CHAPTER 1. INTRODUCTION

1.1 General

National Fire Protection Association (NFPA) Standard 414, Aircraft Rescue and Fire Fighting Vehicles, defines a High Reach Extendable Turret (HRET) or Extendable Turret as: "a device, permanently mounted with a power-operated boom or booms, designed to supply a large-capacity, mobile, elevated water stream or other fire extinguishing agents, or both".

1.2 Purpose

a. HRETs provide significant tactical Aircraft Rescue and Fire Fighting (ARFF) capabilities. The skill sets required to best deploy these capabilities are only realized through structured hands-on training and continuous practice. This training first requires mastering the operation of ARFF vehicles and then HRET's.

b. This Advisory Circular (AC) describes the functions, capabilities and benefits of HRETs. It also outlines the standards for training and qualification of ARFF vehicle and HRET operators. This document also serves as a reference providing specific data that will be helpful in making specific strategic decisions relative to piercing aircraft involved in fire.

1.3 Overview of HRET Technology

HRETs provide ARFF firefighters with a number of tactical advantages when involved in ARFF operations. Testing conducted by the FAA compared a P-19 roof turret with an HRET involving pooled fuel test fires (refer to DOT/FAA/AR-05/53 – High Reach Extendable Turrets with Skin Penetrator Nozzle, Final Report November 2005). The HRET in its optimum attack mode, the down-in-front configuration, was compared to the P-19 roof-mounted turret agent delivery system. Both vehicles were tested under the same conditions. The HRET in the down-in-front attack mode extinguished the burn area an average of 53% faster than the P-19 roof-mounted turret. Both vehicles used a frontal attack method on the large-scale burn area. The HRET in the down-in-front position was able to extinguish the burn area by oscillating the HRET from right to left without repositioning the vehicle. The P-19, however, had to make slight vehicle adjustments to the right and left of the burn area in order for its roof-mounted turret to reach the sides of the large-scale aircraft mockup.

a. The HRET and skin-penetrating nozzle evaluated at the fire test facility outperformed the standard roof-mounted turret and hand line. In all aspects of the evaluation, the data gathered from simulated real fire aircraft crashes involving the HRET with skin-penetrating nozzle demonstrated the ability to extinguish fire faster, increase the accuracy of firefighting agent application by positioning the HRET close to the source of the fires, and using less firefighting agent on several fires. Other fire extinguishment performance advantages included the extendable reach of the HRETs nozzle, increase in firefighting agent throw range because of its extendibility, and its ability to reposition the HRET in all directions without moving the airport firefighting vehicle.

b. The HRET with skin-penetrating nozzle, when used on the full-scale fire field test using a training aircraft, showed the ability to control and contain the fire from spreading beyond the tail section, reduce high cabin temperatures from over 1500°F (815°C) to approximately 250°F (121°C), provide rapid smoke ventilation, and the ability to extinguish fire. The injection of fine mist water spray showed immediate results providing a fire-block and lowering cabin temperatures. The ability to ventilate using

the skin-penetrating nozzle is a less manpower-intensive and time-consuming process compared to using traditional ventilation fans. The cabin conditions after discharging the fine mist water spray allowed fire fighters to enter the aircraft.

c. The extendable turret places the nozzle well forward and below the operator, thus eliminating foam overspray and providing a clearer view of the effectiveness of agent application. The ability to position the nozzle nearer to, or in alignment with the target allows more precise aiming, reduces disruption from wind and helps to conserve agent.

d. When the nozzle is positioned at the seat of the fire, it allows extinguishment of ground based fires more effectively as agent is applied directly on the burning surface. This eliminates the "raindrop" application, a situation that generally results in wasted agent, as the heated smoke plume and wind carry it away. In addition, the nozzle can be placed near an elevated engine or wing fuel tank fire to cut off running fuel fires.

e. The extendable turret with precision nozzle placement can be more effective with rates in the 250 to 500 gallon per minute (946 to 1892 Liters per minute) range, whereas conventional primary turrets flowing 750 to 1000 gallons per minute (2839 to 3785 Liters per minute) exhaust the supply of agent much more rapidly. This technology allows the operator to extinguish the fire with short bursts of agent with more precision, as opposed to mass application.

f. The operator has the ability to switch agent application rates between high flow and low flow. This allows the operator to select the amount of agent needed to do the job most effectively. In large fires, a high flow rate is the most effective way to overcome the intense heat and quickly control the fire. In other situations, where less flow can be effective, a low flow rate helps to conserve agent for reapplication to maintain the integrity of the foam blanket.

g. HRETs increase ability and safety in getting agent to a high mounted engine as well as with 3 dimensional running fuel fires. The ability to quickly position the nozzle in the most effective attack position, increases effectiveness of the stream, reduces agent consumption and provides a safe vantage point for the firefighter.

h. HRETs are very effective in fighting fires on aircraft undercarriage. The tool allows precise positioning of the nozzle without putting the firefighter in harm's way.

i. All of the benefits of an HRET that have been verified through extensive testing and during actual events can only be realized if the tool is in the hands of skilled, qualified operators.

