ELECTRIC AUTO ASSOCIATION

CURRENT EVENTS

Promoting the use of electric vehicles since 1967

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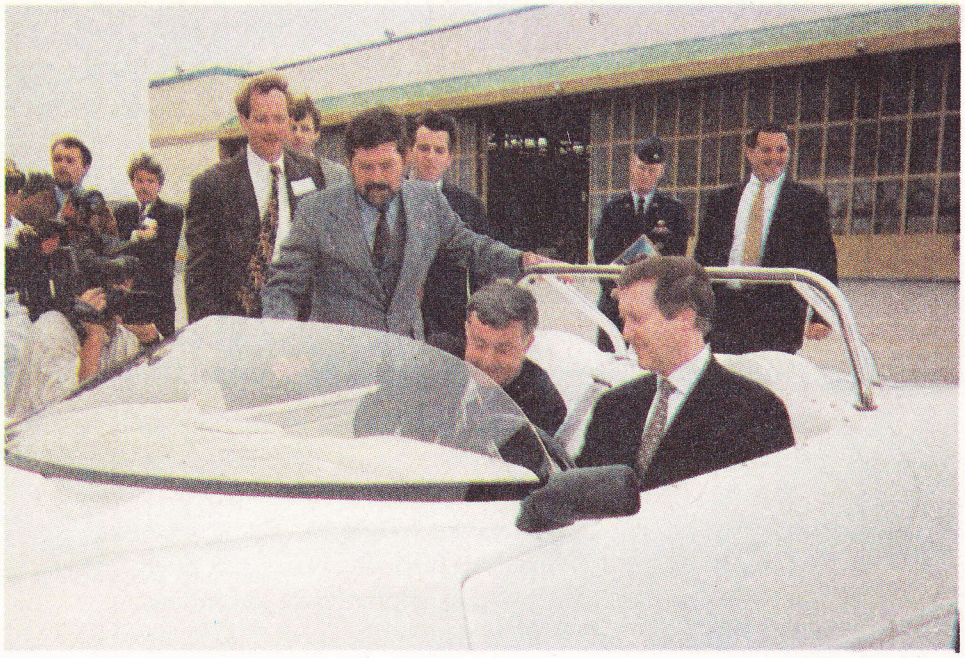
Secretary of Defense Drives Zebra at CALSTART



Escaping his Secret Service security and acting on an impulse of the moment, Secretary of Defense William Cohen hopped in a Zebra Motors roadster for an impromptu test drive. Inviting the Mayor of Alameda, Mayor Ralph Apezzato, to join him, Cohen zoomed off for a quick run up behind the hangars at the former Naval Air Station. While delighted spectators and dismayed security personnel looked on, the dignitary-bearing Zebra sports car squealed its tires in a sharp turn around the parking lot barriers and then reluctantly returned to the in-progress press conference outside CALSTART's Hangar 20.

Cohen had been scheduled to test-drive a PIVCO Citibee from Green Motorworks; however, his schedule organizers nixed that, as Cohen was running behind on time. But the Secretary unexpectedly broke free of all the official encumbrances, and opted for a spin in the electric striped pony. Mayor Apezzato jumped in as a copilot while a benevolent Congressman Ron Dellums (D-Berkeley/Oakland) ran interference and traffic control between the Zebra's driver and the press. Dellums' East Bay district was hard hit by base closures and he has been a key driving force in base reuse actions. Project Hatchery Alameda Director John Huetter gave the Secretary some pointers in EV driving (see photo). CE's editor, reporting on the visit and the conference, whipped out a disposable camera and got some hot shots for the accompanying photo essay, (a CE exclusive!)

Although Bob Reese of Green Motorworks didn't manage to get Cohen or Dellums into a PIVCO, his persistence paid off by getting hats with the Green logo into the hands of the major players (the hats are visible in the photos).

The unscheduled excursion took place during Cohen's official visit to Alameda Point to review progress on base conversion activities. The former Alameda Naval Air Station is viewed as a model for other base closures around the country. As a consequence, much attention has been focused on the reuse plans and civilian startup companies. Although the visit took place at CALSTART's Hangar 20, the visit's focus was conversion activities on the base as a whole rather than on alternate transportation technologies.

During the official briefing which preceded the press conference, CALSTART's Project Hatchery Alameda was recognized for its success in helping start-up companies. The former naval helicopter hangar; Hangar 20, has become an incubator for several EV start-ups and is a hotbed of EV ideas and concepts originating from companies such as Kaylor Energy Systems, Green Motorworks, Jefferson Programmed Power, Altamont Technologies, Zebra Motors and others. CALSTART companies are also finding new uses for military technologies, such as composites and advanced electronics.

To showcase the Hatchery activities, the Secretary spoke briefly to Roland Maynard of Forem Metals Manufacturing, a former base worker who has started up his own precision sheet metal fabrication business in Hangar 20. Forem has done fabrication for several EV

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EV Driving Lesson. CALSTART Project Hatchery Director John Huetter gives some pointers to Secretary of Defense William Cohen.

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Common Sense and the Energy Policy Act of '92

BY BOB BATSON, ELECTRIC VEHICLES OF AMERICA, INC.

July 1997—The Energy Policy Act of 1992 written by the Department of Energy (DOE) requires many fleets (federal, state, municipal, and utility) to initiate purchase of alternative fueled vehicles (AFVs). These AFVs can be costly. The primary goal of the Energy Policy Act is to strengthen national energy security by reducing dependence on "imported oil". There is a better way of achieving the same goal at only a fraction of the cost.

Our recommendation is: "Allow utilities and other fleets to meet the requirements of the Energy Policy Act by leasing batteries to individuals and businesses in exchange for the vehicle credit as an Electric Vehicle (EV)."Our recommendation is so simple that we like to think of it as just plain common sense. This approach has the following benefits:

Reduced Demand for Oil

The demand for imported oil is reduced in accordance with the primary goal of the Energy Policy Act. Although each utility may only have to purchase a small number of EVs, the number of EVs with battery leasing could be many times more. With battery leasing in place, each utility would probably have 1-2 percent of its customer base looking to lease.

Reduced Cost to Utilities

The cost of vehicle credits to the electric utilities is reduced. The cost of an EV to the electric utility is approximately $30,000-50,000. There is minimal cost ($500-1,000) in leasing of battery packs to existing customers. And we know that the cost of EVs is borne by the consumer. So it reduces our overall costs to consumers.

Reduced Cost to EV Users

The cost of EV conversions to individuals who want to drive EVs is reduced. These EV enthusiasts can now lease their batteries instead of spending $1,000-10,000 in initial costs.

Increased Demand for New Technology

The demand for new battery technology is increased. Electric utilities can provide bulk purchasing of batteries, thus reducing the cost and spurring the production of new battery technology. For example, one utility might lease 200 battery packs across the country. That represents a purchase of 4,000 batteries. The demand for new battery technology would thus help to decrease production costs.

Lower Cost of Emission Reduction

The cost of achieving a reduction in emissions is lowered. If the utility can achieve similar emission reductions by spending only 5 percent of the cost of a new EV; then the cost of the emission reduction is reduced, getting 20 times the emissions per dollar. Think about this!

Eliminatation of Emissions

By converting an existing internal combustion engine (ICE) vehicle to electric, the emissions from that ICE are eliminated. Yes, eliminated! If an EV is purchased, that claim cannot be made because the ICE frequently remains in use. This is called "recycling" of the vehicle. "Recycling" of existing vehicles is not only common sense but good economics. Let's use common sense to get off of imported oil.

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Membership Dues Increase

At the June 14th EAA Board meeting held in Sacramento, California, the National Board of Directors unanimously approved an increase in membership dues from $35/year to $39/year.

The increase is necessary to keep EAA financially sound. Increased publishing and mailing costs for the EAA EV's Buyer's Guide as well as increased printing and mailing costs for CE, are the reasons for this increase.

The cost of these two publications represent 70% of the EAA budget. An additional 17.5% is rebated to the local chapters.

The board constantly strives to improve the quality of the EAA publications. Improved publications are helping to improve EAA's image and attract new members. We are also increasing our visibility on the Internet. Some of this year's expenses went toward establishing our own web site — www.eaaev.org.

Editor's Note: A battery leasing program would tend to encourage the development of standards for easily-exchangeable battery packs and vehicles that could use those packs and also encourage facility-dependent technologies such as zinc-air (the utilities could put the zinc-air exchange/ recharge stations on their premises and run them). —CB

EVA E-MAIL

Safety First

BY BOB BATSON OF ELECTRIC VEHICLES OF AMERICA, INC. AND MICHAEL BEEBE OF EV MOTOR SPORTS

Safety is essential in any vehicle, whether an ICE vehicle or an EV.

Although Electric Vehicles (EVs) have been in existence for more than 100 years, their recent interest and development and interest in them have occurred faster than the ability of the industry to establish standards. The purpose of this technical paper is to present the authors' experience in building an EV that can be safely operated and maintained as well as being crashworthy. The authors have extensive experience in building EVs and automotive testing.

A good design results only from careful consideration of the specific EV being built. Each component and each modification to an existing vehicle must be considered relative to its impact on the conversion design and the safety of the overall vehicle. Therefore, any EV project should make use of a qualified engineer for critical decisions.

The specific recommendations should be intended to represent a conservative design for the protection of the driver, vehicle occupants, and the general public.

There should be no intention to supersede or negate any existing codes, standards, or governmental regulations.

Criteria

It is important to first identify the criteria for a safe design,which are:

The assumption of a "Single Failure". There should be no single component that is critical to safe operation. One must assume that any single component may fail and ensure that safety is maintained, even in the event of a crash or rollover. For example, if a circuit is protected by a fuse, consider what would happen in an over-current situation, if the fuse failed to "blow". Safety must still be maintained, perhaps by the inclusion of an additional fuse.

The assumption of a single failure leads naturally to "redundancy" of safety components. A second fuse should ensure that at least one fuse blows. Redundant contactors, activated by separate power sources, should also be considered to ensure that high voltage power sources can be interrupted, if necessary.

"Separation" between high voltage components is also critical for a safe design. Batteries, contactors, or other components that have a significant voltage difference should not be located near each other. For example, in a 120 volt power system, the first and last battery should not be located beside each other. Similarly, the negative side contactor should not be located adjacent to the positive side contactor, if used.

Construction

It is essential that an EV operate safely to protect drivers, passengers, and pedestrians. The following design practices are recommended:

Electrical System Recommendations

All control and power circuits should be fused. The fuse should be located near the source of power. As a minimum, the power system should be protected by at least one fast-acting fuse; however, two fuses should be considered based on the "single failure" criteria.

