Metro Line LRT

Status Update

Recommendation:

That the August 17, 2015, Transportation Services report CR_2712, be received for information.

Report Summary

This report outlines the Metro Line LRT public communications plan, significant deficiencies related to the project, and developments regarding the status of efforts to open the Metro Line for revenue service.

Previous Council/Committee Action

At the July 7, 2015, City Council meeting, the following motions were passed:

1. That the City Manager develop and immediately implement a public communication plan that will ensure maximum transparency on the progress toward the opening of the Metro Line, including regular bulletins for public, stakeholder and Council awareness.
2. That Administration provide a report to Council that outlines any significant deficiencies with this project, the remedy that was secured in each case, and what, if anything, has been learned that will be applied to future similar projects.
3. That a Special City Council meeting be scheduled on August 17, 2015, from 1:30 p.m. to 5:30 p.m.

Report

Public Communications Plan and Activities

Administration has implemented a public communications plan to ensure openness and transparency regarding status and significant decisions relating to the City's goal to open the Metro Line as soon as possible for safe and reliable public service. Communications build on the practices established for Metro Line engagement, which include:

- regular updates to City Council
- stakeholder updates through the project email bulletin to more than 400 subscribers
- proactive and reactive media relations, including media briefing sessions to announce significant developments
- project newsletter distributed electronically to subscribers and mailed to businesses and residences surrounding the Metro Line between MacEwan Station and NAIT station

- key internal and external stakeholder meetings including NAIT, MacEwan, the Royal Alexandra Hospital, Kingsway Mall and students' associations
- web updates and information (http://www.edmonton.ca/metroline)
- social media engagement with more than 23,000 followers
- responses to public inquiries via the LRT Projects Information Centre

In addition to updates to City Council about the Metro Line, Administration will increase the frequency of the City's proactive outreach to stakeholders and the public.

Significant Deficiencies – Civil Construction

There are no significant civil construction deficiencies with the Metro Line project. Civil construction deficiencies are to be expected with any infrastructure project, and while the Metro Line LRT project experienced typical civil construction deficiencies, none of them have impacted timelines for the opening of the Metro Line to public service. Furthermore, civil construction deficiencies have not caused any delays with implementation of the Metro Line signalling system.

Generally speaking, deficiencies are classified as either minor or major. Minor deficiencies (e.g. scratched paint on a pedestrian access ramp handrail) involve non-essential aspects of infrastructure that do not impact LRT operations. Major deficiencies (e.g. guardrail heaving) involve essential aspects of infrastructure that could impact LRT operations. A major deficiency is only considered to be significant to the overall project if it carries impact to the substantial completion of the infrastructure in question and has bearing on whether or not the infrastructure will be fit for public service. Furthermore, a deficiency is only considered to be significant to the overall status of a project in terms of project schedule, scope, cost or risk.

The City follows a robust quality management process with contractors and an independent engineering expert, referred to as the Owner's Engineer, to correct deficiencies as they occur. For the Metro Line civil construction, the City engaged the North Link Partnership, a joint venture between SNC Lavalin and Graham Construction & Engineering Inc, and AECOM as Owner's Engineer. The quality management process for Metro Line civil construction uses three main tools: Inspection and Monitoring; Non-Conformance Reports; and Deficiency Lists.

Inspection and Monitoring

During construction, City staff, the Owner's Engineer, and contractors perform regular (i.e. daily) site checks of work as it progresses. Field reports are proof of these regular site checks. Issues raised during site checks are often addressed immediately and therefore no further follow-up documentation beyond the completed field report is required, as the field report documents the issue resolution.

Non-Conformance Reports

A Non-Conformance Report documents any item that does not comply with contract specifications once the work component is substantially complete. When an item is identified (i.e. in a field report) a Non-Conformance Report is created and the contractor,

Owner's Engineer, and City staff discuss the best way to remedy the problem using one of four options:

- repair or replace a deficient part
- mitigate the deficiency by redoing the work
- use as-is because the deficiency is inconsequential
- accept the deficiency with compensation (e.g. financial consideration, extended warranty, etc.).

Before any solution is finalized, both the Owner's Engineer and the contractor responsible for the original design of the specific item must verify that the resolution is acceptable and meets the original function and intent of the design.

