue efforts. ARFF personnel should be skilled in the use of appropriate extrication tools and equipment and possess the basic knowledge and skills to properly stabilize an injured occupant prior to removal from the wreckage.

9.6.6 ARFF personnel rescue and extrication knowledge should include accepted post–aircraft accident procedures, particularly those matters dealing with fatalities and preservation of evidence as described in Chapter 13. If it is necessary to move portions of a damaged aircraft, either in rescue operations or fire control, caution should be taken to avoid changes in the aircraft's stability. Undue strain on the airframe can release fuel from damaged tanks, cause collapse or rollover of the fuselage, or cause greater injuries to trapped occupants.

9.6.7 Aircraft accidents can occur during temperature extremes. These conditions can seriously aggravate the condition of persons trapped within an aircraft wreckage for an extended period. During this time it is extremely important to maintain the critical body temperature and vital functions of trapped victims. Tarps, blankets, portable lights, fans, oxygen units, and portable temperature control units (heating and cooling) should be immediately available at an accident site. Portable heating and cooling units should be designed or located so as not to be an ignition hazard.

Chapter 10 Fire Control and Extinguishment (NFPA 402)

10.1 General.

10.1.1 The risk of fire at an aircraft accident is due to the close proximity of the systems that contain and distribute the fuel and ignition sources such as heated components in engines and aircraft undercarriages, damaged electrical circuits, and friction caused by ground slide.

10.1.2 Any post-accident fire can seriously affect the ability of the aircraft occupants to evacuate safely and will reduce the time available to mount a successful firefighting operation prior to rescue.

10.1.3 Upon impact, or after impact, a post-accident fire can develop to severe intensity very quickly and can enter the fuselage through opened exits and openings created by the impact.

10.1.4 Aircraft designers are continually studying design factors and construction material changes that will increase "crashworthiness" and limit the development of fire situations that can impede evacuation. Additional modifications intended to increase the impact survivability of occupants are being developed, such as passenger restraints, reduced combustibility of cabin interiors, better marking of exit routes, upgraded emergency exits, and greater emphasis on the training of flight deck crews. Prompt and effective intervention by trained ARFF personnel becomes even more important because a greater number of aircraft accident survivors needing assistance can be expected. ARFF personnel should become familiar with all aircraft types using the airport and should preincident plan the optimum rescue and firefighting effort that the fire department can produce with the resources at its disposal. Careful consideration of the recommendations in this guide can facilitate the development of practical operational plans.

10.2 Extinguishing Agents for Aircraft Fires.

10.2.1 Foam approved by the AHJ is the primary extinguishing agent preferred for aircraft rescue and firefighting.

10.2.2 It is important that complementary and principal agents are carefully selected to ensure they do not adversely affect each other's firefighting or vapor suppression capabilities.

10.2.3 Complementary extinguishing agents consist of approved dry chemicals, clean agents, and carbon dioxide agents. These are generally best for use on three-dimensional flammable liquid fires or on fires in concealed spaces, such as those occurring behind wall panels, engine nacelles, or wheel wells.

10.2.4 Experience has shown that dry chemicals tend to be more effective than clean agents when used in the open air to extinguish three-dimensional fires, while clean agents are the preferred agents for electrical fires and fires in concealed areas.

10.2.5 Different types of foam concentrates should not be mixed. The ARFF vehicle manufacturer should be consulted to ensure that the agent system design is compatible with the agent to be used.

10.2.6 AFFF and FFFP are compatible with protein and fluoroprotein foams in the applied form and can be applied simultaneously on the same fire area.

10.2.7 AFFF and FFFP agents are compatible with dry chemicals. These agents can be applied simultaneously to improve flame knockdown and control fire spread.

10.2.8 Protein foams should be applied only with compatible dry chemicals.

10.2.9 Fluoroprotein foams have demonstrated an improved compatibility with dry chemicals; however, the user should determine that the agent is adequate to meet operational requirements. If any problems arise, the agent manufacturer should be consulted.

10.2.10 If foam is being used and the fire is not completely extinguished before the supply is depleted, it might be necessary to complete extinguishment with water streams. When this occurs, avoid applying water or walking in any area that has been secured with foam, as water can break down the established vapor seal that the foam blanket provides.

10.2.11 If the fire has not been completely extinguished by foam, the secured area will "burn back" at a rate that is dependent on the stability of the foam being used.

10.3 Water and Agent Resupply and Conservation. Additional water supplies should be available whenever there is any indication of possible need, especially when the aircraft accident site is known to be beyond water relay capability. Prearrangements should be made to ensure that additional supplies of extinguishing agents are brought to the scene. Prudent utilization of agents under these circumstances is particularly important, and application methods should be carefully selected to ensure their most effective use.

10.3.1 It is considered impractical to require airport authorities to provide quantities of extinguishing agents to deal with the worst situation that could arise using only the equipment located on the airport. Therefore, it is necessary for airport emergency plans to contain instructions for requesting support from externally based fire services following an emergency. It is not easy to specify an operational requirement that makes adequate provision in all circumstances. It is clear that a need for additional water could arise in as little as 5 minutes, although in this time the initial fire situation should be greatly reduced. If total extinguishment has not been achieved, the fire can quickly extend and the equipment must be replenished.

10.3.2 Airports should consider providing additional water as a support facility. There might be exceptions where airports have adequate piped, stored, or natural water supplies, provided that these are available at an accident in sufficient quantity and in time to meet the operational requirement.

10.3.3 In each case, the AHJ should consult closely with the chief fire officer of the Mutual Aid Fire Service regarding response and supply of additional agent/media supplies. The airport authority will need to assess the suitability of the agent/media resources that can be mobilized to support the airport fire service when a serious and prolonged post-accident fire occurs. The speed of mobilization and the rate at which the agent/media can be delivered to the accident site, and its compatibility, are important factors.

10.4 Rescue Operations.

10.4.1 The primary objective of ARFF personnel at the scene of any aircraft accident is to control and extinguish the fire to enable safe evacuation of the aircraft.

10.4.2 Occupant survival is generally limited to aircraft accidents that are of low impact in nature, where the fuselage is not severely broken up and a fuel fire has not developed. In more severe accidents, even those where fire does develop, ARFF personnel should assume that there is always the possibility of survivors and take actions to control the fire, initiate evacuation, and rescue those unable to self-evacuate.

10.4.2.1 Local procedures should be in place for ARFF/pilot communications during a declared emergency situation.

10.4.2.2 These procedures should limit the frequency specifically for emergency responders and pilot usage. Guidelines for this topic can be found in local state publications such as FAA Advisory Circular 150/5210-7D, *Aircraft Rescue and Firefighting Communications*.

10.4.3 Rescue operations should begin as soon as conditions permit and often are a simultaneous function during the firefighting phase that requires considerable coordination. The rescue team's mission includes assisting evacuees, accomplishing forcible entry if necessary, completing interior extinguishment, extricating trapped survivors, and removing the injured to safety.

10.5 Size-Up.

10.5.1 The size-up process is initiated by the first-responding ARFF personnel and is maintained throughout the duration of the incident to varying degrees of depth and scope.

10.5.2 The size-up process is initiated by the first-responding ARFF personnel and is maintained throughout the duration of the incident to varying degrees of depth and scope by later-arriving superior officers.

10.5.3 When an aircraft accident occurs, first responders should have knowledge of some size-up information in the form of established facts as a result of training, pre-incident planning, knowledge of available resources, and interpretation of alarm information. Additional facts can be discerned during response and upon arrival at the scene.

10.5.4 Vital operational decisions based on initial size-up information should be made without delay. Realistic objectives are critical and consideration should be given to the capabilities of the resources that are immediately available.

10.5.5 The original assignment of tasks based on the initial size-up is generally not fixed and tends to be modified as an incident develops. The size-up process should continue throughout the duration of the incident and any changes to

the strategy or objective should be communicated to key personnel involved in the operation.

10.6 Aircraft Accident — Fire Involvement.

10.6.1 In an aircraft accident, occupants are confined within the fuselage and are surrounded by very large amounts of fuel that, when ignited, can release heat at about five times the rate that develops in the typical structure fire. An aircraft fuselage has a very low resistance to fire, except for engine areas, cargo compartments, and galleys, because fire and smoke barriers are nonexistent.

10.6.2 Priority should be given to aircraft occupant survival. Those who have survived the impact forces then face exposure to fire and toxic products of combustion. Total extinguishment of the fire is an acceptable initial approach if it is determined to be the most effective method of successfully accomplishing rescue. A resource-conserving alternative would be selective control of fire in areas where occupants are successfully evacuating and maintaining these escape routes until it has been determined that evacuation is complete. A decision as to the precise method of initial fire attack should be made by the ARFF incident commander immediately upon arrival at the scene. All members of the ARFF team should realize that initial plans are always subject to change and should remain alert for orders that alter operations as conditions dictate.

10.6.3 If upon arrival at an aircraft accident the operator of the first-arriving ARFF vehicle encounters a small fire, the best tactic would be to extinguish it rapidly and then begin to blanket any fuel spill with foam. Later-arriving vehicles should assist in the foam application if needed or perform other tasks as directed by the incident commander.

10.6.4 If a large fire is in progress upon arrival of the ARFF personnel, foam should be applied using the vehicle turrets. Since initial foam supplies can be exhausted in 2 minutes, turret operators should understand that foam application by this method must be effective and that streams should be shut down on occasion to assess progress and conserve foam. Once a fire has been controlled and any fuel spill blanketed with foam, consideration should be given to employing foam handlines that are more maneuverable and therefore more effective for maintaining a foam blanket and extinguishing small fires.

10.6.5 If foam becomes contaminated by fuel splashing into it, then at some time the foam will become flammable. The degree to which this is a problem depends on the type of foam and the amount of contamination. As solution drains from the foam, the water drains at a faster rate than the fuel, resulting in a fuel-rich foam matrix that can ignite if exposed to a source of ignition. This problem is more evident in AFFF than in other foams because it has a much faster drainage rate and becomes flammable at a lower level of contamination.

10.6.6 Foaming agents should form a blanket over the surface of a flammable liquid fire in order to extinguish it. The foam should be applied using a dispersed pattern over the surface of the burning fuel to completely cover the spill area. It needs to be applied in such a manner that it does not break up any previously established blanket. If isolated openings in the foam blanket occur, foam should be reapplied and the foam blanket maintained for the duration of an existing hazard.

10.7 Extinguishment Techniques.

10.7.1 Vehicle approach to a burning aircraft should be such that turret streams can be applied along the length of the fuselage with efforts concentrated on driving the fire outward while keeping the fuselage cool, protecting occupants as they evacuate, and assisting with the entry of rescue teams.

10.7.2 The location of survivors, if known, and the area of fire will determine where the first streams should be applied. If the fire has penetrated the fuselage, a direct interior attack should be initiated as soon as possible.

10.7.3 Where it is compatible with the evacuation process, it is best to approach an aircraft fire from the windward side. Agents should be applied from the windward side to provide better reach and greater ability to monitor extinguishing effectiveness, as the heat and smoke will be moving in the opposite direction. When vehicle turrets are in operation on opposite sides of a fuselage, care should be taken that the fire is not driven underneath from one side to the other.

10.7.4 When an aircraft comes to rest on sloping terrain or adjacent to a gully or wash, circumstances permitting, the fire should be approached from high ground and the burning fuel driven away from the fuselage.

10.7.5 Aircraft accidents do not occur under the best conditions or permit the ideal conditions for combating a fire. It will not always be possible to approach the fire from high ground or the windward side. What is important is that an aggressive attack is used to isolate the fuselage from the fire, and efficient fireground coordination is in place to achieve a successful evacuation of occupants and complete fire extinguishment.

10.7.6 The initial attack on an aircraft fuel fire should normally be by judicious application of foam, or alternatively by the combined use of foam and a complementary agent. A three-dimensional or flowing fire should be extinguished by using an approved dry-chemical or clean agents, followed by an application of foam. Even where foam alone is used, a suitable complementary agent should be available to deal with fire inaccessible to direct foam application.

10.7.7 If a fire threatens exposed aircraft, structures, or other combustibles, the exposure should be protected by foam or water spray. Water streams or runoff should not be permitted to destroy any foam blanket in the critical fire area.

10.7.8 If a large fuel spill occurs without igniting, it is important to eliminate as many ignition sources as possible while the spill is being stabilized with a foam blanket. There can be enough residual heat present in jet engines to ignite fuel vapors 30 minutes after shutdown.

10.7.9 Extinguishing agents should be applied in a manner to avoid spot cooling of components that can cause stress failure and disintegration. If possible, streams should be employed so that even surface cooling can result. Approved dry chemicals and clean agents can extinguish fires involving hydraulic fluids or lubricants, but they lack the cooling ability necessary to prevent reignition.

10.7.10 Firefighting foam can be applied with turret nozzles or handlines. Either spray or straight streams can be used as the situation dictates. It is best to approach the fire area as closely as possible and apply the foam in a wide spray pattern initially, changing to a narrower pattern after the heat has been reduced. The stream should be applied gently to avoid unnec-

essary plunging of the stream into the burning fuel. The foam should be applied to the near edge of the fire with a rapid side-to-side sweeping motion to distribute the foam rapidly and thinly over the burning fuel. Firefighters should advance as the fire is controlled, always applying the foam to the nearest burning fuel surface, and should advance only after a continuous, unbroken foam cover is established. The entire foam blanket integrity should be maintained to compensate for voids created by movements of ARFF personnel, evacuees, and equipment, as well as the normal drain down of the foam.

10.8 Turret Operations.

10.8.1 ARFF vehicles should be positioned to make the most effective use of all extinguishing agent systems. The most efficient use can require movement of the vehicle during turret or even handline operations. It is vitally important not to waste available agent. TURRETS SHOULD BE USED ONLY AS LONG AS THEY ARE BEING EFFECTIVE. After initial knockdown of the heat and flame, use of handlines to maintain control of evacuation areas can be the key to a successful rescue operation.

10.8.2 When selecting vehicle positions for applying extinguishing agents from a turret, remember that wind has a considerable influence upon the quality of the pattern and the rate of fire and heat travel. Utilize the wind whenever possible to achieve more effective fire control.

10.8.3 Turret application should never be directed so as to drive fuel or fire toward the fuselage. The main objective is to maintain an escape route for occupants until complete evacuation is achieved.

10.8.4 Usually water supplies are a key factor, and turret operators should concentrate their extinguishing efforts on the escape route from the aircraft.

10.8.5 The "pump and roll" concept, a method of applying agent from a turret while the vehicle is in motion, can be a very effective fire control technique when used correctly.

10.9 Turret Application.

10.9.1 The basic principle of this type of foam application is to distribute a visible foam blanket over the burning fuel to act as a blanket for vapor suppression. The original blanket should not be relied on to be permanent and should be maintained as necessary until the fuel vapor hazard no longer exists.

10.9.2 Both aspirating and nonaspirating nozzles can be used for foam application. A nonaspirated nozzle typically provides longer reach and quicker control and extinguishment. However, expansion rates and foam drainage times are generally less when foam is applied with nonaspirating nozzles, and it should be understood that the foam blanket might be less stable and have a lower resistance to burnback than that formed using aspirating nozzles. Manufacturers should be consulted for guidance on nozzle performance. Extreme caution should be taken when using the straight stream method, as this can cause an increase in the liquid pool surface or cause an opening in the foam blanket, releasing flammable vapors.

10.10 Foam Application.

10.10.1 Foaming agents should be applied to burning fuel so that they gently form a uniform and cohesive blanket with the least possible turbulence to the fuel surface.

10.10.2 Aspirating nozzles should be used for applying protein and fluoroprotein foams in either the straight stream or dispersed patterns to distribute the foam over a wide area. When using the straight stream method of application, the foam should be applied indirectly using deflection techniques, and special care should be exercised to avoid disturbing the established foam blanket.

10.11 Handline Foam Application.

10.11.1 As soon as the fire has been knocked down by turrets, the turrets should be shut down, perhaps repositioned, and held in a state of readiness to resume operation should the need occur. During this phase of rescue and firefighting, handlines are more effective than turrets in controlling the fire, maintaining rescue paths for occupants, mopping up spot fires, maintaining the foam blanket, and conserving vital agent supply.

10.11.2 Foam application principles are the same for handlines as they are for turrets.

10.12 Aircraft Accident — No Fire Involvement. At an aircraft accident without fire, appropriate fire prevention measures should be initiated immediately.

10.12.1 All spilled fuel should be cleaned up or covered with foam.

10.12.2 The washing of spilled fuel from around the aircraft requires caution; any fuel and/or vapors should be directed away from sources of ignition.

10.12.3 Every effort should be made to prevent sparks whenever there is the possibility of exposed fuel or fuel vapors in the area. Particular care should be taken to prevent sparks due to arcing before the aircraft electrical system can be de-energized.

10.12.4 ARFF personnel need to exercise extreme care when cutting tools are used at an accident site where fuel liquid and vapor is present. A support firefighter should be on standby with a fully charged hoseline to deal with any incipient fire that might develop.

10.13 Exposure Protection.

10.13.1 After rescue of occupants, protection of exposed property should be the next consideration at the scene of an aircraft accident, whether fire exists or not. In addition to protecting airport structures and other aircraft, plans should include preventing contamination and fire spread into drains, sewers, waterways, and any belowground facilities. Authorities should be immediately notified of any exposure to fire or contamination involving property under their control.

10.13.2 Early and effective fire extinguishment ensures the least amount of property loss, and that includes exposed properties whether involved in fire or not. Where resources are limited, conditions will dictate which exposures receive first priority for protection.

Chapter 11 Interior Aircraft Fires (NFPA 402)

11.1 General.

11.1.1 The recommendations contained in this chapter are provided for the guidance of ARFF personnel encountering interior aircraft fires occurring in both parked, unoccupied aircraft and aircraft with passengers and crew aboard.

11.1.1.1 Examples of circumstances that could lead to an aircraft internal fire are the following:

(1) An external fire (normally burning aviation fuel) penetrates the fuselage skin and combustible materials inside are ignited.
(2) Combustible materials inside the aircraft cabin are for some reason ignited. In this situation the fire may be discovered early and may be dealt with by trained aircraft crew, or the fire may have developed and the crew can merely strive to contain or minimize the effects of the fire until the aircraft can effect an emergency landing at a suitable airport.
(3) Smoke or fumes may be present in the aircraft cabin, but the source may not be obvious and may be difficult to locate.
(4) A fire involving aircraft engines, auxiliary power units, or aircraft undercarriages may spread to areas inside the fuselage.
(5) Cargo or baggage carried on the aircraft may for some reason cause a fire that may develop and spread to occupied areas of the aircraft.

11.1.1.2 However an internal fire comes about, if there is or there is suspected to be life involvement, a prompt response following the correct tactics is vital.

11.1.2 The occurrence of interior aircraft fires where passengers and crew are onboard presents a major problem for ARFF personnel. An acute life safety hazard exists in these instances, and the ability to enter the aircraft and extinguish the fire might have to be delayed until evacuation has been completed. Because forcible entry and rescue are discussed in detail elsewhere in this guide, they will not be covered here. Instead, emphasis will be on the procedures and techniques of attacking and extinguishing interior aircraft fires.

11.1.3 Aircraft passenger cabin fires normally involve ordinary combustibles such as upholstery, paneling, carpeting, refuse, electrical insulation, and carry-on materials. Generally, a direct attack on the fire with water streams, using structural firefighting techniques, is effective.

11.1.4 ARFF personnel should understand the structural characteristics of an aircraft fuselage. The absence of fire stops at the floor, behind wall panels, and above ceiling areas permits fires to spread undetected and unchecked through combustible materials once fire has entered those areas. ARFF personnel should always assume, until it is proven otherwise, that fire has moved away from its origin via these concealed spaces. Sections of flooring, wall panels, and ceilings should be removed where fire travel is suspected so that complete extinguishment can be accomplished.

11.1.5 Because the burning of aircraft interior materials creates a toxic atmosphere, ARFF personnel should wear positive-pressure SCBA whenever working inside the fuselage both during the firefighting stage and later, while overhauling. Additionally, the entire fuselage should be ventilated as quickly as possible by whatever means available. Ventilation fans can expedite horizontal ventilation and are usually the only method to choose as an aircraft has no designed vertical openings.

11.1.6 Interior aircraft fire situations can differ widely; therefore, explicit guidance regarding extinguishment techniques is not possible. Points of entry and methods of attack should be dependent upon an evaluation of conditions and assessment of resource capability by the ARFF incident commander.

11.1.7 An interior aircraft fire location and its intensity can, to some degree, be determined by observation through cabin windows, smoke characteristics, aircraft skin that shows buckling or paint blisters, or by use of a handheld or vehicle-mounted thermal imaging camera.

11.1.8 In the event that an interior aircraft fire cannot be immediately extinguished, the application of foam or water spray should be considered for cooling and protecting external risks.

11.1.9 ARFF personnel should consider the development and behavior of fire in interior aircraft fires and adopt firefighting techniques that minimize the risk of sudden conflagration.

11.2 Aircraft Interior Fires Occurring in Flight.

11.2.1 A major hazard of commercial aviation is the in-flight fire that cannot be controlled by onboard portable extinguishers or fixed extinguishing systems.

11.2.2 Aircraft emergency landings or accidents can be the result of uncontrolled fires occurring in flight. The most common types of in-flight fires involve the following:

(1) Engines
(2) Cabin areas
(3) Lavatories
(4) Heaters
(5) Cargo areas
(6) Electrical compartments

11.2.3 In accordance with NFPA 408, portable fire extinguishers are required to be mounted at specific locations in the cabin of passenger aircraft and flight deck crews must receive periodic training for their use. Fire extinguishers are designed to handle incipient fires in accessible areas. However, fires can and do originate in locations not readily accessible from the cabin while the aircraft is in flight. If the area involved in fire is isolated and is not equipped with a fixed extinguishing system, a serious fire can develop and spread rapidly.

11.2.4 When the aircraft is on the ground, heat, smoke, and gases will build up, creating a toxic atmosphere and setting the stage for a flashover.

11.2.5 After the aircraft has landed and the flight deck crew has initiated emergency evacuation, it should be assumed that some of the occupants might not have the ability to self-evacuate. ARFF personnel should allow normal procedures to be carried out to their full potential without compromising the evacuation process. However, ARFF personnel and vehicles should be placed in strategic positions to effect entry into the fuselage to confirm complete evacuation and achieve fire control.

11.2.6 If there is no evidence of occupant evacuation, immediate steps should be taken to make entry for control of the fire and rescue of occupants. Entry will permit an inrush of fresh

air into a possibly overheated or unstable atmosphere that could rapidly accelerate the fire. Toxic gases will be present, so ventilation and a thorough search for survivors should take place immediately and simultaneously with the firefighting effort. In darkness or heavy smoke conditions these efforts will be much more difficult.

11.2.6.1 Consideration should be given to details such as the following:

(1) Options for gaining access
(2) Methodical search patterns
(3) Communications
(4) Hose management

11.3 Interior Fires in Unoccupied Aircraft.

11.3.1 Fires occurring in unoccupied aircraft often result in delayed detection. An unattended aircraft with its doors closed can contain a smoldering fire that can burn unnoticed for an extended period of time. Under these conditions, a build-up of extremely hot fire gases can develop as the fire consumes all the available oxygen. Opening up an aircraft under such circumstances can be very hazardous because when oxygen is introduced into such an atmosphere the entire interior can become immediately ignited, possibly with explosive force. Handlines that are fully charged need to be in place prior to entry into the fuselage.

11.3.2 When arriving at a closed, unoccupied aircraft that is suspected of having an interior fire, the internal atmosphere should be assessed before entry is attempted. If flame cannot be seen, and the windows are hot to the touch and obscured by heavy smoke, it can be expected that a hot, smoldering fire exists and entry of outside air at this time would ignite the entire interior.

11.3.3 If an interior fire in an unoccupied aircraft has not reached the smoldering stage, there is sufficient oxygen present and a free-burning fire can be maintained. Under these circumstances, entry should be made and the fire extinguished with water or foam in the conventional manner.

11.3.4 Extinguishment of a hot, smoldering, internal aircraft fire can be very difficult. Where this type of fire exists, one method is worth consideration. It can be referred to as an indirect attack that is made from small fuselage openings such as slightly opened exits or openings made in cabin windows. A coordinated multiple-point attack is more effective than a single-point attack and is necessary when applying the method to fires in wide-body or multideck aircraft with large-volume interiors. It must be remembered that this method is not suitable if there is any possibility of occupants being onboard the aircraft.

11.3.4.1 The extinguishment principle of this indirect method is based on the conversion of water spray into steam as it contacts the superheated atmosphere within an enclosure. The rapid expansion of water spray droplets into minute stream droplets increases the surface area of the water, permitting it to absorb more heat, thus making it more efficient as a cooling agent. Water in this form and under pressure has the ability to penetrate dense burning materials and enter areas behind panels and coverings. When properly applied, the method lowers the temperature of the entire fire area to a point where combustion ceases.

11.3.4.2 Should a smoldering, interior aircraft fire occur in compartments below the passenger and flight deck levels, the indirect attack method can also be applied and adapted to the particular circumstances involved. However, it can be more difficult to achieve convenient openings in these compartments.

11.4 Penetrating Nozzles.

11.4.1 The use of penetrating nozzles is another way of combating aircraft cabin and compartment fires. Most penetrating nozzles are designed so that any agent currently used by ARFF providers can be utilized.

11.4.2 To extinguish an aircraft cabin or compartment fire using penetrating nozzles, the total fire area requiring agent application needs to be considered. For example, to extinguish a large fire in the cabin of a wide-body aircraft, penetrating nozzles injecting agent simultaneously from dispersed, multiple injection points would be required to provide a sufficient amount of agent to effect extinguishment in a timely manner.