1.4 Options and Considerations

HRETs must meet the requirements of NFPA 414 and AC 150/5220-10, Guide Specification for Aircraft Rescue and Fire Fighting Vehicles.

a. ARFF vehicles equipped with HRETs are eligible for funding under the Airport Improvement Program (AIP). Consideration for funding will be limited to one of these devices at each ARFF Station at Airports at Index B and above. If funded by the FAA, the HRET must include a skin penetrating nozzle. The penetrating nozzle must be movable to allow for proper alignment of the penetrator to the aircraft fuselage for piercing operations.

b. Complementary agent can be provided through individual hose reels or through combined agent systems, which combine one or more complementary agent lines with a water/foam line.

c. In addition to the complementary agent hose reels, options are available on HRETs which can provide discharge of the selected complementary agents at the tip of the boom, or through the piercing tip.

d. Forward-looking Infrared (FLIR) Cameras are now standard equipment on any ARFF vehicle purchased with AIP funds. FLIR Cameras provide a number of capabilities and properly locating the best mounting position for the camera and the monitor on the vehicle helps ARFF fire fighters get the greatest advantage from the FLIR.

e. The selection and installation of the FLIR and the FLIR monitor should be in compliance with AC 150/5210-19, Drivers Enhanced Vision Systems.

f. Night vision capability will improve visual awareness in smoky, foggy, or dark environments by sensing thermal radiation instead of visible light. FLIR Cameras were first installed on ARFF Vehicles because of the value they provide during low visibility response. Response on the airfield during periods of fog, darkness or inclement weather reduces visibility for drivers, and adds to response times. The view provided by the FLIR camera during low visibility response is enhanced by the thermal signature of fixed targets and landmarks as well as moving people, vehicles and aircraft.

g. In addition to its' benefits during low visibility response, FLIR cameras provide a number of tactical benefits. FLIRs provide excellent visual indicators during initial assessment for hot spots or overheated aircraft components as well as to measure effectiveness of firefighting efforts or other tactical operations.

h. ARFF vehicles equipped with HRETs and DEVs may be eligible for two (2) FLIR cameras. The FLIR associated with Driver Enhanced Vision Systems (DEVS) should be mounted with remote controlled pan and tilt capabilities. It should be sufficiently tight so that the picture is clear and stable. Line of sight should be aligned with that of the driver. The mounting should not compromise operation of the HRET in any manner. The mounting of the FLIR should be accomplished in such a way that the FLIR is still able to view the aircraft during piercing operations

i. Roof vision panels in the cab are very helpful during HRET operation, but should be equipped with tint or other accommodation to ensure that monitors, controls and indicators in the cab are not washed out by bright sunlight.

j. Remote color video cameras provide a number of capabilities helpful during ARFF tactical operations and, if connected to a digital recorder, provide a record of the incident for training and incident documentation.

k. FAA AC 150/5220-10, Guide Specification for Aircraft Rescue and Fire Fighting Vehicles, fully describes all eligible equipment and options for ARFF Vehicles.

CHAPTER 2. SAFETY

2.1 Overhead Hazards

One hazard when operating a HRET is the possibility of contact with overhead energized power lines. Although power lines typically run underground at airports, operators must be aware of any overhead hazards which may be present in and around structures. Most fire department Standard Operating Guidelines (SOGs) require operators of man-rated and non man-rated aerial apparatus to maintain at least a 10-foot (3.048 M) separation from overhead electrical hazards. Operators should be constantly aware of overhead hazards, remembering:

- Electricity from high-energy lines has the ability to arc several feet to an HRET.
- Water conducts electricity.
- Metal conducts electricity.

2.2 Object Free Zone

Airports have a number of rules and restrictions designed to maintain safety. One of those restrictions is directly related to operating a boom within an obstruction free zone for a runway. Airports are required to develop procedures to comply with Title 14, Chapter 1, Part 77, Objects Affecting Navigable Airspace. These procedures are developed primarily to restrict cranes and derricks from being raised in areas that might interfere with safety of flight. Operating the HRET boom may be subject to the same restrictions and requirements placed upon construction cranes working in and around the airport. This issue is primarily raised to increase awareness during vehicle inspection run-ups and training events. Areas used for HRET training must conform to applicable airport design standards stated in AC 150/5300-13, including the airspace obstruction clearance criteria contained therein. There may be requirements for notifications and strobe warning lights to be attached to your HRET. These procedures should be coordinated through airport operations and the control tower.

CHAPTER 3. TRAINING

3.1 General Training Background

Training is critical in every area of fire fighting, but even more so when operating ARFF vehicles and utilizing roof turrets and HRETs. Developing proficiency in controlling of HRETs and roof turrets is a skill that must be developed and maintained or it will be lost without use. There are a number of tools available in the industry, but "time on the joy stick" is the best way to maintain the skill sets developed.

a. ARFF departments should have an internal training program which is used to initially qualify an operator, as well as continuation training to maintain and re-qualify. A predetermined method of demonstrating proficiency in qualification and requalification training should be in place for each vehicle in the ARFF fleet. Requalification should be required at least annually, but may be required more frequently based on the ARFF Departments procedures for vehicle staffing assignments**.** (See References in Appendix D.)

b. If the HRET can normally be operated from more than one position, qualified operators should train in both positions and meet the performance qualifications established by the department. Each seat offers different views of the controls, the HRET, and the aircraft or training mock up. Operating joy sticks and controls from both positions requires practice with both hands. A trained individual who is not simultaneously operating the vehicle will be more efficient than one who is multitasking

c. Each ARFF department should have an established standard for qualifications of a training officer. The person conducting the training must be qualified to instruct and have the knowledge and experience necessary. The training officer must possess proficiency in the subject matter and skills sets being taught. Students need to have confidence in the instructor's ability to provide the training necessary for them to develop required proficiencies. It is difficult to develop highly trained and skilled ARFF Firefighters without using highly trained and skilled instructors.

