

Kings Canyon Unified School District

Central Valley Electric School Bus Demonstration Project

Final Report for G11-AQIP-04

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| | |
|---|----|
| Executive Summary..... | 3 |
| Introduction | 5 |
| Project Shortfalls & Then Success..... | 10 |
| Who Builds The Electric School Bus? | 13 |
| Technical Specifications for the Electric School Bus | 18 |
| Technical Development of the KCUSD Project eBuses | 20 |
| California Highway Patrol School Bus Certification | 25 |
| Central Valley Electric/Hybrid School Bus Demonstration Project Outreach..... | 33 |
| Route Performance Transporting Students | 51 |
| Conclusion - The Electric School Bus Journey has only Begun..... | 61 |

Executive Summary

This Central Valley Electric School Bus Demonstration Project report is about a new technology all-battery electric powered school bus coming to a rural school district in the heart of the fertile San Joaquin Valley. This report is NOT complete. This is merely the beginning chapters of more research and information yet to be gathered during the 2014/2015 school year. This is the beginning of what will become more still yet to be developed all -electric and extended range electric trucks and buses. As we are in the harvest season during the drought of 2014, the sun is shining on what slowly and painfully is a new beginning in transportation. This is a new and brighter beginning for School Pupil Transportation as we have never known it.

Credit needs to go to the pioneer of electric powered school buses, Ralph Knight of Napa Valley Unified. Ralph was leading the charge in the mid-1990s with a Type "D" lead-acid" battery powered school buses. Next he moved to Clean Diesel Hybrid Electric powered school buses and a whole white fleet array of EVs to provide support services in his school district. Kings Canyon Unified was to have received one of those Lead-Acid powered school buses along with other San Joaquin Valley school districts and it never materialized.

Many California school district transportation directors and fleet managers have seen the transition during their careers from gasoline to diesel to compressed natural gas and even propane powered school buses. The moves to various fuel types were as a result of advancement in technologies, fuel prices, availability, emissions reductions and new school bus funding for the opportunity to dabble in alternative fuels. Bottom line our primary responsibility is to bring school pupils to school and home safely and in a cost effective manner without delays, because when the bell rings, school is in session.

Once again, this project is far from completed. The electric school bus is an emerging technology under development and continually expanding. Kings Canyon Unified is on the bleeding edge with the California Air Resources Board in concert with the California Energy Commission in this project to bring another option to the school pupil transportation industry. The promise of this project and other electric school buses projects presently developing in

California, will reduce both the tail pipe and greenhouse gas emissions, while reducing fossil fuel usage and escalating expenses to our schools. Partnering with Motiv Power Systems, Trans Tech Bus and Creative Bus Sales we introduce this new Type "A" all- electric school bus to the industry with the knowledge that what we have learned in these beginning chapters of this Air Quality Improvement Program AB 118 sponsored Central Valley Electric School Bus Demonstration Project will be transferred to improve the next technology in improving the next, and the next and the next bigger and better electric powered school bus.

At the end of the day when the last student has been delivered home safely on a clean air zero emissions school bus, we can say, "It was for the Children!"

So, thanks Ralph Knight, you sparked an interest in my desire to keep this vision going!

Special Thanks to the Kings Canyon Unified Governing Board for allowing our Transportation Team to participate in worthy endeavor clean air, alternative fuels school bus projects that benefit air quality for our children and our communities of the San Joaquin Valley, Juan Garza - District Superintendent and Jason Flores-Director of Transportation for allowing me to come back and play in this electric school bus adventure.

Finally, a special thanks to Patrick Chen and Earl Landberg of the Mobile Source Control Division for ARB for putting up with me. They are passionate for our environment and believed in this project, sharing in the ups and downs we encountered with this emerging technology!

John D. Clements
Grantee- Project Manager

Introduction

Central Valley Electric/Hybrid School Bus Demonstration Project

Kings Canyon Unified offices and transportation department are located in Reedley, California. KCUSD is a public educational institution that provides services to Pre-kindergarten through the 12th grade to nearly 10,000 students at over twenty school sites for a 600 square mile area from the San Joaquin Valley floor to the Kings Canyon National Park. Our primary communities served are Reedley, Orange Cove, Squaw Valley, Dunlap, Miramonte, Pinehurst and Wilsonia. KCUSD boundaries cover all or portions of 12 different zip codes for Southeastern Fresno County and Northeastern Tulare County. Of the nearly 10,000 students in the school district, 5,000 receive transportation services by way of the school buses owned and operated by the district each school day.

School district surveys have indicated that 1 in 5 families in portions of KCUSD have a second car available. The region is made up of primarily rural farmland with adjacent foothill and mountainous terrain. Rural Transit in the areas of KCUSD mostly provides limited door to door service to Reedley and Orange Cove within the community boundaries. So the school district school bus transportation system is the dominant transportation provider in this region to bring the children safely to school and from home by way of school buses.

Kings Canyon Unified is within one of the worst non-attainment regions for air quality in the nation. Student surveys have indicated that as many as 1 in 6 students must carry an inhaler to school to assist with breathing. While the school district is within one of the most fertile farming regions in the world, over seventy percent of our student population qualifies for free and reduced school provided breakfasts and lunches. In recent years the unemployment in our school district has been 29 to 30%. Kings Canyon Unified is the largest non-agriculture based employer for the area.

Kings Canyon Unified must operate an efficient fleet of school buses to provide the educational services and opportunities to our students. The 72 school buses that KCUSD operates travel over a million miles annually and are parked out at four sites over the district.

The fleet composition is primarily larger 40 foot Type “D” transit style school buses fueled with either ultralow sulfur diesel or compressed natural gas. The district received five 2012 diesel hybrid/electric Type “C” school buses.

Since 1993 Kings Canyon Unified has replaced 45 of their school buses and has grown by 16 additions to the fleet. These replacements were primarily cleaner advanced diesel, compressed natural gas, hybrid electric and more recently two all-battery electric powered school buses. KCUSD has actively sought after clean air grant funding to obtain these school buses and the needed infrastructure to refuel these alternative fuel units. The funds to advance the emissions reduction through obtaining these newer school buses and replacing older buses have exceeded over \$10,000,000.

Why Electric School Buses?

The Central Valley Electric/Hybrid School Bus Demonstration Project concept began as a dream to bring new battery electric and diesel hybrid electric school buses to Kings Canyon Unified School District (KCUSD). KCUSD began discussions with Creative Bus Sales in October 2010 with a concept of an all-electric school bus based on a previously successful European truck chassis as a cut away platform for a brand new alternative fueled school bus.

This concept developed and was actually built and introduced to the world in a year after, in October 2011. Kings Canyon Unified received the grant funds to nearly cover the entire cost of the 1st new electric school bus to use the latest in electric battery technology since earlier California attempts in the 1990s. This concept school bus actively was transported and paraded around California and the nation proudly wearing the Kings Canyon Unified school district name and that of our many clean air funding sponsors.

With the promise from manufacturers that our very first electric school bus would be completed and go into production, Kings Canyon Unified actively pursued AB118 Air Resource Board Air Quality Improvement Program funds. These clean air funds would be used to obtain more electric school buses with the idea of demonstrating this advanced technology as a viable means for a school district to reduce operating expenses by reducing petroleum usage, while

helping to reduce emissions with this zero emissions technology in our San Joaquin Valley that so desperately needed help.

In February 2012 Kings Canyon Unified was the successful awardee for nearly \$500,000 dollar from the AQIP AB118 Hybrid/Electric School Bus Demonstration Program. The objective would be to obtain two more all electric school buses and then in combination with the one we already had and five hybrid electric school buses we would demonstrate their use in day to day home to school student transportation use. In most school bus operations across the country, transportation supervisors and school superintendents just want the school bus to run safely and deliver on time, with cost and emissions as their secondary goal.

As Kings Canyon Unified planned to demonstrate both hybrid and electric school buses in their own daily routes, several electric and hybrids in this program were to be shared with other school districts. The original grant plan was to ship or drive either a new electric or hybrid school bus to a willing participant public school district to allow that district to actually demonstrate the technology in their home terrain risk free. California Highway Patrol approvals were to be secured as a demonstration school bus moved about the state from one CHP region to another. Insurance agreements were in place to obtain the needed additional coverage certifications. Over 400 eligible districts were identified as being members of same insurance group as Kings Canyon Unified for either the primary or secondary insurance. One of the primary objectives was to put new technology in the hands of other school districts to remove the fear of trying something new without the risk of having to buy this school bus. At the end of a trial test demonstration period driver and borrowing district feedback was to be obtained along with performance, fuel savings and emissions data.

Sadly our first electric school bus prototype was never completely finished. The eTrans as it was known did not receive Federal Motor Carrier Safety Standard certification. As a result of no FMVSS the California Highway Patrol was unable to provide a completed Initial School Bus Certification on our eTrans. It never was able to transport students and become anything more than just a prototype. This nearly caused the Central Valley Electric School Bus Demonstration Project to fail.

The next option was to reach out to our manufacturer of the Hybrid Electric school buses. The thought was we could still provide the demonstration and share the diesel powered hybrid electric school buses with other school districts. Sadly the Hybrid school bus manufacturer chooses to discontinue their production of the hybrid school bus due to the low sales volumes.

So by March of 2013 we had no electric school bus and no additional hybrid school buses available to share in this demonstration project. Then in May 2013, a small California startup company that builds electric drive systems called Motiv Power Systems came to our rescue. CEO Jim Castelaz called and offered to build Kings Canyon Unified an electric Type "A" school bus that would help complete most of the major milestones of this project. This would be a first for Motiv to work to manufacture an electric school bus utilizing a Ford E450 chassis that they had already used as a chassis platform for a successful electric shuttle bus.

In the following pages of this report you will find the completed milestones achieved on the project. Just completing and obtaining two new never been built before all-battery electric school buses manufactured as original equipment (not older buses repowered) was a major milestone. This task was completed successfully in a matter of months, not over a year. Becoming fully California Highway Patrol certified to operate as a school bus in California was a second hurdle.

You will then see the specification of the two electric school buses obtained and purchased for this project, technical issues that were overcome as the components of a traditional cab and chassis become an electric cab and chassis to become a school bus that is electrified. Included are the CHP and FMVSS certifications and discussion of that process.

Because of the limited time to start the bus manufacturing process a second time, our school district sharing demonstration became a public outreach and awareness program. Our eBus ZEV-9, as it is identified in KCUSD, made many Clean Air Expos and Summit events throughout California within a short window.

Most importantly, ZEV-9 transported school children within Kings Canyon Unified in the San Joaquin Valley. This is a milestone never met by any other electric school bus before. On six afternoons between February and March this Spring 2014 we delivered school children home from school in an all- electric powered school bus and it worked! While this was a small period of time, some data collection numbers show some significant energy cost saving derived from a no NOx, no CO2, no HC and no PM emitting school bus...Stay Tuned more to come.



Project Shortfalls & Then Success

An agreement to replace this original eTrans unit and build two more for this AQIP project was still in place by Oct. of 2013. The three all new Trans Tech eTrans would never be completed. Crash testing was requested by the National Highway Transportation Safety Administration. The chassis builder and Trans Tech never agreed upon the funding needed for obtaining the side impact testing nor the engineering to develop cage protection of the electric vehicle batteries that were located outside the frame rails of the cab and chassis used to develop this unique school bus.