11.4.3 Currently, there are a number of hand-held penetrating nozzles in use. The manner of application can be slow, awkward, and occasionally dangerous when applied to aircraft firefighting and should be done with great care. When using this type of penetrating nozzle, ARFF personnel should make certain that they have proper footing and sufficient operating area, and have an understanding of aircraft design and construction and emergency access points of entry.

11.4.4* Boom-Mounted Turrets and Piercing Nozzles.

11.4.4.1 Boom-mounted turrets and piercing nozzles can be used to discharge extinguishing agents inside the aircraft.

11.4.4.2 Boom-mounted piercing nozzles can usually push cabin and fuselage windows inward, allowing access for interior agent application. Because of the forward-facing cockpit window construction, boom-mounted piercing nozzles should not be used to penetrate these windows.

11.4.4.3 Boom-mounted piercing nozzles are effective at penetrating the fuselage below the cabin floor level and baggage compartments to extinguish fire in concealed spaces.

11.5 Interior Aircraft Fire Overhaul. During the overhaul phase of an interior aircraft fire, hose lines should remain charged and available to extinguish any deep-seated fire, hidden uncovered fire, or reignition. Carpeting, wall panels, partitions, and ceiling covering should be removed when necessary to ensure that all fire is extinguished and that there is no threat of reignition. The use of portable lighting units and ventilation fans will help to make the aircraft interior safer and more tenable for ARFF personnel. Any person entering the aircraft during the overhaul phase should use positive-pressure SCBA.

Chapter 12 Miscellaneous Aircraft Incidents (NFPA 402)

12.1 General.

12.1.1 Each year ARFF personnel respond to numerous on-airport incidents that are considered "minor." These seemingly routine activities do not make headlines, but the absence of intervention could often result in catastrophic loss of life, serious injuries, and extensive property loss.

12.1.2 Guidance presented in this chapter is intended to inform ARFF personnel of a variety of aircraft incident types and how to deal with them so that the hazards relative to on-airport aircraft operations can be safely abated.

12.2 Engine Fires.

12.2.1 It is reasonable for ARFF personnel responding to aircraft engine fires to expect that all of the following actions have probably been accomplished by the flight deck crew, where appropriate:

(1) Engine shut down
(2) Engine fire extinguishing system (if any) activated
(3) Electrical power to the affected engine(s) de-energized
(4) Fuel supply to the affected engine(s) shut down

12.2.1.1 These actions should be verified as conditions permit. It should be emphasized that turbine engines, following shutoff of power and fuel, can remain a potential hazard during "wind down," with high heat retention continuing for as long as 30 minutes. This heat constitutes a potential ignition source for flammable vapors.

12.2.1.2 On propeller-driven or rotary-wing aircraft, contact with propellers or entry into their path of rotation should be avoided during all stages of the emergency.

12.2.2 When jet engines are started or shut down in certain wind conditions, hot starts or tail pipe fires can occur. These fires can usually be controlled by the flight deck crew. In some cases, however, fire department intervention might be necessary.

12.2.3 When reciprocating engine fires are confined within the nacelle but cannot be controlled by the aircraft extinguishing system, dry chemical or a clean agent should be applied first, as these agents are more effective than water or foam for fires inside an enclosure. Foam or water spray should be used to cool the outside of the nacelle.

12.2.4 Fires confined to the hot section of jet engines can be best controlled by keeping the engine rotating. Such action should be considered in the context of necessary aircraft evacuation and other safety considerations. Fires outside the combustion chambers but confined within the nacelle are best controlled with the engine's fixed extinguishing system. If the fire continues after the system has been discharged, or if reignition occurs, an extinguishing agent should be applied through the maintenance openings. In order to carry out post-fire inspections, ARFF personnel should be aware of the methods of opening the engine nacelle and the subsequent danger of pooled hot fuel contained within the nacelle. The aircraft operator should be advised of the type of extinguishing agent used so that appropriate maintenance action can be taken.

12.2.5 Foam or water should not be applied to either the intake or exhaust of a jet engine unless control cannot be secured or confined to the engine nacelle using a clean agent or dry chemical. If foam or water is applied to either the intake or exhaust, ARFF personnel should stand clear to avoid being struck by disintegrating engine parts.

12.2.6 On fires contained within tail pipes, ARFF personnel should carry out an internal post-fire inspection of the surrounding area to ensure that the fire has been contained within the engine or APU and the heat has not been transmitted by conduction. When tail pipe fire occurs in the elevated center engine of three-engine wide-body aircraft or a B-747 APU, special elevating equipment might be required to effectively discharge agent onto the fire. *(See also Annex C.)*

12.3 Aircraft Fuel Servicing Incidents.

12.3.1 A number of aircraft fires have occurred during fuel servicing. Ignition has been caused by static developed in flowing fuel, surface-generated static within an aircraft fuel tank or refueling vehicle, defective fuel pumps, an external source of ignition, and other improper fueling procedures. Defueling and fuel transfer operations are also serious fire potentials. Standards relative to aircraft fueling procedures and proper equipment maintenance should be diligently enforced by the AHJ on the airport.

12.3.2 Fuel spills exterior to the aircraft should be handled in the manner described in NFPA 407 when fire does not occur. If fire does occur, it should be handled similarly to any other aircraft accident, with primary emphasis on life safety. The practice of fueling occupied transport category aircraft necessitates that, in the event of a fuel spill fire, an immediate check of the interior for occupants is imperative.

12.3.3 Many transport category aircraft have ganged fuel tank vents near wing tips. Vented JET A–type fuel (kerosene grades) vapors normally present very little hazard. If tanks are overfilled, the fuel will discharge through the vents, causing a fuel spill. There is a greater potential for a flammable vapor-air mixture being present in the immediate vicinity of wing tip vents when JET B fuel is used. Regardless of which fuel is used, it is good practice not to position or operate vehicles within an 8 m (25 ft) radius of aircraft fuel system vent openings.

12.4 Hot Brakes.

12.4.1 Hot brakes can contribute to the overheating of wheels and tire assemblies. The heating of aircraft tires causes overpressure and presents a potential explosion hazard. Good judgment should be exercised in determining the severity of the situation, and this information should be conveyed to the flight deck crew. The flight deck crew in turn can assist the rescue and firefighting effort by performing necessary procedures.

12.4.2 In order to avoid endangering ARFF personnel and aircraft occupants and causing unnecessary damage to the aircraft, it is important not to mistake hot brakes for brake fires (where flames are visible). Hot brakes normally cool by themselves and do not require an extinguishing agent; however, overheating can create circumstances that necessitate additional actions.

12.4.3 When a hot brake condition occurs on a propeller-driven aircraft, it is usually beneficial to keep the propeller that is directly forward of the wheel with hot brakes operating until the brakes have cooled. Larger, modern aircraft have fusible plugs mounted in the wheels that fail at high temperatures, allowing the tires to deflate before dangerous pressure can develop.

12.4.4 ARFF personnel should remain clear of the sides of aircraft wheel assemblies on all landing gear emergencies and approach only at a 45 degree angle from the fore and aft directions. Because heat is transferred from the brake to the wheel, extinguishing agent should be available.

12.4.5 Acceptable cooling procedures should include, but not be limited to, the following:

(1) Advise the flight crew to continue taxiing the aircraft when appropriate.
(2) Stand by and monitor gear conditions without intervention.
(3) Apply water to gear using a narrow fog pattern.
(4) Apply forced-air ventilation.

12.5 Wheel Fires.

12.5.1 ARFF personnel should extinguish any wheel fire with any extinguishing agent available. Effective cooling is a primary consideration.

12.5.2 Dry-chemical and clean agents might extinguish fires involving hydraulic fluids and lubricants, but reignition can occur since these agents lack sufficient cooling effect. Clean agents are particularly effective in extinguishing aircraft undercarriage fires. However, where magnesium wheel components are burning, clean agents should not be used.

12.5.3 Effectiveness of any gaseous extinguishing agent can be severely reduced if wind conditions are such that sufficient concentration cannot be maintained to extinguish the fire.

12.5.4 Fires involving magnesium wheels have been successfully extinguished by applying large amounts of water from a distance. This method rapidly reduces the heat to a point below the ignition temperature of the magnesium, and the fire is extinguished. ARFF personnel should exercise extreme caution when this method of extinguishment is used, as explosive failure of the wheel components is likely.

12.6 Combustible Metal Fires. Burning magnesium or titanium parts should be isolated, if possible, and extinguished by applying a Class D agent. Large quantities of water could be effective when a Class D agent is not available.

12.7 Broken Flammable Liquid Lines. Broken fuel, hydraulic, alcohol, and lubricating oil lines should be plugged or crimped when possible to reduce the amount of spill potential.

12.8 Heater Fires. Heaters located in wings, fuselage, and tail sections of aircraft can be protected with a fixed fire extinguishing system. In the event of an airborne heater compartment fire, it can be assumed that the system would have been activated. After the aircraft has landed, a thorough check of the heater compartment and surrounding area should be made to ensure that there has been no reignition or spread of fire.

12.9 Bomb Threats/Security.

12.9.1 Incidents of unlawful acts, including terrorism, have forced airports to implement ever-increasing security measures, often impacting the operation of emergency services.

12.9.2 Preplanning and response protocols must be in effect for mutual aid responders to access staging areas and the accident site. Protocols must ensure that only authorized persons are granted access to the operating interior of the airport.

12.9.3 When a bomb threat involving an aircraft is declared an emergency, the aircraft should be evacuated without delay. The situation might dictate the use of the emergency evacuation slides or built-in stairs. Use of portable stairways might be the safest and most practical alternative.

12.9.4* Immediately after evacuation has been completed, the aircraft involved will normally be moved to a remote location designated by the AHJ.

12.9.5 Airport pre-incident plans should incorporate assignment of initial responsibility in any bomb threat emergency for initiating protective measures, conducting and controlling any search activities, transferring their responsibility, and declaring the termination of the emergency.

12.9.6 The role of the ARFF personnel in bomb threat emergencies should be limited to the following:

(1) Assisting occupants evacuate the aircraft
(2) Assuming a standby status and remaining in readiness after evacuation is complete and the aircraft has been moved to a safe location
(3) In the event of a bomb detonation, assuming command and control of any rescue operation or fire incident that results

12.9.7 The airline is responsible for the safety and well-being of its passengers and resources, and should cooperatively assist local authorities in any search of the aircraft or its contents.

12.10 Incidents Where Aircraft Fire Warnings Occur.

12.10.1 It is often difficult for the flight deck crew to accurately evaluate conditions following actuation of an aircraft fire warning indicator. Therefore, the aircraft should be brought to a stop before approaching the terminal. ARFF personnel should inspect the affected area by checking for external evidence of smoke or heat. If no evidence exists, the aircraft should continue on to the terminal, where a more thorough inspection can be made.

12.10.2 If there is evidence of fire, immediate access should be made and the fire extinguished. If this occurs, the aircraft should be shut down and the decision made as to whether an evacuation of occupants should take place. Airline maintenance personnel and equipment should be requested to respond and assist ARFF personnel in gaining access and operating ground power units, and to assist with portable stairways if needed for evacuation.

12.11 Emergency Landings.

12.11.1 Often, a landing gear stuck in the retracted position is the result of broken hydraulic lines or loss of electrical power. Spilled hydraulic fluid can ignite in the wheel wells due to the presence of electrical shorts, friction sparks due to a wheels-up landing, or other heat sources. Should ignition occur, the fire has a tendency to travel up into the fuselage and can rapidly become a major interior fire. ARFF personnel should take immediate steps to ensure the stabilization of this problem even if appearances from the exterior do not immediately indicate the presence of fire.

12.11.2 Hydraulic problems on landing aircraft can involve the brake systems, flaps, spoilers, and so forth. This has a tendency to lengthen the rollout after touchdown and can also affect the aircraft's directional control. As soon as the aircraft touches down and passes each ARFF vehicle that is standing by,

that vehicle should immediately follow the aircraft and be ready to perform any necessary operation when it comes to a stop.

12.11.3 At emergencies involving landing gear malfunctions, tire problems, or flight control and hydraulic problems, there is always a possibility of the aircraft veering off the runway after landing and hitting standby ARFF vehicles. It is difficult to predict the touchdown point. Therefore, if there are two or more ARFF vehicles available, they should stand by on opposite sides of the runway, a suitable distance from the edge.

12.12 Aircraft Accidents in the Water.

12.12.1 Many aircraft accidents in the water have occurred in the critical response area off the end of the runway. Where runways terminate adjacent to a significant body of water, special provisions should be made to ensure the rapid response of ARFF services. For any aircraft overrunning or landing short of the runways into water, response times should be as close as possible to those of land emergencies.

12.12.2 Many transport category aircraft not engaged in intercontinental overwater flights are equipped only with flotation-type seat cushions as emergency flotation devices. Survivability of passengers using this equipment is limited. Survivors are susceptible to hypothermia in water below 21°C (70°F) and ingestion of vapors from floating fuel. Rapid response is extremely important.

12.12.3 In water landing accidents, the possibility of fire is normally reduced because of the cooling of the heated surfaces by the water. In situations where fire occurs, chances of its control and extinguishment are minimal unless the accident occurs within close proximity to shore and extinguishing operations can take place at close range.

12.12.3.1 Airport runways located within 800 m (½ mile) of large bodies of water should ensure immediate access is available, that is, wide service roads able to handle ARFF vehicles and boat ramps capable of rapidly deploying rescue boats.

12.12.3.2 Blow-up tents or other types of emergency shelters should be available for emergency workers and survivors in areas where there may be inclement weather conditions.

12.12.4 Where the distance offshore is within range, fire hose can sometimes be floated into position by scuba divers or boats and used to supplement other means of fire attack.

12.12.5 The impact of an aircraft into water can rupture fuel tanks and lines. It is reasonable to assume that fuel is floating on the water surface. Watercraft having exhausts at or above the waterline can present an ignition hazard and should not enter the area. Advantage should be taken of wind and water currents when dealing with floating fuel. Every effort should be made to keep floating fuel from moving into areas where it would be hazardous to rescue operations. As soon as possible, pockets of fuel should either be broken up, moved away with large velocity nozzles, covered with foam, or disposed of by commercial reclaiming enterprises. The local water pollution control agency can be of assistance during this operation.

12.12.6 If fuel on the water has ignited, approach should be made from the direction where wind direction and velocity, water current, and site accessibility create an advantage. Fire can be moved away from an area by using a sweeping technique with hose streams. Foam and other extinguishing agents can be used where practical and necessary.

12.12.7 Scuba diving units should be dispatched to the scene of an aircraft accident in the water. Helicopters can be used to expedite the transportation of divers to the actual area of the accident. All divers who might be called for this type of service should be qualified in both scuba diving and underwater search and recovery techniques.

12.12.8 In all operations where divers are in the water, standard diver's flags should be flown and all watercraft restricted from the diving area.

12.12.9 Victims in the water are more apt to be found downwind or downstream. Where only the approximate location of the impact site is known upon arrival, divers should use standard underwater search patterns, marking the locations of major parts of the aircraft with marker buoys. If sufficient divers are not available, dragging operations should be conducted from surface craft. In no instance should dragging and diving operations be conducted simultaneously.

12.12.10 Life-sustaining air can remain in large, submerged, occupied sections of the aircraft. As soon as practicable, entry by divers should be made carefully at the deepest point possible.

12.12.11 Where occupied sections of the aircraft are found floating, great care should be exercised not to disturb their buoyancy, and supplemental floating devices should be attached. Removal of any occupants should be accomplished as smoothly and quickly as possible. Any shift in weight or lapse in time can result in the section sinking. Rescuers should use caution so that they are not injured or trapped should the section capsize or sink.

12.12.12 A command post should be established on an adjacent shore to facilitate implementation of the airport/community emergency plan. *(See Chapter 14.)*

Chapter 13 Post-Aircraft Accident Procedures (NFPA 402)

13.1 General.

13.1.1 Many local statutes stipulate that it is the duty of the fire department to protect life and property from fire and to extinguish all destructive fires. They further state that no person has the right to interfere or hinder the fire department in the performance of this responsibility. It is vital that the area of an accident site be identified and sealed off as soon as possible; only persons required for the rescue and firefighting should be allowed access to the wreckage, thus protecting vital evidence from being destroyed by well-intentioned persons. The investigating authority will require detailed information from ARFF personnel where, in the execution of their duty, wreckage, switches, or other parts of the aircraft were moved for rescue purposes *(see 7.1.2)*.

13.1.2 During post-aircraft accident operations, a reassessment of the potential risks to personnel and the environment should be undertaken, and subsequent control measures put into operation to ensure the safety of all agencies working on site.

13.1.3 It is essential that personnel are aware of the possibility of the ignition of fuels. Any source of ignition should be prohibited at the accident site (smoking, etc.). It is of paramount importance that adequate control measures are put into place before using equipment that may produce a source of

ignition. Procedures should be implemented to ensure that PPE is worn, with full-body and respiratory protection, and that a "no drinking, no eating" rule is enforced within the immediate accident site.

13.1.4* ARFF personnel should familiarize themselves with all applicable regulations relating to movement of aircraft wreckage and disposition of accident fatalities. *(See also Annex D.)*

13.2 Preservation of Evidence.

13.2.1 Following extrication of occupants from an aircraft, preservation of evidence at the site is of vital importance in determining the probable cause of the accident/incident. ARFF personnel should be aware of this requirement, and it should be stressed in training exercises.

13.2.2 ARFF personnel should take notice of and record the condition and position of the aircraft structure prior to beginning any significant cutting and shifting of any portions of the wreckage. If time permits, photographs should be taken of initial conditions for later study.

13.2.3* The preservation of evidence also includes debris that may be scattered across the accident site, for example, on runways or taxiways. This evidence can include parts of the aircraft and effects belonging to passengers and crew. A large number of documents and papers may be carried on aircraft, recovery and preservation of which is vital. (If the flight deck is intact, then these documents should not be removed unless there is risk of loss or damage.) In addition, the observations of ARFF personnel can be useful in assisting the investigating authorities.

13.3 Fatalities.

13.3.1 The location of all fatalities in and about the aircraft wreckage should be clearly identified by the use of flags, stakes, or other suitable markings, numbered to coincide with a number securely attached to the body, and photographed, if possible. Triage/medical tags can be used for this purpose. *(See also Chapter 14.)*

13.3.2 Premature removal of remains can interfere with identification and destroy pathological evidence; however, if removal of remains is absolutely necessary, the original location of the remains should be properly documented. Movement of fatalities remaining in or around an aircraft wreckage can be done to minimize further hazards and preserve evidence. Consideration should be given to tactics involved in extinguishment, rescue operations, preservation of evidence, and showing proper respect towards the deceased prior to moving a confirmed fatality.

13.4 Preservation of Mail, Baggage, and Cargo.

13.4.1 The original location of mail sacks, baggage, and cargo should be observed and this information passed on to investigators. These items should be protected from further damage and, if necessary, removed to a safe location such as the command post.

13.4.2 Postal officials normally extend blanket authority to fire departments to remove mail from aircraft involved in an accident, for the purpose of saving as much of it as possible. After the responding postal official has been properly identified, the ARFF officer can transfer the custody of the mail.

13.4.3 If it is necessary to remove baggage from an aircraft involved in an accident, it should be placed in the custody of airline officials. Under certain circumstances, customs officials would be granted initial custody. Responsibility for final disposition of baggage belongs to the airline involved.

13.4.4 Cargo manifests should be reviewed for the presence of dangerous goods. If present, they should be examined for leakage or damage to packaging. If damage has been sustained, containment and decontamination procedures should be initiated immediately by qualified personnel. If cargo is removed from the aircraft, it should be held by the responsible agency.

13.4.5 When personal property, such as jewelry, purses, watches, and so forth, is found in the vicinity of an aircraft accident, ARFF personnel should not move it but record the location and notify their incident commander, who should advise security personnel of the information. These items and their locations can be of great value to the AHJ in making positive body identifications.

13.5 Flight Data and Cockpit Voice Recorders. Flight data and cockpit voice recorders, as shown in Figure 13.5(a), are usually located in the aft fuselage area of most commercial aircraft, as shown in Figure 13.5(b), and are designed to be resistant to crash forces and fire. The outer surface is normally painted "International Orange." ARFF personnel should be able to recognize these recorders so that they can be protected from loss or damage until accident investigators assume responsibility. Although no attempt should be made to remove these recorders from the aircraft, as they could be damaged by such efforts, if failure to remove them will result in their total loss, recovery should be made.

13.6 Defueling Accident Aircraft.

13.6.1* Defueling operations should be done under the direct supervision of a qualified aircraft fuel systems specialist. The defueling itself should be performed by qualified technicians using approved methods. Provision should be made for an ARFF vehicle to stand by on-site while defueling takes place.

FIGURE 13.5(a) Flight Data Recorder and Cockpit Voice Recorder.

13.6.2 Defueling of aircraft should not take place until there has been full consultation between the airport fire service, police, airline, and accident investigation authority. Aircraft should not be defueled during rescue operations. If there is fuel leakage, it should be dealt with in the same manner as any other fuel leak, regardless of the aircraft's attitude.

13.6.3 Defueling an inverted aircraft has potentially very serious implications. A number of reasons why an inverted aircraft should not or cannot be defueled during the rescue operation are as follows:

(1) Ignition can be caused by surface-generated static as the fuel flows between the aircraft fuel tank and the fueling vehicle.
(2) Due to the accident, fuel pump access doors and the fuel pumps themselves could have been damaged.
(3) The wing attitude could make it difficult to determine in which tank the fuel is located, in what position, and in what quantity, with the result that while attempting to defuel, the fuel could be accidentally discharged onto the accident site.
(4) Fueling normally involves delivery by pressure, and defueling utilizes gravity flow from underwing orifices when the aircraft is on its wheels. Inverted aircraft or those on their bellies do not offer the benefits of gravity flow. This technical problem is compounded by the fact that most fueling vehicles cannot "lift" fuel by suction in the same way that fire vehicles "lift" water from a ground level reservoir up into their water tanks.

FIGURE 13.5(b) Location of Flight Data Recorder and Cockpit Voice Recorder.

13.6.4* During defueling operations, an ignition-free area with a radius of at least 15 m (50 ft) from the outer edge of the operating area should be maintained. Persons within the controlled area should be only those necessary for the work being done. Open flames, floodlights, ground power units, and radio transmitters should be prohibited in the operating area. ARFF personnel should also be aware that their vehicles and equipment can be a source of ignition and should take necessary precautions.

13.6.5 Concurrent operations such as jacking, shifting, and removing panels should not be conducted during defueling operations. Transfer of fuel during defueling operations can cause changes in weight distribution, balance, and stability of the aircraft. Cribbing, blocking, use of air bags, and other stabilizing methods and equipment should be in place, ready for use if needed. Safe access for fueling vehicles, empty or full, should be provided.

13.7 Post-Accident Fuel Leaks.

13.7.1 To control fuel system leaks prior to completion of aircraft defueling, fuel cell sealant, clay, or other material can be used to make mini-dams on smooth surfaces to direct the flow of fuel into containers. Crimping, pegs, and plugs should also be used where appropriate. It might also be possible to dig trenches to direct the fuel to collecting spots where it can be protected from ignition sources.

13.7.2 Prior to moving the wreckage, the interior of the aircraft should be well ventilated to ensure a fire-safe environment.

13.7.3 After removal of the aircraft, hard ground surfaces should be thoroughly cleaned to remove any flammable liquids or debris before permitting normal traffic to resume. Soft ground surfaces may be contaminated. Advice should be sought from an environmental agency as to whether removal of contaminated ground surfaces may be required.

13.8 Aircraft Systems Hazards. ARFF personnel should seek the advice of aircraft systems specialists concerning items that might present problems during overhaul and salvage operations. Advice can include information regarding liquid or pressurized systems that need to be bled off prior to any cutting, bending, or prying around components.

Chapter 14 Elements of Emergency Planning (NFPA 424)

14.1 General.

14.1.1 It is the function of the airport operator to develop an airport/community emergency plan (AEP) and procedures for all perceived emergencies applicable to the airport's characteristics and operation. The AEP should describe the coordination of the actions to be taken in an emergency occurring at an airport or in its vicinity. It should be built around an Incident Command System (ICS) compatible with the locally adopted emergency management system.

14.1.2 "During-the-emergency" considerations depend on the exact nature or location of the incident, or both. The location should dictate the agency responsible for management of the emergency. As the nature of the incident changes from emergency operations to the investigative phase, the appropriate investigative agency should assume command and responsibility for the incident scene. All agencies responding to the inci-

dent should know in advance their respective roles and the established lines of authority.

14.1.3 "Post-emergency" considerations also should be given considerable attention. Transition of authority and other legal factors should be discussed and preplanned. Consideration should be given to the restoration of protective services in order to permit continuation of normal airport/aircraft operations and public protection that were disrupted by the emergency. Due to specialized training and equipment, aircraft rescue and firefighting (ARFF) units should be made available for response as expeditiously as possible.

14.1.4* The recommendations contained in this document are based on the requirement that rescue of aircraft occupants and other related accident victims is the primary operational objective. Effective operations require a great deal of preplanning. Regular exercises provide an opportunity for realistic training of personnel from all agencies that will be involved in the incident.

14.1.5 It is crucial that response agencies consider local weather conditions and nighttime operations while developing details of the AEP. For example, low temperatures can freeze medical solutions or tubing during protracted extrication operations. Severe weather conditions also can negatively affect firefighting foam solution. Precautions should be taken where necessary to mitigate weather-induced physical problems such as hypothermia and dehydration. Such considerations should apply to emergency personnel, as well as victims of the accident.

14.1.6 Amendment of the AEP.

14.1.6.1 The airport operator should maintain the master records of the AEP and transmit to each participating agency amendments, additions, and revisions as appropriate.

