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YORK REGION TRANSIT
REVIEW OF ALTERNATE FUELS

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, November 23, 2004, from the Commissioner of Transportation and Works be adopted:

1. RECOMMENDATIONS

It is recommended that:

1. York Region Transit continue with the acquisition of clean diesel conventional transit buses for the immediate future, continuing to specify the use of low sulphur number one diesel fuel for the bus fleet.

2. Staff be authorized to investigate and report on the feasibility of using bio-diesel fuel as a requirement of the next series of performance based contracts, including the rapid transit operations and maintenance contract.

2. PURPOSE

York Region Transit (YRT) staff have initiated a review of the feasibility of utilizing alternative fuels in YRT transit vehicles to reduce harmful exhaust emissions, and to address cost concerns with the rise of oil and gas prices.

3. BACKGROUND

Diesel fuel is the largest source of fuel for the propulsion of transit vehicles in North America, accounting for well over 95% of Canadian urban transit bus fleets. York Region's entire fleet of 241 buses is so equipped.

Alternate fuels have been pursued as a method to reduce emissions and to a lesser extent, reduce the intrusiveness (noise) generated by the large diesel engines.

3.1 Current Industry Profile and Product Options

An average of 4,500 urban transit buses are sold annually in North America, with Canada's share accounting for less than ten percent of that amount. This consists of a mix of diesel powered (75%), compressed natural gas (CNG) (20%), and hybrid (diesel-electric) (5%). Other forms of propulsion including LNG (liquefied natural gas), straight electric, propane, fuel cell, etc. account for less than 1% of bus sales. Typically, these

other forms of propulsion include a high percentage of prototype or demonstration models.

3.2 YRT Transit Fleet

The Region's current bus fleet of 241 buses is maintained at three contractor facilities. Contractors are required to provide fuel under their respective operations and maintenance contracts, the cost of which is included in the hourly rate charged to the Region. These facilities also fuel other vehicles from the same source in addition to the Region's bus fleet. To introduce another product, unique to the Region's bus fleet, would require supply chain changes and may impact contract costs.

The current contracts with the contractors specify they supply low sulphur, number one diesel fuel meeting a specific Canadian standard. Changes in fuel requirements initiated by the Region before the end of existing contracts would require the contractors' agreement and would result in a higher cost to the Region.

4. ANALYSIS AND OPTIONS

4.1 Clean Diesel Engine

The diesel engine is subject to ever increasing emission controls mandated by legislation. There have been more and more stringent requirements on exhaust emission over the past 20 years. Use of electronic controls, fine tuning of components and other measures have significantly reduced emissions of pollutants such as carbon monoxide, nitrous oxide and particulate matter. Today's diesel engines are referred to as "clean diesels". Further emission reductions have been mandated by legislation to occur in 2006.

The planned replacement of the YRT fleet will reduce emissions by replacing older buses with new "clean diesel" buses. Through coordination with the contractors, the older buses will be progressively relegated to low mileage runs and peak hour service, reducing their environmental impact.

In future performance based contracts, fuel specifications will be updated to ensure the cleanest commercially available diesel fuel is mandated.

An even more refined diesel product known as ultra-low number one diesel has also been recently introduced. As a premium product, it has started to gain some use and it appears legislation will see it eventually become mandated. It should be noted that in order to provide the performance of low sulphur number one diesel, ultra-low sulphur required a reformulation of chemical properties to achieve adequate lubricity, which contributes to its higher cost.

4.2 Emission Control Devices

Staff are currently testing an emission control device on a random group of older buses and will report back on the results if they are found to be favourable. This could lead to the installation of the devices across the entire group of older buses that are equipped

with less sophisticated engine emission controls. When emission checks are made for annual licensing of buses, measurements will be obtained and reviewed.

4.3 Bio-diesel Fuel

Recent initiatives include the commercial use of bio-diesel fuel. Waste by-products from the processing of vegetable oil have been turned into a combustible fuel, which is typically mixed in various proportions with conventional diesel fuel (20% in summer), or used in a non-diluted form. It offers reduced emissions as well as reduced dependency on fossil fuel and is now slowly being introduced into the commercial market place. However, it presents a problem in cold weather because of congealing. A weak mixture (5%) is therefore needed for the winter months. Although there are a few fleets that are using bio-diesel, it has a premium cost at this earlier juncture. The Toronto Transit Commission has recently placed a tender for the supply of bio-diesel for a portion of its fleet on a six-month trial basis at one of its garages.

The overriding issue with all alternate fuel products, and their formulation and performance, is not simply emission reductions. The impact on the lifespan, performance and health of the engine are also critical. For these reasons, the approval of engine manufacturers is required in order that warranties are not voided.

4.4 Compressed Natural Gas (CNG)

CNG has been used in a limited number of transit bus fleets in Canada for about 20 years. It has been used in lieu of diesel fuel because it is cleaner burning and has lower emission levels. There are a number of drawbacks in the use of CNG. In addition to a greater capital cost for vehicles, a large investment in infrastructure is required, including special safety provisions in garages, staff training and certification, a compressor station, and more complex refuelling processes. There is also added weight with CNG buses compared to diesels due to the CNG storage cylinders being carried. CNG engines require more maintenance and do not have the life span of diesels. The conversion of transit fleets to CNG has only been made possible by the significant amount of funding available from senior levels of government in both Canada and the United States.

