FOX VALLEY ELECTRIC AUTO ASSOCIATION NEWSLETTER FOR JUNE 2001

NEXT MEETING: Saturday June 16 at 9 AM in the Triton INDUSTRIAL CAREERS BUILDING, (East Campus), Room 108

DISCUSSION TOPICS: 1 Exhibit opportunities. 2 Triton Project. 3 Open Topics.

MEMBERSHIP INFORMATION

Any person interested in electric cars is welcome to join the FVEAA. The cost for a full year's dues is $ 20 which will entitle members to receive our monthly Newsletter that contains useful information about electric car conversions, construction, news, policies, and events. Membership is not required to attend our meetings. Dues for NEW members joining in June will be $ 10.

To obtain info about the FVEAA you may contact either Past-President Ken Woods or President Shafer

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PRESEZ

We need to discuss two exhibit opportunities coming up. The first will be Fourth of July Parades. I have asked Net Gain to join Fred Kitch and I at Riverside's Celebration. Anyone else will be welcome. Bad Amplitude was unable to attend last year because of a breakdown in their towing equipment.

The second event will be July 14-15 at the Science Museum. I have asked the organizer of the event to allow two or three of our cars to join *Bad Amplitude* to show how their owner's use them. Rick Lane, Editor of the Ottawa Newsletter, e-mailed me to report the event will include (1916-vintage) Milburn electric cars. Rick is bringing his from Ottawa to join the Museum's restoration of their Milburn.

By meeting time the FVEAA will have completed five Saturday working sessions on the Triton Project. Work is ahead of the expected schedule, thanks to the excellent quality of persons recruited by Triton for the experimental course. The Contractor (John Emde) is expected to deliver the motor-transmission assembly by June 16th and it can be inspected. Battery box work started on June 2nd. A contract has been awarded for the major electrical components. These will be installed in the next few weeks.

The Newsletter will be a little slim for the next two months for two reasons; The Editor is occupied with the details of the Triton Project, and news about electric vehicles is almost nonexistent. Auto companies are concentrating on hybrids.

BILL

MINUTES OF THE MAY 19, 2001 MEETING

The meeting at Triton was called to order by President Shafer at 9:15 AM. Seven members attended. Approval of the April minutes and the Treasurer's report was deferred to the June meeting. President Shafer announced the two electric vehicles available for sale by FVEAA members had been purchased. Long-time member Al Wilson of Beloit, WI bought Steve Leisner's "*VOLTSRABBIT"* so the car stays in Wisconsin. Treasurer Corel purchased the 90% completed *FESTIVA* from Ken Meyer's estate.

President Shafer described is attendance at Morton College's Auto Technology Jamboree held in the infield of Hawthorn Racetrack on May 11th. The event was quickly put together about six weeks ago. FORD and GM were represented. N-Source exhibited a natural gas powered dragster and a muscle car, there were several natural-gas truck conversions, Honda had their INSIGHT and Toyota the PRIUS on display. My RX-7 was the only **electric** vehicle there. Darwin Burkhart from the Springfield EPA was there. I personally assured him the rebate program is effective in stimulating conversions. Attendance was mostly students from the Automotive Technology classes at Morton.

Ken Woods reported on the Alternative Energy Fair at the IBEW Training facility on May 12th. It was pretty much a repeat of last year's experience. Net Gain exhibited *Bad Amplitude* and Fred Kitch's *RANGER* attended the event. Net Gain did a few tire burnouts, during which one of their two controllers went up in smoke. Member Ray DeBoth observed that inadequate cooling of the controllers was the probable cause. He recommended that vapor-phase cooling be investigated.

The Meeting was recessed at 10 AM, at which time the Triton Project was convened.

Nine persons have been enrolled for the course on electric car conversion. We were pleased to note there was a father-son team participating.

Bill Shafer briefly outlined the conversion process and introduced the three major electrical elements involved. He announced that removal of major engine-related elements is the objective for the first-day's shop work. Member Ray Oviyach, also serving as the Triton Project manager, established the rules for shop conduct.

The group moved to the Auto Shop where Ed Meyer, using his aircraft scales, measured baseline wheel weights for the 1996 *RANGER* to be converted.

During the three-hour shop session lasting from 11AM-2PM the following items were removed:

> From the rear area - Truck bed, exhaust system, and gasoline tank.
> From the front area - radiator and hoses, power-steering pump, accelerator pedal and other connections between the engine and frame. Engine removal will be at the next session on May 25th.

The vehicle was pushed to an outdoor storage site, tools retrieved, and the workplace cleaned.

The meeting was adjourned at 2:20 PM

From the notes of Bill Shafer
May 19, 2001

From other EV Newsletters and articles affecting EVs

DEVC, the Newsletter from Denver, in their March issue reports that California now will pay $9000 for each **new** battery-powered EV under the revised ZEV Mandate. The program ends in 2002. Editor's note – if the program were expanded to pay $ 4500 for an individual conversion it could rapidly put a lot of electric cars on the road in California.

