
TORONTO TRANSIT COMMISSION
REPORT NO.

MEETING DATE: February 22, 2006

SUBJECT: Technology And Costs Affecting Accessibility On Streetcars

RECOMMENDATION

It is recommended that the Commission:

1) note that staff concluded that after exhaustive research on the means of making the current streetcar fleet accessible, and on consideration that the only technically feasible lift device would cost approximately $80,000 per car, or $15.7 million dollars for the fleet of 196 CLRVs, the impact on customer service, the significant safety concern in its operation on streetcars; and the increased operating costs due to the deployment time required for lift operation, this is not a practical objective and that this should not be pursued further;

2) note that, in order to make TTC streetcar service accessible to people with mobility difficulties, the most practical way is to accelerate the procurement and introduction of new streetcars which would be low floor and fully accessible;

3) forward this report to the City of Toronto, in satisfaction of one of the directives of the City Council adopted at its December 14 and 16, 2005 meeting. At this meeting, the Council amended Policy and Finance Committee Report 9, Clause 31b – Streetcar Fleet Plan, and requested "that the Toronto Transit Commission be requested to advise City Council on the additional costs required to make streetcars accessible, and provide an opportunity for City Council to consider these additional costs prior to a future decision being made by the Toronto Transit Commission on any refurbishing of current streetcars or purchase of new streetcars."

FUNDING

Funding for this accessibility feature on CLRVs has not been included in the 2006-2010 budget.

BACKGROUND

The capital project to extend the life of the 196 Canadian Light Rail Vehicles (CLRVs) by 10 to 15 years was initially established in the 1999-2003 Capital Program budget. Scope of work and detail budget were further defined and submitted in the 2006-2010 Capital Program budget.

At the December 14 and 16, 2005, City Council meeting, on approving Capital Project 4.15 – Streetcar Overhaul, the Council directed that:

"the Toronto Transit Commission be requested to advise City Council on the additional costs required to make streetcars accessible, and provide an opportunity for City Council to consider these additional costs prior to a future decision being made by the Toronto Transit Commission on any refurbishing of current streetcars or purchase of new streetcars."

This report addresses the above mentioned directive.

The capital project to extend the life of the 196 Canadian Light Rail Vehicles (CLRVs) by 10 to 15 years was initially established in the 1999-2003 Capital Program budget. One of the key objectives was to improve on vehicle availability and reduce service delays

DISCUSSION

At its meeting of June 22, 2005, the Commission approved a staff report entitled "Future Streetcar Fleet Requirements and Plans". The report recommended that the Commission "approve proceeding immediately with the process of procuring new streetcars for the TTC…." and "note that, in order to make the TTC streetcar service accessible to people with mobility difficulties, the most-practical approach is to accelerate the procurement and introduction of new streetcars which would be low-floor and fully accessible…"

At its meeting of November 28, 2005, the Commission approved a status report on Accessible Transit Services Plan. In the report, staff recognized that "making the TTC's streetcar fleet accessible will likely be the last component to be completed in the TTC's plans to make all its services and facilities accessible". Staff also made reference to the June 22, 2005 Commission approval which authorized staff to proceed immediately with the process required to procure new accessible streetcars, while recognizing the long-term funding for this initiative has not been secured.

Vehicle Modifications Required to Make CLRVs Accessible

Concurrently, TTC staff conducted extensive research, including discussions with the Office of Accessibility at APTA, and the UITP Task Force leader who chaired the "Guideline for European Internal Market for Light Rail System on Accessibility", into the means of making the current streetcar fleet accessible. These measures have included construction of high-level platforms comparable to that found at GO train platforms, changing the grade of streetcar tracks at streetcar loading platforms to equalize the streetcar floor level with the platform, the use of low-floor wheelchair accessible trailers attached to streetcars, and the retrofitting of the current streetcars with lifts. Preliminary studies suggested that investigative effort should focus on on-board wheelchair lifts, in general, as a potential device to overcome the many technical constraints encountered in changing loading platforms or incorporating low floor trailers. A summary of the research results on wheelchair lifts is attached in Appendix 1. It should be noted that all lift types generated varying degrees of concerns, from economical units requiring extensive manual manipulation of flaps and guards to larger systems requiring substantial changes to both carbody and undercar structure, and equipment case relocation. Three possible lift installation locations were considered: front door, rear door and a dedicated access door.