The wire size should be adequate for the intended load. In addition, the wire should be automotive wire. Wire designated as "THHN" or "TEW" or that is marked "oil and gas resistant" is not automotive wire. This wire should not be used because its insulation will crack and contribute to ground faults.

Wiring should be protected against mechanical damage. Wires penetrating metal surfaces, such as the firewall, should use grommets or other protective barriers to protect against chafing of the wire. Other wires in proximity to metal edges or other objects which cause fraying should also be protected. The power system should not be grounded through the vehicle frame. Although this is acceptable on the 12 volt system, it is unacceptable and unsafe for voltages greater than 24 volts.

Upon actuation by the key "switch," a voltmeter or indicator light should indicate that the power system is connected. Putting the key "switch" in the "off" or "stop" position should disable the power system.

Opening any vehicle front door with the key "switch" in the "on" position should activate an audible alarm. This indicates a potentially "live" power system.

A contactor is recommended as an electrical disconnect when the power system is turned "on" through a key "switch". Circuit breakers are not designed or recommended for this service.

Flexible wire is recommended in place of solid buss bars for the battery interconnects. Flexible wire doesn't transmit vibration between batteries and provides greater protection from short circuits.

All EVs require an auxiliary battery (12V), even if a DC-DC converter is in use. This ensures operation of the warning flashers, brake lights, headlights, etc. if the DC-DC converter fails.

If the regenerative braking system is actuated on throttle release, the brake lights on the vehicle should be lit.

The wiring system in the vehicle should be protected from the effects of high humidity, salt and water spray.

The accelerator potbox should not be placed in a crush zone of the vehicle. This is to prevent the possibility of causing full power to the motor if the potbox lever is pushed to wide-open position.

The power system should be automatically disconnected in the event of a crash; this can be accomplished by con-

necting an inertia switch to the contactor(s) control circuit.

The controller, motor, and other large components should be located such that they do not penetrate or significantly damage the passenger compartment in the event of a crash or rollover.

Battery System Considerations

In a vehicle with flooded lead acid batteries, contactors and other components that can create an arc should not be located above or near batteries where they might cause a hydrogen gas explosion. In a vehicle with flooded lead acid batteries, the battery box should be vented to ensure that the buildup of hydrogen gas is prevented. A warning signal should alarm or a fuel gauge should indicate when the battery is at minimum state of charge. The batteries should be located in enclosed compartments designed to prevent any electrolyte leakage into the passenger compartment during a crash or rollover. The battery compartment should prevent the batteries from exiting the vehicle or entering the passenger compartment in the event of a crash or rollover event. Welding a restraint system is preferred if the vehicle has a frame. For a unit body vehicle, the requirements are more complex and may involve a combination of welding and bolting to carefully selected attachment points. The batteries should be restrained inside the battery compartment sufficiently to prevent their leaving the compartment during a crash or rollover event.

Vehicle Handling Recommendations

The vehicle center of gravity should be kept low. Locating the batteries high will adversely affect vehicle handling. There is considerable flex in a vehicle frame or unit body, so it is essential to allow for differential movement between components. The Gross Vehicle Weight Rating (GVWR) as identified on the door jam placard should not be exceeded. If this rating is exceeded, one should evaluate the impact on the vehicle including brakes, wheel bearings, axle strength, and fatigue of the unit body. Decreasing the vehicle payload capacity (e.g., passenger, cargo, etc.) will be required in most EV conversions.

The weight distribution of the EV should be considered and remain within the limits set by the manufacturer to ensure proper vehicle handling.

Maintenance

The EV will require periodic maintenance. Therefore, the design should accommodate ease of maintenance as well as safety from electric shock. The following practices are recommended:

It should be possible to disconnect mechanically both electric poles of the battery pack from the motor and controller. These maintenance disconnects are in addition to the electrical disconnects used for operation. The installation of maintenance disconnects provides positive separation of battery voltage from the motor and controller. Components should be arranged to allow accessibility for testing and removal. Segregating the batteries into three or four battery boxes will minimize exposure to high voltages when

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Conductive Connections

BY TOM STOCKEBRAND
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I was first made aware of the plug problem by my friends who went to the Phoenix races and reported that there was not one standard plug there either.

I ran into several problems as I set out to provide my electric truck with the proper plugs and connections to be used with charging stations that might set up around Albuquerque in the future. My hope was to do it right the first time so that changes wouldn't have to be made in the infrastructure at a time when many more EVs were on the road.

As I looked into the problem I found that it became more and more intricate. In this article I want to suggest a method for us amateurs that uses the Society of Automotive Engineers (SAE) recommended practices for doing the wiring and the control protocol but substitutes readily available standard wiring devices for the expensive inlet that SAE specifies. Later, if the inlet ever comes down in price, the same electrical protocols can then be used, just put the SAE plug on the existing wires. Meanwhile as the recommended practices get implemented in commercial charging stations around the country, we will be ready for it. For a start, adhering to good engineering practices will go a long way toward getting ready properly for the future. These include: Frame Grounding, Dead front (power off until connected), safety interlocks and proper Electromagnetic Shielding (so as not to mess up radios and TVs as you drive by).

Although GM is pushing the Hughes Magnetic Coupling method, it's not much use for those EV folks who are trying to economize and particularly need to couple a variety of sources such as solar and external batteries or Gensets to their vehicles. It's expensive, not very flexible and somewhat inefficient. The SAE has developed standards (actually, recommended practices) for direct conductive connections for charging EV batteries including control protocols for what they call Level 1 (120V AC for on-board chargers), Level 2 (208-240 V AC for on-board chargers) and Level 3 (DC, usually high-current from off-board chargers). Although the standards are solid and provide safety and control for charging, they recommend a vehicle inlet and connector combination that presently costs $1,600 since its in low volume production (although I'm told it should come down to only $800 soon and $2-300 if production ever gets to high volume). Furthermore, for the hardware protocol to implement the signaling (Std J1850) used by the on-board control for off-board (DC) sources the SAE couldn't chose between Ford's fast, two-wire differential hardware connection and GM's slow one-wire connection so they waffled and allowed both. This makes it hard for people who want to set up charging stations since both protocols must be accommodated if the recommended practice is to be observed.

I was first made aware of the plug problem by my friends who went to the Phoenix races and reported that there was not one standard plug there either. (Although the race folks are clear in stating that a NEMA 14-50 shall be the 50 amp 125/250 V 4-wire connector.)

In addition to being able to plug into an AC source, I want to be able to charge my batteries using solar power (from a Photovoltaic array). Also I want to be able to have the PVs charge batteries in my garage when the truck is not there and later dump the power from the garage batteries into the truck. Furthermore, when I go on a long trip I want to be able to drag a trailer (rented from my local EV association) with a Genset on it so as to increase my range. The Genset will provide either AC or DC and, if DC, needs to be controlled by the electronics in the vehicle. If I were to use the inductive paddle system I would have to build equipment to convert all these sources to the high frequency AC required by the paddle. This would be far too expensive.

The primary need is safety: In the case of plugging into a power source nothing should be "hot" until the connections are made. If an outlet available to the public is hot then presumably someone could hurt him or herself or others by inserting wires in the receptacles (or dropping the pigtail with the energized cord connector on the end in a puddle of water), a sure invitation to lawsuits in this country. Control is also important: if ventilation is required, it should be supplied. The on-board charger needs to know how much current it can draw from the AC mains without blowing the breaker even though there is only one plug style but several possible mains current limits. Provision must be made for circuit breaker reset in the event of a circuit overload. DC sources need to be controlled too: the Solar source or a battery supply needs to have its current limited as the battery pack fills up. A DC Genset needs to be told when to stop supplying power when coasting, for example.

Problems to be Solved

- A standard Plug/receptacle combination that is cost-effective.
- No "Hot" Connections (Dead Front).
- A variety of possible charging sources.
- Power drawn by the on-board charger to match what the source can supply, with circuit reset capability.
- Control of various types of DC power from various external sources.
- How to charge from one of the many standard outlets (non-standard, now).

Solutions

The question of how much power is available and in what form is usually

settled by having a great variety of plugs with different pin arrangements. The common household receptacle with ground pin found throughout the US (NEMA 5-15R) is rated for 15 Amps single phase 120 volt AC. The 30 amp dryer receptacle (NEMA 10-30R) with one L-shaped pin and no frame ground connection is rated for 30 Amps single phase 125/250V 3-wire with neutral, etc. The circuit breaker or fuse plus the wiring behind the outlet can be depended upon not to blow if the rated current draw is not exceeded and the socket style indicates the current, voltage, and phase. The 30 A 220 V receptacle available in most RV parks is actually rated for 277 V 20 Amps (NEMA 7-20R) but it doesn't meet the National Electrical Code (NEC) 1996 which calls for a similar but asymmetrical TT connector; and so it goes. But in the case of the EV there needs to be one common connector that will fit any EV charging station independent of the current it can supply.... The system will not always be able to supply the maximum current that could be demanded by every on-board charger, however.

Both problems are solved in the SAE recommended practices by having the source provide a "pilot" wire which has a +/-12 volt square wave imposed on it whose duty cycle is proportional to the current that the station can supply. The present standard calls for 60 amp contacts for future use. Furthermore, the pilot wire must be connected (through resistors and diodes) to frame ground in the vehicle before the contactor in the charging station can close to energize the AC pins. This guarantees that the frame ground connection is made and specifies the amount of current that is allowed to flow (determined by the size of a resistor in the on-board equipment) and whether ventilation is required, the on-board charger is turned on, etc.

The DC pins in the SAE standard outlet are to support a whopping 400 Amps on the theory that that will charge a typical pack 1/2 full in 15 minutes when it drives into the EV charge station of the future. However, for many DC uses such as solar charging, only a few amps need to be accommodated. The control signals for the external DC charging equipment are to be supplied through a two or three-wire connection which uses the same signaling scheme that's present on all modern cars in which microprocessors in the vehicle sense various changes (manifold pressure, O2 sensors, headlight malfunction, doors open, etc.) and then do something about it. The messages are sent around at 10 Kbaud unbalanced (GM) or 40.4 Kbaud balanced (Ford). The messages are standardized and new ones for EVs have been spelled out.

Thus the SAE inlet (which is similar to, but not identical with the existing European EV plug, sadly) has nine pins:

- One for frame ground.
- Two for up to 40 (or 60) amps AC 220 V single phase.
- One for the pilot wire.
- Two for up to 400 Amps DC at 600V.
- Three for the control leads (one of which is signal ground).

