SAN FRANCISCO FIRE DEPARTMENT

Division of Training

Training Bulletin

Electrically Powered Vehicles

TRAINING BULLETIN 97-4

ELECTRIC VEHICLES

INTRODUCTION

Due to Federal and State mandates requiring energy diversification and higher air quality standards, electric vehicles will soon be a reality in San Francisco. This training bulletin provides guidelines for properly handling emergencies involving electric vehicles. The majority of rescue procedures used with electric vehicles will be identical to those currently used in emergency situations involving gasoline-powered vehicles. However, differences do exist. At the present time, there are very few electric vehicles on the road. Hence, there is not a great deal of history written with regards to emergencies involving electric vehicles. Therefore, as more information is gained on this subject from fire departments throughout the nation, this training bulletin will be updated to reflect improved methods for handling electric automobile emergencies.

MANUFACTURERS

Electric vehicles soon to be marketed will not look like vehicles out of the future or from outer space. These vehicles, for the most part, will look almost identical to their gasoline powered counterparts. Some of the electric vehicles soon to be on the market are: the Toyota RAV 4, the Ford Ranger, the Chevrolet S10, the Honda EV Plus, the Chrysler EPIC, the Nissan Prairie Joy, and the General Motors EV1. The electric automobile, therefore, may not be readily identifiable to rescuers.

There are, however, ways to identify an electric automobile. Responders should look for an electric vehicle insignia or label on the body of the vehicle. Labeling may be located on the sides or rear of the vehicle body. If the vehicle is on its side with its underbody visible, a smooth underbody with no exhaust pipes or gas tank will be seen. If the vehicle's hood is open, the absence of engine components and the presence of "High Voltage" warning stickers are indicators of an electrically powered automobile.

MARKET

Where will we begin to see electric vehicles? These vehicles are expected to make headway into places where they make the most sense. For instance, expect to see electric vehicles in delivery fleets for private companies, in utility companies like P.G. & E., and in city vehicles. Electric vehicles work well in the above area because they can be used during the day and be recharged during the night or visa versa.

Will the general public be purchasing electric vehicles? Due to their high cost and limited range, electric vehicles used by the public will probably be confined to urban areas like San Francisco and/or for use as a family's second car.

SIMILARITIES TO GASOLINE POWERED VEHICLES

Although we can expect to find a greater use of aluminum and light weight plastics, many of the materials used in the production of electric vehicles are the same as those used for gasoline powered vehicles. The steel, fluids, coolants, lubricants, refrigerant, and brake components used are consistent with those used in gasoline powered vehicles.

Expect to find the same accessories and safety features such as air bags on electric vehicles.

GENERAL HAZARDS INHERENTLY ASSOCIATED WITH ELECTRIC VEHICLES

ELECTRIC SHOCK

When we respond to a fire or other emergency involving a gasoline powered automobile, one of our least concerns is probably getting an electric shock. After all, the typical automobile utilizes 12 volts. With an electric automobile, we are now dealing with voltages up to 360 volts alternating current. This is three times the voltage of a typical household wall outlet. Why the need for this "High Voltage"? Manufacturers are using "alternating current" or "AC" motors in their electric vehicles because "AC" motors are lighter, smaller, and more efficient than "direct current" or "DC" motors. These "AC" motors require high voltage. This "High Voltage" is obtained by wiring as many as thirty 12 volt batteries together in series.

It would be one thing to only have the worry about "High Voltage" to the motor, but manufacturers are using this "High Voltage" to power other components on the car such as the power steering motor, the heat pump (used for passenger heating and cooling), and the power electronics bay. There is also "High Voltage" at the vehicle's charging inlet. Therefore, caution must be used at all times around all areas of the vehicles. What indicates that wiring or a component are "High Voltage"? "High Voltage" wiring is easily identifiable by its ORANGE color. Components with ORANGE wiring routed to them are "High Voltage." Also high voltage components have "High Voltage" warning stickers attached to them.

Fortunately, the metal body of an electric automobile is not used as a common ground for the high voltage wiring and components . The electrical connections are isolated from the vehicle frame. What this means is that the system is designed so that a responder cannot be shocked by touching the vehicle frame. This is true even if there is an isolation failure. Nevertheless, in major electric vehicle accidents, assume that the entire vehicle has an electrical charge.

There is also an additional safety feature with regards to high voltage. OEM electric vehicles have automatic high-voltage system disconnects. In the event of an accident, this safety feature will remove high voltage from all areas outside of the battery pack (the area where batteries are located). But, high voltage still remains in the battery pack!

BATTERIES

Batteries are the weakest link when it comes to electric automobile technology and we can expect to see the greatest amount of future development in this area. Manufacturers are now utilizing three types of batteries to power electric vehicles; lead acid, nickel metal hydride, and lithium ion. "Advanced" lead acid batteries are likely to be common in the initial electric vehicle fleets. These advanced lead acid batteries are not "flooded" with electrolyte. Rather the electrolyte is trapped in an absorptive glass mat. Therefore the actual amount of electrolyte contained within the batteries is very small. In the event of a battery puncture, the amount of electrolyte would be about one to two teaspoons.
In addition, these advanced design batteries produce very little hydrogen and oxygen emission during recharging.