- The Front Door Option

The front door location for a wheelchair lift would result in the cleanest installation from a vehicle interior aspect but a satisfactory lift could not be identified. The two possible lift types that could be utilized at the front step entryway are a step conversion lift or an undercar cartridge lift. The custom design of a 3-step conversion lift would make it a very expensive and unreliable choice. The second option, a cartridge style lift, is not possible due to the presence of the centre sill for the coupler for multiple unit operation. Front door lift is therefore not an option;

- Rear Door Option

Due to the presence of undercar equipment cases, in-stair installation of lift equipment in the rear door is physically impossible. A swing-out floor-mount lift as adopted by Southeastern Philadelphia Transit Authority (SEPTA) on 18 PCC streetcars was reviewed by Senior Management but discounted due to concerns about operational difficulty, unacceptable time for deployment and retrieval, and potential occupational hazards;

- Dedicated Access Door Option

The dedicated access door option is technically feasible and affords acceptable reliability and maintainability, albeit being the most costly and labour intensive option as it requires an opening to be cut into the vehicle skin and its structural carlines (ribs). Modifications to the vehicle structure and the installation of a slide and plug door with the necessary door operator mechanism can be made, although further analysis to the structural integrity design needs to be conducted. A lift from Ricon or Maxon Mobility sometimes used on highway coaches can be modified and fitted onto the interior floor of the vehicle.

One major concern of this option is the safety of persons on the lift, when deployed from a 920 mm high car floor, reaching out to the ground level in the path of automobile traffic, where no service stop island exists. The attached two diagrams depict the location of the lift (immediately behind the front entrance), and the general geometry of this style of lift. A preliminary engineering assessment of this modification is attached in Appendix 2.

The cost for on-vehicle modification is estimated to be approximately $80,000 per car, or $15.7 million dollars for the fleet of 196 CLRVs. Maintenance cost and operational impact have not been evaluated.

Review by Independent Consultant

To ensure that staff have researched all reasonable and available venues, and taken the necessary steps to assess their relative merits, an independent consultant firm, Booz Allen Hamilton Inc., with special expertise in accessibility issues was retained. The following is an excerpt of the Executive Summary of the consultant's report, along with its comparison matrix.

"Booz Allen supports the comprehensive evaluation performed by TTC Surface Vehicle Engineering. There are no regulatory requirements mandating TTC convert its CLRVs to be accessible. However, the TTC has made commitments to improving accessibility. It is technically possible, albeit complex, to implement a wheelchair lift on the CLRVs, however, the TTC must still address the concern of getting wheelchair and non-ambulatory passengers to and from the CLRV in wayside traffic. After reviewing the internal documentation provided and conducting an independent analysis of the alternatives, it is apparent that there is no ideal solution to make the CLRV accessible.

The TTC identified four on-vehicle mounted wheelchair lift alternatives, as well as wayside improvements to implement wheelchair accessibility. Of the on-vehicle lift alternatives, the floor mounted lift provides for safe and reliable wheelchair accessibility to the CLRV. However it would require modification to the CLRV for an additional access door, resulting in a permanent loss of seating at the wheelchair lift location and does not fully address the safety concerns of loading/unloading in wayside traffic, particularly at non-platformed service stops.

Installation of wayside wheelchair ramps improves wayside safety and provides level boarding for

wheelchair and non-ambulatory passengers. Unfortunately not all streetcar stops can accommodate a wayside ramp, and the logistics of implementing wayside improvements can be time consuming."

Wayside Changes

The majority of the TTC's streetcar service stops do not have service islands. Deployment of a wheelchair lift on these routes will require assurance that the person requiring the use of the lift can be transported safely in the path of automobile traffic. Modifications to the curbside stop may also be required to allow non-ambulatory persons to get down to the roadway, and to the streetcar. Some form of demarcation or signal system may be required. Deployment of a wheelchair lift at service stops with service islands would require significant widening and changes to the ramps.

The TTC has included in the 2006-2010 Capital Budget a project entitled "Streetcar Network Upgrades for LRT". This project is scheduled to commence this year to evaluate the work required, and the cost estimates, to upgrade the streetcar network to accommodate new low floor LRT cars. Most of the civil work for routes with no service platform will be common to both CLRVs with lift and low floor vehicles. For routes with service platforms, the major difference will be that the lateral reach (extension) of the platform on a low floor car is significantly reduced due to the low floor height being only approximately 350 mm above the top-of-rail, compared to 920 mm on a CLRV.

Workscope definition and cost estimate for these changes will be prepared in 2007, with some rough-order-magnitude estimates available in 2006.

