Orange County Fire Authority

AERIAL FIRE APPARATUS

STAFF REPORT

By: Truck Study Group

SEPTEMBER 2013

Section I - Overview

The Aerial Truck Study Group was created at the direction of the Fire Chief to evaluate current truck apparatus and make recommendations for the next generation of trucks. The study group included personnel from Operations, Fleet Services and Fire Prevention for this specific evaluation.

Various trucks from many like-size fire departments such as San Diego City, LA County, San Francisco, Seattle, Sacramento, Long Beach and Ventura County were reviewed. Members also attended the 2013 Fire World Expo in San Diego.

Evaluation surveys (appendix 13) were distributed to the Operations personnel for input, personal evaluation, and experience. The survey included topics on recommended type of truck, equipment standards, minimum aerial size, relief truck expectations, and technical rescue truck staffing standards. This data was used to ensure the truck study group was considering all aspects of truck company operations, equipment compliments, relief truck expectations, and that Operation's personnel could contribute to overall recommendations in this study.

The truck study group also included sub-committee personnel that evaluated six other truck company objectives that weighed into this study:

- Truck Company Operational Expectations
- Truck Equipment
- Relief Aerial Apparatus
- Salvage Unit Feasibility
- US&R Staffing
- Standards of Coverage

Each of these objectives and findings played a significant role where recommendations were made in this staff report. The truck study group concluded that an evaluation of a tandem-axle truck, mid mount platform and tractor drawn aerial met the needs of the organization. OCFA's T45, T9, and T6 were used for comparison analysis. The apparatus were evaluated in four dynamic functional categories:

- Maneuverability - Vehicle maneuverability is a measure of how well a driver can make a vehicle follow a particular path. For most vehicles, it is based simply on the turning radius — the shorter the turning radius, the better the maneuverability.

- Tactical - Tactical is the necessary task of being able to spot the apparatus adjacent to a building and safely ladder a building or various heights in order to access windows, roofs, or elevated points.

- Versatility - Being able to accommodate equipment weight loads and being able to store that equipment in a firefighting functional manner.

- Extrinsic Value - The group looked at down time for maintenance issues and the purchase price between the three apparatus

The OCFA Planning and Development Services Section utilizes the Fire Master Plans for Commercial & Residential Development Standards. This guideline was used to help with the on-site comparisons. Brett Anderson and Jeff Whitaker from Fire Prevention were on site during the evaluation to help define the requirements in the Fire Master Plan document. The following sections from the Fire Master Plans guideline were used in the evaluation:

- Section 2 Fire Access Roadways
    - Loading
    - Width and Parking Restrictions
    - Vertical Clearance
    - Turning Radii
    - Dead-end Access Roadways

- Section 5 Obstructions to Emergency Vehicle Access
    - Clear Width
    - Turning Radii and Setbacks
    - Gate Barrier and Design

- Section 9 Access to Structures
    - Access Walkways

These standards were used to help compare the maneuverability, tactical, versatility, and extrinsic evolutions using a KME tandem axle 75-foot straight service aerial, a Sutphen tandem axle 100-foot platform, and an American LaFrance 100-foot tractor drawn aerial.

Section II – Truck Caparisons

The Truck Study Group compared three different styles of apparatus as comparisons Truck 45, Truck 9, and Truck 6. Truck 45 is 2011 tandem-axle, rear mount, 75-foot service aerial manufactured by KME. Truck 9 is a 2010 tandem-axle, mid mount, 100-foot platform aerial manufactured by Sutphen. Truck 6 is a 2007 tractor-drawn 100-foot straight aerial manufactured by American La France.

Evaluations were focused on five diverse areas for truck company operations found throughout Orange County. Residential highrise, high denisity multi family, hill-side urban interface, commercial, and residential. Each of these areas offer unique challenges for large areial apparatus and their operations on the fire ground.

