LONG BEACH
TRANSIT

Agenda Item No. 13
April 27, 2015

SUBJECT
Battery Electric Bus Procurement

RECOMMENDED ACTION
To authorize the President and CEO to enter into a contract with BYD Motors, Inc. (BYD) for the purchase of 10 battery electric buses (BEB), supporting charging systems, training, and required equipment, for a total authorization not to exceed $11,069,319. The recommendation also includes contract options for 14 BEB for future consideration by LBT and additional options for 36 BEB for Anaheim Transportation Network and Gardena Municipal Bus Lines.

BACKGROUND

Overview

In August 2010, the Board adopted an alternative fuel strategy to pursue gasoline hybrid-electric and Compressed Natural Gas (CNG) buses and funding for a zero-emission bus project. At that time, LBT purchased 89 gasoline hybrid-electric vehicles. Since then, LBT installed a CNG station at its 68th Street facility and purchased 85 CNG buses. LBT also secured funding to purchase up to 10 zero-emission, all-electric buses and charging equipment from the Federal Transit Administration's (FTA) Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER III) Program, California Proposition 1B bonds and the Port of Long Beach's Greenhouse Gas Emission Reduction Mitigation Grant Program.

Initial Request for Proposal (RFP)

In October 2012, an initial RFP was issued to the industry. Multiple proposals were evaluated, a vendor was selected, and a contract was awarded in March 2013. Several months later, LBT received notification from the FTA that the vendor was ineligible to receive federal funds for lack of a Disadvantaged Business Enterprise (DBE) certification. As a result, LBT and the vendor agreed to a mutual cancellation of the contract, which on recommendation of the President and CEO, the Board ratified in March 2014.

Current RFP

On September 22, 2014, the Board authorized the President and CEO to re-solicit a Best Value RFP for the purchase of BEB. The RFP was issued on September 23, 2014.

PROCUREMENT

The current RFP was issued to purchase up to 10 BEB with options, the associated charging and support equipment. LBT received and evaluated eight proposals from three vendors: BYD

Motors, Inc., New Flyer of America, Inc., and Proterra, Inc. The proposals provided a variety of technology options and prices ranging from $9.5 million to $11.6 million.

Company	Model	Battery Pack	Depot Charger	On-Route Charger
Proterra	Catalyst FC	108 kWh	-	500 kW Overhead
	Catalyst XR	259 kWh	50 kW	50 kW WAVE
	Catalyst XR	259 kWh	50 kW	100 kW Overhead
New Flyer	XE40	100 kWh	-	300 kW Overhead
	XE40	200 kWh	100 kW	300 kW Overhead
	XE40	300 kWh	100 kW	-
BYD	K9	320 kWh	80 kW	-
	K9	320 kWh	80 kW	50 kW WAVE

The evaluation of proposals was conducted in accordance with criteria in the RFP which included vendor experience, bus technical design, charging station technical design, customer and community considerations, maintainability, product support, price, and life-cycle costs. The evaluation process was conducted in three phases, as follows:

1. **Responsiveness and Responsibility Review**
   The LBT Purchasing Department conducted a preliminary review of each proposal to determine if the proposer met the responsiveness and the responsibility criteria. Purchasing verified that each proposer met federal requirements and certifications as follows:
   a. Disadvantage Business Enterprise
   b. Federal Motor Vehicle Safety Standard
   c. Buy America Certifications
   d. Federal Bus Testing

2. **Proposal Review**
   Technical: Each qualified proposal was reviewed and scored by three teams representing multiple departments within LBT. The teams read each proposal, deliberated and considered an independent technical analysis conducted by the Center for Transportation and the Environment (CTE), the program management support consultant. The technical analysis included bus and route modeling and fuel (electricity) consumption modeling that fed into the life-cycle cost analysis.

   Pricing: The results of the life-cycle cost analysis on each proposal were presented to the evaluation teams for inclusion as part of the price and costs assessment.

3. **Final Assessment**
   Proposals were further reviewed after receiving clarifications and product demonstrations by each proposer. A best and final offer was requested from vendors whose proposals met all LBT requirements and received the highest scores. Purchasing conducted pre-award audits and negotiations resulting in the final terms and conditions presented in this recommendation.

RECOMMENDATION

Based on the results of the evaluations, and receiving the highest overall score, LBT staff recommends awarding a contract to BYD Motors Inc., of Los Angeles, CA.

BYD has built and provided BEB to various countries and began manufacturing buses in the United States in 2014. BYD has delivered 20 buses to the emerging zero-emission American bus market and has established a manufacturing facility in Lancaster, CA.

