Houston Fire Department

Aircraft Rescue Fire Fighting

Risk Assessment

Structural and/or Proximity Gear

February 19, 2015

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Regulations requiring the Risk Assessment and Minimum Requirements:
This risk assessment is in compliance with Texas Administrative Code: Title 37, Part 13, Chapter 435, Rule §435.1, Protective Clothing and NFPA 1851: Standard on Selection, Care and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting, 2014 Edition.

Texas Administrative Code: Title 37, Part 13, Chapter 435, Rule §435.1, Protective Clothing
A regulated fire department shall:

(1) Purchase, provide, and maintain a complete set of protective clothing for all fire protection personnel who would be exposed to hazardous conditions from fire or other emergencies or where the potential for such exposure exists. A complete set of protective clothing shall consist of garments including bunker coats, bunker pants, boots, gloves, helmets, and protective hoods, worn by fire protection personnel in the course of performing fire-fighting operations;

(2) Ensure that all protective clothing which are used by fire protection personnel assigned to fire suppression duties comply with the minimum standards of the National Fire Protection Association suitable for the tasks the individual is expected to perform. The National Fire Protection Association standard applicable to protective clothing is the standard in effect at the time the entity contracts for new, rebuilt, or used protective clothing; and

(3) Maintain and provide upon request by the commission, a departmental standard operating procedure regarding the use, selection, care, and maintenance of protective clothing which complies with NFPA 1851, Standard on Selection, Care, and Maintenance of Structural Fire Fighting Protective Ensembles.

NFPA 1851, 2014 Edition, Chapter 5.1.1
Prior to starting the selection process of structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensembles, the organization shall perform a risk assessment.

NFPA 1851, 2014 Edition, Chapter 5.1.2
The risk assessment shall include, but not be limited to, the hazards that can be encountered by structural or proximity fire fighters based on the following:

Additional questions and statements considered in this risk assessment:

Per the Federal Aviation Administration (FAA), Guidance for Safety Management System (SMS) which details how to assess risk.
The objective of risk management should always be to reduce risk to as low as practicable, regardless of whether the assessment shows that the risk can be accepted as is. This is a fundamental principle of continuous improvement. All identified risks that are judged to be unacceptable must be mitigated to an acceptable level. [5.55(b)]

Risk Assessment Goal:
Today the Houston Fire Department issues structural and proximity fire fighting gear to all of its ARFF Firefighters. This risk assessment is being performed to determine if HFD will continue issuing structural and proximity gear, issue just structural gear or issue just proximity gear to all HFD ARFF Firefighters.

Definitions

ARFF: (Per NFPA 1500, 2013 Edition) Aircraft Rescue Fire Fighting, the fire-fighting actions taken to rescue persons and to control or extinguish fire involving or adjacent to aircraft on the ground.

Frequency: (Per NFPA 1250, 2015 Edition, no definition found in NFPA 1851) The number of occurrences per unit time at which observed events occur or are predicted to occur.

Enplanement: (Per 49 CFR 1510.3; Title 49 – Transportation; Subtitle B -- Other Regulations Relating to Transportation; Chapter XII -- Transportation Security Administration, Department of Homeland Security; Subchapter A -- Administrative and Procedural Rules; Part 1510 -- Passenger Civil Aviation Security Service Fees) A person boarding in the United States in scheduled or nonscheduled service on aircraft in intrastate, interstate, or foreign air transportation.

FAA: Federal Aviation Administration

HOU: William P. Hobby Airport

IAH: George Bush Intercontinental Airport

NFPA 1250: Recommended Practice in Fire and Emergency Services Organization Risk Management.

Risk: (Per NFPA 1250, 2015 Edition, no definition found in NFPA 1851) A measure of the probability and severity of adverse effects that result from an exposure to a hazard.

Risk Assessment: (Per NFPA 1250, 2015 Edition, no definition found in NFPA 1851) An assessment of the likelihood, vulnerability, and magnitude of incidents that could result from exposure to hazards.

Risk Control: (Per NFPA 1250, 2015 Edition, no definition found in NFPA 1851) The management of risk through stopping loss via exposure avoidance, prevention of loss (addressing frequency) and reduction of loss (addressing severity), segregation of exposures, and contractual transfer techniques.

Risk vs. Benefit: The acceptable level of risk is directly related to the potential to save lives or property. Where there is no potential to save lives, the risk to HFD ARFF members should be evaluated in proportion to the ability to save property of value. When there is no ability to save lives or property, there is no justification to expose HFD ARFF members to any avoidable risk, and defensive fire suppression operations are the appropriate strategy, even though defensive operations are not completely without exposure to hazards. When considering acceptable risk to firefighters, the HFD ARFF utilizes the following rules of engagement after evaluating the survival profile of any victims and the value of any property involved. We will risk our lives a LOT, in a calculated manner, to save a SAVABLE life. We will risk our lives a LITTLE, in a calculated manner, to save SAVABLE property. We will NOT risk our lives at all for lives or property that are NOT SAVABLE or already lost.

PPE: Personal Protective Equipment

Proximity Fire Fighting: (Per NFPA 1851, 2014 Edition) Specialized fire fighting operations that can include the activities of rescue, fire suppression, and property conservation at incidents involving fire producing high levels of radiant heat as well as conductive and convective heat.

Proximity Fire Fighting Protective Ensemble: (Per NFPA 1851, 2014 Edition) Multiple elements of compliant protective clothing and equipment that when worn together provide protection from some risks, but not all risks, of emergency incident operations.

Total Cargo: (Per Airports Council International – North America "ACI-NA") Loaded + unloaded freight + mail in metric tons. Data includes transit freight.

Total Movements: (Per Airports Council International – North America "ACI-NA") Landing + take off of an aircraft.

Total Passengers: (Per Airports Council International – North America "ACI-NA") Arriving + departing passengers + direct transit passengers counted once.

Structure Fire Fighting: (Per NFPA 1851, 2014 Edition) The activities of rescue, fire suppression, and property conservation in buildings, enclosed structures, vehicles, marine vessels, or like properties that are involved in a fire or emergency situation. (Per NFPA 1500, 2013 Edition) The activities of rescue, fire suppression, and property conservation in buildings or other structures, vehicles, rails cars, marine vessels, aircraft, or like properties.

Structural Fire Fighting Protective Ensemble: (Per NFPA 1851, 2014 Edition) Multiple elements of compliant protective clothing and equipment that when worn together provide protection from some risks, but not all risks, of emergency incident operations.

TEEX: Texas A&M Engineering Extension Service. Training Institute used by HFD ARFF for Live Burns, Aircraft Rescue and Basic ARFF Certification classes.

