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YORK REGION TRANSIT
HYBRID BUS DEMONSTRATION PROJECT

The Transit Committee recommends:

1. The presentation by Rick Takagi, Manager of Operations and Peter Chatoff, Fleet Co-ordinator be received; and

2. The recommendations contained in the following report, October 26, 2004, from the Commissioner of Transportation and Works be adopted:

1. RECOMMENDATIONS

It is recommended that:

1. Regional Council authorize the execution of an agreement between The Regional Municipality of York and Overland Custom Coach, BET Services Inc. and the Ministry of Transportation, with respect to the Hybrid Bus Demonstration Project, subject to negotiations satisfactory to the Chief Administrative Officer, Commissioner of Transportation and Works, and Commissioner of Finance and Treasurer.

2. The Agreement provide for the purchase of the four demonstration vehicles by the York Region for a nominal cost at the end of the demonstration period, should the Region choose to continue use of the vehicles in revenue service.

3. The Regional Solicitor be authorized to prepare the agreement.

4. The Regional Chair and Clerk be authorized to execute the agreement on behalf of the Region.

5. Regional Council authorize the expenditure of $400,000 from the draft 2005 Capital Budget for conventional bus replacement as its participatory contribution to this demonstration project, subject to confirmation of subsidy funding allocation as outlined in this report.

6. The Purchasing By-Law be waived and staff be authorized to purchase up to four hybrid buses, after the demonstration period, subject to satisfactory technical evaluation by staff.

7. Regional Council authorize staff to negotiate with one of its transit service contractors for implementation of this test pursuant to the terms of the Performance Based Contracts and report back thereon.

2. PURPOSE

This demonstration project will evaluate the operating performance, costs and viability of a battery-dominant hybrid-powered bus in York Region Transit's conventional service. It will also demonstrate the use of an alternate propulsion system which is more environmentally friendly than current conventional diesel powered engine technology. The project would use four new demonstration buses of this type, each costing the Region $100,000.

3. BACKGROUND

3.1 Concept

The Region has been presented with an opportunity (unsolicited proposal) to participate with the private sector and other agencies in a hybrid bus demonstration project. The manufacturing and the research and development principals are Canadian firms with expertise in the area of small buses and alternate vehicle propulsion technology. One of the principal parties, Overland Custom Coach (OCC), manufactures the Elf bus, a low floor accessible vehicle for para-transit and light transit applications. The Region owns a number of the Elf units in its Mobility Plus fleet. The other principal party is BET Services Inc. (BET), a firm involved in the use of state-of-the-art batteries applied in hybrid vehicle technology. Both companies have been working jointly to date and are in need of a suitable participant to undertake the demonstration portion of the project and initiate the funding from the other agencies. The same initiative is also being presented to another transit agency and a decision is pending although they are both stand-alone ventures. There are also other firms supporting the project.

3.2 Description of Technology

The hybrid technology essentially optimizes the use of available power through the use of high capacity, slow discharge, rapid recharge state-of-the-art batteries carried on board the vehicle. Unlike other battery types, this product (Zebra battery) is not impacted by temperature and has no ongoing maintenance requirement. The batteries supply electricity to an electric-drive motor on one of the vehicle axles. Unlike a conventional motor vehicle, there is no transmission. Electric power also drives all the vehicle subsystems such as windshield wipers, doors, air conditioning and heater fans.

During vehicle braking, a frequent occurrence in the duty cycle of a stop and go transit bus, electricity is produced by the electric motor acting as a generator, returning power to the batteries for future use. Modern light and heavy rail electric mass transit vehicles also employ regenerative braking features placing power back into the source grid. The capacity of the batteries based on full charge, supplemented by power generated by braking, is more than sufficient to operate the bus during a peak period (rush hour) time requirement.

However, recognizing the need to offer a longer time duration and mileage range than a rush hour timeframe, the vehicles are equipped with a small diesel engine. The engine

drives a generator that produces electricity which slows the rate of battery discharge. This provision gives the vehicle a longer in-service range but recharging is needed after a full service day. Recharging is done by plugging into a special wall mounted electrical outlet. There are suitable converters for voltage on board the vehicles. Full charging can be done overnight. Rapid recharge can also be done between rush hours while the bus is at its garage facility. In addition, if the bus is on a route at a terminal point with an extended dwell time interval, the bus can be plugged in to help replenish battery capacity. The vehicle is being defined as battery dominant as the engine is used only in a supportive mode as needed rather than in a constant operating situation.