BYD's proposal was deemed the most responsive and responsible and met LBT's requirements for the zero-emission buses. Apart from meeting the technical, price and schedule requirements of the RFP, BYD offers a 12-year warranty on its vehicle batteries, inverters and traction motors. The warranty on these major components covers the 12-year useful life planned for the buses as required by the FTA.

Purchasing negotiated a final price and terms with BYD for the purchase of 10 BEB with supporting charging systems, diagnostic tools, training, and spare parts, for a total of $9,675,410.

Additionally, LBT staff recommends the purchase of an inductive on-route charging system supplied by Wireless Advanced Electrification, Inc. (WAVE) of Salt Lake City, UT through BYD. The inductive charging system will be located at the Queen Mary bus stop and would supplement the plug-in depot charging system, extending the useful mileage range. The cost for the inductive charging system was negotiated for a total of $926,500.

Finally, LBT is requesting a contingency of five percent for a total of $467,409, which would address any additional technical requirements or unanticipated modifications to the bus, charging system, or charging stations. The BEB Executive Steering Committee will review any requested changes for approval prior to execution of any contingency work.

PRE-AWARD AUDITS

Prior to final negotiation, Purchasing coordinated pre-award audits with the preferred vendor that included:

a) Buy America audit of bus and charging equipment,
b) Independent Safety, Health and Environmental review of the battery system, and
c) Independent Safety, Health and Environmental review of the WAVE system.

The results of these reports show that BYD and WAVE are in compliance with state and federal regulations and that BYD is able to meet LBT's project requirements.

ALTERNATIVES CONSIDERED

The two alternatives staff considered are as follows:

1. LBT staff, with the support of CTE, evaluated a total of eight proposals using the RFP evaluation criteria. Subsequently, LBT requested the best and final offers from the two vendors with the highest ranked four proposals, as shown below:

Rank	OEM	Model	Battery	Depot Charger	On Route Charger	Technical Score	LCC Score	Overall Score
1	BYD	K9	320 kWh	80 kW		870	375	1,245
2	BYD	K9	320 kWh	80 kW	Wave 50 kW	810	318	1,128
3	New Flyer	XE40	300 kWh	100 kW		825	234	1,059
4	New Flyer	XE40	100 kWh		Overhead 300 kW	720	298	1,018

The other four proposals were considered to be higher in financial and service operating costs to LBT. Therefore, staff does not recommend these proposals.

2. The Board could cancel the procurement and not buy BEB, resulting in the forfeiture of the FTA TIGGER III grant funding and, potentially, other state and local funding assistance. Staff advises against this alternative as LBT would lose the opportunity to develop and learn from the zero-emission technology and would potentially risk future opportunities in securing future bus procurement funds.

BUDGETARY/FISCAL IMPACT

The total budget of $13,950,000 is comprised of the FTA's TIGGER III Program of $9,571,429; CA Prop 1B bonds of $3,578,571; and a $700,000 grant award from the Port of Long Beach's Greenhouse Gas Emission Reduction Mitigation Grant Program.

Staff is requesting authorization to enter into a contract with BYD to purchase 10 BEB, depot charging equipment, WAVE inductive charging system, oversight of construction, diagnostic tools, training and spare parts for a not-to-exceed cost of $10,601,910, plus, authorization for an additional $467,409 to address any unforeseen requirements, for a total authorization of $11,069,319.

The contract will also include options for up to 50 additional BEB and corresponding equipment. Future LBT options to be exercised will be brought back to the Board for approval.

K. McDonald

Kenneth A. McDonald
President and Chief Executive Officer

Long Beach Transit
Battery Electric Bus Project

Staff Recommendation

April 2015

Contents

1. Introduction

The purpose of this document is to describe the process used to procure the buses for the LBT Zero-Emission Battery Electric Transit Bus Evaluation Project (Project), including the development of the Request for Proposal (RFP), submission of proposals, technical analysis of proposals, and the evaluation and selection of the recommended solution.

On November 17, 2011, the Federal Transit Administration (FTA) announced that Long Beach Transit (LBT) was awarded a grant under the Transit Investments for Greenhouse Gas and Emission Reductions (TIGGER III) program. The grant awarded 70 percent of the original request, and LBT committed to fund the full project with other funds. In February 2012, LBT applied and was awarded a Port of Long Beach Greenhouse Gas (GHG) Emission Reduction Mitigation Grant to cover the cost of one bus.

The project is to deliver up to 10, 40' battery-electric transit buses to replace conventionally fueled diesel transit buses operated by LBT. The Project is a unique and innovative way to reduce GHG emissions and energy consumption.

In May 2012, LBT hired the Center for Transportation and the Environment (CTE) to provide program management and technical support for the Project. LBT and CTE developed a project work plan that guided the project team through the entire project.

