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Achieving effective ARFF in a challenging economy

This is the second part of Jack Kreckie's article that highlights the challenges associated with effective ARFF within the current economic climate. The first part of this paper was published in issue five of *International Airport Review*, 2011.

NFPA Guidelines

In addition to the two primary regulators of ARFF e.g. ICAO and the FAA, there are consensus standards that are provided to indicate a 'best practice' in any number of categories. Many of the consensus standards developed by the National Fire Protection Association (NFPA) have been adopted or used as guidelines at various locations around the world. These standards are not binding unless the Authority Having Jurisdiction (AHJ) has adopted them and committed to the particular standard.

The NFPA standard for ARFF protection levels is detailed in NFPA 403, *Standard for Aircraft Rescue and Fire-Fighting Services at Airports*. This third reference, if adopted, requires greater quantities of firefighting agent, ARFF vehicles and addresses manpower levels. Neither ICAO nor the FAA provide specific requirements for staffing levels, but rather indicate that the personnel on hand should be adequate to deploy all of the required resources as shown in **Table 1** (opposite).

There are two primary reasons why the NFPA standards requires so much more fire-fighting agent. Both ICAO and NFPA base their minimum required quantities on separate calculations of quantities required for specific tasks. In order to understand the methodology, certain definitions must be understood. They are as follows:

Theoretical Critical Area (TCA)

TCA is the theoretical area adjacent to an aircraft in which fire must be controlled for the purpose of ensuring temporary fuselage integrity and providing an escape area for its occupants.

The original TCA definition and formulas were determined by the ICAO Rescue Fire-Fighting Panel (RFFP). The system was adopted and refined by NFPA over the years. The determination of the TCA is based on a rectangle having as one dimension the overall length of the aircraft, and the other dimension determined by the following:

- For aircraft with an overall length of less than 20m (65ft), 12m (40ft) plus the width of the fuselage
- For aircraft with an overall length of 20m (65ft) or more, 30m (100ft) plus the width of the fuselage.

The theoretical critical area serves only as a means for categorising aircraft in terms of the magnitude of the potential fire hazard in which it may become involved. It is not intended to represent the average, maximum, or minimum spill fire size associated with a particular aircraft. As a result of studies and comparisons of actual spill fires and aircraft incidents, it was determined that the quantities of agent required for the area determined to be the TCA were greater than the quantities actually used.

Practical Critical Area (PCA)

The PCA equals an area which is two thirds the size of the TCA. It was concluded that fire control time and fire extinguishment time within the critical area should be considered individually and defined as follows:

- The time required from the arrival of the first fire-fighting vehicle to the time the initial intensity of the fire is reduced by 90 per cent (Control time)
- The time required from arrival of the first fire-fighting vehicle to the time

the fire is completely extinguished (Extinguishment time).

The discharge rate of agent was considered to achieve the fastest possible fire control time, that is consistent with the objective of preventing the fire from melting through the

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fuselage or causing an explosion of the fuel tanks. It was also agreed that the equipment and techniques to be used should be capable of controlling the fire in the critical area in one minute and of extinguishing the fire within another minute. The primary objective in protecting, controlling and extinguishing fire in the critical area is based on providing a safe path of egress for occupants escaping the aircraft.

Quantities of agent required

It was agreed that determining the amounts of extinguishing agents to be provided, the amounts required to control and to extinguish a fire should be determined separately. The quantities were named and defined as follows:

Quantity Q1

The quantity required to obtain a one-minute control time in the PCA. The formula for the water required for control (Q1) in the PCA can be expressed as Q1= PCA x R (Rate of application for the specific foam) x T (Time of application)

Quantity Q2

The quantity required for continued control of the fire after the first minute or for complete extinguishment of the fire or for both.

The development of the requirement for these two quantities of water is based on aircraft fuel spill fire control parameters (aircraft exterior). Information from actual incidents in recent years indicated that with increased aircraft crash worthiness, water for interior fire-fighting operations is also necessary. This quantity of water (called Q3) is based on the need for hand lines to be used for interior fire fighting.

Hence, the total quantity of water (Q) is defined by NFPA as Q=Q1 + Q2 + Q3

Q1 (Water requirement for control of PCA)
Q2 (Water requirement to maintain control, extinguish the remaining fire or both)
Q3 (Water requirement for interior fire fighting)

This explanation, which is based on the work conducted by ICAO's RFFP, beginning in 1970 and further developed by the NFPA Aviation Committee, is intended to put some science behind the numbers. The increased agent quantities that exist in NFPA 403 are intended for interior firefighting efforts.