While the bus is operating in the battery-only mode there are no emissions. When the small engine is turned on to achieve the extended range, there are low emissions. The engine is similar in displacement to a subcompact car.

4. ANALYSIS AND OPTIONS

4.1 Program Outline

As in the case of any other motor vehicle, design and manufacture would be subject to testing and certification for compliance with Canadian Motor Vehicle Standards.

Essentially, the proposed project is scheduled to be a two-year program. The first year will be the engineering and manufacturing of the buses and the acquisition of necessary regulatory approvals. The second year would be the one-year demonstration period in regular transit service. While in the service of YRT, the application of this technology would be assessed. The full year is required to assess performance in all weather conditions. After this period, the Region could exercise an option to purchase the buses subject to the terms of the agreement. Conversely, terms would be established for the Region to be released from further obligations if such a decision is made.

In order for the proponents to further pursue this program, participation and funding as described above is needed. As part of the funding partnership, the Ministry of Transportation is being asked to verify their funding process which currently provides for one-third subsidy on transit bus purchases, supplemented by an additional one-third subsidy on the premium cost of alternate fuel technology. If the Region’s upfront cost for the buses is not deemed to be a purchase, it may be considered as a capital lease. It is anticipated these buses would operate on routes either currently using conventional buses or placed on a new route, but in either case, suitable to this size of bus.

The Region would also have to successfully negotiate with one of its current transit operating contractors for the insertion of such a vehicle into the assigned fleet. It is expected any out of pocket premium costs incurred by the contractor would have to be compensated by the Region. The overnight recharging cost would be netted against much reduced fuel consumption since the cost of fuel is a contractor responsibility.

4.2 Benefits

The version of hybrid technology described offers many advantages, one being its simplicity. Other forms of alternate propulsion are based on more complicated and costly designs. In the case of some automobiles, internal combustion engines and electric motors work in parallel depending on speed and load. Other bus manufacturers offer diesel hybrid designs where the engine is constantly running to drive the generator, producing electric power much more similar to diesel electric locomotives. In both cases, emissions are reduced but not to the same extent as the design presented to the Region. The small diesel engine is compatible in size to a subcompact car (a version used in Volkswagen automobiles) and is quieter than typical bus engines. Special fuelling and infrastructure facilities are not required as in the case of compressed natural gas, which is a common alternate fuel.

Being design-built around the hybrid technology, the proposed vehicles are lighter as they do not have to consider the mass of large diesel engines, transmissions and axles of compatible sized buses of similar passenger capacity. This in turn transforms into energy savings as less mass needs to be propelled. The lighter weight allows for automotive type hydraulic brakes and eliminates the need for air brakes and air systems, which are required on heavier vehicles. The use of the electric drive motor to produce electricity during braking also creates a braking or drag effect, reducing brake lining wear. The lighter weight also permits a smaller wheel and tire on a lighter capacity axle.

Without the dependency on an internal combustion engine, the vehicle is impacted far less by cold weather starting issues associated with conventional buses parked out of doors overnight. All of the Region's contractors currently have outside plug-ins for engine block heaters which would be used for recharging the batteries in the hybrid units.

Not only are emissions reduced, but the noise when operating in the electric-only mode is a fraction of a vehicle with an internal combustion engine and a transmission. Low noise, low emissions and lighter weight make these vehicles much less intrusive than their counterparts of similar dimensions. Elimination of the air compressor, typically found on larger buses for braking and other sub-systems, further reduces noise.

Technical merits of the bus include a simple powertrain without a transmission. Maintenance beyond engine servicing and a battery replacement projected at mid-life allow the vehicles to be serviced without complex tools or extended training. Although the batteries are relatively expensive, they could be leased and a reduction in upfront capital outlay realized.

While it can be argued that emissions are produced by the small on-board engine, it is only used in an as-required basis with a capacity matched to its sole and simple function of driving the generator. Similarly, emissions produced by the power generating plant supplying the plug-in locations are done through a controlled environment and possibly through a source other than fossil fuels.