In October 2012, an initial RFP was issued to the industry. Multiple proposals were evaluated, a vendor was selected and a contract was awarded in March 2013. Due to notification from the FTA regarding the vendor's disadvantaged enterprise program ineligibility, a mutual cancellation of the contract was agreed to with the vendor. On recommendation of the President and CEO, the Board ratified the mutual cancellation in March 2014. After multiple meetings, the Board authorized the President and CEO in September 2014 to re-solicit Best Value RFPs as competitive negotiations for the purchase of zero-emission battery electric buses.

2. Market Analysis

The first major task toward the Bus Procurement Milestone was to conduct a Market Analysis.[1] Since a market analysis had been done previously in 2012, LBT requested that CTE update the market analysis to include any changes in the past two years. The market analysis team researched and reviewed the types of electric transit bus technologies available, as well as the transit vehicle manufacturers.

The analysis was limited to battery electric buses, i.e., those buses that are propelled entirely by electric motors powered by electricity from on-board batteries without any on-board range extending power generation. In general, the analysis revealed that the market is immature. Legacy transit bus manufacturers have only recently introduced all-electric products. Current vendors offer a variety of battery configurations and charging methods, including overnight depot charging and on-route charging. Currently, no single approach has been favored by the market and industry standards are still developing.

The LBT project team used the market analysis to draft and issue an RFP.

3. Route Evaluation

LBT decided it was essential to select a route that meets the criteria for electric bus operation, as the travel ranges of current electric buses are limited compared to the travel ranges of diesel or Compresses Natural Gas (CNG) buses. Several criteria were used to determine the routes for an electric bus evaluation. The criteria were based on the current state of the battery, vehicle, and charging technology, as follows:

1. **Route Length:** the round trip route length must be less than 30 miles (including any interlining), or the average daily distance of each block must be less than 120 miles. Based on those criteria, the following nine routes were candidates: Passport, 45, 46, 81, 111, 112, 121, 151, and 171.

2. **Peak Bus Usage:** The project scope included a maximum of 10 buses (eight in service plus two spares), which was assumed would all be placed on the same selected route(s). Thus, further refinement was conducted based on criteria #1 by eliminating routes that use more than eight buses during peak operating hours. As a result, Routes 45, 46, 111, and 112 were eliminated because they require more than eight buses.

3. **Capacity:** It is important to allocate sufficient transit capacity to meet the ridership demand, particularly during the peak period. Routes 81, 121, and 171 experience overcrowding conditions during certain times of the day, based on ridership data. Therefore, those routes were eliminated from consideration.

4. **Electric charging station location**: The selected solution may require a charging station on the route to charge the bus. Therefore, the route must currently have a layover or dwell time of at least 5 to 10 minutes. The potential charging station site should be in an area that is out of normal traffic flow, have space for the necessary charging equipment, and is accessible to high voltage power supply. In addition, construction of the station must have minimal environmental impact. The Queen Mary Event center parking lot on the Passport route is a preferred site for a charging station due to the fact that it is a current layover point, and the site meets the requirements of a charging station. The corner of Pine Avenue and First Street was selected as a secondary site, if necessary, because it also serves as a layover point and is accessible to the Transit Gallery.

Leveraging the previous assessment, the LBT project team focused the current procurement effort on the Passport route. However, the team established that many LBT routes would be compatible for future expansion of an electric fleet.

4. Request for Proposal

The RFP[2] was based on the Standard Bus Procurement Guidelines issued by the American Public Transportation Association (APTA), also known as the "APTA White Book." It is a comprehensive and standardized RFP used throughout the transit industry for bus procurements to ensure a complete response by bus manufacturers.

Using the APTA White Book as a baseline, the LBT Project Team created an RFP that met the specific requirements of this project, as follows:

- The current version of the "White Book" considers diesel, hybrid, and CNG buses, but not all-electric buses. It was necessary to remove references and requirements related to these other fuels and to add specific requirements for a battery electric transit bus.
- LBT planned an open specification based on performance, so the RFP was modified to provide information about LBT's route requirements. The concept of route and rate modeling were introduced in the RFP to ensure that vendors propose the best solution to meet LBT's specific performance requirements.
- Charging equipment is typically specific to the bus manufacturer. LBT required the bus manufacturers to be responsible for integration with the charging equipment required that supports their solution and any software support/programs for managing electricity and charging.
- LBT added best practices to the RFP which included life-cycle cost analysis, asset equipment condition assessments in years one and three, a requirement of an annual audit, a marketing partnership, and options for maintenance of all charging equipment.
- LBT included unique agency requirements for equipment that is standard for all LBT buses to ensure maintainability (i.e., headsigns, radio system, video surveillance, windows, air conditioning, seats, etc.)
- LBT used the procurement guidelines and followed LBT's standard procurement processes.