With the Metro Line, Non-Conformance Reports identified 215 issues of non-conformance with contract specifications. Most Non-Conformance Reports (177, or 82 per cent) were resolved as repair/rework, or were accepted with compensation. For example, as part of the Metro Line, contract tactile warning strips for visually impaired pedestrians are being installed at several road crossings. In 2012, a Non-Conformance Report indicated that some of the tactile warning strips were missing or had been incorrectly installed. The Non-Conformance Report disposition was to repair the tactile strips, which was done.

Thirty-eight of the Non-Conformance Report issues (18 per cent) were resolved by accepting use as-is, because the non-compliance issues were inconsequential to the overall completion and operation of the Metro Line project. For example, during construction of the tail track by Health Sciences Station, a concrete median was built in the middle of 114 Street in order to close vehicle access to 83 Ave south of the LRT station. Design specifications called for a break in the median to allow for drainage, but during construction, the subcontractor placed the drainage channel farther south than the contract specified. Through observation, it was determined that the drainage still functions as intended, therefore the Non-Conformance Report disposition was to use as-is.

Deficiency Lists

Deficiency Lists are primarily related to quality. Once the work is considered to be substantially complete, a Deficiency List is generated. It is standard practice to grant completion certificates with a list of deficiencies that must be repaired, including a holdback dollar amount and a planned timeline for rectification. Deficiencies can also be identified during the warranty period, and must be repaired before final acceptance by the City at the end of the warranty period, otherwise the contract is still considered open and the contractor is obligated to meet its requirements at the contractor's expense.

Currently there are 31 civil construction deficiencies still considered open on the Metro Line, all of which are being addressed through the City's quality management process. Twenty-five of these deficiencies are considered minor. Six of the 31 deficiencies are

considered major deficiencies (see Attachment 1). None of the deficiencies are considered significant, because they have no impact on substantial completion of the infrastructure in question and have no bearing on whether or not the infrastructure is fit for public service. None of the outstanding deficiencies has resulted in extra costs to the City or impacted the timing of the opening of the Metro Line to public service.

South LRT Comparison
Overall, the Metro Line project has experienced 1114 civil construction deficiencies. This number is typical for an infrastructure project of the Metro Line's scope. In comparison, the South LRT extension of the Capital Line from South Campus to Century Park experienced 1230 deficiencies as a regular part of a major civil construction project. None of the South LRT deficiencies resulted in extra costs to the City, and all have been resolved.

Auditor Comments
The Office of the City Auditor produced a Capital Projects Advisory Assistance Status Report about several City projects on January 22, 2014 (Audit Report # 12343), to investigate whether or not "sound management practices are being applied consistently throughout the life of a project" (Page 1). In reference to the Metro Line project, the City Auditor's Capital Projects report stated that, "Based on our review, we believe that the LRT Design and Construction office continues to apply leading project management practices" (Page 9), including the quality management of construction-related deficiencies. Lastly, the Office of the City Auditor concluded that the "… Metro Line LRT, NAIT to downtown construction has provided us with insights into the City's continuous improvement of its project management practices" (Page 11).

Significant Deficiencies – Communication Based Train Control (CBTC) Signalling
The significant deficiency related to the delay of the Metro Line is the lack of functionality of the Communication Based Train Control (CBTC) signalling system and documentation supporting testing and safety certification.

The City engaged Thales Rail Signalling Solutions Inc. (Thales) to deliver a Communication Based Train Control (CBTC) system for the Metro Line and Hatch Mott MacDonald as Owner's Engineer for the signalling system work.

Communication Based Train Control (CBTC) Signalling System
Light Rail Transit systems require a signalling system for many purposes, such as activating controls (e.g. signal lights), providing train movement updates (e.g. switch activation and station announcements), and initiating safety measures (e.g. intersection crossing arms). All signalling systems must provide such basic operations and maintain safe distance between each train on the system. When it comes to maintaining space between trains, there are two basic types of LRT signalling systems: the traditional fixed block system and the more advanced moving block system.

A fixed block system, like the one currently operating on Edmonton's Capital Line LRT, maintains a block of empty space on the tracks between trains. Tracks are divided into

blocks of space and a train cannot enter a block of space until the train ahead of it has cleared the way, leaving an empty block of space between trains.

With a moving block system, like the Thales Communication Based Train Control (CBTC) system, the block of empty space is kept around each train, rather than between trains. Using advanced technology, trains communicate with each other, with a zone controller and with a master control, to maintain safe distance. This allows safe operation of trains closer together than a fixed block system, resulting in increased frequency of service for passengers.