d. All training should start with vehicle familiarization and the use of a lesson plan that identifies the course outline, learning objectives, critical performance items, goals and methods of evaluating proficiency. Successful completion of training should be used as a prerequisite for a formal certification process used to "qualify" vehicle driver / operators. Qualified operators will have demonstrated proficiency in the knowledge and skills required to drive and or operate the vehicle and mounted equipment. Each qualified operator should be re-qualified as per the ARFF departments training program at an interval not to exceed every 12 consecutive calendar months after demonstration of knowledge and skills required for proficiency in the operation of the vehicle and its mounted components including HRETs.

e. A separate lesson plan is required for each vehicle or each type of ARFF vehicle. An ARFF vehicle equipped with an HRET requires a more detailed lesson plan than one without an HRET. At a minimum, the lesson plan should include: vehicle specifications, height and weight restrictions, agent, capacities, flow rates, mounted component complement, stored equipment inventory, daily - weekly – monthly inspection procedures, maintenance procedures, operating procedures, hazards, restrictions and related department SOGs.

f. Vehicles with HRETs have a higher Center of Gravity (CG), and an increased gross vehicle weight than identical vehicles without the HRET. Lesson plans should identify this difference and discuss the specific operational effects in driving, cornering, approaching side slopes or grades and

stopping. Furthermore, this additional weight and height may require additional driving restrictions to avoid areas having height and weight restrictions.

g. All lesson plans should be considered a draft document. Each class, and each use at an incident will produce additional knowledge and lessons learned which may be of added value, resulting in changes to lesson plans. Firefighters should be encouraged to submit topics, lessons learned and experiences for consideration in updating lesson plans.

h. PowerPoint presentations and videos are very effective methods of delivering classroom training. Training in the use of HRETs is not limited to how to operate the HRET and its accessories, but must include Department Standard Operating Guidelines (SOGs) on Tactics and Strategies and aircraft construction.

i. There are some training tools available that allow virtual training utilizing the HRETs. Full size cab mock ups with airport specific driver training models can be customized where a student can virtually drive the new vehicle around their airport, respond to an aircraft accident, fight a fire and even penetrate the aircraft using the HRET and penetrating nozzle. Other technology available makes use of virtual training from a desktop PC that utilizes joysticks and controls identical to those in the ARFF vehicle to develop good technique before attempting a penetration on a fuselage or trainer. These trainers are fundable under the Airport Improvement Program (AIP).

j. The ability to pierce material that forms an aircraft is an essential element in the development of operator proficiency in the use of HRETs with skin penetrating nozzles. Donated aircraft fuselages acquired for simulated training is the best tool for piercing training. Commercially available skin penetrating training mockups with replaceable skin panels are excellent training aids for developing piercing skill proficiency. They may be fundable under AIP.

3.2 Proficiency

Proficiency with HRET operations is only developed through hands-on-training and practical experience. HRET operators need to develop a good sense of the range of the boom and the turret in various patterns using high and low flow rates, become proficient in aiming streams and have a complete understanding of the capabilities and limitations of the device. Training exercises, as well as demonstrations of proficiencies, need to include all of the capabilities of the vehicle and HRET. This would include driving, and primary turret operation with the HRET in the stowed position and with the HRET in various pre-deployment, attack and various other positions, while stationary and in pump and roll modes. It should also include approach considerations, set up, stand-off distances and piercing operations in various positions, pumping through the penetrating nozzle, simulated or actual discharge of complementary agent through HRET, and the use of mounted components, including cameras and lights.

ARFF Department procedures describing the methods used for the evaluation of the proficiencies required to qualify ARFF vehicle operators and HRET operators should be detailed in the ARFF Department Standard Operating Guidelines (SOG) on training. Records of the initial training and proficiency testing / evaluation for each operator shall be maintained with the ARFF Training records. The training SOG will indicate who can qualify a firefighter as an operator for assignment to a position.

3.3 Recurrent Training

Satisfactory completion of a training program and proficiency evaluation / testing procedures qualifies an operator for assignment to a vehicle. Daily operation of a vehicle and its components helps to maintain familiarity with the controls and some of the skill sets. The skills that are not routinely practiced will

diminish with time. The qualification to operate a vehicle and/or HRET should not remain in force longer than the skills required to remain proficient (never more than 1 year). ARFF department training SOGs should indicate the period of time during which the operator remains qualified before requiring recurrent training and proficiency testing / evaluation. Records of the recurrent training and proficiency testing / evaluation for each operator shall be maintained in the ARFF training records.

3.4 Airline Partnerships in Safety

It is advisable to always call for an airline representative that can serve as an aircraft Subject Matter Expert (SME) to a Command Staff. The representative can provide a great deal of expertise, as well as the resources of the airline and their contractors to support emergency management. As the representative may have been involved in previously conducted training evolutions and emergency planning activities, cooperation and communications during emergency management may be enhanced.

boom in a position to reach the high mounted engine from the upwind side, without blocking passenger egress or other possible access.

b. For a pooled fuel fire burning under an aircraft, the HRET offers a tremendous tactical advantage. If the ARFF vehicle equipped with an HRET is positioned upwind, at the nose or the tail, a low attack position with the boom allows the placement of agent beneath the wings and fuselage. Using the available rotation of the boom up to 30 degrees to the left and right allows the operator to position the boom to one side of the fuselage, applying foam to that side of the aircraft, and then reposition the boom to the other side. The entire pooled fire can be covered without repositioning the vehicle.

c. When responding to an aircraft with a fire on board, there are a number of immediate needs and concerns. The deployment of the tools, the establishment of a Unified Command Post, and the positioning of ARFF assets are all critical first steps in the management of this emergency. After all occupants are safely off the aircraft, an interior fire on board is among the highest priorities in the risk assessment. The Incident Action Plan (IAP) should be developed drawing upon the combined knowledge of all of the stakeholders serving as resources at the Unified Command Post. Information collected and shared in the Unified Command Post specific to the aircraft, the cargo carried, existing conditions, available resources, and technology, contribute to educated collaborative decisions guiding the actions taken to manage the incident.