14.1.6.2 The scope of the AEP should include command, communication, and coordination functions for executing the AEP. The AEP should be constructed using a modular and severable format in order to facilitate revisions of specific elements without having to rewrite the entire AEP. The AEP should be reviewed on an annual basis by all participants. The review should include a comprehensive analysis of lessons learned from training sessions, incidents, geographical and physical changes, legal and technical changes, and other factors that can influence the adequacy of the AEP.

14.1.7 Training Costs. The costs of a major training exercise can be a considerable factor for even the smallest of airports. Budgetary planning for training costs should include salaries for personnel; consumables such as fuel, extinguishing agent, and medical supplies; legal advice; and other necessary items, such as food for all participants.

14.2 Types of Emergencies and Emergency Alerts. *(See Annex G.)*

14.2.1 Many different types of emergencies can strike a community. However, when creating the AEP, the focus should be on aircraft-related incidents. Preparation, including risk assessment for other types of emergencies, should be addressed in the pre-emergency planning documents built around the special nature of those incidents.

14.2.2 Most aircraft accidents occur within the airport operational area. However, experience has shown that the most devastating aircraft accidents have been those that occur off-airport, involving structures. Therefore, it is necessary to design a plan that provides for the needs of both.

14.3 Essential Elements of the AEP. The following elements should be considered essential to the AEP:

(1) Establishment of formal instruments/agreements/joint powers, and so forth, to initiate development and implementation of the AEP
(2) Detailed planning for 24-hour response, communications, accountability, logistics, and so forth
(3) Agreement for incident command and control systems and procedures (All agencies involved in the AEP should be aware of each other's defined duties.)
(4) Funding for practice exercises
(5) Regular and "as needed" AEP updates
(6) Public relations efforts that bring popular and political support to maintaining readiness
(7) An emergency notification system or alarm system that has a distinctive signal for each emergency situation as determined via a preliminary hazard assessment (PHA) and is in compliance with the requirements of 29 CFR 1910.165 at a minimum.

Chapter 15 Agencies Involved (NFPA 424)

15.1 Agencies.

15.1.1 The AEP should have an up-to-date list of all agencies involved. In addition to agency identification, the list should include current telephone numbers, e-mail addresses, and names of primary contact persons. This list should be reviewed, revised as necessary, and distributed to all agencies on a regular basis.

15.1.1.1 Written agreements should be established with all organizations and agencies that will be involved in responding to an emergency situation. The agreements should be reviewed annually or upon a change in operations that could affect existing emergency response plans and updated as necessary. The emergency response plan will be compatible and integrated with the disaster, fire, and/or emergency response plans of local, state, and federal agencies.

15.1.2 The first step in a viable AEP is to have the cooperation and participation of all concerned airport/community authorities and agencies. The authorities and agencies that should be involved are as follows:

(1) Air Traffic Control (ATC) services
(2) ARFF services (departments)
(3) Agency tasked for personnel decontamination and HAZMAT response
(4) Police/security services
(5) Airport operator
(6) Emergency medical services, including ambulance services and hospital coordination center
(7) Hospitals
(8) Aircraft operators
(9) Government services
(10) Communications services
(11) Airport tenants
(12) Transportation authorities (land, sea, and air)
(13) Rescue coordination center
(14) Civil defense
(15) Mutual aid agencies
(16) Harbor Patrol and/or Coast Guard

(17) Military
(18) Clergy
(19) Public information office/news media
(20) Mental health agencies
(21) Customs
(22) Public utilities
(23) Postal authorities
(24) Veterinary services
(25) Coroner
(26) Volunteer organizations (e.g., International Red Cross)
(27) Civil engineering contractors
(28) Environmental agencies

15.2* ATC Services. For emergencies involving aircraft, the ATC provider is required to contact the ARFF service and provide information on the type of emergency, such as the type of aircraft, number of persons on board, fuel quantity, and location of the accident, if known. After the initial call, mutual aid agencies should be provided the airport grid map reference, rendezvous point/staging area, and, where necessary, the airport entrances to be used. Alternately, this function can be assigned by the AEP, either in whole or in part, to another organization or unit. The AEP also can specify that ATC services is responsible for initiating the notification of local fire departments and other appropriate agencies in accordance with procedures established in the AEP. The AEP can assign this function to another agency, such as the local fire department dispatching center, but it is very important that this extremely crucial function be well documented and understood by all concerned. It will be the responsibility of the airport operator to restrict airport operations in coordination with ATC services and through the issuance of a Notice to Airmen (NOTAM).

15.3 ARFF Services (Departments).

15.3.1* The primary responsibility of ARFF personnel is to save lives. Property endangered by aircraft incidents and accidents occurring on or near the airport should be preserved as far as is practical. To achieve this objective, fire control is normally defined as securing the area to prevent any re-ignitions. However, there might be aircraft accidents where fire does not occur or where a fire is rapidly extinguished. In every case, each action taken should be aimed at providing the most immediate attention possible to survivors of the accident, with special emphasis on the initial care, decontamination, and timely transportation of the immediate care (Priority I) victims to the appropriate facilities based on the local EMS and hospital disaster plans.

15.3.2 ARFF personnel should receive emergency medical training that meets the minimum standards of their state and local jurisdictions. The stabilization of seriously injured victims can depend entirely upon these first-arriving personnel. Coordination with other responding personnel having advanced medical expertise (paramedics and medical doctors) should be addressed in the AEP.

15.3.3 The firefighting officer in command should be identified by a standard distinctive uniform. In addition, the AEP should provide a highly visible vest or other apparel with reflective lettering, front and back, that reads, "INCIDENT COMMANDER."

15.3.4 Only firefighting and rescue personnel wearing approved firefighting protective clothing and equipment should be allowed in close proximity to an aircraft accident site until the Incident Commander (IC) determines it is safe for others to enter [100 m (300 ft) from any point on the aircraft or any fuel spillage is usually considered a safe distance].

15.3.5 As part of the interagency planning process, health and safety risks associated with an aircraft accident/incident should be communicated to other agencies that could become involved. The IC of the ARFF response should ensure that other agencies working within the immediate crash site are aware of the potential hazards and the appropriate personnel protective clothing/equipment that could be required.

15.4 Police/Security Services.

15.4.1 In an airport emergency, it should be expected that the first police or security officer to arrive at the scene will initiate site security procedures and request reinforcement as needed. It should be expected that these responsibilities will be spelled out in the AEP, identifying the responsible law enforcement agency for the accident site and providing for a smooth transition of command, should responsibility for site security shift from one agency to another.

15.4.2* Congestion-free ingress and egress roads should be established immediately for emergency vehicles. The security services, police force, or other appropriate local authorities should be expected to ensure that only persons with specific tasks are allowed at the scene of the accident, and they also should be expected to route the normal traffic away from or around the accident site.

15.4.3 The AEP should provide for the prevention of unauthorized access to the accident site and for preserving the site undisturbed for investigation purposes.

15.4.4 A mutual aid program should be instituted between all potentially involved security agencies, for example, airport, city, local, and governmental security forces; mail inspectors; and, where appropriate, military police and customs officials.

15.4.5 A method of easy identification of responding emergency personnel should be implemented at security checkpoints to ensure that appropriate emergency personnel have immediate access to the accident site. "Emergency Access" identification can be pre-issued by the airport operator to emergency personnel for use during an emergency.

15.4.6 In many cases it is not possible or practicable for vehicles of mutual aid fire departments, ambulances, and so forth, to proceed directly to the accident/incident site. It should be essential that the emergency plan include procedures for meeting at a designated rendezvous point or points. A rendezvous point also can be used as a staging area where responding units can be held until needed at the accident site. Suitable accommodation should be provided at the rendezvous point(s)/staging area for the rendezvous point/staging area manager to facilitate the briefing of incoming officers in charge of supporting services. Adequate telephone and radio provisions should be available. The rendezvous point-staging area office(s) should also consider the suitability of vehicles to adverse terrain and conditions at the accident site in order to prevent obstruction of the access route by disabled vehicles. Staging of vehicles can prevent traffic jams and confusion at the accident scene.

15.4.7 To easily identify and distinguish the security/police officer in command, a distinct colored vest with reflective lettering displayed front and back should be utilized.

15.5 Airport Operator.

15.5.1 The airport operator is responsible for establishing, promulgating, and implementing the AEP and designating a person to take charge of the overall operation at the ICP. (Incident command should rest with the agency having jurisdiction [AHJ].) The AEP should call for the airport operator to ensure that the information on names, e-mail addresses, and telephone numbers of offices or people involved in an airport emergency is kept up to date and distributed to all concerned. The AEP also should include necessary meetings of the airport emergency plan coordinating committee, composed of key personnel from participating agencies, for a critique of the AEP after it has been tested or implemented. The airport operator should be responsible for closing the airport, or part of it, and ensuring that aircraft operations are resumed only when circumstances permit aircraft to operate safely without interfering with rescue activities.

15.5.1.1 The removal of disabled aircraft should be part of the AEP.

15.5.1.2 It is incumbent on the airport operator to ensure that airlines using the airport have made adequate plans and arrangements either separately or conjointly to ensure prompt arrival of recovery equipment and qualified personnel.

15.5.2 To easily identify and distinguish the airport operations officer, a distinctive colored vest with reflective lettering displayed front and back should be utilized.

15.6 On-Scene Medical Services.

15.6.1 The purpose of medical services is to provide triage, medical care, decontamination, and transportation for accident victims. The optimal goal should be decontamination and transportation of the immediate (Priority I) victims to the appropriate facilities based on the local EMS and facilities disaster plans.

15.6.2 It is essential that the medical aspects of the AEP be integrated with other local community emergency plans and agreements, as well as local facilities.

15.6.3 A medical group supervisor should be assigned to assume command of emergency medical operations at an accident site. In some cases, it might be necessary to appoint an interim medical group supervisor who will be relieved when the designated medical group supervisor arrives.

15.6.4 ARFF services should have established plans to return to an index/category level of operations after an on-airport incident. Such plans should address resupplying extinguishing agents and ensuring adequate staffing and availability for secondary ARFF incidents.

15.6.5 The ARFF agency should have a water rescue plan in place for aircraft incidents that occur in or near airports located in close proximity to bodies of water such as oceans, lakes, and rivers. The ARFF agency might choose to have its own water rescue resources and/or utilize mutual aid resources coordinated through the appropriately prepared section of the AEP. The ARFF agency should reference Chapters 16 through 22 of NFPA 2500 for more information.

15.6.6 Medical and ambulance services are an integral part of airport services, particularly when an ambulance service is a part of an airport's ARFF service. Wherever medical and ambulance services are not available at the airport, prearrangement with local, private, public, or military medical and ambulance services should be performed. The AEP should ensure the dispatch of a satisfactory amount of personnel, equipment, and medical supplies. To ensure a rapid response, the AEP can include arrangements for land, sea, and airborne transportation of medical services to the scene and the subsequent transportation of persons requiring immediate medical care. Prearrangements are necessary to ensure the availability of doctors and other medical personnel for all airport emergencies.

15.6.7 The AEP should designate a medical transportation leader whose responsibilities include all of the following:

(1) Alerting hospitals and medical personnel of an emergency
(2) Directing transportation of casualties to hospitals suited to particular injuries
(3) Accounting for casualties by recording the route of transportation, the hospital to which they were sent, and each casualty's name and the extent of their injuries
(4) Advising hospitals when casualties are en route
(5) Maintaining contact with hospitals, medical transportation, the senior medical officer, the on-scene command post, and the ICP

15.7 Hospitals.

15.7.1 Participating hospitals should have contingency emergency plans that provide for blood donations and mobilization of necessary medical trauma teams to the accident site in the shortest possible time. Availability of qualified personnel and adequate facilities at the hospitals are vital. Therefore, it is important to establish in advance an accurate list of surrounding hospitals classified according to their effective receiving capacity and specialized features, such as neurosurgical ability or burn treatment.

15.7.2 The hospital's distance from the airport and its ability to receive helicopters should be considered. Reliable two-way communication between the ICP and these entities is important. An aircraft accident alert should be made to a single medical authority/agency, which then alerts all appropriate facilities according to a local medical communications network.

15.7.3 It is essential that hospitals continually communicate through a central control point to facilitate distribution of critically injured patients. Information regarding the availability of a specific trauma center, operating room, and ward space should be collected at a central control point, designated in the AEP, and disseminated to the medical transportation officer at the scene.

15.8 Aircraft Operators. *(See Annex H.)*

15.8.1* The aircraft operator/company of an aircraft involved in an accident should dispatch a liaison to the ICP to provide full details of aircraft-related information, such as the number of persons on board, fuel, and cargo information (i.e., Dangerous Goods/HAZMAT). This information is vital to the IC and can influence the tactics and strategies used to deal with the emergency.

15.8.2 Aircraft operators also should be responsible for first providing arrangements for any uninjured survivors who need to continue their journey or require accommodation or other assistance. Next, they might be responsible for contacting deceased passengers' next of kin. Clergy, police, international

relief agencies (Red Cross, etc.), and mental health agencies normally will assist in the accomplishment of this task.

15.8.3 The proper disposition of all cargo, mail, and baggage aboard an aircraft involved in an accident is the responsibility of the aircraft operator. Permission to remove these items from the aircraft can be granted by the IC after the emergency has been abated and the requirements of the accident investigators have been met.

15.8.4 The AEP should designate an agreed resource to respond to emergencies that involve a chartered, private, military, or other nontenant aircraft operator.

15.9 Government Agencies. In order to avoid conflict and confusion between participants, the AEP should clearly define the obligation, controls, and limitations placed on the airport operator by government agencies. Post-accident investigation, unlawful seizure of aircraft, bomb threats, and bombings can fall into a jurisdiction other than that of the airport operator. The environmental or rivers protection agency or both should be aware of the potential hazards from an aircraft accident to ensure that measures are in place to prevent contamination through fuel spillage, firefighting media, airborne particulates, and oxidization of metals. The AEP should include procedures for informing these agencies of an accident.

15.10 Communication Services. Arrangements should be made to provide all airport agencies involved in an emergency with two-way communication capabilities. The AEP also should provide an adequate communication network to be maintained with the off-airport agencies responding to an emergency. The AEP should call for the ICP and emergency operations center to have the capability of freely communicating with all participating agencies. Cellular telephones can be extremely effective. Amateur, military, and civil defense radio networks are worth considering as a backup.

15.11 Airport Tenants. Airport tenants and their employees should be considered a prime source of readily available equipment and manpower who might have intimate knowledge of the airport and aircraft. These people can be invaluable, especially if their backgrounds include medical training, food preparation, or transportation. It is important that they be deployed under supervision and assigned specific functions to avoid duplication of efforts and the possibility of disrupting other emergency operations.

15.12 Transportation Authorities (Land, Sea, Air).

15.12.1 In an emergency, vehicles are needed to carry out rescue operations, transport personnel, and haul supplies and debris. Responsibility for the control of vehicles to be used during an emergency should be assigned to a designated transportation officer. The AEP should include an inventory and assignment of transportation and mechanical equipment held at the airport, such as transportation vehicles, trucks, diggers, cranes, and cars, with contingency plans for staff to be called to operate the equipment.

15.12.2 In airport emergencies, provision should be made for an easily identifiable guide vehicle(s) equipped with two-way radio communication to lead groups of vehicles from the rendezvous point(s) or staging area to the accident site, to avoid interference with aircraft operations.

15.12.3 To easily identify and distinguish the transportation IC, a distinct colored vest with reflective lettering displayed front and back should be utilized.

15.12.4 Suitable rescue equipment and services should be available for use at an airport where the area to be covered by the appropriate services includes water, swampy areas, or other difficult terrain that cannot be fully served by conventional wheeled vehicles. This suitability is particularly important where a significant portion of approach and departure operations takes place over these areas.

15.13 Rescue Coordination Center. Rescue coordination centers can play a significant role in an aircraft accident occurring in the vicinity of an airport, if the site of the accident is not known or if rescue facilities in addition to those available at or near the airport are required to be brought into action. Rescue coordination centers should have means of immediate communication with all rescue units within their areas of responsibility, including units able to provide aircraft, helicopters, and special rescue teams and, where appropriate, with coastal radio stations capable of alerting and communicating with surface vessels. Assistance from these units can be essential in responding to an accident in the vicinity of the airport. Therefore, it is suggested that the potential role of the rescue coordination center be highlighted in the proposed AEP document in a separate paragraph.

15.14 Emergency Management. The airport's emergency plan should be integrated with the local comprehensive emergency plan and local search and rescue teams. Consideration should be given to the role the airport might play as a result of coordination with emergency management officials and in support of any local emergency plan requirements.

15.15 Mutual Aid Agencies.

15.15.1* Airport emergencies can be of such magnitude that local ARFF, security, law enforcement, and medical services are inadequate to handle the situation. Therefore, it is strongly recommended that written mutual aid agreements be initiated to ensure the prompt and orderly response of these agencies.

15.15.2 All mutual aid agreements should be reviewed or revised annually. Telephone and personnel contacts should be reviewed and updated monthly.

15.16 Harbor Patrol and Coast Guard. Harbor Patrol and Coast Guard services are vital to airports adjacent to large bodies of water. Coordination of such services should be included in the AEP where applicable. Communication requirements to obtain the immediate response of such services (and the ability to communicate during the emergency) should be an essential ingredient of the AEP. If the area where the boats are to be operated is subject to freezing, vehicles suitable for operation on ice (i.e., hovercraft, swamp boats, etc.) should be available. *(See Annex I.)*

15.17 Military. Where a military installation is located on or in the vicinity of an airport, a mutual aid agreement should be initiated to integrate personnel with command, communication, and coordination functions of the AEP.

15.18 Clergy. The AEP should include advance agreements with clergy of all faiths to provide comfort to casualties and their relatives.

15.19 Public Information Officer (PIO). A PIO should be designated as part of the AEP. This officer should coordinate

and release factual information to the news media and also should coordinate public information statements between all parties involved. It is recommended that the television and radio news media be requested to withhold the release of accident information to allow sufficient time for adequate security to be established.

15.20 Mental Health Agencies. The AEP should include the local mental health agencies. Therapeutic treatment as well as follow-up procedures for dealing with the possible long-term effects of the emergency should be available for survivors, relatives, eyewitnesses, and emergency scene personnel.

15.21 Customs. The AEP should include agreed procedures required by the customs authority for the examination of baggage and freight to ensure that dutiable goods and contraband are not being brought into the country illegally.

15.22 Public Utilities. An airport relies heavily on the supply of public utilities; the AEP should include agreed procedures in the event of a potential emergency, which affects the supply of gas, electricity, water, and communications.

15.23 Post Office. Postal services include the transportation of mail by air; the AEP should include procedures for the retrieval of official post, which might be carried on aircraft that have been involved in an accident.

15.24 Veterinary Service. Procedures should be in place within the AEP to ensure that in the event of an aircraft accident, veterinary services respond immediately.

15.25 Coroner. The AEP should reflect agreed-upon procedures for temporary mortuary arrangements, which should be located remote from public view and be large enough for its intended use, with electricity, running water, and suitable screening. Fire department facilities or any facility used by responding emergency personnel should not be used for this purpose.

15.26 Volunteer Organizations. Within the airport envelope, many volunteer organizations exist that support the local community and that in a time of crisis have contingency plans in place to render assistance. When a plan is being compiled, it is important that these organizations are approached regarding facilities or support they may be able to offer to complement the AEP (e.g., International Red Cross, trained volunteers).

15.27 Additional Support Services. Where necessary, airport operators should ensure that the AEP reflects additional support through the use of external civil engineering contractors.

Chapter 16 Functions of Each Agency for an Aircraft Accident On-Airport (NFPA 424)

16.1* General. The AEP should be implemented immediately upon an aircraft accident occurring on-airport. Responding agencies should comply with Sections 16.2 through 16.10.

16.2 Action by ATC Services.

16.2.1 Air traffic control (ATC) services should initiate an emergency response using the alarm communications system. When an alarm is received or an accident is observed, or when there is reason to consider that an accident is imminent, airport ARFF services should be alerted immediately.

16.2.2* Information on the location of an accident, including grid map references or identifying terrain or landmark features, should be provided by ATC services immediately. The initial details should include the type of aircraft involved. Subsequent information should include details such as the state of the occupants, the amount of fuel on board, the aircraft operator (if known), and the presence or absence of any dangerous goods, including the type, quantity, and location of those goods.

16.2.3 ATC services should initially restrict aircraft operations to the degree necessary to prevent expansion of the accident scenario and facilitate emergency response.

16.2.4 ATC should immediately establish restricted airspace over the immediate vicinity of the accident to facilitate the evacuation of casualties by helicopter and preclude interference with emergency operations by nonemergency flights.

16.2.5 An appropriate NOTAM should be initiated by the airport; for example, "Airport ARFF protection reduced/unavailable until [insert time] or until further notice due to aircraft accident." (Note that this notice might be automatic if it is so delineated in the AEP.)

16.2.6 ATC should confirm that the actions designated in 16.2.1 through 16.2.4 have been completed by utilizing preestablished checklists and indicating the notification times and names of the people performing the actions.

16.3 Action by Aircraft Rescue and Firefighting Services.

16.3.1 An alarm for an aircraft accident on the airport will normally be received from the ATC services. However, when an alarm is received from any other source, or when an accident is observed or there is reason to consider that one is imminent, the airport ARFF services should initiate immediate action. The ATC services should be informed by the responding firefighting services as to the nature of the alarm, its location, and the response initiated.

16.3.2 Airport ARFF services should carry out the following steps:

(1) Proceed via established access routes to the incident as indicated by ATC services
(2) Advise mutual aid fire departments of the following while en route:
    (a) Rendezvous point
    (b) Staging area(s)
    (c) Manpower and equipment required for support, if known
    (d) Any other pertinent information
(3) Immediately establish an on-scene ICP

16.3.3 Command authority at any accident site should be predetermined according to the jurisdictional responsibilities of the agencies involved and as designated in the AEP.

16.3.4 Prior agreement should be reached between the on-airport ARFF service and the off-airport mutual aid fire departments as to who is best equipped to fight fires in aircraft hangars or other airport structures. Additionally, there should be prior agreement as to which agency will be in command when an accident involves an aircraft or an airport structure or both.

16.4 Action by Police/Security Services.

16.4.1 The primary responsibilities of police and security personnel should be traffic flow and site security.

16.4.1.1 Police or security personnel should send a representative to the ICP to be part of the unified command structure.

16.4.2 The first security/police officer to arrive should coordinate with the IC and, to the extent possible, immediately establish traffic-free lanes on ingress and egress roads for emergency vehicles, initiate security responsibility, and request reinforcements as needed.

16.4.2.1 After consulting with the IC, police and security personnel should initiate traffic control measures to aid responding emergency vehicles.

16.4.2.2 Police and security personnel should notify the appropriate communications center of the location of the accident and available means of access and egress. They should notify the airport security communications center or the IC (where appropriate) of the location of the accident; access, ingress, and egress roads available; and where responding security personnel should make initial response, as well as recommendations for setting up roadblocks away from the accident site to aid responding emergency vehicles.

16.4.2.3 Responding police vehicles should not proceed directly to the accident site, but should set up appropriate roadblocks at least two to three blocks away as directed by the supervisory authority to prevent road congestion.

16.4.3 Security personnel and police should admit only authorized emergency personnel to the scene, keep unauthorized persons away from the accident site, and preserve the accident scene.

16.4.4 The accident site should be cordoned off as soon as possible to exclude intruders, media, sightseers, onlookers, and souvenir hunters. Appropriate markings should be prominently displayed to advise all persons of possible hazards that could cause serious injury should they encroach on the area.

16.4.5 Communication between all the security checkpoints and the ICP or emergency operations center or both should be established as soon as possible.

16.4.6 Identifying armbands, site passes, ID tags, or other indication of empowerment should be issued by the authority having jurisdiction (AHJ) and monitored by security services.

16.4.7 Special security provisions should be instituted for the protection of the flight crew, flight data recorders and cockpit voice recorders, any official post involved, and any dangerous goods that might be present.

16.4.8 Responding emergency units should meet with authorized persons at the staging area to be escorted to the accident site.

16.5 Action by Airport Operator.

16.5.1 The airport operator representative should respond to the accident site and, as needed, set up an easily identifiable mobile command post. The mobile command post should be adequately staffed by senior representatives can make decisions involving the following types of operations:

(1) Airport
(2) Security
(3) Medical
(4) Aircraft
(5) Aircraft recovery
(6) Aircraft fueling

16.5.1.1 The emergency operations command post should be established as needed. This post can be mobile or located in a predesignated area based on the location of the incident. Representatives from the following entities should be present:

(1) Airport administration
(2) Airline involved
(3) ARFF
(4) Airfield operations
(5) Police
(6) Terminal operations
(7) Emergency medical
(8) Emergency management
(9) Environmental services
(10) Health and safety
(11) Airport public information officer (PIO)
(12) TSA or equivalent
(13) ATC
(14) Political leaders
(15) Fixed-base operators
(16) Regional political authority.

16.5.1.2 The emergency operations center should remain open and operational throughout the duration of an incident and until such time as determined by the airport operator.

16.5.2 The airport operator should commence pre-established checklist procedures that verify the following:

(1) The airport emergency operations center has been activated.
(2) Mutual aid police procedures have been initiated and secondary notification calls have been made.
(3) Medical and ambulance services have been alerted and their arrivals verified at the designated rendezvous point or staging area.
(4) Mutual aid fire departments have been notified and escort has been provided to the accident site.
(5) The affected aircraft operator has been notified and information has been obtained on any dangerous goods or hazardous materials on board the aircraft — such as explosive substances, flammable gases and liquids, combustible solids, oxidizing substances, poisonous substances, radioactive materials, or corrosives — as well as the total number of occupants (passengers, crew, non-revenue-generating passengers, infants.)
(6) Liaison has been established with ATC services concerning the closure of airport areas, designation of emergency response corridors, and issuance of voice advisories and NOTAM advising on the status of airport ARFF protection.
(7) Government aircraft accident investigation authorities, such as the National Transportation Safety Board (NTSB), have been notified. (If military aircraft is involved, the appropriate military organization should be notified.)
(8) The meteorological department has been notified to release a special weather observation.
(9) Arrangements have been made for the affected runway to be immediately surveyed by the appropriate personnel to identify the location of crash debris and to ensure

that the debris is secured pending release by investigating agencies.
(10) Airspace reservation coordination offices (air traffic flow control office), if any, have been advised of airport capabilities.
(11) Medical examiner's/coroner's office has been notified to assist with fatalities, if necessary.
(12) Mortuary annex facilities have been identified and designated.