The First 7 Sections are in response to the NFPA 1851, 2013 Edition, Chapter 5.1.2 Minimum Risk Assessment Questions

1. **Type of duties performed**

Activity Types:

Fire Suppression
- ARFF
- Structural
- Vehicle
- Bulk fuel storage
- Bulk fuel transport
- Other

Rescue
- ARFF
- Structural
- Vehicle
- Confined space
- Collapse
- High Angle
- Trench

Functions or Tasks:

Fire Suppression
- Drive/operate apparatus
- Deploy attack lines
- Engage in offensive fire attack
- Engage in defensive fire attack
- Engage in marginal fire attack
- Deploy/operate appliances
  - Handline nozzles
  - Master streams
- Deploy/operate adapters
  - Wyes/Siamese
  - Adaptors
- Deploy/operate supply lines
- Deploy ladders
- Operate from ladders
- Deploy hand tools/equipment
  - Operate hand tools/equipment
    - Pulling
    - Prying
    - Chopping
    - Cutting
  - Deploy powered equipment
  - Operate powered equipment
    - Pulling
    - Prying
    - Chopping
    - Cutting
  - Don/doff SCBA
  - Work from SCBA air supply
  - Support activities

Rescue Operations
- Drive/operate apparatus
- Deploy ladders
- Operate from ladders
- Deploy/operate hand tools/equipment
  - Pulling
  - Prying
  - Chopping
  - Cutting
- Deploy/operate powered equipment
  - Pulling
  - Prying
  - Chopping
  - Cutting
  - Don/doff SCBA
  - Work from SCBA air supply
  - Deploy/operate stabilization equipment
    - Aircraft stabilization
    - Structural stabilization
    - Vehicle stabilization
    - Trench stabilization
  - Deploy/operate confined space lowering/lifting equipment
  - Deploy/operate high angle lowering/lifting equipment

Health Risks and Safety Hazards Expected to be encountered by HFD ARFF firefighters:

Physiological:

- Physical stress
- Fatigue
- Body core temperature

Physical:

- Sharp edges
- Sharp points
- Falling objects
- Flying debris
- Projectiles
- Splash exposure
- Slippery surfaces
- Vibration
- Abrasive or rough surfaces

Physics:

- Stored thermal energy (heat saturation)
- Thermal energy migration
- Compression

Biological Hazards:

- Bloodborne pathogens
  - Blood and other potentially infectious body material
- Airborne pathogens
- Biological toxins
- Biological allergens

Electrical Hazards:

- High voltage
- Electrical arc
- Static charge buildup

Radiation Hazards:

- Ionizing radiation
- Non-ionizing radiation

Flame/Thermal:

- Radiant heat
- Convective heat
- Conducted heat
- Flame impingement
  - Flashover
  - Backdraft
- Burning embers
- Steam
- Scalding water
- Molten metals
- Hot surfaces
- Others

Environmental:

- Time of day
- Ambient temperatures
- Humidity
- Internal moisture
  - Inside the protective element
- External moisture
  - On the outside of the protective element
- Confined or small spaces
- Rain
- Snow
- Ice
- Wind
- Others

Hazardous Materials & Substances:

- Explosives
- Compressed Gasses
- Flammable Liquids
- Flammable Solids
- Oxidizers
- Poison
- Radioactive
- Corrosives
- Miscellaneous
- Other Regulated Materials
- Liquids
  - Fuels
    - Aviation fuels
    - Motor fuels
    - Propellants
  - Hydraulic fluids
  - Lubricants
  - Firefighting agents
  - Chlorine
  - Blood or other potentially infectious body materials
  - Alkaline
  - Acids
    - Battery Acid
  - Oxidizers
  - Others
- Liquefied gases
  - Oxidizers
  - Liquid Oxygen (LOX)
  - Liquid Propane Gas (LPG)
  - Others
- Compressed gasses
  - Oxidizers
  - Air
  - Oxygen
  - Nitrogen
  - Helium
  - Others
- Solid chemicals
  - Firefighting agents
  - Alkaline
  - Acids
  - Oxidizers
  - Others

2. **Frequency of use of ensemble elements**

Chart # 1 data, are the findings and the results of:

a. Charts 4 and 5 when answering question (3), “Organization’s experiences”
    - In years 2012 – 2014 response data, neither HOU nor IAH has had a response with high levels of radiant heat.

b. The Houston Fire Department Airport Guideline, Section 6.01, General Policy Statement regarding high levels of radiant heat, gear that will be worn into a structure fire, and tactics to be used by ARFF firefighters.

Frequency of use is defined as:

- Limited – lowest thirty percentile (0 to 30%)
- Moderate – median thirty percentile (31 to 60%)
- Often – upper forty percentile (61 to 100%)

IAH and HOU ARFF Response Data from January 1, 2012 - December 31, 2014		
Usage of proximity PPE due to high levels of radiant heat during a response	0.00%	Limited
Usage of structural PPE due to high levels of radiant heat during a response	0.00%	Limited
Usage of structural PPE during a structural fire response, per HFD Airport SOG	100.00%	Often

Chart # 1

Frequency-Severity Index Using Chart 1 Data:

Usage of Structural PPE during a Structural Fire Response

Low Severity Low Frequency	Low Severity High Frequency
High Severity Low Frequency	High Severity High Frequency

Chart # 2

Usage of Proximity PPE or Structural PPE While Responding to High Levels of Radiant Heat

Low Severity Low Frequency	Low Severity High Frequency
High Severity Low Frequency	High Severity High Frequency

Chart # 3

3. Organization’s experiences

- Chart # 4: Three year frequency of ARFF and Fire events for HOU Airport.

Frequency of experiences and/or events based specifically on this emergency response data and is explained utilizing the following charts:

Frequency of event is defined as:

- Limited – lowest thirty percentile (0 to 30%)
- Moderate – median thirty percentile (31 to 60%)
- Often – upper forty percentile (61 to 100%)

HOU ARFF FIRE Response Report

Chart # 4	2012		2013		2014	
Nature of Emergency	Percentile	Frequency	Percentile	Frequency	Percentile	Frequency
High levels of Radiant Heat Fires	0.00%	Limited	0.00%	Limited	0.00%	Limited
Alert 1	13.95%	Limited	26.83%	Limited	19.51%	Limited
Alert 2	86.05%	Often	73.17%	Often	78.05%	Often
Alert 3	0.00%	Limited	0.00%	Limited	2.44%	Limited
Percentage of fire responses that were alerts	56.58%	Moderate	50.00%	Moderate	45.05%	Moderate
Aircraft Crash	0.00%	Limited	0.00%	Limited	0.00%	Limited
Aircraft on Fire	0.00%	Limited	0.00%	Limited	0.00%	Limited
Automatic Alarm	6.58%	Limited	0.00%	Limited	1.10%	Limited
Battery Problem	1.32%	Limited	1.22%	Limited	1.10%	Limited
Bird Strike	3.95%	Limited	0.00%	Limited	0.00%	Limited
Brakes	2.63%	Limited	0.00%	Limited	0.00%	Limited
Building/Structure	2.63%	Limited	0.00%	Limited	0.00%	Limited
Vehicle or Tug Fire	1.32%	Limited	0.00%	Limited	0.00%	Limited
Engine/APU	9.21%	Limited	3.66%	Limited	7.69%	Limited
Flap/Slats	6.58%	Limited	0.00%	Limited	3.30%	Limited
Fuel Spills	2.63%	Limited	13.41%	Limited	15.38%	Limited
Hazmat	0.00%	Limited	0.00%	Limited	0.00%	Limited
Hot Fuel	28.95%	Limited	31.71%	Moderate	38.46%	Moderate
Hydraulic	3.95%	Limited	2.44%	Limited	1.10%	Limited
Landing Gear	13.16%	Limited	19.51%	Limited	17.58%	Limited
Lightning Strike	0.00%	Limited	0.00%	Limited	0.00%	Limited
Smoke in the Aircraft	3.95%	Limited	1.22%	Limited	4.40%	Limited
Other	11.84%	Limited	25.61%	Limited	8.79%	Limited
EMS Response	0.00%	Limited	0.00%	Limited	0.00%	Limited

