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Transportation
Authority

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TO: BOARD OF DIRECTORS

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REGIONAL TRANSPORTATION PLANNING
AND DEVELOPMENT

SUBJECT: ARTICULATED BUS DEMONSTRATION PROJECT

ISSUE

At a previous Board meeting, Director de la Vega suggested that the operation of articulated buses could reduce MTA operating costs. Staff was requested to review the possible acquisition of articulated buses and report back with a feasibility assessment.

An internal study group was formed with representatives from the Operations and Planning departments to review service application issues and associated cost impacts.

DISCUSSION

Over the past 18-months, the acquisition of articulated buses has gained Board interest as a means for reducing service costs. Similar vehicles are also planned to be used on the high-speed, Bus Rapid Transit alternatives currently under review through the Eastside, Mid-Cities/Westside, and San Fernando Valley Corridor studies. However, BRT vehicles may differ from current generation articulated buses, particularly with respect to power sources. This report is focused on the savings potential of current generation articulated buses applied to existing MTA services.

While recently adopted Air Quality Management District rules include an exemption process, until more is known regarding our ability to procure non-CNG vehicles, near-term use of articulated buses may be out of reach for MTA service.

Findings

Assuming a 58-seat vehicle, articulated buses may reduce the direct operating cost of a high demand service by up to 15-percent if they are scheduled to replace standard sized buses on a seat-for-seat basis. To achieve these savings, their use should be focused on the top ten routes in the MTA system and the Wilshire-Whittier Rapid Bus line. Actual savings may be lower than 15-percent due to the inability to

interline buses between local and limited stop services or in situations where the operating environment does not permit the use of larger vehicles.

Articulated buses may also be used to either defer an increase in cost or reduce the rate of cost growth when used in specific time periods where passenger demand spikes dictate an increase in service capacity. Spikes in demand occur at rail terminals, for example, where trains discharge large numbers of passengers that must use connecting bus service to complete their trips.

If articulated buses are purchased, issues that should be carefully considered include design of the vehicle; how and where the vehicles are deployed; and the projected costs associated with vehicle acquisition, facility modifications, maintenance, and operation. The issues are discussed below along with staff recommendations where choices are available.

Vehicle Design

Articulated buses can be configured in a number of ways. Major issues include the type of fuel and associated matters, high versus low-floor, number of doors, and seating.

Fuel type: Although manufacturers offer a variety of power plants for buses, to date none of the manufacturers in the United States produce an articulated bus equipped with a CNG powered engine. Other fuels such as LNG and electricity require major support facilities and systems that would incur a major capital expense for the MTA.

While diesel powered articulated buses are readily available, acquisition would require an exception to the MTA Board's policy specifying procurement of alternative fueled buses only. Also germane to this issue, recently adopted AQMD Rule 1192 does include an alternative fuel exemption that may be granted on a case-by-case basis if it can be demonstrated that "...no alternative-fuel engine and chassis configuration is available commercially or could be used."

In order to make this determination, it appears that the AQMD may require some review of the procurement process and associated documentation before an exemption is granted.

Should local policies ultimately forbid procurement of diesel powered articulated buses, it is recommended that the MTA postpone their acquisition until industry experience with alternative fuels in such vehicles is established.

High vs. Low-Floor: Vehicle floor height and the number of doors generally affect the seating capacity of the bus and the speed with which passengers can be loaded and unloaded. Generally, low-floor buses are easier and faster for riders to board and alight and the MTA has made a major commitment to supporting these vehicles in recent new bus purchases.

Doors: The number of doors on an articulated bus is also important for passenger ease, convenience, and speed. A third door would enhance convenience and assist the MTA in testing new boarding strategies based on pre-paid fare areas at station stops, as suggested in some of the recent service studies brought before the Board of Directors.

Seating: For the MTA, seating is a critical issue since standees are determined as a fixed percentage of seats instead of vehicle design capacity limits. In turn, this drives the cost savings potential. The cost savings estimates discussed in this report assume 58-seat, low-floor, three-door buses would be deployed which matches the design profile of the New Flyer articulated bus briefly tested by the MTA last year. However, the MTA may be in a position to seek a revision to the current load-to-seat ratio commensurate with the design of the particular vehicle selected.

Design Recommendation: For the procurement of articulated buses, the following key features are recommended:

- Low-floor with three doors for rider convenience and speed in boarding and alighting;
- Seating capacity for at least 58-riders (more if possible); and
- Diesel power plant if local policies permit.

Deployment

Issues include service application and division assignment.

Service Application: To achieve operating cost savings, a high-demand bus route must be selected. Line 204 (Vermont Avenue) and the new Wilshire-Whittier Rapid Bus route, which serve the two heaviest bus corridors in the MTA system, emerged as two of the better candidates for articulated buses. Other candidate services in the top 10 could also be considered.