The April issue of Popular Science on Page 18 reports the Department of Energy will install 32,100 square feet of photovoltaic panels on their Washington HQ. Peak power rating – 200 kW.

A Canadian study has concluded that EVs are cleaner no matter how their electricity is generated. Hydro provides most of the electricity in many Canadian Provinces.

EEVC, from the Eastern Group, in their May newsletter reported on the Organization's Earth Day activities. Iinstead of rock bands playing in the bandshell they report this year the entertainment featured folk singers. The issue listed six production vehicles, fifteen prototypes, 1hydrogen, 16 battery vehicles, and a number of vehicles in the Demonstration category.

The April issue of EV News, feature story was the 2001 *Tour de Sol***.** It appears to your Editor the event has strayed far away from its early emphasis on electric vehicles. Note the roster in the preceding paragraph.

This issue has an article authored by U. S. Congressman Sherwood Boehlert, Chairman of the House Science Committee. He notes that energy policy is one again on the front burner in Washington.

The revised ZEV mandates have initiated an automaker search on how to meet the new requirements. The 2001 goals are to put 10,000 full function EVs on the road by 2002, 20,000 by 2010, 30,000 by 2012, and 51,000 by 2018. This is a long time span, particularly considering the increasing rate of oil depletion and likely fuel price future increases. Already GM is in court challenging program.

An article notes that battery EVs were barely visible at the SAE Congress in Detroit in March. Fuel cell and hybrid vehicles were well represented. There was not a single paper on battery-electric vehicles. Among 1200 exhibitors there were only two booths showing battery vehicles, both of them from overseas. One interesting vehicle was the UK's Zytek who converted *SMART* electric car. It was refitted with a 60kW brushless motor and can cruise at 60 mph for 100 miles.

VEVA, The Vancouver Group's May Newsletter contained mostly minutes of club meeting activities. There was a 1986 Fiero advertised for sale. It has a 9" motor and 18 T-125 batteries. Listed price is $ 7800. Information available from Tim at (604) 885-9234.

The following handout was prepared for ***The Triton Project Session 3 classwork***.

Internal Combustion Engine (ICE) Cars

A. Principles of operation

1. Cars have used ICE engines for 125 years. Today's engines are highly developed.
2. Engines work by a sequence of controlled explosions inside a cylinder.
   a. Engine is a complex device.
   b. Now uses electronic control of many functions.

B. Gasoline Fuel

1. Heat energy stored in one gallon = 115,000 Btu. (33 kWh/gal)
2. ICE fuel use @ 20 miles per gallon = 5750 Btu/mile (1.68 kWh) (SUV's)
   27.5 " = 4182 " (1.22 ") (CAFÉ)
   60 " = 1916 " (0.86 ") (Hybrids)
3. Infrastructure in-place and fuel available. There are an estimated 150,000 gas stations in the U.S.
   a. Today's retail price is about $ 2 per gallon in Illinois.
   b. Crude oil used to make gasoline accounts for 74 cents (37%) of the price.
   c. Distribution, marketing and profit is ten cents (5%).
   d. Refining cost and profit accounts for 52 cents (27%).
   e. Taxes (Federal, State, County & Municipal) total 64 cents (32)%.
4. Today imported oil furnishes 58% of petroleum requirements while domestic sources supply 42% Every day 18 million gallons is consumed.

C. Gasoline fuel is vital

1. Since WW II persons, housing, factories and business have dispersed to the suburbs. Cars provide personal transportation. With a car you can go anywhere you wish at any time and with anyone you choose. No public transportation can provide this flexibility of service.
2. Aircraft and ships must use petroleum. They have no other choice for a fuel.

The Laws of Motion govern all cars

Torque sells cars. Most auto reviews emphasize horsepower, torque, and the 0-60 mph time. Torque requirements vary over a driving cycle. ***Acceleration*** requires the most torque. Next is ***aerodynamic*** drag. The third is ***hill climbing*** and the fourth is ***rolling resistance***.

Acceleration requires the most torque. The WarP 9-inch motor has a continuous rating of 25 horsepower (HP) and a peak power rating of about 75 HP for acceleration. The motor was chosen based on the experience of FVEAA members in building their conversions. They have found that with a 120-volt system this motor, when combined with gear shifting, will give a satisfactory acceleration for driving in urban traffic. Calculation of the expected acceleration times requires information about the overall drivetrain gear ratios.

During the first shop session the Ranger was weighed. The total weight was 2938 pounds. After ICE component removal and addition of electrical components we expect the total weight of the converted vehicle to be about 4000 pounds. Batteries should be about 30% of the final weight.

The Laws of Motion govern all cars (Continued)

Aerodynamic drag results from moving the vehicle against the air. They increase as the square of the speed. The Ranger does not have a good aerodynamic shape. It is like pushing an upright sheet of plywood at road speed. Triton is expected to use the Ranger on local streets where the maximum speeds seldom to exceed 40 mph. The drag force at this speed will be about 120 pounds and require about 100 lb-ft of torque.

