SRJC-NBEAA ELECTRIC VEHICLE CONVERSION PROGRAM

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PROJECT OBJECTIVES: Design, fabricate, assemble and test a state-of-the-art Electric Vehicle (EV) conversion utilizing Lithium Iron Phosphate (LiFePO4) batteries and Alternating Current (AC) drive systems as part of the Santa Rosa Junior College (SRJC) EV Conversion program curriculum. Use vehicle for staff to travel between campuses and to promotional events. Fully document the design and process in both book and video form. Complete project by the end of 2009, then use the vehicle, book and video in future SRJC EV conversion classes, as well as to promote the program to industry, government and the public.

PROJECT CONTEXT: EVs whose charge is offset by renewable energy are part of the solution to energy independence and emission reductions. Battery researchers and large automotive companies are working on new long-range low-cost electric vehicles, but it is expected to be many years until they are readily available and displace the existing fleet. Conversion of existing petroleum powered vehicles to electric has been done on thousands of vehicles over the past several decades, but many are either very heavy or have a short range due to the lower cost readily available lead acid batteries and DC drive systems that are commonly used. Furthermore lead is toxic and we are trying to reduce its use. Mid-range conversions using LiFePO4 batteries and AC drive systems have been done recently on a few vehicles, but most have been unique designs, and no one conversion found has a complete feature set for safe, reliable, maintenance-free driving.

By working collaboratively with those who provide these state-of-the-art components and these advanced converters in an open source fashion, we can develop a common design that can fit in several common compact vehicle models with only minor mounting adapter differences. The final product will then be more complete and error-free, and individuals and shops can take the course or read the book and watch the video, then replicate the designs in high volumes that will reduce the cost in the form of component discounts, more efficient assembly times, and competitive offerings.

PROPOSED METHODOLOGY: Obtain a popular late model compact manual transmission donor car, such as a Ford Focus Wagon, Toyota Corolla or Honda Civic. Convert an SRJC fleet vehicle or obtain a donation. Remove all Internal Combustion Engine (ICE) systems including motor, radiator, fuel tank and exhaust system. Refurbish remaining systems including brakes, steering and suspension. Affix SRJC, AAA and NBEAA logos on the vehicle.

Purchase the EV components, including LiFePO4 deep cycle high power long life large format traction batteries and management system, AC drive system with flywheel and bell housing adapter, sealed isolated PFC UL and FCC compatible 30 amp universal input on-board traction battery charger, and miscellaneous EV related items including

cables, fuses, circuit breaker, main contactor, accessory battery, DC-DC converter accessory battery charger and other small electronic parts.

Fabricate the mounting racks and boxes for the above equipment such that the original body is not permanently modified, the safety and crashworthiness is not affected, and each major component can be easily removed and installed.

Assemble and test the vehicle to determine speed, range and weight performance. Have SRJC staff utilize vehicle when traveling between Petaluma, Santa Rosa and Windsor campuses and to promotional events. Utilize existing charging outlets in Lounibos Hall and the Public Safety Training Center in Windsor. Maintain and repair the vehicle as needed in a timely fashion. Retest vehicle performance each semester over the life of the vehicle.

Disassemble and reassemble the EV portion of the vehicle to fully document the process and design in both book and video form. Sections include design analysis, decisions, rationale and theory of operation; fabrication drawings, schematics and bill of materials; ICE component removal and EV assembly and test procedure; and preventative maintenance, troubleshooting and repair guide. Use vehicle and documentation in future SRJC EV conversion course offerings.

Post all documentation online. Set up on-demand hard copy book and video production. Promote the program by including industry and non-profit partners on an advisory committee, showing the vehicle at public events, and presenting the vehicle and our program to fleet operators, government officials, EV conversion shops, EV component vendors, relevant industry and educational conferences, and the press.

EXPECTED RESULTS:

- <100 lb curb weight change
- >40 miles average range at >2 miles per kWh
- >65 MPH top speed at <25 second 0-60 MPH acceleration on flat ground
- charge time <3 hours via 240V/30A AC outlet, and <12 hours via 120V/15A

QUALIFICATIONS:

- Steven Cohen: Dean of departments including Industrial Trade Technology which offers several Alternative Fuel Vehicle classes including EV conversions.
- Chris Jones: BSEE and BSME from UC Davis. 17 years experience in telecom industry R&D and manufacturing engineering and project management. Converted 1966 Mustang to LiFePO4 batteries in 2006. NBEAA chapter president since 2006.

PROPOSED COST ESTIMATE: $40K total. The following cost categories may vary:

- $17K for traction batteries and management system
- $ 8K for AC drive system and adapter
- $ 7K for traction battery charging system
- $ 8K for miscellaneous other EV conversion parts, shop tools, electronic test equipment, documentation materials, and to refurbish and affix logos on donor car