16.5.3 In conjunction with mutual aid police, the airport operator should carry out the following:

(1) Designate rendezvous points and pre-established staging areas for the inner and outer perimeters.
(2) Assign security personnel at the staging area or rendezvous point or both to escort vehicles and ensure the orderly flow of emergency personnel to the accident site, particularly the escort of ambulances responding to the rendezvous point and from the staging area.
(3) Assign parking areas for escort vehicles and ambulances, giving consideration to the need for rapid deployment when dispatched.
(4) Provide protective clothing for those involved in investigation and recovery

16.5.4 The airport operator should also, to the extent possible, arrange to have the following services available as necessary:

(1) Portable emergency shelter for use by other than medical services
(2) Lavatories
(3) Drinking water
(4) Ropes, barriers, and so forth
(5) Food service
(6) Mobile or portable lighting
(7) Portable heating system
(8) Cones, stakes, flags, and signs
(9) Machinery, heavy equipment, and extraction tools
(10) Communications equipment, such as megaphones, portable telephones, and so forth
(11) Fuel removal equipment

16.5.5 The airport operator should provide the initial briefing to their airport PIO. The airport operator should then coordinate, as appropriate, with the PIOs of all the agencies involved to provide the following:

(1) A joint information center (JIC)
(2) Media releases for the various media officers
(3) Briefings and statements that will be released to the media

16.5.6 Upon concurrence of the chief fire officer, police/security chief, and the medical group supervisor, the airport operator's IC should notify all the participating mutual aid organizations of termination of the airport emergency. Note that this notification might not terminate all the actions and responsibilities of participating agencies.

16.5.7 The aircraft operator representative should make arrangements for bus transportation from the accident site to the designated trauma holding area. Passengers should be under medical supervision while awaiting transportation, during transport, and at the receiving processing site.

16.6 Action by Emergency Medical Services. The medical group supervisor should coordinate with the medical transportation officer and medical services to perform the following:

(1) Verify that mutual aid medical and ambulance services have been alerted and arrive at the rendezvous point or staging area and that a medical communication network is established.
(2) Ensure an EMS representative is available at the emergency operations center or incident command post.
(3) Provide preventative medical treatment for all personnel engaged in response, investigation, and recovery.
(4) Determine the necessity for patient decontamination and set up a decontamination area if required.
(5) Organize the triage and treatment of casualties, as well as their eventual evacuation by appropriate means of transport.
(6) Dispatch casualties to the appropriate hospitals by land, sea, or air.
(7) Maintain an accurate list of the casualties, including names, as available, and their destinations for treatment.
(8) Coordinate with the airport operator and aircraft operator concerning the transportation of the uninjured to the designated holding area.
(9) Arrange for the restocking of medical supplies if necessary.
(10) Provide medical analysis and transportation for the walking wounded or traumatized.

16.7 Action by Hospitals. Hospitals listed in the AEP should be prepared to do the following:

(1) Provide medical care to the casualties when they arrive
(2) Provide doctors and trauma teams in accordance with the AEP
(3) Ensure that adequate doctors and nurses, blood, operating rooms, intensive care, and surgical teams are available for emergency disaster situations, including aircraft accidents

16.8 Action by Aircraft Operators.

16.8.1 An aircraft operator representative should report to the ICP and/or emergency operations center to coordinate the aircraft operator activities with the IC.

16.8.2 The aircraft operator representative should provide information regarding the occupants and dangerous goods or hazardous materials on the aircraft. The materials might include explosive substances, flammable liquids or gases, combustible solids, oxidizing substances, poisonous substances, radioactive materials, and corrosives. Information of this nature should be relayed as soon as possible to the chief fire officer and the medical group supervisor to assist them in ensuring that the appropriate personal protective equipment (PPE) is utilized and that personnel decontamination is deployed if needed.

16.8.3 The aircraft operator staff should proceed to the designated uninjured holding area. The aircraft operator representative at the uninjured holding area should appoint a receptionist, registrars, and welfare coordinators from staff who have been previously trained in these functions.

16.8.4 The aircraft operator representative who is in command of the uninjured holding area should oversee the overall operations by making arrangements for commissary items, clothing, telephone facilities, and additional medical

services if required. It might also be advisable to have an air carrier representative available in the facilities to which the injured are transported.

16.8.5 The receptionist should meet the transportation vehicles as they arrive from the accident scene and direct passengers to the registrars' tables where they will be processed. The receptionist should also explain where toilet facilities, telephones, and other amenities are located. Migration outside the holding area should be prevented until each person transported to the holding area is identified and processed according to the AEP.

16.8.6 The registrar should record each passenger's name on the manifest and determine what reservation requirements are desired; that is, hotel accommodations, air transportation, other modes of transportation, and so forth, as well as any persons to be notified of the passenger's physical or mental condition and potential plans. The registrar should then make out an ID tag or sticker and place it on the passenger. When their registration is completed, the registrars should direct passengers to the welfare coordinators.

16.8.7 Welfare Plan.

16.8.7.1 Welfare coordinators and mental health specialists trained in stress management should proceed with the following:

(1) Give support and comfort to relatives and friends of persons on board the aircraft involved with the incident.
(2) Register relatives and friends waiting at the airport for information about persons on board.
(3) Provide care, comfort, and assistance to the walking injured and uninjured survivors and responding personnel (if required).
(4) Assist in the provision and serving of refreshments to waiting relatives and friends.
(5) Assist in providing critical incident stress management and care to all involved.

16.8.7.2 The welfare plan should provide for a suitable location to carry out the functions and procedures for alerting and coordinating with welfare organizations.

16.8.8 The aircraft operator should provide notification of the aircraft accident to the following:

(1) Health and welfare agencies
(2) Customs, where applicable
(3) Immigration, where applicable
(4) Post office
(5) Environmental protection agencies, where applicable

16.8.9 A senior aircraft operator official should be responsible for the initial notification of relatives and friends at the airport. The aircraft operator should work closely with hospitals and/or the coroner to make notification to friends and/or family on the status of persons involved with the incident.

16.8.10 News releases by aircraft operators should be prepared in conjunction with the joint information center (JIC).

16.8.11* The aircraft operator is responsible for the removal of the wrecked or disabled aircraft as soon as authorized by the Accident Investigation Board or its designee.

16.9 Action by Government Agencies. Government agencies that can take the appropriate action should be indicated in the AEP.

16.10 Action by the PIO.

16.10.1 In general, the official authority for news releases concerning an aircraft emergency should be one of the following:

(1) JIC
(2) A PIO designated by the airport operator
(3) A representative of the aircraft operator involved
(4) Upon assumption of jurisdiction, the lead investigative agency

16.10.2 All media personnel should be directed to a designated news media staging area for news media personnel authorized to cover an airport emergency. Selection of staging areas should take into consideration media needs for photography and video transmission. In this area, the following should be provided:

(1) The latest briefing
(2) Communications (telephones)
(3) Transportation services to and from the scene of the emergency where permissible and where it will not interfere with rescue, medical treatment of casualties, and the accident investigation

16.10.3 Only members of the news media, freelance reporters, and photographers wearing valid press-news media credentials should be admitted to the briefing area or designated news media staging area or transported to the scene of the emergency.

16.10.4 Under no circumstances should the news media or any other personnel not involved in life-saving or firefighting operations be permitted inside security lines until all rescue operations have been completed and the area has been declared safe by the chief fire officer. When establishing security lines, the interests of news coverage should be considered insofar as rescue operations permit.

16.11 Organization Charts.

16.11.1 Organization charts should be prepared for each anticipated type of emergency situation, off-airport incident, on-airport incident, earthquake, or flood.

16.11.2 These charts should depict the relationships and duties of all components of the AEP in such detail that each participating agency has a full understanding of its duties and responsibilities.

Chapter 17 Functions of Each Agency for an Aircraft Accident Off-Airport (NFPA 424)

17.1* General. The AEP should be implemented immediately upon an aircraft accident occurring off the airport. Responding agencies should comply with Sections 17.2 through 17.10.

17.2 Action by ATC Services.

17.2.1* ATC services should initiate emergency response by using an alarm communications system as shown.

17.2.2* ATC should alert the ARFF service, police and security services, airport operator, and medical services in accordance with the procedure in the AEP, giving grid map reference.

Information on the location of the accident, giving grid map reference or other identifying terrain/landmark features, should be provided immediately by the ATC provider. Subsequent calls can expand this information by providing details on the number of occupants; fuel on board; aircraft operator (if known); and the presence or absence of any dangerous goods, including type, quantity, and location.

17.2.3 If the accident location is beyond pre-established ARFF response protocols, and the fire department having jurisdiction so requests, dispatch of the ARFF service should be in accordance with the AEP and any mutual aid agreements. An appropriate NOTAM should be issued immediately if the firefighting protection of the airport is reduced or unavailable.

17.2.4 The ATC provider should immediately establish restricted airspace over the immediate vicinity of the accident to facilitate evacuation of casualties by helicopter and preclude interference with emergency operations by non-emergency flights.

17.2.5 ATC should confirm that the actions in 17.2.2, 17.2.3, and 17.2.4 were completed, utilizing preestablished checklists indicating notification time(s) and names of person(s) completing the action(s).

17.3 Action by ARFF Services.

17.3.1 A call for an aircraft accident off-airport normally is received from the ATC services, local police, or local fire departments. Designated vehicles should be sent in accordance with the existing mutual aid department agreements. The ATC provider should be advised of any reduction of airport category due to the reduction of fire cover, and the onward transmission of information to airmen should include the maximum size of aircraft the airport can accept and an example of the aircraft type.

17.3.2 Responding airport ARFF services should do the following:

(1) Proceed via preestablished access routes, considering vehicle weight, height, and width, to the off-airport accident site in coordination with local police/security direction
(2) While en route, advise or request the fire department having jurisdiction over the area to provide all of the following:
    (a) Rendezvous point or staging area or both
    (b) Staffing and equipment responding
    (c) Any other pertinent information
(3) Report to the Staging Manager/Rendezvous Point Coordinator or the IC of the fire department having jurisdiction over the area to request orders

17.3.3 Prior agreement should be made between the ARFF service and the local fire department in command and mutual aid fire departments as to who is to fight fires involving aircraft or structures or both. Additionally, there should be prior agreement as to which agency will act in command when an accident involves both an aircraft and an off-airport structure. Mutual aid fire departments and ARFF services should discuss joint risk assessment and control measures at the accident site. Procedures should be implemented to allow an airport and local fire departments to test agreed practices.

17.4 Action by Police/Security Services.

17.4.1 The first security/police officer to arrive should coordinate with the IC and, to the extent possible, immediately establish free traffic lanes on ingress and egress roads for emergency vehicles, initiate security responsibility, and request reinforcements as needed. Traffic flow and site security are the primary responsibility of police and security personnel. They should notify the appropriate communications center of the location of the accident and available means of access and egress. After consultation with the IC, police and security personnel should initiate traffic control measures in order to aid responding emergency vehicles.

17.4.2 Police and security personnel will be needed to handle traffic in the vicinity of the accident site and to prevent disturbance of material scattered over the site. The accident site should be cordoned off as soon as possible to exclude intruders, media, sightseers, onlookers, and souvenir hunters. Appropriate markings should be prominently displayed to advise all persons of possible hazards that can cause serious injury should they encroach on the area. Flares should not be used within 300 ft (100 m) of the accident site to prevent ignition of fuel vapors.

17.4.3 Communications between all security checkpoints and the ICP or emergency operations center or both should be implemented as soon as possible.

17.4.4 Appropriate means of identification, such as armbands, site passes, ID tags, or other indications of empowerment should be issued by the AHJ and monitored by the security services.

17.4.5 Special security provisions should be made to protect the flight data and cockpit voice recorders, any mail involved, or dangerous goods that might be present. Flight crews should always be afforded specific security provisions to preclude physical attack resulting from emotional outbursts predicated upon "fault" assignment.

17.5 Action by Emergency Medical Services. The medical group supervisor should coordinate with the medical transportation officer and medical services to do the following:

(1) Verify that mutual aid medical and ambulance services have been alerted and verify their subsequent arrival at the rendezvous point or staging area, and that a medical communication network is established
(2) Organize the necessary action for triage and treatment of the casualties and their eventual evacuation by appropriate means of transportation
(3) Provide control and dispatch of the casualties to the appropriate hospitals by land, sea, or air
(4) Maintain an accurate list of the casualties including their names (as available) and their destination for treatment
(5) Coordinate, with the aircraft operator involved, the transportation of the uninjured to the designated holding area
(6) Arrange for the restocking of medical supplies, if necessary
(7) Provide medical analysis of the walking wounded and uninjured

17.6 Action by Hospitals. Hospitals listed in the AEP should be prepared to do the following:

(1) Ensure that adequate doctors and nurses and operating room, intensive care, and surgical teams are available for emergency situations, including aircraft accidents.

(2) Provide medical care to the casualties when they arrive.
(3) Provide trauma teams to the accident site in accordance with the AEP.
(4) Notify coroner/medical examiner.

17.7 Action by Airport Operator.

17.7.1 If previously agreed on in the airport mutual aid emergency agreement with the surrounding community, the following actions can be taken by the airport operator:

(1) Report to the accident site
(2) Ensure that, if required, the airport emergency operations center and the mobile command post are activated
(3) Extend as much emergency aid as requested by the jurisdiction agency in command of the off-airport accident/incident
(4) Notify the aircraft operator involved
(5) Notify other agencies as required

17.7.2 According to the mutual aid emergency agreement with the surrounding community, the airport operator can provide, if requested and if available, a part of its medical equipment (i.e., first aid equipment, stretchers, body bags, mobile shelters, etc.) and assistance at the accident site of emergency medical teams.

17.8 Action by Aircraft Operators.

17.8.1 An aircraft operator representative should report to the ICP to coordinate with the IC.

17.8.2 The aircraft operator representative should provide information regarding occupants and dangerous goods on the aircraft. These goods include explosive substances, gases, flammable liquids or solids, oxidizing substances, poisonous substances, radioactive materials, corrosives, and ordnance. Information of this nature should be relayed as soon as possible to the chief fire officer and the medical group supervisor.

17.8.3 The aircraft operator should make arrangements with the airport for transportation from the accident site to the designated holding area. Transportation of the walking wounded from the scene should be permitted only after consultation with the medical group supervisor.

17.8.4 The aircraft operator staff should proceed to the designated holding area. The aircraft operator representative at the holding area should appoint a receptionist, registrars, and welfare coordinators from staff who have been previously trained in these functions.

17.8.5 The aircraft operator representative who is in command of the holding area should oversee the overall operations by making arrangements for commissary items, clothing, telephone facilities, and additional medical services if required.

17.8.6 The receptionist should meet the transportation vehicles as they arrive from the scene of the accident and direct the passengers to the registrars' tables where they will be processed. The receptionist should know where support facilities such as toilets, telephones, clothing, and drinking water are located.

17.8.7 The registrar should record the passenger's name on the manifest and determine what reservation requirements are desired, that is, hotel accommodation, air transportation, or other modes of transportation, and so forth, and names of any persons to be notified of the passenger's physical or mental condition and potential plans. The registrar should make out an ID tag or sticker, available from the emergency kit, and place it on the passenger. When the registration is completed, the registrars should direct the passenger to the welfare coordinators.

17.8.8 Where necessary, the aircraft operator should provide notification of the aircraft accident to the following:

(1) Health and welfare agencies
(2) Customs, where applicable
(3) Immigration, where applicable
(4) Post office
(5) Agriculture agencies
(6) Environmental agency
(7) Accident investigation board

17.8.9 A senior aircraft operator official should be responsible for the initial notification of relatives and friends at the airport.

17.8.10 The aircraft operator should work closely with the hospitals and/or coroner to make notification to friends and/or family on the status of persons involved with the incident.

17.8.11 News releases by aircraft operators should be prepared in conjunction with the airport PIO and liaison officers from other agencies responding to the accident.

17.8.12* The aircraft operator is responsible for the removal of the wrecked or disabled aircraft as soon as authorized by the aircraft accident investigation operator.

17.9 Action by Government Agencies. The following government agencies, after being notified, can be required to take appropriate action as indicated in their AEP:

(1) Government accident investigation personnel
(2) Health and welfare
(3) Post office
(4) Customs
(5) Immigration
(6) Agriculture
(7) Military

17.10 Action by the PIO.

17.10.1 News releases concerning an off-airport emergency should be the responsibility of the following personnel:

(1) The representative of the aircraft operator
(2) A PIO designated by the government operator in command
(3) A public information representative designated by the airport operator

17.10.2 Under no circumstances should the media or other personnel not directly involved in firefighting, rescue, or emergency medical care be permitted inside security lines until all rescue operations have been completed and the area is declared safe for entry by the IC/chief fire officer.

Chapter 18 Airborne Emergencies (NFPA 424)

18.1 Full Emergency Incident — Aircraft in Flight.

18.1.1 The agencies involved in the AEP should be alerted to "full emergency" status when it is known that an aircraft approaching the airport is, or is suspected to be, in such trouble that there is a strong likelihood of an accident.

18.1.2 Action by ATC Services.

18.1.2.1 The ATC provider should alert the airport and provide as many of the following details as possible:

(1) Type of aircraft
(2) Nature of trouble
(3) Runway to be used
(4) Estimated time of landing
(5) Aircraft operator, if appropriate
(6) Fuel on board
(7) Number of occupants, including special occupants — handicapped, immobilized, blind, deaf, and so forth
(8) Any dangerous goods on board, including type, quantity, and location, if known
(9) A discrete VHF (DEF) communications frequency to the IC

18.1.2.2 The calling of the mutual aid fire department(s) and other appropriate organizations should be initiated in accordance with procedures established in the AEP.

18.1.3 Action by Other Agencies. The specific responsibilities and roles of the various agencies itemized in Sections 16.2 through 16.10 for responding to an aircraft accident on the airport can be applied for "full emergency" as required by local operating requirements.

18.2 Local Standby.

18.2.1 The agencies involved in the AEP should be alerted to "local standby" status when an aircraft approaching the airport is known or is suspected to have developed some defect, but the trouble is not such that would normally involve any serious difficulty in effecting a safe landing.

18.2.2 Action by ATC Services.

18.2.2.1 ATC should call the ARFF service to stand by as requested by the pilot or to stand by as local airport agreements require at the predetermined standby positions applicable to the runway to be used.

18.2.2.2 As many of the following details as possible should be provided:

(1) Type of aircraft
(2) Nature of trouble
(3) Runway to be used
(4) Estimated time of landing
(5) Fuel on board
(6) Number of occupants, including special occupants — handicapped, immobilized, blind, deaf, and so on
(7) Aircraft operator, if appropriate
(8) Any dangerous goods or hazardous materials on board, including quantity and location, if known

Chapter 19 Other Emergencies (NFPA 424)

19.1 General. Procedures and techniques should be developed to mitigate a threat to life or property on the airport grounds. It should be recognized that medical and fire emergencies, hazmat incidents, bomb threats, hijacking, civil disobedience, contagious diseases and natural disasters can arise at any location on the airport grounds. In airports, this problem can be severe because of the large number of persons exposed to the hazards.

19.1.1 The diverse character of persons traveling by air suggests the need for the airport operator to arrange to have available emergency medical services to treat conditions such as cardiac arrest, abdominal pains, burns, cuts, abrasions, communicable diseases, and other medical problems. This can require immediate care facilities and detailed mutual aid plans with outside agencies. Automatic external defibrillators (AEDs) have been shown to be effective in certain cardiac events. Strategic positioning of AEDs throughout the airport is strongly recommended.

19.1.2 Although the ARFF service provides a commitment to assist in non-aircraft-related emergencies, attendance at those incidents should not compromise their immediate level of response to aircraft accidents or incidents.

19.1.3 The natural disasters airports can be subjected to include storms, floods, earthquakes, and seismic sea waves. The vulnerability of an airport to any of these disasters will, in good measure, be affected by geography. While nothing can be done to avert them, there are actions that can be taken to minimize damage and expedite restoration of aircraft operations.

19.1.4 ARFF services and the local fire department(s) should undertake a joint risk assessment of the potential hazards to the airport and establish a joint plan of action. This AEP should be reviewed annually.

19.1.5 Development of weather patterns, prediction and tracking of storm movement, and notification to the public of the resulting potential danger will normally be carried out by a meteorological service in the area.

19.1.6 The AEP should provide for initial protective measures, personnel shelter, and post-storm cleanup and restoration. Aircraft operations might be interrupted for several hours before the arrival of the storm and until several hours after it passes.

19.1.7 As soon as severe storm warnings are received, all owners of aircraft based or on the ground at the airport should be notified and warnings issued to all aircraft pilots en route to the airport. Aircraft owners and pilots should be responsible for their aircraft but, if possible, all aircraft on the ground should be evacuated to airports outside the storm area. Aircraft in flight should be advised to divert to an alternative destination. Aircraft on the ground that cannot be dispersed should be put under cover or tied down so as to face into the approaching winds.

19.1.8 Power interruptions are common during a natural disaster, either by damage to generating plants or by destruction of transmission lines. Airports located in severe storm areas should take measures to ensure minimum interruption to the power supply, either by providing standby electrical generators or dual sources of commercial power for essential functions.

19.1.9 Personnel assignments regarding building protection should be specified in the AEP to collect or secure all loose objects that can be blown about by the winds and to fill and place sandbags if there is any possibility that the storm is accompanied by floods.

19.2 Sample Notification Charts.

19.2.1 Having an up to date, preplanned call list with vital telephone numbers can assist in rapid communication in the event of an emergency.

19.2.2 Separate sample notification charts should be developed for each type of emergency included in the AEP. It is important that the method of notification be clearly outlined in the AEP.

19.2.3 Telephone numbers and other contact information should be verified at least annually.

Chapter 20 Emergency Operations Center and Mobile Command Post (NFPA 424)

20.1 General. The emergency operations center is a fixed designated area on the airport that is usually used in supporting and coordinating operations in accidents and incidents, such as unlawful seizure of aircraft and bomb threats. The unit should have the necessary communication equipment and personnel to communicate with the appropriate agencies involved in the emergency, including the mobile command post, where the unit is deployed. The communication and electronic devices should be checked regularly.

20.2 Emergency Operations Center (EOC).

20.2.1 An EOC should be available for the purpose of dealing with emergency situations at each airport.

20.2.2 The EOC should provide the following:

(1) A fixed location with communications and support equipment
(2) Support of the IC in the mobile command post
(3) A command, coordination, and communication center for other incidents that could affect airport operations (i.e., unlawful seizure of aircraft, bomb threats, or global events affecting aviation)
(4) Operational availability 24 hours a day

20.3* Mobile Command Post. *(See Figure A.20.3.)*

20.3.1 Certain emergency situations also will require a mobile command post at the scene. This mobile unit is normally provided by the airport operator and, during the emergency, is normally under the direction of the IC.

20.3.2 The mobile command post is a point where cooperating agency representatives assemble to receive and disseminate information and make decisions pertinent to the operations. The main features of this unit are as follows:

(1) It is a mobile facility capable of being rapidly deployed.
(2) It serves as command, coordination, and communications center for aircraft accidents or incidents.
(3) It is operational during aircraft accidents or incidents.

20.3.3 In the event of any major accident or incident, a designated, recognizable, and highly visible mobile command post should be a high-priority item. The mobile command post should be established as quickly as possible and preferably with the initiation of fire control and rescue activities. It is important that a continuity of command be maintained so that each agency reporting to the mobile command post can be adequately briefed on the situation before proceeding to assume control of its individual responsibilities.

20.3.4 The mobile command post should contain the necessary communications equipment and personnel to communicate with all agencies involved in the emergency, including the EOC. The communication and electronic devices should be checked regularly as required by local conditions.

20.3.5 Maps, charts, and other relevant equipment and information should be immediately available at the mobile command post.

20.3.6 The mobile command post should be easily recognizable.

20.3.7 In some cases it might be necessary to establish a subcommand post. Where this is required, one location should be designated as an ICP with adequate communications to the subcommand post.

Chapter 21 Communications (NFPA 424)

21.1 Communications Network.

21.1.1 A coordinated communications network should be a prerequisite to any large-scale operation that involves agencies from more than one jurisdiction.

21.1.2 A communications network should consist of a sufficient number of radio transceivers, telephones (both mobile and land line), and other communication devices to establish and maintain a primary and a secondary means of communication. These networks should link the EOC and the ICP as well as with all participating agencies as shown in Figure 22.2.

21.1.3 The operational communications network should provide a primary and, where necessary, an alternate effective means for direct communications between the following, as applicable:

(1) The alerting authority (e.g., control tower, flight service station, airport manager or designee, fixed-base operator, or airline office) and the ARFF units serving the airport
(2) Air traffic control tower, flight service station, or both; the appropriate fire department alarm room/dispatch center(s); and the ARFF and medical services personnel en route to an aircraft emergency and at the accident/incident site
(3) Appropriate mutual aid agencies located on or off the airport, including an alert procedure for all auxiliary personnel expected to respond
(4) The ARFF vehicles, including a communications capability between crew members on each ARFF vehicle

21.2 Communications Equipment.

21.2.1 It is important to provide communications equipment in sufficient quantity to ensure rapid response of personnel and equipment to an emergency. The communications equipment in 21.2.2 through 21.2.9 should be available for immediate use in the event of an emergency.

