GO Transit’s Union Station
Infrastructure Improvement Program

Special Track Upgrades

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Abstract

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GO Transit operates a regional commuter rail service with its primary operations hub at Toronto’s Union Station. GO Transit has embarked on a multi-year infrastructure improvement program to upgrade the entire plant within the 6 km Union Station Rail Corridor (USRC). Presently, GO Transit is installing Special Trackwork and performing early works to facilitate the upgrade to signals, electrical and communication plant.

This paper, will describe upgrade of the special trackwork, focusing on the installation process and the lessons learned from this process.

This paper will therefore provide:

- An overview of the Upgrade Program
- Details of the Special Trackwork upgrade such as:
  - Procurement of special trackwork, including 50 double slip switches
  - Procurement of track panel lifting device
  - Roadbed construction
  - Installation of track panels
- Details associated with early signal works such as:
  - Design
  - Testing
- Details of the enabling works such as:
  - Retaining walls
  - Troughs and duct banks
  - Maintenance roads
- A comprehensive listing of the lessons learned during the process
SPEED UPGRADE THROUGH SPECIAL TRACKWORK

INTRODUCTION

The Greater Toronto Transit Authority (GO Transit) is currently implementing a major upgrade to the Union Station Rail Corridor (USRC) known as the USRC Infrastructure Improvement Program (IIP). It includes station improvements, track and signals upgrades, as well as related enabling works. This paper will focus on the upgrade of the special trackwork and some of the associated work.

BACKGROUND

Toronto’s Union Station, and its 3½ (5.6 kms) mile rail corridor, is Canada’s busiest commuter passenger rail terminal. Union Station and its corridor were originally constructed by the Grand Trunk and Canadian Pacific railways in the late 1920’s. GO Transit purchased these rail assets from the railways in 2000. The USRC is the hub of GO Transit’s commuter passenger rail services with 12 platforms to service patrons. The USRC also serves VIA Rail Intercity service, Amtrak, Ontario Northland and both the Canadian National (CN) and Canadian Pacific (CP) freight systems. Rail movements are controlled by approximately 260 power switch machines and approximately 300 signals, which, for the most part, date back to the 1920’s. The operation and maintenance of the USRC is contracted out by GO Transit to the Toronto Terminals Railway (TTR).

During its first year of operation in 1967 GO Transit’s yearly ridership was 2.5 million and its current ridership is 50 million people per year. This increase has been achieved by maximizing capacity using existing facilities with no major upgrades to the infrastructure. Today’s ridership is expected to double by the year 2031 and it is recognized by both the federal and provincial Canadian governments that significant infrastructure upgrades are required to meet projected demands. The USRC IIP was therefore established with a mandate to upgrade items such as platforms, track and signal systems.

To facilitate the upgrade, GO Transit hired a Joint Venture (JV) consulting team to perform the overall management. The JV team includes personnel from Hatch Mott MacDonald, Delcan Corporation and IBI
Group and is known as the HDI Joint Venture. To establish design goals for the upgrades a Working Committee (WC) with appropriate personnel from each of GO Transit, TTR and HDI was formed.

To maximize the capacity of the upgraded USRC, one of the items agreed by the WC was a design speed of 30 mph through the divergent route of the special trackwork and 45 mph on tangent routes.

EXISTING TRACK CONFIGURATION

The existing USRC track configuration provides extremely good operational flexibility. Redundant ladders in both directions provide recovery options for operational disruptions and routing alternatives. The major disadvantage, however, is the civil speed of 15 mph over divergent legs imposed by #11 Double Slip Switches (DSS) and the #11 lateral turnouts.

The challenge of the design team was to see how speeds could be increased and implemented within the existing track layout. When presented to the WC it was quickly realized that the best solution was to design special trackwork to accommodate the higher speeds within the same footprint.

Through consultation with track manufacturers, it was determined that a DSS could be designed using tangential geometry with a 1200 foot radius in the diverging route which would allow 30 mph and stay within the existing USRC footprint.

OTHER SPECIAL TRACKWORK DESIGN UPGRADES

There are several other innovations that were added to the special trackwork to improve the stability of the facility for increased speeds.

