



U.S. Emergency Responder Safety Training for Advanced Electric Drive Vehicles



8) State Partnerships for EV/Hybrid Classroom Training

Next, NFPA worked with the North American Fire Training Directors (NAFTD) to develop a plan to sign a Memorandum of Understanding (MOU) with each state in order to outline expectations on both sides, including a venue and logistics. NFPA offered to each state a full day of a train-the-trainer program with up to 100 state and fire academy instructors and local fire service trainers participating. These instructors in turn continue to provide a much more extensive reach for this training initiative by training the emergency responders in their respective regions, as the program cascades throughout each state.



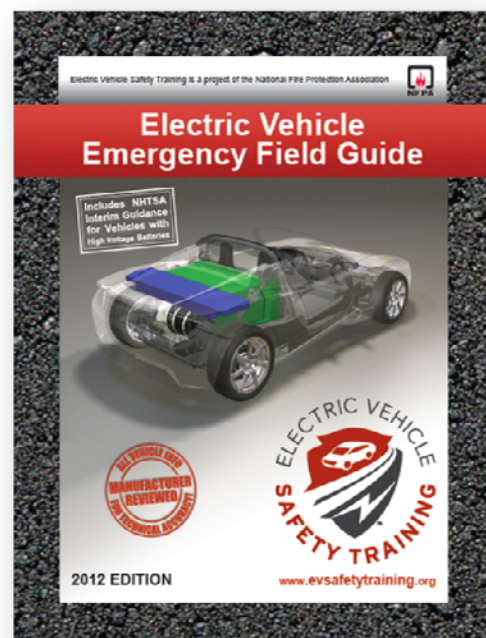
As the project progressed, forty-eight states formed partnerships with NFPA and in turn held very successful training programs for their training officers.

9) Training Toolkit Development

To further increase the reach of this training program, NFPA has overseen the creation and delivery of a training toolkit to each classroom train-the-trainer participant. This toolkit includes the instructor’s guide, digital student manual, digital NHTSA High Voltage Battery Interim Guidelines, a digital pre & post test, full length training videos, animations, simulations, and a full color print edition of the Emergency Field Guide quick reference on-scene manual. The printing and distribution of all the printed material, tests, manuals and the Emergency Field Guide to all participants was donated by NFPA to the fire service, outside of the DOE grant funds or cost share requirements.

10) Emergency Field Guide Development

Early in the project, NFPA recognized large gaps existed for the emergency responder communities when they need vital on-scene safety information for specific vehicles. EV and Hybrid auto manufacturers create safety reference material for each of their specific make and model vehicles for Emergency Responders, which are usually called Emergency Response Guides (ERG). These manuals, usually





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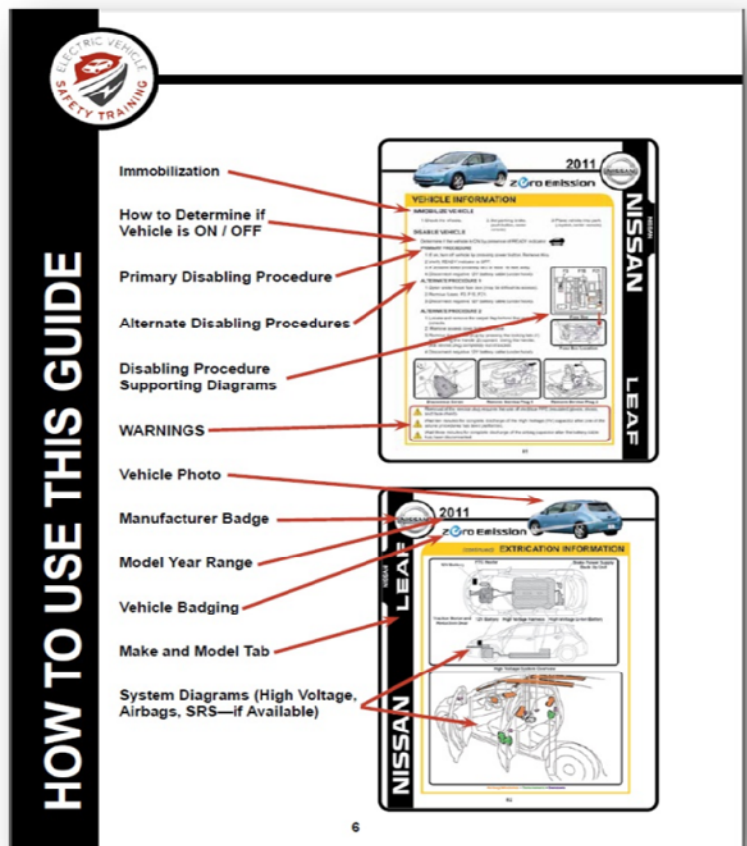


adapted from technician manuals and rarely written from emergency responder perspectives, can range in size from roughly 30 pages to 90 pages, again, for each make and model vehicle. NFPA printed each of these ERGs and bound them into multiple volumes. The stack of books measured a foot tall. As the classroom training pilots were taking place, polls were taken about how many responders actually read any of these ERG manuals. The results were that only a few even read one manual, out of hundreds surveyed, due to time it took to locate the manuals and then the information inside the manuals.

To find a solution, NFPA worked with GM, Nissan, Ford, Kia, Hyundai, Tesla, and other manufacturers to help redesign their ERGs. In many instances, a more consistent format was developed and more relevant information was conveyed. Again, all of the ERGs were then distributed to the first responders on NFPA’s EV Safety Training Website (www.EVsafetyTraining.org).

A couple manufacturers asked NFPA to work with them to distribute their ERG’s directly to the fire service, and NFPA set up an email blast to accomplish these special requests.

Although these efforts did make some ERGs more consistent and effective for responders, there was still the major problem of the inordinate amount of material that a responder would need access to in a crash situation. In order to meet a responder’s need in locating vital safety information about a car, in the middle of a stormy night with the vehicle in



question wrapped around a tree, upside down, work began on a quick reference manual.