Subsequently, Kings Canyon Unified attempted to use these AQIP funds to then salvage this program and planned to obtain and purchase more Navistar IC charge sustaining Diesel Hybrid Electric powered school buses. By this point KCUSD had received 5 hybrid units that were successfully operating throughout our school district. Navistar informed us that they would no longer be producing the Diesel Hybrid Electric IC school bus due to low production numbers being purchased nationally. These hybrid units were to be shared with neighboring school districts along with our eTrans School buses in Central and Northern California, however now neither buses were commercially available for purchase.

As a result of these two manufacturing setbacks with this project most grantees would have terminated the project contract and just simply walked away. There was admittedly a level of frustration as a project manager on such a challenging grant award, while still maintaining a full time transportation role. I served as a full time school district transportation director with a staff of seventy and a fleet of seventy school buses, moving over 5,000 school children daily over a 600 square mile region of the San Joaquin Valley. So in May of 2014, I choose to retire from Kings Canyon Unified after 20 years as the director of transportation and 39 years total service with the district in pupil transportation. There was over \$1.6 million dollars of clean air vehicle grant funding from local, state and federal programs on my back shelf of my soon to be old office as I left on May 20, 2013. Under the California Retirement Reform Act I would not be able to work for any public agency for 6 months. I took those project binders home, including this AQIP Electric School Bus Demonstration Project. I voluntarily continued to complete these clean air alternative fueled vehicle, tractor, truck and school bus projects one by one.

As a result of my pursuit of an all new electric chassis manufacture the development of a second all electric school bus began to occur in June of 2013. This new electric school bus would use a new plug in place designed electric drive propulsion system. This electric drive system would be combined with Trans Tech's existing school bus line utilizing a Ford Motor Company's incomplete cab and chassis that was available in a school bus prep package. This electric school bus would be driven with a Motiv Power System electric drive. It would be

placed into a Ford E450 cab and chassis as an engineered up fit by Roush Industries, an approved Qualified Vehicle Manufacturer of Ford. Next the fully electrified chassis complete with batteries would be shipped to Trans Tech Bus in Warwick, New York where the school bus body would be installed, interior CE White seating and yellow exterior paint added. Trans Tech Bus would then become the final stage manufacturer of record for the totally electrified new Type "A" school bus for our AQIP project.

By late Oct. 2013, nearly two year after our first failed attempt to bring an electric school bus to Kings Canyon Unified, our second attempt would successfully deliver on a promise to our Community, the San Joaquin Valley and the State of California. This first new Type "A" Trans Tech SStE powered by a Motiv Electric Power System with Kings Canyon Unified School District lettering and ARB AQIP AB 118 signage as our grant funding agency was unveiled that month at the National Pupil Transportation Association Conference and Trade show held in Grand Rapids, Michigan.

In November 2013 our initial school bus arrived at Motiv in Foster City, California. Preparation for drive and field testing began with preliminary warming of the drive batteries, software integration between Motiv and Ford components. At the end of November 2013 this school bus became temporarily DMV registered to Kings Canyon Unified and insured for the purpose of legally being able to drive the eBus on the public roadways and as a result initial road/field testing. As this project manager I requested that Kings Canyon Unified place me on their substitute school bus driver approval list and I was then Governing Board approved to return as a part time employee. I was once again added to the transportation departments' Commercial Driver Drug and Alcohol Random Test group. I was then insured by KCUSD to operate the Motiv eBus as their software engineers and technicians now needed me to test drive our eBus. I would find myself gone from home nearly 40 days between Nov. 2013 and Feb. 2014, primarily to drive test our eBus while Motiv software technicians rode onboard writing, monitoring and modifying operating code language for our new electric school bus. In between drive tests runs I assisted and worked directly with staff engineers and technicians of Motiv to prepare this electric school bus for the initial California Highway Patrol School Bus Certification Inspection. My role as their school bus expert was to inform and even teach the Motiv staff of the daily operational uses and needs of this electric bus, soon to be used as a school bus to transport our most precious cargo, "School Children."

Our School District sharing/demonstration and data collection did not occur with other schools. This was due to a manufacturer's failed attempts that did not provide the needed and ordered electric school buses. This caused time setbacks within the project window of opportunity. Additional time was lost on the project while working to find and develop another more suitable new electric school bus alternate that too was new to the school bus industry.

To reach as many public interests with news of an alternative fueled school bus, Kings Canyon Unified sought the help of ARB. There was a need to modify this project. Public Outreach and Clean Air Electric Vehicle sharing through ride and drive events could become a major focal point of this product development, acceptance and commercialization success in the remaining project time.

Who Builds The Electric School Bus?

Who Builds the Kings Canyon Unified School District - Central Valley Electric School Bus Demonstration Project School Bus?

This is **Kings Canyon Unified School District's (KCUSD)** second attempt to bring an all-electric battery powered school bus to our San Joaquin Valley based public school district and to fulfill our commitment to this project supported and funded through the California Air Resources Board AB118 Air Quality Improvement Program's Electric/Hybrid School Bus Demonstration Project.

Motiv Power Systems – Motiv is the electric propulsion system manufacturer and assembler. They are based in the Silicon Valley with an office and engineering lab in Foster City and a production assembly line in San Jose. Motiv's system can drive any truck or bus with a plug in place electric drive train. They can use many different electric vehicle battery systems and electric drive motors as their electronics are adaptable.

Ford Motor Company – Ford supplies the cab and chassis as an incomplete school bus approved prep package on their existing E-450 cab and chassis. This school bus ready chassis is rated at 14,050 GVWR.

Roush Industries - Motiv then ships their electric propulsion system to Roush Industries in Michigan. Here Roush converts this chassis from an internal combustion engine to an electric drive platform. Motiv technicians work hand in hand to build and make this chassis conform to highest standards knowing that children will ride in the school bus and adults may ride on the shuttle.

Trans Tech Bus - The electrified school bus prepped E-450 now is transported to Trans Tech Bus in Warwick, New York. Trans Tech next builds there SST model school bus Type "A" as our electric school bus body and then calls it the SSTE.

Creative Bus Sales –Creative Bus is the California warranty Center for Trans Tech performing body shop work and light maintenance. Creative Bus has supported the electric school bus program at Kings Canyon Unified as a partner in the Electric School Bus Demonstration program with contact information at schools desiring more electric school bus information.

Chassis verification from Ford Motor Company for ZEV 72, our second eBus

INCOMPLETE VEHICLE MFD. BY FORD MOTOR COMPANY

| | | | |
|-------------------------------|------------------------------|-------|-------|
| DATE: 08/13 | GVWR: 6373 KG (14050 LB) | | |
| FRONT GAWR: 2087 KG (4600 LB) | REAR GAWR: 4355 KG (9600 LB) | | |
| WITH LT225/75R16E 115/112R | WITH LT225/75R16E 115/112R | TIRES | TIRES |
| 16x6.0K | 16x6.0K | RIMS | RIMS |
| AT 515 kPa/ 75 PSI COLD | AT 550 kPa/ 80 PSI COLD | | DUAL |
| VIN: 1FDFE4FL7DDB29948 | | | |

Equipped with the Ford School Bus Prep Pkg

EXT PNT: BY RC: 53 DSO:

| | | | | | | | |
|----------------|--------|-------|---|------|----|------|------------------|
| WB | INT TR | TP/PS | R | AXLE | TR | SPR | DE414 |
| 158 | AE | | 7 | 83 | T | VVBB | Y05 |
| MADE IN U.S.A. | | | | | | ULN | ▽5U5A-3520472-AA |

Incomplete Chassis at Roush having data uploaded to the CPU in the cab



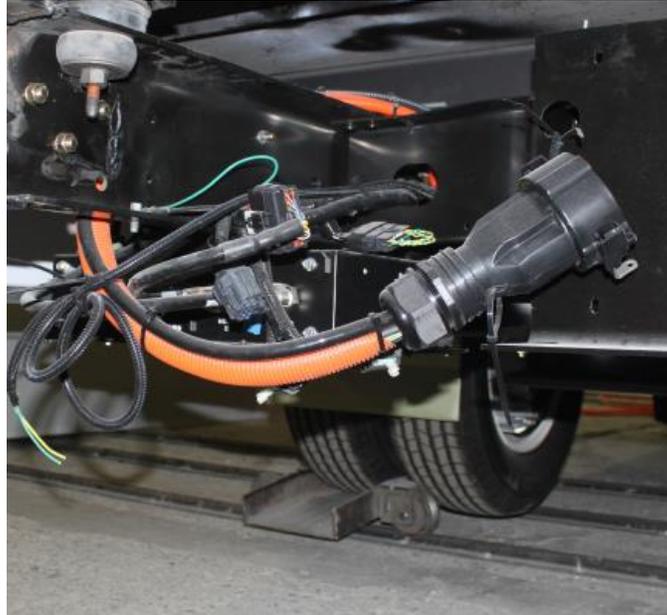
Motiv Power System Technicians working with the Roush engineer



The Ford incomplete chassis without the electric drive system



Electrification occurs at Roush with the installation of batteries, motor and controllers



Roush hand places and fits each component



ZEV-72 near completion in New York at Trans Tech



Final stage completed at Trans Tech with freshly GREEN painted bumper and wheels



The Motiv Team that design, engineers and builds the electric propulsion system

Technical Specifications for the Electric School Bus

Specifications for the Kings Canyon Unified Electric Type “A” School Buses for the Central Valley Electric School Bus Demonstration Project:

Chassis Base: Ford E-450 rated at 14,050 GVWR, Manufactured 8/13

Chassis Build: As an “Incomplete Vehicle MFD. By Ford Motor Company,” Equipped with the Ford School Bus Prep Package

Front Axle rating: 4,600 LB Rear Axle rating: 9,600 LB with Tires and Rims Dual

Weight with the Trans Tech School Bus Body is 10,420 LB

Passenger Carrying Capacity remaining on the chassis after school bus body installation is 3,630 LB

School Bus Body: Manufactured by Trans Tech, a TCI Company of Warwick, New York.

School Bus Body Model Year: 2015

Body Build: Steel and wood flooring with floor rails for track adjustable seating. Steel roof bows, wall supports and roof panels with aluminum siding. Front and rear roof caps are of composite/fiberglass materials.

School Bus Interior: Uses Standard 3 point passenger restraint system to California with some seats containing a smaller child integrated safety seat built into the seatback. Smooth galvanized steel interior panels are below the double sash tinted passenger windows.

School Bus Exits: This bus has a front right entrance door and a left front driver’s door. To the rear of the bus is located a vertical emergency exit with driver warning lamp and buzzer for driver notification. One roof top emergency hatch is available.

Federal Motor Vehicle Safety Standard Approval granted October 2013

Propulsion Specifications: Battery Electric using 4- 20kWh located between the Ford Chassis frame rails

Battery Manufacturer: Fiamm, Motiv Power System’s eBus can use nearly any battery built with software modifications to the electric Powertrain Control System.

School Bus Range: Designed for 80 mile range, real range 65 miles with state of charge allowing reserve 20% charge to remain in the battery to prevent battery damage.