SAE J1772 Summary

This recommended practice covers the connection between the vehicle and the power source. It defines conductive charging: "...consists of electro-mechanical contacts that join the electrical conductors at the vehicle/supply interface and utilizes the established utility equipment grounding system as the foundation for safety management. The contacts are not accessible to personal contact and are de-energized when not connected. Interlocks ensure against connecting or disconnecting under power [load] to eliminate arcing. Conductive couplers allow an open architecture for the charging system design and the location of the primary components."

Levels Defined

Level 1 charging using the most common grounded receptacle (NEMA 5-15R) for 120 VAC single phase with a 15 amp breaker. The load is to draw no more than 12 amps continuous for 1.44 KVA. (80% maximum loading per the National Electrical Code).

Level 2 charging uses dedicated EV supply equipment in private or public locations using an on-board charger. The power is 208-240 VAC single phase 32 amps continuous for 6.7 to 7.7 KVA. They recommend that current values 50% larger be allowed for in future for batteries capable of 150 miles range).

Level 3 charging at up to 600 VDC at 400 Amps for a maximum of 240 kW! The idea is to 1/2 charge a battery pack in 15 minutes at an electric "filling station" of the future. Serial data communication (J1850) is only mandatory for this mode although it is allowed in Level 2 (for customer information, time to charge, state of charge, etc.).

The recommended practice doesn't mention solar charging, battery-to-battery charging, and Genset charging although by inference these are all level three (DC, off board) systems and therefore require the serial data communication. But in each of these cases the off-board equipment does need to be controlled (at least by specifying the maximum current that it should supply) so it might as well be done using (one of) the serial data scheme(s) that is becoming standard in the automobile industry anyway. The DC plug will often be at the back, for a trailer Genset, along with a duplicate control plug. If an AC Genset is to be in the trailer and the "normal" AC connection is at the front, then a duplicate AC plug needs to be at the rear.

Of course, we will often want to charge up at the local RV park or from a dryer outlet at a friends house for example. For these applications we will need to carry jumper cables with the right male plugs which connect to our AC inlet and the means to make sure that our on-board charger doesn't overload the circuit. To be sure, many of these older connectors do not have a frame ground so the jumper will need to "mislead" the system by tying the frame ground to neutral and hoping that the electrician did it right by tying the neutral to ground somewhere.

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Conductive Connections

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The basic safety mechanism is a double fault tolerant personnel protection system as described in UL2202 and 2231. EV chargers must also meet FCC regulations (CFR 47 Part B) concerning electromagnetic emissions so as not to mess up TV's and radios in the vicinity (or in ones own vehicle).

Pilot Signal

The new and interesting requirement is for a "Control Pilot" conductor which is connected to the equipment ground conductor through the control circuitry on the vehicle. "It performs several functions, including assurance that the vehicle is present and connected, start/stop control, charging area ventilation requirements, supply equipment current rating, and provides for the continuous monitoring of the presence of the equipment ground."

For Level 2 charging it is assumed that there is a "box on the wall" with a contactor inside and a cord hanging out that has a cord connector on the end which mates with the "inlet" on the vehicle. The standard defines a 9-pin plug which is crammed into the inlet. At the moment the price of this connector + inlet seems to be about $800 now (less if volume production ever occurs) from Melltric in the US. The use of each of the wires is defined above and, more completely in the standard.

In the "wall box" is an oscillator which drives the pilot line with a +-12 volt square wave at 1000 Hz through a 1000 ohm source resistor. In the vehicle's charger the pilot line is to be connected to ground through a switch and a load resistor. By switching various sized resistors between the pilot and ground the charge controller causes various currents to flow in the pilot line to indicate A)Not connected (open), B) Connected but not ready to accept energy, C) Connected and ready, ventilation not required, D) Connected, ready, and ventilation required.

In addition, the duty cycle of the square wave tells the charge controller how much current is available from the circuit. This can vary from 5 amps (5% duty cycle) to 48 Amps (80% duty cycle) (48*125% equals 60 amps which is what the NEC requires for the wiring for such current). If the duty cycle is 90% then the source is an off line DC charger which needs to be controlled using the serial port. J1772 defines a start up sequence: First, proximity detection in which the vehicle drive system is locked out once its plugged in. Then, when current in the pilot line is detected, the EV source does internal checks and maybe waits until the electrical utility's off-peak time before being allowed to proceed. Meanwhile the charge control does its start-up tests and signals state C) or D) whereupon the contactor closes (and the ventilation fans go on if necessary) and charging commences. If the pilot indicates that it's a (DC) off board connection then serial communication must be established before the supply can turn on. If the pilot current ceases, everything turns off and defaults to a safe mode.

For the details of how all this works, see the J1772 recommended practice. Unfortunately, the electronic diagrams are a bit ambiguous in the 6/22/96 release which I have been using. When it comes time to use the serial communication, there are several chipsets on the market that will provide an interface between the vehicle's serial bus and the charger and the supply electronics. For the slow-speed GM interface called VPW (variable pulse width) Motorola has a chip called DLC and Harris has one called HIP7020. For the faster differential interface called PWM (Pulse Width Modulation) Motorola has a chip called HBCC. A company called Advanced Vehicle Technologies in MD (//www2.ari.net/avt-inc/) is developing an interface that will deal with both versions of J1850 as well as ISO9141-2 (which I will check out).

I propose that the vehicles we build should comply as far as possible with the standards being developed. This means that the signaling and interlocking should be along the lines recommended by the SAE. Since changes in the proposals are coming along regularly and new products are being developed continuously, I'm sure that this article will be somewhat out of date by publication time. Hopefully those of you out there who know more about this subject will submit notes to Clare Bell that she can publish. But as a first step I propose that the hardware interface to the vehicle be as follows:

Since the National Electric Code specifies a lock-in type connector, a 50 amp twistlock like the Pass and Seymour CS6364,65,69,75 group should be used. NEMA doesn't specify a 50 Amp lock -in connector. To comply with the SAE recommended practice mechanical sensing of the connector being "twisted in" needs to be added. There must be an upstream GFCI also.

(A connector with !EC 309 type pin and sleeve connector would be better, but I haven't found it.

The DC connection be a standard 350 Amp fork lift hermaphroditic connector (Anderson 6320G1, Brad Harrison 49210, SMH SY6320G1, Grainger 6A2073 ($13-18).

The Control and Pilot Leads be a standard 4 wire "Microphone" shielded, locking connector costing $5.30 at radio supply stores. Female Bulkhead connector, male on cable. Contact one (signal gnd) engages first, disengages last. Switchcraft QGP, Amphenol 91-850, Excellite 91-450, Cannon XLR-4.

The "wall mounted" box for level 2 has a contactor inside and both provides the pilot signal voltage and monitor the current to close the contactor under the conditions specified in J1772 (proper current flowing in the pilot lead to ground). It will either have a single cable forked to accommodate the two plugs (AC or DC, and pilot/Control) or have two separate cables.

The On-Board charger to sense and drive the pilot connection properly as outlined in J1772.

The Level 3 (off board DC) control signals be the Ford version of the control wiring (J1850 40.4 Kbaud PWM) which is both faster and more reliable than the 10 Kbaud GM protocol and most Mfgs other than GM are using or will use it.

(The ISO 9141-2 std needs to be looked at too, does anyone have information on it?)

It is true that the NEC says that the connector for the EV should be unique, not matching anything else that's likely to be encountered in the charging area. I believe that the Twistlock wiring device mentioned earlier not usually be there. In the case that it does exist (and will be hot, naturally) the on-board controller will either turn on if it is plugged in, as most do currently, or not turn on if wired to meet the SAE pilot signal standards.

If this proposal passes the scrutiny of you folks out there then a follow-up article should be prepared with a wiring diagram and the details of the protocol and the connections that will keep both the NEC and the SAE happy. I have read the California Rules and they look like the NEC rules to me, but I could be wrong. Also some mention should be made of 2nd Harmonic considerations for the charging device since a lot of chargers on a given grid will mess it up if they are the usual rectifier types that are standard today.

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J1772 Conductor Charge Coupler Recommended Practice
J2293 Energy Transfer System for EVs
J1850 Class B Data Communications Network Interface
J2178 Class B Data Communication Network Messages -Network Management

Strategies 5 Parts
J1742 Connections for High Voltage On-Board Vehicle Electrical Wiring Harness
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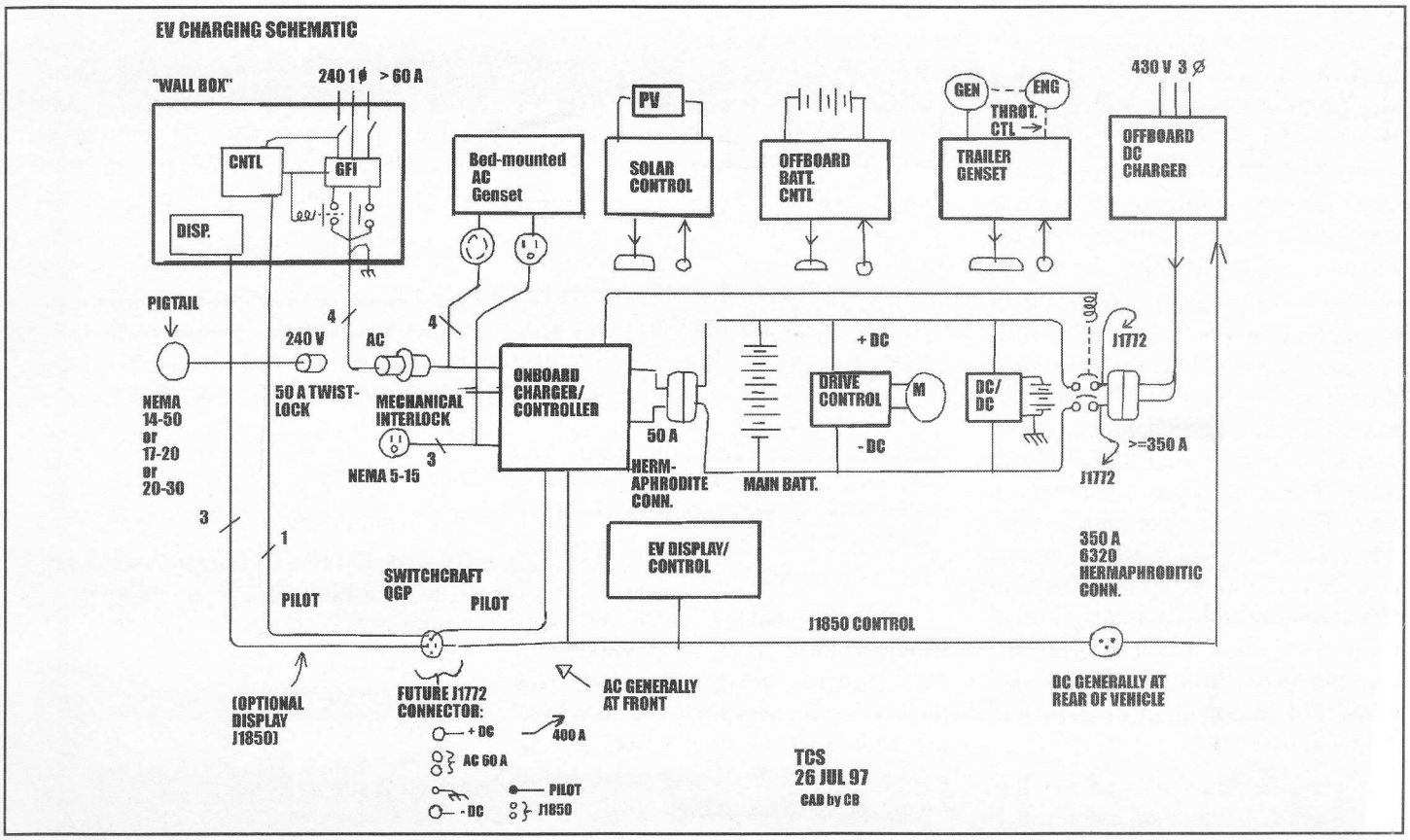
National Electric Code NFPA 70- 1996 Article 625
NFPA (800)344-3555