The timeline of the RFP was as follows:

RFP Issue Date:	September 23, 2014
Pre-Proposal Conference:	October 3, 2014, 10:00 a.m. PDT
Written Questions / Requests Due:	October 17, 2014, 3:00 p.m. PDT
Response to Questions set out by:	October 29, 2014, 5:00 p.m. PDT
Submit Proposal By (Due Date):	November 26, 2014, 2:00 p.m. PST

During the course of the proposal process, bidders requested, and received, an extension of the Proposal Due Date to December 10, 2014.

5. Pre-Proposal Meeting, RFP Question and Clarifications

LBT conducted a pre-proposal meeting for all interested bidders on October 3, 2014. The meeting was also available via teleconference and webinar for those bidders who could not attend in person. More than 40 individuals, in person or via the webinar, representing 30 different vendors and suppliers, participated in the pre-proposal meeting. LBT and CTE gave presentations covering project background, scope, proposal requirements, technical requirements, evaluation process, and evaluation criteria. Potential bidders were provided with an opportunity to ask questions.

Potential bidders submitted written questions and requests for clarification. A total of 275 questions were submitted. LBT issued a written response to all questions on October 29, 2014.

6. Submitted Proposals

LBT received a total of eight proposals from three bidders on December 10, 2014, listed as follows:

Table 1 - BEB Proposals

Company	Model	Battery Pack	Depot Charger	On-Route Charger
Proterra	Catalyst FC	108 kWh	-	500 kW Overhead
	Catalyst XR	259 kWh	50 kW	50 kW WAVE
	Catalyst XR	259 kWh	50 kW	100 kW Overhead
New Flyer	XE40	100 kWh	-	300 kW Overhead
	XE40	200 kWh	100 kW	300 kW Overhead
	XE40	300 kWh	100 kW	-
BYD	K9	320 kWh	80 kW	-
	K9	320 kWh	80 kW	50 kW WAVE

7. Proposal Qualification

Upon receipt, each proposal was reviewed to determine if it met the basic criteria for completeness and responsiveness to be considered eligible for evaluation.

A complete and responsive proposal is one that follows the requirements of the RFP, includes all requested documentation, is submitted in the format outlined in the RFP, is of timely submission, and has the appropriate signatures as required on each document. Proposals must have complied with the following requirements to be considered qualified for evaluation:

- All required federal certifications signed and submitted
- Disadvantaged Business Enterprise (DBE) Certification signed and submitted
- Recognized as a certified Transit Vehicle Manufacturer (TVM) by the FTA
- Federal Motor Vehicle Safety Standards (FMVSS) self-certification signed and submitted
- Buy America Certification for both the Bus (Rolling Stock) and Charging Equipment (Manufactured Product) signed as having met the requirement and submitted
- Federal Bus Testing verification via Altoona Test Report, or proof that testing has started, by the time the proposal was submitted

All proposals reviewed met the completeness and responsiveness criteria and were deemed to be in the appropriate format, were timely, and contained all the required forms and signatures.

The RFP requested proposals be submitted in five packages;

- Package 1 (Proposal Summary)
- Package 2 (Technical Proposal)
- Package 3 (Price Proposal)
- Package 4 (Qualifications)
- Package 5 (Proprietary/Confidential Information)

Packages 1, 2 and 4 were made available to each technical evaluation team and CTE. Package 3 was given to the Finance Department for review and summarization to be done separately from the evaluation teams. Package 5 was not distributed to the evaluation teams but were reviewed by, and kept within, the Purchasing Department.

8. Technical and Cost Analysis

8.1. Bus Modeling and Route Simulation

The Technical Evaluation used simulation analysis[3] to predict the performance of a specified vehicle on a given route. CTE engaged the University of Texas – Center for Electromechanics (UT–CEM) to assist in the Technical Evaluation of proposals submitted. The researchers at UT–CEM worked with CTE and LBT to develop computer models for each vendor's proposed electric bus, then used simulation software to predict the performance of each proposed bus on the Passport route. The simulation models utilized a software application called the Powertrain Systems Analysis Toolkit (PSAT) developed by Argonne National Laboratory.

Bus specifications and vehicle attribute data provided by each proposer was the basis for all bus models constructed by UT–CEM. The accuracy of the models was dependent on the quality of the vendor-supplied data. Some of the data provided was inconsistent or incomplete. If proposals had incomplete or inconsistent information, UT–CEM used publically available information and their previous transit bus modeling experience to define missing or incomplete attributes.