Fire ground operations for truck companies are challenged in many areas as seen throughout Orange County. Access to multi-family apartment units, narrow streets throughout downtown San Clemente, downtown Seal Beach, narrow alleys in Westminster, downtown Santa Ana, Lemon Heights, The Canyons, and Ladera Ranch are just a few areas that have made for difficult maneuverability for truck companies. Trucks 43 and 45 have implemented a practice to bring their battalion utilities to incidents located in the Silverado, Modjeska, Trabuco and Rose Canyon areas because of the inability to get their apparatus close to an incident.

For the maneuverability, tactical, versatility and extrinsic comparison, the truck study group used areas through the master planned communities in south Orange County.

Maneuverability – Test #1

According to the OCFA Fire Master Plans for Residential Development, it states, “fire access roadways, commonly referred to as a fire lane, shall be provided for every facility or building when any portion of an exterior wall of the first story is located more than 150 feet from a public roadway”. Width of fire access roads shall be a width of 20 feet. The plan also states that no parking will be allowed on any fire access street.

Streets throughout master planned communities are 20 feet in width and have a vertical clearance of 13 feet 6 inches. For this evaluation, simulated structure fire scenarios were evaluated in communities where these dimensions are apparent. This location offered utilizing 20-foot fire access roadways, which is the minimum width for fire apparatus. The set up for each evaluation was objective. The on duty crews during the evaluation were given a location and tactical objective once they arrived on scene. The fire apparatus engineers were all experienced in their vehicles and had a minimum of seven years driving experience.

The three trucks were asked to maneuver into the complex, make an immediate left turn and then an immediate right turn to the address given. It was common througout the observation that had vegetation encrouchment into the 20 foot fire road width and 13’ 6” height clearance. This evolution was used to evaluate the trucks ability to negotiate turns.

There are two types of turning radius to consider. The curb-to-curb turning radius is the path the outside front wheel follows when the steering wheel is turned to the limit on one side or the other. It is useful when there are no obstructions above the level of the curb. The wall-to-wall turning radius is the path the outermost and forward most portion of the chassis or body follows (i.e. the outer corner of an extended front bumper). The wall-to-wall radius is generally larger than the curb-to-curb radius. It's useful when there are walls, posts or other obstructions next to the road.

Tandem-Axle Rear Mount 75-foot Service Aerial

The tandem axle 75-foot service aerial maneuvered through the entry driveway, then made the left turn and then an immediate right on to the address given for the simulated fire. It was slow but was able to maneuver through without stopping or a series of back up maneiuvers.

It had diffuculty exitting the complex. They could not swing wide enough when making the right turn to exit. Swinging in wider on their approach would of had the back left corner scraping bushes. Their approach became shallow and the the result was the right side rear duals slightly rubbing the curb.

Right rear duals brushed the curb

The tandem axel 75-foot service aerial has an outrigger foot print of 16 feet from edge to edge of their outrigger. The truck needed to position in the middle of the street only allowing for two feet on either side to the curb line.

Tandem-Axle Mid Mount 100-foot Platform

The tandem axle mid mount 100-foot platform was given the same assignment. The length of this apparatus made it difficult to make the first left turn into the complex. In order for the truck to make the turn a series of two forward and reverse manuevers were needed to clear the rear of the right side of the truck. The vegeatation and the street sign forced the engineer to clear the right corner of the truck before making the left turn.

Once the truck cleared the first left turn, the truck was not in position to make the next turn. It took two attempts making the next right turn into the street for the simulated structure fire.

The tandem axel mid mount platform has an outrigger footprint of nearly 20 feet. The Sutphen needs to be positioned in the center when on Fire Access Roads. Any position other than center would cause the truck to short jack.