Electric Motor Power: 150 kW / 200 horse power

Torque: 1,200 Nm/855 ft -lbs

Top Speed 60 MPH, measured top speed has been at 54 mph

Charge Time: overnight or 10 hours, can optimally charge up to 50% in 5 hours

Power Source: uses 208 volt 3 phase for a universal fast charge

Technical Development of the KCUSD Project eBuses

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Written by Urvi Nagrani and Kim Kilday



A Motiv Technician resolves a code merge issue to allow software updates to improve the electric school bus.

Motiv Power Systems was brought into a project by Kings Canyon Unified School District in an attempt to “rescue” that project from its past failure to deliver a certified, all-electric school bus. Motiv was excited to be a part of this project, but was saddled from the onset with a timeline and budget that did not allow enough time or resources for an ideal vehicle development and testing program. Despite these challenges, Motiv and KCUSD were able to work together with Trans Tech Bus to make the project a success.

Unlike traditional fossil fuel vehicles which rely on primarily mechanical interactions to run, electric vehicles include complex software challenges as they integrate mechanical, hardware, and software components. In the long run, this means increased reliability as software can be reliably copied. For development; however, much of the testing process is front-loaded into the first vehicle. The accelerated pace for the development of the Trans Tech SSTe electric school bus meant that many testing scenarios which may usually be included in the normal development of a new electric vehicle were ongoing during the delivery. This allowed an exciting opportunity to integrate driver feedback with initial bug testing, but also meant that feature development, field testing, and bug testing were all done hand-in-hand with the fleet operator.

In addition, as the first currently-operating CHP certified all-electric school bus, the process of certification necessary to begin road operation was completed prior to road testing, which

meant many testing tasks that could otherwise run in parallel were forced to be done sequentially and in the tight timeline allowed for this project.

The following table illustrates some of the bugs discovered and features requested during the first months of operation of the SSTe. The table then lists their current status, the date identified and a description of the actions done. Note that a “Closed” status means that the bug was successfully fixed and is no longer a problem, or the feature was successfully implemented. The learning from this table is applicable to future vehicles. Some of the items discovered on the Trans Tech SSTe electric school bus were fixed using software developed on other Motiv-equipped vehicles, such as Motiv’s electric Refuse Truck. Likewise, some of the findings on this vehicle will be applicable to other Motiv-equipped vehicles. This development and learning accelerates the commercialization of electric vehicles not just for Motiv, but for the partners, suppliers and customers who are impacted by the learnings.

| Short Description | State | Severity | Submit Time | Notes |
|--|--------|----------|-------------------------------------|---|
| Hydraulic Leak | Closed | Major | 11/08/2013 09:46:12 GMT-07:00 | Supplier provided a poorly sealed reservoir so the seal wouldn't work. |
| No communication with school bus battery 3 | Closed | Major | 11/12/2013 19:06:25 GMT-07:00 | The no communication problem was due to missing rework on the connected APC. However, when communication was restored the BMI would now deliver power because of short circuit and recharge errors. The BMI was replaced with a new unit from Fiamm |
| CHP Item 39 - Wiring | Closed | Major | 11/25/2013 18:45:05 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| CHP Item 48 - Drive Shaft Guard | Closed | Major | 11/26/2013 08:11:02 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| CHP Items 6, 49, 50, 52 Need to test Speedometer and odometer and brakes | Closed | Minor | 12/01/2013 19:13:00 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| CHP Item 5 - install cardholder | Closed | Major | 12/01/2013 19:16:07 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| CHP Item 9 Check that windows all comply with the requirements | Closed | Major | 12/01/2013 19:19:13 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |

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|--|--------|-------|-------------------------------------|---|
| CHP Item 14 - check steering wheel clearances | Closed | Minor | 12/01/2013 19:21:21 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| CHP Item 17 - Floor Aisle | Closed | Minor | 12/01/2013 19:29:49 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| CHP Item 19 - Check heights | Closed | Minor | 12/01/2013 19:35:18 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| CHP Item 23 - First Aid kit - require 24 unit | Closed | Major | 12/01/2013 19:37:10 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| CHP Item 39 - check that wiring complies with regulations | Closed | Major | 12/01/2013 19:42:09 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| CHP Item 35 - review the side light requirement** | Closed | Minor | 12/01/2013 19:51:24 GMT-07:00 | Motiv passes CHP check 8:00 AM Thursday January 16th. |
| 12 V battery connection | Closed | Major | 12/02/2013 15:38:45 GMT-07:00 | OEM manufacturer components and Motiv components - suboptimal in initial design (drain on 12V battery from Trans Tech system). Improvements planned for future builds. |
| Auxiliary safety systems making noise through speakers | Closed | Minor | 12/02/2013 16:23:57 GMT-07:00 | Identified issue and communicated to OEM manuf. for review |
| Dash indication fail intermittently - odometer and speedometer | Closed | Major | 12/13/2013 09:14:28 GMT-07:00 | There was a bad connection connecting the Ford ground and the chassis ground. We cleaned off one of the ground connections and made a new ground connection (the loose ground wire under the dog house was connected to chassis ground). After we made the latter fix, we were unable to replicate the problem of the dash cutting out. |
| Red Lights must be manually operable | Closed | Major | 12/19/2013 13:24:10 GMT-07:00 | Patch from Trans Tech was installed and we found a sequence that makes it operate as required. |
| Remount of traction motor controller | Closed | Major | 12/20/2013 19:06:33 GMT-07:00 | Cables were hanging too low. Changed mounting of Motor controller to fix this issue. |

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|--|--------|-------|-------------------------------------|--|
| rewire master switch - wires unlabeled and unidentified. | Closed | Major | 12/26/2013 19:49:09 GMT-07:00 | Error in wiring which was initially complicated by inadequate labeling. Issue resolved and designs simplified for future maintenance. |
| Lengthen the wires from the 12 v fuses to the terminal block for accessibility | Closed | Major | 12/27/2013 10:25:02 GMT-07:00 | 3 Fuses made more accessible. |
| Label all wires to 12 volt battery and to terminal blocks | Closed | Major | 12/29/2013 10:00:46 GMT-07:00 | To help with maintenance. |
| Coolant leaks | Closed | Major | 01/02/2014 15:21:30 GMT-07:00 | Degas bottle was found to be leaking. After loosening and repositioning the clamp the leak was resolved. |
| Shudder going 10 MPH going downhill | Closed | Major | 01/02/2014 16:03:32 GMT-07:00 | Ramps down regeneration at slow speeds so that the driver experience is smoother. |
| Batteries not ready, 700V not coming up | Closed | Major | 01/07/2014 16:02:56 GMT-07:00 | Variations in code not successfully merged. After bug was identified, code fix was integrated. |
| Multiple Gland nuts are loose on ePCS components | Closed | Major | 01/09/2014 19:25:16 GMT-07:00 | Needed to clearly communicate specification for upfitter use. |
| Trans Tech electrical periodically shuts down | Closed | Major | 01/09/2014 20:55:10 GMT-07:00 | Trans Tech system designed to shut down whenever 12V battery drops below 8.5V. Future redesigns considered and identified a way to restart the system. |
| bleed for the heater coolant line | Closed | Major | 01/13/2014 15:05:36 GMT-07:00 | Installed new bleeder and issued an engineering change order to include in all future vehicles. |
| Reroute and reduce length of eStopp to drive shaft brake cable | Closed | Minor | 01/13/2014 19:24:17 GMT-07:00 | Redesign issued for future vehicles to reduce time that eStopp takes to engage. |
| Vehicle must charge when the key is turned off and removed from the vehicle | Closed | Major | 01/14/2014 10:28:30 GMT-07:00 | Code is modified so that key can be off during charge. |

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|--|----------|----------|-------------------------------------|--|
| Merge back in power limiting improvements in PCU | Closed | Major | 03/10/2014 11:18:15 GMT-07:00 | Improvement in calculation of torque mapping to power mapping transition point that gave us increased performance was lost in a merge. Add line back in to fix |
| Driveline brake releases during period between 12V switch on and key cycle | Closed | Critical | 03/19/2014 17:35:54 GMT-07:00 | Rewired eStopp circuit and made corresponding code change so that eStopp does not change during power off cycle. Updated wiring, code and user manual to reflect the changes and allow engineers, service technicians, and drivers up to date information. |
| Use of heater causes system to fault, then restart | Closed | Critical | 03/27/2014 12:45:52 GMT-07:00 | Power scheduling merged from refuse truck. |
| Turtle Mode | Assigned | Critical | 04/01/2014 15:57:22 GMT-07:00 | Designed to warn drivers at low state of charge and reduce power usage to extend vehicle range. |

There are some identified feature improvements which are being worked on to further improve the performance of the vehicle. For example, "Turtle Mode" will help prevent vehicles from running out of battery power in the field and becoming immobile. Testing on route offers a totally different environment with differing driver assumptions, climate differences, driver behavior in speed and other changes which impact key learnings. Motiv is willing to give KCUSD a free monthly preventative maintenance report for the first 12 months of operation. Both Motiv and KCUSD will allow for continuous improvement on this vehicle and future vehicles which will have the benefit of this vehicle's software upgrades from day 1.

Additionally, use of this vehicle by KCUSD over the next year will allow in-depth route testing to validate key developments, support integration of other Motiv ePCS improvements, and give KCUSD time to work with Motiv's staff to optimize the use of the SStE. Motiv is pleased to have been involved in the Central Valley Electric School Bus Demonstration Project. We hope that this successful project completion will carry over into future projects where instead of being the "rescue team", Motiv can be brought in as the first technical partner. In this role, we are confident that Motiv could set and meet even higher goals in the development and commercialization of electric trucks and buses.

California Highway Patrol School Bus Certification

Kings Canyon Unified Electric School Bus ZEV-9



A major milestone of this Electric School Bus project was the CHP certification of the new all-electric Trans Tech/Motiv Type “A” school bus.

A new school bus is required to receive an initial inspection to ensure that there are no violations or defects and to determine that the school bus is safe to transport school pupils.

An electric school bus is not your typically powered or fueled school buses. In the case of the Motiv Power System drive system, many batteries, wire and electronics are used to make the bus function. A diesel or compressed natural gas fueled and powered school bus must meet fuel tank integrity side impact worthiness to ensure that the school children who ride this bus are safe. KCUSD’s previous attempt to bring an electric school bus to California failed as that chassis did not meet Federal Motor vehicle Safety Standard. As a result of NO data or chassis certification, the California Highway Patrol would not allow CHP certification and school aged children were never allowed to ride that electric school bus.

Working closely with the Motiv Team of technicians and engineers, ZEV-9 was inspected and re-inspected multiple times to ensure compliance. Not only did the electric drive system meet the requirements, but that all components met the requirements. Not a missing screw or loose wire or a leaking hose or missing band-aid.

Kings Canyon Unified under a routine initial inspection of a new diesel or CNG school bus would have requested through the local CHP division office that an initial appointment occur at our main terminal at our transportation offices in district. The school district formally

requested through Director of Transportation Jason Flores in contact with the CHP Central Division for the Initial Inspection to occur at the Motiv Power Systems facility in Foster City. Motiv is within the Golden Gate Division CHP Area. This was valuable exercise in learning the needed detail to attention required for the safe operation and manufacturing of a school bus for the Motiv staff as they prepared ZEV-9 for this initial CHP certification. Added transport expenses would have been incurred to bring our eBus home for inspection and then returned to Motiv if an issue was found.

