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Direct Communication Between Flight Crews, ARFF Incident Commanders Can Reduce Injuries

Civil aviation authorities and airports in several parts of the world have implemented discrete radio frequencies and practical procedures to enhance communication between pilots and aircraft rescue and fire fighting incident commanders. Enhanced communication prevents unwarranted aircraft evacuations, which often result in injuries to exiting passengers and aircraft crewmembers.

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FSF Editorial Staff

Officials of aircraft rescue and firefighting (ARFF) services at airports in several nations believe that direct communication between aircraft flight crews and ARFF incident commanders — sometimes called ARFF-to-crew communication — significantly enhances conventional communication methods in some emergencies.[1] Statistical studies of this method could not be found, but anecdotal information suggests that this capability can reduce the need for unwarranted aircraft evacuations, and may enable ARFF personnel to avoid hazards to themselves, to minimize damage to equipment and to prevent unnecessary application of fire-suppression agents.

Implementation of ARFF-to-crew communication varies among airports and nations, partly because of the inherent need for flexibility in responding to aircraft emergencies. (See "Some Airports Have Unpublished ARFF-to-crew Communication Options" on page 3.) Nevertheless, several international airport officials who have implemented ARFF-to-crew communication cited the following elements:

- Simple procedures that do not require advance knowledge among flight crews to be useful in an emergency;
- Agreements between air traffic control (ATC) and ARFF services that define roles, responsibilities and phraseology;
- Designation of at least one discrete aeronautical radio frequency at the airport (a frequency or frequencies that ATC will use only for this purpose during an emergency);
- Clarification of the authority of the aircraft captain and the ARFF incident commander during an emergency;
- Capability for ATC controllers and ARFF incident commanders to communicate with the pilots of an emergency aircraft on a specific frequency without interference from other radio calls, and for ARFF personnel to monitor ATC–pilot communication;

- Requirement for ARFF incident commanders to receive ATC authorization before communicating with the flight crew of an emergency aircraft, and to refrain from initiating communication with a flight crew while airborne unless requested by the pilot-in-command or coordinated with ATC; and,

- Modest initial costs and training requirements.

Organizations that have implemented ARFF-to-crew communication typically prefer that one discrete frequency be designated for national use; some countries — including the United States — have adopted other methods because of the limited number of frequencies available currently.

Advocates of ARFF-to-crew communication have said that flight crews typically need to know the following information during an emergency:[2]

- The estimated time of arrival for the ARFF equipment;

- Where ARFF vehicles are located (on the airport and in relation to the aircraft) and where these vehicles will stop;

- Whether smoke or fire is visible from a specific engine following engine shutdown and after the flight crew's use of a fire-suppressing agent;

- When fire-suppressing agent is being dispensed onto the aircraft; and,

- Updates about the condition of the aircraft exterior.

Similarly, ARFF incident commanders need to know the following information during an emergency:

- The nature of the emergency and whether conditions are becoming better or worse;

- Whether smoke in the cockpit and/or cabin has dissipated or has increased;

- Actions taken by the flight crew and/or cabin crew to help suppress a fire (by isolating systems and activating suppression equipment);

- As time permits, the total number of passengers and crew, the total quantity of fuel on board in pounds or kilograms, and any known dangerous goods or hazardous material (including the type of hazmat and its location on the aircraft);

- The intentions of the flight crew after landing the aircraft (for example, full stop on the runway or to exit on a taxiway);

- The captain's evacuation decision and plan; and,

- Updates as circumstances change.

ARFF–flight crew coordination may affect the emergency response. For example, the ARFF incident commander may prefer that the flight crew position the aircraft on the runway to allow firefighters maximum working space and/or position the aircraft to allow the wind to aid in the control of smoke and flame. An ARFF incident commander typically will not interfere in a captain's decision of whether to evacuate but will provide timely information to support the decision.

Several Countries Use Discrete ARFF-to-crew Frequencies

John O'Sullivan, fire protection manager for British Airways, said that ARFF-to-crew communication has been available for many years in the United Kingdom. The system provides a single discrete frequency. Using such direct communication is a recommended practice and not mandatory; the system is used only when necessary based on the expertise of the airport fire chief and the ability of flight crews and ARFF incident commanders to communicate in a common language, he said.[3]

U.K. Civil Aviation Publication (CAP) 168, regarding the licensing of airports, says, "At aerodromes Category 5–9, vehicle mounted/portable radio facilities to enable the airport fire officer to communicate with the aircraft flight deck whilst the aircraft is on the ground are to be provided. This is to be achieved via the 121.6 [megahertz (mHz)] channel. It is recommended that a recording facility for this specific frequency be provided."

O'Sullivan said, "In the United Kingdom, we can communicate freely when flight crews and ARFF commanders speak English, but this is not universal in Europe or in other parts of the world. Many of the world's [ARFF] duty officers who operate at airports will not be able to speak effectively or efficiently in English. There is no requirement [for ARFF incident commanders] to be able communicate in English [or for flight crews to speak in a language other than English]."