The Metro Line is designed to enhance Edmonton's transportation system, not only by providing an LRT connection between Churchill Station and northwest Edmonton, but also by providing greater frequency of service between Churchill Station and Health Sciences Station. This section of LRT experiences heavy ridership that is expected to increase as Edmonton's population grows. Increasing LRT frequency to two-and-a-half minutes during peak periods through this section is the main benefit of adopting a Communication Based Train Control (CBTC) system. Furthermore, the Metro Line is expected to bring more than 13,000 new passengers to Edmonton's LRT network, thus increasing demand for frequency of LRT service. The Communication Based Train Control (CBTC) system is an innovative approach to managing increasing ridership, but the technological leap that Communication Based Train Control (CBTC) offers carries inherent risks, as many public transit authorities around the world are currently experiencing. Edmonton is not unique in its struggle to adopt Communication Based Train Control (CBTC)-type technology.

Project Timeline, Delay and Update

At time of writing, the Metro Line LRT project is almost 16 months delayed from its original targeted opening in April 2014 due to deficiencies with the Communication Based Train Control (CBTC) signalling system. Although construction was complete on time and the civil components of the infrastructure (i.e., tracks, stations, etc.) are ready for public service, it is taking Thales longer than anticipated to complete the signaling system.

Thales' challenge is complex and has many aspects. The primary aspect is a lack of functionality related to the integration of signalling software between the Communication Based Train Control (CBTC) system for the Metro Line and the existing signalling system on the Capital Line. Thales has encountered numerous issues related to the software integration, such as periodic instances where a train ceases its communication with the rest of the system. Communication issues of this type can only be remedied by Thales adjusting the software integration between the two systems. Overall, functionality issues related to software integration must be resolved by Thales for the Communication Based Train Control (CBTC) system to be fully operational.

As the project chronology indicates (see Attachment 2), the signalling deficiency originally manifested as a missed milestone in August 2011, when Thales failed to provide the Concept Design Report for the Communication Based Train Control (CBTC)

system. This report was eventually delivered in October 2012. This delay in delivery was the first in a series of missed deadlines by Thales that included:

- preliminary design report (due November 2011; delivered June 2013)
- final design report (due Feb 2012; still outstanding)
- first article inspections (due July 2012; delivered September 2013/August 2014)
- training and spares (due May 2013; still outstanding)
- practical completion of work (due January 2014; still outstanding)
- Six-month Performance Demonstration (due July 2014; not yet begun)
- Twelve-month Performance Demonstration (due January 2015; not yet begun)

With each missed deadline, the City expressed its concern to Thales and requested revised work schedules. The City escalated its concerns by withholding payments to Thales beginning in February 2012. Several payments have been withheld since then. To date, the City has paid for work Thales has performed as required by the contract, but withheld approximately 50 per cent of the value of the Communication Based Train Control (CBTC) signalling contract, which is worth $53.4 million.

In September 2013, the latest schedule from Thales had the Metro Line on schedule for an April 2014 opening date. In December 2013, Thales updated their schedule again, indicating an opening date of June 2014, with reduced service. Administration informed City Council on December 4, 2013, that the Metro Line would be delayed. In January 2014, the City escalated its project oversight and continued working with Thales and Hatch Mott MacDonald on a revised project schedule. The City also engaged a project management expert, SMA Consulting Inc., to monitor the Metro Line's progress and track deficiency aspects with the signalling system. In February 2014, Thales began working on a staged implementation of the Communication Based Train Control (CBTC) system in an effort to mitigate further delays, with a commitment to hand over the system to City control in November 2014 for a December opening. However, Thales also failed to meet this timeline, as well as a subsequent December 31, 2014, commitment. On March 23, 2015, Thales handed over part of the CBTC system to the City, along with documentation supporting staged implementation of Communication Based Train Control (CBTC) operations and a safety certificate that Thales produced.