	2012	2013	2014
ARFF Fire Response Total	76	82	91

- Chart # 5 is the three year frequency of ARFF and Fire events for IAH Airport

Frequency of experiences and/or event based specifically on this emergency response data and is explained utilizing the following charts.

Frequency of event is defined as:
- Limited – lowest thirty percentile (0 to 30%)
- Moderate – median thirty percentile (31 to 60%)
- Often – upper forty percentile (61 to 100%)

IAH ARFF FIRE Response Report

Chart # 5	2012		2013		2014	
Nature of Emergency	Percentile	Frequency	Percentile	Frequency	Percentile	Frequency
High levels of Radiant Heat Fires	0.00%	Limited	0.00%	Limited	0.00%	Limited
Alert 1	1.10%	Limited	7.00%	Limited	2.88%	Limited
Alert 2	98.90%	Often	92.00%	Often	97.12%	Often
Alert 3	0.00%	Limited	1.00%	Limited	0.00%	Limited
Percentage of fire responses that were alerts	39.06%	Moderate	39.37%	Moderate	38.10%	Moderate
Aircraft Crash	0.00%	Limited	0.00%	Limited	0.00%	Limited
Aircraft on Fire	0.00%	Limited	0.39%	Limited	0.00%	Limited
Automatic Alarm	42.49%	Moderate	37.40%	Moderate	26.74%	Limited
Battery Problem	0.43%	Limited	0.39%	Limited	0.00%	Limited
Bird Strike	1.29%	Limited	0.79%	Limited	1.10%	Limited
Brakes	0.86%	Limited	2.76%	Limited	3.30%	Limited
Building/Structure	0.86%	Limited	2.76%	Limited	3.30%	Limited
Vehicle or Tug Fire	1.72%	Limited	1.57%	Limited	0.73%	Limited
Engine/APU	5.15%	Limited	5.51%	Limited	4.03%	Limited
Flap/Slats	5.15%	Limited	3.54%	Limited	2.56%	Limited
Fuel Spills	4.29%	Limited	8.27%	Limited	13.19%	Limited
Hazmat	0.43%	Limited	0.39%	Limited	0.37%	Limited
Hot Fuel	5.58%	Limited	5.91%	Limited	15.75%	Limited
Hydraulic	3.00%	Limited	3.94%	Limited	6.59%	Limited
Landing Gear	7.73%	Limited	7.09%	Limited	5.13%	Limited
Lightning Strike	1.29%	Limited	0.39%	Limited	0.00%	Limited
Smoke in the Aircraft	2.58%	Limited	4.72%	Limited	4.40%	Limited
Other	11.16%	Limited	14.96%	Limited	14.29%	Limited
EMS Response	7.54%	Limited	5.93%	Limited	8.08%	Limited
	2012		2013		2014	
ARFF Fire Response Total	233		254		273	

4. Incident operations

Guidelines and policies are an important tool for the Houston Fire Department and are mandated by the Fire Chief. As such, the following HFD Airport Guideline, Sections 2.01, 2.02 and 6.01 apply in answering Question # 4. The full HFD Airport Guideline can be found in the appendix.

AIRPORT GUIDELINES, VOLUME NO. II, REFERENCE NO. II-18

2.01 Primary Objectives (in order):

A. Firefighter Safety
B. Life Safety/Rescue
C. Incident Control/Mitigation
D. Property Conservation/Environmental Concerns

2.02 These objectives will be accomplished using a risk vs. benefit analysis. ARFF firefighters should only take large risks when there is a large benefit at stake. Small benefits only deserve a small amount of risk.

6.01 General Policy Statement:

When encountering large volumes of radiant heat during an aircraft fire or emergency, fire operations shall be conducted in a defensive mode using ARFF truck turrets to protect the firefighters and exit paths of evacuating victims. Per NFPA 402, 10.11.1 (National Fire Protection Association, 2013 Edition), as soon as the fire has been knocked down, the turrets should be shut down and maintained in a state of readiness. Handline operations with firefighters wearing PPE and SCBA may begin. If a firefighter makes entry into a fuselage/structure, they shall wear structural PPE with SCBA.

Supporting documentation for HFD Airport Guideline, 6.01 General Policy Statement:

Per NFPA 402, National Fire Protection Association, 2013 Edition

- 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.
- 10.6.4 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.
- 10.11.1 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 fire fighting, 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.
- 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 fire-fighting techniques, is effective.
- 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 fire-fighting 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.

5. **Geographic location and climate**

Geographic Location

Houston, seat of Harris County, Texas, is located on the upper Gulf coastal plain at 9522' West and 2946' North, 50 miles from the Gulf of Mexico.

TOPOGRAPHY: Houston lies largely in the northern portion of the Gulf coastal plain, a 40- to 50-mile-wide swath along the Texas Gulf Coast. Typically, elevation rises approximately one foot per mile inland.

Northern and eastern portions of the area are largely forested; southern and western portions are predominantly prairie grassland; coastal areas are prairie and sand.

Surface water in the Houston region consists of lakes, rivers, and an extensive system of bayous and manmade canals that are part of the rainwater runoff management system. Some 25%-30% of Harris County lies within the 100-year flood plain. *Elevation ranges (a.s.l.):* Brazoria 0'-146', Chambers 0'-85', Fort Bend 12'-158', Galveston 0'-43', Harris 0'-310', Liberty 0'-269', Montgomery 43'-435', Waller 80'-357'.