On January 16th, 2014 two senior CHP Motor Carrier Inspectors and two junior (in training) CHP Motor Carrier Inspectors arrived in the morning at Foster City from the CHP Golden Gate Division. They worked diligently as a team to determine that our new first of a kind all-battery electric school bus met all of the rules and regulations related the safe operation of a school bus including the construction, design, equipment and color. After a full day of inspecting and in periodic consultation with their area supervisor and the CHP Commercial Motor Vehicle Safety Section of Headquarters in Sacramento, it was determined that there were no issues that would prevent ZEV-9 from receiving a CHP School Bus Certification 292 card.

ZEV-9 was now officially a California school bus that could transport school pupils!

Actual CHP 292 School Bus Inspection Certificate for ZEV-9

First all-battery electric Type "A" school bus to be certified in California

STATE OF CALIFORNIA
DEPARTMENT OF CALIFORNIA HIGHWAY PATROL

INSPECTION APPROVAL CERTIFICATE School Bus School Pupil Activity Bus Farm Labor Vehicle
 Wheelchair School Bus Youth Bus General Public Paratransit Vehicle

CHP 292 (Rev. 3-08) OPI 062

| | | | | |
|--|-------------------------------|--|--------------------------------|------------------------------|
| YEAR 2014 * | MAKE FORD / TRANS TECH BUS | VEHICLE IDENTIFICATION NUMBER 1FDFE4FL9DDB29949 | VEHICLE LICENSE NO. 1436289 | COMPANY I.D. NUMBER ZEV-9 |
| OWNER'S NAME KINGS CANYON UNIFIED SCHOOL DISTRICT | | ADDRESS 675 WEST MANNING, REEDLY, CA 93654 | CONTRACTOR/TCP NO. N/A | |

This certifies that on the date entered below, an authorized employee of the California Highway Patrol inspected the vehicle described herein and found it complied with applicable laws and regulations relating to construction, design, and equipment.

| SIGNATURE | I.D. NUMBER | LOC. CODE | DATE CERTIFIED | STICKER NUMBER | ODOMETER READING |
|---------------------------|-------------|-----------|----------------|----------------|------------------|
| <i>Robert [Signature]</i> | A13299 | 330 | 01/16/2014 | N/A | 188 |
| | | | | | |
| | | | | | |

1. NOTICE: The passenger capacity of the vehicle described when used as a school bus, school pupil activity bus, youth bus or farm labor vehicle is 20 passengers in installed seating and 0 passengers in wheel chairs and driver.
 2. It is unlawful to drive this vehicle unless this certificate has been validated within the preceding 13 months.
 3. This certification shall be posted in plain sight in the driver's compartment of the vehicle.

1. NOTICIA: La capacidad de pasajeros del vehículo descrito aquí dentro cuando es usado como autobús escolar, autobús de actividad estudiantil, autobús de jóvenes o vehículo de trabajadores agrícolas es 20 pasajeros en sillas instaladas y 0 pasajeros en sillas de ruedas y el conductor.
 2. Es contra la ley manejar este vehículo a menos que este certificado se haya validado dentro de los 13 meses anteriores.
 3. Este certificado debe estar puesto a plena vista en el compartimiento del conductor del vehículo.

This certificate is the property of the Department of California Highway Patrol.
Use previous editions until depleted.

DRIVER/VEHICLE EXAMINATION REPORT

Aspen 2.14.1.1



407F/343A-Aspen
California Highway Patrol
Questions regarding this report may be direct
the telephone number listed below.
Telephone 707-648-4180

Report Number: CA30XN000242
Inspection Date: 01/16/2014
Start: 8:15:00 AM PT End: 2:51:20 PM PT
Inspection Level: V - Terminal
HM Inspection Type: None

KINGS CANYON UNIFIED SCHOOL DISTRICT
675 WEST MANNING
REEDLEY, CA 93654
USDOT#: Phone#: State:
MC/MX#: Fax#: State:
State#: 49744

Driver: License#: State:
Date of Birth:
CoDriver: License#: State:
Date of Birth:

Location: 1665 CHESS DR STE E, 94404
Highway:
County: SANTA CLARA, CA

MilePost: Shipper:
Origin: Bill of Lading:
Destination: Cargo:

VEHICLE IDENTIFICATION

| Unit | Type | Make | Year | State | Plate # | Equipment ID | VIN | GVWR | CVSA # | CVSA Issued # | OOS Sticker |
|------|------|------|------|-------|---------|--------------|-------------------|--------|--------|---------------|-------------|
| 1 | SB | UNK | 2013 | CA | 1436289 | ZEV-9 | 1FDFE45L9DDB29949 | 14,050 | | | |

BRAKE ADJUSTMENTS

| Axle # | 1 | 2 |
|---------|------|------|
| Right | N/A | N/A |
| Left | N/A | N/A |
| Chamber | HYDR | HYDR |

VIOLATIONS: No Violations Were Discovered.

HazMat: No HM Transported.

Placard: No Cargo Tank:

Special Checks: No Data for Special Checks.

State Information:

Beat/Sub Area: 4404; Veh #1 Type: 13; Regulated Vehicle: Y; Odometer: 188; Passenger Capacity: 20; Bus Type: 1; School Bus Cert. 01/16/2014;

Report Prepared By:
R. PEREZ

Badge #:
A13299

Copy Received By:

Page 1 of 1



CA CA30XN000242

X _____

X _____

Actual CHP Driver/Vehicle Examination Report: Found No Violations or Defects on ZEV-9 the Trans Tech/Motiv SStE model eBus

STATE OF CALIFORNIA
DEPARTMENT OF CALIFORNIA HIGHWAY PATROL
SCHOOL BUS
INITIAL INSPECTION
CHP 294 (Rev. 9-09) OPI 062

DISTRIBUTION
Original & one copy - Division
One copy - Carrier

ODOMETER READING 188
PASSenger CAPACITY 20
CA NUMBER 49744
UNIT NUMBER ZEV-9
LOCATION CODE 435

CARRIER INFORMATION

Public Private Contractor

CARRIER NAME AND ADDRESS (INCLUDE STREET ADDRESS, CITY, STATE AND ZIP CODE)

KINGS CANYON UNIFIED SCHOOL DISTRICT, 675 WEST MANNING, REEDLY, CA 93654

New Type 1 Transit Other Seated Only Fixed Combination Wheelchair / Seated
 Used Type 2 Conventional Wheelchair Only Variable Wheelchair / Seated

CHASSIS MAKE/MODEL FORD E-450 BODY MAKE/MODEL TRANS TECH VEHICLE IDENTIFICATION NUMBER (VIN) 1FDDE4FL9DDB29949 ENGINE FUEL N/A
DATE OF MANUFACTURE 10/2013 VEHICLE LICENSE 1436289 ENGINE MAKE/MODEL/CYLINDERS N/A ELECTRIC POWER 700 VOLT DC

| A. CHASSIS RATINGS (LBS.) | | B. TIRE CAPACITY (LBS.) | | | |
|---------------------------|--------|---|--------------|---------------|---------------|
| | | NO. OF TIRES | TIRE SIZE(S) | TIRE RATINGS | AXLE TOTALS |
| AXLE 1: | 4,600 | AXLE 1: 2 | 225/75R 16 | Single: 2,680 | 5,360 |
| AXLE 2: | 9,600 | AXLE 2: 4 | 225/75R 16 | Single: N/A | 9,880 |
| AXLE 3: | | AXLE 3: N/A | N/A | Single: N/A | |
| TANDEM (2&3): | | ← If tandem axles rated as a unit, enter rating as indicated, leaving Axle 2 and 3 ratings blank. | | | TOTAL: 15,240 |
| GVWR: | 14,050 | | | | |

| C. LOAD CAPACITY | | D. FIXED COMBINATION SEATING CAPACITY | | E. VARIABLE SEATING CAPACITIES | |
|---------------------------|-------------|---------------------------------------|-----------|--|-----------|
| 20 Pax at 120 pounds each | 2,400 lbs. | Seated pax | N/A | Pax with all seats installed ♦ | N/A |
| Driver at 150 pounds | 150 lbs. | WC stations | N/A | Pax in WCs with all seats removed | N/A |
| Unladen weight of bus | 10,420 lbs. | WC size to compute capacity | N/A x N/A | WC size to compute capacity | N/A x N/A |
| Calculated gross weight* | 12,970 lbs. | Pax = passenger WC = wheelchair | | ♦ Variable combinations shall not exceed this number | |

*The gross weight (Item C) shall not exceed the chassis ratings (Item A) or the total tire capacity (Item B). The gross weight on any axle or tandem axles shall not exceed the rated capacity (Item A) or the rated capacity of the tires on such axle (Item B). Authority: VC 34501.5, 13CCR 1217(a), 1217(b), 1276, 1278(a)