For UL standards (800)704-4050
UL2202 Standard for EV Charging System Equipment



Advance Copy of Princeton Lead Battery Study Available by Net

GOLDIE.EV1@JUNO.COM (DAVID E GOLDSTEIN)

With thanks to EVA/DC Environmental Chairman Morris Altschuler, who first called this item to my attention, I have tracked down an advanced, pre-publication copy of the Princeton University 24 page study that firmly rebuts the Carnegie-Mellon "lead battery pollution" hysteria. The new study, which will be published shortly in the MIT Journal of Industrial Ecology, is entitled "The Industrial Ecology of Lead and Electric Vehicles" by Robert Socolow and Valerie Thomas of the Princeton University Center for Energy and Environmental Studies. The Summary reads in part:

"The lead battery has the potential to become one of the first examples of a hazardous product managed in an environmentally acceptable fashion. . . ."

"A well-known risk analysis of electric vehicles is misguided, because it treats lead batteries and lead additives in gasoline on the same footing and implies that the lead battery should be abandoned. The use of lead additives in gasoline is a dissipative use where emissions cannot be confined . . . . The use of lead in batteries is a recyclable use, because the lead remains confined during cycles of charge and discharge . . . ." The full 24 page report with graphics can be downloaded from the MIT Press Homepage using Adobe Acrobat from: http://mitpress.mit.edu/journals/JIEC/05socol.pdf. If you don't have a copy of "Acrobat" handy, there is an installed version built in to the hypertext button that reads: "JIE Forums — Abstract "The Industrial Ecology of Lead and Electric Vehicles, Winter, 1997." You will find this hypertext at: http://mitpress.mit.edu/journal-issue-abstracts.tcl?issn=10881980&volume=1&issue=1.

(Note that the word "journal" is in the singular here, as opposed to the word "journals" given in the previous homepage address.)

I have not yet had an opportunity to review this study, which I intend to do over the weekend. I will welcome your comments, and, after completing my review, I'll be happy to share mine.

Dave Goldstein, President, EVA/DC and Program Development Associates, Gaithersburg, MD. Tel/FAX: 301-869-4954

Fwd: CM report — Princeton Rebuts Carnegie-Mellon on Lead Batteries!

BY CLARE BELL

Here's some good news: the Carnegie-Mellon report was an infamous study trying to prove that electric cars were not beneficial to the environment and were actually a threat. It was a classic piece of "bought" science and very bad science at that. CE published one of the first and most in-depth rebuttals of that report. It is nice that Princeton agrees with us. I'm feeling very vindicated.

Yr. ed.

CB

Carnegie-Mellon Battery Report Suffers New Hit

New Jersey =97 A widely-discredited Carnegie-Mellon report that claims lead-acid batteries used in electric vehicles (EVs) are worse for the environment than conventional cars has suffered another hit with the release of yet another contradicting study, this time from Princeton University.

An EV Update article this week says the study, which also touts lead-acid batteries for hybrid-electric vehicles, will be published in the Massachusetts Institute of Technology's Journal of Industrial Ecology.

Researchers from Princeton's Center for Energy and Environmental Studies primarily fault the Carnegie-Mellon report's use of figures based on lead in slag, a manufacturing byproduct, rather than lead in the atmosphere. Also ignored were extremely high battery recycling rates (News Notes 1/17/96) and already existing environmental controls for battery plants.

A battery industry official, critical of the Carnegie-Mellon study, called it a comparison of "apples" to "marbles" filled with faulty analyses and inappropriate conclusions.

VEHICLE EFFICIENCY

NESEA American Tour de Sol Data

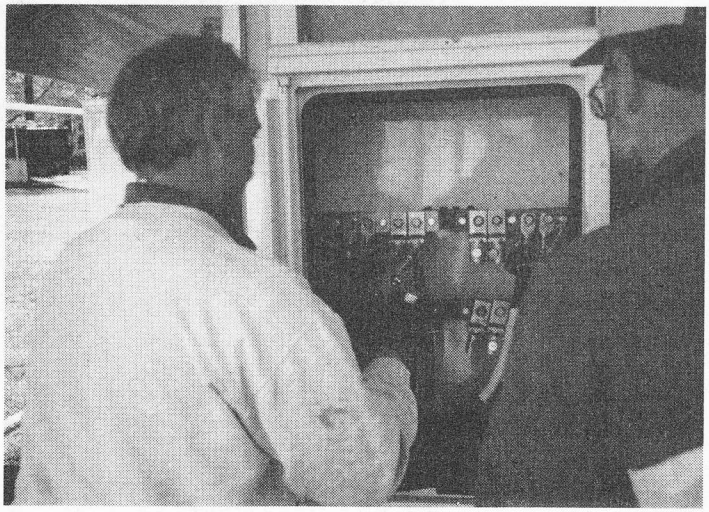
CO-AUTHORED BY NANCY HAZARD, DAN LAROCHE, BOB GOODRICH AND MIKE BIANCHI

As an EV enthusiast, you know how important it is to get a full charge, and so you can appreciate how necessary the charging trailer is at the annual Northeast Sustainable Energy Association (NESEA) American Tour de Sol.

Actually, the charging trailer is technically a distribution system that allows 50 vehicles to charge at once. It also allows us to monitor both the energy use of each vehicle and the effect that charging each one has on overall electrical quality. We can also monitor the exact charging profile for each vehicle.

The Juice Bar

Over the past five years, Bob Goodrich, a professor of electrical engineering at Norwich University and a retired Northeast Utilities employee, has worked with NESEA to develop a 5' x 8' utility trailer with a collage of 20 and 30 amp 120V and 208V receptacles. At each stop, the local electricity company brings a 600 amp, three-phase service to the trailer. Typically vehicles are hooked up to charge for 12 hours each night, from 7pm to 7am.



The electric utitlity company connects the charging trailer to a 600 amp 208V three-phase service.

The Key — MPGe

For Nancy Hazard, Director of the NESEA Tour de Sol, vehicle efficiency data is particularly interesting — and so the NESEA Energy Challenge was created a few years ago, along with the concept of miles per gallon equivalent (MPGe). This measurement allows direct comparison of the energy used by EVs, hybrid electric vehicles (HEVs), and conventional gasoline internal combustion engine (ICE) vehicles in terms that the average citizen can understand.

ICE and EV Versions

This year, during the 348-mile American Tour de Sol, a conventional gasoline powered Toyota RAV4 and a Geo Metro were driven immediately behind their electric counterparts. This year's Tour, organized by NESEA, was a 5-day road rally on secondary roads which went from Waterbury, Connecticut to Portland Maine. The route included challenging mountainous terrain, high-speed country roads, and slower roads through the many New England towns dotting the countryside. Fuel use was measured, as was the electricity that was used to recharge the vehicles each evening at the charging station provided by event officials. MPGe were then calculated, assuming each kilowatt (kWh) of energy used is equivalent to 0.0658 gallons of gasoline. Losses of 20% were assumed in the production and distribution of gasoline. So, a gallon of crude oil at the well-head is the benchmark.

NESEA volunteers position the Charging trailer.

EVs Get Twice as Much

The data collected substantiates the claim that electric vehicles (EVs) are twice as efficient as gasoline vehicles in normal driving conditions. This means they can go twice as far on the same amount of energy! The RAV4-EV entered by Toyota got 39 miles per gallon equivalent (MPGe), while the gasoline version of this sport utility vehicle got only 16 MPGe. Similarly, the electric Geo Metro entered by Solectria Corp., of Wilmington, Massachusetts got 59 MPGe, while its control got 32 MPGe. It might also be of interest that the Solectria used an average of 134 wh per mile during the event (this was measured by a DC watt hr meter - so it is battery-to-wheels efficiency. Unfortunately we did not get good data from the Toyota vehicle.)

Hybrids — Still Getting There

The hybrid vehicle data is also very interesting. Entered by colleges, univer-

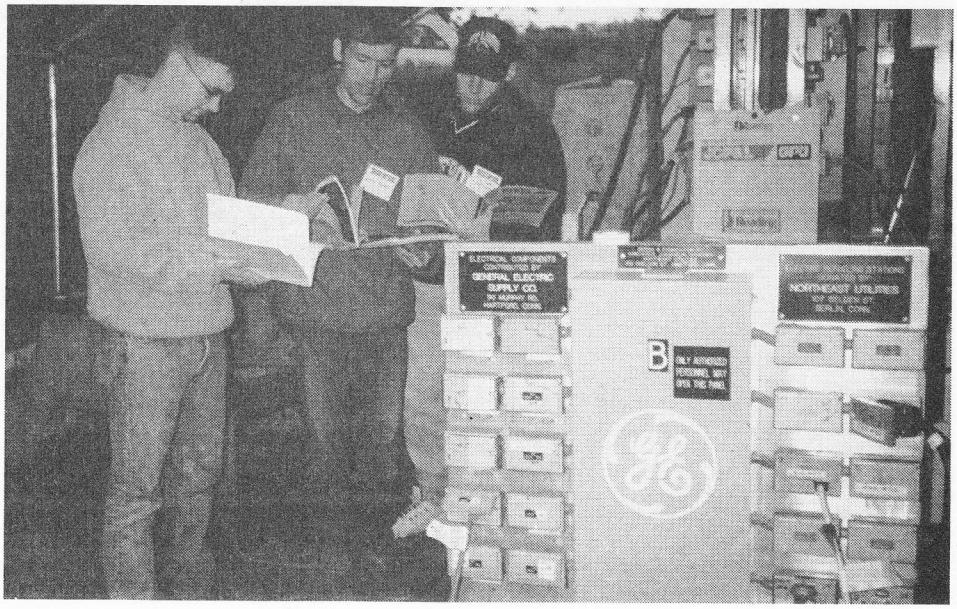
sities and private individuals, these vehicles used several different fuels, including liquid propane gas (LPG), compressed natural gas (CNG), methanol, and diesel. The best performing vehicle was a '96 Chevy Beretta converted by Swarthmore College students. It achieved an efficiency of 42 MPGe, while the overall average for the category was 30 MPGe. While these figures reflect a slight increase in efficiency over conventional ICEs, it is the hope of many car companies that hybrid technology will enable them to meet the presidential challenge of 80 mpg by 2004.

