Unjustified RESOURCES

BY WAYNE ROSENKRANS

Accident analysis yields few cost-benefit insights into ARFF enhancements at U.S. airports.

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Proposals to increase aircraft rescue and fire fighting (ARFF) capability at most air carrier airports in the United States ideally would sail through government reviews. Missing so far, however, is sufficient confidence that lives would be saved by investing, for example, $3 billion initially and then spending $1 billion more per year than currently is budgeted. U.S. air carrier accident data from the past 11 years provide little guidance for deciding which international standards to adopt as new ARFF requirements, according to a report prepared for the U.S. Transportation Research Board (TRB) of the National Academies.[1]

"It is difficult to suggest what might happen in terms of future accidents," said the report, designed to supply recent accident survivability data and analyze the predominant ARFF cost factors. "With the very small number of accidents in passenger air carrier operations and the multiplicity of causes and outcomes, it is not possible to reach a conclusion from past accidents about how improved ARFF response times and capabilities would reduce accident mortality. However, the review of accidents … suggests that enhanced ARFF standards may have made a difference in the outcome for at most one individual."

A resolution of the U.S. Congress early this year called on the Federal Aviation Administration (FAA) to more closely align Federal Aviation Regulations (FARs) for ARFF with 2009 global consensus standards — especially NFPA 403, *Standard for Aircraft Rescue and Fire-Fighting Services at Airports, 2009 Edition,* published by the National Fire Protection Association (NFPA),

and Annex 14, *Aerodrome Design and Operations,* of the International Civil Aviation Organization (ICAO). The research for TRB was limited to a representative sample of fire stations, ARFF vehicles and firefighters located at 476 U.S. airports categorized as Class I, II or III by FARs Part 139, *Certification of Airports,* based on the seating capacity of aircraft typically operating at the airport and whether the air service is scheduled or unscheduled. Table 1 shows the scale of ARFF operations for these classes.

"While the average airport has 26 firefighters and three vehicles, Class IA airports have 10 firefighters and two vehicles, and Class IE airports have 115 firefighters and seven vehicles," the report said. "NFPA standards apply to airport operators if the state where the airport is located or the airport operator has adopted those standards. … The FAA and the NFPA have worked together to adopt common standards whenever possible; however, there are areas where the FAA and NFPA differ significantly."

The major drivers of cost are the number of firefighters, airport fire stations and ARFF vehicles that enable firefighters to achieve a specified response time for the first ARFF vehicles to arrive at designated points on runways and begin applying extinguishing agents.

The FARs specify three minutes for the first vehicle to arrive at the midpoint of the farthest air carrier runway or other specified point of comparable distance on the movement area available to air carriers, and four minutes for all other required vehicles. This time period has been interpreted to mean with direct routes, dry pavement and good weather.

The NFPA standard requires the first vehicle to reach any point on the operational runway in two minutes or less with good visibility and surface conditions. The ICAO standard requires the first ARFF vehicle to reach any point on each operational runway within three minutes in optimum visibility and surface conditions.

The elements of any standard adopted become critical in building and staffing airport fire stations. The key finding of the 2009 research therefore was that "the NFPA two-minute runway response requirement could more than double the number of firefighters and ARFF vehicles at the 476 Part 139 airports considered in this study."

FAA, ICAO and NFPA also have standards for minimum ARFF vehicles on duty, and at least general guidance on the basis for determining the number of firefighters per shift. Neither the FAA nor ICAO specifies the number of firefighters on duty per shift, except to require a sufficient number of trained personnel as determined by the number of fire stations and ARFF vehicles to achieve the minimum response time adopted. In contrast, NFPA standards specify minimum shift-staffing requirements based on the class of airport (Table 2).

Few Relevant Accidents

The researchers studied 23 FARs Part 121 air carrier aircraft accidents and 13 Part 135 commuter aircraft accidents during scheduled operations in the period Jan. 1, 1997, through Dec. 31, 2007. Three accidents in the Part 121 record and three accidents in the Part 135 record were considered relevant to ARFF response issues.

Current Firefighters and ARFF Vehicles at U.S. Air Carrier Airports[1]

	FAA Airport Class and ARFF Index[2]						
	IIIA/IIA	IA	IB	IC	ID	IE	Total
Airports	99	131	111	78	33	24	476
Firefighter count[3]	60	103	193	256	215	460	1,287
Average firefighters[4]	8	10	15	28	43	115	26
Estimated firefighters[5]	743	1,349	1,648	2,219	1,419	2,760	10,137
Vehicle count[3]	10	17	22	38	22	29	138
Average vehicles[4]	1	2	2	3	4	7	3
Estimated vehicles[5]	124	202	188	247	145	174	1,080

FAA = U.S. Federal Aviation Administration; ARFF = aircraft rescue and fire fighting