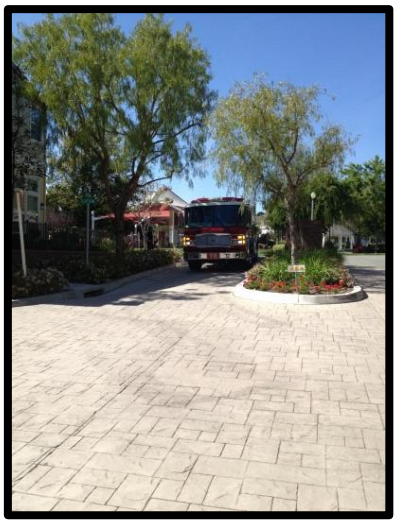
Access past the truck once it is set up is problematic for crews trying to get from one side to the other with equipment.

When exiting, there was difficulty clearing the right turn out of the complex. They found it difficult to swing wide enough to enter into the lane to exit.

Both the right side and the left front bumper were into the bushes to try and get the front wheels and rear duals into the lane.

The right duals came up and over the curb with the left front bumper into the low lining bushes.

100-foot Tractor Drawn Aerial



The tractor drawn aerial maneuvered without readjusting, backing up or repositioning. They were able to maneuver into the complex without having to negotiate the vegetation or street sign.

As the TDA entered the complex for the left turn, the maneuverability of the TDA allowed for the set up for the next immediate right turn. The maneuverability was smooth through the transition and did not have to stop to reposition.

The tractor drawn aerial has an outrigger footprint of 17 feet 6 inches.

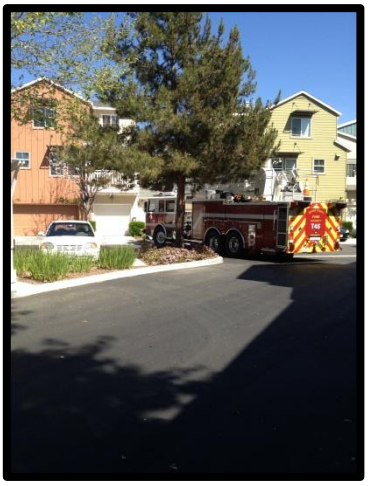
When exiting the complex, they were able to clear the curb and turn without issue.

Maneuverability – Test #2

A second maneuverability evaluation was done to compare three styles of aerial apparatus. The evolution has each truck come down a Fire Access Street to a simulated structure fire at a two-story condo. The travel path to the structure fire was a typical response route. The on duty crews were the same individuals in the first evaluation and were not given any direction other than the address of the fire. This evaluation focused on a left turn on a fire access road in a master planned community.

The three trucks had to make a right turn followed by a left turn at the end of the street to get to their simulated objective.

Tandem-Axle Rear Mount 75-foot Service Aerial



Before the evaluation could start, vehicles parked in a fire lane had to be moved. It is a reality that vehicles parked within these communities challenge engine and truck company operations on the fire ground. It was also noted that a pine tree at the in-turn created a problem for the three trucks. The tree encroached into the 13'6" vertical clearance. Truck 45 made the turn with one three-point turn.

Tandem-Axle Mid Mount 100-foot Platform Aerial

The left turn was problematic from the standpoint the bucket wasn't able to clear the right side. The pine tree again was didn't give a 13' 6" clearance.

The Sutphen made two attempts at making the left turn. The location where the two back up firefighters are was where the car was parked originally. Any vehicles parked in the road way would not of allowed the truck to maneuver through.

100-foot Tractor Drawn Aerial

The TDA made the first turn and was able to negotiate the next left turn. As the truck moved forward into the left the next left turn, the TDA has the ability to reposition itself without having to back up into an approach angle.

The TDA had the same pine tree that the other two trucks had to contend with. It was able to make the turn and negotiate away from the hazard and still make the turn without stopping.

Maneuverability	100-foot Mid Mount Platform	100-foot Tractor Drawn Aerial	75-foot Service Aerial
Turning Radius	42'11"	34'	33'8"
Wheel Base	236"	176"	210"
Overall Length	46'	60'	37'7"
Height	11'6"	11'3"	11'5"

The chart above outlines the difference in turning radius, wheelbase, overall length and height.