Although CNG fuel originally provided a much a cleaner option to diesel fuel at the time of its original introduction, the ever more stringent emission standards introduced since have improved the performance of diesel engines to the extent that there is a much smaller difference in emissions between CNG and modern clean diesel engines.

CNG's higher capital and operating costs have caused its use to be largely discontinued in Canada. A number of Ontario municipalities including Cornwall, Burlington, and Grand River (Kitchener-Waterloo), after having purchased CNG powered buses over the last decade, have reverted back to diesel. Mississauga converted its CNG's powered buses back to diesel several years ago. The Toronto Transit Commission's CNG powered fleet has remained at 125 units based at one garage for several years with no plans for expansion. They have converted one bus to diesel. Hamilton, a strong CNG proponent, has asked for diesel options in its current new bus tender.

It is entirely possible, given the diesel hybrid product becoming a viable option, that transit systems with CNG fleets may evaluate the costs of renewing CNG infrastructures when the need arises.

4.5 Hybrid

Although a new application in the contemporary transit world introduced to address emission concerns, versions of hybrid technology have been in place for a number of years. Internal combustion engines (typically diesel) drive alternators that produce electricity to power electric motors. There may be one large motor or a number of small motors powering the drive axle. Diesel-electric railway locomotives use this basic concept, and many years ago, there were buses configured in this manner so as to eliminate the manual transmissions of the time.

The current hybrid technology takes this one step further. Storage batteries are added in the bus propulsion system. The energy generated by braking is transmitted back to the batteries for use in propulsion along with the other power being produced. As a by-product, brake lining life is also extended. The engine is smaller and works less intensively. There is no transmission and hence no shifting of gears.

Hybrid technology is becoming a viable future alternative. A large order of such buses has been place by New York City and there are other properties evaluating this type of product. Since there is no additional infrastructure cost, it has desirable features particularly with the Region's bus fleet which is operated and maintained by contractors.

YRT staff are currently negotiating an agreement to participate in a small bus demonstration project using hybrid vehicles which will provide practical experience before any major commitments are made to this technology. This was the subject of a report to Transit Committee in November.

The higher capital cost of this alternate propulsion system will no doubt be reduced as it becomes more common in the industry.

4.6 Other Forms of Propulsion

In addition to those types described above, there exist a number of other forms of alternate fuel or propulsion. This includes such products as fuel cells using hydrogen gas, liquefied natural gas (LNG), propane, and straight electric power, etc. There is generally a higher cost to these variant forms due to the prototype/demonstration state of most of them and the corresponding lack of commercial market availability and penetration. Electric power on its own does not offer the range needed for transit operations. The only exception would be trolley buses where an overhead electric wire and distribution network exists. Similarly, in certain select geographic areas such as Arizona, there is an apparent abundant supply of LNG, making it a viable option for the local transit systems. However, the buses used are essentially "orphans" specifically designed for that application. With trends towards more stringent emission controls, it is important to monitor and evaluate these alternatives in order that future reviews and determinations can be intelligently made.

The other forms of propulsion such as those mentioned earlier are in limited use and in developmental and demonstration stages. While it is highly essential to monitor these initiatives, at the present time they do not offer a practical option for either demonstration purposes or for new fleet acquisition.

Table 1 below is a summary of emissions from various types of fuel.

Table 1
Comparison in Emissions

Type of Emission	Diesel Hybrid grams/mile	CNG grams/mile	Clean Diesel grams/mile
NOx (nitrous oxide)	12.90	14.90	30.10
Particulate matter	0.01	0.02	.24
CO (Carbon monoxide)	0.10	12.70	3.00
Greenhouse Gases (principally carbon dioxide)	1848.00	2708.00	2779.00

4.7 Relationship to Vision 2026

Minimizing exhaust emissions from the Region's transit vehicles complements the Vision 2026 goal area of "Enhanced Environment, Heritage and Culture".

5. FINANCIAL IMPLICATIONS

In terms of capital cost, there is an approximate 10% surcharge for a CNG powered bus as opposed to a diesel powered version. Hybrids, with a more current technology and a more recent market introduction, have a 60% premium in cost over a diesel powered product. The other forms of propulsion generally have an even higher premium relative to the basic diesel powered bus because of low production quantities and their research and development/prototype state.

Continuing with the acquisition of clean diesel transit buses as provided for and detailed in the 10 Year Transit Capital Plan will require continued funding at the budgeted level. Should it be decided at a later date to pursue another option such as hybrid, corresponding changes to the budget would be necessary at that time. Currently, provincial subsidy continues to be available for both expansion and replacement buses. It is further understood based on new funding formula, there is a subsidy supplement to cover a portion of the additional incremental cost of alternate technology.

6. LOCAL MUNICIPAL IMPACT

There are no local municipal impacts associated with this report.

7. CONCLUSION

Through planned fleet turnover as vehicles reach the end of their feasible life, the continued infusion of clean diesel buses will reduce overall emission levels. This will be further enhanced through legislation on fuel composition. Monitoring of industry and technology changes will allow for follow-up study. The current review of small hybrid diesel-electric buses and their potential use in a demonstration project in the Region will provide further hands-on experience. These initiatives also reaffirm the Region's commitment to seeking out viable alternate fuel strategies and thereby promoting clean air policies and initiatives.

The Senior Management Group has reviewed this report.