Conclusion

Based on staff's research on the means of making the current streetcar fleet accessible, and discussions with the Office of Accessibility at APTA, the UITP Task Force leader on "Guideline for European Internal Market for Light Rail System on Accessibility", and other transit properties in North America, and on consideration that:

- there exists a significant safety concern for people in a wheelchair or on crutches on a 920 mm high lift while in the path of automobile traffic, particularly at non-platformed stops;
- the only technically feasible lift device would cost approximately $80,000 per car, or 15.7 million dollars for the fleet of 196 CLRVs; and,
- the increased operating costs due to increased headway and higher demand for vehicles to maintain the same service level due to the deployment time required for lift operation,

staff conclude that this is not a practical objective and recommend that this not be pursued further.

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Attachments: Appendix 1 – Preliminary Feasibility Assessment – Wheelchair Lift
Appendix 2 – Preliminary Implementation Investigation Report

APPENDIX 1

Preliminary Feasibility Assessment
WHEELCHAIR LIFT
Life Extension Program – Canadian Light Rail Vehicles

A. Basic Information

Type	Lift Configuration	Manufacturer	Appl'n	Deploy & Retrieve Time	Comment
1	Rotary / swing (Dismissed by Senior Management – slow, labour intensive & risk of occupation injuries)	Stewart & Stephenson, Ricon	SEPTA PCC II	~ 4 min.	Major structural change for lift support post, and, a. If for front door, loss of sandbox seat, centre stanchion, passenger line of sight through windshield blocked, vestibule / aisle width considerations; b. If for rear door, change to slide-plug or bi-fold (same as front) doors required, loss of 2 seats for lift mechanism.
2	Floor-mounted	Ricon, Maxon Mobility	Van, vintage trolley or highway coach	TBD	• Requires new dedicated door by converting 1 window; • Plug doors & door operator; • Structural reinforcement; • Can accommodate people on crutches and with stroller as door height can be 72" • Most sheltered, simple and economical lift
3	Behind step riser cartridge	Lift-U	Bus, van	N/A	Declined TTC enquiry – no design to suit CLRV
		Ricon, Maxon Mobility	Bus, van	TBD	Requires 72" stow depth – no room on CLRV. Impossible on front door due to coupler mounting anchor beam
4	Under-vehicle cartridge	Braun	Bus, coach	TBD	Requires 72" stow depth – no room on CLRV
5	Folding Step	Ricon	Bus	TBD	CLRV has 3 steps. Ricon design has 2-step only – can develop but recommend against it due to vendor's concern about complexity and reliability.
		RTS	RTS bus	TBD	Purpose built / designed for RTS bus, sells separately for ~ US$30K. Can develop 3 step lift for TTC @ $???

B. Assumptions:

- All types meet ADA requirements in Test Load, Size, Bridgeplate and Guard Provisions, and Fail-Safe Design etc.

C. Common issues:

- All lift types except Floor-Mounted (Type 2) are only for wheelchair bound persons; **not** for standing persons with leg in cast, on crutches or with a baby stroller – door opening measures 57" (1.45m) from floor, destination sign box 15" (37 cm) with door operator mechanism inside.
- For front door installation, eliminate side destination sign and retrofit taller doors for standing headroom to meet FULL accessibility?
- For rear door and with step type lift, (i) heater is needed to melt snow / ice; (ii) treadle mat door control has to be changed to an infra-red or pushbar type door activation system for rear door installation.
- Change seats to provide for flip-up seats for wheel chair positions; tie-downs; wheel chair space delineations. Alternatively, remove seats for wheelchair space(s) and increase standee area if no wheelchair on board. Could lose up to 3 rows (8 seats) for floor-mounted type lift with dedicated doorway.
- Impossible to free up undercar space for lift power & hydraulic equipment

D. Safety Issues:

- Backup power source, hydraulic source, hand pump,
- Mechanical failures **while person on lift**.
- Binding / freezing of hinges, bearings, pins, bushings or other moving parts **while person on lift**.
- Clearance
- Interface with uneven platform/roadway surface
- Integrity of operational interlocks and proximity sensors
- Potential occupational injury – swing load, bend load, finger entrapment

E. Rough Order Magnitude Cost Estimate:

Type 2 – Floor-mounted. Assuming Cerajet "sander" test is successful and it can be truck-mounted, it will cost approximately $80,000 per car, or 15.7 million dollars for a fleet of 196 CLRVs, with seat conversion to perimeter flip-ups.

F. Impact to LEP Schedule:

Approximately 3 to 6 months, depending on complexity of changes to scope of work, such as door system design changes and if taller doors should be installed to provide necessary headroom for standing persons on crutches.