21.2.2 Portable Radios. A sufficient number of portable, two-way radios should be available to provide each participating agency with the ability to communicate with the ICP.

21.2.3 Strict communication discipline should be employed to prevent jamming of emergency frequencies.

21.2.4 Radios should be available at the ICP to provide direct communication with the aircraft or ground controllers should it become necessary. Direct communication also can be established with the pilot or the aircraft cockpit by use of cockpit-to-ground lines. This communication requires a proper connector, wire, microphone, and headset. Cooperation and coordination between the airport ARFF service and the individual air carrier(s) are needed to establish this type of communication capability. Normally this capability results from the use of a ground service headset that is plugged into a wheel-well interphone jack.

21.2.5 A sufficient number of telephone lines (both listed and unlisted) or cellular phones should be available at the ICP to provide direct communication with agencies outside the airport, as well as inside the airport. Direct lines save time and reduce the probability of overwhelming radio communication channels.

21.2.6 Medical facilities and ambulances need communications capability in order to take advantage of advance life support systems within the medical community.

21.2.7 A dedicated vehicle equipped with necessary communications equipment and self-contained electrical power is a definite asset to a good communication system. A well-equipped communications vehicle is an indispensable part of an efficient, well-managed mobile command post. Planning should always include a qualified vehicle driver/operator.

21.2.8 Recording devices with time and date insertion units should be installed at the operations center, mobile command post, or both to ensure that all communications are recorded for later analysis. All emergency communications, including printed communication, should be recorded, maintained, and secured.

21.2.9 Runners should be assigned to the mobile command post to augment other modes of communication. The use of runners can prove invaluable should a temporary lapse of communication occur.

21.3 Testing and Verification.

21.3.1 The communications system should be tested daily to verify the operability of all radio and telephone networks.

21.3.2 A complete and current list of interagency telephone numbers should be available to all agencies and to personnel responsible for the AEP. These phone numbers should be verified monthly to ensure that they are correct.

Chapter 22 Command and Coordination for the AEP (NFPA 424)

22.1 General.

22.1.1 Once an accident has occurred on the airport, the direction and control of ARFF operations should be the responsibility of the airport service IC. Any transition of authority and command responsibility should be established previously in the AEP and exercised accordingly. Off-airport accidents should be under the direction and control of the jurisdiction where the accident occurred.

22.1.2 The AEP should identify other responsible entities and their authority and function in the command organization.

22.2* ICS. The AEP should include a scalable organizational structure that enhances management of all activities at the incident/accident site. This structure should include a description of each element of the AEP, the agency assigned to each element, and a brief summary of the authority and responsibility necessary to execute each element. A diagram of an organization chart from a typical ICS is shown in Figure 22.2.

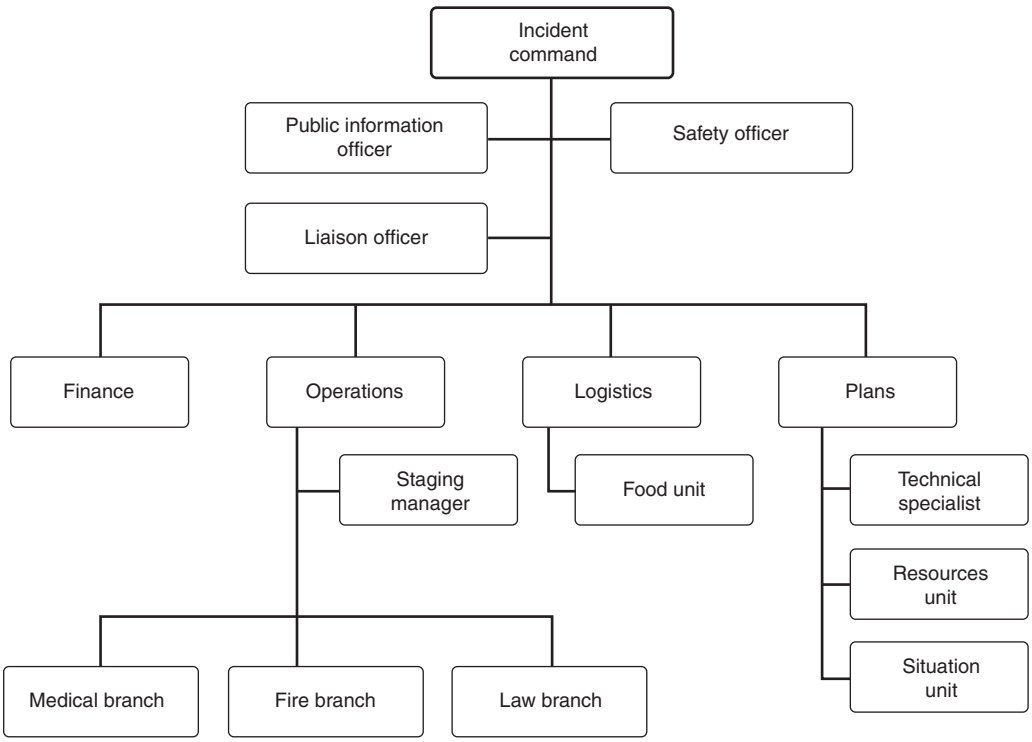


FIGURE 22.2 Incident Command Flow Diagram.

Chapter 23 Emergency Medical Care (NFPA 424)

23.1 Basis of Recommendations.

23.1.1 These recommendations are based on the existence of an established level of emergency medical service that can be expanded into a comprehensive emergency medical system at the scene of an aircraft accident with numerous casualties. *(See Annex J.)*

23.1.2 The responsibilities of emergency medical system personnel should include all aspects of medical care at the scene of an accident or incident, such as triage, treatment, and transportation.

23.2 Emergency Medical Training of Airport Personnel.

23.2.1 ARFF personnel should be trained to the current emergency medical care standards as required by the AHJ.

23.2.2 At a minimum, the subjects covered in a course of instruction for airport personnel to effectively provide emergency medical services should enable the personnel to do the following:

(1) Define the accepted method of infection control and universal blood and body fluid precautions as prescribed for public safety workers.
(2) Demonstrate methods of decontamination, disinfection, and disposal of personal protective equipment (PPE) that has become contaminated.
(3) Explain or demonstrate the accepted procedures for single-rescuer and two-rescuer cardiopulmonary resuscitation (CPR), including the procedures for adults, children, and infants.
(4) Demonstrate management of an obstructed airway for a conscious and unconscious adult, child, and infant.
(5) Perform a primary survey for life-threatening injuries.
(6) Describe and demonstrate techniques for managing the following:
    (a) Head injuries
    (b) Chest injuries
    (c) Fractures
    (d) Spinal injuries
    (e) External bleeding
    (f) Internal bleeding
    (g) Moving injured patients
    (h) Triage systems
    (i) Treatment of fatalities
    (j) Contacting medical control
(7) Describe the symptoms and demonstrate emergency treatment for the following:
    (a) Shock
    (b) Fainting
    (c) Allergies
    (d) Convulsions
    (e) Heart attack
    (f) Stroke
    (g) Ingested poisons
    (h) Drug overdoses
    (i) Diabetes
    (j) Childbirth and OB/GYN issues
    (k) Behavioral and mental health emergencies

23.3 Airport Emergency Medical Supplies and Equipment.

23.3.1 Sufficient medical supplies to treat the capacity of the largest aircraft normally utilizing an airport should be available on or adjacent to the airport. Adequate supplies should also be

kept on hand to deal with routine medical and trauma emergencies.

23.3.2 The type and quantity of such supplies should be determined by the principal medical authority for the airport. Recent incidents have demonstrated that the unique characteristics presented by any given location should be considered when deciding on the type and quantity of supplies to keep available for major incidents. For instance, extremes in temperature should be considered and the appropriate supplies stockpiled. Geographical conditions, topographical conditions, or both should also be taken into consideration.

23.3.3 Stretchers, blankets, cervical collars, backboards, and body bags should be available in the airport, preferably on a suitable vehicle (e.g., trailer) that can be transported to the accident site. Blankets are needed to alleviate victims' exposure to shock and possible adverse weather conditions. The backboards and spine boards should be of a type designed to fit through access ways and aisles of commercial and business aircraft. They should have restraining straps available so a patient can be secured to the board. A cleat should be attached to the underside of the backboard to facilitate lifting by personnel.

23.3.4 Sufficient resuscitation equipment should be available to treat cardiac arrest. This should include an automatic external defibrillator (AED).

23.3.5 Consideration should be given to the procurement and maintenance of an inventory of equipment that can be used to decontaminate patients (when necessary) prior to transporting them to public medical facilities. This inventory should include showers, cleaning equipment, cleaning solutions, water, and tools for containment of contaminated fluids.

23.4 Airport Medical Service.

23.4.1 Emergency medical services should be readily available to an airport. The primary purpose of emergency medical services is to provide triage, stabilization, and transportation. If medical and ambulance services are not available at an airport, prearrangements with local agencies providing these services should be made.

23.4.1.1 Minimum considerations for the level of airport medical service should include the following:

(1) Number of passengers served
(2) Number of persons employed at the airport
(3) Industrial activity on airport property
(4) Distance from adequate medical facilities

23.4.1.2 Ideally, every airport should have a properly staffed and equipped first aid room/medical facility on-site and, in addition, should arrange for the emergency response of trained medical personnel with the capability to treat serious injuries and transport those injured to proper medical facilities.

23.4.2 The delivery to an accident site of trained medical personnel capable of treating and transporting injured victims of an aircraft accident is a vital component of an AEP. An AEP should establish who will provide this service and make all the necessary legal and financial arrangements for personnel before an accident occurs. These arrangements might include integration with local community plans, mutual agreements, or both.

23.4.3 The AEP should ensure the dispatch of a satisfactory amount of trauma-trained emergency service medical personnel, equipment, and medical supplies. The AEP should also address the location of surrounding medical facilities and the level of service each facility provides.

23.4.4 The AEP should provide for the control of patient transport from the scene to the receiving medical facilities. The AEP's ICS should include a transportation control officer. The responsibilities of this position should include the following:

(1) Communicating with medical facilities, the central communications point, or both for local medical facilities
(2) Overseeing and ensuring effective priority casualty transportation to the appropriate medical facilities
(3) Managing all the other aspects of medical transportation

23.4.4.1 Patient transportation has proven to be a very demanding and labor-intensive job that requires a minimum of three subordinate positions, including the following:

(1) Transportation control (for routing of ambulances to and from the scene)
(2) Transportation recorder (for documenting all patient movement)
(3) Medical communications (for all communications regarding medical transportation)

23.4.4.2 A fourth position, transportation team leader, should also be considered.

23.4.4.3 The AEP's ICS should include a transportation control officer. The responsibilities of this position should include the following:

(1) Communicating with medical facilities, the central communications point, or both for local medical facilities
(2) Overseeing and ensuring effective priority casualty transportation to the appropriate medical facilities, including routing of ambulances to and from the scene
(3) Recording all transportation (for documenting all patient movement)
(4) Managing all the other aspects of medical transportation

23.4.5 Participating hospitals should have contingency emergency plans to provide for the mobilization of the necessary medical teams. The availability of qualified personnel and adequate facilities at hospitals to deal with airport emergency situations is vital. In this respect, it should be mandatory to establish in advance an accurate list of the surrounding hospitals classified according to their effective receiving capacity and specialization; for example, neurosurgery or burn treatment facilities.

23.4.6 A hospital's distance from an airport and its ability to receive helicopters should be considered. Reliable two-way communication should be provided between hospitals and ambulances and helicopters. Notification of an aircraft accident should be made to a single communication controlling medical facility that then alerts all the other facilities according to the local medical communications network. Police escort vehicles and helicopters for medical staff should be provided for in the AEP.

23.5 Immediate Need for Care of Those Injured in Aircraft Accidents.

23.5.1 In the aftermath of an aircraft accident/incident, many lives can be lost and many injuries aggravated if immediate medical attention is not provided by medically trained rescue

personnel. Victims should be examined, given the available emergency medical aid, and promptly transported to the appropriate medical facilities.

23.5.2 *Triage* is the sorting and classification of casualties to determine the order of priority for treatment and transportation, as is shown in Figure 23.5.2. Triage identification equipment and treatment area tarps should be color-coded to identify the severity of injury to victims. Casualties should be classified into the following four categories:

(1) Priority I, immediate care (RED)
(2) Priority II, delayed care (YELLOW)
(3) Priority III, minor care (GREEN)
(4) Priority 0, deceased (BLACK)

23.5.3 Triage should begin immediately. Qualified medical personnel should be assigned to this task. Victims should be moved from the triage area to the appropriate treatment areas before definitive treatment is rendered. Casualties should be stabilized in the treatment areas and then transported to the appropriate facilities. The use of colored tarps or other means to identify treatment areas should be used.

23.5.4 Triage is most efficiently accomplished in place. However, the conditions of an accident scene and wind direction might require the immediate movement of casualties before triage can be safely performed. In that case, casualties should be moved the shortest distance possible, well away from firefighting operations, and upwind and uphill from the scene.

23.5.5 Triage of casualties should include the use of casualty ID tags to aid in the sorting and transportation of the injured to hospitals. This technique is especially suited to multilingual situations.

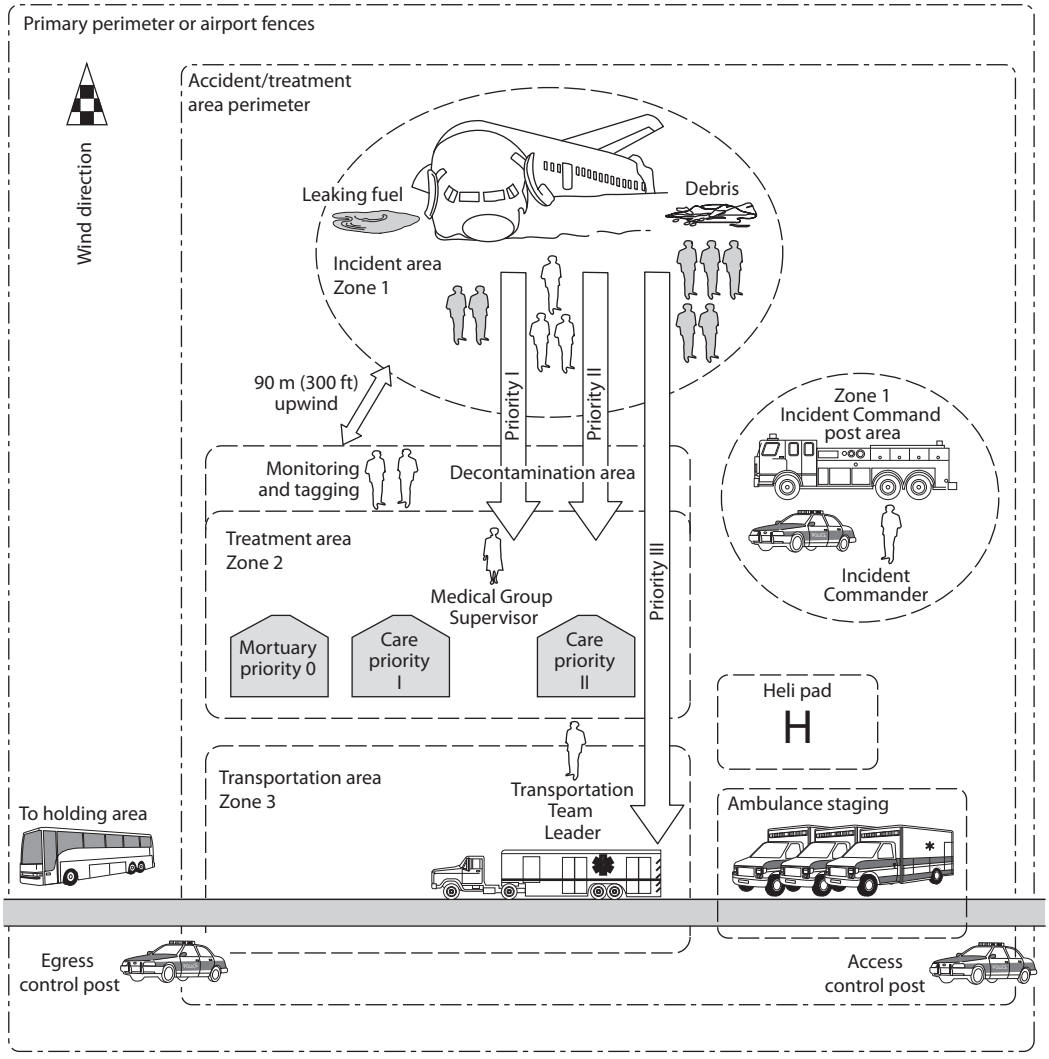


FIGURE 23.5.2 Triage and Medical Care at Aircraft Accident Site.

23.5.6 Medical Care of Ambulatory Survivors.

23.5.6.1 The aircraft operator (where involved), the airport operator, or a different predesignated agency that is selected should be available to perform the following:

(1) Select the holding area most suitable for the particular emergency from among the predesignated passenger holding areas designated in the AEP.
(2) Provide for the transportation of uninjured passengers from the accident site to the designated holding area.
(3) Arrange for emergency medical personnel to examine and treat seemingly uninjured passengers.
(4) Interview uninjured passengers and record their names, addresses, phone numbers, and where they can be reached for the next 72 hours.
(5) Notify relatives or next of kin where it is deemed necessary.
(6) Coordinate efforts with the designated welfare agency (Red Cross, etc.).
(7) Provide security to prevent unauthorized interference by persons not officially connected with the rescue operation in progress.

23.5.6.2 Prearrangements should be made for immediate transportation of the walking wounded and uninjured from the accident site to the designated holding area by bus or by another suitable means. Transportation processes should begin automatically following notification of an emergency. Emergency medical personnel should accompany survivors to the designated holding areas. Every passenger should be examined for shock and smoke inhalation. Cold or inclement weather might require additional provisions for the passengers' protection and comfort.

23.5.6.3 Occupants evacuating an aircraft via the evacuation slides might be barefoot and without proper apparel. Prior planning should include emergency footwear, eyeglasses, clothing, and blankets to remedy this situation. If an aircraft accident occurs in water or a marshy area, survivors will be wet and uncomfortable. If such potential exists, it might be necessary to establish a special designated staging area where survivors can be stabilized prior to transporting them to the normal holding area and to provide blankets and temporary protective clothing to prevent hypothermia.

23.6 Standardized Casualty ID Tags.

23.6.1 Need for Standardized Tags. Casualty identification tags should be standardized with color-coding and symbols to make the tags as simple as possible. Tags can help to expedite the treatment of mass casualties in a triage situation and, thus, enable more rapid evacuation of the injured to medical facilities.

23.6.2 Tag Design. Standardized tags require minimal information, are usable under adverse weather conditions, and are water-resistant. On these tags, numerals and symbols can be used to indicate the medical priority classification of casualties as follows:

(1) *Priority I (Immediate Care)*: RED-colored tag, roman numeral I, rabbit symbol
(2) *Priority II (Delayed Care)*: YELLOW-colored tag, roman numeral II, turtle symbol
(3) *Priority III (Minor Care)*: GREEN-colored tag, roman numeral III, ambulance with X symbol
(4) *Priority 0 (Deceased)*: BLACK-colored tag, spaded cross symbol

23.6.3 If tags are unavailable, casualties can be classified using a different method. Red, yellow, green, or black ribbons can be used, with the ribbon being secured to the patient. Another method involves using roman numerals on adhesive tape or markings made directly on the forehead or on another exposed skin area to indicate priority and treatment needs. If marking pens are unavailable, lipstick can be used. Felt-tipped pens are not advisable, as they can smear in rain, snow, and under other climatic and body conditions.

23.7 Care Principles.

23.7.1 Stabilization of the seriously injured should be performed at the accident scene. Immediate transportation of the seriously injured before stabilization should be avoided.

23.7.2 In accidents occurring at or adjacent to an airport, ARFF personnel are generally the first emergency personnel on the scene. It is imperative that those who are seriously injured be located and stabilized as quickly as possible. In cases where fire control or prevention does not require the efforts of all ARFF personnel, casualty stabilization should commence immediately under the direction of the most qualified trauma-trained individual(s) on the scene. First response rescue vehicles should carry the initial supply of victim-care equipment.

23.7.3 The triage procedure and subsequent medical care should be placed under the command of the designated medical group supervisor upon arrival. Prior to the arrival of the designated medical group supervisor, command of triage should be assumed by the designee of the IC until that person is relieved by the predesignated medical group supervisor. The triage procedure should be based on the standard for the region in which the AHJ is operating.

23.7.4 The medical group supervisor should report directly to the IC and is responsible for all medical aspects of the incident. The primary function of the medical group supervisor should be overseeing treatment and transport personnel, not participating as part of the medical group treating the injured.

23.7.5 For distinct and easy identification, the medical group supervisor should wear a standard, distinct uniform. In addition, the AEP should provide a highly visible vest or some other apparel with reflective lettering, front and back, that reads, "MEDICAL GROUP SUPERVISOR," or other appropriate lettering given the terminology used in the AEP.

23.7.6 Patient care priority should be administered based on the triage decision. Priority I or red tags should be the first priority. The next priority should be the Priority II or yellow tags. Priority III or green tags are cared for after the red and yellow patients. Patients who are deceased or who have suffered injuries not compatible with life will be black tagged. Care for casualties that sustained injuries that do not need emergency medical treatment to sustain life can be delayed until the Priority I casualties are stabilized. Transportation of Priority II casualties should be performed following the appropriate care given on-site.

23.7.7 Care of Priority I Immediate (Red) Casualties. This type of casualty includes, but is not limited to, the following:

(1) Major hemorrhages
(2) Severe smoke inhalation
(3) Asphyxiating thoracic and cervico-maxillo-facial injuries

(4) Cranial trauma with coma and rapidly progressive shock
(5) Open fractures and compound fractures
(6) Extensive burns (more than 30 percent)
(7) Crush injuries involving internal organs
(8) Any type of shock
(9) Spinal cord injuries

23.7.8 Care of Priority II Delayed (Yellow) Casualties. This type of casualty includes, but is not limited to, the following:

(1) Non-asphyxiating thoracic trauma
(2) Closed fractures of the extremities
(3) Limited burns (less than 30 percent)
(4) Cranial trauma without coma or shock
(5) Soft tissue injuries

23.7.9 Care of Priority III Minor (Green) Casualties. This type of casualty involves minor injuries. Certain accidents/incidents will occur where passengers have either minor injuries, no injuries, or where they appear to be uninjured. Because this type of casualty can interfere with other priorities and operations, it is important that these passengers be transported away from the accident/incident site to the designated holding area where they can be re-examined.

23.7.10 Specific treatment areas, such as an empty hangar, a designated area in a passenger terminal, a fire station, or other sites of adequate size (hotel, school, etc.) should be predesignated for this purpose. Any such area selected should be equipped with heating and cooling systems, electric light and power, water, and toilet facilities. Adequate telephones should also be available. A number of such preselected sites should be chosen so that when an accident occurs, the most convenient site in regard to travel distance and space (based on the number of casualties involved) can be selected. All aircraft operator personnel and airport tenants should know the location of such designated facilities.

23.8 Control of the Flow of the Injured.

23.8.1 The injured should pass through five areas that are carefully located and easily identifiable *(see Figure 23.5.2)*. The five areas are as follows:

(1) *Collection Area.* The collection area is the location where initial collection of the seriously injured from the aircraft or debris is accomplished. The need to establish this area will depend on the type of accident that occurs and the circumstances surrounding the accident site. Custody of casualties is normally transferred from fire rescue personnel to medical services at this point.
(2) *Triage Areas.* The triage areas should be located at least 90 m (300 ft) upwind of the accident site if fire and smoke are imminent. If necessary, more than one triage area can be established.
(3) *Decontamination Area.* The decontamination area is where patients are processed to remove chemical, etiological, biological, or radioactive matter from their person to prevent contamination of the modes of transportation or medical treatment facilities. This process should be conducted by a specifically identified team in a separate area away and downwind from the care area.
(4) *Care Area.* Initially, there is only a single care area. Subsequently, the care area can be subdivided into three subareas according to the three categories of casualties; that is, immediate care (Priority I), delayed care (Priority II), and minor care (Priority III). Care areas can be identified with colored traffic cones, bicycle flags, or colored blankets (red to denote immediate; yellow, delayed; and green, minor).
(5) *Transportation Area.* A transportation area for the recording, dispatching, and evacuation of survivors should be located between the care area and the egress road. Only one transportation area is normally required; however, if there is more than one transportation area, it is essential to have communication between them.

23.8.2 In remote areas where transportation to appropriate medical facilities would be delayed or where climatic conditions dictate, consideration should be given to the use of mobile quarters for the stabilization and medical treatment of immediate care and delayed care casualties. Ideally, these quarters should be operational upon arrival or in less than one half hour. The design of the mobile facilities should, therefore, permit rapid response to the site and rapid activation to receive casualties. *[See 3.3.82, Mobile Emergency Hospital (MEH).]*

23.8.3 All areas should be clearly marked and visible to first responders. This can be accomplished using the approved standards of the region in which the AHJ is operating.

Chapter 24 Care of Fatalities (NFPA 424)

24.1 Care Prior to Site Investigation.

24.1.1 Airport firefighters and other rescue personnel should understand the basic need for and the techniques and procedures used in aircraft accident investigation. Wherever possible, the wreckage should remain undisturbed until the arrival of the appropriate investigating agency.