Unless the pilot can understand immediately the emergency information provided by the ARFF commander in a common language, direct communication is not helpful, he said.

"You could be lucky to find that someone on the [ARFF] team could speak English, but that should not be taken for granted," O'Sullivan said. "Without a doubt, it is best to communicate through ATC in a situation where the ARFF personnel do not speak the flight crew's language."

In Europe, most ARFF services have the capability of listening to communication between aircraft crews and ATC, but may not have the equipment or the authorization to respond directly to an aircraft crew, O'Sullivan said.

Some Airports Have Unpublished ARFF-to-crew Communication Options

While nationally recommended guidelines or mandatory procedures have been adopted by civil aviation authorities of some countries, individual airports in other countries have developed methods for emergency communication between aircraft rescue and fire fighting (ARFF) crews and flight crews. The following examples were noted by some members of Airports Council International:

- Alan Skennerton, manager, safety and security, Dubai International Airport, United Arab Emirates, said that the frequency 121.6 megahertz (mHz) has been designated should the need arise for direct radio communication between an ARFF incident commander and the flight crew of an aircraft. Skennerton said that this procedure has not been published in aeronautical information publications but is based on an agreement by the airport, air traffic control (ATC) and Dubai Airport Fire Service. When the procedure is used, the aircraft crew is instructed by the control tower to change to this frequency, he said;[1]

- Gerhard Gruber, manager, rescue and airport operations, Vienna International Airport, Austria, said that the ARFF incident commander (who is responsible for chiefs of the firefighting service and the emergency medical service) can monitor emergency communication involving an aircraft and ATC. Gruber said that the frequencies for approach control, tower control and ground control can be monitored. All emergency response vehicles are equipped with radio transceivers on 121.9 mHz for emergency crews to obtain ATC approval to operate on airport maneuvering areas. Gruber said, "This frequency and 121.8 mHz can be used to request [from] ATC that the aircraft select the same frequency, enabling [the ARFF incident commander] to communicate directly [with the flight crew]. If a long-lasting communication between [the ARFF crew] and aircraft is intended, primarily 121.8 mHz (owned by the airport) is used to release 121.9 mHz … for clearance requests, towing trucks, etc. In intensive discussions, we did not see a benefit to publishing these frequencies [for pilots] because initial emergency communication between aircraft [flight crews] and ATC is done on tower/ground [frequencies] and monitored by [ARFF] people [who can request] immediately that the pilot switch to the alternate 121.8 mHz or 121.9 mHz."; and,[2]

- Jan Mens of Amsterdam Schiphol Airport, Netherlands, said that direct ARFF-to-crew communication has not been implemented, but the airside operation manager (duty manager) may use the frequency 121.9 mHz to communicate directly with an aircraft crew while maintaining direct contact with the ARFF incident commander (airport fire officer) on a separate frequency. Mens said, "On top of this procedure, ATC has a discrete frequency for emergencies. All aircraft [pilots] with problems are assigned to this frequency and are handled by one [ATC controller] so they do not have to switch frequencies anymore." Mens said that the airside operation manager always monitors ATC's discrete frequency for emergencies and, if desired, may join in communications on this frequency.[3]♦

— FSF Editorial Staff

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Ralph Issott, senior airport fire officer of London Gatwick Airport and assistant chief fire officer for BAA, a company that owns seven airports in the United Kingdom, said that the immediate circumstances of an emergency influence the decision of when 121.6 mHz should be used for direct communication. Uniform guidelines applicable to all U.K. airports have not been developed, he said.[4]

Typically, ARFF incident commanders at each BAA airport decide when to request from ATC ARFF-to-crew communication, he said.

"[ARFF] response depends on the problem," said Issott. "The station officer in charge of the responding fire crew [ARFF incident commander] can, depending on the nature of the incident, request via ATC that the aircraft captain select 121.6 mHz to talk directly with the responding fire crews. The station officer may request that the captain come up on 121.6 regarding a deflated tire on landing, for example. The benefit is that the captain can get information directly from the fire crew while going down the runway. This allows the pilots full knowledge of conditions and to take control actions, such as stopping the aircraft and determining which side is the one with the affected

tire so that the evacuation is conducted on the other side. The captain continues to receive updated information as to the external state of the aircraft throughout the incident. Direct communication also assists the fire crews in understanding the captain's intentions."

Such information helps the captain to decide the next course of action — typically, whether to continue to taxi, to stop the aircraft for inspection by the ARFF crew or to evacuate the aircraft (including whether to evacuate from exits on one side only or both sides), Issott said.

Australia Introduces National Discrete Emergency Frequency

Simon Reilly, airline emergency procedures coordinator for Aviation Rescue and Firefighting, a division of Air Services Australia, said that in September 2000, 16 airports in Australia introduced a method of ARFF-to-crew communication. The standard frequency 131.0 mHz has been designated as a discrete frequency for this purpose. In the first two months after implementation, this frequency was used 14 times during aircraft emergencies, he said. (Air Services Australia provides national ATC and ARFF services.)[5]

"The new procedure was used operationally in Sydney the other day, for example, with an aircraft that had nose-wheel hydraulic problems on landing — which ended in a 180-degree turn with the nose wheel touching the grass," said Reilly. "The ARFF incident commander kept in communication serving as the pilot's external eyes and ears with instantaneous information. What we are trying to achieve is to save injuries by prevention of evacuations that are not warranted. Direct communication expedites the decision-making processes when an aircraft is on the movement area, thereby limiting disruption to other airport operations."