| COMPLIES | | YES | | NO | | COMPLIES | | YES | | NO | |
|---|----------------------------------|----------------|---|----|--|--|-----------------------------------|-----|--|----|--|
| 1. Chassis manufacturer's label(s) | 13 CCR 1272(a) | ✓ | | ✓ | | 30. Stoplamps | VC 24603 | ✓ | | ✓ | |
| 2. Steps-inches from ground: | 11 inches | 13 CCR 1280(a) | ✓ | ✓ | | 31. Backup lamps | VC 24606 | ✓ | | ✓ | |
| 3. Entrance doors, Type 1 | | 13 CCR 1281(a) | ✓ | ✓ | | 32. Reflectors | VC 24607, 24608 | ✓ | | ✓ | |
| 4. Stanchion, bars, shield, padding | 13 CCR 1267, 1278(d)(2), 1281(b) | ✓ | | ✓ | | 33. Red/amber warning lamp system | VC 25257, 13 CCR 696 | ✓ | | ✓ | |
| 5. Inspection certificate holder | 13 CCR 1231(a) | ✓ | | ✓ | | 34. Stop signal arm(s) | VC 25257, 13 CCR 1256.5 | ✓ | | ✓ | |
| 6. Speedometer/odometer | 13 CCR 1262 | ✓ | | ✓ | | 35. Side lamps (permitted) | VC 25102.5, 13 CCR 695 | ✓ | | ✓ | |
| 7. Driver's view-eyeshade | VC 26708, 26711 | ✓ | | ✓ | | 36. Strobe lamps (permitted) | VC 25257.7, 13CCR 695.5 | ✓ | | NA | |
| 8. Glazing materials-w/shield AS: 1 other glass AS: 2&3 | VC 26708 | ✓ | | ✓ | | 37. Other permitted lamps | VC 24402-24404, 24602 | ✓ | | NA | |
| 9. Windows- Type 1 size: 12 x 23.25 | 13 CCR 1285 | ✓ | | ✓ | | 38. Color, signs, permitted reflectorization | 13 CCR 1256.5 | ✓ | | ✓ | |
| 10. Mirrors | 13 CCR 1258 | ✓ | | ✓ | | 39. Wiring | 13 CCR 1249, 1250 | ✓ | | ✓ | |
| 11. Windshield wipers | VC 26706, 26707 | ✓ | | ✓ | | 40. Wheel clearance | 13 CCR 1289 | ✓ | | ✓ | |
| 12. Driver's seat and seat belt | 13 CCR 1270(a) | ✓ | | ✓ | | 41. Chassis mounting | 13 CCR 1275 | ✓ | | ✓ | |
| 13. Horn | VC 27000 | ✓ | | ✓ | | 42. Body construction | 13 CCR 1273 | ✓ | | ✓ | |
| 14. Steering wheel | 13 CCR 1291 | ✓ | | ✓ | | 43. Batteries | 13 CCR 1248 | ✓ | | ✓ | |
| 15. Heater, defroster, ventilation | 13 CCR 1259, 1260 | ✓ | | ✓ | | 44. Bumpers | 13 CCR 1290 | ✓ | | ✓ | |
| 16. Interior-projections, lined, lighting | 13 CCR 1263, 1273(b)(4) | ✓ | | ✓ | | 45. Tires, rims & wheels | VC 27465, 13 CCR 1244 | ✓ | | ✓ | |
| 17. Floors, aisle | 13 CCR 1273(b)(1), 1279 | ✓ | | ✓ | | 46. Fuel system | 13 CCR 1254, 1255 | ✓ | | ✓ | |
| 18. Aisle width 16 inches | 13 CCR 1279 | ✓ | | ✓ | | 47. Exhaust system | 13 CCR 1281 | ✓ | | ✓ | |
| 19. Inside height, Type 1 | 13 CCR 1273(b)(3) | ✓ | | ✓ | | 48. Drive shaft guards | 13 CCR 1268(a) | ✓ | | ✓ | |
| 20. Pupil seats-securement, locations, spacing | 13 CCR 1276 | ✓ | | ✓ | | 49. Brakes-general | VC 26301-26522, 13 CCR 1245, 1246 | ✓ | | ✓ | |
| 21. Emergency exits | 13 CCR 1282, 1283, 2184 | ✓ | | ✓ | | 50. Service brakes | VC 26453 | ✓ | | ✓ | |
| 22. Warning devices-floor-level doors behind driver | 13 CCR 1281.1 | ✓ | | ✓ | | 51. Emergency stopping system (air brakes) | VC28508 | ✓ | | NA | |
| 23. First aid kit 24 units | 13 CCR 1243 | ✓ | | ✓ | | 52. Parking brakes | VC28451 | ✓ | | ✓ | |
| 24. Fire extinguisher 10 B:C rating | 13 CCR 1242 | ✓ | | ✓ | | 53. Wheelchair school buses | | | | NA | |
| 25. Emergency reflectors | 13 CCR 1292 | ✓ | | ✓ | | 54. Entrance, exit doors | 13 CCR 1293(c) | ✓ | | NA | |
| 26. Headlamps | VC 24400 | ✓ | | ✓ | | 55. Emergency exits | 13 CCR 1293(d) | ✓ | | NA | |
| 27. Turn signal lamps | VC 24951, 13 CCR 1288 | ✓ | | ✓ | | 56. Aisles | 13 CCR 1293(a) | ✓ | | NA | |
| 28. Taillamps | VC 24600 | ✓ | | ✓ | | 57. Loading device installation | 13 CCR 1293(e) | ✓ | | NA | |
| 29. Clearance, sidemarker lamps | VC 25100 | ✓ | | ✓ | | 58. Wheelchair securement devices | 13 CCR 1293(f) | ✓ | | NA | |

Other mechanical defects 13 CCR 1232(a) Page 1 of _____

| INSPECTION OFFICIAL | ID NUMBER | DATE | CERTIFICATION DATE | REINSPECTED BY | ID NUMBER |
|---------------------|-----------|------------|--------------------|----------------|-----------|
| R. PEREZ | A13299 | 01/16/2014 | 01/16/2014 | | |

Use Previous Editions

0294_0909.pdf

ZEV-9 CHP 294 School Bus Initial Inspection Report

No violations or defects found on the Trans Tech/Motiv SSTe model eBus initial CHP inspection

The certificates shown in the photos below are from ZEV-9. This is the FMVSS, Federal Motor Vehicle Safety Standard Certification and Data Plate that must be displayed – 13 CCR 1272



Sections from CHP Handbook 82.7:

The Department of the California Highway Patrol has the Responsibility to adopt rules and regulation designed to promote the safe operation of school buses.

(34501.5 and 34508 VC).

The California Highway Patrol is also responsible for:

Inspecting and certifying school buses at least once each year to ascertain whether the construction, design, equipment and color comply with all provisions of law (2807 VC).

Inspecting driver records and school bus preventative maintenance and inspection records (2807.2 VC and 13 CAC 1202).

Interpreting and enforcing laws and regulations governing the construction, design, equipment, color, and safe operation of school buses (34501.5 and 34508 VC).

Required Regulations – 34500 VC. The following section is quoted from the VC:

34500. The Department (CHP) shall regulate the safe operation of the following vehicle:

(c) Buses, school buses, school; pupil activity buses, youth buses and general public paratransit vehicles.



Central Valley Electric/Hybrid School Bus Demonstration Project Outreach

Due to the manufacturing failure of the first Trans Tech electric school bus (known as the eTrans) with their electric chassis builder, the sharing and demonstration of these electric school buses with other California school districts did not occur. Time that would have been available to successfully achieve a long run of home to school student delivery time on routes operating in both Kings Canyon Unified and other school districts with the Central Valley and Northern California was lost. It was both regrettable and frustrating to see a unique all electric school bus fail, however where one door closes another opens. This is the story of part of that new electric powered school bus journey. Many people have been on this eBus ride with me.

Our School District sharing/demonstration and data collection did not occur with other schools. This was due to a manufacturer's failed attempts, this did not provide the needed and ordered electric school buses. This caused time setbacks within the project window of opportunity. Additional time was lost on the project while working to find and develop another more suitable new electric school bus alternate that too was new to the school bus industry market.

To reach as many public interests with news of an alternative fueled school bus Kings Canyon Unified sought the help of ARB. There was a need to modify the project so that Public Outreach and Clean Air Electric Vehicle sharing through ride and drive events could become a major focal point of this product development, acceptance and commercialization success in the remaining project time.

Listed below are the Public Outreach and Share, Ride and Drive Events the Kings Canyon Unified Electric School Bus Participated at within California.

February 8, 2014 Our eBus was transported to Creative Bus Sales in Chino for body shop maintenance and prepared for the South Coast AQMD visitation.

February 14, 2014 Attended the South Coast AQMD for a Ride and Drive Staff Demonstration,

Introduction of this Trans Tech SSTe electric school bus was made to the Creative Bus Sale Staff. The eBus was driven from Chino to South Coast AQMD in Diamond Bar by way of I-60 and I-57 freeways. Surface streets with steep grades were used around the AQMD facility to demonstrate the power and grade ability of this all electric school bus to the Air District Officials who rode aboard this new eBus. The staff officials were pleasantly surprised by the consistent speed of electric drive motor's torque while climbing and the holding power of the regenerative braking on the hill descent. They commented on the quietness and smoothness of this Trans Tech SSTe school bus. They were interested in the future Kings Canyon Unified 3rd and 4th units being ordered with wheel chair lift capability and desired more information on the seating and capacity configurations. Our eBus was found to be extremely maneuverable for their urban foothill area. They specifically asked about obtaining a larger capacity eBus in the future for their South Coast school districts and to serve in a future test program. The eBus was then driven back to the Creative Bus Sales facility over the Chino Hills surface streets to further demonstrate the capabilities and performance. This trip was approximately 56 miles round trip saving nearly 9.5 diesel gallons of fuel and producing zero emissions.



South Coast AQMD Officials stand proudly beside the new Trans Tech SSTe eBus

Comments written from Joe Angeli, School Bus Sales Manager at Creative Bus Sales following South Coast AQMD visit:

Hi John,

My sales team and I are very much looking forward to marketing and selling the TransTech SSTE electric bus powered by Motiv Power Systems. The few years that have passed since we worked on the eTrans/Smith Electric project together and the industry has seen tremendous advancements in electric vehicle technology. I'm a big fan of electric vehicles...especially buses.

I think our first demo at the South Coast AQMD went well. It started off at our shop with a big question mark when the bus wouldn't start. But after a few minutes of technical support with the Motiv folks, our technicians were able find the shorted fuse wire, install a \$3 part and we were on our way. The bus ran great on the freeway in transit to the AQMD, many demos with Ranji and associates around Diamond Bar, and then back to the shop with plenty of SOC to spare. As impressed as Ranji and his associates were with the performance up and down the hills of Diamond Bar, no one was more impressed than me. Having lived through the eTrans/Smith Electric launch, I was understandably skeptical. But after the demos we've done and my visit to Motiv, I am back and 100% in.

Thank you for keeping the faith and dragging me along with you. I truly appreciate your passion and our friendship.

Most sincerely,

Joe



Joe Angeli | School Bus Sales Manager
Creative Bus Sales, Inc.
JoeA@CreativeBusSales.com
O | 800.326.2877 C | 714.801.0838



February 20, 2014 Our first Central Valley Electric School Bus Demonstration Project eBus arrives home at Kings Canyon Unified School District for the first time.

School bus drivers and shop technicians arriving from the afternoon bus runs came to see the return of an electric powered school bus after a long absence with the arrival of this all new Trans Tech SStE electric school bus.

February 22, 2014 Fresno CASTO School Bus Drivers Roadeo - Ride and Drive Demonstration

Our new eBus was driven on this Saturday to the Fresno Area Central Valley California Association of School Transportation Officials (CASTO) sponsored School Bus Safety Roadeo held at the Central Unified School District Transportation Facility, in Northeast Fresno. At these events school bus drivers competed in skilled, timed and scored drive events to show or improve upon their driving skills and abilities. Events included backing, parking, off set alley and turning maneuvers. Over 15 area school district competed with more than 75 drivers as participants.

Our eBus was driven approximately 60 miles to this event via local highways and surface streets. During the School Bus Roadeo area school bus drivers and transportation managers/directors were encouraged to come and drive this electric school bus around the Roadeo Driving Course or to the bus staging lot. I shuttled Roadeo Judges about the grounds during this event. Everyone that came in contact with this eBus liked it, found it easy and quiet to drive. Many stated that would trade their diesel powered school bus for an electric if it was an option. No smelly diesel fumes was one comment made at this event. The local area Creative

Bus Sales representative was on hand helping at this event. We were able to talk with Directors of Transportation about school bus funding opportunities and how AB 118 HVIP funds could make an electric school bus a suitable in many San Joaquin Valley applications with local HVIP plus funding.

These school bus roadeos are held annually with one held in Fresno and Visalia. Area School Bus Training Workshops are held in several of the same locations within the eBus driving range of these worth future outreach events. Kings canyon Unified school bus drivers will be able to take these school buses to these Saturday training and in-service events where other school bus drivers can have the opportunity to see and drive these new electric Zero emissions school buses. Area supervisors often attend these and other clean air events for further future outreach opportunities.