Solar EVs — Impressive!

The energy gained from solar panels was not measured, and therefore not accounted for, skewing the data and making some vehicles appear more efficient than they really are. NESEA did, however, have DC watt hour meters on the vehicles that measured energy use from the battery to the wheels — and the performance of New Hampshire Technical Institute's entry, the Sungo, was impressive. This car used 91 wh/mile - which is extremely impressive for a two-seat vehicle!

Power Quality

Power quality issues may not, at first blush, be very interesting, but the Tour de Sol teams soon learned how important this information can be in assuring that they got a full charge each night. In the past, many teams have not received a full charge as their circuit breaker "popped" some time during the night. This led to many a dispute. Mike Bianchi talked to two of the volunteers who were working with Bob Goodrich at the charging trailer. They showed him their Dell Pentium PC and monitor mounted on the side of the charging trailer which was showing RMS readings of current waveforms and energy spectra (frequencies that are present in the waveform) for each car plugged in.



NEASEA volunteers compare notes at the NESEA Charging Trailer.

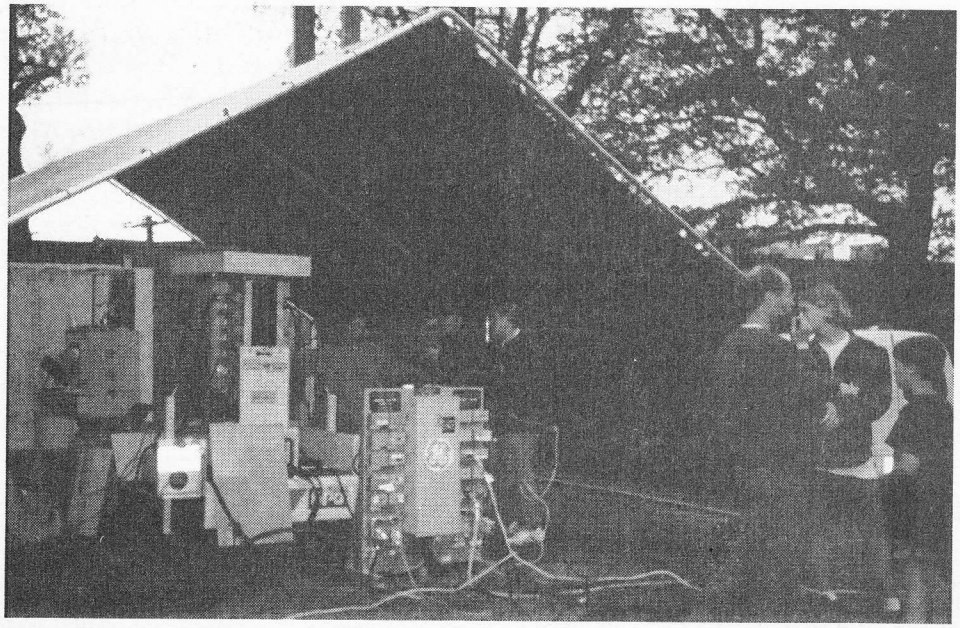
RMS readings are very important, because they indicate the amount of heating the current will cause. But most ammeters used by teams to measure the amount of draw do not capture the RMS reading.

Charger Waveforms

Most of the teams had modern commercial chargers which display fairly smooth, sine waves on the screen. However, there were still a few older chargers being used, and some home-built versions that "worked," but injected so much noise into the line that they would have made a power engineer cry! One charger's current looked closer to a square sine wave with a ski jump mounted on top of it. Another had jagged and irregular spikes that completely masked the 60 Hertz period — and these irregularities can cause more heating than expected in the circuit breakers causing them to "pop." In some cases, teams were able to adjust their chargers so there was less heating, and they were then able to look forward to an uninterrupted night's sleep and a fully charged car in the morning.

The monitor also allowed charging trailer volunteers to watch the 600 amp, three-phase current coming in from the power grid. This allowed them to study the cumulative effects of having many

continued on pg 14



The Charging Trailer under the 20' x 30' tent ready for business.

NESEA

continued from page 13

chargers on a power line, as when you have a fleet of EVs.

We were also able to look at the current draw of each vehicle each hour over the entire charging time. The current draw is dictated by the charger, battery type, and the state of charge. These graphs can be very useful in analyzing power interruptions and other anomalies that occur during the charging period.

Conclusions

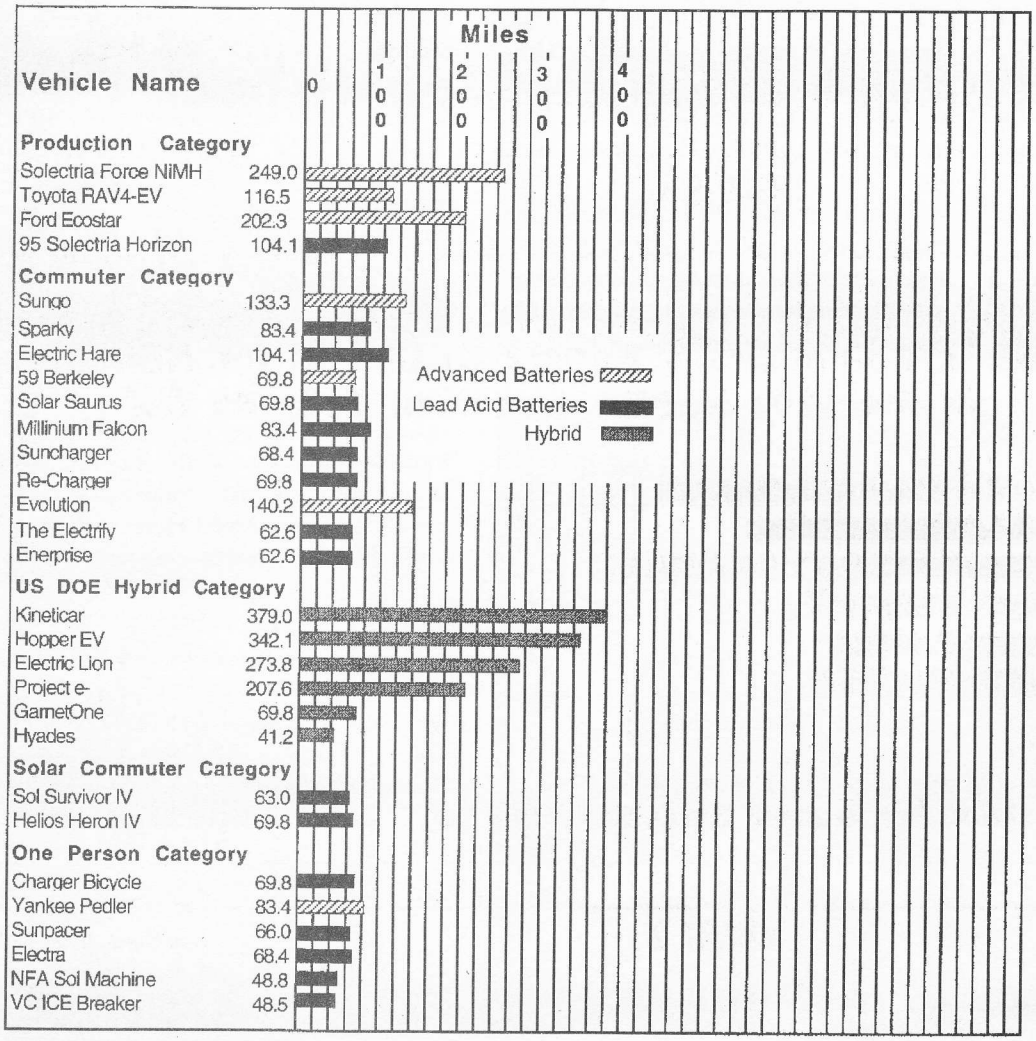
NESEA has discovered a lot about vehicle efficiency and about charging EVs over the past few years. We could not have learned all this without the many teams that have entered vehicles over the years, and the many volunteers that assist NESEA every year collecting data and helping with logistics. All this information is critically important as we work together toward bringing to market high quality EVs, which are friendly to the electrical grid — and save us energy each mile they are driven.

Nancy and Dan work at the Northeast Sustainable Energy Association, Greenfield, MA. Nancy is Director of the NESEA Tour, while Dan is the Technical Coordinator. Bob Goodrich is an electrical engineer at Norwich University and coordinator of the charging trailer. Mike Bianchi is the official chronicler of the event. Please check the NESEA web site at http://www.nesea.org. for complete results, team profiles, and much more.

[Chart 1] The NESEA Kummerow Energy Challenge rewards the most efficient vehicle. By converting energy used to miles per gallon equivalent (MPGe) we can compare the energy used by EVs, hybrid electric vehicle (HEVs) and standard internal combustion engine cars (ICEs). EVs are considerably more efficient than ICEs. The hybrid vehicles are currently less efficient than EVs, but many car companies hope to meet President Clinton's goal of 80 mpg by 2004 with hybrid vehicles. All MPGe numbers refer to one gallon of crude oil at the well head, or well-to-wheels efficiency.

[Chart 2] same as a Chart 1 but only the HEV vehicles.

Source: Northeast Sustainable Energy Association, Attn: Nancy Hazard, 50 Miles St, Greenfield, MA 01301, 413-774-6051 Ext. 18



Range, or the distance that a vehicle can travel on one charge, continues to improve each year. Solectria set a new range record of 249 miles for a sedan using advanced batteries, and the Ford Ecostar set a new range record of 202 miles for a utility vehicle using advanced batteries. The hybrid vehicles really come into their own when it comes to range. Total on-board fossil fuel allowable was the equivalent of 5 gallons of gasoline.