Each vendor provided their own route simulation results for comparison. In performing route simulations, UT–CEM simulated each vendor's modeled bus on a single loop of the Passport route. Specific assumptions regarding passenger loads and auxiliary loads (i.e., air conditioning) were applied to the route simulation generated for each proposal. The energy consumption was calculated and the number of loops per charge was estimated. The amount of time needed to recharge the batteries was determined based on the power rating of each vendor’s battery charger.

The results of the route simulation were used to evaluate how well each proposer’s solution would perform on the Passport route and whether or not the solution would meet LBT’s performance requirements. In review of the results, UT–CEM notes that all bus solutions proposed by the vendors appear to be viable candidates on the Passport route. However, consideration may need to be given to blocking schedules, quantity of buses operating and/or some type of on route or opportunity charging to successfully meet the operational requirements of the route.

The onboard energy storage for each solution provided ample range to complete the route under worst case load scenarios, even with end-of-life battery degradation. The efficiency (kWh/mi) of the proposed solutions all appeared to be on par with one another as well, with the most efficient bus at 2.72 kWh/mi under nominal conditions and the least efficient bus at 2.96 kWh/mi.

8.2. Route Modeling

Route modeling[4] is a continuation of the technical evaluation effort conducted by UT–CEM and CTE. Route modeling uses bus energy efficiency calculated through bus modeling and route simulation to evaluate bus range and assess operational impacts. This analysis is performed to develop an understanding of the charging events and the number of buses required to complete a full day of service.

The bus modeling and route simulation determines fuel efficiency under nominal and maximum loading conditions. This information is the key input for the second phase of the technical evaluation: route modeling. The purpose of route modeling is to determine whether or not the proposed vehicles can successfully operate a given route, at both the beginning-of-life and the end-of-life of the battery.

CTE worked closely with LBT staff to define operational parameters for the proposed buses operating on the Passport route. This data helped to establish the useful capacity of a given battery pack, which was critical for analyzing vehicle range. CTE then used route modeling to analyze performance on a single loop. The principle behind this analysis is that if a bus does not have enough energy storage to run an entire loop without charging at the beginning-of-life and end-of-life of the battery, then it should no longer be considered a viable option for a given route. Finally, CTE uses route modeling to analyze performance over an entire day of operation, based on a given blocking schedule. If the bus cannot complete an entire day of operation for a given route, then the agency may need to consider alternate blocking schedules and/or additional buses to meet the demands of the route.

Route modeling includes the following steps:

1. ***Useful Capacity Analysis***: Determine how much of the vehicle's energy storage can be used for daily operations. The analysis considers maximum operating state of charge, minimum operating state of charge, and agency-defined reserve capacity.

2. ***Single Loop Endurance Analysis***: Determine the ability of a given bus configuration to complete a single loop of the Passport route based on nominal and maximum loading at the beginning and end-of-life of the battery.

3. ***Daily Endurance Analysis***: Determine the ability of a given bus and charger configuration to complete the daily blocking schedule of the Passport route.

4. ***Re-blocking Analysis:*** The re-blocking analysis is a simple comparison of the quantity of buses over time constrained by range limitations. The analysis predicts the number of vehicles required to fulfill a given blocking schedule.

8.3. Rate Modeling

Rate modeling[5] uses energy consumption data provided by the route model, electricity rate schedules provided by the local utility provider, and a charging profile which provides a daily schedule of charging events. The data is used to calculate estimated annual electricity costs to operate these buses. Different buses require different amounts of energy based on their weight and efficiency of components on the bus, and models for vehicle charging (i.e., overnight depot charging vs. on route charging). The cost of energy and demand charges varies significantly depending on the time of day; hence, the charging profile becomes critical in estimating operating costs.

CTE retained Barkovich & Yap, a well-known utility consulting firm based in Oakland, CA to assist in developing the rate model for the LBT electric bus project. Dr. Barbara Barkovich is an electric utility consultant advising utilities and industrial consumers on rate design, demand response and dynamic pricing, electric industry restructuring, and electric resource analysis and planning. The project team also spoke with Southern California Edison (SCE) on several occasions to discuss potential operating scenarios and applicable rate structures.

Rate models were generated for each of the proposed bus and charger systems. These models were used to estimate annual electricity costs based on the route models generated by the project team.

The rate models also incorporate a number of assumptions which dictate how and when charging would take place to derive a probable estimate of energy costs. Key assumptions include the following:

- LBT expects to incorporate a charge management system at the depot; power outages or operational issues could minimize the charging window requiring all vehicles to be charged simultaneously. This will have the effect of driving up energy demand at the depot.