Division Assignment: Division assignment is a key issue. Candidate divisions should be located close to the target service to minimize non-revenue travel. With minor alterations, five divisions are capable of supporting articulated buses (Divisions 5, 8, 10, 15, 18). Other issues include impacts on CNG fueling facilities; the displacement of standard-sized buses at the articulated bus host division(s); and how many divisions should host the vehicles.

The CNG fueling facility issue is particularly sensitive due to the public-private partnerships the MTA has developed. At Division 5 for example, if CNG consumption were to drop below the amount specified in the agreement, penalties would be applied. If articulated buses powered by non-CNG engines were assigned to the division, the penalty could be significant, up to $1.1 million annually.

Projected Costs

Due largely to higher maintenance costs, articulated buses cost more to operate on an hourly basis. However, fewer hours of service are needed to provide the same capacity. The substitution ratio (number of standard-sized buses replaced by articulated buses) provides a starting point to estimate potential savings.

Estimated Operating Costs: For this review, a 50% increase in maintenance cost was assumed. Additionally, other factors were adjusted such as PL/PD, fuel consumption, accident repair and so forth due to the increased bus size. As shown in Attachment 1, the projected marginal operating cost per hour would increase from about $66.28 per hour to around $81.15.

Substitution Ratios: Substitution ratios vary according to the number of seats for each bus type. MTA currently operates 40-foot high-floor buses that typically seat 43-passengers. With MTA commitment to low-floor buses, new buses on order will seat 40-riders. Three-door, low-floor articulated buses reviewed to date seat 58-riders. Depending on the standard bus assigned to the target service, a seat-for-seat substitution ratio would range from three standard to a little over two articulated buses to provide equivalent seats in a time period.

Operating Cost Savings: Line 204 is currently equipped with 43-seat buses. As shown on Attachment 2, substituting 43-seat buses with 58-seat articulated buses might reduce operating costs around nine-percent. If Line 204 is equipped with the low-floor, 40-seat standard buses currently in the delivery cycle, the potential savings may improve to about 15.5-percent, as shown in Attachment 3.

The estimated savings do not account for other variables such as deadhead time, running time, and schedule interlining impacts. Additional expense may be incurred in some of these areas but it may be possible to mitigate the impacts over time as service schedules are refined.

Start-Up Costs: The estimated start-up costs are shown in Attachment 4. It is estimated that start-up costs would total around $45.5 million to acquire 100 articulated buses and make necessary modifications to the host division and bus stops for two candidate routes. For comparison purposes, the estimated acquisition cost for the latest version of the MTA's low-floor, 40-seat, 40-foot CNG bus is included to illustrate the difference in vehicle acquisition cost when substituting higher capacity buses on a seat-for-seat basis. The $2.2 million difference is based on a 3-to-2.1 substitution ratio. The estimates do not account for CNG usage penalties that may apply depending on the facility selected as the host division, and additional modification expense if more than one division is selected.

NEXT STEPS

Since recently adopted AQMD policy does include an alternative fuel exemption, a report recommending the procurement of up to 100 low-floor, three-door, diesel powered articulated buses will be prepared for Board consideration. Detailed costs for maintenance base upgrades as well as costs associated with deployment and impacts to the remainder of the system will be identified. As shown in Attachment 5, with Board approval, the process for acquisition, testing and deployment would take, at a minimum, 24-months. This time frame would enable the MTA to deploy the new vehicles on the target service concurrent with the June 2002 Service Change Program.

ATTACHMENTS

1. Projected Marginal Service Delivery Cost by Bus Type
2. Articulated Bus Direct Operating Cost Comparison (43-Seats)
3. Articulated Bus Direct Operating Cost Comparison (40-Seats)
4. Start-Up Costs
5. Preliminary Articulated Bus Deployment Timeline

Attachment 1

PROJECTED MARGINAL SERVICE DELIVERY COST BY BUS TYPE

		Per Revenue Service Hour		
		40' Conventional	60' Articulated	Notes:
Service Delivery	UTU-	$36.54	$36.54	Savings in UTU cost occurs with reduced revenue hours
	Service Attendants-	2.81	4.22	These increase based on size/weight of bus
	Fuel-	2.38	3.57	
	PL/PD-	3.83	5.75	
	Subtotal-	**$45.58**	**$50.08**	
Division Maintenance	Scheduled and Unscheduled **Subtotal**	**$11.26**	**$16.89**	Per average experience reported by other properties 50%+
RRC Maintenance	Division Support, Accident Repair, and Power Plant **Subtotal**	**$ 5.73**	**$ 8.60**	Assuming a proportional increase due to size of the bus
Special Programs	Primarily Graffiti/Appearance, Painting and Windows **Subtotal**	**$ 3.73**	**$5.59**	On average artic would experience proportional increase due to size
Total Service Delivery Cost Per Revenue Hour		**$66.28**	**$81.15**	