Notes

1. The table is based on 53 interviews completed during a February 2009 survey of airports regulated under Part 139, *Certification of Airports,* of U.S. Federal Aviation Regulations.
2. U.S. airports serving air carriers are certificated in one of four classes based on the passenger seating capacity of the typical aircraft and the scheduled or unscheduled nature of these flight operations. Generally, a Class I airport can serve all sizes of passenger aircraft, and a Class III airport can provide scheduled and unscheduled services for aircraft that have 30 or fewer seats. FAA ARFF indexes subdivide the Class I airports by the length of the longest aircraft conducting more than five scheduled departures per day (A less than 90 ft [27.4 m], B 90 ft but less than 126 ft [38.4 m], C 126 ft but less than 159 ft [48.5 m], D 159 ft but less than 200 ft [61 m] and E longer than 200 ft). Class II and III airports meet ARFF Index A as a minimum, and Class II airports may qualify for alternative means of compliance using local community fire fighting capability. Class IV airports were excluded from this study.
3. The count was provided during interviews with airport managers or other representatives.
4. The average was the number of firefighters/vehicles counted divided by the number of airports in the study sample.
5. Total firefighters and ARFF vehicles for all 476 airports were extrapolated.

Source: Richard Golaszewski, Benedict Castellano and Robert E. David

Table 1

Applying Unmet ICAO and NFPA Standards for ARFF Response to U.S. Airports

	Airport Class and ARFF Index[1]						
	IIIA/IIA	IA	IB	IC	ID	IE	Total
Airports	99	131	111	78	33	24	476
Effect of ICAO three-minute runway response standard[2]							
Additional fire stations	50	24	34	46	13	24	190
Additional vehicles	25	12	94	78	26	48	283
Additional firefighters	124	83	589	559	198	420	1,973
Effect of NFPA minimum vehicles and firefighters standard[3]							
Additional vehicles	0	60	60	13	0	0	132
Additional firefighters	371	1,691	3,057	1,950	363	210	7,642
Effect of NFPA two-minute runway response standard[4]							
Additional fire stations	85	131	111	117	58	90	592
Additional vehicles	42	107	222	351	116	180	1,018
Additional firefighters	509	1,905	3,244	2,802	908	1,680	11,047
Effect of NFPA three-minute movement area response standard[5]							
Additional fire stations	28	24	43	46	25	60	225
Additional vehicles	0	71	102	124	33	120	450
Additional firefighters	283	1,870	3,099	2,152	330	960	8,694

ARFF = aircraft rescue and fire fighting; ICAO = International Civil Aviation Organization; NFPA = U.S. National Fire Protection Association; RRA = rapid response area

Notes

1. Table 1 (p. 44) explains FAA airport classes and ARFF indexes. The analysis in the study assumed that standards discussed would apply to ARFF satellite stations at Index D and Index E airports.
2. The ICAO standard requires that the first ARFF vehicle reach any point on an airport runway within three minutes.
3. NFPA 403, *Standard for Aircraft Rescue and Fire-Fighting Services at Airports,* 2009 Edition, sets the following minimum numbers of ARFF vehicles: one or two for the equivalent of FAA ARFF Index A, two for Index B, three for Index C and Index D, and four for Index E. The standard requires airports to have the following number of ARFF firefighters per shift: four or five for the equivalent of FAA ARFF Index A, six for Index B, seven for Index C, eight for Index D, and nine or 10 for Index E.
4. NFPA 403 requires the first ARFF vehicle to reach any point on an airport runway within two minutes and any point in the RRA within 2.5 minutes.
5. NFPA 403 requires the first ARFF vehicle to reach any point on an aircraft movement area beyond the runways or the RRA within three minutes.

Source: Richard Golaszewski, Benedict Castellano and Robert E. David

Table 2

The air carrier accidents of the period most relevant to ARFF response issues were American Airlines Flight 1420 on June 1, 1999, a McDonnell Douglas MD-82 that overran Runway 4R at Little Rock, Arkansas; Air Midwest Flight 5481 on Jan. 8, 2003, a Raytheon Beech 1900D that struck a maintenance hangar and terrain during takeoff with an incorrectly rigged elevator control system at Charlotte-Douglas International Airport, North Carolina, U.S.; and Comair Flight 1591 on Aug. 27, 2006, a Bombardier CRJ-100 that crashed during takeoff from the wrong runway at Lexington, Kentucky, U.S.

The report cited a finding by the National Transportation Safety Board (NTSB) that, although the Little Rock accident potentially was survivable for two fatally injured passengers, faster ARFF response would not have made the difference in saving their lives. "In one case, the passenger would have had to evacuate the aircraft immediately and, in the second case, the ARFF response team would have had to enter the aircraft instead of first suppressing the fire," the TRB report said.