NFPA proceeded to develop and release the Electric/Hybrid Vehicle Emergency Field Guide (EFG), a quick reference field guide containing only the most vital EV safety information, descriptions,



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diagrams, locations of high voltage (HV) vehicle components and batteries, HV cables, deactivation switches, fuses, power down procedures and extrication diagrams, in a highly indexed and consistent format for each manufacturer. As part of this task, NFPA requested and received permission from each manufacturer to use their vehicles' information and each manufacturer reviewed their completed section for technical accuracy. The guide also has content from the NFPA's courses on identifying, immobilizing, disabling, crash extrication, fire, battery re-ignition, vehicle submersion and spill hazards. It also includes NHTSA's Interim Guidance for Vehicles with High Voltage Batteries, which NFPA also worked with the NHTSA government agency on developing during the course of this project.

The EFG is available as a printed handbook (currently under 150 pages) and as a downloadable PDF, which can be used on mobile smart devices. The full print version of the EFG is available on NFPA's EV website and updated at least once a year with new vehicles and evolving safety practices.

11) NFPA/SAE EV Safety Summit and Technical Panel Meetings

During this project, NFPA wanted to become more involved in the continued development of



vehicle safety, and partnered with the Society of Automotive Engineers (SAE) to co-host a yearly EV Safety Standards Summit. Each year for the past three, a conference was held in the fall which included multiple presentations and an opportunity to have round table discussions on topics of interest and debate. Auto manufacturers, DOT, DOE, Electric Utilities, Fire, Law Enforcement, Towing Services, safety and standards organizations and several government agencies participated. New EV/Hybrid vehicles were on display and several auto manufacturers were on-site to answer questions and provide information. This event was viewed as a resource to gain additional training content, as well as to provide a unique opportunity for first responders and the auto manufacturers to hear one another and influence future vehicle safety designs, labeling, documentation and responder best practices.

12) New York State Police Classroom Training Development

A new Statement of Project Objectives (SOPO) was approved by DOE in Q1 2012, which included new training targets of the Law Enforcement community. In Q1 2012, NFPA signed





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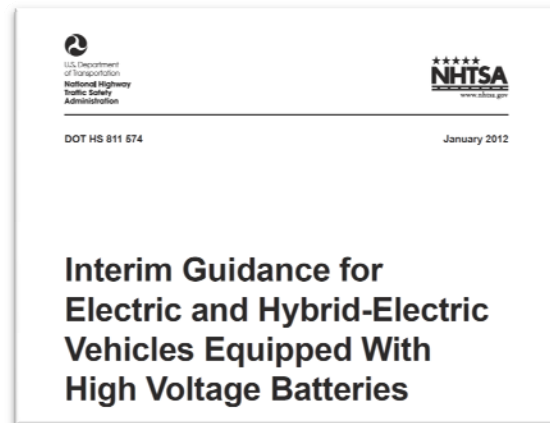
an agreement with the New York State Police Academy to co-develop a state of the art Law Enforcement EV/Hybrid training program, and in Q2, the planning and kickoff meetings were held. The program was completed in Q3 and piloted and released in Q4 2012. The program is currently embedded in the NY State Police Academy's ongoing training curriculum and has received the highest marks from their reviews.

NFPA also constructed a one page (front and back) high level quick reference card for the Law Enforcement Community on how to work with EV/Hybrid Crashes safely. This reference card has been distributed to the NY State Police and will also be made available on the NFPA EVSafetyTraining.org website in 2013.

13) NHTSA Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped with High Voltage Batteries

In the fall of 2011, The National Highway Traffic Safety Administration (NHTSA) put a Chevrolet Volt through a side impact crash test, where it performed very well and received a 5 star rating.

While the vehicle successfully passed the test, the battery case was compromised during the testing process. Following the test, the vehicle was placed in a storage area and several weeks later, was found gutted by a fire that destroyed the Chevy volt and several adjacent vehicles. The post fire investigation, conducted by NHTSA and Chevy, concluded damage sustained by the high voltage battery during the side impact testing was the cause of the fire, which originated in the battery itself and spread to the passenger compartment. NHTSA did additional testing of several Volt lithium ion batteries with similar results, delayed fire occurrence after completion of the testing.



Following these events, the Department of Transportation, (DOT) invited NFPA to assist NHTSA in preparing safety guidelines for first and second responders, as well as the public. NFPA provide technical staff from its Public Fire Protection Division, the Electrical Division, Fire Protection Research Foundation, and senior management along with the Electric Vehicle Safety Team, to support NHTSA on this endeavor. The result was a full color document for all first and second emergency responders entitled "NHTSA Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped with High Voltage Batteries", and NFPA assisted in disseminating this information across the country. Since these events, GM has reinforced and protected its high voltage battery pack, and NHTSA has approved the resolution. Both GM and NHTSA have crash tested the improved Volt, with good results,



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and NFPA, NHTSA, GM and the world learned much more about battery placement, protection, discharging, storing damaged high voltage (HV) vehicles and batteries and what warning signs to look for when a HV battery in a crash appears damaged. All of these lessons learned and interim guidance was incorporated in NFPA's online and classroom training courses, as well as all of our reference material.

The National Highway Traffic Safety Administration (NHTSA) is committed to ensuring the highest standards of safety on our Nation's roadways. To better protect consumers and the public safety community from the potential risk of fire and other hazards related to vehicles that have been involved in a motor vehicle crash, NHTSA has developed "Interim Guidance for Electric and Hybrid-Electric Vehicles Equipped With High Voltage (HV) Batteries." Developed with the assistance and expert input of the National Fire Protection Association, the Department of Energy (DOE) and others, the interim guidance for electric and hybrid-electric vehicles identifies appropriate post-crash safety measures for vehicle owners and the general public, emergency responders, and for towing/recovery operators and vehicle storage facilities.