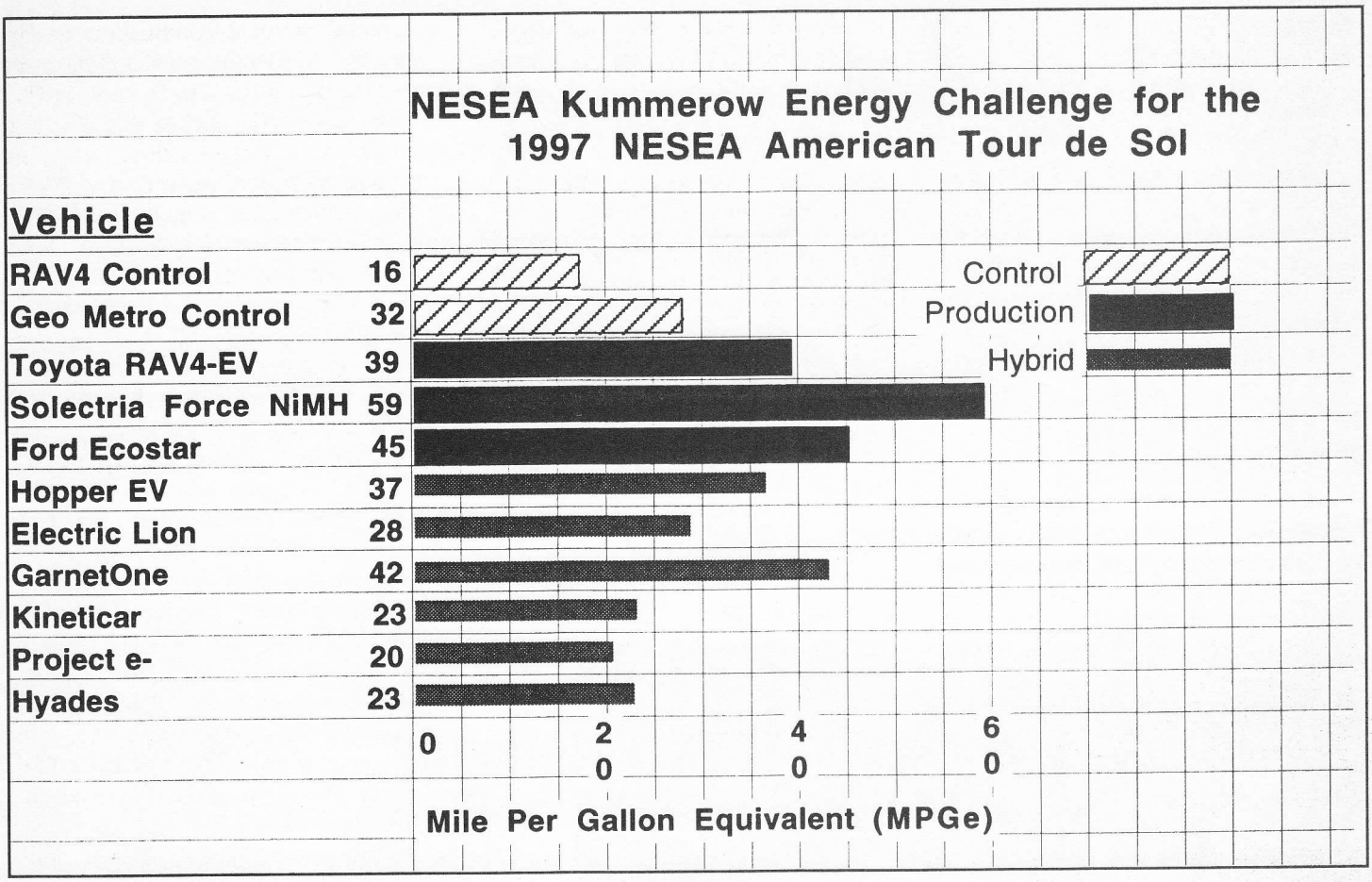


CHART 1

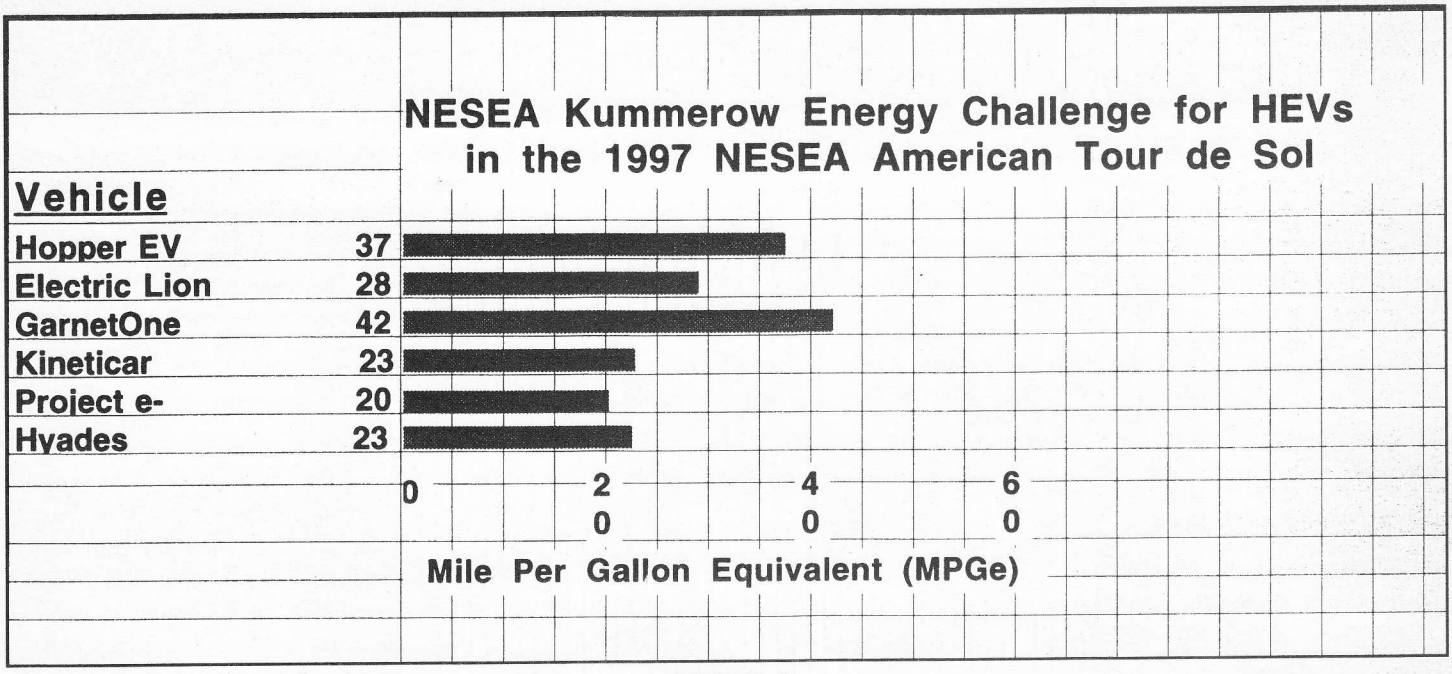


CHART 2

continued on page 22

Secretary of Defense pilots a Zebra. Alameda Mayor Ralph Appezzato in the right-hand seat. Secret Service sighs in the background.

Cohen coaxes Appezzato to join him while the Secret Service raises an eyebrow.

Bob Geese of Motorworks presents Cohen with an honorary Green capy just before the ride.

companies in the Hatchery. The day before the interview, Forem received a contract through CALSTART with Granny Goose, the potato chip manufacturer.

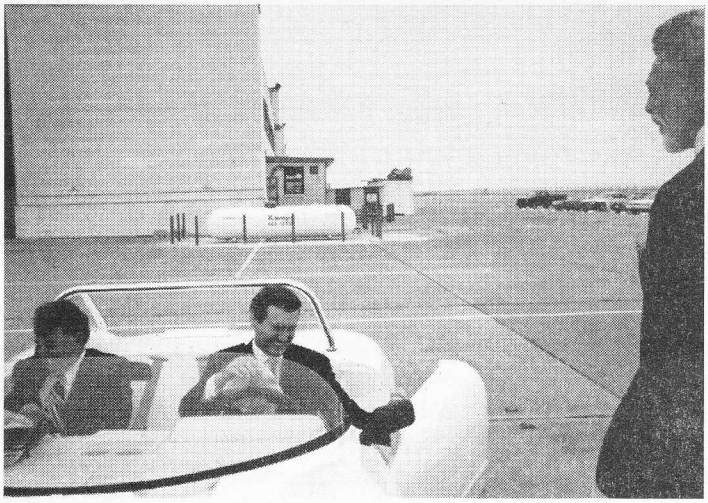
Secretary Cohen said the naval-base conversion could be a model for other base closures that may occur in the future, reports Reuters. "I'm more persuaded than ever that if the people of this country can see what is taking place here—if we can make it a complete success—it will in fact provide the role model for other communities."

Additional members of today's inspection delegation included Oakland Mayor Elihu Harris, State Senator Barbara Lee (D-Oakland), and representatives of the East Bay Conversion and Reinvestment Commission, the Alameda Reuse and Redevelopment Authority, the Oakland Base Reuse Authority and the Port of Oakland.

CALSTART and its more than 200 participants worldwide are dedicated to creating an advanced transportation technologies industry and its markets, including electric vehicles, natural gas vehicles, hybrid electric vehicles and Intelligent Transportation Systems (ITS). CALSTART's goals are creating quality jobs and cleaning the air. Participants include defense, aerospace and electronic technology firms, vehicle manufacturers, transit and government agencies, labor and environmental groups, and major electric and natural gas utilities.

For Further Information Contact:
Bill Van Amburg (818) 565-5600
John Huetter (510) 864-3000

Sources: (BUSINESS WIRE)—7/21/97
CALSTART News Notes, 7/21/97

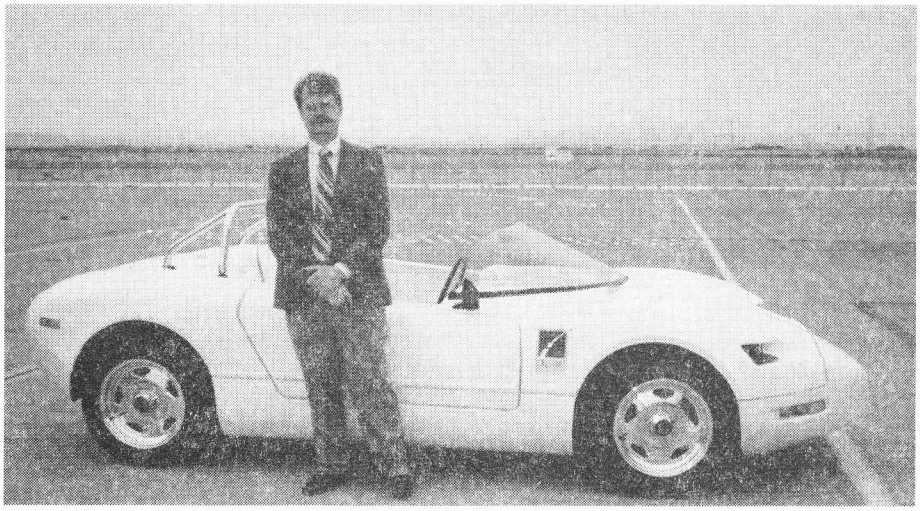


A fatherly Dellums shephers a laughing Cohenand Appezzato back to official duties.