Climate

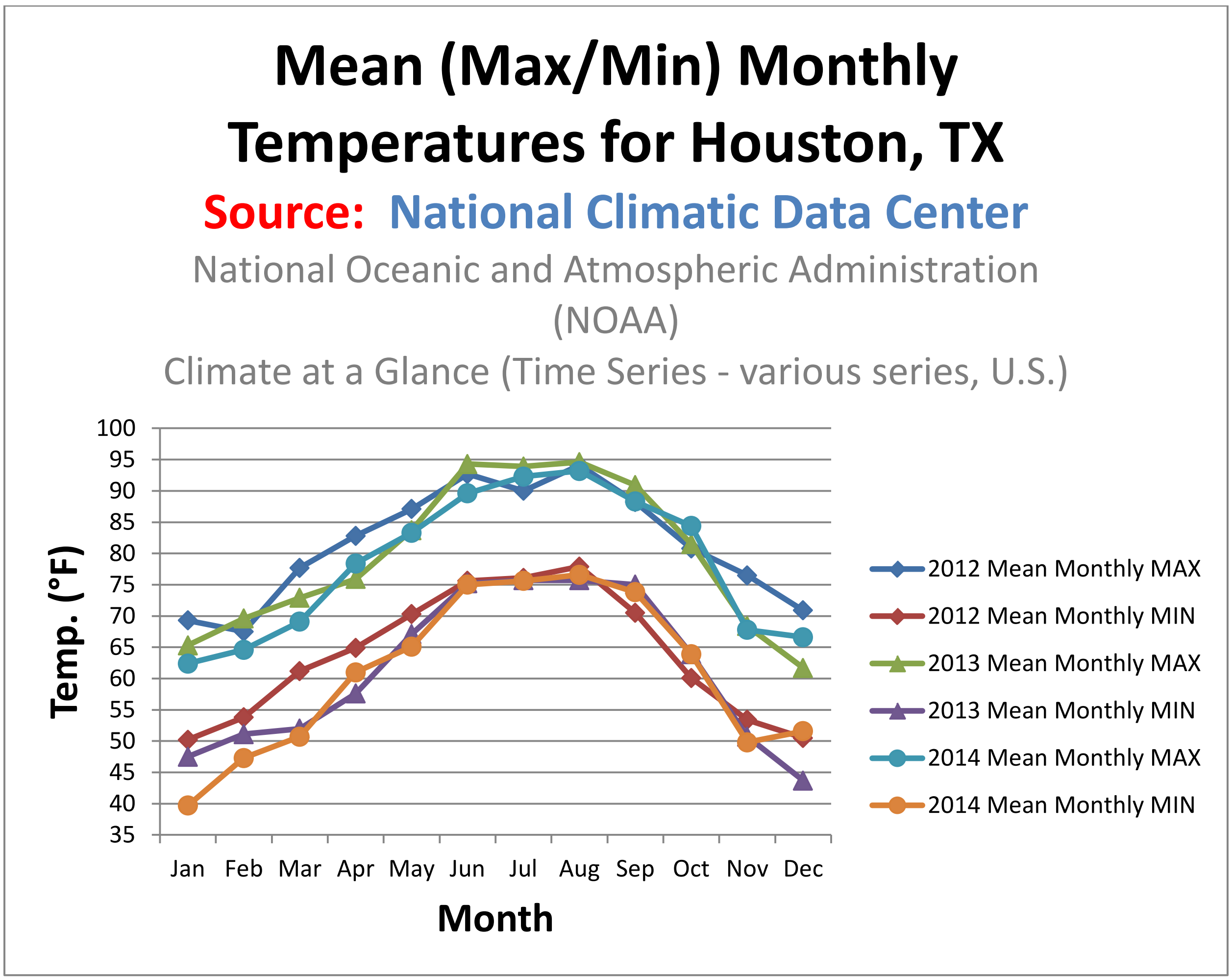

Chart # 6

6. Specific physical area of operation

William P. Hobby Airport: Latitude 29.6456ºN, Longitude 95.2789ºW

Chart # 7

George Bush Intercontinental Airport: Latitude 29.9844ºN, Longitude 95.3414ºW

Chart # 8

7. Likelihood of or response to a CBRN terrorism incident

The likelihood of a response to a CBRN terrorism incident is LOW due to the LOW frequency/history of CBRN incidents at HOU and IAH.

Three concerns HFD ARFF has regarding a CBRN Incident:

1. The increase of Global Terrorism, per the Institute of Economics and Peace.
2. The High Severity of human loss
3. The High Severity of long term environmental impact

To respond and mitigate a CBRN incident at IAH or HOU, HFD ARFF refers to the Houston Fire Department Guidelines.

- Subject: Hazardous Materials, Volume NO. Ⅱ, Reference NO. Ⅱ-15
- Subject: Weapons of Mass Destruction, Volume NO. Ⅱ, Reference NO. Ⅱ-41

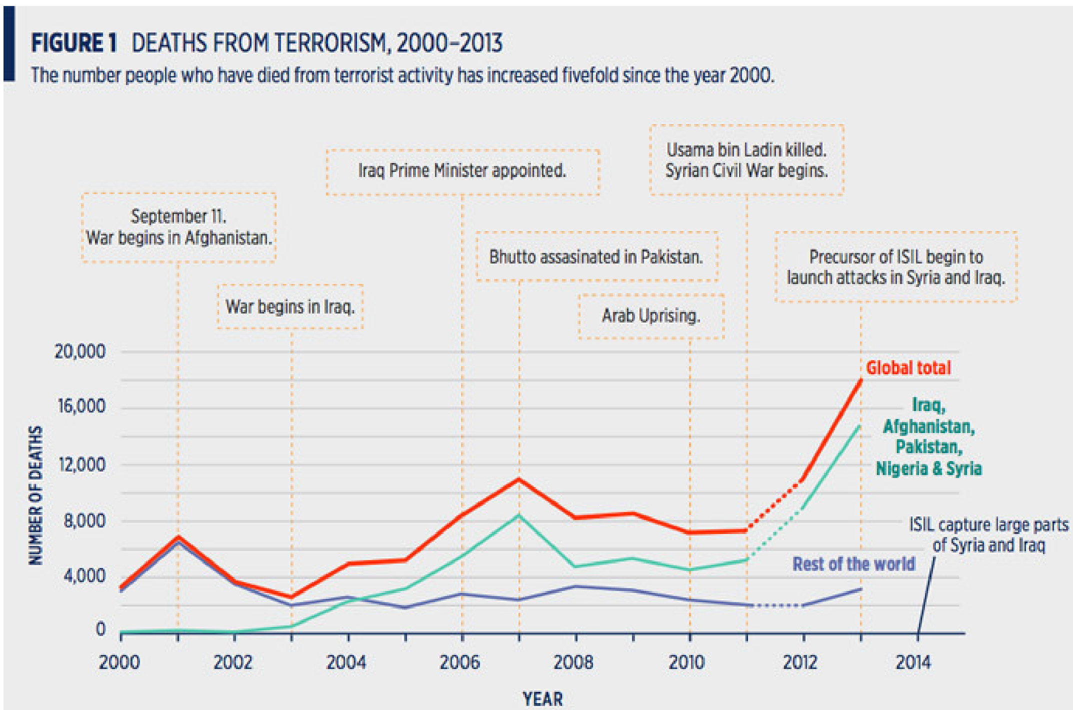

Chart # 9

Questions 8 – 15 are additionally added questions and statements to this risk assessment:

8. Statement of HFD ARFF Fire Fighter training, duties and responsibilities.

HFD ARFF, like most professional "ALL RISK" fire departments, maintains aggressive strategies and tactics for the suppression of fires. HFD ARFF firefighters are exposed to all phases of fire progression including incipient, free burning, rollover, flashover, backdraft and smoldering. Throughout these fire phases, HFD ARFF firefighters will be exposed to a range of temperatures from moderate through extreme. Based on the HFD ARFF Standard Operating Guidelines, tactics, activities, functions, or tasks performed are identified in this section. Additionally, firefighters are exposed to varying temperature ranges during training exercises conducted at the TEEX Fire Academy, HFD VJTF live structural drills, and the Mobile ARFF trainer which maintains the proficiency of the HFD ARFF fire fighter. Therefore, the PPE must be capable of protecting HFD ARFF firefighters during their expected duties.

9. Statement of ARFF staffing and FAA Requirements.

HFD ARFF Staffing

The Houston Fire Department (HFD) currently has 144 Aircraft Rescue Fire Fighting (ARFF) personnel assigned to the four (4) Houston Airport System (HAS) fire stations- Three (3) at Houston Intercontinental Airport IAH and one (1) at William P. Hobby HOU (Figure 1). These personnel cover four, 24 hour shifts. Each shift at IAH has a minimum staffing of 22 Aircraft Rescue Firefighters on duty. Each shift at HOU has a minimum staffing of 5 Aircraft Rescue Firefighters on duty. HFD ARFF heavy apparatus (1500 gallons of water or greater capacity) shall be staffed with at least two personnel.

IAH:

1 – Senior Captain
3 – Captains
10 – Engineer Operators
8 – Firefighters

HOU:

1 – Captain
2 – Engineer Operators
2 – Firefighters

FAA Requirements:

Federal Aviation Regulation (FAR) PART 139 only specifies the number of vehicles and agent an airport must have in operation to be in compliance. The number of personnel is not specified. The only guidance for the number of personnel is that "sufficient rescue and firefighting personnel are available during all air carrier operations to operate the vehicles, meet the response times, and meet the minimum agent discharge rates required by this part" (FAR 139.319). The HFD ARFF Division currently meets all federal regulations and has performed satisfactorily based on current staffing levels and Federal inspections.

10. **HFD ARFF apparatus, resources, and capabilities that will be used to mitigate an emergency**

The following 4 charts (10-13) will show that HFD ARFF meets and exceeds the Federal Aviation Administration FAR PART 139 requirements regarding apparatus. The complete Federal Aviation Administration FAR PART 139 can be found in the appendix.

These units also meet FAA Advisory Circular 150/5210-6D and NFPA 403, Annex B, §B.2 regarding Control Time.

- **Per FAA Advisory Circular 150/5210-6D:** The control time is the time required from the arrival of the first fire fighting vehicle and the beginning of agent discharge to reduce the initial intensity of the fire by 90 percent. The equipment and techniques to be used should be capable of controlling the fire in the Practical Critical Fire Area (PCA) in 1 minute.

Protection against Radiant Heat Installed on the ARFF Fleet:

1. Pump and Roll capabilities, these units are able to discharge firefighting extinguishing agents while driving. This capability allows the firefighters to quickly move from one location to another while fighting the fire in the safety of the unit.
2. Bumper and roof turrets that can attack the fire from 100 – 250', keeping the firefighter at a safe distance.
3. Each ARFF unit has solar control film applied to the windshield and windows. The solar control film protects the firefighters in the unit against high levels of radiant heat.
4. Windshield deluge system with 4 nozzles which keeps the windshield cool.

Station 81 HOU Apparatus FAA Index C	AR-26	AR-27	Reserve AR-28
	2006 Rosenbauer	2006 Rosenbauer	2003 E-One
	4X4 RIV	6X6 HRET	6X6 HRET
Specifications			
Water - gallons	1500	3000	3000
AFFF - gallons	200	400	400
Purple K - lbs.	450	None	None
Halotron 1 - lbs.	None	460	460
Roof Turret	375 - 750 gpm	500 - 1000 gpm	500 - 1000 gpm
Roof Turret - Reach	190'	250'	230'
Piercing Applicator	None	250 gpm 7 lbs. / sec.	250 gpm 7 lbs. / sec.
Bumper Turret	375 - 750 gpm	300 gpm	300 gpm
Bumper Turret - Reach	190'	200'	150'
Undertruck Nozzles	20 gpm	20 gpm	20 gpm
Preconnect Handlines	None	1 3/4" 2 - 200'	1 3/4" 1 - 200' 1 - 150'
Hose reel	None	Halotron - 150' 5 - 7 lbs. / sec.	Halotron - 150' 7 lbs. / sec.
Class D Extinguishers	2 - 30 lbs.	2 - 30 lbs.	2 - 30 lbs.
Dry Chem Extinguishers	None	None	None
CO2 Extinguishers	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.
Halotron I	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.

Chart # 10

Station 54 IAH Apparatus FAA Index E	AR-2	AR-3	AR-4	Reserve AR-32	AR-8
	2007 F-550	**2007 Rosenbauer**	**2006 Rosenbauer**	**96 Oshkosh**	**1999 E-One**
	4X4 RIV	**6X6 HRET**	**6X6 Panther**	**6X6 HRET**	**Cyclone Pumper**
Specifications					
Water - gallons	94	3000	3000	3000	500
AFFF - gallons	6	400	400	400	50
Purple K - lbs.	450	None	450	None	None
Halotron I	None	460	None	None	None
Roof Turret	None	500 - 1000 gpm	600 - 1200 gpm	500 - 1000 gpm	None
Roof Turret - Reach	None	230'	250'	230'	None
Piercing Applicator	None	250 gpm 7 lbs. / sec.	None	250 gpm 7 lbs. / sec.	None
Bumper Turret	Hydro-Chem 60 gpm 7 lbs. / sec.	300 gpm	Hydro-Chem 500 - 1000 gpm 17 lbs. / sec.	300 gpm	None
Bumper Turret - Reach	100'	150'	200'	150'	None
Undertruck Nozzles	None	20 gpm	20 gpm	17 gpm	None
Preconnect Handlines	None	1 3/4" 2 - 200'	1 3/4" 2 - 200'	1 3/4" 2 - 200'	1 3/4" 2 - 200'
Hose reel	Hydro-Chem - 100' 60 gpm 7 lbs. / sec.	Halotron - 150' 7 lbs. / sec.	Hydro-Chem - 100' 60 gpm 7 lbs. / sec.	Booster - 150'	Booster - 150'
Met LX Extinguishers	2 - 30 lbs.	2 - 30 lbs.	2 - 30 lbs.	2 - 30 lbs.	1 - 30 lbs.
Dry Chem Extinguishers	None	None	None	None	1 - 30 lbs.
CO2 Extinguishers	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.
Halotron I	None	1 - 15 lbs.	1 - 15 lbs.	None	1 - 15 lbs.