Maneuverability Summary

1. Tandem Axle 75-foot Service Aerial

- Was able to maneuver through the first evaluation without adjusting
- Had difficulty exiting the complex with rubbing the right duals
- Had to reposition once through the second evaluation.
- Maneuverability for them was given adequate. Some consideration should be given to placing this style of truck in a challenged area for maneuverability.

Good ***Adequate*** Inadequate

2. Tandem-Axle 100-foot Mid Mount Platform

- Made 3 attempts to readjust and maneuver through the first evaluation
- The outrigger for this truck takes up all 20’ of a fire access road
- Had difficulty exiting the complex with multiple attempts
- Had to reposition twice through the second evaluation.
- Maneuverability for them was given an inadequate score. Consideration should be given to not placing this style of truck in a challenged area for maneuverability.

Good Adequate ***Inadequate***

3. 100-foot Tractor Drawn Aerial

- Was able to maneuver through first and second evaluation without stopping or repositioning.
- The TDA has the ability to reposition itself after turns and has the ability to maneuver through challenging turns.
- Maneuverability for them was given a rating of good. Consideration should be given to placing a TDA in areas that have maneuverability challenges.

Good Adequate Inadequate

Tactical

The fire ground vulnerability for the OCFA are buildings between 33 and 55 feet in height. This is due to the limited reach of a 35 feet ground ladder, which is 33 feet at a working angle of 75 degrees. Buildings over 55 feet are classified as high-rise with built in fire protection systems that reduce the exposure/need for life safety rescue and external fire suppression activity.

Vertical reach for aerial apparatus is broken up into three ranges of climbing angles. Climbing angles of 35, 60, and 80 degrees are used to have various reach capabilities. A tactical comparison of aerial reach was done utilizing the same three trucks.

Tactical			100-foot Mid Mount Platform	100-foot Tractor Drawn Aerial	75-foot Service Aerial
Vertical Reach	Vertical Reach	35°	50'6"	60'	48’
	Vertical Reach	60°	74'	86'	65’
	Vertical Reach	80°	82'	95'	72’
	Max GPM		1,500	1,000	1,000
	Tip Load		1000 lbs.	500 lbs.	500lbs.

Two separate tactical comparisons were used to evaluate the reach capabilities of each truck. The first evaluation was for each truck to ladder a three-story multi-family apartment unit that had carports out front. The crews were not given direction were to spot their apparatus.

The tandem axle 75-foot service aerial spotted in the center of the driveway and put their turntable in a location that would best match reaching their objective.

They found themselves about 5 feet short from their objective. Even if the Engineer cheated a little to the right it would have been too close to carport if they would have reached their objective.

Carports, greenbelts, sidewalks, parked vehicles, engine companies, and police units are all common occurrence obstacles.

The tandem axle mid mount 100-foot platform and the 100-foot tractor drawn aerials were successful in meeting their objective despite the carport set back. The outrigger footprint for the dual axle mid mount 100-foot platform again took up the entire street.

Tactically speaking, where we can't get an aerial to the roof because of setbacks or positioning, we rely on 35 foot ground ladders. In this scenario, the firefighters off the trucks were given instruction to set their aerial up and throw a second ground ladder.

The ground ladder was fully extended but did not have enough rungs over the roofline to climb safely. If the ground ladder was moved to the Bravo side of the structure it would have cleared the roofline but there was not enough room to get the ladder in between the two structures.

This scenario was a garage fire lapping into the second floor balcony.

The group agreed where the first in Engine Company would typically spot their apparatus. The trucks came in behind the simulated engine and set their trucks up. The tandem axel 75' service aerial did not meet their objective. If they knew a head of time they could have backed down the alley putting their rear mounted turntable closer to their objective. However, the group agreed that wouldn't have been practical.