Currently, the most significant aspect of Communication Based Train Control (CBTC) signalling deficiency is the lack of documented evidence supporting Thales' system safety certification and Hatch Mott MacDonald's inability to recommend the Metro Line as suitable for full, unrestricted operation in public service. The City requires both of these in order to fully open the Metro Line. Hatch Mott MacDonald reviewed the documentation provided by Thales supporting their safety certificate. After reviewing the documentation, Hatch Mott MacDonald determined that, although it was sufficient to begin training operations, it was insufficient to demonstrate that the Communication Based Train Control (CBTC) system was suitable for public service. While Hatch Mott MacDonald worked with Thales to obtain the proofs necessary to confirm Thales's documentation, Administration began training operations in preparation for the opening.

Communication between Hatch Mott MacDonald and Thales did not yield the necessary information to demonstrate sufficient assurance of Thales' safety documentation.

In July 2015, the City sent Hatch Mott MacDonald representatives to Thales' offices in Toronto to conduct spot audits of safety certificate documentation. Hatch Mott MacDonald was "unable to confirm that Thales have a sufficient trail of documentation to demonstrate that they have followed due process in compiling the Safety Case". Therefore, the City accepted Hatch Mott MacDonald's recommendation to undertake an independent safety audit of Thales' documentation.

Next Steps

The City has retained Rail Safety Consulting (RSC), a U.S. firm specializing in rail safety audits, to identify gaps in the documentation and work with Thales to close them. Rail Safety Consulting (RSC) has advised the City that an initial assessment will be available in six to eight weeks, depending on the documentation made available by Thales. Rail Safety Consulting (RSC) also anticipates the complete independent safety audit could take approximately six months, depending on the information gaps that exist and the work required to close them. Once Rail Safety Consulting (RSC) and Thales identify and close remaining gaps, by providing documented proof of the safety certificate, the City will phase in the first stage of Communication Based Train Control (CBTC) system operations.

In the meantime, the City has explored options to open the Metro Line. The project team has developed a 'line of sight' operation that is safe and suitable for public service, and can be implemented immediately, so the Metro Line can open in time for the start of the school year.

'Line of sight' is a railway industry mode of operation that requires a speed restriction so that train operators can come to a stop within half the range of their vision. The 'line of sight' operation for the Metro Line requires that trains do not exceed 25 km/hr between MacEwan and NAIT stations. The speed restriction will allow LRT service approximately every 15 minutes between Churchill and NAIT stations. Travel times and frequencies are better than bus service (approximately 14 minutes), but do not meet the contractual terms agreed to by Thales.

The City's objective remains to graduate operations to the full Thales Communication Based Train Control (CBTC) system as per the contract. The Communication Based Train Control (CBTC) system is an integral part of Edmonton's LRT development and it is required to meet current and future LRT ridership demands. Any option that opens the Metro Line to public service without using the complete Communication Based Train Control (CBTC) system does not fulfill Thales' contractual obligations, and is not acceptable as a long term solution. Administration continues to work with Thales to ensure it meets its obligations to bring the Communication Based Train Control (CBTC) system into full revenue service as soon as possible.

Lessons Learned

The key lesson that the City has learned from its experience with the Metro Line signalling deficiency is not to split a major construction infrastructure contract into separate project delivery models with differing lines of accountability and differing degrees of contract leverage. The contract for the Metro Line was split into two parts, using two different project delivery models. The civil construction is being delivered under a Construction Manager contract, while the signalling system is being delivered under a Design/Build contract.

Background

Infrastructure projects can be delivered using a number of different project delivery models. For example:

- A **Design/Bid/Build** model uses a contract where a contractor is hired to build the infrastructure based on pre-existing detailed design completed by the City. This method was used to construct the South LRT Extension.
- A **Design/Build** method uses a contract where the contractor that designs the infrastructure is also responsible for building the infrastructure. This method was used for the Metro Line Communication Based Train Control (CBTC) signalling contract.
- A **Construction Manager** method uses a contract where the contractor(s) that design the infrastructure have the opportunity to bid on contracts to build the infrastructure. This method was used to construct the Metro Line civil infrastructure.
- A **Public-Private Partnership (P3)** model uses a contract where a private sector consortium invests its own capital to design, construct and operate the infrastructure according to strict performance specifications. This method is being used to design and construct the Valley Line.

The City selected a Construction Manager delivery model for civil construction of the Metro Line. Typically the LRT Design & Construction Branch is responsible for setting up and executing contracts for LRT projects in Edmonton. The LRT Design & Construction Branch was responsible for set up and execution of the Metro Line Construction Manager contract. This model was selected primarily because the Construction Manager model holds the contractor responsible for all aspects of a construction project, including project schedules. The City conducted a standard procurement competition and the successful proponent for this contract, the North Link Partnership, was responsible for all Metro Line civil construction.