Reilly said that Air Services Australia worked with industry representatives for 14 months and conducted meetings around the country. During the meetings and subsequent educational seminars for operators, the following scenarios suitable for ARFF-to-crew communication were discussed:

- Unplanned emergencies, such as rejected takeoffs or overheated brakes/tires; and,
- Planned emergencies, such as those in which sufficient time exists for a flight crew to notify ATC and the responding agencies (for example, an aircraft crew reporting a hydraulic system problem 100 nautical miles from the destination airport).

"In planned emergencies, the pilot can pass on details to ARFF on what to expect," he said.

The request for ARFF-to-crew communication may be initiated by a pilot or an ARFF incident commander through the ATC control tower, which will monitor the communication and will continue to provide ATC instructions on 131.0 mHz.

"This is so much easier for the pilot than before, and makes responding to the emergency easier for ATC because it gets the emergency aircraft off the busy ground control frequency," Reilly said. "ATC gets rid of the frequency-congestion problem by sending the problem to someone who can deal with it."

Reilly said that the process of implementing a national discrete frequency and developing practical procedures also has provided to airlines an opportunity to learn more about current ARFF methods and capabilities, and has provided to ARFF incident commanders more current information about airline procedures and operations.

Canada Proposes Regulation for ARFF-to-crew Communication

Bernard Valois, senior aircraft fire fighting specialist at Transport Canada, said that a regulatory amendment, entitled "Communication and Alerting System," was proposed in fall 2000 to provide a national discrete emergency frequency, to enable a flight crew to communicate directly with the senior fire officer (ARFF incident commander) responding to an emergency. The proposed amendment would require airport operators of 28 designated airports to provide equipment and training to implement the procedure, including training and information for ARFF personnel and flight attendants, and information on hand signals and system availability for pilots.[6]

Valois said, "A dedicated national frequency has been selected, and it may be implemented through an advisory notice until the standards are amended. The procedure will be different in Canada than in the United States because implementation by the airports will be a requirement and *not* advisory."

Canadian Aviation Regulations (CARs) Standard 323.19 would be amended to require a site-specific memorandum of understanding between each airport's air traffic service and ARFF service, which incorporates requirements and responsibilities for use of a discrete frequency between aircraft crews and ARFF personnel, and a requirement for recording communications on the discrete frequency and maintaining the recordings for three years.

Accident Prompts Rethinking of ARFF Communication Methods

In the United States, some airports considered changes to their ARFF communication methods in the 1980s, but proposals for specific methods of ARFF-to-crew communication were not discussed widely until the early 1990s. Several early

advocates said that specific accidents and incidents increased interest among ARFF leaders, airports, pilots and ATC in methods of augmenting conventional procedures.

Chief John Horton of the Cincinnati-Northern Kentucky [U.S.] International Airport Fire Department began considering additional methods of ARFF-to-crew communication after a 1983 aircraft fire in which 23 passengers were killed.[7,8]

Horton said, "This accident got me thinking that we needed a local discrete frequency. I did not find out the number of passengers and crewmembers in the 1983 fire until that airplane actually was on the ground, but I do not know if this would have made any difference." (The U.S. National Transportation Safety Board [NTSB], in its final report, said that the information was requested by an air traffic controller, but the captain of the accident aircraft was unable to provide this information during an emergency descent because of smoke in the cockpit and deteriorating flight conditions.)

Horton said that over time, he and others concluded that a local discrete frequency would be valuable. His department and the airport control tower signed a letter of agreement in 1994 designating 133.325 mHz as the local discrete frequency.

"To my knowledge, we were the first airport in the United States to have an ARFF-to-crew discrete frequency," Horton said.

Previously, when an aircraft emergency occurred, the ARFF incident commander obtained all information about the unfolding events from the control tower, but that method limited communication, he said.

Horton said, "If for example, the aircraft was on fire, would the captain know our intentions? How would I know, on the ground, the density of the smoke and where the smoke was coming from? How would I know the effect of the fire on people inside the aircraft? I needed to talk with the flight crew. Instead of third-hand information that could get cluttered, I needed to let the pilot know that we were there waiting and that we had equipment and personnel to handle the emergency. We were concerned then that ATC might not repeat everything that was said by the crew and might [unintentionally] leave out one little thing that was important."

He said that ARFF-to-crew communication now involves more than gathering information that is pertinent to the emergency.

"Typically, when the aircraft is on short final approach, the controller will tell the aircraft captain to switch to 133.325 [mHz] and say that the ARFF incident commander is ready if the flight crew wants to talk," Horton said. "When a pilot calls [ARFF], only that one ARFF incident commander will talk. The commander will say initially that the ARFF team is standing by and its intentions. Normally, we do not ask the flight crew anything before the aircraft lands. Our discrete frequency is an asset — no doubt about it — to secure an incident, whether large or small."