Truck 45 Front Bumper

Garage Fire extending to second floor balcony

This was a true spot with a simulated engine parked in front of the truck. Because tandem axel service aerial is a rear mount, they lose the distance of their truck when trying to reach their objective.

Many community developments throughout Orange County have standard sized driveways with second stories set back on the property like this residence in Coto De Caza. The 75-foot service aerial was not able to reach the second story even though they were positioned out front.

Battalion 7 units had a roof fire on the back side of this two story condo complex in Rancho Santa Margarita. Ground ladders were thrown but the aerial was needed for further overhaul. The tandem axle 75-foot service aerial was repositioned and still unsuccessful reaching the roof line because of the set back.

Tactical Summary

1. Tandem Axle 75-foot Mid Mount Service Aerial

- The tandem axle 75-foot service aerial was not able to meet their objective of laddering the 3-story roof. The carports did not allow for the truck to get close enough.
- They also had difficulty reaching their second objective of a two story-condo fire. The height of the building was not a problem it was the reach. Because of a rear mount aerial, anytime the truck needs to reach anything over the front cab, they lose the length of the truck. Mid-mount apparatus offer the best opportunity to reach their objective because they don't lose a great deal of length in any direction.
- Tactical score for Truck 45 was given inadequate.

Good Adequate ***Inadequate***

2. Tandem Axle Mid Mount 100-foot Platform

- They were able to reach their objective in both evolutions. Mid-mount apparatus have more flexibility when reaching their objective.
- Pictures were not available
- Tactical score was given a score of good.

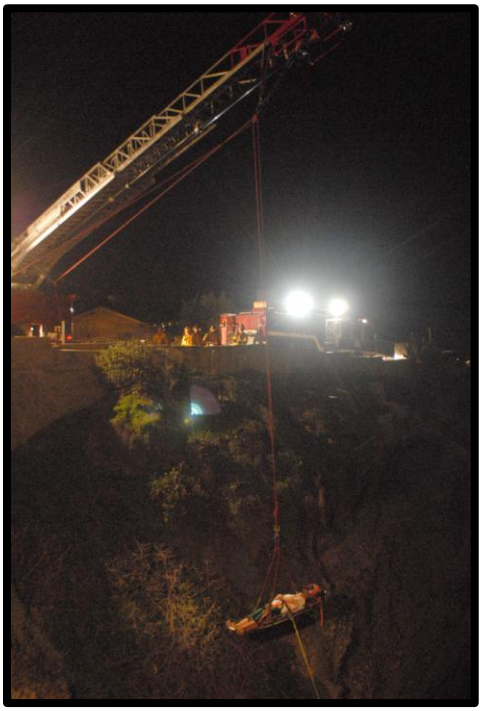
Good Adequate Inadequate

3. 100-foot Tractor Drawn Aerial

- They were able to reach their objective in both evolutions. Mid-mount apparatus have more flexibility when reaching their objective.
- Pictures were not available
- Tactical score for Truck 6 was given a score of good.

Good Adequate Inadequate

Tactical Rescue Considerations



The truck study group evaluated the rescue capabilities between the 100-foot tractor drawn aerial / the tandem axel 75-foot service aerial and the tandem axel mid mount 100-foot platform truck.

- The tractor drawn aerial and service aerial have a working tip load of 500 lbs. The shallower the angle on the aerial, the less strength the tip has. The tip strength reduces down to 250 lbs. at a 35-degree angle.

- The tandem axel mid mount 100’ platform has a tip load of 1,000 lbs. at any angle.

- The box frame aerial construction on the 100-foot mid mount platform is stronger and has more resistance to any stress when using mechanical advantage systems.