24.1.2* The concept of preservation of evidence should be applied at an aircraft accident site. It is important to realize that an undisturbed site can produce the most reliable evidence for determining cause and corrective action that would help prevent a similar incident in the future. The AEP should include contingencies that address management of the deceased at the scene of the emergency that coordinates with plans established by the coroner/medical examiner and local authorities (law enforcement). The AEP needs to designate the person responsible for contacting and coordinating with the coroner/medical examiner. The coordination of the AEP and the coroner/medical examiner's plan is essential.

24.1.3 Areas immediately surrounding the location of the deceased should be completely secured. Areas where a large number of fatalities or dismembered remains are located should be left undisturbed until the arrival of the medical examiner or coroner (or their representative) and the Accident Investigation Board investigator or his or her designee. The coroner/medical examiner normally manages issues related to documenting the remains and conducting identification.

24.1.4 If it becomes necessary to move human remains, wreckage, or personal effects, photographs, video, or both should be taken showing their relative position within the wreckage and their respective positions prior to removal. In addition, tags should be affixed to each body or part of the wreckage that was displaced, and corresponding stakes or tags should be placed where they were found in the wreckage. A journal should be kept of all tags issued. Special precautions should be taken to avoid disturbing anything in the cockpit area. Should any control be displaced, photographs, video, drawings, or notes should be taken.

24.1.5 Extrication of the deceased and removal of personal effects prior to the arrival of the coroner or appropriate authority should be performed only when necessary to prevent their destruction by fire or for similar compelling reasons. If bodies must be moved, previously mentioned precautions and documentation should apply. Provisions should be made to obtain body bags or other containers to hold and transport remains and personal effects.

24.1.6 Body bags should be made of heavy-duty vinyl, have a C-zipper, and comply with bloodborne pathogen requirements. Body bags are normally available from major local suppliers of caskets, from funeral directors and their equipment and supply firms, and from nearby military facilities. Stocks of body bags at each airport are desirable. For fragmentary remains, smaller biohazard bags can be used.

24.2 Care after Site Examination.

24.2.1* Body identification and determination of cause of death should be conducted only by the local medicolegal authority. Remains are not identified at the scene; rather, they are stored and examined in a facility where proper forensic methods can be used. This operation is generally conducted with the cooperation of forensic teams and other specialists. Forensic teams may consist of law enforcement officials, pathologists, radiologists, odontologists, fingerprint experts, anthropologists, DNA experts, and funeral directors.

24.2.2 Accidents that produce a large number of fatalities can overload normal morgue facilities. In these types of accidents, a mortuary annex needs to be established. The mortuary annex should be isolated in an area remote from places where relatives, media, or the general public have access. Strict security measures need to be taken and enforced. The mortuary annex ideally should contain electricity, running water, a closed drainage system, nonporous flooring, adequate ventilation, and enough floor space to accommodate complete morgue operations. An area of approximately 4000 square feet is usually adequate for this purpose. A remote airport hangar or maintenance facility often makes an excellent mortuary annex. In areas where delay or temperature can contribute to the deterioration of tissue, refrigerated storage needs to be available. Typically, refrigerated, metal-lined, generic semitrailers are used for this purpose. The mortuary annex should consist of areas devoted to postmortem examination (reception), radiology, pathology, odontology, anthropology, fingerprint collection (FBI), DNA collection, and funeral directors. The postmortem examination area consists of registration, collection, cataloguing, and storage of personal effects.

24.2.3* The victim identification process is thorough, deliberate, and based on proven scientific methods. As a rule, personal effects removed from the remains are considered to be a presumptive method of identification that is used to determine who the deceased might be. Positive victim identification requires comparison of antemortem (before death) records and samples, such as dental and medical X-rays, with similar information collected from the remains. Antemortem information and records are obtained through interviews with family members and by contacting the dentist and doctor of the deceased. Exact matches of unique biological characteristics found in both the antemortem and postmortem records leads to a positive identification. Such methods include comparison of dental records and radiographs; comparison of fingerprints; comparison of bone structure in radiographs; comparison of healed fractures to radiographs; tattoos and other skin markings; unique medical features, such as implants/prosthetics; and comparison of DNA. This victim identification process must be followed to positively identify the remains of the deceased. Because the victim identification process involves notification of the next of kin, the AEP should establish a protocol for contacting the next of kin for support and coordination of travel to a Family Assistance Center. Family members often travel to the accident site to receive information about the accident and to obtain the remains of the deceased. In the US, the NTSB is required by federal law to coordinate information and services provided to family members. The air carrier is responsible for establishing the Family Assistance Center and transporting family members to the Center, where they will gather to obtain information about the accident, provide information for victim identification, and receive support services. The Center should be staffed with Red Cross volunteers, air carrier employees, clergy, and members of a DMORT. The Family Assistance Center should be located at a site remote from the accident scene and the investigation. If possible, the Center should be located at a site removed from the press and the general public. Locating the Center in the same hotel where accident investigators are staying is generally not suitable. All efforts to work with the next of kin of the deceased concerning victim identification issues should be managed through the coroner/medical examiner's office. Where needed, DMORT will handle coordination with family members.

24.2.4* The accident investigation team generally has the authority to require autopsies and toxicological analyses on crew members. In certain cases, they may ask that autopsies be conducted on passengers and ground fatalities. Normally, the local coroner/medical examiner will autopsy any remains they deem necessary. Decisions regarding autopsy will be made before remains are released from the morgue.

24.2.5 As soon as is practical after the emergency, all participants in the firefighting and rescue effort should be debriefed. Their observations should be recorded by the proper authorities. Sketches, diagrams, photographs, films, and tape and video recordings made on the accident site, as well as appropriate details on the tagging of bodies and parts of the wreckage removed from their positions, can be requested by the investigative authorities.

24.2.6 Close coordination between airport officials, local medicolegal authorities (coroner/medical examiner), and disaster service organizations (e.g., Red Cross) is essential to assure an effective and efficient operation. The chain of command and jurisdictional issues need to be clearly resolved and understood prior to an aviation accident.

Chapter 25 AEP Exercise (NFPA 424)

25.1 Emergency Plan Exercise.

25.1.1 The purpose of an AEP exercise is to test the adequacy of the following:

(1) AEP and related procedures
(2) Response of all personnel involved
(3) Emergency equipment and communications
(4) Command structure and lines of authority

25.1.2 It is important that the AEP contain procedures requiring testing of the AEP to correct as many deficiencies as possible and to familiarize all personnel and agencies concerned with the roles and responsibilities of each participant in the AEP.

25.2 Need for and Types of AEP Drills.

25.2.1 The AEP should be subject to full-scale emergency exercises to test all facilities and associated agencies at intervals of about 1 year. The exercise should be followed by a full debriefing, critique, and analysis. Representatives of all organizations participating in the exercise also should actively participate in the preparation for the exercise and the final critique.

25.2.2 It is important that small-scale simulated emergency exercises be held at more frequent intervals than the full-scale emergency exercise. These more frequent exercises should be aimed at testing and reviewing the response of individual participating agencies, such as the ARFF service, as well as other parts of the AEP, such as the communications system.

25.2.3 It is desirable that, in addition to the full-scale and simulated emergency exercises, a "tabletop" exercise involving the AEP coordinating committee be held at least annually, but not coincidentally with any of the emergency exercises in 25.2.2.

25.2.4 A liaison program should be implemented with the emergency services surrounding the airport, with regular direct points of contact established.

25.3* Planning for Full-Scale Emergency Exercises.

25.3.1 The first step in planning full-scale emergency exercises should be to have the support of all airport and community authorities concerned.

25.3.2 Each agency head should be thoroughly familiar with the AEP and should develop a plan for his or her department in coordination with the AEP. The agency heads should meet regularly to develop an understanding of each agency's respective roles, responsibilities, and requirements to enhance cooperation with other agencies.

25.3.3 An aircraft representative of the largest aircraft using the airport should be sought for the full-scale emergency exercise, to add realism to the exercise and to familiarize participants with the problem of removing casualties from aircraft. If an aircraft is not available, a bus or similar large vehicle can be used.

25.3.4 The emergency exercises should be held in locations that will provide maximum realism while ensuring minimum disruption to the operations of the airport or the orderliness of the community.

25.3.5 At least 120 days prior to the scheduled full-scale emergency exercise, a meeting of all key supervisory personnel of principal participating agencies should be called by the authority in charge. At this time, the aims of the exercise should be outlined, a scenario formulated, work tasks assigned, and duties of all agencies and personnel defined. A suggested time schedule and checklist are as follows:

(1) *120 Days Prior.* Organizational meeting of supervisory personnel of participating agencies. Aims outlined, scenario formulated, work tasks assigned, emergency plan coordinators selected. Schedule tests of all communication systems.
(2) *90 Days Prior.* First progress report on arrangements.
(3) *70 Days Prior.* First meeting of all participating agencies (individual committee representatives).
(4) *60 Days Prior.* Complete arrangements for full-scale emergency exercise site or staging area. Written scenario completed.
(5) *50 Days Prior.* Training for moulage team begins. Second meeting of the individual committee representatives. A moulage chairperson can be selected from hospitals, ARFF personnel, civil defense, military personnel, and so forth.
(6) *40 Days Prior.* Arrangements completed for transportation, feeding, stretcher bearers, and volunteer workers.
(7) *30 Days Prior.* Third meeting of the individual committee representatives. A preliminary "warm-up" communications exercise is held.
(8) *21 Days Prior.* Fourth meeting of the individual committee representatives. Make-up team training and arrangements completed for volunteer casualties.
(9) *14 Days Prior.* Final meeting and briefing for all participants, including critique team.
(10) *7 Days Prior.* Final meeting of supervisory personnel to review assignments.
(11) *Day of Exercise.*
(12) *1–7 Days After.* A critique following the exercise so that all participants can hear the observers' reports.
(13) *30 Days After.* The supervisory personnel meet to review written critiques submitted by observers and participants and revise procedures to correct mistakes and shortcomings indicated in the exercise.

25.3.6 In preparing the scenario, the use of real names of aircraft operators and types of aircraft should be avoided, which will prevent any possible embarrassment to companies or agencies involved in civil aviation.

25.3.7 In order to obtain the maximum benefit from a full-scale emergency exercise, it is important to review the entire proceedings. An observer critique team comprised of members who are familiar with mass casualty accident proceedings should be organized. A chairperson of the team should be appointed and should be present at all meetings. The team should be present at the final organizational meeting (7 days prior to the exercise) and, in coordination with the authority in charge, ensure that significant problems are incorporated into the exercise. Each member of the critique team should observe the entire exercise and complete the appropriate emergency exercise critique forms.

25.4 Review of the Airport Emergency Plan Drill.

25.4.1 Experience has shown that quite often the findings during an exercise or an actual emergency necessitate changes to the provisions set forth in the AEP.

25.4.2* A critique and review of the procedures followed by the participants during an emergency exercise or an actual accident/incident should be scheduled as soon as all data can be acquired from all agencies. This critique should be held not more than 7 days after the exercise or emergency.

25.4.3 The airport operator should make every effort to contact other airport authorities involved in actual aircraft accidents and those who have conducted full-scale emergency exercises to acquire data and procedures to correct and upgrade their AEP.

Annex A Explanatory Material

Annex A is not a part of the recommendations of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.3.1 General. A wide variety of terms are in use throughout the world to describe facilities, procedures, and services related to airports. Wherever possible, the terms used in this guide are those that have the widest international use and the meanings given in Chapter 3.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment, or materials, the "authority having jurisdiction" may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The "authority having jurisdiction" may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA standards in a broad manner because jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.3.2 Airborne Emergency. The seriousness of these emergencies can be defined by using alert status guidelines stated in FAA terms, and aircraft emergencies for which services may be required, as defined in the International Civil Aviation Organization's *Airport Services Manual*, Part 1, "Rescue and Fire Fighting."

A.3.3.5 Aircraft Accident Pre-Incident Planning. A pre-incident plan should define the emergency organizational authority and the responsibilities of all those involved.

A.3.3.9 Aircraft Firefighting. Aircraft firefighting does not include the control or extinguishment of airborne fires in aircraft.

A.3.3.10 Aircraft Incident. An incident does not result in serious injury to persons or substantial damage to aircraft.

A.3.3.12 Aircraft Rescue and Firefighting (ARFF). Additionally, ARFF personnel will enter the aircraft to provide assistance to the extent possible in the evacuation of the occupants. Although life safety is primary to ARFF personnel, responsibilities such as fuselage integrity and salvage should be maintained to the extent possible.

A.3.3.21 Airport Manager. The manager can have administrative control over aircraft rescue and firefighting services, but normally does not exercise authority over operational fire and rescue matters.

A.3.3.32 Composite Materials. Composite materials do not present unusual firefighting problems, but products of their combustion arising from an aircraft fire should be considered a potential respiratory hazard to firefighters.

A.3.3.52 Flight Data Recorder (FDR). It is usually mounted in the tail area of an aircraft and is designed to withstand certain impact forces and a degree of fire. Its purpose is to provide investigators with flight performance data that might be relevant in determining the cause of an accident/incident.

A.3.3.54.1 Aqueous Film Forming Foam (AFFF) Concentrate. The foam formed acts as a barrier both to exclude air or oxygen and to develop an aqueous film on the fuel surface that is capable of suppressing the evolution of fuel vapors. The foam produced with AFFF concentrate is dry chemical compatible and thus is suitable for combined use with dry chemicals. [**11,** 2021]

A.3.3.54.3 Fluoroprotein Foam Concentrate. This has the effect of giving the foam a measurable degree of compatibility with dry-chemical extinguishing agents and an increase in tolerance to contamination by fuel.

A.3.3.70 Ignition Temperature. Reported values are obtained under specific test conditions and might not reflect a measurement at the substance's surface. Ignition by application of a pilot flame above the heated surface is referred to as pilot ignition temperature. Ignition without a pilot energy source has been referred to as autoignition temperature, self-ignition temperature, or spontaneous ignition temperature. The ignition temperature determined in a standard test is normally lower than the ignition temperature in an actual fire scenario. [**921,** 2021]

A.3.3.71 Incident Commander (IC). Per A.3.4.4.3 in NFPA 470, the IC has overall authority and responsibility for conducting and managing all incident operations.

A.3.3.94 Protective Clothing. Protective clothing is divided into three types:

(1) Structural firefighting protective clothing
(2) High temperature–protective clothing

(3) Chemical-protective clothing
    (a) Liquid splash–protective clothing
    (b) Vapor-protective clothing

[**470,** 2022]

A.3.3.104 Self-Contained Breathing Apparatus (SCBA). For the purposes of this guide, where this term is used without any qualifier, it indicates only open-circuit self-contained breathing apparatus or combination SCBA/SARs. For the purposes of this guide, combination SCBA/SARs are encompassed by the terms *self-contained breathing apparatus* or *SCBA*.

A.3.3.120 Ventilation. Ventilation can be achieved by introduction of fresh air to dilute contaminated air or by local exhaust of contaminated air. [**302,** 2020]

A.4.2.2 When creating the response roadways from the firehouse to the incident area(s), the airport designer should consider the information in Table A.4.2.2(a) and Table A.4.2.2(b) when sizing the radius of curves. ARFF vehicles accelerate much faster than over-the-road vehicles and are capable of obtaining higher speeds in a short distance.

A.6.2.2 Previous editions of this document used the following alerts:

(1) Local Standby Alert was Alert I
(2) Full Emergency Alert was Alert II
(3) Aircraft Accident Alert was Alert III

A.7.2.2.4 Examples of this type of non-emergency ARFF response would include, but not be limited to, aeromedical evacuation operations with patient(s) on board, commercial passenger aircraft that are refueling without airstairs adjacent to opened doors, and aircraft defueling operations.

A.8.3.5 For more information on the physical properties of aviation fuels, see Annex B of NFPA 407.

A.11.4.4 Figure A.11.4.4 shows an example of a boom-mounted penetrating nozzle.

A.12.9.4 Proximity to runway approach and departure corridors will require vertical clearance as well. Temporarily restricting runway thresholds may be required.

A.13.1.4 See ICAO Annex 13, *Aircraft Accident and Incident Investigation,* and ICAO Document 6920, *Manual of Aircraft Accident Investigation*.

A.13.2.3 These documents can include Certificate of Airworthiness, Certificate of Registration, Certificate of Maintenance, Technical Log, Load and Balance Sheets, Passenger and Flight Manifests, Crew Licenses, Navigational Log Sheets, Aircraft and Operations Manuals, Maps, and Notes. Eyewitnesses' and passengers' statements will be fundamental in assisting the investigating authorities in determining the probable cause, for example, indicating the final flight path.

Table A.4.2.2(a) Vehicle Speed over Distance from a Standing Start

Distance Traveled from a Standing Start of the Vehicle		Speed of Vehicle at the Given Distance					
		Vehicle Water Tank Capacity ≥378.5 to ≤1892.5 L (≥100 to ≤500 gal)		Vehicle Water Tank Capacity 1892.5 to ≤6000 L (>500 to ≤1585 gal)		Vehicle Water Tank Capacity >6000 L (>1585 gal)	
m	ft	kph	mph	kph	mph	kph	mph
30.5	100	29.0	18	32.2	20	29.0	18
76.2	250	40.2	25	48.3	30	40.2	25
152.4	500	48.3	30	64.4	40	48.3	30
228.6	750	64.4	40	72.4	45	64.4	40
304.8	1000	72.4	45	80.5	50	72.4	45

Table A.4.2.2(b) Minimum Radius of a Curve Based on Speed

Speed		Minimum Radius of a Curve with a 0.04 Supervention (Almost Flat)*	
kph	mph	m	ft
32.2	20	39.6	130
48.3	30	92.0	302
64.4	40	174.6	573
80.5	50	291.1	955
88.5	55	436.5	1432
96.6	60	498.9	1637

*Values were extracted from *A Policy on Geometric Design of Highways and Streets*, 2011 edition.

FIGURE A.11.4.4 Boom-Mounted Penetrating Nozzle.

A.13.6.1 See NFPA 407, NFPA 410, and ICAO *Airport Service Manual,* Part 5, "Removal of Disabled Aircraft."

A.13.6.4 ARFF personnel should be made aware that defueling an inverted aircraft has very serious potential for fire. The common conclusion of experts in this field is, "If there is no leakage, leave it alone until the rescue operation is completed." The issue here is defueling an inverted aircraft, not fuel leakage. If there is fuel leakage, it should be dealt with in the same manner as any other fuel leak, regardless of the aircraft's attitude.

A.14.1.4 For each emergency involving the AEP, personnel should be able to provide descriptions or identify the following:

(1) Describe the chain of command and command authority at incidents both on and off the airport
(2) Identify the personnel associated with each responsibility in the incident command system
(3) Describe the procedures for the change of command during any phase of the emergency
(4) Identify and describe other agencies involved, including the role, responsibility, and authority of each
(5) Describe, in general, various personnel duties and responsibilities under the AEP
(6) Describe the incident command structure in use at the airport and how this structure interfaces with external mutual-aid organizations

A.15.2 The opening or closing of an airfield or portion thereof is the responsibility of the airport operator. However, in the fast developing dynamics that occur immediately after an accident or incident, the airport operator may not be in the best position to assess the situation and make a decision whether to continue operations or close the airfield. To ensure the safety of airfield operations, it might be beneficial to establish procedures with the ATC tower that give the authority for closing the airfield to controllers under defined circumstances and guidelines. This task can be accomplished through a Letter of Agreement with the ATC Tower. Such procedures must provide safeguards to ensure that airport operations are continued or resumed only after it is determined that there is not an adverse effect on persons or property on the airfield and that appropriate level of ARFF coverage is available. In addition, operations should resume only after the following conditions:

(1) Only after it can be ascertained that the rescue and evacuation activities associated with the event will not be impacted negatively by resumption of airfield operation.
(2) The accident event does not pose a hazard to the resumption of airfield operations.

Because these kinds of plans must be formulated as part of the AEP for the airport and require cooperation and coordination of various airport interests, the importance of advance preparation cannot be overemphasized.

Additionally, the emergency declarations associated with preflight and postflight aircraft operations, maintenance, and servicing are generally referred to as *aircraft ground emergencies.*

A.15.3.1 For a comprehensive description of training and skills required see NFPA 1003.

A.15.4.2 The first security officer to arrive should assume security responsibility, survey the scene, and request reinforcements as needed. This security officer should remain until relieved by the appropriate security authority with jurisdiction over the area.

Security personnel and police will be needed to handle traffic, to keep unauthorized personnel from the crash site, and to assume custody of personal effects removed from the aircraft.

Appropriate security provisions are necessary to protect any mail involved and any dangerous goods that might be present.

The emergency site should be cordoned off as soon as possible to exclude unauthorized persons. Appropriate markings should be prominently displayed to advise all persons of possible hazards that can cause serious injury should they encroach on the area.

Visible identification should be issued by the controlling authority and monitored by the security coordinator and his or her team.

A.15.8.1 Table A.15.8.1 provides data for some common aircraft.

A.15.15.1 The close proximity of an airport to surrounding communities and the possibility of an off-airport aircraft accident give rise to the need for mutual aid emergency agreements.

A mutual aid emergency agreement should specify initial notification and response protocols.

Mutual aid emergency agreements should be prearranged and duly authorized. A sample of a letter of emergency mutual aid agreement is shown in Figure A.15.15.1. Should more complicated jurisdictional or multiagency agreements be necessary, the airport operator may have to act as the coordinating agency. This annex entry contains guidelines compiled to assist with the preparation of mutual aid emergency agreements with local fire departments for accidents occurring on and off the airport.

Procedure for Local Fire Department(s) — Aircraft Accident On-Airport. The following steps should occur:

(1) A call to an aircraft accident on the airport will normally be received from ATC services.
(2) The mutual aid fire department(s) should report to the rendezvous point or staging area on arrival at the airport. Escort by airport police/security should be provided from the rendezvous point or staging area to the accident site.
(3) Upon arrival at the accident site, the following should occur:
    (a) The senior officer of the airport ARFF service receiving mutual aid should have full authority at the scene, unless other laws or agreements contradict this statement.
    (b) Fire department mutual aid communications should be carried out on the predesignated communications channel.
    (c) Communications transmissions should be prefaced by a call sign.

Table A.15.8.1 Aircraft Data

	Span		Length		Gross Weight	
Aircraft Type	**m**	**ft**	**m**	**ft**	**kg**	**lb**
Airbus						
A-318	34.1	111.87	31.44	103.1	59,000	130,070
A-319	34.1	111.87	33.84	111	64,400	141,980
A-300	44.83	147.08	54.05	177.3	165,016.8	363,800
A-310	43.89	144	46.66	153.1	138,617.7	305,600
A-320	33.91	111.25	37.57	123.3	73,481.1	162,000
A-321	34.1	111.25	44.51	146	89,000	196,210
A-330-200	60.3	197.83	58.82	192.9	230,000	507,060
A-330-300	60.3	197.83	63.69	208.9	230,000	507,060
A-340-300	60.3	197.83	63.69	208.9	275,000	606,270
A-340-500	63.45	208.16	67.93	222.8	372,000	820,120
A-340-600	63.45	208.16	75.36	247.2	368,000	811,300
A-350-800	64.75	212.43	60.54	198.6	248,000	546,750
A-350-900	64.75	212.43	66.89	219.4	268,000	590,840
A-350-1000	64.5	211.61	73.88	242.3	298,000	656,980
A-380	79.75	261.64	72.72	238.58	560,000	1,234,588
Antonow An-22	64.31	211	50.9	167	226,796	500,000
Antonow An-225	88.39	290	84	275.58	600,000	1,322,750
ATR 72	27	88.58	27.15	89.08	20,003.41	44,100
Beechcraft 1900	16.61	54.5	17.63	57.83	7,529.627	16,600
Beechcraft King Air 350	17.65	57.92	14.23	46.67	6,803.88	15,000
Boeing 727	32.92	108	46.69	153.17	86,636.07	191,000
Boeing 737-300	28.86	94.67	36.42	119.5	63,049.29	139,000
Boeing 737-600	34.3	112.7	31.2	102.6	66,000	145,500
Boeing 737-700	34.3	112.7	33.6	110.4	70,080	154,500
Boeing 737-800	34.3	112.7	39.5	129.6	79,010	174,200
Boeing 737-900 ER	34.3	112.7	42.1	138.2	85,130	187,700
Boeing 747-400	64.31	211	70.64	231.75	394,625	870,000
Boeing 757	38	124.67	47.32	155.25	108,862.10	240,000
Boeing 767-200 ER	47.6	156.1	48.5	159.2	179,170	395,000
Boeing 767-300 ER	47.57	156.08	54.94	180.25	186,880	412,000
Boeing 767-400 ER	51.9	170.4	61.3	201.4	204,120	450,000
Boeing 777-200	60.9	199.11	63.7	209.1	247,200	545,000
Boeing 777-300	60.9	199.11	73.9	242.4	299,370	660,000
Boeing 787-8	60	197	57	186	227,930	502,500
Boeing 787-9	60	197	63	206	247,208	545,000
Boeing DC 10-40	50.37	165.25	55.02	180.5	259,454.6	572,000
Boeing MD-11	51.59	169.25	61.16	200.67	273,289.2	602,500
Boeing MD-88	32.82	107.67	45.03	147.75	67,812	149,500
Casa CN-235	25.76	84.5	21.34	70	14,399.73	31,746
Cessna Citation 5	16.28	53.42	14.83	48.67	7,302.831	16,100
DeHavilland Dash 8	25.91	85	22.25	73	15,648.92	34,500
Grumman Gulfstream 4	23.67	77.67	26.9	88.25	33,384.37	73,600
Ilyushin IL-86	48.31	158.5	58.45	191.75	187,605.7	413,600
Lockheed L-1011-500	50.06	164.25	50.04	164.17	228.610.4	504,000
Short 360	22.81	74.83	21.59	70.83	11,793.39	26,000
Tupolev Tu-154	37.54	123.17	47.91	157.17	90,015.33	198,450

Procedure for Local Fire Department(s) — Aircraft Accident Off-Airport. The following steps should occur:

(1) A call to an aircraft accident off-airport will normally be received from ATC services or police. If that is not the case, the local fire department should notify ATC services or police via radio or telephone that an accident has occurred, giving the approximate location on the grid map.
(2) Upon arrival at the accident site, the local fire department should perform the following:
    (a) Ensure that the mutual aid emergency agreement is initiated.
    (b) Establish an ICP. (This post can be temporary until the airport operator mobile command post is available and operative.)
    (c) Ensure that all communications are on the designated aircraft accident channel.
(3) The local fire department should provide the following information to ATC services or police:
    (a) Exact location of the accident site
    (b) Location of the ICP
    (c) Specific location/rendezvous points on the grid map to which fire units should respond
    (d) Any request for specialized equipment, if necessary

A.16.1 Full AEP implementation is not necessary where general aviation or small- to medium-size business aircraft are involved. Large passenger and cargo aircraft and some military aircraft (medevac, explosive-laden, large passenger or cargo aircraft) would necessitate full implementation.