NHTSA does not believe that electric vehicles present a greater risk of post-crash fire than gasoline-powered vehicles. In fact, all vehicles—both electric and gasoline-powered—have some risk of fire in the event of a serious crash. However, electric vehicles have specific attributes that should be made clear to consumers, the emergency response community, and tow truck operators and storage facilities. Out of an abundance of caution to prevent injury and loss of property, the interim guidance identifies considerations and actions for all electric and hybrid-electric vehicle crashes, including those involving the growing number of vehicles powered by lithium-ion batteries.

This interim guidance is intended to serve as a general reference for vehicle operators and responders. It was developed using current best practices and instructions from vehicle and battery manufacturers and others. It is not intended to replace information issued by the vehicle manufacturer, but rather to be used as a supplement to vehicle-specific guides. For more information about specific vehicle models, individuals should consult guidance provided by the vehicle manufacturer.

NHTSA, together with the Department of Energy, is continuing to explore strategies to ensure that the public and responder community receive the best information in the shortest possible time. The agency hope that this guidance will help to inform activities to educate responders and the public about electric vehicles including efforts already underway by DOE, NFPA, vehicle manufacturers, and others.



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D) Original Objectives and Accomplishments

Project Tasks from the DOE Statement of Project Objectives (SOPO):

Task 1: Project Management Plan

NFPA will complete a Project Management Plan and maintain and update the plan as needed during the course of the project.

- This project was developed using Project Management Institute (PMI) standards and Microsoft Project was used as the tool to develop and maintain the schedule. Below is a sample of the Key Milestones setup for this project:

ID	% Complete	WBS	Task Name	Duration	Start
0	0%	0	Advanced Electric Vehicle First Responder Training	780 days	Tue 2/2/10
1	0%	1	Key Milestones	776 days	Mon 2/8/10
2	0%	1.1	Project Initiation	0 days	Mon 2/8/10
3	0%	1.2	Review Historical Data & Grant	0 days	Fri 2/26/10
4	0%	1.3	Hire Fire Protection Research Foundation	0 days	Mon 3/1/10
5	0%	1.4	Fire Service Tech Panel Assemble & Meeting	0 days	Thu 3/11/10
6	0%	1.5	Fire Service Tech Panel Opinion Poll Results	0 days	Wed 3/31/10
7	0%	1.6	Hire Communications Firm	0 days	Fri 4/2/10
8	0%	1.7	Logo & Branding Complete	0 days	Fri 6/18/10
9	0%	1.8	Wireframe Web Portal Completed	0 days	Fri 7/16/10
10	0%	1.9	Send out RFP for SME Approval Process	0 days	Mon 6/14/10
11	0%	1.10	SME Team Chosen	0 days	Fri 9/24/10
12	0%	1.11	SME Topics Developed	0 days	Fri 2/11/11
13	0%	1.12	Setup External Focus Groups (Marketing)	0 days	Thu 7/1/10
14	0%	1.13	Focus Group Results	0 days	Tue 11/30/10
15	0%	1.14	Send out Fire Service Surveys	0 days	Mon 12/6/10
16	0%	1.15	Survey Results	0 days	Mon 1/10/11
17	0%	1.16	Send RFP to Find Team to develop CBT Training	0 days	Mon 6/28/10
18	0%	1.17	CBT Identification Team Selected	0 days	Mon 8/2/10
19	0%	1.18	CBT Development Vendor Selected	0 days	Fri 9/17/10
20	0%	1.19	Send RFP to Content/Curriculum Development Vendors	0 days	Fri 6/4/10
21	0%	1.20	Choose Content/Curriculum Vendor	0 days	Wed 6/30/10
22	0%	1.21	All Classroom Modules Complete	0 days	Mon 5/2/11
23	0%	1.22	Selected Classroom Modules Converted to CBT	0 days	Mon 9/12/11
24	0%	1.23	Portal Development Vendor Selected	0 days	Mon 10/11/10
25	0%	1.24	Portal/CBT Training Released	0 days	Mon 6/6/11
26	0%	1.25	Train the Trainer Curricula Development Vendor Selected	0 days	Mon 11/1/10
27	0%	1.26	Classroom Pilot Training Released	0 days	Mon 5/2/11
28	0%	1.27	Reference Guide (EFG) Vendor Selected	0 days	Mon 1/17/11
29	0%	1.28	Reference Guide (EFG) Released	0 days	Mon 4/16/12
30	0%	1.29	First series of Train-the-Trainer sessions starts	0 days	Thu 7/28/11
31	0%	1.30	Last Train-the-Trainer session Complete	0 days	Thu 1/31/13
32	0%	1.31	Project Closed	0 days	Thu 1/31/13

Project: Advanced Electric Vehicle Fir
Date: Tue 4/23/13

Task Milestone

Split Summary

Progress Project Summary

External Tasks

External Milestone

Deadline

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Task 2.0: Advisory Services

The implementation of this project is dependent on the strong collaboration of two sectors: the fire service (who are the intended audience for the training) and the automotive industry that has access to cutting edge information that will form the core of the training content. The interface with these two groups will be accomplished through the formation and administration of a Fire Service Advisory Panel and an NFPA/SAE yearly EV Summit, which hosts Technical Support Groups.

Subtask 2.1

NFPA will form and administer an advisory panel consisting of representatives from major U.S. fire service organizations. This group will represent the U.S. fire service's interface with this topic. The role of the advisory panel will be to review detailed work plans, provide advice on fire service messaging and delivery strategies, and to assist with the implementation and dissemination of the training and information programs. The advisory panel, which will consist of approximately 12 individuals, will meet approximately four times over the course of the three year project.