- Platform apparatus provides a safer platform during defensive fire master stream operations. The platform also offers the ability to overhaul steep angle roofs, compromised roofs and

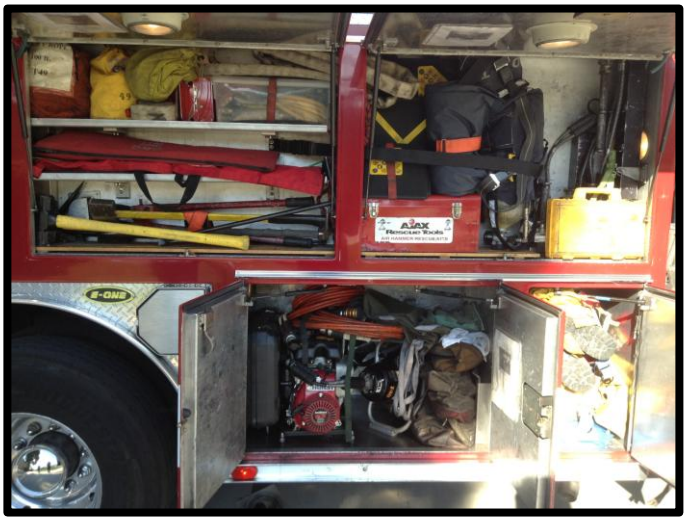
- Platform apparatus offer a safer platform for victim rescue from

Versatility

		100-foot Mid Mount Platform	100-foot Tractor Drawn Aerial	75-foot Service Aerial
	Drive Axle	48,000	54,000	48,000
	Total	87,500	77,000	71,000
Available Load		8,000 lbs.	10,000 lbs.	11,000
Storage Cubic Feet		300cf.	322cf.	247cf.

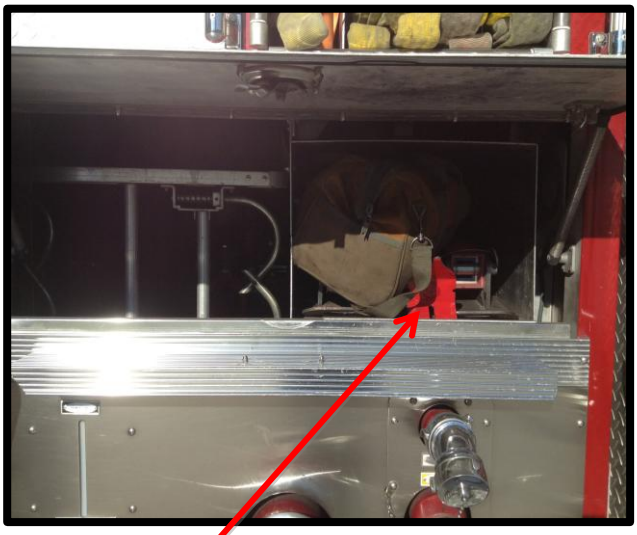
The ability to carry the required equipment complement for these apparatus is based on the load carrying capacity of the aerial apparatus and the available storage space. Other considerations such as the height at which storage compartments are located on the vehicle should be considered. The tractor drawn aerials have a lower storage space configuration of the aerial apparatus. The new Sutphen still utilizes "top boxes" which are located high off the ground.

G.V.W.R is the gross vehicle weight rating which identifies the maximum permitted weight load of the vehicle. The drive and rear axles of the aerial apparatus assume the greatest share of the load carrying capability of aerial apparatus. Available load is the difference between the aerial apparatus's weight while empty (unloaded) and the vehicles G.V.W.R. Storage cubic feet is based on the measurement / dimensions of the compartments of these aerial apparatus. Usage storage space will be based on the available load-carrying capacity of the aerial apparatus.



Trucks with less than 300 cubic feet storage do not have the ability to organize equipment for functionality. Equipment is stored throughout the truck based on it fitting in a compartment not based on like equipment or need. Example: Not having all the hydraulic equipment in one compartment. Having the equipment in multiple compartments because of spacing. Or all the rope bags in one compartment.

Another example of how equipment is stored in odd locations. Before ladders can be deployed off this truck, miscellaneous equipment needs to be pulled out first



Long stabilization struts are stored in a make shift compartment above the 2 ½" discharges on the right side of the truck.