- Two separate charging station locations are required for high power, on route charging. This type of charging is used for bus configurations that require on route charging and the second station is necessary for redundancy. Typically, only one station is used under normal operating conditions.

- LBT assumed that the second charging station may be used once per month when traffic congestion or events cause the primary station to be inaccessible.

- For low power, on route charging, two chargers will be co-located at the same charging station.

As a result, annual costs for electricity range from $145k to $268k across the eight scenarios. The amount of energy used is fairly consistent among the options with variations caused by minor differences in bus and charger efficiencies. The majority of the cost variance is due to differences in energy demand costs. Demand cost is driven by a combination of the number of buses charging simultaneously, the charger's rated power, and the time of day when charging takes place.

8.4. Life Cycle Cost Analysis

In 2010, LBT completed an alternative fuel analysis with West Virginia University (WVU) that included the task of evaluating the full life-cycle costs of CNG, Liquefied Natural Gas, conventional diesel, diesel hybrid and gasoline hybrids. The study utilized the Transportation Research Board Transit Cooperative Research Program C-15 Life Cycle Cost Model to assess the cost implication associated with the procurement of any of these technologies. The study included a brief estimate of Fuel Cell and Battery Electric. LBT used this model[6] to consider the cost of the zero-emission bus solutions proposed.

LBT engaged WVU to conduct this battery electric analysis based on a scope of work as described in the electric bus RFP. The project team provided WVU with the inputs required to run the life-cycle cost models.

An engineering estimate was used to provide civil and construction costs for each proposal. Depending on the type of charging required for a given proposal, real estate, site preparation, and construction costs can be significant.

WVU provided an input sheet required for the model and CTE summarized the data based on the proposals and the various models produced. As one of the inputs, CTE used the route model and the rate model results for each of the proposed solutions. The route model was used to estimate the annual amount of energy required to operate a given number of buses on the specified route. Once the route model was completed, CTE used the rate model to provide a projection of electricity costs. The costs were provided as a cost per mile into the life-cycle cost model.

9. Proposal Evaluation and Results

An evaluation committee was established with Subject Matter Experts (SME's) representing the various departments within LBT. The Evaluation Committee included staff from most LBT departments, including, Transit Service Delivery and Planning, Fleet Maintenance, Infrastructure, Safety, Training, and Marketing/Government Relations. This was to ensure a more thorough and balanced evaluation. The Evaluation Committee was divided into three SME teams. In order to maintain consistency within the discussion, three of the core team members were asked to lead an SME team by coordinating the material for review within an assigned evaluation group, gathering input, and establishing a consensus score for first round evaluations.

On December 12, 2014, an evaluation kickoff meeting was held with the SME Evaluation Committee. The purpose of the meeting was to instruct the members of the evaluation team on the evaluation timeline process, evaluation criteria, and scoring.

In addition, this was a joint procurement with Anaheim Transportation Network (ATN) and Gardena Municipal Bus Lines (GMBL). As a result, they were invited to participate in each of the SME evaluation teams. ATN accepted and was included on the third team. GMBL declined as they were in the middle of demonstrating two battery electric buses (BEB), and did not want to influence the evaluation with their demonstrations.

The evaluation was conducted into two phases.

1. Technical Evaluation
2. Pricing Evaluation

9.1. Technical Evaluation

Once the proposals cleared the initial review by the Purchasing Department, the Technical Evaluation commenced. The Technical Evaluation was worth 75 percent (1,125 points) of the total proposal evaluation score of a possible 1,500 total points, as outlined in the RFP in the Instructions to Proposers. It consisted of the following elements, as outlined in Table 2:

Table 2 -Technical Evaluation Criteria

Technical Evaluation Criteria	Maximum Points
Overall Proposal	5
Vendor Experience	20
Bus Operations	15
Charge Station Operations	15
Customer and Community	10
Product Support	10
Total Technical Evaluation Points	75

The Technical Evaluation consisted of five primary activities:

1. **Individual Reviews:** Each member of the Evaluation Committee was provided a copy of each vendor proposal and was asked to read and comprehend each proposal.

2. **SME Team Workshop #1:** Each team gathered to discuss individual reviews and to document requests for clarifications.

3. **Technical Analysis Workshop:** CTE presented the results of the Bus Modeling, Route Simulation, and Route Modeling to the Evaluation Committee.

4. **SME Team Workshop #2:** Each team gathered again to develop the technical evaluation score.

5. **Vendor Presentations:** Vendors were invited to LBT to provide a presentation, respond to questions/clarification requests generated by the SME team and to perform a product demonstration.