Aircraft evacuation

Having adequate supplies of agent on hand is only a portion of the mission of ARFF. The primary goal is the safety of all of the occupants of the aircraft. Aircraft evacuation is a critical event during an aircraft emergency. The specific staffing required for ARFF to assist in an aircraft evacuation is not referred to by ICAO or the FAA. In order to consider what the airport should provide in terms of staffing, an understanding of evacuation requirements, modeling and human factors should be studied.

Certification of an aircraft by the FAA requires a full scale demonstration where a full complement of passengers and crew deplane through half of the emergency exits in the dark of night in 90 seconds or less.

Certification requirements are based on a single evacuation trial. The subjects used to conduct the evacuation test are prepared for the evacuation, and are appropriately dressed for the situation. EASA (European Aviation Safety Agency) and FAA regulations require that 35 per cent of the participants must be over age 50, a minimum of 40 per cent must be female, and 15 per cent must be female and over 50.

In order to balance the requirements with the safety of the volunteers conducting the evacuation test, aircraft manufacturers will do

TABLE 1 Water – Gals (G) Liters (L)

Category	Index	ICAO Performance Level B	ICAO Number Of Vehicles	FAA	FAA Number Of Vehicles	NFPA	NFPA Number Of Vehicles
1	GA-1	230 (L) 61 (G)	1	0	0	450 (L) 120 (G)	1
2	GA-1	670 (L) 177 G	1	0	0	750 (L) 200 (G)	1
3	GA-2	1200 (L) 317 (G)	1	0	0	2500 (L) 670 (G)	1
4	A	2400 (L) 634 (G)	1	379 (L) 100 (G)	1	5050 (L) 1340 (G)	1
5	A	5400 (L) 1427 (G)	1	379 (L) 100 (G)	1	10450 (L) 2760 (G)	2
6	B	7900 (L) 2087 (G)	2	5678 (L) 1500 (G)	1 or 2	14150 (L) 3740 (G)	2
7	C	12100 (L) 3196 (G)	2	11356 (L) 3000 (G)	2 or 3	18450 (L) 4880 (G)	3
8	D	18200 (L) 4808 (G)	3	15142 (L) 4000 (G)	3	29450 (L) 7780 (G)	3
9	E	24300 (L) 6419 (G)	3	22712 (L) 6000 (G)	3	36200 (L) 9570 (G)	4
10	E	32300 (L) 8533 (G)	3	22712 (L) 6000 (G)	3	54000 (L) 14260 (G)	4

ICAO quantities shown is from the Foam Meeting Performance B Table, as ICAO approved AFFF's are Performance level B. All quantities in the table are based on AFFF foam production. All quantities listed are for water for foam proportioning and does not include quantities of complimentary agent.

what they can to minimise risk. The A-380 evacuation test was a perfect example of that. Over 1,000 volunteers were assembled at Airbus's Finkenwerker Plant in Hamburg on 26 March 2006 for the drill. The volunteers consisted of 50 per cent Airbus employees and 50 per cent of members from a local gym. Prior to being approved to participate, an agility test was conducted, which was designed to cull out the very elderly or clinically infirm. Prior to boarding the aircraft for the evacuation test, warm up exercises were conducted with the group.

Airport planners must consider in a practical application what type of assistance during evacuation satisfies the airport's intent during an emergency. Bear in mind that during an emergency, the area under the aircraft where the slides meet the ground is in the 'hot zone'. Only trained, properly protected emergency responders should be allowed in the 'hot zone'.

In the development of a 'staffing task analysis' to accomplish evacuation, the airport must determine what it feels is effective, reasonable, and defendable. If a B-747 is to be evacuated of its 400 plus passengers and crew, and everything works correctly, 10 escape slides will be deployed. It is very clear that injuries are likely to occur during evacuations. Is it reasonable to staff the bottom of each slide with one person, assisting the passengers safely away from the aircraft and directing them to a safe area of refuge? If not every slide, should the plan be to staff half of the slides? If so, which ones? If the wind is blowing and the slides are being raised off of the ground, how many slides should be manned? How many people should be staffing a slide when a passenger leaps into it through the smoke?

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The responsibility goes well beyond minimum requirements. There is far too much at stake.