These improvements include:

- Full elastic fastening system – no cut spikes.
- Longer, fuller steel support plates throughout.
- Robust insulated joint technology with elastic fasteners.
- Hollow Steel Ties (HST) for all track connecting rods that can be tamped.

Figure 1 Hollow Steel Ties Installed
• HST for mounting switch machines and protecting switch machines rods.
• Special non-conducting plates supporting insulated joints.
• Non conducting gauge rods.
• Steel tie ducts for snow clearing devices.
• Implementation of Stanley Pin Brazer for Signals bonding

PROCUREMENT OF SPECIAL TRACK WORK

A tender for the procurement and design of 50 Double Slip Switches and 50 Single Switches and 6 Diamonds was prepared in 2005. The procurement included pre-assembled panels on pre-drilled wood and composite ties. Delivery to site is staged over four years (2006 through 2010) and is being performed by panel cars (25%) and truck (75%). The procurement was awarded to VAE Nortrak for approximately, $21 million Canadian.

SPECIAL TRACKWORK INSTALLATION USING A TRACK PANEL LIFTING SYSTEM

Past practice was to build the DSS in three pieces off site, then perform final assembly at the permanent location. Typically this took 2 weeks to complete and had a major impact on USRC operations.

After reviewing alternate methods of installation the design team decided that a track panel lifting and transporting device would best suit installation of panels.

A tender for the procurement of a track panel lifting device was prepared in 2005. The successful proponent was Modern Track Machinery with a machine called a PEM LEM.
The PEM LEM has twelve units that act as one and was purchased for $2 million Canadian. It has lateral traveling capabilities and can transport a complete 180 ft., 50 ton fully assembled DSS track panel to its permanent location.

To ensure that project wouldn’t be delayed due to any failure of the PEM LEM the project team decided to enter an on call service agreement with the vendor of the PEM LEM. The service agreement requires technicians on site during critical PEM LEM operations i.e. moving and placing panels. This proved to very beneficial to project.

**TRACKBED CONSTRUCTION**

Geotechnical investigations revealed very poor ballast and subballast conditions. Hence, it was advantageous to rehabilitate the subgrade and ballast at the same time as the special trackwork installation. 12 inches of new modified free draining Granular B subballast was installed and compacted. On top of the subballast, 12 inches of new granite ballast was added below the bottom of ties.

In addition to the substructure construction it was necessary to provide new conduits beneath the special trackwork to facilitate the installation of future signal cables for the new signalling system that will be installed following the completion of the special trackwork upgrades. This was done to prevent future excavation for signal cable installation that would contaminate the newly installed ballast and subballast.

**PREPARATION OF TRACK PANELS**

Track panels arrive at site by one of two methods. 25% arrive by rail panel car and 75% by truck. They are then assembled in a pre-build area. This activity is a continuous operation for the track forces, keeping them fully employed 12 months a year. Preparation of the panels includes, the installation of switch machines, bonding and tie ducts for snow clearing devices.
This process has worked well with the exception of the installation of pre-drilled ties. Ties are now drilled on site as it was determined that that pre-drilled ties are not built to tight enough tolerances.

Initially, much effort was spent ensuring the pre-built panels were completely adjusted from both a track and signal point of view - for instance switch machines being fully adjusted. However, once the panel was installed it was discovered that almost the same amount of time was required to readjust components. It was therefore decided to only rough adjust the track and signal rods at the pre-build area and perform the final adjustment after the panel is installed in the track.

**INSTALLATION OF TRACK PANELS**

Crews work the day prior to the installation preparing the site for the installation. In most cases the old track sections are removed piece by piece. Removal of old track panels with the PEM LEM was attempted but the integrity of the wood ties prevented this in most cases.

The PEM LEM system is then used to transport the full DSS from the preassembly site to installation site. The delivery time is dependant on distance but generally it takes 1-2 hours.

Installation into the prepared area is accomplished by using a temporary track. This allows panels to be driven right in to the placement area and was the best solution for this installation. Final placement takes approximately one hour.