4.3 Benefits of Combined Technologies

One of the most valuable tools used in evaluating fire conditions on board and aircraft is the Forward Looking Infra-Red (FLIR) camera. The heat created by a fire on board the aircraft will present as a bright spot or “bloom” on the FLIR display. This bloom will identify the location and relative intensity of the fire, and will be visible by using the FLIR camera.

a. The FLIR camera provides the advantage of monitoring the effectiveness of any action taken. If the FLIR Camera indicates that the firefighting efforts are not having the desired effect, [meaning the “bloom” is not reducing in size in spite of the agent application,] re-evaluation is necessary. It is likely the agent is not reaching the fire. If the bloom is not growing in size or intensity and / or is diminishing in size or intensity, it is an indication that the action taken is having the desired effect upon the fire.

b. Use of the FLIR camera on an aircraft will identify all visible heat signatures. Training will aid in the understanding of normal heat signatures. As an assessment tool, a thermal scan of a closed compartment adds valuable data to the risk analysis performed prior to decisions to open doors or to pierce spaces.

c. Spotlights mounted near the tip of the HRET provide illumination for piercing operations, and may also be used to illuminate a target being examined using remote optics. The lights can be directed in a door or from above to contribute to illumination of the scene. From the door position, the boom-mounted lights can provide interior illumination and help mark the door location. HRET mounted cameras can be used to monitor interior conditions.

4.4 Complementary Agents

ARFF Vehicles equipped with HRETs may be equipped with complementary agent systems, such as dry chemical, Halon 1211 or Halotron 1. Complementary agent can be provided through individual hose reels or through combined agent systems, which combine one or more complementary agent lines with a water/foam line. These combined use hose reels provide the firefighter with a number of firefighting

options that can be used individually or in combined discharge. Foam/dry-chemical/clean agent simultaneous delivery systems must be designed and installed to comply with the requirements of AC 150/5220-10, Guide Specifications for ARFF Vehicles.

a. In addition to the complementary agent hose reels, options are available on HRETs which can provide discharge of the selected complementary agents at the tip of the boom, or through the piercing tip.

CHAPTER 5. FIREFIGHTING STRATEGIES

Since no two aircraft fires are alike, the best strategy is to develop objectives in the order of their priority. For each of the objectives, multiple strategies may exist. The best strategy for the situation is determined through risk analysis, based on specific conditions present and resources available.

The tactical considerations that follow are provided to assist ARFF Fire Fighters and Commanders in decision making during an aircraft fire. No two situations are alike and no single tactic can be depended upon. ARFF responders need to combine knowledge of aircraft construction, fire loads, and fire behavior with available assets, a risk analysis, resource management and common sense to affect the best possible outcome for the event. Airline representatives can provide a great deal of knowledge as well as resources and should be included in the Unified Command Post.

a. The first and most important objective is the protection and preservation of life. In a cargo aircraft, there will typically be fewer people on board than on the same type aircraft flown in passenger service. Ensuring and maintaining a safe rescue path, assisting with evacuation, or the rescue of occupants from the aircraft is the first priority.

b. The second objective may be accomplished in response to the first. If there is pooled fuel or a spill fire, it must be controlled and extinguished in order to provide a clear safe path for evacuation. The spill area needs to be covered and maintained with a foam blanket. The HRET boom is very effective in accomplishing these tasks. A low approach with the HRET provides the operator with a clear view of the nozzle and the target. The vehicle operator can observe the effectiveness of the application of water and foam. The attack angle permits agent application under the wings and under the fuselage if the aircraft is still up on its landing gear. Using a low attack sweeping mode of the boom on low flow provides an effective method of maintaining the foam blanket, reducing the risk of plunging, until hand lines can be established.

c. This attack mode is very effective in fighting pooled spill fires and/or providing a foam blanket over the spill area. When the nozzle is positioned at the seat of the fire, it allows extinguishment of ground based fires more effectively, as agent is applied directly on the burning surface. This eliminates the “raindrop” application, a situation that generally results in wasted agent, as the heated smoke plume or thermal column dissipates the effectiveness and the wind carries it away. As long as there is fuel on the ground, there is a hazard of ignition. Protection over the area through manning vehicles or hand lines as necessary for the size of the spill area must be maintained. Activities that will break the seal of the foam blanket should be restricted. Using a hand line, foam should be reapplied, as needed, to maintain the integrity of the foam blanket.

d. If the aircraft is intact with an interior cargo fire that has not breeched, an effective first step may be to secure the openings of the aircraft to restrict the introduction of air. Deep seated cargo fires may smolder for a long time before the fire is of sufficient intensity to breech the container or the fuselage. This tactic may be applicable if a direct attack is not immediately possible.

e. In evaluating fire conditions onboard an aircraft, the FLIR camera is a valuable tool. The heat created by the fire on-board will present as a bright spot or “bloom” on the FLIR display. This bloom will identify the location and relative intensity of the fire, and will be visible through the fuselage using the FLIR camera. After locating the fire on board with the FLIR camera, a sense of the fire size, location and intensity can be determined.