Table 3, on page 13, provides the results of the Technical Evaluation:

Table 3 -Technical Evaluation Scores

Rank	OEM	Model	Battery	Depot Charger	On Route Charger	Technical Score
1	BYD	K9	320 kWh	80 kW		870
2	New Flyer	XE40	300 kWh	100 kW		825
3	BYD	K9	320 kWh	80 kW	Wave 50 kW	810
4	New Flyer	XE40	200 kWh	100 kW	Overhead 300 kW	720
5	New Flyer	XE40	100 kWh		Overhead 300 kW	720
6	Proterra	XR	259 kWh	50 kW	Wave 50 kW	645
7	Proterra	FC	108 kWh		Overhead 500 kW	610
8	Proterra	XR	259 kWh	50 kW	Overhead 100 kW	585

No vendors were eliminated from consideration as a result of technical scoring. Hence, each vendor was invited to LBT to provide a vendor presentation summarizing their proposals and providing requested clarifications. In addition, each vendor provided a demonstration of its proposed bus.

9.2. Pricing Evaluation

The Pricing Evaluation consisted of three primary activities:

1. **Review of Price Proposals:** Purchasing provided the vendor price proposals to each SME team lead for review
2. **Life-Cycle Cost Workshop:** CTE and WVU conducted a workshop with the core evaluation team to review the results of the Life-Cycle Cost Analysis
3. **SME Evaluation Team Workshop #3:** Team leads individually conducted a pricing evaluation based on each vendor's price proposal and the results of the Life-Cycle Cost Analysis. In addition, SME teams had the opportunity to adjust Technical Evaluation scores based on the results of the vendor clarifications, presentations, and demonstrations.

The Pricing Evaluation was 25 percent of the total proposal evaluation score with a 375 point maximum of 1,500 total possible points. Table 4 provides the results of the Pricing Evaluation scoring.

Table 4 - Pricing Evaluation Scores

Rank	OEM	Model	Battery	Depot Charger	On Route Charger	LCC Score
1	BYD	K9	320 kWh	80 kW		375
2	BYD	K9	320 kWh	80 kW	Wave 50 kW	319
3	New Flyer	XE40	100 kWh		Overhead 300 kW	312
4	Proterra	XR	259 kWh	50 kW	Overhead 100 kW	291
5	Proterra	FC	108 kWh		Overhead 500 kW	282
6	Proterra	XR	259 kWh	50 kW	Wave 50 kW	278
7	New Flyer	XE40	300 kWh	100 kW		249
8	New Flyer	XE40	200 kWh	100 kW	Overhead 300 kW	248

10. Final Assessment

The final assessment was the third phase of the proposal selection process. The technical and pricing score were added, as listed in Table 5. Based on the technical and pricing evaluations, LBT requested best and final offers from BYD and New Flyer on proposed bus configurations that represented the four options receiving the highest scores. A series of questions were sent to both vendors.

Table 5 - BEB Evaluation Scores

Rank	OEM	Model	Battery	Depot Charger	On Route Charger	Technical Score	LCC Score	Overall Score
1	**BYD**	**K9**	**320 kWh**	**80 kW**		**870**	**375**	**1,245**
2	**BYD**	**K9**	**320 kWh**	**80 kW**	**Wave 50 kW**	**810**	**319**	**1,129**
3	**New Flyer**	**XE40**	**300 kWh**	**100 kW**		**825**	**249**	**1,074**
4	**New Flyer**	**XE40**	**100 kWh**		**Overhead 300 kW**	**720**	**312**	**1,032**
5	New Flyer	XE40	200 kWh	100 kW	Overhead 300 kW	720	248	968
6	Proterra	XR	259 kWh	50 kW	Wave 50 kW	645	278	923
7	Proterra	FC	108 kWh		Overhead 500 kW	610	282	892
8	Proterra	XR	259 kWh	50 kW	Overhead 100 kW	585	291	876

10.1. Best and Final Offer

BYD and New Flyer provided final pricing sheets on the requested proposals and provided any final clarifications requested by LBT. The price adjustments and added warranty were reflected in the life-cycle costing, creating new scores for each proposal.

The SME evaluation teams conducted a final evaluation based on the latest information submitted by BYD and New Flyer, and the resulting final scores are provided in Table 6:

Table 6 - Final Evaluation Scores (with BAFO)

Rank	OEM	Model	Battery	Depot Charger	On Route Charger	Technical Score	LCC Score	Overall Score
1	BYD	K9	320 kWh	80 kW		870	375	1,245
2	BYD	K9	320 kWh	80 kW	Wave 50 kW	810	318	1,128
3	New Flyer	XE40	300 kWh	100 kW		825	234	1,059
4	New Flyer	XE40	100 kWh		Overhead 300 kW	720	298	1,018

10.2. Recommended Vendor

Based on the detailed analysis conducted by LBT staff, CTE, the University of Texas – Center for Electromechanics, Barkovich & Yap, and West Virginia University, and as a result of the evaluation and scoring performed and adjusted with the best and final offer, the preferred vendor is BYD Motors, Inc. (BYD).