Congratulations from the Congressman.

Oakland Mayor Elihu Harris.

Cohen speaks with Forem Manufacturing's Roland Maynard.



Zebra Motors' Jeff poses by his honored baby.

News in Brief is compiled by Ruth M. Shipley from information supplied by the Environmental Information Network. If reprinted, please credit CE and Ruth Shipley.

Officials Tour Converted Naval Base

A former naval air station that now houses a bustling incubator for EVs and other advanced transportation technologies was the first stop on a San Francisco Bay area inspection tour of successful base and defense conversion projects. Secretary of Defense William Cohen, Congressman Ronald Dellums (D-CA) and other state and local leaders started with a tour of CALSTART's Project Hatchery Alameda, which converted a former naval helicopter hangar into a center for advanced transportation technologies. "With the leadership of Congressman Dellums and with the Department of Defense as a partner, we've brought 17 new clean vehicle technology companies into this facility, working on electric, hybrid-electric or natural gas-powered transportation," said Michael Gage, president and CEO of CALSTART.

(CALSTART RELEASE: 7/21)

K&W Introduces Battery Charger

Marion, IA-based K&W Engineering has announced the availability of its new BC-2000 compact 400 watt EV battery charger. The 13-pound charger measures less than half a cubic foot and is designed for in-vehicle mounting. The charger features a dual-mode, constant-current, constant-voltage charge profile and state-of-the-art high-frequency switching regulator circuits. The BC-200 can be used to charge 84-156v DC battery packs at a 20-ampere rate, with protection through automatic charge control. Charging voltage is adjustable between 100 and 200v DC, and constant current charging can be adjusted up to 20 amperes. Input voltage is 200 to 240 vac, at 50/60 hertz, one phase. The charger features the BADICHEQ charge management interface, which is supplied as a standard feature.

(K&W ENGINEERING RELEASE: 7/21)

New York's EV Efforts Increase

Efforts to boost the growth of EVs and other alternative fuel vehicles (AFVs) in New York State are on the rise. Recently, Governor George Pataki implemented the Governor's Clean Air-Clean Water Bond Act, which allocated $55 million for clean fueled mass transit buses and state fleet vehicles. To do its part in boosting EV technology, New York Power Authority has implemented an "Electricity in Motion" program that includes a station car program that provides EVs and charging stations at a suburban rail station, the introduction of the first electric-powered school bus in the Northeast, field testing of electric shuttle buses by transit companies, and the use of nearly 70 EVs by NYPA customers in their fleets.

(NYPA RELEASE: 7/16)

Students Demonstrate Hybrid EV

Engineering students at the University of California, Davis recently showcased their award winning "AfterShock" hybrid EV at the Thompson Center Plaza in Chicago, IL. "Team Fate" discussed the design plans of their converted 1996 Ford Taurus with Chicago Environmental Commissioner Henry Henderson and Mayor Richard Daley before traveling to the National Argonne Laboratory for electrical recharging and to Washington, DC, where they met with Vice President Al Gore. The team won this year's FutureCar Challenge, a collegiate competition to build a midsize passenger car that has up to three times the fuel efficiency of current vehicles.

(ARGONNE NATIONAL LAB RELEASE: 7/16)

Fleet Managers Nix EVs

Before EVs can achieve substantial penetration of the fleet market, EV technology marketing efforts need to be increased, according to a recent survey of fleet operators. About 76 fleet decision makers were interviewed as part of an "EPACT 92 Compliance Study," commissioned by the Advanced Lead Advanced Battery Consortium (ALABC). They were asked about their views on EVs, lead-acid batteries and compliance with the Energy Policy Act (EPACT). The survey found that several fleet operators do not consider EVs a viable option in meeting fleet requirements of EPACT. EVs were perceived as expensive and not readily available, despite recent advancements. Further, respondents felt EVs offered limited range.

(KEEPING PACE: JULY 1997)

BAT Int'l Gets Caribbean Partner

BAT International recently announced an agreement with Barbados-based BAT CARs of Barbados, Inc. for the purchase of 55 BAT cars, one of the largest single EV purchases ever. The production EVs are similar to a model that set a long-distance record of 1,043 miles on a single charge with Kummerow zinc-air batteries. BAT said it hopes to procure other purchase order and development contracts from Latin American and Asian nations and to establish Barbados as a center for economic development and clean transportation in the Caribbean. The company also is considering the establishment of a joint venture vehicle assembly facility in Barbados with BAT CARS where electric and super-efficient vehicles and electric bicycles would be manufactured and distributed.

(BAT INTERNATIONAL RELEASE: 7/10)

Lithium Battery Cars Good for Environment

Japan's Agency of Industrial Science Technology, an arm of the Ministry for International Trade and Industry, recently announced the results of a test of a vehicle powered by lithium batteries. The agency noted that lithium battery-powered vehicles emit 54% less carbon dioxide than gasoline-powered vehicles, and use 41% less energy. In addition, 84% of the total weight of a lithium battery is comprised of recyclable components. The agency conducted studies measuring emissions from a lithium battery-powered vehicle throughout its entire life cycle, from production to disposal. The vehicle was capable of traveling close to 250 miles on a single charge. The lithium battery-powered vehicle was compared to a gasoline-fueled vehicle with a fuel economy of 11 kilometers per liter.

(NIKKEI ENGLISH NEWS: 7/12)

CA EV Projects Qualify for Funding

City and county government agencies in Southern California could receive as much as $6.5 million to help purchase electric and other alternative fuel vehicles (AFVs) under a new matched-dollars program managed by the Mobile Source Air Pollution Reduction Review Committee (MSRC). Up to 25% of the cost for qualifying AFV and EV expenses would be paid under MSRC's Local Government Subvention Fund Match program, aimed at reducing mobile source emissions within the state's South Coast Air Basin. In addition to purchasing EVs and AFVs, the money also may be used to install refueling and recharging stations and to conduct training for AFV mechanics. The program is partly funded by a $4 vehicle registration surcharge in California. The money will be awarded on a first-come, first-served basis.

(CURRENT: VOL.2, ISSUE 5)

San Diego Becomes EV-Ready

A network of EV recharging stations was recently installed in and around the San Diego metropolitan area by local businesses and interest groups. Among those involved were Costco, ScrippsHealth, Mission Valley Center and the Wild Animal Park, all of whom have chargers within their parking facilities enabling customers to recharge their vehicles. The entire effort was underwritten by the San Diego Air Pollution Control District and Edison EV, who received a $50,000 incentive from Enova Corporation, the parent company of San Diego Gas & Electric (SDG&E), for installation of the chargers. In an attempt to ensure San Diego's lead in EV infrastructure, Enova and SDG&E are currently working on an incentive package for EV users that would include enhanced customer service and lower utility rates.

(SDG&E RELEASE: 7/10)

CA Utility Tests EVs

Select Southern California Edison (SCE) fleet customers will be given the chance to experience a new and exciting technology, while at the same time providing the utility with valuable data about the impact EVs have on the power supply system. The information collected from SCE's "EV Trials" program will help the utility plan the recharging infrastructure needed to accommodate a growing EV market. In addition to its past EV trials, SCE said at least six more trials are scheduled through the end of this year. Fleet customers such as city building inspectors in the City of Rancho Palos Verdes and other Los Angeles Basin communities are slated to participate in the program.

(CURRENT: VOL.2, ISSUE 5)

Humboldt Puts Fuel Cell in Kewet

Researchers at the Schatz Energy Research Center at California's Humboldt State University have begun working on converting a battery-powered, two-seater Danish Kewet EV to fuel cell power. The work will build on the conversion over the past year of three battery-powered golf carts to fuel cells. The lab purchased the Kewet El-Jet 3 from Green Motor Works in North Hollywood, CA. The battery-powered version features a range of up to 30 miles and a top speed of 40 mph. The Schatz team will attempt to fit the Kewet with a 10-kilowatt (optimal) fuel cell, which they expect to yield a range of close to 50 miles. The fuel cell-powered Kewet will require a larger air blower and heat exchanger, due to the size of the fuel cell.

(HYDROGEN AND FUEL CELL LETTER: JULY 1997)

MEMBER WANT ADS

For Sale

1984 English For Van Ecostar model, right drive, 120v/550A, Prestolite, 20 US 220ah batts, 100 cycles, 3000 lbs, E-meter, DC/DC, Lester 220/120v 25a charger, fast, functional, useful, $7500/obo. Call for video. Call Eric at 1 (800)-289-8203 wk or (714)770-8541 hm (Irvine, California)

1985 Fod Tempo, 4-dr, 4 passenger, 5-spd. transmission, Curtis controller, Sevcon DC/DC, Zivan charger, 120VDC, NEW - 18x6V Trojan T125 batteries, 70 mph, 40-50 mile range, E-Meter; $5500. Call (310) 532-4536. (California)

1974 Porsche 914 Electric. Recent conversion, 114 volts, Advance D.C., 9" motor, Curtis PMC controller. Registered and on the Road in San Francisco. $6800. Call Jeff Wasserman at (415) 885-7970.

WANT ADS: Print clearly or submit typed copy of your ad with your name, address, and phone number. The EAA is not responsible for the accuracy of ads. Want ads must be received before the 1st of each month and must include payment to run in the next issue of CE.

$10 for the first 35 words. Each additional word, 25 cents. Want Ads are available to EAA members for the sale of electric vehicles, equipment and parts only. If you want to run your ad in more than one issue, please specify and include payment for each issue requested.

For corrections or updates, please send a written note or fax to EAA Want Ads @ 408.374.8750. Photographs of your vehicles may be submitted with your ad. If room is available, we run one photo each issue. These photos will not be returned. Send your Member Want Ad request and check made payable to: EAA Want Ads, 18297 Baylor Avenue, Saratoga, CA 95070.