February 24, 2014 Showing at the San Joaquin Valley Air District Ride Event with Staff

Kings Canyon Unified Director of Transportation Jason Flores and I scheduled an appointment to present the fully CHP certified Electric School bus to Nhia Vu and her staff of Air Quality Specialist at the San Joaquin Valley APCD. KCUSD had received a Public Benefits Advanced Transit and Transportation Grant Award in the amount of \$359,000 toward the purchase of two large Type C or D electric school buses. We had given the funding back when our first electric school bus failed to make production. An eBus ride was given to the Valley Air District staff through Fresno surface streets and the adjacent freeway. Nhia informed Jason

that our large electric bus funding was still available as we showed her the CHP 292 certification card on this new electric school bus.

February 26, 2014 The Trans Tech SSTE went on afternoon three School Bus Route with school children for the first time in an all- electric school bus at home in Kings Canyon Unified, this milestone makes headlines. Details of eBus Route Performance noted separately...



This first school bus run began public outreach of a local and personal nature. School bus drivers spend hours with children every day. School bus drivers are often the first school employees to greet children in the morning and the last to say good night at the end of the day. Questions from the children about our electric green school bus began on this very first trip that will lead to future dialog and conversations about air quality, vehicle emissions, energy usage and our environment. This electric school bus and project will lead to further environmental conversations within the classroom. KCUSD will make these eBuses available for

teachers interested in having the eBus visit the near their classroom as a foundation for science and environmental curriculum. We may not know the far reaching impact that this eBus may have upon the career paths that these young children may take as adults, based upon this electric school bus experience riding to and from school.



March 3-5, 2014 On Route KCUSD and Photo Opportunity with Students and Staff

Continued Local Public Outreach occurred at several of our home district school sites with this visitation of our eBus at area campuses for professional public relations photos. News and Public Media Relations organizations were calling for photos of the new eBus that were approved for public display with school children on or around this special green school bus. Kings Canyon Unified Media Relations Erik Valencia became the transportation department's point man to obtain parental permission for these press approved photos with children. Anchorwoman Liz Gonzalez of Fresno television station KMPH 26 interviewed Director Jason Flores with the eBus in the background. The TV Video crew rode upon the eBus and followed as the eBus went on route to obtain file footage for the 10 o'clock Evening News. Even this crew was excited to be onboard and experience this zero emissions school bus for themselves.



March 7, 2014 Governor Brown's ZEV Summit at ARB in Sacramento

The Governor's ZEV Summit held at the California Air Resources Board building in downtown Sacramento was an exciting moment. This was an opportunity that I had declined the prior year as I had no electric school bus to display due to the manufacturer's failure I spoke of previously. Now I felt honored to attend this exciting event and I had the opportunity to share with the attendees and ARB staff, a project that was made possible by the talented men and women of the ARB. They believed and supported Kings Canyon Unified and the ability of our district to bring a new and robust electric school bus to the San Joaquin Valley for our children to benefit from. Our electric school bus was well received.

More attendees and general public chose to come to and look at our eBus, than the two other electric work trucks and a hydrogen fuels City Transit bus parked, for this event next to our Green Electric school bus. Representative from various environmental groups, air districts, environmental agencies and non-profit health groups were at attendance. Shuttle rides on our eBus were provided to ARB staff in the morning and at noon. General public who asked about the eBus were invited to come along for the eBus ride. Clean Cities representatives from the San Joaquin Valley were asked to cancel their taxi and were driven in the eBus to their hotel in Old Town Sacramento, receiving their first electric school bus ride.

March 10 -13, 2014

eBus returns to Motiv for Software updates and Electronics Inspections

This was the first occasion during our outreach opportunities that allowed our electric school bus to return home to Motiv Power Systems. This gave the Motiv Team the opportunity to check the running gear and inspect electronic of the eBus. On the afternoon of March 13th the eBus was driven from Foster City to Richmond approximately 47 miles, all most entirely on the freeways. The performance was fabulous as the traffic was dense, with stop and go congestion, in and around Oakland. The eBus used less that ½ of the battery state of charge as regenerative braking in these freeway conditions was extremely beneficial.



March 14-15, 2014

Bay Area Alt Car Expo Ride and Drive, Conference...Receives US EPA 2013 Environmental Achievement Award for John Clements and Kings Canyon Unified for Electric Bus and Truck Work in the San Joaquin Valley

The Central Valley Electric School Bus Demonstration Project eBus became a focal point at the Bay Area Alt Car Expo. The eBus was placed in a location where all of the attendees and public guests walked past the eBus to attend classes on discussions on electric vehicle deployment and availability. ARB Member John Giaio and CEC Commissioner Jeana Scott spoke at this event. Both had their photos taken with the project eBus at this event. ARB Member Giaio came back to this event on Saturday with his children to see the electric school bus. Many local bay area government agency and elected officials attend the event and viewed our new

electric school bus on Friday. Electric Car Clubs held a rally at this event on Saturday. The General public, particularly children viewed the eBus on the 2nd day of the event. The eBus was well received, with participants wanting to know when these eSchool buses might be available for their communities. I was present along with Motiv staff to provide answers to their questions regarding this vehicle and funding opportunities. Two television news interviews occurred.

March 17- 21, 2014 Our eBus returned back home available for routes in KCUSD



April 3, 2014 California State University Fresno Alt Fuels San Joaquin Valley Collaborative on Electric Vehicles in Modesto

For months leading up to this first of many to come San Joaquin Valley Electric Vehicle Collaborative, a request had been made to have our Kings Canyon Unified Project electric school bus attend this event. This event was the first stakeholders meeting and was attended by Clean Cities representatives, air district officials, public school, community college and university officials, EV dealership and manufacturer representatives, charging system manufacturers and EV owners. The goal was to bring more electric vehicle to our valley region by working together. Kings Canyon Unified was proud to display our electric school bus and participate in this event. Participants were able to ride on our eBus after the event and engage

in conversation on how this eBus might help their valley communities as the work to help attain local emissions goals. The next collaborative meeting will be June 23rd at the San Joaquin Valley Air District offices. This KCUSD project eBus and the New KCUSD EVI Cold Car electric refrigerated truck will be on hand at this event. This ongoing outreach will continue to be part of KCUSD'S continued commitment to local and regional electric school bus outreach to demonstrate this technology to our neighboring school district, public agencies and private interests.



April 7-8, 2014 CEC Visit & Green California Summit in Sacramento

Our Project eBus was invited by request to attend and be placed on the floor of the Sacramento Convention Center for the Green California Summit. This request came from Tim Olson and Freya Arrick of the Sacramento Metro AQMD as I had been invited to lead a panel discussion on the commercialization of electric trucks and buses at this event with representative from Motiv, VIA and EVI. Our eBus was extremely well received. Local and state school district officials came to see the electric school bus. Regional and national Clean Cities representatives were present.

Prior to staging the eBus for this event, I took the eBus over to the California Energy Commission. As I parked the eBus in front of the CEC Building I drew a crowd of on lookers at the curb. It was many of the CEC staff and managers who had heard the backup alarm beeping while I was parking the eBus from their second floor offices. They inspected the bus, came

aboard, and then we went on an electric school bus ride through downtown Sacramento and Freeways. This eBus had been part of their AB118 work with the Motiv Power Systems to assist with engineering and development for this power system. The CEC staff that rode upon this eBus were as excited to ride upon this school bus with their technology as if it were their first day at school and they rode the bus for their first time. The performance impressed them. They expressed appreciation for being able to not only see, but ride upon the fruits of their work. It was a privilege to share our eBus with this staff.

Following the event the eBus would be returned to Foster City in preparation for the next Bay Area Outreach. While being staged at Motiv the eBus would again be re-inspected and additional software upgrades would be uploaded into our eBus.



April 24, 2014 Silicon Valley Driven, Charged & Connected in Palo Alto

This event was sponsored by the Silicon Valley Leadership Group. Our Electric School Bus was sought after by this this collaborative. This was an all-day event with a Ride and Drive component. Our electric school bus was present with representative electric vehicles from Mercedes, Chevrolet, Cadillac, BMW, Fiat, Toyota, Nissan and Tesla. We provided rides over a two mile loop in Palo Alto that included hills and grades showing perspective purchasers the capabilities of the eBus. Several private Silicon Valley Schools Superintendents were interested as their schools serve as Green Curriculum schools and they currently shuttle students between campuses. A fleet representative from Google, Sam Mateo County Fleet (drove) and San

San Francisco Department of Environment rode on the eBus. The interest level at this event was very high. Eventually contact follow-up visits would come from this event.



May 1, 2014 San Francisco City Environmental Department Staff City eBus Tour Demo Ride

As a result of a contact from our previous Palo Alto event we received a warm invitation to share the project eBus with the City of San Francisco's Department of Environment. They wanted a first-hand opportunity to truly see this unique all electric school bus perform in their city street conditions. This was also yet another opportunity to travel into San Francisco from Foster City in local street and freeway conditions and put this bus to extreme tests with an audience. I was accompanied by Motiv marketing staff and management, as well as a software engineer who monitored the eBus operating conditions continuously. The SF City staff boarded downtown on Market Street. I took them to the oldest school in San Francisco on Jackson near Hyde Street, next down Lombard to demonstrate the regenerative braking and up the steep California Street before returning them to their offices. On this day our eBus traveled about 58 miles and we returned with over 20% SOC remaining within our batteries. This team expressed interested in the repower to electric drive for mobile command centers, ambulances that stay within the city, book mobiles and medium duty public works utility vehicles. They seek grant funding to make this a reality.

This team is also interested in alternative fuels city catering trucks. I introduced them to a Pizza Bus concept currently being used in New York.

May 19-20, 2014

San Mateo/Foster City Schools Demo Rides



On May 19th by their invitation after seeing our eBus in a trade journal we shared our eBus with representatives of the San Mateo-Foster City School District, First Student-SF Branch and the San Mateo High School District. We took them for an hour ride in the eBus around their school district city streets and up the Hwy 92 grade between Hwy 101 and I-280. The First Student Director wanted to see the power and grade ability of the eBus. Our eBus from my experience would pull this grade at a constant and consistent 30 mph and then hold to under 50 mph on the down grade with no use of the foot brake thanks to the regenerative braking. The maneuverability on the tight urban streets impressed them. The uphill grade speed was a concerning factor for First Student. This could be remedied with a fifth battery placement on future models of this electric school bus. On the following day, the MOT of San Mateo Foster

City Schools returned to Motiv for a facility tour and another eBus Ride. He received eBus quotes and additional funding opportunity information.

May 28, 2014 Our eBus returns from Bay Area Schools Demo to KCUSD

Our Public Outreach was an extreme success. Several thousand individuals have seen or ridden on this zero emissions school bus within a short window of opportunity. More phone calls and emails continue to come in. Calls for the eBus to attend more events continue to come into to us. Unfortunately, our ability to transport the eBus beyond the battery range is limited by our grant project funding. Requests for the eBus to return to events in Sacramento and Southern California are occurring. Some of these events may be possible as delivery of our 3rd and 4th eBuses will arrive in the Fall of 2014. These eBuses may be routed through neighboring states that desire to see these electric school buses attend their regional Clean Cities events.