- NFPA created the Emergency Responder Technical Panel, who initially consisted of representatives from the following organizations: North American Fire Training Directors, International Association of Firefighters, United States Fire Administration, International Association of Fire Chiefs, National Volunteer Fire Council, International Fire Marshals Association, National Association of State Fire Marshals, the Metro Chiefs, as well as Fire Service Sections of NFPA. Later in the project, the Technical Panel expanded to include the Law Enforcement and Towing communities. Representatives from the International Association of Chiefs of Police (IACP), National Sheriffs Association (NSA) and the Towing and Recovery Association of America (TRAA) were included. The role of this panel was to assist in steering the training development direction, influence its content, review the drafts of the deliverables, approve the deliverables and help disseminate the program across emergency responder communities nation-wide. The technical panel met at least three times a year, on conference calls, video virtual meetings and in person. Each year, the panel met in person at NFPA's conference & exposition, where the deliverables from the prior year's work were displayed and voted on. Each year the panel unanimously voted to approve the works completed and offered their suggestions for improvement, which were incorporated shortly thereafter. The panel was a large success, and has held together past this project's duration to continue to provide direction for other electric vehicle projects that the Fire Protection Research Foundation is currently working on.

Subtask 2.2

NFPA will form and administer Technical Support Groups at their yearly NFPA/SAE EV Summit, which will consist of representatives from major vehicle manufacturers, peer safety



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organizations, utilities and emergency responder organizations who participate in workshops to serve as a conduit of safety information. This group will meet on a yearly basis during the project to facilitate the transfer of information and help steer the direction of the program development.

- NFPA's worked together with Society for Automotive Engineers (SAE) on J2990 EV work groups to continue to share ideas related to safety guidelines for auto manufacturers around EVs. For the past 3 years, NFPA, together with SAE, held an EV Safety Conference in Detroit Michigan where over 100 attendees for the Auto, Battery, Electrical, Safety, Emergency Responders and Code sectors converged each year to present their work, studies, findings, practices and to showcase the latest electrified vehicles. These gatherings allowed this project to administer technical support groups of these qualified, relevant sectors, in order to share information and directions that not only greatly benefited the safety training programs, but also the auto manufacturers and Electric Vehicle Supply Equipment (EVSE) OEMs, as they heard first-hand how to create safer vehicles, chargers, responder information and guidelines that would help make this new technology even more viable and accepted. Each year, an update was given on the EV Safety Training program and quality feedback was received by many attending the conference.

EV/ HEV Cabling
Color coded to SAE voltage levels

- Low Voltage: <30 Volts
Often **Red** or **Black**
- Intermediate: 30-60 Volts
Usually **Yellow** or **Blue**
- High Voltage: >60 Volts
Orange

4) Electric Shock

The diagram illustrates the color coding for EV/HEV cabling according to SAE standards. It lists three voltage levels: Low Voltage (<30 Volts) in red or black, Intermediate (30-60 Volts) in yellow or blue, and High Voltage (>60 Volts) in orange. A warning sign indicates a risk of electric shock. Three inset images show examples of these colored cables in a vehicle's battery pack area.

Task 3.0 – Product Development

Information provided by Fire Service Subject Matter Experts and the vehicle manufacturers will form the core of the training. This information gathering will establish the content for a hired training organization to construct curricula for NFPA's EV Safety courses.

Subtask 3.1

A core curriculum will be developed from this information and will be utilized in many different formats throughout this project. Research will be conducted to determine the best training methodology, learning styles, and delivery methods for the emergency responder community. Emergency Responder Focus groups will be held in major cities across the country





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where EVs are expected to be released first, and a quantitative study will be held, focusing on Fire Service Training Officers across the country.

- NFPA hired Chadwick Martin Bailey (CMB), who conducted 17 focus groups of emergency responders in 8 cities that NFPA and DOE deemed the most likely early adopters of this new vehicle technology, and then conducted a quantitative survey, speaking to 425 emergency responder training officers nation-wide. NFPA's also assembled and surveyed the Emergency Responder Technical Panel, who represents every major fire service organization in the U.S. The purpose of this research was to determine the needs and concerns of the fire service with respect to EVs across the country, to find the optimum training mediums to reach the national fire service, and to find the formats and training approaches to reach the most firefighters. The results were documented in two reports produced by CMB, and this information was used in the development of all deliverables.

Subtask 3.2

A dedicated website will be developed to serve as a hub for emergency responder safety training on advanced electric vehicles. There will be links to all training materials including awareness content and interactive media. Updates on technology improvements will be posted by partner organizations and an emergency responder discussion board will also be included. This website will host the communications program described below.

- NFPA developed a website (www.evsaftytraining.org) as a portal to host Electric Vehicle Safety resources and important project updates. Included in the website is a directory of manufacturers' Emergency Response Guides for electric and hybrid drive vehicles, classroom training sessions, the Electric Vehicle Safety Training blog, Electric Vehicle Safety Training videos, an online training program for electric and hybrid vehicle safety, updates to the training, training materials for purchase, conference and events, and the latest electric and hybrid vehicle news.
- The website has proven to be a central location for first and second responders to access information regarding electric and hybrid vehicles and has received 161,681 visits.

Subtask 3.3

NFPA will offer participation in Auto Manufacturer's EV Safety Training programs for emergency responders, if the manufacturers agree. NFPA will write and revise scripts, provide a video introduction and a fire service SME to teach and offer supporting documentation for participants.





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- Two auto manufacturers agreed to offer vehicle specific safety training. The first was General Motors, partnering with NFPA to assist in developing and hosting an extrication video early in 2010, which is available on our website. The second was Mitsubishi motors, who donated a Miev '1' vehicle in the fall of 2012 for NFPA to produce an in-depth vehicle extrication video series as part of this project.

Subtask 3.4

NFPA will construct and host online electric vehicle specific self-paced training courses and video modules for the first all electric mass produced vehicles on the market, specifically for GM, Nissan and Ford, depending on the auto manufacturer's desire to do so. These trainings will be hosted on NFPA's EV website and made available to emergency responders in the U.S.

- A Chevy Volt online course was developed and is hosted on the Training page of our EVSafetytraining.org website, with over 19,000 first responders participating in this online self-paced training to date. GM has publicly turned over all of their future EV Safety Training efforts to NFPA. After much discussion, Nissan and Ford decided not to proceed with self paced training courses up to the present time.

GM passes the torch to NFPA on EV Training



NFPA President Jim Shannon speaks at a press conference in Detroit and talks about NFPA's role in providing electric vehicle safety training to first responders.