He said that only the ARFF incident commander and air traffic controllers communicate with a flight crew. The frequency is monitored by all personnel operating ARFF equipment on the airport, however.

"Direct communication tells the ARFF incident commander what the captain's intentions are," Horton said. "Is he going to stop and disembark? Will he shut down the engines as soon as possible on the runway? Do we have time to get the aircraft to a gate? When the aircraft is on the ground, the incident commander typically says, 'This is [Cincinnati command]. We have you in sight. We will visually check your aircraft.' I need to know the captain's response to the emergency so that I will have a better understanding of what ARFF personnel are going to do."

He said that for safety, ARFF incident commanders should maintain a good rapport with FAA air traffic controllers, exchanging current information periodically about respective operations and job tasks.

"The tower controller has the authority to interrupt or interject a message at any time — for example, if another emergency occurs or we miss something," Horton said. At the same time, the ARFF incident commander should work within the operational framework of the captain's authority for aircraft safety, he said.

"It is the captain's ship — I cannot tell the captain his operation," he said. "When the aircraft is on the ground, ARFF crews will attack the fire and provide information. If I see fire, I will have to apply good general knowledge of what has to be done. The captain and ARFF incident commander both have the same [objective] in mind."

Aircraft Rescue and Fire Fighting Services Report Advantages

Deputy Chief Robert Donahue of the Massachusetts [U.S.] Port Authority (Massport) Fire Rescue Department said that during a fire fighting school attended by 70 U.S. fire chiefs during 2000, the American Association of Airport Executives conducted an informal survey of the attendees to estimate the number of airports that had implemented ARFF-to-crew communication. Representatives of 20 airports said that this method of communication had been implemented or was pending. Three additional U.S. airports also said that ARFF-to-crew communication has been implemented in accordance with the AC.[9]

Donahue said, "A lot of people in the fire service wait for FAA to address their problems with regulations — even on this issue. We have developed local strategies and solutions to

our issues and operational concerns. We spent a lot of time researching and analyzing the relationship between [Boston Logan International Airport] and the New England region, the airlines and safety services." (See "Massport ARFF Experience Shows Steps to Direct Communication.")

"We had multiple ARFF response facilities all operating on different ATC frequencies and controllers assigned frequencies to aircraft based on their location on the airport," said Donahue. "Now throw the emergency aircraft itself into the mix — the flight crew was passed from controller to controller.

"In 1996, a Boeing 767 landed with an engine fire in Salt Lake City [Utah, U.S.]. No formal ARFF-to-crew communication procedure existed, but this happened at a time of night when the airport was quiet. After the aircraft was landed, the pilot asked ATC where the fire department was located. ATC gave the fire department the frequency of the flight crew and gave the ARFF incident commander permission to speak directly to the pilot on the ground control frequency, which was monitored by ATC. The fire department was able to give to the pilots a quick assessment of what was going on outside the airplane. The fire chief told the pilot, 'Before you take any action, please give me a minute to see what is happening.' The [ARFF] crew went in and knocked the fire down and the captain did not do an evacuation."

Donahue said that the incident was an early example of a scenario in which an ARFF incident commander developed a joint strategy in cooperation with the aircraft captain.

"A short time later, we had a [McDonnell Douglas] DC-10 land here at Boston; it blew out all main gear tires on landing. The aircraft had a fire condition in both main gear. Although not formalized then, ATC told the ARFF incident commander, 'You can have the frequency,' and we began direct communication with the pilot. We made a quick assessment and gave the pilot information about what we had [observed] outside. Our response was fairly quick; we got in quickly and knocked the fire down, which was communicated to the pilot. We advised the pilot that he had a small-to-moderate fire condition in both main gear. We also informed the pilot that the emergency equipment was on the scene and that we had initiated fire-suppression operations. We were not directing the pilot, just giving information that would help him or her to make a decision. We had averted an evacuation and the consequences that could result. Then we made a decision to develop a Boston-based strategy."

Joe Lawless, director of public safety for Massport, said that ARFF incident commanders know that pilots may be occupied with emergency checklists and ATC communication, and sometimes will not be able to communicate directly with ARFF personnel. Circumstances also may occur in which this method of communication should be suspended because of immediate life-safety concerns.[10]

"Direct communication usually will continue to enhance the safety of the situation until the last person is off the aircraft," Lawless said. "We never would expect an aircraft crew to jeopardize itself to keep communicating, however. On a case-by-case basis, it may be more advantageous to give up the communication."

He said that Logan has not experienced incidents in which English language proficiency caused a problem during ARFF-to-crew communication.

Massport ARFF Experience Shows Steps to Direct Communication

Deputy Chief Robert Donahue of Massachusetts [U.S.] Port Authority (Massport) Fire Rescue Department said that after a few incidents in which direct communication with pilots proved valuable, the fire service envisioned a safety-enhanced warning system for aircraft emergencies, including a method of unified command at Boston Logan International Airport. The concept was for aircraft rescue and fire fighting (ARFF) incident commanders to augment the flight crew's observations, instrument indications and warning devices, he said.