However, the Metro Line signalling system was separated from the Construction Manager contract and the North Link Partnership was not responsible for its delivery. The decision to separate the signalling contract was made because of the choice to use the advanced technology of Communication Based Train Control (CBTC). Adopting Communication Based Train Control (CBTC) meant there would be considerable benefit for the Edmonton Transit System (ETS) to have primary project oversight:

- ETS has local knowledge of and expertise with LRT signals in Edmonton.
- Integrating the Communication Based Train Control (CBTC) system with the Capital Line signalling system required significant ETS involvement and coordination with ETS operations.
- Retrofitting the City's fleet of light rail vehicles required significant coordination with ETS maintenance operations at D.L. MacDonald garage.

A separate Design/Build contract for the Metro Line signalling system was created and its execution was assigned to ETS. The City conducted a standard procurement competition and the successful proponent for this contract, Thales, was responsible for designing and building the Communication Based Train Control (CBTC) signalling system for the Metro Line.

Separating the signalling system contract from the overall civil construction contract resulted in differing lines of accountability and differing degrees of contract leverage. On the accountability side, the construction contract and the signalling contract did not follow the same project management principles. Management of the signalling contract did not have clearly defined roles and responsibilities, which resulted in a breakdown of the chain of command and inability to address emerging issues in a timely manner. It also resulted in a lack of communication with senior management and City Council.

On the contract leverage side, the use of a Design/Build model in a situation where overall project responsibility for delivery and success was divided between two proponents reduced the City's ability to benefit from the combined leverage of the Construction Manager contract, where all contractors are held accountable collectively for their performance. If the signalling contract had been included in the Construction Manager contract, the North Link Partnership would have been accountable for delivery of the signalling system, as it was for the civil construction. The collective accountability inherent in the Construction Manager model would have provided much more rigorous project oversight, quality management, and contingencies for deficiencies.

The decision to split the Metro Line contract was made for sound reasons, as there was considerable benefit to be gained from ETS playing the project manager role, overseeing the adoption of advanced Communication Based Train Control (CBTC) technology. But the risk of sacrificing contract leverage by splitting the signalling contract from the overall Construction Manager contract has materialized, and it outweighs the benefit of ETS involvement and expertise with LRT signals. Despite significant payment holdbacks the signalling contractor, Thales, has yet to meet its contract obligations.

The City has taken steps to ensure this kind of contract separation is not repeated. For instance, lessons from the Metro Line project were applied to the Valley Line Public Private Partnership (P3) project agreement that places substantial financial incentives on the proponent for complete project delivery, and incorporates an independent safety audit into the compulsory hand-off process.

In future, the City will engage third party experts to review project management issues as soon as project milestones are being missed. For example, in 2014, the City engaged a third-party expert to investigate project management issues with the Metro Line, and they continue to provide valuable insight related to project management and advice on course-corrections. This kind of third-party review could have been incorporated earlier in the project lifespan.

The City will also ensure that consistent principles and methodologies are adhered to, including quality assurance and quality control activities through training and/or advanced project management tools. Furthermore, the City will ensure that project roles and responsibilities, lines of communication, management of working relationships and decision authority levels are clearly defined, assigned, and communicated for all major projects. To this end, Transportation Services will work with Financial Services and Utilities and the Corporate Centre for Project Management to develop a standard corporate reporting methodology for major capital projects that will include schedule, scope, and budget status, as well as overall risk assessment and quality management.

Clearly, the early failure to escalate Metro Line schedule concerns led to poor communication with City Council and the public. Transportation Services began regular project status reporting in December 2013. In future, the City will provide more regular updates about major infrastructure projects to City Council and to the public.

Summary

The City has developed an interim approach to open the Metro Line to public service in September 2015. The City has initiated an independent safety audit of documentation related to the signalling system that Thales has been contracted to provide. The City has learned that contract decisions about project delivery models and project management structures should not be made in isolation. Lessons learned from the Metro Line project are being applied to the City's overall approach to LRT development, including procurement for the Valley Line LRT project.

Attachments

1. Metro Line LRT Summary of Major Civil Construction Deficiencies
2. LRT Metro Line Chronology