A.16.2.2 See Figure A.16.2.2.

A.16.8.11 For aircraft removal techniques, see the International Civil Aviation Organization *Airport Services Manual*, Part 5, "Removal of Disabled Aircraft." Also see *International Air Transport Association — Guidelines for Airport Operators and Airport Authorities on Procedures for Removal of Disabled Aircraft.*

AGENCY (Name and Address):

_____

_____

Endorses the XYZ (International) Airport Emergency Plan, associated airport emergency plan document dated (insert date), and attached procedures and agrees to comply with all the procedures and instructions, and fulfill all applicable responsibilities therein.

_____

Signature of Authorized Representative

_____

Date

FIGURE A.15.15.1 XYZ (International) Airport Emergency Plan Letter of Emergency Mutual Aid Agreement.

A.17.1 Full AEP implementation is not necessary where general aviation or small- to medium-size business aircraft are involved. Large passenger and cargo aircraft and some military aircraft (medevac, explosive-laden, large passenger or cargo aircraft) would necessitate full implementation.

A.17.2.1 See Figure A.17.2.1.

A.17.2.2 See Figure A.17.2.2.

A.17.8.12 For aircraft removal techniques, see the International Civil Aviation Organization *Airport Services Manual*, Part 5, "Removal of Disabled Aircraft."

A.20.3 Figure A.20.3 shows an example of a mobile command post.

A.22.2 Security measures within the wreckage area should be established as soon as possible. All authorized personnel should have and display proper "Emergency Access" identification as required by the AEP.

All security personnel should be briefed on proper identification procedures. Two-way radio communication with appropriate authorities on the site can help identify any person seeking entry whose credentials are questionable.

Accident sites can be exceptionally dangerous areas, owing to the possible presence of flammable fuels, dangerous goods or hazardous materials, biological hazards, damaged composite materials, and scattered pieces of wreckage. All necessary safety precautions in the emergency area should be carried out rigidly, which includes exercising good judgment during fire control and throughout all rescue efforts. Safety equipment and approved protective clothing should be worn by all personnel involved. All other personnel should remain outside the security perimeter until the chief fire officer declares the area safe.

A.24.1.2 In the US, major aircraft accidents are investigated by the NTSB, except those delegated by the Board to the Federal Aviation Administration. Part 830, "Notification and Reporting of Aircraft Accidents or Incidents and Overdue Aircraft, and Preservation of Aircraft Wreckage, Mail Cargo, and Records" of the NTSB, Section 830.10 reads as follows:

"Civil aircraft accident investigation is normally conducted by a number of investigators of the NTSB or their designees interested in establishing the probable cause. Federal or state governments are usually charged with the official responsibility but the operators, pilot groups, airport management, and others may be active in accident investigation work. Fire officials normally make their own investigation."

For guidance on preservation of evidence, see Chapter 13 and Annex E.

In the US, the Aviation Disaster Family Assistance Act of 1996 tasks the NTSB with coordinating the disaster response resources of federal, state, local, and volunteer agencies to meet the needs of aviation disaster victims and their families. Family counseling, victim identification and forensic services, communicating with foreign governments, and translation services are some of the services the Board coordinates. The NTSB will play a primary on-scene role in family assistance and victim identification.

A.24.2.1 Forensic teams within the US can be made available through state or federal resources. Federal resources include National Disaster Medical System/Disaster Mortuary Operational Response Teams. (NDMS/DMORT). Outside the US, Interpol has Disaster Victim Identification teams, which use scientific methods and standard protocols to conduct victim identification.

A.24.2.3 The Aviation Disaster Family Assistance Act of 1996 tasks the NTSB with coordinating the disaster response resources of federal, state, local, and volunteer agencies to meet the needs of aviation disaster victims and their families. Family counseling, victim identification and forensic services, communicating with foreign governments, and translation services are some of the services the Board coordinates. The NTSB will play a primary on-scene role in family assistance and victim identification.

A.24.2.4 The NTSB under the Independent Safety Board Act of 1974 and 49 CFR 831.10 can order autopsies and other tests to be performed where necessary to investigate an accident. The need for these tests should be determined as early in the process as possible and prior to the release of the bodies. The NTSB is authorized to obtain, with or without reimbursement, a copy of the report of autopsy performed by state or local officials on any person who dies as a result of having been involved in a transportation accident within the jurisdiction of the Board. The investigator-in-charge, on behalf of the Board, may order an autopsy or seek other tests of such persons as may be necessary to the investigation, provided that to the extent consistent with the needs of the accident investigation, provisions of local law protecting religious beliefs with respect to autopsies should be observed.

A.25.3 Some examples of full-scale exercises could include:

(1) Training
(2) Response drills
(3) Table-top command training
(4) Functional exercises

A.25.4.2 Figure A.25.4.2 shows an emergency exercise critique form.

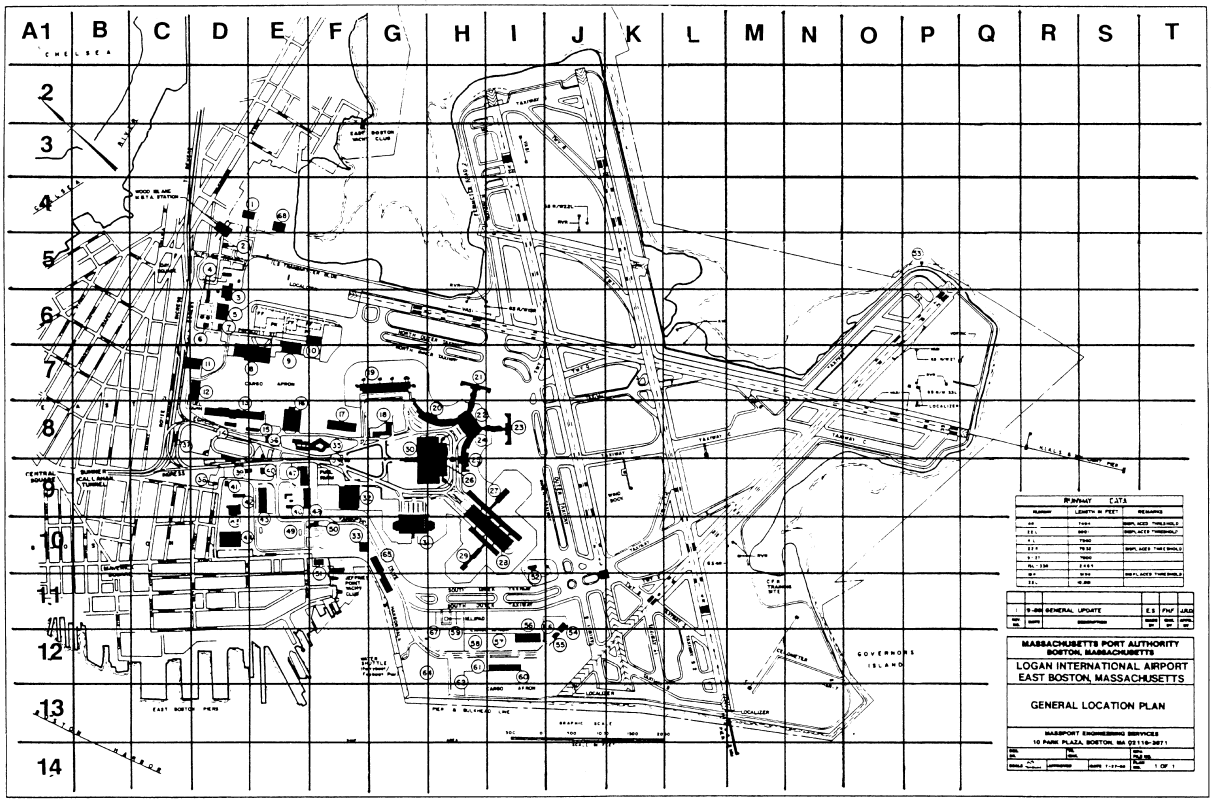


FIGURE A.16.2.2 Typical Airport Grid Map.

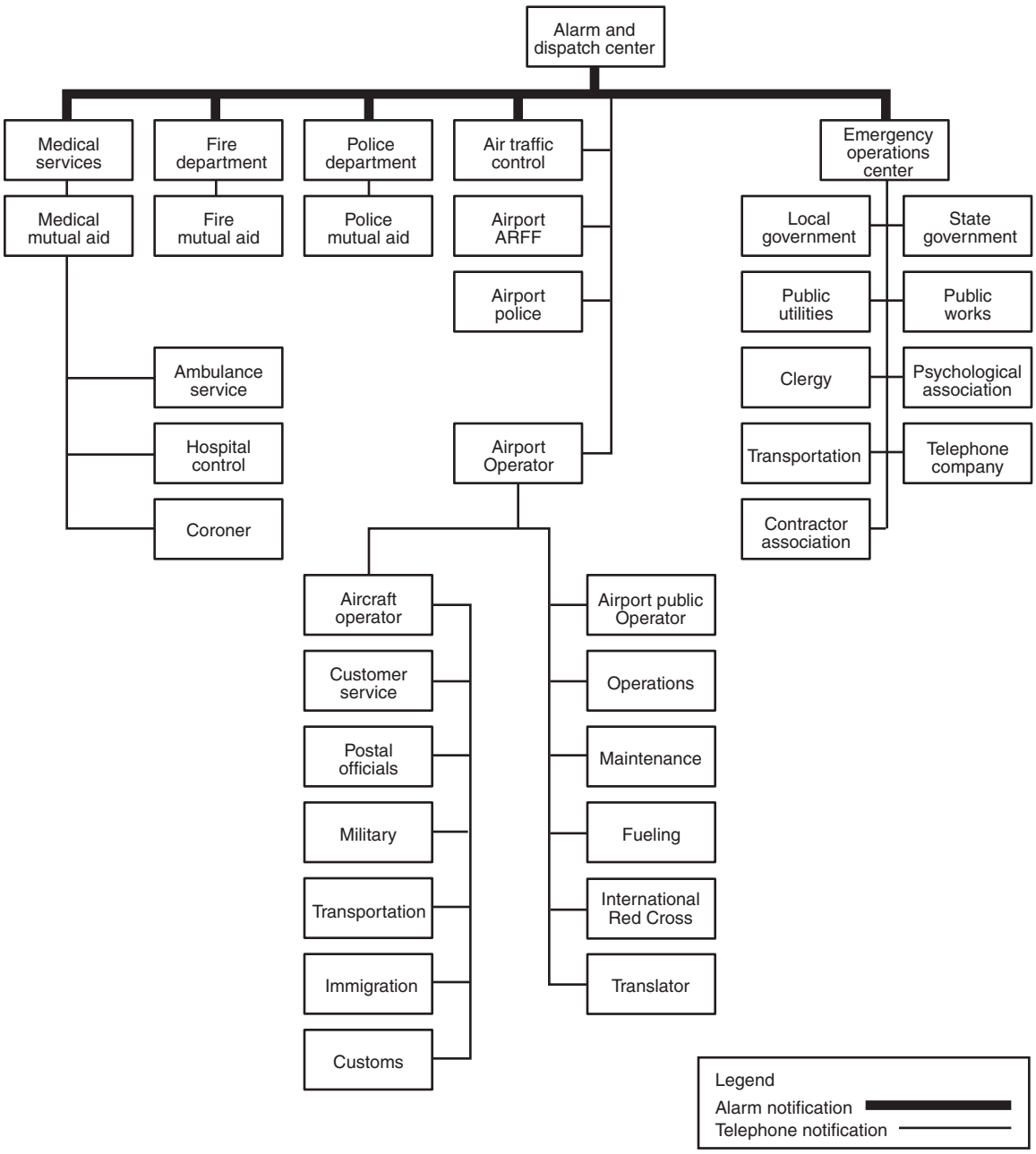


FIGURE A.17.2.1 Sample Notification Chart — Aircraft Accident Off-Airport.

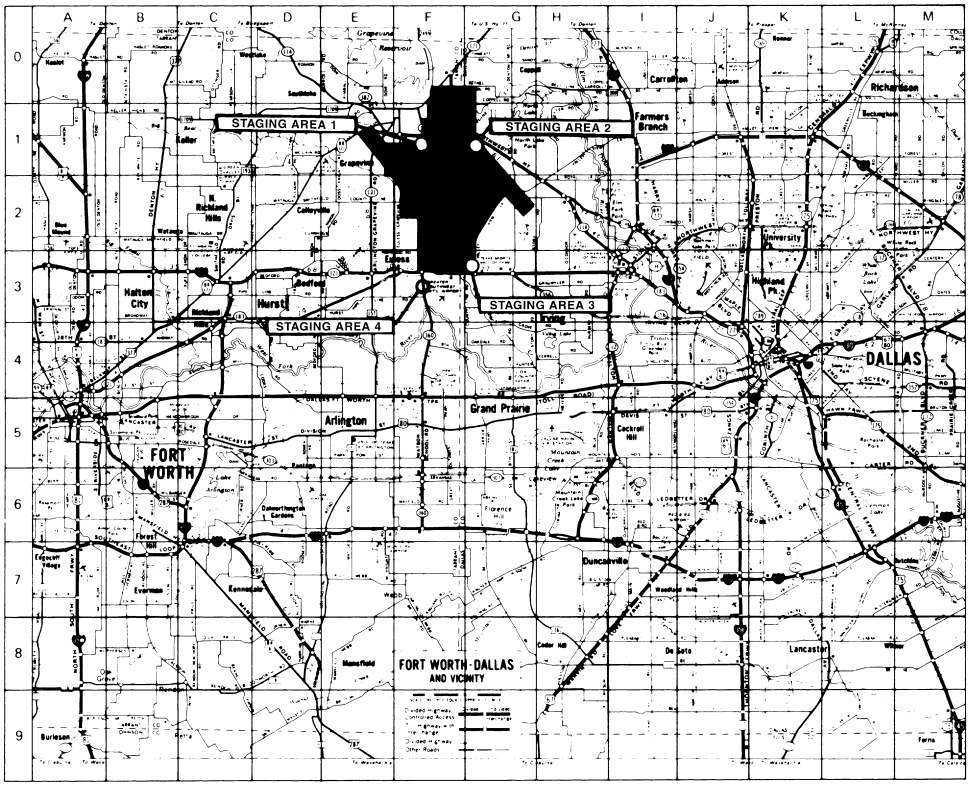


FIGURE A.17.2.2 Typical Municipal Grid Map.

FIGURE A.20.3 Mobile Command Post.

EMERGENCY EXERCISE CRITIQUE FORM
XYZ (INTERNATIONAL) AIRPORT

Person performing critique _____

General

1. Date and time of emergency _____
2. Emergency location _____
3. Type of emergency _____

Rescue Operations

Person performing critique _____
Organization _____

4. Time of emergency notification _____
5A. First agency or individual to arrive at emergency _____
B. Time of arrival _____
6A. Arrival time of airport rescue firefighting service at emergency _____
B. Approximate number of fire personnel at site _____
C. Time and type of first fire protection action (foam, dry chemical, etc.) _____
7A. Time first casualty evacuated from airport _____
B. How evacuated _____
C. Number of casualties evacuated from inside aircraft _____
D. Time last casualty evacuated from aircraft _____
Comments: _____
_____
8A. Number of injured _____
B. Number of noninjured _____
C. Number of dead _____
9A. Time first casualty transported to triage area _____
B. Time last casualty transported to triage area _____
10A. Name of other services participating in first aid _____
B. Who was in charge of these services? _____
C. How many persons involved? _____
11A. Name of other organizations participating in rescue operations _____
B. How many persons involved? _____
12. Was the moulage realistic? _____

Security

Person performing critique _____
Organization _____

13A. Time of emergency notification to police/security _____
B. Who was first police/security officer to arrive at emergency site? _____
C. Time of arrival _____
14A. How many persons involved? _____
B. Did command of security at emergency site change at any time? If so, give sequence of command change and agency represented. _____
_____
15. Was the traffic satisfactorily controlled? _____
16. Was there any provision for the security of personal effects? _____
17. Any special problems at accident site with security (spectators, etc.)? _____
_____

Medical Services

Person performing critique _____
Organization _____

18A. Who was the first medical official to arrive at emergency site? Medical facility associated with? _____
_____
B. Time of notification _____
C. How notified? _____
D. By whom? _____
E. Arrival time at emergency site _____
19A. Who was the medical coordinator in charge of medical care and evacuation of casualties? _____
B. Time of notification _____
C. How notified? _____
D. By whom? _____
E. Arrival time at emergency site _____
20A. Number of physicians responding _____
B. Number of nursing personnel responding _____
21A. Was a triage area designated at emergency site? _____
B. Was the triage area located to expedite the flow of casualties? _____
C. Were the casualties properly classified and tagged? ___
D. Were the casualties moved quickly to receiving hospitals? _____
22. How were medical and first aid personnel identified?
_____
23A. What time were relief agencies (International Red Cross, Salvation Army, etc.) notified? _____
B. How notified? _____
C. By whom? _____
D. Arrival time _____
E. Personnel participating _____

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FIGURE A.25.4.2 Emergency Exercise Critique Form XYZ (International) Airport.

Ambulances

Person performing critique _____
Organization _____

24A. Time of notification to ambulances _____
B. How notified? _____
C. By whom? _____
D. Name of ambulance company _____
E. Time of arrival at accident site of first ambulance _____
25A. How many casualties did ambulance handle? _____
B. Time of departure _____
C. Hospital _____
D. Arrival time at hospital _____
26A. Was ingress or egress to accident site a problem? _____
Explain: _____
_____
B. Any special problems driving from accident site to hospital? _____
Explain: _____
_____

Hospitals

Person performing critique _____
Organization _____

27. Number of physicians responding _____
28. Number of nursing personnel responding _____
29. Number of other hospital personnel responding _____
30. Number of casualties received _____
31. Kind of casualties received _____
_____
32A. Time first alert was received _____
B. Time disaster message authenticated _____
C. Time first casualties arrived _____
D. Time first casualties were seen by a physician _____
E. Time last casualties arrived _____
F. Time last casualties were seen by a physician _____

Leadership

Person performing critique _____
Organization _____

33. Did leadership by incident commander cause people to take effective action? _____
_____
34. Were there any problems in the coordination of medical, fire, police, and other services? _____
_____
35. Was the general spirit of the participants conducive to the success of the exercise? _____
36. Who demonstrated leadership? _____

Public Information

Person performing critique _____
Organization _____

37A. Time of notification to airport public information officer _____
B. How notified? _____
C. Arrival time _____
38A. Who was the public relations officer? _____
B. From what organization? _____
39. What special problems were indicated? _____
Explain: _____
_____

Communications and Control

Person performing critique _____
Organization _____

40. Did the command post perform effectively? _____
41. Did the emergency operations center perform effectively? _____
42. Was the personnel call system effective? _____
43. Was the physician call system effective? _____
44. Was the emergency message accurately received? _____
45. Were communications with the hospital effective? _____
46. Were there any problems with internal communications? _____
47. What kinds of communications systems were used?
_____
A. Two-way radio _____
B. Telephone _____
C. Walkie-talkie _____
D. Messenger _____
E. Other _____

NARRATIVE: Make any comments that may be helpful in evaluating this exercise. _____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

FIGURE A.25.4.2 ***Continued***

Annex B Air Transport of Dangerous Goods (Hazardous Materials and Restricted Articles) and Nuclear Weapons (NFPA 402)

This annex is not a part of the recommendations of this NFPA document but is included for informational purposes only.

B.1 Commercial Air Transport of Dangerous Goods.

B.1.1 The carriage of dangerous goods in commercial transport aircraft is an accepted practice and is closely controlled by national and international regulations.

B.1.2 Definition of Dangerous Goods. Dangerous goods include the following:

(1) Explosives and any other article defined as a combustible liquid, corrosive material, infectious substance, flammable compressed gas, flammable liquid, flammable solid, magnetized material, nonflammable compressed gas, oxidizing material, poisonous article, radioactive material, or other restricted article.
(2) Some unlikely items can come under the heading of dangerous goods. For example, wheelchairs could contain wet-cell batteries, and breathing apparatus might have compressed air cylinders. Personnel should be aware of hazards that might not be immediately apparent.

B.2 Radioactive Material. Radioactive materials constitute a particular hazard. They emit certain rays that can be a health hazard and that cannot be detected except by instruments. Radioactive materials transported by air fall into the following three categories:

(1) *Category I.* Material emits minimal radiation.
(2) *Category II.* Material emits more radiation and is assigned a transport index up to 1.
(3) *Category III.* Material could have a transport index of 1.1, up to a maximum of 10.

B.3 Transport Index.

B.3.1 The transport index for a package of radioactive material is a simplified expression of the maximum amount of radiation emitted, in millirem per hour, measured one meter from the surface of the package. This number should appear on the notification, and such notification should be received by the pilot-in-command. The sum of the transport indexes is the primary concern, along with the stowage of the packages, to ensure that no living beings are exposed to hazardous radiation.

NOTE 1: In the United States, dangerous goods are transported by air under authority of 49 CFR 175, "Transportation."

NOTE 2: The International Air Transport Association has issued the IATA *Restricted Articles Regulations*. Also, the International Civil Aviation Organization has developed technical instructions (Document 9284, *Technical Instructions for the Safe Transport of Dangerous Goods by Air*) for the safe transportation of dangerous goods by air.

B.3.2 Dangerous goods are regularly being carried on commercial transport aircraft. This includes passenger aircraft, passenger cargo aircraft (COMBI), and cargo aircraft. While the packaging requirements used to transport these materials are designed for proper containment, the possibility of breakage cannot be overlooked. This introduces the hazards of leaking flammable liquids and poisons, or radioactive contamination at an accident site. By knowing and recognizing dangerous goods labels, firefighters can be alerted to these hazards.

B.4 Dangerous Goods Warning Labels.

B.4.1 The dangerous goods warning labels are authorized by the US Department of Transportation (DOT) based on the United Nations labeling system and are authorized for domestic and foreign shipments. Shippers must furnish and attach the appropriate label(s) to each package of dangerous goods being offered for shipment by air. Refer to the AHJ references for descriptions, labels, and information regarding dangerous goods.

B.4.2 The pilot-in-command of an aircraft should be provided with all relevant information regarding dangerous goods onboard the aircraft, and, in the event of an incident, this information should be obtained by airport emergency services either directly from the pilot or through the operations office.

B.4.3 The NFPA publication *Fire Protection Guide to Hazardous Materials* provides essential information for those confronted with emergencies such as fire, accidental spills, and aircraft accidents. With the urgency of prompt identification in mind, this guide has been arranged so that the user can access the information with a minimum of delay.

B.5 Incidents or Accidents Involving Radioactive Materials.

B.5.1 Radioactive materials carried in commercial transport aircraft are packed in rugged containers of varying sizes, such as steel drums, wooden containers, heavy corrugated cardboard, or lead boxes. In the event of an aircraft accident, the possibility of these containers breaking should always be considered.

B.5.2 This introduces the hazard of radioactive contamination of an accident site. The following procedures should then be followed in the United States (similar procedures are followed in other countries):

(1) Notify the nearest Department of Energy office or military base (if military aircraft is involved) of the accident immediately. They in turn will respond with a radiological team to the accident scene.
(2) Restrict the public to as far away from the scene as possible. Souvenir collectors should be forbidden at all accident scenes.
(3) Segregate firefighters who have had possible contact with radioactive material until they have been examined further by competent authorities.
(4) Remove injured from the area of the accident with as little physical contact as possible and hold them at a transfer point. Take any measure necessary to save lives, but carry out minimal (no more than necessary) first aid and surgical procedures until help is obtained from the radiological team physicians or other physicians familiar with radiation medicine. Whenever recommended by a doctor, an injured individual should be removed to a hospital or office for treatment, but the doctor or hospital should be informed when there is reason to suspect that the injured individual's body or clothing has been contaminated with radiation.
(5) In accidents involving fire, fight fires upwind as far as possible, keeping out of any smoke, fumes, or dust arising from the accident. Handle this as a fire involving toxic chemicals (using positive-pressure SCBA and full-protective clothing). Do not handle suspected material

until it has been monitored and released by monitoring personnel. Segregate all clothing and tools used at the fire until they can be checked by the radiological emergency team.

(6) Do not eat, drink, or smoke in the area. Do not use food or drinking water that might have been in contact with material from the accident.

(7) Measure the level of radioactivity. The use of instruments such as Geiger counters, ionization chambers, dosimeters, and so forth, is the only accurate means of determining if radioactive contamination is being given off.

(8) Control runoff. To the extent possible, runoff water and other agents used in firefighting and cleaning should be channeled, collected, and dammed to prevent entry into watercourses and the possible spread of contamination.

B.6 Military Aircraft Carrying Weapons.