Subtask 3.5

A comprehensive reference guide will be developed to assist emergency responders in the identification of hazards in advanced electric drive vehicles. This guide will be based on the latest information from the automotive industry. Vehicle diagrams, designs and wiring schemes will be included. This guide will be developed with input from the major vehicle manufacturers and will be updated as technology changes. This guide will be available in formats that will accommodate numerous electronic devices.



- NFPA has developed and released our Electric Vehicle Emergency Field Guide (EFG), a quick reference on-scene guide containing EV safety information, descriptions,



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diagrams, locations of high voltage vehicle components, deactivation switches, fuses and power down procedures. The EFG is available as a printed handbook and downloadable PDF, and in the coming months will be adapted into a mobile application. The full print version of the EFG is available on NFPA's EV website. Updating the EFG with new vehicles and evolving safety practices will continue, with updates scheduled at least once a year. The 2013 edition, with 22 new vehicles, will be released in May 2013.

Subtask 3.6

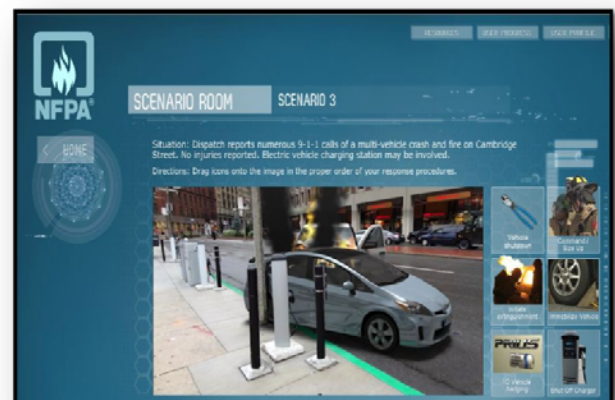
A Training Toolkit will be developed which will include video, PowerPoint slides, animations and other training media as well as an instructor's guide aimed toward emergency responders. This toolkit will be made available on a cost recovery basis to community colleges, training academies, as well as licensed to other countries in order to support the self sustaining goal of this project.

- Trainer "toolkits" have been developed containing deliverables to provide the training materials to each first responder trainer that attends one of our train-the-trainer classroom sessions. These deliverables consist of course supplies and electronic reference material, provided on DVDs, which include the pre-test, post-test, training videos and animations, scenarios, exercises, a student manual, classroom instruction slides, the print version of the Emergency Field Guide, FAQs, a resources sheet, and NHTSA Interim Guidelines to Vehicles with High Voltage Batteries. The disk is self loading and prompts the instructor through loading and displaying the entire course. The printing and distribution of all the printed material, tests, manuals and the Emergency Field Guide to all participants was donated by NFPA to the fire service, outside of the DOE grant funds or cost share requirements.

Subtask 3.7

A web-based e-Learning training program will be developed based on the core curriculum. It will include a simulation component consisting of emergency response tactics for electric vehicles based on current information from the automotive industry. The training will be structured to meet the needs of emergency responders based on appropriate needs assessments.

- NFPA launched an online self paced emergency responder training course for electric and hybrid drive vehicles in July of 2012. This course consists of six modules with a data review at the end of each that the first responder must pass to be able to move to the next module. In addition to the five modules that cover the basic training, all with engaging videos, animations and





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interaction, there is a scenario room that exposes the student to real life scenarios and requires each to pick the correct steps to handling the incident, and poses additional questions based on their answers. After successful completion of the online training, a certificate is generated and sent to the student. A database in the LMS monitors each student progress and captures the number of participants who successfully complete the program.

Subtask 3.8

A Train-the-Trainer Program will be developed in the format of a 1-day face to face seminar. A PowerPoint program and hand-off materials will be available via digital download. The audience for this program will consist of state fire academies, community college fire science programs and other organizations that train emergency responders. To meet the sustainability objective, this delivery vehicle will be part of the sales cost recovery. An Ask the Experts webinar will also be developed and made available to Emergency Responders as a follow-up to the training programs. This will be hosted by NFPA's Subject Matter Experts.

- A complete train-the-trainer program for fire service trainers was developed and includes a full day of instructor led classroom coursework, downloadable student manuals, instructor guides, videos, simulations, PowerPoint class instruction, in class exercises, a pre and post exam, outdoor hands-on training and a full 19 minute video overview of the topics covered. This program has thus far been trained to fire service instructors in 48 states.

Subtask 3.9

As part of the implementation plan, NFPA will monitor the various training products. Input from the advisory panel and from participant evaluations will be used to make any necessary changes to the curriculum. Since the majority of the training and information will be provided through the website, the number of participants will be tracked and reported. For the train the trainer program, rosters will be collected.



- Online Training: The online training programs have a built in Learning Management System (LMS), which tracks the users' progress in each module and provides a check on learning. As part of the training program, examinations are provided to students at the conclusion of each chapter. In order for the student to progress to the next training module, they must correctly answer all questions in the data review. These data reviews given to the student at the conclusion of each training module are a measure of the curriculum effectiveness and implementation.



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- Classroom Training: In lieu of the electronic data review and scenario rooms found in the online course, a series of realistic scenarios has been designed for the classroom course that are discussed in a group setting facilitated by the course instructor, applying best practices learned in the course in concert with personal experience and baseline professional knowledge. The purpose is to not only provide examples of best-practice and procedural application, but also to stimulate discussion using individual judgment and preexisting knowledge.
- Rosters, feedback forms and course evaluations are collected and reviewed at the end of each train-the-trainer session. After fire service instructors train the end user responders, rosters are submitted for certification. These rosters include information of name, department, position, and email of students. Over 5,000 students have been sent certificates for successful completion of the Electric Vehicle Safety Training course in the past 18 months.
- These courses has been provided to the Emergency Responder Technical Panel and piloted in various locations and with chosen responders from the West, Mid-Atlantic, South and East first responders. All of their feedback was collected and provided input into future versions of the programs.
- The feedback obtained from the participants and the instructors, along with changes in technology, has led to the safety course being updated three times in two years. Another major revision is under construction and its released is scheduled for the summer of 2013.