Short stabilization struts and hydraulic rams shoved together into a compartment that would accommodate their length.



Compartments with adequate storage space

Truck companies that have 300 or more cubic feet of storage capability have the ability to carry the required US&R 120-1 standard light and medium equipment complements. Apparatus that do not currently have 300 cubic feet of storage are left to store equipment on the exterior. Ventilation blowers, fans, WMD boxes, stokes baskets, hose packs and other equipment are common storage places on the 75-foot apparatus. Having equipment stored on the exterior is subject to the elements and is difficult to maintain.

Versatility Summary

1. 75-foot Tandem Axle Service Aerial

- They have 247 cubic feet of storage capability. 300 cubic feet is the groups recommended minimum.
- Similar equipment is spread out through various compartments.
- Versatility score for the tandem axle 75' service aerial was given an inadequate.

Good Adequate ***Inadequate***

2. 100-foot Tandem Axle Mid Mount Platform

- It has 300 cubic feet of storage. This is the recommended minimum for storage capabilities.
- Four added high boxes were added to help accommodate equipment storage.
- Tactical score for the tandem axle mid mount 100' platform was given a score of adequate

Good ***Adequate*** Inadequate

3. 100-foot Tractor Drawn Aerial

- Tractor drawn aerials have 322 cubic feet of storage for equipment.
- Equipment is stored for firefighting operations on one side and rescue operations on the other.
- Equipment is stored to allow for quick operations.
- Tactical score for the 100' tractor drawn aerial was given a score of good.

Good Adequate Inadequate

Extrinsic Value

These are other factors that should be considered during the selection process. Annual down time was derived from a review of Fleet Services internal maintenance system. The purchase costs reflect what the OCFA paid at the time of contract. The annual down time includes warranty and scheduled preventative maintenance schedule.

Extrinsic	100' Mid Mount Platform	100' Tractor Drawn Aerial	75-foot Service Aerial
Annual Down Time	43 days	13 days	32 Days
Purchase Cost	$1,282,116.00	$1,000,000.00	904,000.00

Section III – Evaluation Summary

When reviewing the other nine Orange County fire agencies that have truck companies, all have 100-foot aerials with the following exceptions: Anaheim Truck 8 is a 75-foot, Orange Truck 8 is a 75-foot, and Costa Mesa has one 75-foot truck. Anaheim Truck 3 is a 118-foot Bronto Skylift platform and Huntington Beach has one platform. All other trucks are 100-foot TDA's.

The following choices were recommended by the group for the trucks capabilities in maneuverability, tactical, versatility, and extrinsic.

	100-foot Mid Mount Platform	100-foot Tractor Drawn Aerial	75-foot Rear Mount Service Aerial
Best choice for Maneuverability		X	
Best Choice for Tactical	X		
Best Choice for Versatility		X	
Best Choice for Extrinsic		X	

Based on the findings and evaluations, the following are the group's recommendations. The evaluations and findings from the truck company operational expectations, truck equipment, relief aerial apparatus, salvage unit feasibility, US&R Staffing, and standards of coverage were also considered when making the following recommendations.

Recommendations:

1. Aerial apparatus have quint capabilities

2. Aerial ladders should be a minimum of 100-foot (page 14-19);

3. Storage compartments have a minimum of 300 cubic feet of storage to meet the OCFA and FIRESCOPE US&R-120 equipment needs (pages 21-23);

4. Mid mount aerials provide the greatest reach and flexibility. Rear mounted aerials loose an average of 42 feet when trying to reach an objective out front of the apparatus (pages 14-19);

5. Limit variations of aerial apparatus for better operator familiarity and ease of operation;

6. Have three to four platforms throughout the operational areas. Having platforms gives the OCFA tactical depth for rescue, safer defensive master stream operations, and a better environment for firefighters working off the tip during overhaul.