Chart # 11

Station 92 IAH Apparatus FAA Index E	AR-5	AR-6	AR-7	Reserve AR-31
	2006 Rosenbauer	**2003 E-One**	**2003 F-550**	**91 Oshkosh**
	6X6 Panther	**6X6 HRET**	**4X4 RIV**	**6X6 T-3000**
Specifications				
Water - gallons	3000	3000	94	3000
AFFF - gallons	400	400	6	400
Purple K - lbs.	450	None	450	None
Halotron I	None	460	None	Halon - 450
Roof Turret	600 - 1200 gpm	500 - 1000 gpm	None	600 - 1200 gpm
Roof Turret - Reach	250'	230'	None	250'
Piercing Applicator	None	250 gpm 7 lbs. / sec.	None	None
Bumper Turret	Hydro-Chem 500 - 1000 gpm 17 lbs. / sec.	300 gpm	Hydro-Chem 60 gpm 7 lbs. / sec.	300 gpm
Bumper Turret - Reach	200'	150'	100'	150'
Undertruck Nozzles	20 gpm	20 gpm	None	17 gpm
Preconnect Handlines	1 3/4" 2 - 200'	1 3/4" 1 - 200' 1 - 150'	None	1 3/4" 2 - 200'
Hose reel	Hydro-Chem - 100' 60 gpm 7 lbs. / sec.	Halotron - 150' 7 lbs. / sec.	Hydro-Chem - 100' 60 gpm 7 lbs. / sec.	Halon - 150' 7 lbs. / sec.
Met LX Extinguishers	2 - 30 lbs.	2 - 30 lbs.	1 - 30 lbs.	2 - 30 lbs.
Dry Chem Extinguishers	None	None	None	None
CO2 Extinguishers	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.
Halotron I	1 - 15 lbs.	1 - 15 lbs.	None	None

Chart # 12

Station 99 IAH Apparatus FAA Index E	AR-16	AR-17	AR-18	Reserve AR-33
	2003 E-One	**2006 Rosenbauer**	**2013 Rosenbauer**	**81 Oshkosh**
	4X4 RIV	**6X6 Panther**	**6X6 HRET**	**6X6 T-3000**
Specifications				
Water - gallons	1500	3000	3000	3000
AFFF - gallons	200	400	400	400
Purple K - lbs.	450	450	None	None
Halotron I	None	None	460	None
Roof Turret	300 gpm	600 - 1200 gpm	500 - 1000 gpm	600 - 1200 gpm
Roof Turret - Reach	150'	250'	250'	250'
Piercing Applicator	None	None	250 gpm	None
Bumper Turret	Hydro-Chem 375 - 750 gpm 17 lbs. / sec.	Hydro-Chem 500 - 1000 gpm 17 lbs. / sec.	375 - 750 gpm	300 gpm
Bumper Turret - Reach	200'	200'	150'	150'
Undertruck Nozzles	20 gpm	20 gpm	20 gpm	17 gpm
Preconnect Handlines	None	1 3/4" 2 - 200'	1 3/4" 2 - 200'	1 3/4" 2 - 200'
Hose reel	Hydro-Chem - 100' 60 gpm 7 lbs. / sec.	Hydro-Chem - 100' 60 gpm 7 lbs. / sec.	Halotron - 150' 7 lbs. / sec.	150' Booster Line
Met LX Extinguishers	2 - 30 lbs.	2 - 30 lbs.	2 - 30 lbs.	2 - 30 lbs.
Dry Chem Extinguishers	None	None	None	None
CO2 Extinguishers	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.
Halotron I	1 - 15 lbs.	1 - 15 lbs.	1 - 15 lbs.	None

Chart # 13

11. What are the types of aircraft, amount of fuel, and passenger loads for IAH and HOU?

When assessing the risk at HOU and IAH, you must know hazards and possible number of victims we may have. The following 3 charts (14-16) detail this information in regards to aircraft, amount of fuel, and passenger loads for IAH and HOU.

IAH Cargo Aircraft		
Aircraft Type	FAA Index	Fuel in Gallons
Cessna "Caravan"	A	350
Fairchild Dornier SA-227DC "Metro"	A	650
Short SD3-60	A	650
Lockheed "Hercules"	B	9,000
Airbus 310	C	16,000
Illyushin "Candid"	C	30,000
Boeing 727-200	C	10,000
Boeing 757-200	C	12,000
Boeing 767-300	D	24,000
Airbus 300F	D	18,000
McDonnel Douglas DC-10	D	37,000
McDonnel Douglas DC-8	D	24,000
McDonnel Douglas MD-11	E	38,000
Boeing 777-200LR/F	E	48,000
Antonov An-124 "Ruslan"	E	68,000
Boeing 747-400	E	57,000
Boeing 747-800	E	64,000
Antonov An-225 "Mriya"	E	98,000

Chart # 14

IAH Passenger Aircraft		
FAA Index A - Less Than 90 Feet		
Aircraft	Fuel in Gallons	Passengers
Saab 340	1,000	37
Embraer ERJ 135	1,000	38
CRJ 200	2,000	53
FAA Index B - 90 To Less Than 126 Feet		
Aircraft	Fuel in Gallons	Passengers
EMB 145	1,500	53
EMB 170 & 175	3,000	79
CRJ 700	3,000	74
Dash 8-400	1,500	84
Airbus 319	6,000	135
Boeing 737 - 300, 500 & 700	7,000	134
EMB 190	4,000	104
CRJ 705 & 900	3,000	94
Boeing 737-400	6,000	145
Airbus 320	6,000	155
FAA Index C - 126 To Less Than 159 Feet		
Aircraft	Fuel in Gallons	Passengers
McDonnel Douglas DC-9	4000	84
737-800 & 900	8,000	186
MD-80	7,000	155
757-200	12,000	206
FAA Index D - 159 To Less Than 200 Feet		
Aircraft	Fuel in Gallons	Passengers
Boeing 767-200	24,000	206
Boeing 757-300	12,000	232
Boeing 787-800 & 900	33,000	280
Boeing 767-300	24,000	268
FAA Index E - 200 Feet and Greater		
Aircraft	Fuel in Gallons	Passengers
Boeing 767-400	24,000	308
Boeing 777-200	48,000	410
Boeing 747-400	64,000	411
Boeing 777-300	48,000	451
Airbus 380	85,000	500

Chart # 15

HOU Passenger Aircraft		
FAA Index A - Less Than 90 Feet		
Aircraft	Fuel in Gallons	Passengers
CRJ 200	2,000	88
FAA Index B - 90 To Less Than 126 Feet		
Aircraft	Fuel in Gallons	Passengers
ERJ 140	1400	47
EMB 145	2,000	53
EMB 170	3,200	80
EMB 190	4,300	105
CRJ 700	3,000	74
CRJ 900	3,000	80
Boeing 717	3,700	122
Boeing 737-500	5,300	127
Boeing 737-300 & 700	7,000	134
Airbus 319	6,300	142
Airbus 320	6,300	156
FAA Index C - 126 To Less Than 159 Feet		
Aircraft	Fuel in Gallons	Passengers
McDonnel Douglas DC-9	4000	135
737-800 & 900	8,000	186
MD-80	7,000	155

Chart # 16

12. What are the opportunities for incidents, victims, and possible HAZMAT incidents in relation to Total Passenger Count, Total Cargo and Total Movements at IAH and HOU?

