



## Electric Vehicle Challenges for Open & Closed Parking Garages

*By Douglas LeValley*

Parking garages or Parking Structures per the NFPA Codebook can be located underground or aboveground and are usually located in congested urban areas where large open parking lots are not feasible. They can be public or private and store anything from cars, motorcycles, trucks and buses.

We are going to see more and more EV's especially with the nation's most ambitious climate control regulations to date, two-thirds of new passenger cars and a quarter of the new heavy duty trucks sold in the United States are to be all-electric by 2032. One of the issues as the first responders in our communities, we must acknowledge that our communities think of us as the experts in the field of whatever we are mitigating on the streets. What constitutes an expert? (A person with extensive experience or knowledge in a specific field or discipline beyond that of a layperson). In the eyes of our communities, we are the Subject-Matter Expert (SME).

That leads me to this, as the fire service professionals we must understand how these electric vehicles (EV's) work. Here is a basic rundown of how electric vehicles work: EV's receive energy from a charging station and store the energy in its battery. The battery gives power to the motor, which moves the wheels. Obviously, a modern EV requires several other electrical components to operate reliably and efficiently, but that is the fundamentals of EV's. The concerns about parking garages open or closed are starting to get attention in the fire service around the country by what has occurred here in the United States with electric vehicle fires vs parking garages (Case History; Houston Fire Department 1508 Blodgett Street Apartment Fire). While in other parts of the world, fires in parking structures has led to very large economic losses, as evidenced by recent fires at Liverpool's Echo Arena (UK) and at the Stavanger Airport (Norway). These incidents involved hundreds of automobiles, injuries, severe structural damage and structure collapse. In parking garages, vehicles are parked right next to one another to save space, this becomes a combustible nightmare, we must get a handle on the fire within the first few minutes upon arrival or we will lose the battle. Early detection and quick preplanned attacks are critical to the outcome of these incidents, especially when residents are attached to the parking garages.

Something else we must consider, parking garages across the US could be at risk of collapse over the weight of heavier electric vehicles, experts warned, as one such garage fell in Lower Manhattan recently, killing one person and injuring five. Example, the weight of vehicles, (1960 4-door Cadillac 4703 lbs., EV 2023-BMW IX 5769 lbs. and EV 2023-GMC Hummer 9063 lbs.), certainly a concern.

As a reminder, internal combustion motors (ICM) (gas/diesel) are a little easier to battle; the temperatures can reach 1500°F, with these types of fires, EV's can reach temperatures over 4500°F, "big difference". This is a major concern for parking garages as well, the science and research of concrete has been conducted; the mechanism behind heat-induced spalling is simple. When concrete is exposed to temperatures above 212°F, the boiling point of water, the moisture in the concrete turns to steam. If the

temperature rises more rapidly than the steam can escape through the concrete matrix, the rising pressures exceed the strength of the concrete and it begins to spall. This spalling can be explosive in extreme cases can cause major damage, including collapse. EV fires poses threats that are far more serious and challenging than ICM vehicle fires, again they burn much hotter for far longer. Extinguishing them is vastly more difficult and many fire departments are limited in their response capabilities. Electric vehicles burn no more often than ICM, but lithium-ion battery fires are more difficult to extinguish.

Two cities in the US have already ban parking electric vehicles in underground garages. There have been reports of spontaneous combustion in two underground parking garages of EV's that caused fires and structural damage. The good news: there are solutions for electric vehicles in underground parking garages, but they are not simple or cheap. Only with significant structural interventions can fires be contained reliably without the risk of significant secondary damage. There are many solutions in the future, they have looked at both CO2 and water mist concepts for parking garages, but both have issues and are still pushing forward to find the right solution to correct these incidents from getting out of control prior to fire departments arrival. The NFPA Research Foundation has started a project, this research is called the Prospectus Electric Vehicle Hazards in Parking Garages and it has several research goals to conduct. The goals of this project is to quantify the fire hazard and spread characteristics of electric vehicles to reform fire protection requirements for parking structures open or closed per NFPA.

With the influx of electric vehicles, EV chargers are popping up within these existing open & closed parking garages and the fire departments are last to know about them. The Level 2–240V Chargers are the most common type found at residential/commercial charging stations. 220-240V plugs usually offer around 40 amps of service. The safety of the charging stations can be affected by wiring components as well as the competency and experience of the installer. It does not take a degree in Physics to understand that the EV charging station is using a large amount of electrical current to charge an EV to full capacity. In a security video of an EV fire in a parking garage, it reviled a significant fire developed that involved three vehicles in under three minutes. Aside from the speed of the EV fire, the fire also was too large to extinguish with any portable fire extinguishers as soon as it self-vented from the vehicle of origin.

With NFPA setting the 4 minutes of the initial 911 call for the first engine to arrive on scene, some form of fire suppression must occur prior to the fire department's arrival if a conflagration is to be avoided. As first responders, we must have some basic standing operation guidelines in place for open & closed parking garage fires in your first response territories. Remember that the NFPA for open parking garages are not required to have a wet sprinkler system in place. In fact, they are not required to have a sprinkler system at all, they only to have a way of establishing a water supply (Dry Standpipe System) especially on a multi-story open parking garage. The first on scene units must establish a secured water supply; have a way of advancing hose line on multi-story garages. The goal is to get the wet stuff on the red stuff as soon as possible to slow down the heat transfer to other batteries and eliminate lithium-ion battery thermal run-away.

Besides water, there are other alternative suppression measure that are available, (i.e. Fire Blankets, Cutting Extinguisher, Battery Extinguishing System and lastly, the Submerging Tanks) just to name a few.

The bottom line is that we are the electric vehicle SME on scene; the only way firefighters can obtain this title is by getting out in your first alarm territory and learn your districts and the components of the EV's and what makes them work. These quick walk-throughs of the open and closed parking garages within your first response territories can make an impact on how we manage your next EV fire within a parking garage structure.

When conducting these walk-throughs look for:

- Secured Water supply (Primary Hydrant and Secondary Hydrants)
- Standpipe riser locations (Wet & Dry Systems)
- Access to the vehicle fire on multi-story parking garages (i.e. stairs, elevators ramps ect...)
- Estimating the stretch (Utilize High Rise Packs)
- Locations of Level I or II Electric Vehicle Charging Stations
- Utility disconnects
- Sewer, storm drains ect... for environmentally sensitive areas due to contamination runoff

These are just a few tips, there a lot of different types of open & closed parking garages out there in our communities. The goal is to have an advantage prior to arrival when responding to these incidents so we eliminate the problem quickly and safely.

As a reminder, the electric vehicle has three distinct properties, *Chemical, Electrical & Thermal*. All three can make for a bad day on your shift, so get out and learn the components of EV's and know the structures in your assigned areas, you will be surprised on what you might find.

*(Optional for article):*

Please, share your experiences in social media and publications good, bad or ugly so we in the fire service working the streets can learn from them in order to set a safe standard when responding to these incidents moving forward.