8) Setting up on aircraft / Positioning
   a) Wind
   b) Terrain
   c) Access (i.e.) hard pavement, debris field, obstructions
   d) Evacuation Route
   e) Positioning apparatus based on apparatus capabilities and anticipated needs
9) Window Removal
   a) Position piercing tip against passenger aircraft window, slowly advance piercing tip. Mounting clips will fail and window will fall into aircraft.
   b) Position piercing tip against cargo aircraft window blank, slowly advance piercing tip. Mounting clips will fail. Interior gill liner may prevent window from falling into cargo bay.
10) Operating HRET inside aircraft door
   a) Positioning HRET inside aircraft door allows use of HRET mounted lighting and cameras.
   b) Discharging Nozzle with HRET inside door opening causes movement of the boom due to nozzle reaction.
   c) Positioning the HRET boom against door opening before discharging causes boom loading.
   d) Boom loading and / or striking the aircraft door frame can damage the HRET. Check with HRET Manufacturer for specific guidance and limitations.
11) Piercing Operations
   a) Prior to conducting any actual piercing operations, operators must complete classroom training, and Computer Based Training (if available).
      - Classroom Training
      - Aircraft Construction / Piercing Locations
      - Evaluating Heat Signatures to determine piercing locations
      - Evaluating aircraft condition to determine fire intensity / location
      - Aircraft load and balance / effect of firefighting efforts
      - De-watering aircraft
      - Passenger Aircraft – piercing strategies
      - Cargo Aircraft – piercing strategies
      - Cargo aircraft load configurations / distance to pierce
      - Interior fire attack methods / piercing
        - Direct attack – into cargo ULDs
        - Indirect Attack – into cargo bay
      - Monitoring effect of interior fire attack / piercing
      - Piercing approach / Set up
      - Stand off positions

- Piercing attack angles

b) Virtual Training

- Make use of available Computer Based Training

c) Hands on Training

- Inspection / review of HRET components
- Review of check out procedures
- Review of Department SOG on ARFF Vehicle and HRET
- Cab control familiarization / operation (static)
- Cab control familiarization / operational (actual)
- Piercing demonstration on piercing mock up (trainer)
- Piercing training / practice session

12) Practical Training Exercises

a) Turret Training Exercises

- Developing “second nature” operating skills in the operation of joysticks and controls for turrets requires initial and recurring practice. Each set of controls may have an individual feel that must be mastered by operators. When operators have a comfort level with the controls, certain practical training exercises serve as a tool to gauge the effectiveness of the operator’s skill set.
- “T-Ball” Skill development for understanding range and aim of turrets. IFSTA Aircraft Rescue and Firefighting describes placing the softball on the traffic cone, and begin making attacks on the softball, attempting to knock it off the cone without knocking over the cone. This exercise can be timed for competitions among operators. It is effective with all type of turrets on High and Low foam from rolling or stationary positions.
- “Touch and Go” piercing set up exercise. Requires an area with a tall chain link fence. Colored tape or ribbon is used to identify targets at various attack heights reflecting the fleet mix of the airport. The target is simply a circle of tape or ribbon spun through the chain links in various colors. The trainer notifies the operator to approach, set up and pierce the “Red” target which may be positioned for a low, high or mid range attack. The operator must select the correct stand - off position, and establish the correct piercing angle. The operator is instructed to touch the fence in the center of the designated color target and discharge through the piercing tip. The event can be timed from a predetermined approach line.

APPENDIX B. PROFICIENCY EVALUATIONS

Following are examples of Proficiency events that can be adopted or scaled to the specific requirements of the airport.

- HIGH REACH EXTENDABLE TURRET (HRET) SAMPLE PROFICIENCY EXERCISES *(Evaluation for the HRET operator position)*

INSTRUCTIONS

1) The evaluation is to be filled out by the evaluator.
2) Boxes will be filled in with a P for “proficient” or an N for “needs work”.
3) All exercises need to be accomplished to the satisfaction of the evaluator.

EXERCISE/EVALUATION #1

Event:
PASSENGER AIRCRAFT, GROUND FIRE UNDER WING.

Objectives:
☐ Protect escape paths without impeding passenger evacuation.
☐ Create adequate foam blanket, fuselage protection.

Assign side of aircraft to complete tasks. Event can be staged using training aircraft, pavement markings or cones and delineators. SOG should include layout of event so that it is consistently repeated.

- *Simulate evacuation in progress from all exits sides.*
- *Foam coverage on the involved wing/engine without pushing fuel under aircraft.*
- *HRET and nozzle placement to adequately cover fuel and protect fuselage without interrupting evacuation. Low angle.*
- *Maintain a means of egress.*
- *Control fires to allow egress and access for firefighters.*

Critical Performance Considerations:
- ☐ Wind, Topography
- ☐ Pool fire disruption
- ☐ Adequate aeration of foam, correct nozzle setting, external structural aeration.
- ☐ Proper HRET deployment
- ☐ Visibility driver/HRET operator
- ☐ Correct distance from objective
- ☐ Pattern adjustment for correct coverage and reach
- ☐ Discharge initiation in time
- ☐ Coverage of area
- ☐ Communication between operators
- ☐ Agent conservation / depletion

Member:	_____	**Signature:**	_____
	Print Name and Rank	*Date:*	
Proficiency Evaluator:	_____	**Signature:**	_____
	Print Name and Rank		

EXERCISE/EVALUATION #2

Event:
PASSENGER AIRCRAFT, LARGE POOL FIRE UNDER WING IMPINGING REAR FUSELAGE.
Event should be scaled to representative aircraft of the airport Index. Identify area of sufficient size to simulate aircraft size typical to your airport. Mark area with indicators on fence, pavement or grass area. Further identify escape areas for that aircraft.