In steady-state operation the motor must provide the energy to overcome ***road* losses**. These are independent of speed. They are caused by friction in mechanical parts and tire losses. For the Ranger these are expected to be about 70 pounds.

Hill climbing is the fourth factor. Around Triton this can be experienced on North Avenue where the road has an underpass under the train tracks west of First Avenue. The rest of the car's operation will be on level ground. Shifting the transmission will handle hill climbing.

Calculating acceleration, drag and hill climbing is covered in Bob Brand't Book, *Build Your Own Electric Car* if you wish to make detailed calculations. You can also refer to the Table of Torque available prepared for his book, using a Ford l987 Ranger. The Table was included in the second session handout.

Why an electric car?

Probably the most-import long-term reason is that petroleum is a finite resource. Crude oil was formed millions of years ago in the warm, shallow waters of Ancient Seas when plankton died and sank to the bottom. They were covered by a layer of sediment and sealed off from oxygen, layer-after-layer. Geologic movements caused these layers to move deeper where the sediment was converted to porous rock and sealed by impermeable rock layers. Later the layers were raised to about 1000 feet below the present surface. The process required millions of years. Petroleum is found where these conditions existed. The greatest accumulation is in the Saudi Arabian area where reserves are estimated to be 618 billion barrels of oil. The same conditions existed off the Gulf Coast of the United States. U.S. proven reserves are currently about 13 billion barrels.

Extensive extraction of oil began just over a century ago, stimulated by automobile requirements. Before that there was only whale oil. In the last century the world has consumed about half of estimated reserves. Peak production is expected to take place in about 2010. After that it will decline until the end of this century when the age of oil will be over. Declining production will bring increasing price as consumer's compete for gas.

Today the developing countries in Asia are increasing their use of oil for automobiles. Within 50 years at the present consumption rate half the remaining oil will have been used. My grandchildren (Now ages 2-7) will have to accommodate to inevitable continued rise in gasoline prices.

Petroleum supply provides justification for an electric car **today**. An EV does not depend on gasoline. The auto companies have not taken a long-term view. The GM EV-1 trial in California produced the expected result that consumers didn't **seem** to be interested in an electric car having a limited range, even though it could be *substituted* for an ICE vehicle where the driving mission was within the capability of the EV-1. Auto manufacturers have abandoned further EV development in favor of hybrids. If you want an electric car soon, you will have to convert one, as the Triton Project is doing.

The final reasons for an electric car are environmental improvement and reduction in annual owning costs, compared to the ICE alternative. These will be discussed in a later class.

Electricity Fundamentals

An electric car can use anything that generates electricity except rubbing an ebony rod with cat's fur and lightning. Electricity generation, except for solar cells, requires a relative motion between a magnetic field and a conductor. Central-station power plants use steam-driven turbines produce commercial electricity. Coal, oil or natural gas is burned to boil water and produce steam. Nuclear generation uses the heat produced by fission. Hydroelectric power uses the energy of falling water.

Electricity must be generated and used in the same instant. An electric or magnetic field can store only very small quantities of electric energy. Batteries are the usual means of storage. Electricity can be stored electrochemically in a battery (battery charging). When discharged the battery's electrochemical energy is converted back into electricity. **A battery's limited ability to store electrochemical energy is the reason for the limited range of electric cars.**

Electrical power depends on the circuit **voltage** and **current**. Multiplied together yield **watts**, a measure of power. An electric car converter has a choice between voltage and current for his system. A higher system voltage reduces current and requires smaller conductors for any power level. Thomas Edison originally selected 110 volts for houses because that was the level his newly invented incandescent lamp carbon filament required. The ratings for commercial components are usually a starting point for electric car conversions. The usual choice for the car's power system is 120 volts. It provides a balance of motor, controller, battery, and ac electric supply systems factors.

Major components in an electric car

Four components are used in an electric car; the motor, controller, battery, and battery charger. We will start with a discussion of the motor.

An **electric motor** can be either ac or dc. GM's EV-1 has an ac system. The main advantage of an ac motor is its **constant torque** at all speeds. This simplifies the drive train, but requires a complex, expensive device that costs $ 18,000 to convert the battery dc supply to ac for the motor. A typical cost for a dc series-wound motor used for conversions is about $ 1500. Cost is the reason why a dc motor is used for conversions

A dc motor operates by an interaction of magnetic fields. There are two parts to a dc motor. The stator containing coils of wire which establish fixed magnetic fields. The rotor contains its own set of windings. The rotor (armature) has a commutator and brushes that sequentially apply voltage to the rotor windings as the armature rotates.

Motors used for electric cars are series wound. In this type the stator and rotor fields are connected in series so the same current flows through each. A series motor has its maximum torque at standstill; just what is needed for acceleration. Torque **decreases** as the motor speeds up.

The armature is the only moving part in the motor. Brushes are the only component of the motor subject to wear. They have a history running for many years without brush replacement, and that is an easy job. Series motor efficiency is usually over 90% because losses occur only as winding heating, brush and bearing friction, and windage due principally to the built-in cooling fan.