In 1997, Massport ARFF presented its concept of a local discrete emergency frequency for Logan to the U.S. Federal Aviation Administration's (FAA) Boston air traffic control (ATC) management during a quarterly meeting of airport operations managers, airline chief pilots and other airport interest groups. Donahue said that the ARFF officials showed videotapes of incidents that had occurred at Logan and other airports, and presented preliminary case studies. Donahue said, "We wanted the others to agree on the determination of need to pursue this — they said that the concept had some merit and that we absolutely should explore it."

A working group was established, comprising representatives of Massport ARFF, airport operations, state police, FAA Boston ATC, the Air Line Pilots Association, International (ALPA) and Boston chief pilots, representing airlines that have stations at Logan. The working group conducted a more comprehensive analysis of emergency incidents and developed standard operational terminology.

The working group asked FAA Boston ATC to identify a relatively uncongested aeronautical radio frequency that could be monitored 24 hours a day and from which routine traffic could be moved easily to other frequencies. Because of major problems experienced when ground control frequencies were used for some aircraft emergencies, FAA

Boston ATC ruled out the use of ground control frequencies. FAA Boston ATC identified 121.75 megahertz (mHz), the airport's skyways frequency used by traffic helicopters around the city.

Donahue said, "Pilots of traffic helicopters safely could be moved to other frequencies by ATC while 121.75 mHz was assigned as the preferred emergency frequency. At any time, ATC could shift the ARFF incident commander to another frequency."

After ATC identified the frequency, the proposed system was presented during labor-management meetings involving the ARFF union and the ATC union, he said.

"We were able to show that the system would improve safety and efficiencies," he said. "The next step was to conduct a field test during nonemergency conditions, simply coordinating the movement of emergency vehicles on a frequency managed by a single air traffic controller. We centralized and streamlined this process; this did improve operational efficiency, and we prevented surface errors and enhanced ARFF-controller capability."

Donahue said that the working group in mid-1997 drafted joint ARFF–ATC procedures, then brought the Boston chief pilots and ALPA into the process to determine their requirements.

"The working group then conducted an emergency management workshop," Donahue said. "A specially designed tabletop exercise presented three different emergency scenarios. One involved a mechanical problem on the airport that affected aircraft operations and a subsequent emergency declaration by a pilot for a fire condition in flight. The next scenario was an emergency medical situation, a woman delivering a baby. The third scenario was a disruptive passenger and possible hijack situation. Participants procedurally went through how they would manage each of those scenarios using the preferred emergency frequency."

The working group demonstrated theoretically and procedurally that the frequency would work, he said, and the system was refined further by a modular analysis of emergency management functions and operational efficiency.

"We asked, 'Will this streamline vehicle movements, increase operational safety, prevent surface errors, improve survival factors and minimize aircraft go-arounds?'" Donahue said. "We looked at every potential effect in the air and on the ground. Across the board, the answer was yes."

Near the end of 1997, the procedures were finalized, and Massport decided to test and evaluate them during a 60-day period of actual aircraft emergencies. After each emergency during the period, the controller, the ARFF incident commander and an airport operations supervisor completed a questionnaire. The working group also met with the involved flight crews to solicit their comments and observations.

After a review of overall functional performance during the first evaluation period, FAA requested an additional 60-day period of evaluation (all testing was conducted between January and June 1998). Based on the results, Massport implemented the system. A letter of agreement between Massport ARFF and FAA Boston ATC was signed in August 1999.

Donahue said that at the end of 1998, Massport ARFF conducted an operational summary and enhancement analysis. Researchers reviewed all of the forms from the evaluation periods and analyzed 400 ARFF-aircraft emergencies that occurred in 1998.

"Of the 400, we found that in approximately 32 (8 percent) of those emergencies, there was direct pilot–ARFF communication," he said. The airport had about 3,400 total calls for emergency services for the year, he said.

Donahue said that, although life safety and survival factors are the highest priority when ARFF services respond to an aircraft emergency, a business case also can be made for upgrading ARFF services to avoid unnecessary costs for passengers, airlines and airports.

Donahue said that an analysis by Massport showed that unwarranted evacuations not only may cause typically injuries to 15 percent of the passengers, but also may have the following economic consequences:

- In one Massport model, costs were computed at US$1,200 per hour per aircraft (counting factors such as fuel consumption, crew costs and depreciation) and $1,500 per hour for the collective value of lost time to passengers. About 120 aircraft operations per hour are conducted at Logan. Thus, an incident that causes a two-hour delay may generate a loss of $648,000; and,

- An unscheduled airplane cancellation — because of an unwarranted evacuation — may cause a loss of $37,000 to $92,000 per cancelled flight, with two flights per 10-hour utilization period, until the aircraft is returned to service.