AD RATES

Full pg color	7.25" x 9.25"
1 ad	$300 ea

Full page	7.25" x 9.25"
1 ad	$400 ea
3 ads	$300 ea
12 ads	$250 ea

1/2 page	7.25" x 4.50"
1 ad	$250 ea
3 ads	$175 ea
12 ads	$125 ea

1/4 page	3.50" x 4.50"
1 ad	$200 ea
3 ads	$150 ea
12 ads	$100 ea

1/8 page	2.0" x 3.5"
1 ad	$150 ea
3 ads	$100 ea
12 ads	$75 ea

Ads may be placed for 1, 3 or 12 months. Camera-ready copy for each ad must be submitted along with payment. Ads may be submitted on diskette in TIF or EPS format on the PC or MAC. For 12 ads, an invoice will be billed quarterly. A minimum of 3 ads is required to be prepaid.

Ad Deadline

The Deadline for camera-ready copy is the **1st of the month**. Copy received after the 1st will be run in the next issue. Ads will be placed in the priority received. Prepaid ads will receive 1st priority. Make check payable to EAA. Camera-ready copy and payment for the ad should be sent to: EAA AUTO ASSOCIATION, 18297 Baylor Avenue, Saratoga, CA 95070

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CE ADVERTISERS

EAA CALENDAR OF EVENTS

Welcome to the Electric Auto Association calendar of events. Listed are events of direct or related interest to Electric Vehicle Enthusiasts and Alternative Transportation Technology Businesses. If you know of an event that should be listed, please email event information to Kathy Watson (evchdlr@primenet.com)

Sept. 20

Silicon Valley Rally at Stanford University. Rally drivers will be taking passengers. They had the EV1 as a participant last year, and this year Honda, Toyota and other OEMs will participate. Plus your legendary old favorites. Come ride and drive Evs at the place that gave birth to the transistor and Silicon Valley. For more information, contact Will Beckett, email: beckett@radiomail.com.

Sept. 27

East Bay Rally. The EV show season reaches its peak in September with various chapter rallies and Events. East Bay has moved its rally from Berkelely to Alameda Naval Air Station, now known as Alameda Point. Participants include the classic Cornell Ghia, a hutch-full of rabbits, including the freshly converted convertible out of Mike Slominski's shop. For information, call Scott or Anna Cornell, (510 685-7580) or email cornel@pacbell.com

Sept. 22-25

Fifth Grove Fuel Cell Symposium, London, UK. This symposium will provide you with an up-to-date review of fuel cells and their use focusing on the following themes: business development and investment opportunities, key technological advances and system demonstrations, leading edge research results. International speakers are supplemented by a technical poster session. Contact: Sharron Emsley, Conference Organizer. Email:.emsley@elsevier.co.uk. Fax: +44 1865 843958, tel: +44 1865 843721

Sept. 29 - Oct 1

S/EV97 Symposium and Trade Show, Hyannis, MA Annual conference organized by the Northeast Sustainable Energy Association. More than 130 speakers and 60 exhibitors in the electric and hybrid electric field. Contact: NESEA, 50 Miles Street, Greenfield, MA 01301. Tel: 413.774.5051, fax: 413.774.6053. E-mail: nesea@nesea.org

Electric Boat Racing Schedule

E-boat racing season begins at the end of May, Northwest USA. For more E-Boat Racing information, contact: John Paramore, 914, 210th Pl. SW Lynnwood, WA 98036. Tele / Fax: (425) 672-2757. E-mail: wizprodj@eskimo.com

Columbia River, Brewster, WA — June 21-22

Cullaby Lake, Astoria, OR — June 28-29

Capitol Lake, Olympia, WA — July 12-13

Silver Lake, Eatonville, WA — August 23-24 - Surveyed records course

Devil's Lake, Lincoln City, OR — October 18 - Kilometer speed record trials

Call for Articles

CE is constantly on the lookout for interesting stories on EVs and EV-related technology. If you have an interesting story about your EV or technical information other EAA member would like to read, please submit your article to CE.

Articles may be sent to the the Assistant Editor by the 25th of each month for the next month's issue. (See address on page 2) or mail 3.5-inch diskette submissions in "text" format, (PC) or (Mac).

Please send color photographs when avaialable. Photographs (color or black & white) provide better printer output than digital images. All relevant photos will be appreciated.

CE is also interested in articles from our advertisers/sponsors. Share your expertise with the EAA members by contributing articles in your area of expertise.

NESEA

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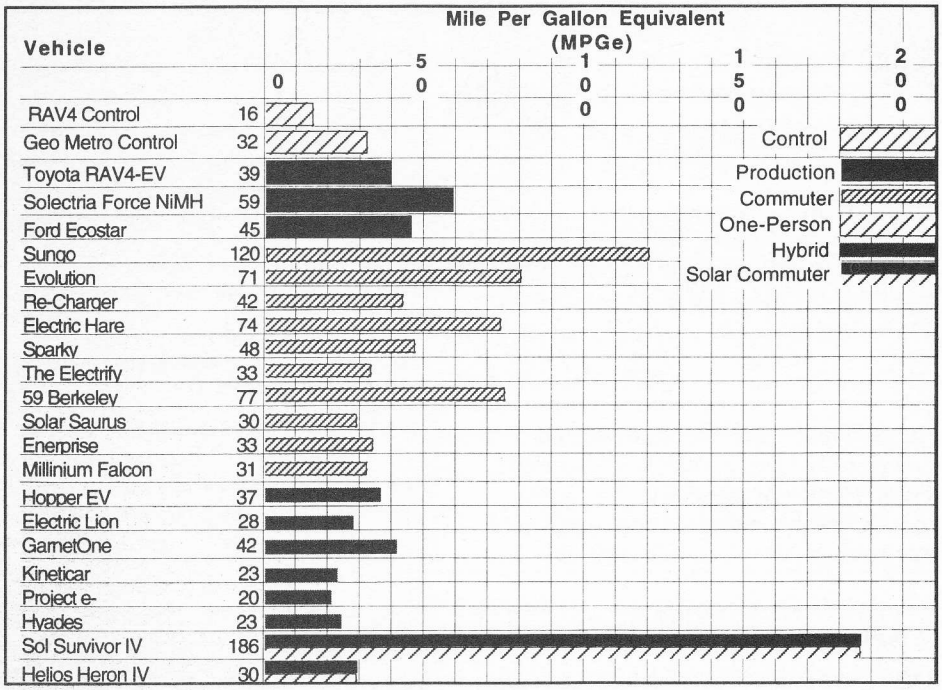

CHART 3

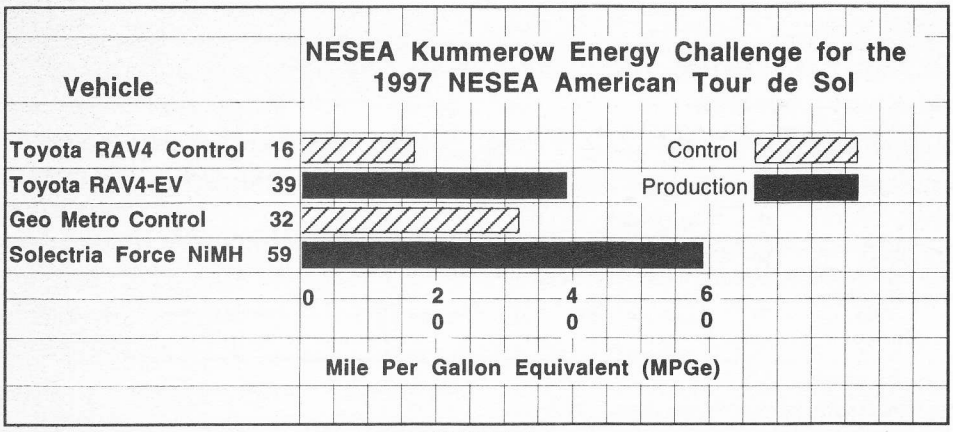

CHART 4

EV - AEMAIL

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maintenance is performed on the batteries.

The distance between first and last battery, contactors, etc. should be maximized in order to prevent an accidental short circuit. Dielectric barriers can be used to assist in this separation. Protective barriers over batteries or protective covers over the battery terminals should be used to protect personnel and reduce the possibility of a short circuit condition.

The battery box should be labeled to alert users of the potential dangers. In addition, if the EV is designed for a specific type of battery, this should be identified. The direct contact with live parts of an electrical circuit whose voltage is greater than 50 VDC or 30 VAC should be prevented by housings, covers, or other types of protection.

Harnesses carrying cables with voltages greater than 50 VDC or 30 VAC should be easily identifiable by color or a "warning" designation. Individual cables routed separately should also be easily identifiable as power cables.

Safety is essential in any vehicle. We accept the explosive risk associated with gasoline vehicles because manufacturers have designed the vehicle to minimize the risk and everyone is aware of the risk. Similarly, everyone should be aware of the risk of electrical shock in an EV.

Bob Batson can be contacted at: Electric Vehicles of America, Inc., P.O. Box 59 Maynard, MA 01754. (508) 897-9393(508) 897-6740. FAX:EVAmerica@aol.com

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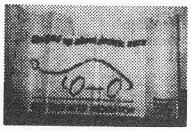

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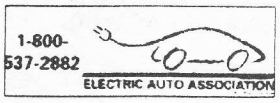

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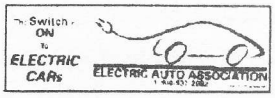

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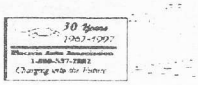

EAA Key Chain , w/LED light
KC001.....$2.50

Printed materials

CE	Selected Current EVents ***(specify specific issue)***	$3.00 each issue
CEFY	Current EVents - Full year ***(specify specific year)***	$20.00 each year
PB001	Discovered:The Perfect EV Battery	$ 2.00
FW001	Flywheel Energy Storage	$ 5.00
BG1997	1997 Buyer's Guide to Electric Vehicles (Apr 97 issue CE)	$ 6.00
BG1996	1996 Buyer's Guide to Electric Vehicles (Feb 96 issue CE)	$ 5.00
BG1995	1995 Buyer's Guide to Electric Vehicles (Feb 95 issue CE)	$ 4.00
TT001	Team Tucson Land Speed Record Plans	$ 5.00
IDX001	EAA Current Events Index - 10 Years!	$ 4.00
XA100	EAA XA-100 Hybrid	$ 5.00

Other EV Items

PN001	Ball point writing pen with EAA and 800 number	$1.00
CS001	Current Solutions/Motor Show Video Tape (14 minute runtime)	$15.00
WL001	Window Literature Holder (fits pages 8.5 x 11 inch)	$25.00
PARK01	'EV Parking Only' Sign (18"x12") green icon on white background	$25.00

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