The safety of the site and site security are also of prime importance. The major work at the site and the movement of panels required tracks to be blocked with Track Occupancy Permits (TOPs). Unfortunately, the length of time required to establish and adjust these TOPs hampered movements within the interlocking. A new method for track protection was therefore implemented for major work installations, whereby the interlocking or large parts of it, were removed from service between 0100 hours and 0500 hours. This was under the strict control of Train Movement Director (TMD) who was specifically tasked to control train movements adjacent to the construction zone. Extreme care was exercised by the TMD and the superintendent in charge to ensure no trains came into the zone and that both personnel and equipment were protected at all times. This protocol was critical in the diamond areas as at least 3 or 4 tracks had to be to be removed from service to perform the installation.
Due to the amount of complex track components to be installed in a very confined area, the installation team found that the effort required to deal with interlacing of ties or adjacent tracks was much greater and more difficult than envisioned. Hence more time was spent in planning this activity.

Installation of frogs was in most cases the tie between sequences. To allow field fitting of this critical connection between stages the project team ordered frogs with longer frog rails. These rails allow for final installation to be completed in the field where minor changes could be made to the rail length to accommodate a new insulated joints location between an adjacent DSS on ladder tracks etc.

The DSS is connected to the adjoining tracks, ballasted and tamped. Signal crews install the switch machines and control cables. Once final testing and commissioning of the signal system is complete the new DSS is put into service.

The whole process now requires only a weekend to complete.

**SIGNS WORK TO ALLOW SPECIAL TRACK UPGRADES CONSTRUCTION**

Temporary signal work to facilitate each stage of trackwork is required and must be performed so as to minimize disruption to train operations. This has proved to be a very big challenge. The existing signals system is 1920 vintage hence parts and expertise is very limited.

One of the biggest hurdles has been the available number of qualified skilled wireman. This is currently an industry wide problem. Training time for new hires is a two year process, thus personnel from maintenance and operations were required to assist. Maintenance and operations staff is restricted in the number of hours that can be worked per week.

Testing of signal changes also proved to be a greater task then originally envisioned. The amount of time actually allowed for testing is limited to 3 hours, therefore work must be scheduled over more days. It was not until the testing team fully understood the on-site restrictions regarding work block times, that appropriate cutovers and testing could be planned. In summary the length of time to perform this work took much longer than anticipated.
Figure 5 Typical DSS Excavation Including Utilities and Future Subdrain
Figure 6 NO. 11 Double Slip Switch
EXCAVATED MATERIAL

Space is at a premium in the USRC. It was decided that more real estate could be created if the elevated corridor was widened. Innovative thinking by the design team determined that bin walls could be constructed on the property lines. The bin walls provided a perfect site to place the approximate 745 tonnes of spoiled ballast/fill that has been generated. The excavated material never has to leave the property and the newly found real estate will provide locations for maintenance material, areas for access roads to be built and space for installation of new signal and power bungalows.

OTHER WORK BEING PERFORMED

With ever increasing traffic in the Toronto area, it is often difficult for maintenance forces to access the infrastructure. If maintenance forces can't perform their work, then operations can be impacted. New maintenance roads are currently being constructed. The goal is to have a maintenance road from end to end on the corridor. There are three classes/size of roads being constructed, emergency vehicles (largest), pickup trucks and maintenance vehicles or the smallest for gators.

To facilitate the installation of cables for systems a cable trough system underground duct bank system has been installed. This has also helped us with some of the early/temporary signals works. The project team decided to install these prior to finalizing track work and has created major coordination issues and some rework.
Conclusion

Spatial constraints and limited time allotments are part of every day life when trying to perform work in the USRC. Various lessons learned have been pointed out throughout the text of this paper. However, the most important lesson to be learned is that there is no substitute for precise pre-planning and having sufficient qualified personnel available. These are the two key prerequisites for carrying out the work in a thorough, efficient and coordinated manner with minimal impact on operations. Preplanning provides the opportunity to anticipate and address scenarios that could occur during the performance of the work. In fact, more time needs to be spent pre-planning the activities than actually accomplishing the work. It is recognized that the nature of the work is that when government funding is provided, it is essential that the work start almost immediately, which doesn’t provide the time required for the preplanning activity.
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