Objectives:
Using HRET, in low attack modem:
- ☐ Protect escape route without impeding passenger evacuation.
- ☐ Create adequate foam blanket.
- ☐ Protect fuselage, maintain integrity of foam blanket.

NOTE: HRET operation can be followed with bumper turret.

Critical Performance Considerations:
- ☐ Wind, Topography
- ☐ Cut off fire from escape route (primary objective protect escape route)
- ☐ Pool fire disruption, horizontal low angle attack, foam application method
- ☐ Proper HRET deployment
- ☐ Discharge initiation in time
- ☐ Visibility driver/HRET operator
- ☐ Correct distance from objective
- ☐ Fuselage cooling and foam application method
- ☐ Pattern adjustment for correct coverage and reach
- ☐ Coverage of area
- ☐ Communication between operators
- ☐ Under truck nozzles, bumper turret, deluge consideration

Member:	_____	**Signature:**	_____
	Print Name and Rank	*Date:*	
Proficiency Evaluator:	_____	**Signature:**	_____
	Print Name and Rank		

EXERCISE/EVALUATION #3

Event:
MASS AGENT APPLICATION USING HRET. UNDERSTANDING OF TACTICAL CONSIDERATIONS. AGENT CALCULATIONS.

Objectives:
Understand application methods:
- ☐ TCA/PCA formulas and principals.
- ☐ Event should be scaled to representative aircraft of the airport Index.

Identify area of sufficient size to simulate:
- ☐ Theoretical Critical Area for aircraft size typical to your airport.
- ☐ Mark area with indicators on fence, pavement or grass area.
- ☐ Further identify escape areas for that aircraft, begin mass application beginning with HRET.
- ☐ Operator must satisfy each critical performance consideration.

NOTE: Event can be accomplished with 1 vehicle or multiple vehicles dependent upon airports capabilities and the quantity of agent required for the size of the aircraft.

Pre-Requisite: Familiarization and training with NFPA 403 and the Theoretical Critical Area (TCA) calculations methods.

Reference Info:
TCA Formula: TCA = L x (100 + w) where L > 65 feet
TCA = L x (40 + w) where L < 65 feet

EXAMPLE

Boeing 757 - Length 155 Ft - External Width 13 feet

TCA for aircraft > 65 feet = Length x (100 + Width)

TCA for 757 = 155 x (100 + 13)

155 x 113 = 17,515 sq feet

Application Rate - .13 GPM per square foot = 2277 gallons water for foam production, (Q1) per minute of control time.

Critical Performance Considerations:

- ☐ Start initial discharge soon enough
- ☐ Proper coverage of objective and pool fire
- ☐ Fuselage/Blast Fence primary objective, acquire targets
- ☐ Low angle discharge no aeration of fuel on ground
- ☐ Pattern manipulation for coverage
- ☐ Boom movement for coverage
- ☐ Bumper usage
- ☐ Visibility with boom turret pattern
- ☐ Judicious use of agent, full coverage
- ☐ Under trucks when in foam blanket
- ☐ Communication between operators
- ☐ Targets acquired
- ☐ Complementary Agent / combined agent consideration, i.e., how used

Tactical Discussion Points

THREE DIMENSIONAL FIRE AND AGENTS USED FOR SUPPRESSION.

Three dimensional, cascading fire, large fire ball, combined agent nozzle use for initial knock down. Injection of Dry Chemical in stream allows for extended reach of Dry Chemical material deeper into the fire.

Dry Chemical extinguisher effective on 3D fires.
When to charge system, why, how?
Discharge, How, Why, How long will system discharge?

APPLICATION CONSIDERATIONS

Proper techniques used for foam application and proper technique for scenario.

Bank Down Method
Foam stream hits fuselage, engine, or object to aerate.

Low Angle Attack
Foam stream discharged horizontal to ground 3 – 6 feet off surface of fuel to disrupt vapors emitting off fuel and allow foam to settle on surface of flammable liquid.

Roll On Method
Effective on pooled liquid fuel (ignited or un-ignited) on the open ground. Direct the stream on the front edge of the liquid pool. Continue foam application, foam rolls across the surface until covering entire area extinguishing the fire or sealing to surface.

Member: _____ Print Name and Rank	**Signature:** _____ *Date:*
Proficiency Evaluator: _____ Print Name and Rank	**Signature:** _____

EXERCISE/EVALUATION #4

Event:
PASSENGER AIRCRAFT WITH INTERIOR FIRE
(Aircraft with smoke, heat source pool fire set in training fuselage)

Need to improve post crash interior fire survivability through better cabin interior fire suppression techniques.

Objective:
☐ Create a survivable atmosphere or extend the period of survivable atmosphere inside an aircraft with an exterior pool fire.

Firefighting efforts should be concentrated on:

Critical Performance Considerations:
- ☐ Establish or maintain a means of egress
- ☐ Control fires to allow egress and access for firefighters
- ☐ Stabilize aircraft, chock and pin gear
- ☐ Stair Truck considerations: Access
- ☐ Pierce fuselage
  - ☐ Penetrator tip horizontal
  - ☐ Deploy HRET on final slow speed approach to aircraft
  - ☐ Stop at proper stand-off position for piercing level anticipated
  - ☐ Determination of correct location to place penetrator
    - Thermal imaging camera
    - Passenger escape route
    - Physical identifiers
  - ☐ Communication between driver and turret operator (if more than 1 in cab)
  - ☐ Penetrator target options and decision
    - Window
    - 10-12” above window
    - Door Opening
    - Other
  - ☐ Discharge rate, quantity, and frequency
  - ☐ Foreign objects and obstructions to impede arrival direction
  - ☐ Closed Doors slide deploy - firefighter entry.
  - ☐ Calculate approximate flow based on discharge rate and time. Calculate weight added to aircraft. Discuss additional weight affect on balance and stability of aircraft. Identify areas to monitor, methods of releasing water.