Task 4.0 – Communications and Implementation Plan

A communications plan will be implemented to ensure the broadest reach for this training.

Subtask 4.1

Media relations will be conducted by NFPA in conjunction with an outside communications firm. This subtask involves monitoring local and national news related to electric vehicles and emergency responder training, and providing news releases on this training program and related new activities to all media channels, including social media outlets.

- NFPA chose Fleishman-Hillard as our communications vendor, and they were tasked with creating and executing a nationwide communications campaign for this project, targeted first at Emergency Responders and then to the general public. Their responsibilities include branding and advertising our training programs, as well as developing a wire frame communication portal where safety EV information, training, a calendar of events and blogging is located, in order to generate public interest and first responder awareness for NFPA's advanced electric vehicle training initiative. Fleishman-Hillard also has managed all media coordination for train-the-trainer classroom sessions, oversaw the advertising placement and schedule and provided media appearances in almost every state visited.



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Subtask 4.2

Government relations will include the preparation of letters to public safety officials to inform them of availability of training, encouraging officials to include information on this training program in their newsletters and on their websites, and supporting NFPA in outreach to build and enhance relationship with existing partners and sponsors.



- NFPA has an office in Washington D.C. and will continue to reach out to government agencies, educating them on this EV safety program and letting various agencies know what is currently available to emergency responders. NFPA has attended conferences and meetings concerning EVs that it has been invited to in Washington, whether hosted by DOE, DOT or other branches of the U.S. government. During the grant, NFPA was called upon and worked extensively with DOT and NHTSA, and extended invitations to DOT and DOE, to allow them to participate in the NFPA's EV/Hybrid training programs. NFPA has also discussed training opportunities for the U.S. Department of Defense on several occasions.

Subtask 4.3

Promotional placements in print and web-based fire service related publications will be carried out. In addition, an email promotional campaign will be implemented targeting partner organization's members, colleges that provide training to emergency responders, as well as to the general fire service audience. NFPA will also create and distribute a monthly EV Newsletter, which will be designed to keep first responders informed on EV related news, events and training releases.

- Fleishman-Hillard was hired and carried out a promotional campaign that integrated key program elements to achieve in print and web based ads throughout the fire and law enforcement communities, as well as colleges that provide responder training. The campaign created over 50 million earned media impressions across the country.
- NFPA created and disseminated a monthly EV Safety Newsletter that has a circulation of over 22,000. This newsletter keeps our responders on top of the latest safety developments in the EV/Hybrid arena.



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E) Research:

The following research, among other sources, was used in constructing the content for the training courses:

- Long, R.T., Colwell, J.D., Ray, R., Grossmann, H.L., Thomas, B., Strassburger, R., “Passenger Vehicle Fires”, Fire Protection Handbook, Section 21, Chapter 1, 20th edition, National Fire Protection Association, Quincy MA, pg. 21-4, 2008
- Grant, Casey C. *Firefighter Safety and Emergency Response for Electric Drive and Hybrid Electric Vehicles*. Tech. Quincy: Fire Protection Research Foundation, 2010.
- Grant, Casey C., and Brian Merrifield. *Assessment of Powered Rescue Tool Capabilities with High-Strength Alloys and Composite Materials*. Tech. Quincy: Fire Protection Research Foundation, 2011.
- Simonian, Lonny, Thomas Korman, Frederick Mowrer, and David Phillips. *Electrical Vehicle Charging and NFPA Electrical Safety Codes and Standards*. Tech. Quincy: Fire Protection Research Foundation, 2011.
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F) Educational Offerings:

The following courses have been developed and are currently being taught or are available on NFPA’s www.EVSafetyTraining.org web portal. At the conclusion of these educational offerings, emergency responders should be able to do the following:

- Describe basic electric concepts pertaining to the high voltage systems found in EVs & hybrids.
- Describe the operation of hybrid and electric vehicle systems and how to safely deal with them at the scene of an incident.
- Demonstrate knowledge of initial response procedures for EV/Hybrid incidents.
- Identify and differentiate the differences between an ICE, hybrid, plug-in hybrid, or electric vehicle.
- Immobilize a hybrid, plug-in hybrid, or electric vehicle.
- Disable a hybrid, plug-in hybrid, or electric vehicle.
- Determine appropriate actions to handle and extinguish a high voltage battery fire.
- Describe post-incident procedures for a damaged electric or hybrid vehicle.



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1) Fire Service Train-the-Trainer EV/Hybrid Safety Course - 8 hours

NFPA's *Electric Vehicle Safety Training* provides firefighter training officers with the information necessary to teach and respond to emergency situations involving all electric vehicles and hybrid vehicles on the road today.

This 8 hour instructor-led, train-the-trainer course is comprised of videos, animations, slides and activities. It has both a classroom and hands-on component, which cover the following topics:

- **Introduction to hybrid and electric vehicles**
- **Basic electrical concepts**
- **Vehicle systems and charging stations**
- **Initial response procedures**
 - Identification methods, Immobilization, Disabling
- **Emergency operations**
 - Unanticipated vehicle movement, electric shock hazards
 - Toxic and flammable gas buildup, Electrolyte skin contact
 - Extrication, Vehicle and battery fires, Submersion
 - High voltage battery damage, Battery re-ignition
 - Incidents involving charging stations
- **Field Evolutions**

Each participant receives all the curricula used throughout the training, an Instructor Guide, a full-color Hybrid/EV Emergency Field Guide and Certificate of Completion.

2) Fire Service EV/Hybrid Safety Training Course - 4 hours

NFPA's *Electric Vehicle Safety Training* provides firefighters and other first responders with the information necessary to respond to emergency situations involving all electric vehicles and hybrid vehicles on the road today.