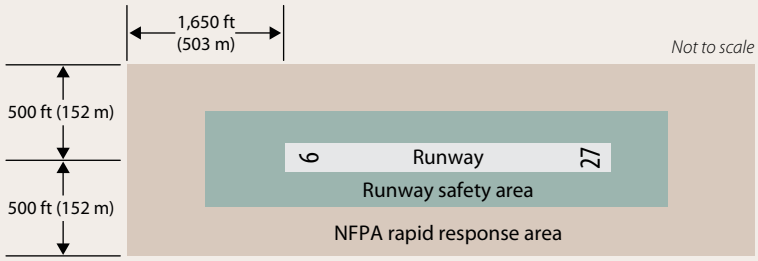
Faster ARFF response would not have altered the outcome in the Charlotte accident because NTSB "determined that all 21 people on board the aircraft died from 'multiple blunt injuries due to an airplane crash,'" the report said. Among passengers who survived the crash impact forces but died from smoke inhalation or thermal injuries in the Lexington accident, "the NTSB found it was not possible to determine how long these passengers survived, but noted that all of the passengers were found close to their seats," the report said. "The accident site was not directly accessible to ARFF vehicles from the runway end. It took the ARFF vehicles approximately 11 minutes to travel about 2.0 mi [3.2 km] by public roads, a dirt road with a significant incline and off-road terrain to reach the site." The Lexington accident site was outside NFPA's proposed rapid response area (RRA, Figure 1, page 46).

Cost Perspectives

The sample comprised 11 percent of all Class I, II and III airports, and was selected for geographic and airport size diversity. Data were collected about direct and indirect costs of enhancing their response capability, including factors such as training more firefighters. Data then were extrapolated to all 476 airports to estimate nationwide costs.

"It was not possible to estimate all costs; the most significant of these is the requirement to make the entire RRA accessible to ARFF vehicles within two minutes," the report said, citing construction and station relocation costs even when the airport owns

Rapid Response Area



ARFF = aircraft rescue and fire fighting; NFPA = U.S. National Fire Protection Association; RRA = rapid response area

Note

In NFPA's proposal, any point in the RRA located on airport property must be accessible to ARFF vehicles. The first responding ARFF vehicle must be able to reach these points within 2.5 minutes during conditions of optimum visibility and surface conditions, and other required ARFF vehicles would arrive at 30-second intervals. The dimensions of the RRA are the same for every runway regardless of the aircraft type used to determine the airport's ARFF index.

Source: Richard Golaszewski, Benedict Castellano and Robert E. David

Figure 1

sufficient land beyond the runway safety area. "Firefighter salaries represent the largest annual cost impact."

Twenty airports in the sample could not meet the ICAO three-minute response standard. Projected costs nationwide just to meet this standard were $36 million initially for ARFF vehicles, equipment and training with recurrent annual costs of $16.5 million.

Projected initial costs for additional ARFF vehicles, stations and firefighters to comply with unmet ICAO or NFPA standards represent a small fraction of the total cost impact over time. For example, "the NFPA two-minute runway response standard has the highest costs, with initial costs of $2.9 billion and annual operating and depreciation costs of $1 billion," the report said. "The NFPA three-minute response to taxiways, ramps and aprons (maneuvering area) has initial costs of $1.2 billion and annual operating and maintenance costs of $747.8 million."

Adoption of the NFPA two-minute response standard would require the most ARFF stations, ARFF vehicles and firefighters. "The 592 additional stations are estimated to cost $2 billion and the 1,018 vehicles are estimated to cost $708 million," the report said. "The largest increase in annual operating cost is $776.3 million for additional firefighters."

The NFPA three-minute movement-area response standard would require 225 new or relocated stations costing $823.3 million, 450 new ARFF vehicles costing $310 million and 8,694 additional firefighters at an annual cost of $635.4 million, the report said.

Adopting the NFPA standard for ARFF vehicles alone would generate a requirement for an additional 132 vehicles, primarily at Class IA and IB airports. "The initial costs of the vehicles are estimated at $67.1 million, while the costs of firefighter equipment and initial training are $76.4 million," the report said. The NFPA staffing requirement — typically adding four firefighters at Class IIA and IIIA airports and more than 20 at Class IB and IC airports — alone would generate added costs of $545.7 million annually in firefighter salaries and benefits.

U.S. airport managers, fire chiefs and other officials expressed logistical and safety concerns about adopting RRAs at their airports. The main concerns were geographic obstacles, including existing major roadways, and safety issues created by driving ARFF vehicles at least 37.5 mph (60.4 kph) across unpaved surfaces of an RRA to meet a response standard.

"Almost 75 percent of the [proposed] RRAs at the airports interviewed (95 of 129 runways) cannot meet the two-minute accessibility requirement as configured today," the report said. "The data gathered did not permit us to make an estimate of the costs needed to make the on-airport RRA specified by NFPA fully accessible to ARFF vehicles."

The TRB also considered the differences in standards for quantities of fire-suppressing agents, which were less significant. The researchers also estimated the costs of all enhancements per enplaned passenger at each of the representative airports.

The report notes that its cost estimates inevitably would vary from actual costs of proposed enhancements because of unknown variables, including assumptions about the future regulatory environment. "The actual increase in ARFF costs experienced by any airport would be based on the specific changes to Part 139, because FAA has the latitude to adopt all, some or none of the other industry standards," the report said.

Note

1. Golaszewski, Richard; Helledy, Gregson; Castellano, Benedict; David, Robert E. "How Proposed ARFF Standards Would Impact Airports." Airport Cooperative Research Program, U.S. Transportation Research Board of the National Academies. June 17, 2009.