Member: _____ Print Name and Rank	**Signature:** _____ *Date:*
Proficiency Evaluator: _____ Print Name and Rank	**Signature:** _____

EXERCISE/EVALUATION #5

Event:
CARGO AIRCRAFT WITH REPORTED CARGO FIRE
(aircraft interior with smoke, heat source set in training fuselage)

Objective:
☐ Operate FLIRs to identify heat source location.

Conditions Upon Arrival:
- Aircraft intact, L-1 door and cockpit windows open, on landing gear, smoke showing from open doors and windows
- No fire showing, no distortion of metal
- Significant heat bloom visible on FLIR camera in the rear 1/3 of the aircraft

Assessment:
- No direct access to burning cargo
- Crew has evacuated and reports all accounted for
- No obvious damage to airframe
- Aircraft is fully on pavement and appears level and stable

Incident Action Plan:
- IC orders crew to secure open doors and windows, attempt to recover NOTOC, and provide assessment from L-1 open door position
- IC orders exterior water stream to top of fuselage above heat bloom to cool metal
- Aircraft gear is chocked and pinned.
- Closing the aircraft has reduced available oxygen to the fire and has given Command the opportunity to populate his Command Post.
- IC orders piercing of aircraft at the 2 o'clock position in the center of the heat bloom.

Critical Performance Considerations:
- ❑ Penetrator tip horizontal to the ground
- ❑ Deploy HRET during final approach to aircraft.
- ❑ Determine location of heat source on aircraft. Approach aircraft heat bloom seen on FLIR at 90 degrees.
- ❑ Determine proper location of target, cargo aircraft 10 or 2 o'clock
- ❑ Window outlines present, 8"-10" above window to attempt piercing into cargo container, 18-20 above window rain down,
- ❑ Announce heat source location on Fire Department Frequency and acknowledge additional reports from other apparatus if available.
- ❑ Coordinate with ARFF Command.

- ❑ Position apparatus, correct stand-off distance and location and height of piercing target.
- ❑ Penetrate Aircraft or piercing mockup, discharge agent.
- ❑ Calculate approximate flow based on discharge rate and time. Calculate weight added to aircraft. Discuss additional weight affect on balance and stability of aircraft. Identify areas to monitor, methods of releasing water.

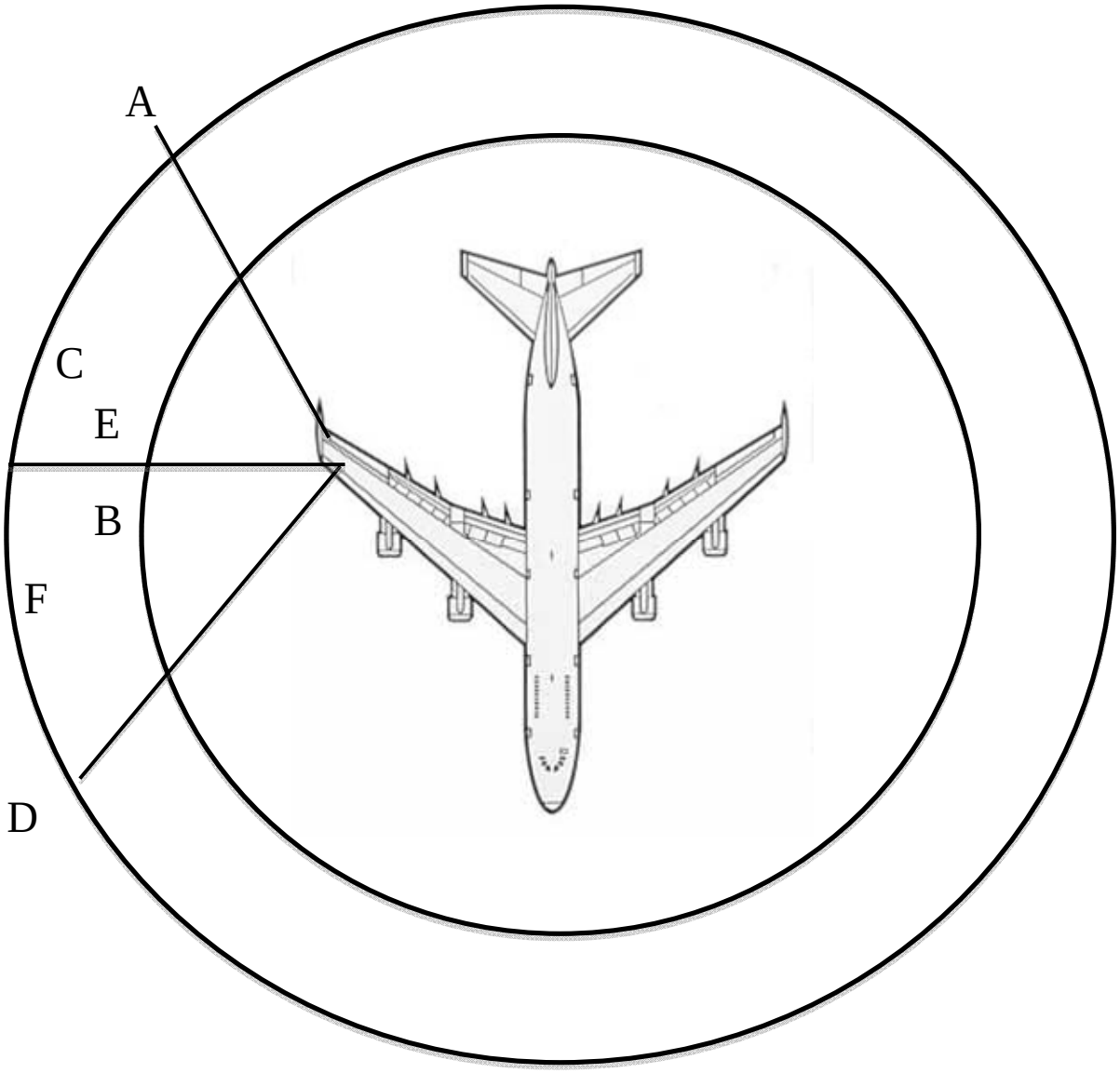
Member: _____ Print Name and Rank	**Signature:** _____ *Date:*
Proficiency Evaluator: _____ Print Name and Rank	**Signature:** _____