Regulations and standards provide a foundation for prudent emergency planning and a common sense approach

The passenger demographics of today's typical flight are comprised of much more diverse profiles of age, health and physical condition. There are a percentage of passengers on every flight who would be unable to evacuate an aircraft in an emergency. ARFF crews understand that, regardless of the minimum requirements suggested by regulation or consensus standards, they may be called upon to make entry for rescue and interior firefighting. The survival of the occupants of the aircraft depends upon ARFF to do just that. There is a level of expectation around the world that if an accident occurs or a fire breaks out, the ARFF crew will respond and be prepared, equipped and trained to do whatever it takes to ensure that passengers are safe. Safety and survival should not be based on a 'minimum standard.' It should be based on a realistic task analysis of the specific needs, conditions and capabilities of any airport conducting flight operations, regardless of whether the aircraft is an air carrier or freighter.

No matter what regulations govern a particular aerodrome, certain basic questions need to be considered. The answers to these questions will lend themselves to the results of a staffing task analysis. The minimum standards require, in theory, enough agent to protect the escape path of the typical air carrier aircraft with service to the aerodrome.

They do not specifically require:

- Provision of additional quantities of agent to fight an interior fire
- Provision of sufficient quantities to prepare for a collision of two aircraft or an aircraft with a building
- Provision of staffing to man escape slides
- Provision of staffing for rescue
- Provision of staffing for the use of hand lines while the ARFF vehicles are still manned
- Forcible entry operations
- Aircraft stabilisation

Common sense, prudent judgment and responsible planning must be applied to the specific needs and objectives of an aerodrome. Operators of aerodromes worldwide have goals to provide the best experience for travellers in terms of convenience, schedule, parking, dining and shopping. Safety should be at the top of that list, not just as a claim, but as evidenced by actions. Safety and preparedness can be used in marketing, rather than being considered a necessary evil that is expensive and hidden behind the scenes.

Everyone wants security to be highly visible, in part to make customers feel at ease. A campaign based on public safety can go a long way in developing a reputation for safety. ARFF is, of course, the compelling mission for an airport fire department. However, this department is also responsible for terminal evacuation plans, fire prevention, and terminal crisis management in collaboration with airport tenants, emergency medical services, ramp safety, and public access defibrillator training. There are dozens of ways to raise the bar on safety, preparedness, emergency management, and training. The benefits will be many, and these actions will, in turn, accomplish the following.

- Better prepare and equip emergency responders
- Better prepare airport tenants
- Raise the level of fire safety in airport facilities
- Raise the awareness and confidence among the airport tenants and travellers
- Develop important relationships and partnerships within the airport community

Looking ahead

The level of ARFF protection should be harmonised throughout the world as the cost of safety can be justified based on the value of human life. The priority for safety should be placed ahead of the budget for airport landscaping, irrigation, art displays and entertainment in the terminals.

In the event of an emergency, passengers deserve and expect an appropriate response of trained and equipped emergency responders

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Each of us has a level of expectation when we fly. Our greatest hope and expectation is to arrive safely. In the event of an emergency, we expect and deserve an appropriate response of trained and equipped emergency responders.

Airport operators, air carriers and regulators all strive to provide a product that is safe, efficient, attractive and affordable. Each strives to be seen as 'the best,' or ideally recognised as 'world class.' Minimum standard has no correlation to 'world class.'

In an aviation industry based entirely on safety, all aircraft would have areas to cut into the aircraft fuselage, outlined and labelled in contrasting colors. Flight attendants would be required to pass strength and agility tests. They would wear natural fiber jump suits with sneakers. There would be no more seat belt extenders or cocktails allowed in the exit rows. Handicapped passengers would be seated in designated areas, standardised so that ARFF crews know where they are. Aircraft would have fire suppression systems in the passenger cabins. Is any of this likely to happen? Although the answer to this question is 'probably not in our lifetime', this is all the more reason why, collectively, there is an obligation to pursue the provision of services needed to contribute to survival.

BIOGRAPHY

Jack Kreckie is a 32 Year veteran of Fire and EMS. He spent the last 28 years of his uniformed career in ARFF, his last 15 years as a Chief Officer. He is the author of the ARFF Chapter of the 20th Edition of the NFPA Handbook, and is a contributing author to Safety Management Systems in Aviation, and Safety Management in Aviation, Implementation both published by Ashgate Publishing. Jack is the proud recipient of the ARFF Legends Award, a lifetime achievement award for significant contributions that have improved the methods of aviation fire protection and prevention. He has served as an overseas guest lecturer for the Singapore Aviation Academy, Senior Fire Officers training programme in 2010 and 2011. In addition, Jack has served as a Director or Officer for the Aircraft Rescue and Fire Fighting Working Group for over 15 years.