Donahue said that by comparison, Massport incurred negligible costs to implement direct communication between flight crews and ARFF incident commanders.♦

— FSF Editorial Staff

Reference

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NTSB Endorses Wide Use of ARFF-to-crew Communication

NTSB has reiterated its support for ARFF-to-crew communication capability in a June 2000 study of evacuations of commercial transport airplanes that occurred between September 1997 and June 1999, and involved 2,651 passengers.

"The Board considers these dedicated frequencies to be vital for assisting airplane crews to conduct successful evacuations and encourages the rapid implementation of these frequencies at all certificated airports," NTSB said.[11]

NTSB issued recommendations for ARFF-to-crew communication following an aircraft evacuation in April, 1997. In that incident, a McDonnell Douglas MD-82 sustained a left engine turbine section failure and a tailpipe fire shortly after takeoff and returned to the Tucson International Airport, Arizona, U.S., where the passengers and crew evacuated the airplane, NTSB said.

NTSB issued the following safety recommendations, asking FAA to:

- "Establish a designated radio frequency at all airports certified under [U.S. Federal Aviation Regulations (FARs)] Part 139 that allows direct communication between [ARFF] personnel and flight crewmembers in the event of an emergency and take appropriate measures to ensure that [ATC] personnel, ARFF personnel, and pilots are aware of its designation. (A-98-41)"; [and,]

- Develop a universal set of hand signals for use between [ARFF] personnel and flight crews and flight attendants for situations in which radio communication is lost. (A-98-42)"

U.S. Airports Adopt Methods Using FAA Advisory Circular

Ben Castellano, FAA manager of airport safety and certification, said that ARFF services respond two times or three times a day to emergencies at most large U.S. airports. Thus, changes that can reduce the time required for an ARFF response — or that help aircraft captains and ARFF incident commanders to make optimal life-safety decisions — have significant influence on safety.[12]

In the conventional method of ARFF emergency communication, ATC specialists in the control tower notify the ARFF service that ARFF equipment is requested by an aircraft captain or by ATC. As the ARFF equipment and personnel move to the location of the emergency, further messages between the captain and ARFF incident commander are relayed through the tower controller. For example, the tower controller relays a question from the ARFF incident commander to the aircraft captain, the aircraft captain transmits the answer to the tower controller, and then the tower controller relays the answer to the ARFF incident commander.

Over time, a few U.S. airports had expanded their local ARFF communication methods. Castellano said that in the mid-1990s, however, Capt. Larry Ganse, a former director of safety for Northwest Airlines, advocated a procedure for ARFF-to-crew communication using a national discrete frequency.

After a series of meetings with interested organizations in 1997 and 1998, FAA published Advisory Circular (AC) 150/5210-7C "Aircraft Rescue and Firefighting Communications" in July 1999. Its objectives include reduced repetition of time-critical information, improved understanding of messages and understanding that the frequency is not for firefighter-to-firefighter communication.[13]

Castellano said, "We want flight crews and towers all to have the same procedure — no matter where the flight crew goes. When an aircraft has been cleared to land in an emergency situation, the tower controller [who has ARFF on the discrete emergency frequency] does not have to convey on two separate frequencies what is happening. Everybody is listening to what is going on."

To implement these guidelines, an airport owner signs a letter of agreement with its control tower, setting up the local ATC frequencies available, the roles and responsibilities, and the basic procedures and phraseology adapted from the AC. Since the AC was published, ARFF representatives and airport managers typically have advocated local adoption of this system, and FAA air traffic managers have decided the frequency assignments, he said.

"From reports we have seen, this has been working out pretty well," Castellano said. "Most controllers like the system, which takes a little of the responsibility off their shoulders. FAA will be following the adoption of this procedure for a couple of years to see if it works, and we may add a note to the *Airport Facility Directory.*"

Castellano said that FAA's AC recommends guidelines for direct communication that do not include a national discrete frequency. Instead, the AC suggests using one or more frequencies already available in the local control tower. Some U.S. airports have two frequencies or three frequencies, he said, and to adopt the system, ARFF services must have (or must add) radio equipment that can transmit and receive on the assigned local aeronautical frequencies.

"We would like to see, ultimately, a designated discrete frequency that is universal," said Castellano. "Currently, ATC assigns a frequency that is not being used at the time or is in light use at the time. I have not heard of any situation where there was not a frequency available for this type of communication. Currently, the frequency would not be known ahead of time to the flight crew."

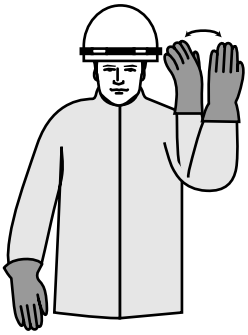
Local air traffic managers' process of identifying suitable frequencies for a given control tower also considers that radio transmissions from an aircraft at cruise altitude have a long range, and might interfere with routine communication by controllers using the same frequency at distant airports, he said.

The U.S. civil emergency frequency — 121.5 mHz — normally is not considered suitable for ARFF-to-crew communication where ATC control towers are operating, to keep 121.5 mHz clear for other in-flight emergency calls and for use by aircraft emergency locator transmitters, he said. On airports without an air traffic control tower (or with a closed air traffic control tower), the pilot of the emergency aircraft may contact an ARFF incident commander on the common traffic advisory frequency published for the airport or on 121.5 mHz.