BATTERY PACKS

A battery pack is the area of an electric vehicle where the batteries (as many as thirty wired in series) are located. Typically, the battery pack is located under the vehicle and/or between the vehicle's rear wheels. Even when high voltage has been disconnected from all wiring and vehicle components, high voltage still exists in the battery pack. NEVER, cut into the battery pack or

"tunnel", or penetrate the battery compartment in any way. Treat the battery pack as if it is a full tank of gasoline!

RECHARGING

The power stored in the batteries gives a small car about one quarter the range of a conventional vehicle under optimum circumstances. There is no doubt that electrical vehicles will spend a good time hooked up to battery recharger. This always creates the possibility of electrical failure such as a short. Electric vehicles will more than likely be charged unattended indoors. Some rechargers will have high voltage (as high as 480 volts) to provide for quick charging (three hours). This presents an additional hazard to responders approaching a vehicle hooked up to a charger.

MANAGING SPECIFIC INCIDENTS INVOLVING ELECTRIC VEHICLES

Warning: ***To guard against potential shock, avoid wearing rings, watches, or other jewelry when working around electric vehicles.***

FIRES

As with any automobile, full fire protective equipment including SCBA's should be worn. As with all newer vehicles, a large amount of plastic is used in their construction. Fumes from burning plastic are toxic. If the batteries are exposed to fire, the fumes and gases generated are extremely corrosive. Electric vehicles can also expose responders to lead, cadium, lithium, and acid mist. If possible, approach electric automobile fires upwind to keep personnel from operating in the smoke. Remember that sealed components such as shock absorbers, grease seals, drive shafts, air bags, headlights, and shock-absorbing bumper mounts can react explosively in a fire. Extinguish electric automobile fires with water and/or foam. If fire is involving the battery pack, use a dry chemical extinguisher.

If the electric automobile on fire is hooked up to a battery charger, first turn off power at the charger and disconnect charging coupler to vehicle. If this is not possible, disconnect power to charging unit at the building's electrical sub panel. Then extinguish fire in the same method mentioned above.

EXTRICATION OF OCCUPANTS FOLLOWING AN ACCIDENT

Before beginning extrication of an electrical vehicle occupant, stabilize the vehicle using the vehicle's parking brake, chocks, and blocks. Because the batteries are located low and in the center of the vehicle, a rollover involving an electric automobile should be rare. If it does occur, the vehicle should be shored to keep the weight of the battery pack from shifting. Make sure power to motor has been turned off at the dashboard. Remember, unlike a gasoline powered vehicle, an electrical vehicle makes almost no noise making it difficult to determine if the motor is still "on".

When an electric vehicle has been involved in an accident, there may be electrical sparking. If there is gasoline leaking from the second vehicle, there is a potential for a deadly combination. Always back-up any and all rescue efforts on all vehicle types with a charged line.

Use high voltage rated nonconductive boots and gloves if you will be coming into physical contact with the vehicle. Be sure your footwear meets minimum standards established by NFPA 1974 Standard on Protective Footwear for Structural Fire fighting, NFPA 1974-1992 and the American National Standard for Personal Protection, Protective Footwear, ANSI Z4-1991 (All safety shoes issued by the SFFD Clothing Depot meet the preceding requirements). Only use hand tools, such

as screw drivers, pry bars, and pliers, that are equipped with insulated handles rated for 1000 volts. Personnel working directly with an electric automobile should also be equipped with "high voltage" rubber gloves. Law enforcement and emergency medical personnel should minimize or completely avoid physical contact with electric vehicles involved in catastrophic accidents.

Use standard cut-in points on the vehicle but avoid high voltage areas. Door prying efforts should be identical to those used for gasoline powered vehicles. Mechanical or hydraulic extrication tools may be used to enter the passenger compartment through the door, door frame, front windshield, rear window, or roof. Extrication procedures may include cutting through the roof "pillars" in the areas of the windshield and door frame. **DO NOT CUT INTO OR NEAR THE BATTERY PACK WHERE HIGH VOLTAGE EXISTS.**

Once inside the vehicle, use caution around undeployed air bags (as you should in any vehicle) as their actuators will still be energized. Do not place your body or any objects against or in close proximity to either air bag locations.

ELECTRIC VEHICLE SUBMERGED IN WATER

If an electric vehicle is immersed in water, either partially or completely, there will be no electrical hazard to either vehicle occupant(s) or emergency response personnel. When water enters the battery pack compartment, the system quickly shorts-out". Battery pack voltage is consumed in a rapid discharge process that is contained in the battery pack compartment.

Because the battery pack is fully isolated form earth ground, the discharge process takes place without risk to either vehicle occupants or the rescue workers. During this rapid discharge process, the water in the battery compartment undergoes an electrolytic process, producing small amounts of hydrogen and oxygen gasses. There could be some minor popping in the battery compartment as these gas "pockets" come into contact with dissipating battery voltage.

Occupant extrication should take place using normal procedures for vehicle immersion circumstances.

Finally, experts disagree as to how successful electric vehicles will become as they make inroads into our country's automobile fleet. Whatever the case, electric vehicles will eventually appear on our city's streets. As emergency responders, they will present a new set of challenges for us in handling automobile emergencies.

REFERENCES:

1. Ev 1 Emergency Response Information Booklet
2. Emergency Response To Electrical Vehicles - California Department Of Forestry And Fire Protection. Office of the State Fire Marschall

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