BYD has built and provided BEB to various countries and began manufacturing buses in the United States in 2014. BYD has delivered 20 buses to the emerging zero-emission American bus market and established a manufacturing facility in Lancaster, CA.

BYD's proposal was deemed the most responsive and responsible and met LBT requirements for the zero-emission buses. Apart from meeting the technical, price and schedule requirements of the RFP, BYD offers a 12-year warranty on its vehicle batteries, inverters and traction motors. The warranty on these major components covers the 12-year useful life planned for the buses as required by the FTA.

10.3. Negotiations

LBT identified a preferred BEB vendor and began negotiations to clarify terms and potential language for a contract with BYD. Additional information was requested to assist in pre-award audits and reviews.

The BEB Executive Steering Team had extensive dialogue with the core team about the associated benefits of on route charging in consideration of the Wireless Advanced Electrification (WAVE) system, designed and manufactured in Salt Lake City, UT. The WAVE system offers an opportunity to extend the range of on-board batteries, by providing a low power charge inductively, while the bus is at a layover point.

WAVE is an "open" charging option and is not exclusive to any bus manufacturer. As a result, buses form multiple manufacturers could use the WAVE system in the future.

The President and CEO of LBT and the core team went to WAVE manufacturing facilities in Salt Lake on April 13, 2015 to see the system in service at the University of Utah. The team observed the system's advanced technology, its operations and its service flexibility. WAVE discussed its projects, which included the installation of four more units by the end of the calendar year, and other projects in the works with bus manufacturers. The in-ground component of WAVE appears to be the least intrusive to current landscape and roadway clearances.

LBT continued negotiations and completed a review of the warranty terms outlined for the general bus, battery, depot chargers, and WAVE system. LBT was also able to review the work schedules, maintenance plans, and software plans, thereby gaining confidence that BYD can meet the project requirements.

10.4. Pre-Award Audits

As part of the negotiation, Purchasing coordinated pre-award audits with the preferred vendor that included:

a) Buy America audit of bus and charging equipment,
b) Independent Safety, Health and Environmental review of the battery system,
c) Independent Safety, Health and Environmental review of the WAVE system.

The results of these reports show that BYD and WAVE are in compliance with state and federal regulations and that BYD is able to meet the project requirements.

10.5. Final Staff Recommendation

Staff recommends the purchase of 10 BYD K9 buses with the WAVE range extender charging option. The purchase will also include 11 depot charging adapters (one to be used at the Queen Mary location – see Table 7), one WAVE on route charging station, an energy management system to help control electricity costs, funds for spare parts, training and diagnostic equipment.

Additionally, staff is recommending a five percent contingency, for a total of $467,409, which would address any additional technical requirements or unanticipated modifications to the bus, charging system, or charging stations. The facility and infrastructure requirements will be brought to the Board under a separate contract.

Finally, staff is recommending a maintenance contract is executed to support the WAVE charging system, both the primary pads on the bus and the secondary pad and the equipment on the route. This contract will be for two years, with an option of 10 years to cover the life of the bus, with a LBT termination for convenience clause that allows LBT to cancel at any time.

Table 7 - Staff Recommendation Pricing

Qty	Contract Item	Each	Costs
10	K9 Model – 320 kWh	$934,818	$9,348,179
10	WAVE inductive primary charger on bus	$54,500	$545,000
11	Depot Chargers	$11,445	$125,895
1	WAVE Inductive Charger on-route	$381,500	$381,500
1	Energy Management System		$54,500
	Spare Parts / Training / Diagnostic Equipment		$140,836
	Conditional Assessment (exercised in yr 1 & 3)		$6,000
	TOTAL Contract		$10,601,910
5% Contingency on bus (processed through RFCO)			$467,409
	TOTAL Authorization		$11,069,319

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[1] *Electric Bus Market Analysis of Long Beach Transit*, Center for Transportation and the Environment – July 2014

[2] *Electric Bus Project Request for Proposal 15-001*, Long Beach Transit – Issued September 23, 2014

[3] *Bus Modeling and Route Simulation Report*, University of Texas Center for Electromechanics – January 2015

[4] *Route Modeling*, Center for Transportation and the Environment – February 2015

[5] *Rate Modeling*, Barkovich & Yap, Inc. and Center for Transportation and the Environment – Spring 2015

[6] *Life Cycle Cost Analysis*, West Virginia University Center for Alternative Fuels Engines & Emissions – April 2, 2015