APPENDIX 2

Preliminary Implementation Investigation Report
FLOOR MOUNTED LIFT INSTALLATION
Life Extension Program – Canadian Light Rail Vehicles

1. Objective

The installation of a Ricon Klearvue or Maxon Mobility style wheelchair lift on the open side of a CLRV using a dedicated access door will require modifications to the vehicle structure and the installation of a slide and plug door with the necessary door operator mechanism. The purpose of this report is to outline the issues involved in designing an installation of the lift.

2. Background

Three possible lift installation locations were considered as part of the CLRV Life Extension Program: front door, rear door, and a dedicated access door. Each of these locations proved to have advantages and disadvantages:

- The front door location for a wheelchair lift would result in the cleanest installation from a vehicle interior aspect but a satisfactory lift could not be located. The two possible lift types that could be utilized at the front step entryway are a step conversion lift or an undercar cartridge lift. The custom design of a 3 step conversion lift would make it a very expensive and unreliable option. The second option, a cartridge style lift installation, is not possible for as long as provisions for Multiple Unit Operation must remain on the car. An installation of a cartridge lift at the front doors would require the removal of the under car coupler anchor beam.

- The rear door installation would severely reduce the passenger flow by narrowing the rear door to approx half the current width. A rear door lift installation would require replacement of the existing doors due to their current two-stream, bi-fold configuration.

- The dedicated access door option is the most labour intensive option as it requires an opening to be cut into the vehicle skin and new door operator tracks to be designed and installed. If a dedicated access door is installed, a widely utilized lift on highway coaches from Ricon or Maxon Mobility can be modified and fitted onto the interior floor of the vehicle.

3. Vehicle Modifications

a) Vehicle Side Skin Structure

In order to accommodate a door opening in the existing vehicle side skin, a portion of the skin and the re-enforcement ribs will have to be removed. Current spacing of side skin vertical members allows for a door width of approx. 50”. A door height of 72” can be accommodated with re-enforcements to the door header skin. Structural analysis of the vertical members on either side of the opening will need to take place to assure adequate re-enforcement to support the roof structure and the new air conditioning unit. Proximity to the front door existing opening will need to be taken into consideration.

b) Floor Structure

Ricon Klearvue and Maxon Mobility style lifts are floor mounted on the inside of the vehicle using a sill plate that bolts to the floor structure. Re-enforcement of the corrugated steel floor will be required to provide adequate strength to the lift installation. A steel plate will be required to bridge the corrugated steel flooring and supplementary structural members will need to be added to the underside of the floor to properly distribute lifting forces exerted by the lift.

c) Door Geometry and Operators

Due to the high off-the-ground dimension of the proposed access door, minimum swing out is desired to prevent accidental contact with passengers at platforms waiting to board vehicle. Based on the above, a parallelogram plug door would be the most favourable door geometry. A single sliding door, as shown in the vehicle mock-up diagram above would allow for the wheelchair ramp to be near the front entry doors and farebox. Due to the width of the proposed door (min 47”), this installation would require door tracks to be located on the side vehicle skin in the area that the door opens into. A door operator would need to be designed to open and close the door. This operator would be mounted on the inside of the moving door.

An alternate to the single sliding door is a double opening door arrangement is depicted in the accompanying picture. This is a common door arrangement found on coach type bus vehicles and utilized a proven door operator mechanism. The width of the door panels would require that the location of the access door be moved one window to the rear from the above location.

d) Vehicle Interior

The interior mounting design of sand box be redesigned or front of the lift will not have any the path to the lift must remain the lift will require that the relocated. The area directly in floor mounted stanchions as clear.

Locating the dedicated access door at the first window behind the front doors allows for the termination of the floor heater duct at the lift installation. Relocating the access door further to the rear of the vehicle will require a bypass duct to be used to deliver air to any floor heaters on the other side of the lift. The current heater design is a rear to front forced air system.

Five seats will be lost to create the mounting space for the floor mounted lift, this number increases to 6 if the access door is relocated further down the vehicle. Fold up seats will have to be strategically located on the vehicle floor plan to secure wheelchairs

during transit. Additional loss of seats due to the installation of fold up seats may result.

e) Interior Lighting

The area near the lift will require dedicated lighting. This lighting must be able to illuminate the ground level that the lift services. Interior lighting of the vehicle may be affected by the door header and door operators that will have to be mounted behind the advertising sign assembly.

f) Stop Request

The stop request pull cord will be terminated at the dedicated access door resulting in the need for push buttons in the lift area. The location of these stop request push buttons will have to be determined once the stanchion location issues are resolved.