The below chart details a 5 year history of Total Passenger Count, Total Cargo and Total Movements at IAH and HOU airports. Each one of these movements could have been a possible incident and the above charts 15 – 16, show the possible number of victims we could have had on a particular aircraft.

Airports Council International - North America					
Top 50 Airports, Report Data					
George Bush InterContinental Airport					
Years	2010	2011	2012	2013	2014
Total Passengers	40,479,569	40,128,953	39,891,144	39,799,414	41,251,015
Total Cargo - Metric Tons	423,483	446,328	438,375	426,805	433,433
Total Movements	531,347	517,262	502,677	496,908	503,696
William P. Hobby Airport					
Years	2010	2011	2012	2013	2014
Total Passengers	8,498,441	9,843,302	10,437,647	11,109,449	11,945,825
Total Cargo - Metric Tons	11,222	10,490	11,982	12,914	12,704
Total Movements	273,031	272,840	170,636	182,056	214,622

Chart # 17

13. **What types of protective clothing are available for HFD ARFF fire fighters?**

    When determining the type of protective clothing to purchase, you must look at the specifications of each set of protective clothing.

Specification of Houston Fire Department Structural Clothing

These specifications meet and/or exceed the NFPA 1971 requirements. (Chart #18, page 33)

Composite Performance:

- The garment composite, consisting of the outer shell, moisture barrier and thermal liner, shall provide a Thermal Protective Performance (TPP) of not less than 41 when tested in accordance with NFPA 1971 standard.
- The garment composite, consisting of the outer shell, moisture barrier and thermal liner, shall provide a Total Heat Loss (THL) of not less than 255 when tested in accordance with NFPA 1971 standard.
- The Heat Transfer Index rating shall be a minimum of 25 seconds for the shoulder when measured at 2 psi (pounds per square inch) and a minimum of 25 seconds for the knee when measured at 8 psi.

Specification of Houston Fire Department Proximity Clothing

These specifications meet and/or exceed the NFPA 1971 requirements. (Chart #18)

Composite Performance:

- The garment composite, consisting of the outer shell, moisture barrier and thermal liner, shall provide a Thermal Protective Performance (TPP) of not less than 40 when tested in accordance with NFPA 1971 standard.
- Total Heat Loss (THL) – N/A
- The Heat Transfer Index rating shall be a minimum of 25 seconds for the shoulder when measured at 2 psi (pounds per square inch) and a minimum of 25 seconds for the knee when measured at 8 psi.

Main Performance Difference Between Structural and Proximity Elements

1. Structural gear has Total Heat Loss (THL) performance
2. Proximity has no THL performance.
    a. Due to the lack of THL, fire fighters must be aware of the possible heat related emergencies that can accrue while wearing proximity PPE
3. Proximity gear has Radiant Protective Performance.
4. Structural gear has no Radiant Protective Performance.

Statements of related information to these types of PPE:

The following is a consensus of the NFPA Technical Committee regarding proximity elements NFPA 1851, 2014 Edition Annex A

A.10.1.3.1 Specific to proximity elements, the consensus of the technical committee is that the life of a proximity outer shell is considerably less than that of a structural shell and that the life span is entirely dependent on the type and amount of field use to which each separate element has been exposed. Given the characteristics of the aluminized outer materials necessary to obtain the required radiant and reflective properties, this type of fabric is especially susceptible to abrasion, which can result in a loss of the protective qualities in a very short time. Regardless of when the element was originally produced, it is imperative that the protective elements be routinely inspected to ensure that they are clean, well maintained, and still safe. Just knowing the age of the elements cannot do that.

Federal Aviation Administration, Advisory Circular (AC), 150/5210-14A, Dated 7/13/1995
Subject: Aircraft Rescue Fire Fighting Equipment, Tools and Clothing

While at least one proximity ensemble per response vehicle is customary, the selection, purchase and use of proximity or nonreflective protective clothing is a decision made by airport management based on operational considerations and risk assessment. Advanced primary firefighting agents, such as Aqueous Film Forming Foam (AFFF), in combination with powerful agent pumps and long-range turrets now enable airport firefighters to control and essentially extinguish large aviation fuel fires while still in the attacking vehicle. This means that aviation fuel fires can be controlled in minutes before leaving the vehicle and advancing handlines. Therefore, firefighters often do not need to leave the ARFF vehicle before the levels of radiant heat are low enough to allow the use of nonreflective gear. If nonreflective protective clothing is selected, fire protection personnel need to be made aware of the limitations of their protective clothing. As with any protective clothing, training and education need to be conducted to educate firefighters concerning proper use, care, and PPE limitations.

Federal Aviation Administration, Advisory Circular, 150/5210-14A, Dated 7/13/1995 has been replaced by Advisory Circular, 150/5210-14B, Dated 9/30/2008. The importance of Advisory Circular, 150/5210-14A is that the FAA recognized in 1995 that the ARFF apparatus of that time were capable of extinguishing large volumes of aviation fuel fires within minutes and reducing the amounts of radiant heat to the point that proximity PPE was not necessary for handline operations. The ARFF apparatus of today have far surpassed the capabilities of those in 1995.

In the FAA AC 150/5210-14A, the FAA made recommendations regarding Aircraft Rescue Fire Fighting Equipment, Tools and Clothing. With FAA AC 150/5210-14B, FAA states that Aircraft Rescue Fire Fighting Equipment, Tools and Clothing must meet the requirements of certain NFPA documents.