On Going Press and Media Coverage as Electric School Bus Outreach

Hundreds of print media articles and press release have occurred as result of milestones met by this project. These include the eBuses being built by Trans Tech and Motiv, the successful CHP certification and the day the eBus was first on route with children. Attached you will find media coverage by radio, television and print media. Lisa Ann Pinkerton of Technica Communications assigned to work with Motiv Power Systems and Trans Tech Bus has estimated that our Electric School Bus project has received 229 items of coverage in print either from press releases or original articles.

Interviews and calls of interest continue to come on a weekly basis desiring more information on the success of this electric school bus related to energy efficiency, emissions reduction, operational savings, likes and dislikes and even the question, "Why are you doing this?"



Early June 2014 Second Trans Tech/Motiv SStE sister eBus arrives in California.

This public outreach continues as the second eBus is road and field tested, CHP certified and readied for the August 2014 start of the new 2014/2015 school year. Time will be spent training the assigned route school bus drivers. The KCUSD service technicians whom may be called upon for a road service call will meet the Motiv Technicians for an interactive training session.

These eBuses will be available to the San Joaquin Valley Clean Cities Coalition for Ride and Drive Event in the Central Valley to meet the demand for further outreach.



The further success of this and other Electric School Bus Demonstration Projects will now be determined by the real life/real time on the eBus daily route experiences and the further support provided to this project.

This project will continuously be monitored by this grantee-project manager and consultant to KCUSD and advisor to Motiv Power Systems.

I want and desire for this project success to lead to the success of the next larger electric OEM school bus development.

The Public Outreach will continue every day in the 2014/2015 school year as these new Type "A" Trans Tech /Motiv SStE model electric school buses begin their journey in daily student home to school delivery in the Kings Canyon Unified School District!



6/10/2014 JDC



Route Performance Transporting Students

February 26, 2014 Our 1st Day that ZEV 9 goes on route:

The 1st new Trans Tech SSTE Model Type "A" electric school bus went on route at Kings Canyon Unified. The bus was driven on the first afternoon school to home route in the Great Western (K-5) Elementary School and Navelencia (6-8) Middle School areas. These schools are approximately 6.5 and 13 miles north of Reedley, California in the heart of the San Joaquin Valley.

The very first group of students to ride upon this new eBus were four kindergarteners. These students went home to 3 rural bus stops at their residences over a nine to ten mile run from their school. The eBus ran very quietly and smoothly. The regenerative braking minimized the use of the service brake. The average run speed driven with the eBus was 40 to 45mph. The eBus was driven on paved single and double lane roadways in the rural setting with intersection stops every mile to half mile.

The second group of students to board the eBus attended from Navelencia Middle School. These students were to be shuttled over to Great Western School that serves as a hub school bus transfer location. The eBus reached the 25 seat maximum capacity. Some students then had to ride upon other larger transfer school buses. As the eBus pulled out from the school fully loaded it began to shudder and stalled at slow speeds. The eBus electrical system was turned "OFF" with the ignition key, then turned back to the "ON" position to restart the bus. Power was restored, but the eBus showed limited and slow movement. I stopped the eBus and transferred these children to another diesel school bus. These middle school students were upset that they were unable to complete the run on this new eSchool Bus.

I again restarted the eBus by recirculating the 12 volt battery by switching the master shut "OFF" and then switching the master shut off back to "ON." The eBus immediately responded and performance resumed normal. I went on to Great Western School within minutes to prepare for my 3rd round of students. This was the first day ever that our eBus had been driven in a rain storm. I was concerned that the shudder issue was moisture related. This was reported to Motiv Power Systems technicians. I later discovered that a loose electrical connection existed near a battery controller and that the 12 volt system that operated Ford components may have low voltage.

The third run of the day consisted of 16 students going to 14 school bus stops over a 14 mile area out from the school in rural farmland. The eBus continued to run smoothly and quietly. Student wanted to know why this bus was smaller, so quiet and had green bumpers and wheels. I explained to the students that this school bus was all electric battery powered and had no diesel engine. Their regular school bus is a larger CNG school bus with seat belts.

Day 1 Table: Miles traveled = 45

Diesel reduced by using the electric school bus = 7.6 DGE*

Students Transported on 3 afternoon School to Home Runs = 45

School Bus Stops made: = 18

*The KCUSD Diesel Fuel Fleet Consumption is averaged at 6 miles per gallon. Diesel Fuel savings is derived from miles traveled divided by 6 mpg to produce the gallons of consumption saved or reduced.



March 3, 2014:

This was the 2nd day returning the KCUSD Motiv Bus ZEV 9 to the same school site. Today the eBus completed two PM bus runs from school to home and a school shuttle run within the Great Western and Navalencia rural school service territories.

At 2:00 nine K through 3rd graders were transported home to 7 school bus stops. The children who rode with me on the previous day asked me to honk the horn on the eBus because their mothers could not hear the school bus coming. This eBus is virtually silent and the children normally ride on a CNG or Diesel bus with louder engine noise. I then realized that the Children's farm dogs were not getting up and chasing this eBus like they would a regular school bus.

At 2:45 PM I returned to Navelencia Middle School where I packed out to the 25 passenger capacity. The children asked me if the eBus would make it today after our shutter bug incident on the previous day. As their driver I assured them we would complete the ride. A KCUSD Shop Technician came out to the school and followed the eBus to the next school transfer point. Data was being gathered on a lap top to provide to Motiv from a technical journal download of the eBus trips. These downloads would occur when the eBus returned to the KCUSD Transportation shops. The eBus performed well, with a full load of Jr. High students at speeds of up to 55mph were attained while on this nearly 7 mile shuttle.

At 3:08 students were off loaded from the transfer run and my final run students were loaded. I had 14 students going to 14 stops today over about a 14 mile region. The bus handled smoothly and I used very little service brake except at the final 20 feet of stopping when using the regenerative braking system. This eBus is designed to have variable regenerative brake settings. While this eBus does not have a transmission, there is a touch pad "P" for the eStop Park Brake, "N" for Neutral, "D" for Drive and "1," "2" & "3." By pressing the numbers on the touch pad the intensity of the regenerative braking can be increased or decreased lessening the need to use the foot brake. This feature will lengthen the life of the standard wheel operated brakes through the foot pedal.

Day 2 Table: Miles traveled = 46

Diesel reduced by using the electric school bus = 7.6 DGE

Students Transported on 3 afternoon School to Home Runs = 48

School Bus Stops made: = 21



Local TV Media Staff follows the eBus on route & interviews parents and students the 2nd day!

March 5, 2014:

This was the 3rd day returning the KCUSD Motive Bus ZEV 9 to the Great Western/ Navelencia service areas. Today the eBus completes the same two PM school to home bus runs and a school shuttle run. On the way out to the school I encounter a thunderstorm. As I used the defroster the eBus power shuts down and the eBus loses speed. I discover this several times into the run prior to kids coming on to the bus. I am able to replicate the power shut down. The reduction in charge remaining is attributed to use of defroster fans and wiper accessories.

Day 3 Table: Miles traveled = 46**Diesel reduced by using the electric school bus = 7.6 DGE****Students Transported on 3 afternoon School to Home Runs = 47****School Bus Stops made: = 19**

ZEV 9 in position to receive Orange Cove children for their 1st ride home in an eSchool bus

March 19, 2014:

The eBus ZEV 9 goes on Route within the City and Rural Areas of Orange Cove for the first time. This afternoon consisted in traveling from Reedley to Orange Cove approximately 24 miles round time to pick up the students. Then completing 3 bus runs. Kindergarten children were transported across the community at several neighborhood bus stopped, followed by two more runs to transport rural middle school and high school children home.

This was the first time to carry high schoolers home. Some were fascinated to hear it was an all battery electric school bus.

Day 4 Table: Miles traveled = 63

Diesel reduced by using the electric school bus = 10.5 DGE

Students Transported on 3 afternoon School to Home Runs = 22

School Bus Stops made: = 23

March 26, 2014:

This day the eBus just covered a middle school shuttle and 3:10 Great Western Elementary school run in familiar area. The bus was running very strong and smooth. Felt like a big oversized golf cart. All of the school bus functions were operating normally.

Day 5 Table: Miles traveled = 21

Diesel reduced by using the electric school bus = 3.5 DGE

Students Transported on 3 afternoon School to Home Runs = 38

School bus Stops made: = 14

April 4, 2014:

On this day I returned with ZEV 9 to the original school that I served the 1st day, and replicated the same afternoon runs as the regular driver was out ill. One little student stated that she did not want to ride on the small special bus with the green bumpers. Then the other students chimed in to say they liked this small bus. I shared that the bus was special as it was electric powered and that I was getting to take them home. The eBus ran smoothly. Most of the little bugs have been corrected by Motiv. By now I have served this rural region of KCUSD five times and the parents waiting for their children are used to seeing this Green Electric School Bus in their area.

Day 6 Table: Miles traveled = 46

Diesel reduced by using the electric school bus = 7.6 DGE

Students Transported on 3 afternoon School to Home Runs = 46

School Bus Stops made: = 19

ZEV-9, the Project eBus operated successfully on six afternoons transporting students in grades Kindergarten through 8th grade. All of the items required for passenger safety on this electric school bus functioned similarly to a diesel powered school bus. These required items needed to transport students include the pupil passenger seating with three point restraint seat

belts, passenger windows, front entrance door, amber warning and red crossover lamps. The driver's compartment functions as any other Type "A" Ford Cut-away chassis school bus. Differences with our eBus would include the fuel gauge showing the State of Charge rather than liquid fuel capacity. In the place of the tachometer is a gauge indicating the amperage leaving the drive batteries or regenerative power from the braking system returning to the drive batteries. Cab area heater and air conditioning functions as normally through the regular driver operated knobs and switches. To simplify describing how this electric school bus drives would be to simply say it drives like a large golf cart. Due to regenerative braking features this eBus holds back on grades and inclines better than a diesel bus with a transmission retarder. Driver proficiency will be necessary to familiarize new drivers with the electric school bus differences in instrument functions and driving characteristics.

Initial Project Route Data for the Electric School Bus - Summary Table:

| | |
|--|---------------------------------------|
| KCUSD eBus on 6 Days of Route Service: | 2/26, 3/3, 3/5, 3/19, 3/26 & 4/4/2014 |
| Total Miles Traveled in 6 days: | 267 miles |
| Total Diesel Reduced: | 44.5 DGE savings |
| Total Number of Students Transported: | 213 |
| Total Number of School Bus Stops: | 114 |

267 route miles divided by 6 miles per gallon* = 44.5 gallons
 44.5 gallons X \$4.00 per gallon of diesel fuel = \$178 in diesel cost for 6 days
 \$178 divided by 267 route miles = \$0.67 per diesel driving mile of operation

Cost of Electricity per kWh varies with time of day usage as the eBus recharges
 The Electric School Bus is expected to consume 1 kWh per mile traveled based on real time data on actual Motiv Power Systems vehicle specifications and field testing

Kings Canyon Unified electricity rates:

- Off Peak = \$0.07/kWh or cost per mile**
- Partial Peak = \$0.10/kWh or cost per mile**
- Peak = \$0.14/kWh or cost per mile**

267 route miles x 1 mile per kWh @ Off Peak = \$0.07/kWh = \$18.69 kWh for 6 days
267 route miles x 1 mile per kWh @ Partial Peak = \$0.07/kWh = \$26.70 kWh for 6 days
267 route miles x 1 mile per kWh @ Peak = \$0.14/kWh = \$37.38 kWh for 6 days

44.5 diesel gallons of fossil fuel usage reduced

Cost of Diesel for 6 afternoons on route = \$178 or \$0.67 per mile

VS.