The AC also describes three hand signals (Figure 1) that were developed in response to the NTSB safety recommendation, which emerged from investigations of accidents in which confusion arose about the meaning of ARFF signals. These hand signals enable the communication of evacuation recommendations from the ARFF incident commander to the flight crew and/or cabin crew in the event of radio communications disruption or failure on the discrete emergency frequency, FAA said. ARFF firefighters should signal the flight crew from a position at the left front side of the aircraft, and should signal the cabin crew from other positions as necessary, FAA said.

When the tower controller tells a flight crew to change to a frequency that enables direct communication with an ARFF incident commander, the tower controller normally will remain on that frequency. Nevertheless, Castellano said that pilots and ARFF incident commanders should be aware that after direct communication has been established, the controller *probably* will be listening to the subsequent communication, but may not be listening — depending on what is required for safe air traffic control.

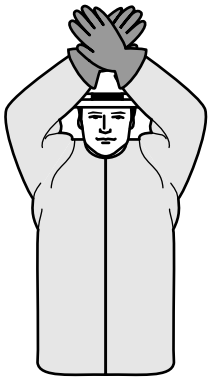
ARFF Emergency Hand Signals in the United States



Recommend Evacuation

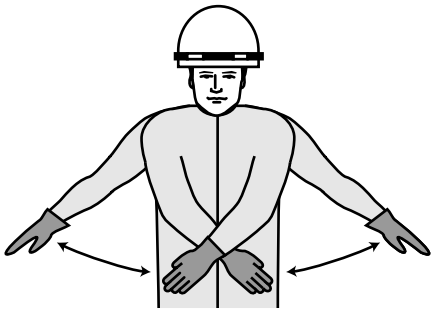
Evacuation is recommended based on the ARFF incident commander's assessment of the external situation.

In this signal, the firefighter's arm is extended from the body and held horizontally with the hand upraised at eye level. The firefighter conducts a beckoning arm motion angled backward. The nonbeckoning arm is held against the body. At night, lighted wands are used for the same signal.



Recommend Stop

The ARFF incident commander recommends that the evacuation in progress be halted. The flight crew and/or cabin crew should stop the aircraft movement or other activity in progress. In this signal, the firefighter places the arms in front of the head, crossed at the wrists. At night, lighted wands are used for the same signal.



Emergency Contained

The ARFF incident commander has determined that there is no outside evidence of a dangerous condition or "all clear." In this signal, the firefighter extends the arms outward and down at a 45-degree angle. The arms are moved inward below the waistline simultaneously until the wrists are crossed, then extended outward to the starting arm position (like a baseball umpire's "safe" signal). At night, lighted wands are used for the same signal.

ARFF = Aircraft rescue and fire fighting

Source: U.S. Federal Aviation Administration, *Aeronautical Information Manual*

Figure 1

U.S. Air Traffic Controllers Have Limited Frequencies

Tom Farrier, national safety coordinator for the National Air Traffic Controllers Association (NATCA) in the United States, said that air traffic controllers, in general, have responded positively to FAA's guidelines for ARFF-to-crew communication. Most controllers believe that the chance of incomplete messages can be reduced and that the speed of communication can be increased during emergencies with such systems, he said.[14]

Farrier said, "Controllers are coming around to the idea, more and more, that such systems are not affecting their situational awareness. Although they believe that this is a great idea, they have practical concerns about these guidelines working at their location without affecting other parts of their business. Many ATC environments are constrained by limited frequencies. Where we get into a problem is clearing a frequency that normally is used for another purpose. Some airports with towers may have only a handful of frequencies from which to select without frequency interference becoming a problem very quickly — for example, airports near Chicago O'Hare International Airport [Illinois, U.S.]"

He said that many controllers were concerned initially about whether any frequencies could be designated for this purpose — even on an as-needed basis — at many locations. They also were concerned about whether controller positions in a tower cab could be realigned to use a designated frequency during an emergency.

Workload and adverse effects on coordination also were raised as issues by controllers when the AC was issued, but such problems have not surfaced, he said.

U.S. Pilots See Advantages in ARFF-to-crew Communication

Capt. Tom Phillips of the Air Line Pilots Association, International, a U.S. pilot union, said that developing the AC on ARFF communication yielded both an alternate method of communication and better methods.[15]

Phillips said, "The previous AC recommended the interphone for ARFF-to-crew communication. Stopping the airplane and plugging in a headphone was not an option sometimes — specifically in the case of hot brakes. Direct radio communication is much superior."

Pierre Huggins, an engineer in ALPA's engineering and accident investigation section, said that advance knowledge among pilots of the availability of ARFF-to-crew communication capability is preferable, but no ALPA pilots have reported difficulty during emergencies when they had no prior awareness of this local capability.[16]

Pilots are able to decide against conducting evacuations with greater confidence that their decisions will not put passengers at risk, said Huggins. Clarity about roles is important during such communication, however, he said.