This 4 hour instructor-led course is comprised of videos, animations, slides and activities. It will cover the following topics:

- **Introduction to hybrid and electric vehicles**
- **Basic electrical concepts**
- **Vehicle systems and charging stations**
- **Initial response procedures**
 - Identification methods, Immobilization, Disabling
- **Emergency operations**
 - Unanticipated vehicle movement, electric shock hazards



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- Toxic and flammable gas buildup, Electrolyte skin contact
- Extrication, Vehicle and battery fires, Submersion
- High voltage battery damage, Battery re-ignition
- Incidents involving charging stations
- **Field Evolutions**

Each participant receives a Student Manual, pre & post test, a full-color NHTSA Interim Guidelines document and Certificate of Completion.

3) Law Enforcement Train-the-Trainer Course - 6 hours

NFPA's *Electric Vehicle Safety Training* provides law enforcement with the information necessary to teach and respond to emergency situations involving all electric vehicles and hybrid vehicles on the road today. This classroom training was developed with the assistance of the New York State Police and provides training for crash recovery teams.

This 6 hour instructor-led, train-the-trainer course is comprised of videos, animations, slides and activities. It has both a classroom and hands-on component, which cover the following topics:

- **Introduction to hybrid and electric vehicles**
- **Basic electrical concepts**
- **Vehicle systems and charging stations**
- **Initial response procedures**
 - Identification methods, Immobilization, Disabling
- **Emergency operations**
 - Unanticipated vehicle movement, risks of pushing a vehicle
 - Toxic and flammable gas buildup, electric shock hazards
 - Electrolyte skin contact, High voltage battery damage
 - Submersion, Incidents involving charging stations
 - Crash Reconstruction Information, Towing recommendations

Each participant will receive all the curricula used throughout the training, an Instructor Guide, a full-color Hybrid/EV Emergency Field Guide and Certificate of Completion.

4) Law Enforcement Training Course - 3 hours

This 3 hour instructor-led course is comprised of videos, animations, slides and activities. It will cover the following topics:

- **Introduction to hybrid and electric vehicles**
- **Basic electrical concepts**
- **Vehicle systems and charging stations**



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- **Initial response procedures**
 - Identification methods, Immobilization, Disabling
- **Emergency operations**
 - Unanticipated vehicle movement, risks of pushing a vehicle
 - Toxic and flammable gas buildup, electric shock hazards
 - Electrolyte skin contact, High voltage battery damage
 - Submersion, Incidents involving charging stations
 - Crash Reconstruction Information, Towing recommendations

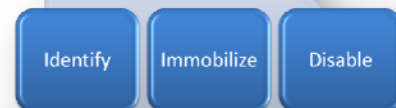
Each participant receives a Student Manual, pre & post test, a full-color NHTSA Interim Guidelines document and Certificate of Completion.

5) Emergency Responder Online Course (Self Paced) - 2 hours

NFPA's self-paced *Electric Vehicle Safety for Emergency Responders Online Course* teaches emergency responders how to safely deal with emergency situations involving all mass produced electric and hybrid vehicles. Each participant earns a Certificate and Continuing Education Units (CEU).

In approximately two hours, this self-paced program effectively trains responders through engaging videos, animations, simulations, and review exercises. The dynamic online curriculum covers high voltage vehicle and safety systems, basic electrical concepts, identification techniques for electric and hybrid vehicles, immobilization and power-down procedures, extrication challenges, recommended practices for dealing with vehicle and battery fires, incidents involving charging stations, and more. Highly-interactive modules are video and graphic intensive, creating an engaging, interactive experience, and you can repeat any section you wish to repeat on demand.

Initial Response Actions



Upon completion of five modules you should be able to:

- Safely conduct emergency scene size-up and management
- Identify an electric vehicle
- Effectively immobilize the vehicle for scene safety
- Disable the vehicle's High Voltage and SRS systems
- Conduct occupant rescue more safely
- Know how to handle a damaged High Voltage Battery / Fire



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- Execute EV recovery and disposal
- Understand what steps need to be taken if Charging Stations are involved

A built-in learning management system lets you exit the program anytime and return where you left off, so you can maximize time and schedule training around professional demands.

The course allows you to demonstrate your proficiency in understanding the content as you complete a series of data reviews at the conclusion of each training module and final scenario room activities at the final exercises. When a student passes these reviews, they earn a Certificate of Educational Achievement and CEU credit.

6) Vehicle Specific Online Chevrolet Volt Course (Self Paced) – 45 minutes

NFPA partnered with General Motors and Chevrolet to help prepare the nation's fire service, law enforcement, EMS, tow and salvage operations to handle the growing number of electric vehicles on the road, with special emphasis on GM's newest electric vehicle.

NFPA, Chevrolet, and OnStar have launched Electric Vehicle Safety Training for the Chevrolet Volt, an extended-range electric vehicle. The training features take an inside look at the vehicle's technology and safety systems, along with information for first responders when approaching incidents involving the Chevrolet Volt. A built-in learning management system lets you exit the program anytime and return where you left off, so participants can maximize time and schedule training around professional demands.

The LMS allows you to demonstrate your proficiency in course content by completing a series of data reviews at the conclusion of each training module and final scenario room activities. Once these reviews are passed, a certificate of completion and CEU credits are awarded.

7) Vehicle Specific EV Extrication Video featuring Mitsubishi 'I' – 45 minutes

In this video, the Fire Service is given the opportunity to see a pure EV, the Mitsubishi 'I', and to learn the layout of the high voltage components, the airbags, the electrical safety systems, and how to safely extricate passengers from a crash. NFPA's SME & Instructor Ron Moore leads the operation, as a fire crew successfully cuts through the high strength steel and demonstrates best practices in these field evolutions. The video is also useful for Towing and Salvage Yard operators who wish to learn about damaged batteries, towing operations, storage and monitoring crashed electrified vehicles.