B.6.1 While most military aircraft will attempt to return to a military airbase in case of emergency, this is sometimes impossible, and landings are frequently made at nonmilitary airports. There are also many cases where "joint-use" airports serve both the military and civil aircraft operations. For these reasons, it is advisable for aircraft rescue and firefighting crews to be familiar with the various types of military aircraft operating in the area. For this purpose, training visits to promote knowledge of the special features of military aircraft at nearby military installations are of value. Such liaisons are encouraged by the military.

B.6.2 Any person receiving information of a military aircraft accident should immediately notify the base operations office at the nearest military establishment, giving all relevant information. Telephone numbers of such military installations should be kept on hand at civil airports, at nearby municipal fire stations, and in airport control towers.

B.6.3 Care should be exercised by the rescue and firefighting crews when approaching any military aircraft involved in fire. Armament, ejection seats, or hazardous or other dangerous cargoes can present severe hazards during such operation.

B.6.4 The possibility of an atomic explosion from the detonation of a nuclear weapon or warhead due to a fire, inadvertent release, or impact accident is so small it is practically nonexistent. Safety features and devices have been carefully designed and incorporated in nuclear weapons and warheads to make this assurance possible. The danger of a nuclear weapon is from the high explosives (HE) used, plus radiation from the components.

B.6.5 The presence of nuclear weapons in aircraft generally creates no greater hazard than does the presence of conventional high explosives. Most weapons contain a high explosive that could detonate upon moderate to severe impact or when subject to fire. In fact, exposure to heat can make the high explosive more sensitive. In nuclear weapons, the amount of high explosive is considerably less than that found in conventional high explosive bombs. Chemical or radiological hazards might exist during and after an accident or in a fire where a nuclear weapon is involved.

B.6.6 Basically, the same techniques are used for fighting aircraft fires involving nuclear weapons as are those in which conventional high explosive bombs are involved; special extinguishing agents are not required to control and extinguish such fires. The brief amount of time available to control or extinguish the fire before an explosion might be expected is the only special factor to be considered.

B.7 Description. In general, nuclear weapons resemble conventional bombs in that they are enclosed in a shell or casing that is generally cylindrical in shape with tail fins. The weapon or warhead casings are of various thicknesses and might break up upon impact. Most weapons contain a conventional type of high explosive that can detonate upon moderate to severe impact or when subject to fire. The quantity of high explosives involved in a detonation can vary from a small amount to several hundred pounds and constitutes the major hazard in such an accident. If the casing breaks upon impact, the exposed and unconfined pieces of high explosive can ignite and burn, or might explode if stepped on or run over. Regardless of the type of weapon, some minor radiological hazards might exist if the weapon burns or if detonation of a high explosive occurs.

B.8 Time Factors. The length of time available to safely fight a fire involving nuclear weapons depends largely upon the physical characteristics of the weapon or warhead case, the intensity of the fire, and the proximity of the fire. Since weapon and warhead cases vary in thickness, firefighting time factors range from 3 minutes to an indefinite period if the fire impact incident does not detonate the high explosive immediately. The time element for each type of nuclear weapon or component is an important factor in fighting these fires. As soon as fire envelops the weapon area these time factors become effective. For weapons or warheads within a fire impact incident area, and subject to extreme heat but not enveloped in flames, a time factor of 15 minutes will apply; if the firefighting time factor is unknown to the firefighters, the minimum time factor of 3 minutes should be observed. Military flight communications procedures normally provide for notification to control towers of pertinent information regarding such time factors. When a weapon or warhead has been involved in a fire and its time factor has expired, even though the fire has been extinguished or burned out, safe evacuation distances should be observed until the arrival of authorized explosive ordinance disposal personnel.

B.9 High-Explosive Blast and Fragmentation. The radius of a high-explosive blast from a weapon varies, depending on the amount of high explosive that actually detonates. High-explosive blast fragmentation distances for these weapons range from a minimum radius of 122 m (400 ft) to a maximum of 305 m (1000 ft). Personnel within these areas can be seriously injured from blast or fragmentation upon detonation of the high explosive. These areas and distances should be considered during the initial fire department approach to an accident where weapons have been enveloped in flames for a period approximating or exceeding the weapon time factor limitations. All except experienced firefighting personnel should immediately evacuate to a minimum distance of 450 m (1500 ft) for protection against blast or fragmentation.

B.10 Precautionary Measures. Under no circumstances should any high-explosive material from ruptured weapons that have been exposed to fire (or any components that have been scattered) be handled, stepped on, driven over, or disturbed in any manner. High-explosive material is extremely sensitive to minor detonations from shock or impact and can cause serious injury. Protective clothing and positive-pressure SCBA should be worn during firefighting operations to provide the firefighter maximum protection from any chemical or minor radiological hazards that are present. Additional protection is afforded by fighting any fire from an upwind position. All exposed clothing, apparatus, and equipment used during a fire or impact incident where nuclear weapons or components have been involved should be monitored for possible radiological contamination by specialized recovery personnel equipped for this purpose.

B.11 Associated Hazards. Some possible hazards are as follows:

(1) *Radiological.* In the event of a high-explosive detonation or burning of a radioactive weapon, one has to be concerned principally with alpha-emitting contamination, which is serious only when ingested. Other types of radiation, which are harmless at the low levels produced in a weapon, can be detected with the use of sensitive detection instruments. (The effect of this radiation can be likened to the effects of radiation emanating from a luminous dial wristwatch.) Since alpha-emitting particles are so fine that they can be carried as smoke or dust from the burning or high-explosive detonation of a nuclear weapon, some alpha-emitting contamination should be expected in the immediate accident area and downwind. Although this material can present a minor radiation problem, danger from these particles exists only when they are inhaled in significant amounts. Protection against the highest alpha levels that could be expected from such burning or high-explosive detonation incidents is afforded firefighting personnel by the prescribed protective clothing and SCBA.

(2) *Fire.* Hazards associated with the burning of nuclear weapons and components are generally the same as those presented by conventional high explosives.

(3) *Impact.* Weapons or warheads can break up, and the high explosive can detonate from impact. Detonation and breakup are contingent to a large degree upon the characteristics of the weapon or warhead case, the impact velocity, and the location of aircraft suspension devices.

(4) *Sympathetic Detonation.* Detonation of a weapon or warhead, by fire or by impact, is also likely to induce detonation (nonnuclear) of any other weapon or warhead in the open within a 15 m to 90 m (50 ft to 300 ft) radius of the incident area.

(5) *High-Explosive Burning Characteristics.* Flame and smoke characteristics of burning high explosives vary and provide no specific pattern upon which to determine when the high explosive is about to detonate. Burning high explosives produce flames of various colors; they can be bright red, yellow, greenish-white, or combinations thereof with no predominant color. Some give off a white smoke, while others burn with no trace of smoke.

Annex C Specialized Vehicles and Equipment (NFPA 402)

This annex is not a part of the recommendations of this NFPA document but is included for informational purposes only.

C.1 Hovercraft. The hovercraft in Figure C.1 is typical of many designs available. They are easily operated and maintained with minimum training and can traverse a variety of surfaces such as water, tidal flats, snow, and ice. Payloads of 908 kg (2000 lb) permit up to 20 life rafts to be carried on this model. Piston engine operation offers a unique rescue vehicle at a fraction of the cost of a helicopter.

C.2 Aircraft Interior Access Vehicle (AIAV). An AIAV can provide valuable assistance for expeditious ingress/egress firefighting operations *(see Figure C.2)*.

FIGURE C.1 Hovercraft.

FIGURE C.2 Aircraft Interior Access Vehicle.

Annex D Sample Format for Agreement for Mutual Aid in Fire Protection and Hazardous Materials Incident Response (US) (NFPA 402)

This annex is not a part of the recommendations of this NFPA document but is included for informational purposes only.

D.1 Source. The material in Section D.2 was provided by the United States Air Force.

D.2 Sample Agreement. This agreement, entered into this XX day of XXX 20XX, between the Secretary of the (insert name of DoD Component) acting pursuant to the authority of 42 U.S.C. 1856a and (insert name of fire organization) is securing to each the benefits of mutual aid in fire prevention and hazardous materials incident response, in the protection of life and property from fire, hazardous materials incident and in firefighting. It is agreed that:

(1) On request to a representative of the (insert name of installation) fire department by a representative of the (insert name of fire organization), firefighting equipment and personnel of the (insert name of installation) fire department will be dispatched to any point within the area for which the (insert name of fire organization) normally provides fire protection or hazardous materials incident response as designated by the representatives of the (insert name of fire organization).

(2) On request to a representative of the (insert name of fire organization) by a representative of the (insert name of installation) fire department, firefighting equipment or hazardous materials incident response and personnel of the (insert name of fire organization) will be dispatched to any point within the firefighting or hazardous materials incident response jurisdiction of the (insert name of installation) fire department as designated by the representative of the (insert name of installation) fire department.

(3) Any dispatch of equipment and personnel pursuant to this agreement is subject to the following conditions:

   (a) Any request for aid hereunder shall include a statement of the amount and type of equipment and personnel requested and shall specify the location to which the equipment and personnel are to be dispatched, but the amount and type of equipment and the number of personnel to be furnished shall be determined by a representative of the responding organization.

   (b) The responding organization shall report to the officer in charge of the requesting organization at the location to which the equipment is dispatched, and shall be subject to the orders of that official.

   (c) A responding organization shall be released by the requesting organization when the services of the responding organization are no longer required or when the responding organization is needed within the area for which it normally provides fire protection.

   (d) In the event of a crash of an aircraft owned or operated by the United States or military aircraft of any foreign nation within the area for which the (insert name of fire organization) normally provides fire protection, the chief of the (insert name of installation) fire department or his or her representative may assume full command on arrival at the scene of the crash.

   (e) Where local agencies do not assign an incident safety officer, an Air Force representative will be assigned to act the incident safety officer to observe operations when responding to mutual aid emergencies.

(4) (Insert name of fire service) may claim reimbursement for the direct expenses and losses that are additional firefighting or hazardous materials incident costs above the normal operating costs incurred while fighting a fire or hazardous materials incident response under this agreement as provided in 44 CFR Part 151, "Reimbursement for Costs of Firefighting on Federal Property."

(5) Both parties agree to implement the National Incident Management System during all emergency responses on and off installations in accordance with NFPA 1561.

(6) Each party waives all claims against every other party for compensation for any loss, damage, personal injury, or death occurring as a consequence of the performance of this agreement. This provision does not waive any right of reimbursement pursuant to paragraph d above.

(7) All equipment used by (insert name of fire organization) in carrying out this agreement will, at the time of action hereunder, be owned by it; and all personnel acting for (insert name of fire organization) under this agreement will, at the time of such action, be an employee or volunteer member of (insert name of fire organization).

For (insert name of fire organization); For the Secretary of the (insert name of DoD Component)

(TITLE)	(COMMANDER)

Annex E Table for International Aircraft Markings (NFPA 424)

This annex is not a part of the recommendations of this NFPA document but is included for informational purposes only.

E.1 Table E.1 provides the international markings for aircraft.

Table E.1 International Aircraft Markings

Code	Country
A2-	Botswana
A3-	Tonga
A5-	Bhutan
A6-	United Arab Emirates
A7-	Qatar
A9C-	Bahrain
A40-	Oman
AP-	Pakistan
B-	China
C2-	Nauru
C5-	Gambia
C6-	Bahamas
C9-	Mozambique
CC-	Chile
C-, CF-	Canada
CN-	Morocco
CP-	Bolivia
CR-, CS-	Portugal
CU-	Cuba

(continues)

Table E.1 *Continued*

Code	Country
CX-	Uruguay
D-	Germany
D2-	Angola
D4-	Cape Verde
DQ-	Fiji
EC-	Spain
EI-, EJ-	Ireland
EK-	Armenia
EL-	Liberia
EP-	Iran
ER-	Republic of Moldavia
ES-	Estonia
ET-	Ethiopia
EW-	Belarus
EX-	Kyrgyzstan
EY-	Tajikistan
EZ-	Turkmenistan
F-	France
G-	United Kingdom
H4-	Solomon Islands
HA-	Hungary
HB- (plus nat. emblem)	Switzerland
HB- (plus nat. emblem)	Liechtenstein
HC-	Ecuador
HH-	Haiti
HI-	Dominican Republic
HK-	Colombia
HL-	Korea (Rep. of)
HP-	Panama
HR-	Honduras
HS-	Thailand
HZ-	Saudi Arabia
I-	Italy
J2-	Djibouti
J3-	Grenada
J5-	Guinea Bissau
J6-	St. Lucia
J7-	Dominican Republic
J8-	Grenadines
J8-	St. Vincent
JA-	Japan
JY	Jordan
LN-	Norway
LV, LQ	Argentina
LX-	Luxembourg
LV	Lithuania
LZ-	Bulgaria
N-	U.S.A.
OB-	Peru
OD-	Lebanon
OE-	Austria
OH-	Finland
OK-	Czech Republic
OO-	Belgium
OY-	Denmark
P-	North Korea
P2-	Papua New Guinea
P4-	Aruba
PH-	Netherlands
PI-	Netherlands Antilles
PK-	Indonesia

(continues)

Table E.1 *Continued*

Code	Country
PP-, PT-	Brazil
PZ-	Surinam
RA	Russian Federation
RP-	Philippines
RDPL-	Laos
S2-	Bangladesh
S5-	Slovenia
S7-	Seychelles
S9-	Principe & San Tome
SE-	Sweden
SP-	Poland
ST-	Sudan
SU-	Egypt
SX-	Greece
T9-	Bosnia/Herzegovina
TC-	Turkey
TF-	Iceland
TG-	Guatemala
TI-	Costa Rica
TJ-	Cameroon
TL-	Central African Rep.
TN-	Congo
TR-	Gabon
TS-	Tunisia
TT-	Chad
TU-	Ivory Coast
TY-	Benin
TZ-	Mali
VH-	Australia
VP-, VQ-, VR-	U.K. Colonies & Protectorates
VT-	India
XA-, XB-, XC-	Mexico
XT-	Burkina Faso
XU-	Democratic Kampuchea
XV-	Vietnam
XY-, XZ-	Myanmar
YA-	Afghanistan
YI-	Iraq
YK-	Syrian Arab Rep.
YL-	Latvia
YR-	Romania
YS-	El Salvador
YV-	Venezuela
Z	Zimbabwe
ZK, ZL, ZM	New Zealand
ZP-	Paraguay
ZS-, ZT-, ZU-	South Africa
3A-	Monaco
3B-	Mauritius
3C-	Equatorial Guinea
3D-	Swaziland
3X-	Guinea Bissau
4K-	Azerbaijan
4L	Georgia
4R-	Sri Lanka
4X-	Israel
5A-	Libya
5B-	Cyprus
5H-	Tanzania
5N-	Nigeria
5R-	Madagascar

(continues)

Table E.1 *Continued*

Code	Country
5T-	Mauritania
5U-	Niger
5V-	Togo
5W-	Western Samoa
5X-	Uganda
5Y-	Kenya
6O-	Somalia
6V, 6W	Senegal
6Y-	Jamaica
7O-	Yemen
7P-	Lesotho
7QY-	Malawi
7T-	Algeria
8P-	Barbados
8Q-	Maldives
8R-	Guyana
9A-	Croatia
9H-	Malta
9J-	Zambia
9K-	Kuwait
9L-	Sierra Leone
9M-	Malaysia
9N-	Nepal
9Q-	Zaire
9U-	Burundi
9V-	Singapore
9XE-	Rwanda
9Y-	Trinidad and Tobago

Annex F Outline of an AEP (NFPA 424)

This annex is not a part of the recommendations of this NFPA document but is included for informational purposes only.

F.1 This outline is intended to ensure uniformity in the development of AEPs. It is the function of the airport operator to develop an AEP and procedures for emergencies applicable to the airport's particular characteristics and operations and, within these guidelines, to perform the following:

(1) Define the responsibilities of the airport operator and other participating agencies
(2) Create effective lines of communication and adequate communication facilities as indicated by a flow chart, and develop a call system to include persons or agencies to be contacted. Where possible, a 24-hour coverage should be maintained
(3) Arrange for the availability of a fixed emergency operations center and a mobile command post at the airport for use during an emergency
(4) Integrate assistance from local support services such as fire departments, security, medical, civil defense, government agencies, local amateur radio organizations, and so forth
(5) Describe the function of ATC services (airport control tower or airport flight information service) relating to emergency actions
(6) Give instructions for response to accidents/incidents

Sections of the AEP document should contain identifiable subjects pertinent to local airport and community conditions.

The AEP and procedures should be issued under the airport or appropriate operator, who will define and negotiate functions of all agencies and personnel on- or off-airport that would or could be involved in an emergency affecting the airport.

In the development of the AEP and procedures, it is vital that arrangements be simple and easily understood by all involved in the AEP.

F.2 Example of Contents of Emergency Plan Document.

F.2.1 Section 1 — Emergency Telephone Numbers. This section should be limited to essential telephone numbers according to site needs, including the following:

(1) ATC services
(2) ARFF services (departments)
(3) Police and security
(4) Medical services
    (a) Hospitals
    (b) Ambulances
(5) Aircraft operators
(6) Government agencies
(7) Civil defense
(8) Others

F.2.2 Section 2 — Aircraft Accident On-Airport. This section should detail the following:

(1) Action by ATC services (airport control tower or airport flight information service)
(2) Action by ARFF services
(3) Action by police and security services
(4) Action by airport operator
    (a) Vehicle escort
    (b) Maintenance
(5) Action by medical services
    (a) Hospitals
    (b) Ambulances
    (c) Doctors
    (d) Medical personnel
(6) Action by aircraft operator involved
(7) Action by emergency operations center and mobile command post
(8) Action by government agencies
(9) Communications network (emergency operations center and mobile command post)
(10) Action by agencies involved in mutual aid emergency agreements
(11) Action by transportation authorities (land, sea, and air)
(12) Action by the public information officer(s)
(13) Action by local fire departments when structures are involved
(14) Action by all other agencies involved

F.2.3 Section 3 — Aircraft Accident Off-Airport. This section should detail the following:

(1) Action by ATC services (airport control tower or airport flight information service)
(2) Action by ARFF services
(3) Action by local fire departments
(4) Action by police and security services
(5) Action by airport operator
(6) Action by medical services
    (a) Hospitals
    (b) Ambulances

(c) Doctors
(d) Medical personnel
(7) Action by agencies involved in mutual aid emergency agreements
(8) Action by aircraft operator involved
(9) Action by emergency operations center and mobile command post
(10) Action by government agencies
(11) Communication networks (emergency operations center and mobile command post)
(12) Transportation authorities (land, sea, and air)
(13) Action by public information officer
(14) Action by all other agencies involved

F.2.4 Section 4 — Malfunction of Aircraft in Flight (Full Emergency or Local Standby). This section should detail the following:

(1) Action by ATC services (airport control tower or airport flight information service)
(2) Action by airport ARFF services
(3) Action by police and security services
(4) Action by airport operator
(5) Action by medical services
(a) Hospitals
(b) Ambulances
(c) Doctor
(d) Medical personnel
(6) Action by aircraft operator involved
(7) Action by emergency operations center and mobile command post
(8) Action by all other agencies involved

F.2.5 Section 5 — Structural Fires. This section should detail the following:

(1) Action by ATC services (airport control tower or airport flight information service)
(2) Action by ARFF services (local fire departments)
(3) Action by police and security services
(4) Action by airport operator
(5) Evacuation of structure
(6) Action by medical services
(a) Hospitals
(b) Ambulances
(c) Doctors
(d) Medical personnel
(7) Action by emergency operations center and mobile command post
(8) Action by public information officer
(9) Action by all other agencies involved

F.2.6 Section 6 — Sabotage Including Bomb Threat (Aircraft or Structure). This section should detail the following:

(1) Action by ATC services (airport control tower or airport flight information service)
(2) Action by emergency operations center and mobile command post
(3) Action by police and security services
(4) Action by airport operator
(5) Action by ARFF services
(6) Action by medical services
(a) Hospitals
(b) Ambulances
(c) Doctors
(d) Medical personnel
(7) Action by aircraft operator involved
(8) Action by government agencies
(9) Isolated aircraft parking position
(10) Evacuation
(11) Searches (dog and human) or by aircraft
(12) Handling, identification, and safe declaration of luggage and cargo on board aircraft
(13) Handling and disposal of suspected bomb
(14) Action by public information officer
(15) Action by all other agencies involved

F.2.7 Section 7 — Unlawful Seizure of Aircraft (Hijacking). This section should detail the following:

(1) Action by ATC services (airport control tower or airport flight information service)
(2) Action by ARFF services
(3) Action by police and security services
(4) Action by airport operator
(5) Action by medical services
(a) Hospitals
(b) Ambulances
(c) Doctors
(d) Medical personnel
(6) Action by aircraft operator involved
(7) Action by government agencies
(8) Action by emergency operations center and mobile command post
(9) Isolated aircraft parking position
(10) Action by public information officer
(11) Action by all other agencies involved

F.2.8 Section 8 — Incident On-Airport. An incident on-airport can require any or all of the action detailed in F.2.2. Examples of incidents the airport operator should consider include fuel spills at the ramp, passenger loading bridge, and fuel storage area; dangerous goods (hazardous materials) occurrences at freight handling areas; collapse of structures; vehicle/aircraft collisions; and so forth.

F.2.9 Section 9 — Persons of Authority — Site Roles. To include, but not be limited to, the following according to local requirements:

(1) On-airport
(a) Airport operator
(b) Airport chief fire officer
(c) Police and security — officer-in-charge
(d) Medical group supervisor
(2) Off-airport
(a) Local chief fire officer
(b) Government authority
(c) Police and security — officer-in-charge
(d) Medical group supervisor

The IC should be designated as required from within the prearranged mutual aid emergency agreement.

Previous documented experience indicates that confusion in identifying command personnel in accident situations is a serious problem. To alleviate this problem, distinctive colored vests with reflective lettering should be issued to command personnel for easy identification. The following colors are examples:

(1) Red — chief fire officer
(2) Blue — police chief

(3) White (red lettering) — medical coordinator
(4) International orange — airport administration
(5) Lime green — transportation officer
(6) Dark brown — forensic chief

An IC should be appointed as the person in command of the overall emergency operation. The IC should be easily identifiable and can be one of the persons indicated above or any other person from the responding agencies.

F.2.10 Section 10 — Emergency Organizations. Table F.2.10 is a list of organizations that could be involved during an emergency.

Table F.2.10 Organizations That Could Be Involved or Assist During an Emergency

Organization	Abbreviation
Aircraft Owners and Pilots Association	AOPA
Air Line Pilots Association	ALPA
American Red Cross	ARC
Canadian Transportation Agency	CTA
Department of Defense	DOD
Department of Homeland Security	DHS
Department of Transportation	DOT
Disaster Medical Assistance Team	DMAT
Disaster Mortuary Operational Response Team	DMORT
Disaster Portable Morgue Unit	DPMU
Environmental Protection Agency	EPA
Federal Aviation Administration	FAA
Federal Bureau of Investigation	FBI
Federal Emergency Management Agency	FEMA
FEMA National Emergency Training Center	NETC
International Association of Fire Chiefs	IAFC
National Association of Emergency Medical Technicians	NAEMT
National Disaster Medical System	NDMS
National Emergency Management Association	NEMA
National Fire Protection Association	NFPA
National Transportation Safety Board	NTSB
Occupational Health & Safety Administration	OSHA
Transport Canada	TC
Transportation Safety Board of Canada	TSBC
United States Coast Guard	USCG
United States Department of Agriculture	USDA
United States Public Health Service	USPHS
Veterinary Medical Assistance Team	VMAT
State emergency management departments	
Other country government organizations	

Annex G Types of Alerts (NFPA 424)

This annex is not a part of the recommendations of this NFPA document but is included for informational purposes only.

G.1 The terms used to describe various categories of aircraft alerts are not standardized. The FAA terms — Local Standby Alert, Full Emergency Alert, or Aircraft Accident Alert — and the International Civil Aviation Organization (ICAO) terms — Local Standby, Full Emergency, and Aircraft Accident — are equivalent.

G.2 Local Standby Alert — Local Standby. An aircraft that is known or suspected to have an operational defect should be considered Local Standby. This defect normally should not cause serious difficulty in achieving a safe landing.

Local Standby Alert also should be initiated when an aeromedical evacuation or presidential/VIP aircraft is arriving or departing.

Airports also should have management policies for implementation of Local Standby Alert procedures whenever required response times cannot be achieved. Factors that can affect response time include construction work; field maintenance; and adverse weather conditions such as snow, ice, or low visibility.

Airports should have management policies for implementation of Local Standby Alert procedures during arrival and departures of certain categories or types of aircraft not normally utilizing the airport.

Under Local Standby Alert conditions, at least one ARFF vehicle should be manned and positioned to permit its immediate use in the event of an incident. The ARFF personnel should be advised of the following:

(1) The type of aircraft
(2) The number of passengers and crew
(3) The type and amount of fuel
(4) The nature of the emergency
(5) The type, amount, and location of dangerous goods
(6) The number of nonambulatory passengers on board, if any

All other ARFF vehicles should be available for immediate response.

G.3 Full Emergency Alert — Full Emergency. An aircraft that is known or is suspected to have an operational defect that affects normal flight operations to the extent that there is danger of an accident is considered a Full Emergency Alert — Full Emergency. ARFF personnel should be provided with detailed information that allows preparation for likely contingencies. A full response should be made with the emergency equipment manned and positioned with engines running and all emergency lights operating so that the fastest response to the incident/accident site can be accomplished. It is important that appropriate radio frequencies be continuously monitored by ARFF personnel. One or more major ARFF vehicles should be able to initiate fire suppression within the briefest period of time following the aircraft's coming to rest. Standby positioning of vehicles should be established for a variety of anticipated circumstances. The ARFF personnel should be informed of any changes in a distressed aircraft's emergency conditions that could affect the touchdown point or the ultimate behavior of the aircraft.