"Firefighters at certain airports have said, 'You have a problem? We will take over from here,'" said Huggins. "Pilots do not like that method. They want to be told the situation and to make decisions based on their own expertise."♦

Notes and References

1. The term "aircraft rescue and fire fighting (ARFF)" is used in the United States. The International Civil Aviation Organization (ICAO) uses the term "rescue and fire fighting service (RFF)" and airports in some nations use other terms. ICAO Annex 6 *Aerodromes*, 9.2.27, Communication and Alerting Systems, as a recommended practice, says, "A discrete communication system should be provided linking a fire station with the control tower, any other fire station on the aerodrome and the rescue and fire fighting vehicles." ICAO has not issued a recommendation concerning direct ARFF-to-crew communication.

2. Air Line Pilots Association, International; Air Transport Association of America; ARFF Working Group; U.S. Federal Aviation Administration. *ARFF–Crew Communication.* Video produced by Northwest Airlines and the American Association of Airport Executives, 1998.

3. O'Sullivan, John. Telephone interview with Rosenkrans, Wayne. Alexandria, Virginia, U.S. November 6, 2000. Flight Safety Foundation, Alexandria, Virginia, U.S.

4. Issott, Ralph. Telephone interview and e-mail communication with Rosenkrans, Wayne. Alexandria, Virginia, U.S. November 2, 2000. Flight Safety Foundation, Alexandria, Virginia, U.S.

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8. U.S. National Transportation Safety Board (NTSB). *Air Canada Flight 797, McDonnell Douglas DC-9-32, C-FTLU, Greater Cincinnati International Airport, Covington, Kentucky. June 2, 1983.* Aircraft Accident

Report no. NTSB/AAR-86/02. On June 2, 1983, Air Canada Flight 797, a McDonnell Douglas DC-9-32, was destroyed by fire after an in-flight lavatory fire was detected during a regularly scheduled international passenger flight from Dallas, Texas, U.S., to Montreal, Quebec, Canada, with an en route stop at Toronto, Ontario, Canada. Twenty-three passengers were killed; three passengers received serious injuries, 13 passengers received minor injuries; and two passengers and five crewmembers were not injured. NTSB said that while en route at Flight Level 330, the cabin crew discovered a fire in the aft lavatory. After contacting air traffic control and declaring an emergency, the crew made an emergency descent and ATC vectored the flight to the Greater Cincinnati International Airport, Covington, Kentucky, U.S. The aircraft landed at the airport. NTSB said, "As the pilot stopped the airplane, the airport fire department, which had been alerted by the control tower of the fire aboard the incoming aircraft, was in place and began firefighting operations. Also, as soon as the airplane stopped, the flight attendants and passengers opened the left and right forward doors, the left forward overwing exit and the right forward and aft overwing exits. About 60 [seconds] to 90 seconds after the exits were opened, a flash fire engulfed the airplane interior. While 18 passengers and three flight attendants exited through the forward doors and slides and the three open overwing exits to evacuate the airplane, the captain and the first officer exited through their respective cockpit sliding windows. However, 23 passengers were not able to get out of the plane and died in the fire." NTSB said, in its final report, that the probable causes of the accident were "a fire of undetermined origin, an underestimate of fire severity and misleading fire-progress information provided to the captain." NTSB said, "The time taken to evaluate the nature of the fire and to decide to initiate an emergency descent contributed to the severity of the accident."

9. Donahue, Robert. Telephone interview with Rosenkrans, Wayne. Alexandria, Virginia, U.S. October 27, 2000. Flight Safety Foundation, Alexandria, Virginia, U.S. Phillips, Pam. Email communication with Rosenkrans, Wayne. Alexandria, Virginia, U.S. October 27, 2000. Flight Safety Foundation, Alexandria, Virginia, U.S. Phillips said that the Port Authority of New York and New Jersey, U.S., has implemented ARFF-to-crew communication at John F. Kennedy International Airport, LaGuardia Airport and Newark International Airport.

10. Lawless, Joe. Telephone interview with Rosenkrans, Wayne. Alexandria, Virginia, U.S. November 2, 2000. Flight Safety Foundation, Alexandria, Virginia, U.S.

11. NTSB. "Safety Study: Emergency Evacuation of Commercial Airplanes." Document no. NTSB/SS-00/01. June 27, 2000. 71.

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13. FAA. "Aircraft Rescue and Firefighting Communications." Advisory Circular 150/5210-7C. July 1, 1999.

14. Farrier, Tom. Telephone interview with Rosenkrans, Wayne. Alexandria, Virginia, U.S. November 2, 2000. Flight Safety Foundation, Alexandria, Virginia, U.S.

15. Phillips, Tom. Telephone interview with Rosenkrans, Wayne. Alexandria, Virginia, U.S. October 27, 2000. Flight Safety Foundation, Alexandria, Virginia, U.S.

16. Huggins, Pierre. Telephone interview with Rosenkrans, Wayne. Alexandria, Virginia, U.S. October 27, 2000. Flight Safety Foundation, Alexandria, Virginia, U.S.

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