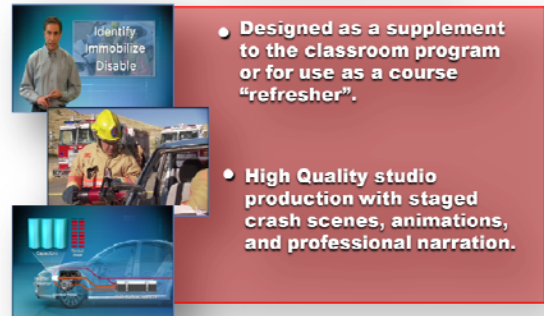
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8) Fire Service ‘Prepare to Respond’ EV/Hybrid Safety Video – 19 minutes

Firefighters need to know how to protect themselves and others when responding to incidents involving electric and hybrid vehicles. This video prepares them to effectively handle the unique challenges presented by this new technology and safely handle crashes involving Hybrid Electric Vehicles (HEV), Plug-in Hybrid Electric Vehicles (PHEV), Electric Vehicles (EV) and their charging stations.

Prepare to Respond EV Safety Video



The skills covered in this video include:

- Safely conduct emergency scene size-up and management
- Identify an electric vehicle
- Effectively immobilize the vehicle for scene safety
- Disable the vehicle's High Voltage and SRS systems
- Conduct occupant rescue more safely
- Learn the recommended practices for extinguishing HV battery fires

9) Law Enforcement ‘Prepare to Respond’ EV/Hybrid Safety Video – 21 minutes

Law enforcement personnel must be able to operate safely at incidents involving hybrid electric (HEV), plug-in hybrid electric (PHEV) and electric vehicles (EV). This video prepares them to effectively handle the unique challenges presented by this new technology and safely handle accidents involving Hybrid Electric Vehicles (HEV), Plug-in Hybrid Electric Vehicles (PHEV), Electric Vehicles (EV) and their charging stations.

The skills covered in this video include:

- Safely conduct emergency scene size-up and management
- Identify an electric/hybrid vehicle
- Effectively immobilize the vehicle for scene safety
- Disable the vehicle's High Voltage and SRS systems
- Conduct occupant rescue more safely
- Learn EV safety for Crash Recovery Teams
- Execute EV recovery and disposal



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G) Job Creation:

During this project, NFPA hired 3 full time people to run the project:

- 1) Andrew Klock, a Senior Project Manager was tasked to oversee the project.
- 2) Angela Burke, a Project Coordinator, was hired to oversee the administration and coordination of training sessions and events.
- 3) John Cannon, a Project Manager, was hired to oversee training development and collaboration with the SMEs and instructors.

All three full time hires are still employed by NFPA.

In addition, NFPA hired 4 Seasonal Employees (temps):

- 4) James Patch, Seasonal Project Manager
- 5) Michelle Shore, Seasonal Intern
- 6) Chris Doherty, Seasonal Intern
- 7) Michael Jenkins, Seasonal Intern

Over the course of the project, 6 additional Subject Matter Experts were contracted (temporary assignments), and 4 Contract Instructors were also retained for the duration of nationwide classroom training programs.

Project Results Overview:

The U.S. Emergency Responder Safety Training for Advanced Electric Drive Vehicles project has been a resounding success on many levels. NFPA's depth of experience in working directly with emergency responders on safety standards, as well as developing and administering training courses throughout the country for decades has allowed the necessary resources, tasks, and milestones to be implemented on time and on budget. The results produced a highly engaging, quality training experience centered on this new vehicle technology for our country's emergency responders, to keep themselves and the public safe. All of these training courses have been proven highly engaging, receiving top marks across the responder feedback forms, unanimous approval from the Emergency Responder Technical Panel and praise throughout the responder communities.



A much tighter bond has been achieved around EV and Hybrid vehicle safety between NFPA, emergency responders and NHTSA, SAE, ANSI, DOE, the law enforcement community, the Towing Association of



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America, and the 18 partnerships with the EV and Hybrid Auto manufacturers. As a direct result of this project, all of these communities are communicating on a deeper level and continue to share information and ideas about vehicle, responder and the public's safety.

This project's effect on the emergency responders' knowledge was unprecedented as the project's plan cascaded these state of the art classroom and online training through the firefighter divisions and ranks across the nation -- over 30,000 emergency responders were successfully trained in 48 states in less than two years, and the EV/Hybrid emergency on-scene quick reference manual was distributed to over 3,200, while NFPA's monthly EV Safety Newsletter circulated to an audience of over 22,000. The web portal was shared with 161,681 in the first two years and has quickly become the 'go to' standard for U.S. EV/Hybrid safety information. The law enforcement classroom training and video was developed with the assistance of the New York State Police, and the video portion was recently nominated for the State Police PACE award. The course has now become part of the New York State Police academy's ongoing training programs and has received top reviews by its participants, and both the International Association of Chiefs of Police (IACP) and the National Sheriffs Association (NSA) Traffic Safety Boards have unanimously voted to approve resolutions approving this course for the Law Enforcement Community. Further funding opportunities will be explored in order to distribute the Law Enforcement training programs across the country in 2013. NFPA is proud to acknowledge that emergency responders are well on their way to having a better understanding of electrified vehicles and how to safely handle them in emergency situations across the United States of America.

- 1) Initial Qualitative and Quantitative Responder Research
 - a. 17 qualitative focus groups nationwide
 - b. 425 quantitative surveys of emergency responder training officers
- 2) Web Portal
 - a. 18 auto manufacturer resource areas
 - b. Nation-wide EV Video, Blog, Event Calendar, Training repository
 - c. 161,681 visits in two years
 - d. 50,922 Blog hits
 - e. The national trusted source for EV/Hybrid Safety Information.
- 3) Communications Campaign
 - a. Print Earned Media Impressions: 425,377
 - b. Broadcast Earned Media Impressions: 396,888
 - c. Online Earned Media Impressions: 56,557,526
 - d. Total Earned Media Impressions: **57,379,791**
- 4) Chevy Volt Online Training & EV Hybrid Safety Program
 - a. Responders Trained: 19,971
- 5) Classroom Training
 - a. Responder Trained: 10,331
- 6) State Partnerships for EV/Hybrid Classroom Training
 - a. 48 States signed MOUs and Held Train-the-Trainer Classes