Attachment 2

ARTICULATED BUS DIRECT OPERATING COST COMPARISON
LINE 204 (VERMONT AVENUE)
YEAR 2002-1.20 LOAD FACTOR - 43-SEAT STANDARD BUS

ASSUMPTIONS:

Replacement ratio of 3 standard size buses by 2.2 articulated buses:
(43-seats x 3 = 129-seats; 58-seats x 2.2 = 128-seats)

(Direct Cost estimated @ $66.28 standard bus and $81.15 articulated bus)

Apply to Line 204-304:

	Standard Peak		Artic Peak Buses:		
*	Buses	54		40	(54 x .73 = 39.4)
	Estimated Hrs/Bus:.	10.7	Estimated Hrs/Bus:	10.7	
	Estimated Rev Hrs:	577.8	Estimated Rev Hrs:	428	(40 x 10.7)
	Estimated Direct Cost:	$38,297	Estimated Direct Cost:	$34,732	

** Estimated Savings: $3,564 9.3%

*Note: Current allocation of 51 buses increased to 54 to add capacity needed to meet load factor reduction in June 2002 (from 1.25 to 1.20 = +3 buses).

**Note: Does not account for: changes in liability exposure due to increased accidents; increased running, dwell and deadhead time. Use of articulated buses may also decrease interlining opportunities. Changes in these areas would reduce the cost savings, perhaps significantly. Service quality issues, such as widened headways, limit the application of articulated buses to high frequency lines or as a one-for-one replacement in certain situations.

Attachment 3

ARTICULATED BUS DIRECT OPERATING COST COMPARISON
LINE 204 (VERMONT AVENUE)
YEAR 2002-1.20 LOAD FACTOR - 40-SEAT STANDARD BUS

ASSUMPTIONS:

Replacement ratio of 3 standard size buses by 2.1 articulated buses:
(40-seats x 3 = 120-seats; 58-seats x 2.1 = 122-seats)

(Direct Cost estimated @ $66.28 standard bus and $81.15 articulated bus)

Apply to Line 204-304:

Standard Peak *Buses	58	Artic Peak Buses:	40	(54 x .73 = 39.4)
Estimated Hrs/Bus:	10.7	Estimated Hrs/Bus:	10.7	
Estimated Rev Hrs:	620.6	Estimated Rev Hrs:	428	(40 x 10.7)
Estimated Direct Cost:	$41,133	Estimated Direct Cost:	$34,732	

**Estimated Savings: $6,401 15.6%

*Note: Current allocation of 51 buses increased to 58 to account for loss in capacity (40 vs. 43-seats = +4 buses), load factor reduction in June 2002 (from 1.25 to 1.20 = +3 buses)

**Note: Does not account for: changes in liability exposure due to increased accidents; increased running, dwell and deadhead time. Use of articulated buses may also decrease interlining opportunities. Changes in these areas would reduce the cost savings, perhaps significantly. Service quality issues, such as widened headways, limit the application of articulated buses to high frequency lines or as a one-for-one replacement in certain situations.

Attachment 4

START-UP COSTS
ARTICULATED BUS ACQUISITION AND FACILITIES MODIFICATIONS

LINE NO.	43-SEAT PEAK BUSES	(1) 40-SEAT PEAK BUSES	(2) W/2002 CONSENT DECREE		(3) ARTIC BUSES
W-W RB	n/a	58	61		42
204-354	51	55	58		40
			119		82
				(4) SPARES	
			24		18
		TOTAL:	**143**		**100**

(5) BUS COST	
STANDARD	ARTICULATED
$47,190,000	$45,000,000

(6) DIVISION MODIFICATIONS	
Hoists, awnings	$490,000

(7) BUS STOP MODIFICATIONS	
W-W RB	$6,000
204-354	$15,400

START-UP TOTAL:	$45,511,400

NOTES

(1) Wilshire-Whittier Rapid bus scheduled for 40-seat NABI buses; Line 204 would require 4 40-seat buses to account for 7.5% loss in capacity.
(2) June 2002 loading standards reduced from 125% to 120%; add 5% in buses for capacity.
(3) Spares calculated @ 20% of scheduled vehicles.
(4) Substitution ratio of 2.1 articulated buses for 3 standard buses applied.
(5) Low-floor, 40-foot 40-seat bus cost est.$330,000 (average for last two orders);low-floor, 58-seat articulated bus cost est. $450,000.
(6) Larger hoists ($240K) and protective awnings ($250K) required at division.
(7) Estimate for field work, paperwork, site work, and inspections est. at $95.91 per stop.

ATTACHMENT 5

PRELIMINARY ARTICULATED BUS DEPLOYMENT SCHEDULE