EXERCISE/EVALUATION #6

Event:

TARGET, BOOM AND NOZZLE MANIPULATION WITH APPARATUS MOVEMENT ON DESIGNED COURSE

Event can be staged using training aircraft, pavement markings or cones and delineators. The target must be mounted or substantial enough to stay in place during continued discharge from turrets. SOG should include layout of event so that it is consistently repeated.



Use of bumper turret (if applicable)

Objectives:

Target, HRET and nozzle manipulation with apparatus movement:

- ❑ From the bedded position
- ❑ High angle attack from distance
- ❑ Low angle attack when in range
- ❑ Maintain safe control of vehicle and discharge during simultaneous operations.
- ❑ Maintain streams on targets during movement

Course to follow while turret stream continues to hit target:

Event A - Start dispersal at A mark, Move apparatus to B mark; Backup apparatus to C mark.

Event B - Start dispersal at D mark, Move apparatus to E mark; Backup apparatus to F mark.

Critical Performance Considerations:

- ❑ Proper approach route, angle and speed
- ❑ Good judgment for range of turrets in various positions and patterns
- ❑ Control during repositioning, forward and reverse
- ❑ Minimize waste of agent
- ❑ Minimize wasted movements

Member: _____ Print Name and Rank	**Signature:** _____ *Date:*
Proficiency Evaluator: _____ Print Name and Rank	**Signature:** _____

APPENDIX C. ACRONYMS

AC	Advisory Circular
AIP	Airport Improvement Program
APU	Auxiliary Power Unit
ARFF	Aircraft Rescue and Firefighting
CertAlert	Certification Alert
CFR	Code of Federal Regulations
CG	Center of Gravity
DOT	Department of Transportation
FAA	Federal Aviation Administration
FBO	Fixed Base Operator
FLIR	Forward Looking Infrared
GPM	Gallons per Minute
GPU	Ground Power Unit
HRET	High Reach Extendable Turret
IAP	Incident Action Plan
IFSTA	International Fire Service Training Association
NFPA	National Fire Protection Association
SME	Subject Matter Expert
SOG	Standard Operating Guidelines
SOP	Standard Operating Procedures

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APPENDIX D. BIBLIOGRAPHY

The following standards and references are listed below for additional background and requirements information purpose:

FAA Documents http://www.faa.gov/airports/airport_safety/aircraft_rescue_fire_fighting/

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http://www.faa.gov/airports/airport safety/certalerts/media/cert9602.pdf

CertAlert 08-07, Guidance on the High Reach Extendable Turret (July 2008)
http://www.faa.gov/airports/airport safety/certalerts/media/cert0807.pdf

Title 14, Code of Federal Regulations (CFR) Chapter I, Part 77, Objects Affecting Navigable Airspace

Title 14 CFR Chapter I – FAA, DOT, Part 139, Certification and Operations: Land Airports Serving Certain Air Carriers

Title 14, CFR Part 139.317, Aircraft Rescue and Firefighting: Equipment and Agents

AC 150/5220-10, Guide Specification for Aircraft Rescue and Fire Fighting Vehicles

AC 150/5210-19, Drivers Enhanced Vision Systems

National Fire Protection Association http://www.NFPA.org

NFPA 402, Guide for Aircraft Rescue and Firefighting Operations

NFPA 405, Recurring Proficiency of Airport Fire Fighters

NFPA 414, Aircraft Rescue and Firefighting Vehicles

NFPA 1003, Airport Fire Fighter Professional Qualifications

International Fire Service Training Association, (IFSTA)

IFSTA, Aircraft Rescue and Firefighting, Fifth Edition

Technical Reports

Report Number DOT/FAA/AR-TN06/13, Evaluation of Quad-Agent Small Firefighting Systems
http://www.airporttech.tc.faa.gov/safety/downloads/

DOT/FAA/AR-05/53, High Reach Extendable Turrets with Skin Penetrating Nozzles
http://www.airporttech.tc.faa.gov/safety/elevated.asp

National Transportation Safety Board (NTSB) Recommendation A-07-100

Commercial Manufacturer Publications

- Crash Rescue Equipment Services, Snozzle® 501 Operators Manual
- Rosenbauer Stinger Operators Manual
- UPS ARFF Training DVD
- FedEx ARFF Training DVD

REFERENCES

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139.303 (c)(5)(e)(1)
139.319 (h)(1)(ii)

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- Figure 5.5 courtesy of Crash Rescue