The marketing of public transit as a viable option to the personal auto is reinforced through the positive image of an environmentally friendly transit vehicle. Also, the size of the vehicle in the 26 to 30 foot range compliments a service delivery profile of smaller (i.e. less than standard 40 foot buses) on certain residential and community routes. The vehicle size and low profile also allow for its use in the Mobility Plus service. The vehicles are of low floor design which permits accessibility to those with mobility impairment.

Participation in such a project would compliment the Region's progressive stance and action in the YRTP initiative. Supporting and working with local Canadian companies on state-of-the-art technology is a desirable pursuit. The tangible realization of lower vehicle emissions is also in keeping with the Region's "green initiatives".

4.3 Risks

As with any innovation there are risks that must be weighed. The two principal companies, although innovative in ideas, are relatively young and without the benefits of mass production and the large financial backing larger manufacturers enjoy. While the now proven ability of the "Zebra" type batteries have made the concept practical, the process of launching a number of vehicles into production and meeting compliance standards is not an easy task. Even though variants of this technology are evident and successful elsewhere in specialized applications, the use in true transit service other than quick demonstrations is a threshold to overcome. Overland Custom Coach has one of its ELF buses so converted, however, its use is for presentations and it is not in day-to-day revenue service.

This proposal does not follow the normal procurement process followed by the Region. If there is failure or delay, strong criticisms could be raised and the Region would suffer embarrassment as well as possible loss of contributed funds. With prototype vehicles, there is a higher capital cost than a mass-produced, technically established, off-the-shelf conventional bus. (The estimated cost of each bus is $632,000 which is an approximate 60% premium over a similar sized conventional bus). As a unique product, spare parts for maintenance and repair would not be in the same supply systems as established mass produced conventional buses. The Region's portion of the project is $400,000 ($100,000 for each of four buses).

Proceeding in the hybrid bus proposal would parallel the faith already expressed by the Region in high-quality contemporary public transit.

At the end of the demonstration project, the Region can decide whether to continue with the operation and buy the equipment outright or return the demonstration buses back to the supplier. Terms of acquisition would be outlined in the agreement and would ensure that ownership and residual value are favourable to the Region. If permanently acquired, the buses would be under the capital replacement program, displacing older buses that have reached the end of their feasible design life or be used for service expansion.

4.4 Relationship to Vision 2026

This is a major step in working towards the "Enhanced Environment, Heritage and Culture" goal of Vision 2026 as there are noticeable reductions in vehicle emissions and noise. This makes the operation of public transit vehicles much less intrusive or offensive in residential areas.

5. FINANCIAL IMPLICATIONS

The proposal involves some financial support from the Region as well as the Region making application to the Centre for Sustainable Community Development (SDTC) for "Green Municipal Funds", which is associated with the Federation of Canadian Municipalities (FCM). The Region would be required to contribute $100,000 per bus for each of the four buses for a total of $400,000. This money would be paid out on delivery of each bus. The total cost of the project is estimated to be $7,440,000. Participant funding and related expenses are summarized in Table 1. It should be noted that operating costs are excluded as the Region already incurs this with current conventional diesel buses which would be replaced for this project. The actual operating cost may differ and be either higher or lower once the true differential between the technologies is determined.

Table 1
Proposed Funding of Hybrid Bus Demonstration Project

Budget	$	Funding Source	$
Engineering	3,110,000	SDTC	$2,670,000
Four 30 ft. Hybrid Diesel-Electric Buses	2,530,000	MTO	1,080,000
Start-Up Costs by OCC/BET	1,800,000	FCM	1,000,000
		YRT - Buses	400,000
		BET/OCC	2,290,000
Total	7,440,000		7,440,000

Before any Regional funds are paid out for the project, an agreement has to be negotiated with the participating private sector firms and government agencies. Among other things, it will be the Region's objective in those negotiations to secure the buses at the end of the demonstration project for a nominal fee.

6. LOCAL MUNICIPAL IMPACT

The demonstration vehicles would run through any of the local municipalities served by YRT routes appropriate to this size of vehicle. Actual location would depend on the service area of the particular contractor operating these units.

7. CONCLUSION

An opportunity has been afforded to the Region to reinforce its progressive stance on public transit and its environmental posture. Subject to satisfactory negotiation of an agreement with the participating private sector firms and government agencies, it is recommended that York Region participate in the project.

The Senior Management Group has reviewed this report.