Cost of Electricity for 6 afternoons on route = \$18.69 or \$0.07 per mile Off Peak

Savings = \$0.60 per mile X 14,000 annual KCUSD average route mileage = \$8,400 savings

Estimates show a 90% fuel cost savings when using Off Peak electric recharging and 80% fuel cost savings when using Peak electric recharging

Current Total Miles on ZEV-9 = 967 miles

Had ZEV-9 been a diesel powered school bus at 6 mpg* would have consumed 161 gallons

161 diesel gallons X \$4.00 = \$644.67 in fuel cost or 967 mile/kWh X Off Peak \$0.07 = \$67.69

or 967 mile/kWh X Partial \$0.10 = \$96.70

or 967 mile/kWh X Peak \$0.14 = \$135.38

Diesel Fuel Cost @ \$644.67 Or Electric Fuel Cost @ \$67.69 off peak/\$96.70 partial peak/\$135.38 peak

- Kings Canyon Unified average annual route miles traveled 14,000 per bus
- 14,000 divided by 6mpg = 2,333 gallons
- 2,333 X \$4.00 = \$9,333 per year
- \$9,333 divided by 180 days of school service = \$51.85 per day fuel rate
- \$52 per day fuel cost
- Many school buses in our fleet get less than 6mpg

Average Fuel Cost of Diesel Buses

Fuel Savings Range to operate an Electric over Diesel Powered School Bus is between:

\$576 off peak to \$509.29 peak to travel the first 967 mile on the Project's first all-electric school bus

These Diesel Fuel estimates do not include diesel fuel consumed during daily pre-trip and post-trip inspections with school bus idling to

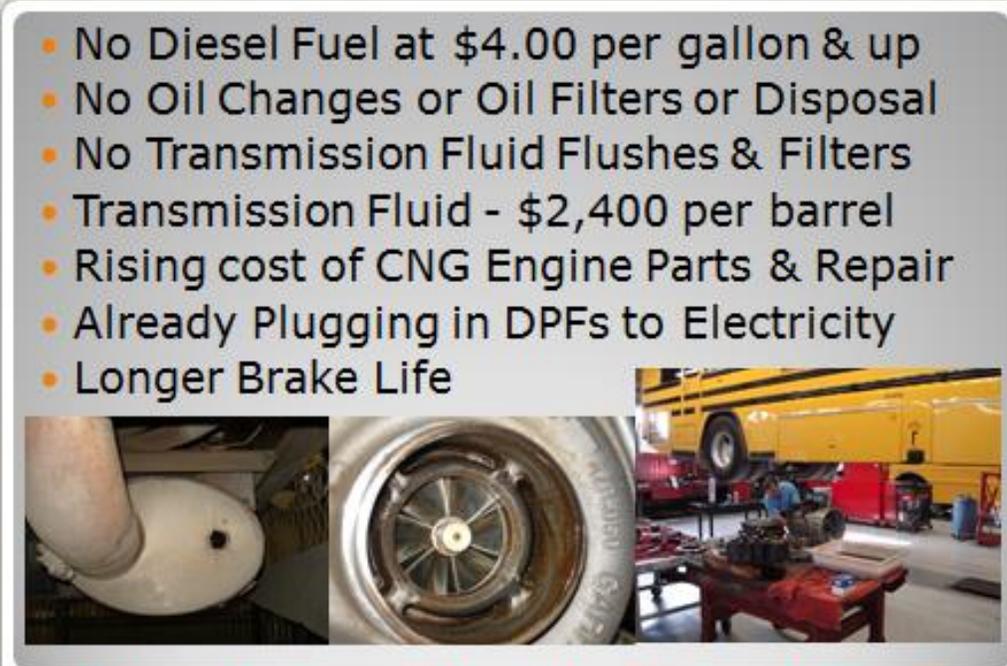
build up air pressure and check lights and safety features. One hour of daily idle time is estimated to equal one additional diesel fuel gallon consumed per day

The Electric School Bus only needs limited petroleum products:

- Chassis Lube
- Rear Axle Fluid
- Power Steering Fluid
- Brake Fluid

The electric school requires NO:

- Engine oil \$2 to \$4 per quart
- Transmission Fluid \$2,400 per drum
- Air Filter \$40 to \$50, Oil Filter & Transmission Filter \$5 to \$15
- No Hazardous Waste Disposal of old filters or fluid



- No Diesel Fuel at \$4.00 per gallon & up
- No Oil Changes or Oil Filters or Disposal
- No Transmission Fluid Flushes & Filters
- Transmission Fluid - \$2,400 per barrel
- Rising cost of CNG Engine Parts & Repair
- Already Plugging in DPFs to Electricity
- Longer Brake Life

Why Not an Electric School Bus?

*6 miles per gallon for diesel fuel consumed is the KCUSD school bus fleet average

The electric charge rate is the actual rates for the KCUSD Reedley High School Campus

Future Data Collection in 2014/2015 School Year with eBuses

The Great Western/Navalencia Schools service area will likely be the targeted route placement for ZEV 9 for the coming 2014/2015 School Year. This route has many stops and starts, with approximately 14 school bus stops made multiple time throughout the day and services two schools with multiple four-ways stop signed intersections. These many stops and starts help extend our charge range on this flat route terrain, through the use of regenerative braking.

ZEV 72 eBus will likely go to a route transporting students with special needs attending schools 5 to 10 miles outside the Kings Canyon Unified system. Longer high mileage eBus routes with fewer stops running at higher speeds traffic speeds will reduce the daily battery state of charge more quickly than stop and go eBus routes. During the 2014/2015 school year, comparison data will be provided to ARB with the intent of comparing differing school bus use cycles.

Only total daily school bus combined bus run mileage for home to school transportation is gathered for the combined route. The eBuses will make multiple runs daily. Example, a 1st AM run, 2nd AM run, kindergarten mid-day run, a 2:00 intermediate grade run, a 2:50 shuttle and a 3:00 upper grade run and perhaps an evening after school program run at 5:00 or 6:00 PM

The individual runs are noted to show the bus usage throughout the day. School districts do not typically track the mileage for individual runs unless a special category of funding is requesting that run mileage for their program. Daily combined bus runs are tracked as a total for the driver and their assigned school bus as total daily mileage. This daily mileage is then combined as an annual total for the year minus any activity trips to receive some portion of the California Dept. of Education apportioned home to school funding reimbursement.

For the purpose of this initial demonstration of the eBus, ZEV 9 was assigned to me as the primary driver to transport the first students in the school district. I ran afternoon runs only as portions of daily routes that needed afternoon drivers coverage due to illness, or activity trip coverage and on routes that were hand selected for our eBus capacity.

This first eBus has a comfortable 65 mile operational range using 4 – 20 KW Nickel Sodium Chloride battery packs. Recharging will occur at night. Some optimal recharging may occur between 8:00 AM and 11:30 AM to extend range and keep costs lower. Daily anticipated

charging cost is expected to be \$16 at low peak to \$17 at a higher peak electric use demand charge per day.

Daily mileage, hours of operation, number of students, school bus stop information, battery electric state of charge at the beginning and end of the day, mechanical defects and prescribed repairs are all expected to be available during the upcoming 2014/2015 school year with ZEV 9 & ZEV 72 in service.

It is anticipated that eSchool Buses ZEV 73 & 74 will be in service near December 2014 or January 2015. These long anticipated additions to the KCUSD fleet too will be added to the KCUSD Data collection anticipated to be provided to this AQIP AB 118 Electric School Bus Demonstration Project.

As local San Joaquin Valley Air Pollution Control District, San Joaquin Valley Clean Cities and CSUF SJV Electric Vehicle Collaborative Clean Air events occur throughout the Central Valley these AQIP funded electric school buses will participate as they can be driven to these events.

Should eBus transportation funding or sponsorship become available additional public outreach will occur outside the San Joaquin Valley. These eBuses would be available to share with other school district transportation officials, school administrations and school governing board members of interest.



ARB Member John Gioia stands proudly beside the Kings Canyon Unified Electric School Bus when on display for Public Outreach at the Bay Area Alt Car Expo in Richmond on March 14, 2014. Mr. Gioia brought his own school aged children back for the 2nd day of this event to come aboard this eBus at the Expo.

Conclusion - The Electric School Bus Journey has only Begun...

This Central Valley Electric School Bus Project is not completed. While our contract time is at an end and most project milestones were met with some success, more data sets comparing the use of an electric powered school bus to other alternative fuel type and different types of diesel engine powered school buses still needs to occur.

The opportunity to share these electric school buses did not occur due to time limits as a result of the previous electric chassis manufacturer's failure to complete testing beyond a prototype. School districts still inquire and have desire to route test electric and hybrid school buses risk free in their own district environments. These new technology school buses are not available as sales demonstrator school buses as they are expensive and currently few in number.

The two Kings Canyon Unified Trans Tech/Motiv SSte model all electric school buses obtained through this ARB AQIP school bus demonstration project are the first two electric Type "A" 25 passenger electric school buses in the World!

These electric school buses have and did meet CHP and FMVSS approval certifications. The electric school buses can now serve the students of California and the Nation.

The electric school buses from this project are zero emissions production models that produce NO tail pipe emissions compared to an internal combustion powered traditional school bus.

In the 967 miles that ZEV-9 has traveled during field testing and student route delivery, this first eBus reduced diesel fuel usage by 161 gallons based on 6 miles per gallon KCUSD school bus average, at a cost of \$644.67 based on \$4.00 per gallon diesel fuel price. The saving through electricity powering our eBus over this travel period was between \$576 off peak and \$509 peak rate charge.

This good news will only improve as solar covered bus port parking structures are considered in the future and more electric school buses come to Kings Canyon Unified for demonstrations and proving.

Public awareness of this electric school bus through Outreach opportunities and speaking engagements did occur. Participants at Clean Air Alternative Fuel expo and summit events have shown good interest and accepted rides on the eBus. Students, parent, teachers, administrators and public officials have been accepting of this quiet green zero emissions school bus within their school district and local communities.

Kings Canyon Unified has issued purchase orders and made an initial deposit payment toward the purchase of the 3rd and 4th Type "A" electric school buses with wheel chair accessibility. Funding has been awarded to Kings Canyon Unified from the San Joaquin Valley Air Pollution Control District Advanced Transit & Transportation Public Benefit Grant to obtain the next larger Type "C" capacity electric school bus currently in design and development.

The hope will be for Kings Canyon Unified to seek further AQIP Demonstration Project funding in the future to bring electric school buses into common acceptance. The desire is to continue to contribute to further data collection studies and provide a series of public school district locations in several air districts with several types of electric school buses strategically located within disadvantaged communities within California for the benefit of our school children.

Stay Tuned...for this electric school bus journey has just begun...