Minimum Requirements Per NFPA 1971

GARMENT STANDARDS COMPARISON CHART

Performance Requirement	**Structural 1971**	**Proximity 1971**
TPP – Thermal Protective Performance Insulation	≥35.0	≥35.0
THL – Thermal Protective Performance Insulation	≥ 205 W/m^2	N/A
CCHR	≥25	≥25
Heat & Thermal Shrinkage	500^{o}F for 5 minutes. No melt, separate, ignite. <10% Shrinkage MB seam – no drip OS – No char	500^{o}F for 5 minutes. No melt, separate, ignite. <10% Shrinkage MB seam – no drip OS – No char
Radiant Protective Perf	N/A	> 20 Seconds
Wet Flex	N/A	No cracking/delaminating
Adhesion after WF	N/A	No separation
Flex at Low Temp	N/A	No breaking, shattering or cracking of the coating, laminate or fabric
Resistance to High temp blocking	N/A	No blocking
Thread Melting	No melt below 500^{o}F	No melt below 500^{o}F
Flame	Afterflame < 2 sec Char length < 4” No melt or drip	Afterflame < 2 sec Char length < 4” No melt or drip
Liquid Penetration	No penetration in < 1 hour	No penetration in < 1 hour
Viral Penetration	No penetration in < 1 hour	No penetration in < 1 hour
Liquid tight integrity	No water penetration	No water penetration
Water Penetration	≥ 25 psi (MB)	≥ 25 psi (MB)
Water Absorption	≤ 30% absorption (OS)	≤ 30% absorption (OS)
Tear Resistance	OS ≥22 lbs TL/MB≥5 lbs	OS ≥22 lbs TL/MB≥5 lbs
Breaking Strength	≥ 140 lbs	N/A
Seam Breaking	Major A ≥ 150 lbs Major B ≥ 75 lbs Minor ≥ 40 lbs	Major A ≥ 150 lbs Major B ≥ 75 lbs Minor ≥ 40 lbs
Light Degradation Resistance	No leakage (MB)	No leakage (MB)
Corrosion	Remain functional No corrosion	Remain functional No corrosion
Trim	≥100 cd/lux/m^2 designation of fluorescent	N/A
Cleaning Shrinkage	≤ 5%	≤ 5%
Label Durability	Legible after exposure	Legible after exposure
Design Requirement	**Structural 1971**	**Proximity 1971**
Fluorescent and Retroreflective Visibility Markings	X	N/A
Radiant Reflective Properties	N/A	X

Chart # 18

14. **TEEX three year injury data for their ARFF classes. What type of gear was the fire fighter wearing at the time of their injury?**

Data received from TEEX shows that there was more injuries to firefighters while wearing proximity gear then while wearing structural gear. TEEX did not know the number of firefighters that wore structural or proximity gear during their training but they did state that they train many more firefighters in structural then in proximity gear. TEEX data is presented in its original format, as shown below.

ARF200 – TCFP ARFF Academy

	2011	**2012**	**2013**
Classes Scheduled	**4**	**2**	**5**
Classes Held	**4**	**2**	**4**
# of Students	**50**	**34**	**28**

Chart # 19

Proximity Gear – No injury

Structural Gear – no injury

*Classes for 2014 had – 16 students no injury

ARF100 – Airport FF 40 hour

	2011	**2012**	**2013**
Classes Scheduled	**11**	**5**	**6**
Classes Held	**11**	**5**	**5**
# of Students	**440**	**31**	**42**

Chart # 20

Proximity gear – 1 burn steam to shoulders and back

Structural Gear – No injury

*Classes for 2014 had 103 students no injury

ARF500 – Hot Drills

	2011	2012	2013
Classes Scheduled	**57**	**70**	**73**
Classes Held	**57**	**70**	**73**
# of Students	**785**	**1101**	**847**

Chart # 21

Proximity Gear –

2011 - No injuries

2012 - 3 injury steam burns to chest and shoulders

2013 – 2 injury radiant burn to chest

Structural Gear –

2011 – No injuries

2012 – 1 injury steam burn to arm

2013 – 1 medical overheat

*Classes for 2014 had 920 students with no injury

* - complete year of 2014 not calculated at this time.

***No injury required further medical care. Noted for training purposes and released to full duty.

15. Per NFPA 1851, A.5.1.1: Consider national trends. What is the National trend for ARFF Fire Departments regarding, issuing their crews proximity and/or structural gear?

The below survey shows that 17 of the 23 Index E ARFF Fire Departments use only structural gear for their fire fighter's. Nationally the trend is moving away from proximity gear to only structural gear.

2014 Index E Airports Structural and Proximity Gear Survey			
Airport	**Structural**	**Proximity**	**Both**
Anchorage	X		
Atlanta	X		
Boston	X		
Dallas/Ft Worth			X
Denver	X		
Detroit	X		
Fort Lauderdale			X
Washington	X		
Houston			X
Las Vegas	X		
Los Angeles			X
Miami	X		
Orlando	X		
Minneapolis	X		
Chicago	X		
Portland	X		
Philadelphia	X		
Phoenix	X		
Teterboro		X	
Seattle	X		
San Francisco	X		
Salt Lake City	X		
Tampa			X
Total:	**17**	**1**	**5**

Chart # 22

Risk Assessment Summary

Goal

Today the Houston Fire Department issues structural and proximity fire fighting gear to all of its ARFF Firefighters. This risk assessment is being performed to determine if HFD will continue issuing structural and proximity gear, issue just structural gear or issue just proximity gear to all HFD ARFF Firefighters.

Findings

1. Based on the types of duties performed, listed in the response to question #1 and the information listed while answering question #13, the following conclusions were made:
    a. Structure PPE will be used to accomplish these duties due to its durability, TPP and THL.
    b. Due to the lack of THL in proximity and the fabric being especially susceptible to abrasions, proximity PPE will not be used during these duties.
2. Houston Fire Department Airport Guidelines state:
    a. When encountering large volumes of radiant heat during an aircraft fire or emergency, fire operations shall be conducted in a defensive mode using ARFF truck turrets to protect the firefighters and exit paths of evacuating victims.
        i. With this tactic, proximity PPE will not be needed and the fire will not be fought using a proximity handline tactic.
    b. If a firefighter makes entry into a fuselage/structure, they shall wear structural PPE with SCBA.
        i. Structural Fire Fighting: Per NFPA 1500, The activities of rescue, fire suppression, and property conservation in buildings or other structures, vehicles, rail cars, marine vessels, aircraft, or like properties.
3. The ARFF apparatus currently in the fleet are capable to control 90 percent of the PCA in one minute from distances of 100 – 250'. This capability allows the firefighter to maintain a safe distance until 90 percent of fire control is reached.
4. Pump and Roll capabilities, these units are able to discharge firefighting extinguishing while driving. This capability allows the firefighters to quickly move from one location to another while fighting the fire in the safety of the unit.

Conclusion

Based on the findings of the risk assessment, the Houston Fire Department Aircraft Rescue Fire Fighting division has chosen structural fire fighting PPE to be the fire fighting ensemble that will be used by all aircraft rescue firefighters. Proximity PPE will no longer be issued and the current proximity PPE inventory will be returned to HFD Quartermaster for salvaging.

Approved: ______________________ Date: 3-6-2015

Terry Garrison
Fire Chief