TITLE:
Automatic Train Control Safety Analysis Update

PRESENTATION SUMMARY:
To present to the Safety and Security Committee an update on the Automatic Train Control (ATC) Safety Analysis.

PURPOSE:
The purpose of this presentation is to provide the Committee on a briefing of the ATC Safety Analysis current status, and its relation to the return to automatic train operation.

DESCRIPTION:
After the June 22, 2009 Washington Metro train collision near Fort Totten Station, The National Transportation Safety Board (NTSB) made the following recommendations (dated July 27, 2010):

- R-10-12: Conduct a comprehensive safety analysis of the Metrorail automatic train control system to evaluate all foreseeable failures of this system that could result in a loss of train separation, and work with your train control equipment manufacturers to address in that analysis all potential failure modes that could cause a loss of train detection, including parasitic oscillation, cable faults and placement, and corrugated rail.
- R-10-13: Based on the findings of the safety analysis recommended in R-10-12, incorporate the design, operational, and maintenance controls necessary to address potential failures in the automatic train control system.

Metro has contracted with Hatch Mott MacDonald (HMM) to assist us in addressing these NTSB recommendations.

The ATC Safety Analysis has been primarily focused on the wayside audio frequency track circuit system and the car born ATC system with hazard analysis of the operating and support functions as well as specific components level subsystem analysis. The primary analysis findings can be categorized in two major classes:
• Process. It has been addressed with updated preventative maintenance and testing guidelines.
• Gaps between the failure mode effects analysis in the original product safety case. This class met the industry standards during the period of manufacture and the modern safety case requirements of today. Metro and HMM have identified a close out plan for the wayside and car bourn equipment.

This independent review was initiated in 2010 with an expected completion time frame of spring 2014.

Key Highlights:

- The ATC independent system safety analysis is scheduled to be completed in spring of 2014 and an overall closeout plan has been defined
- Progress continues on minor findings which have been provided through existing programs and process improvements

Background and History:

The ATC network provides for the safe and efficient movement of trains through a series of track circuits and integrated logic for routing controls and speed controls. Major subcomponents of the ATC network include Automatic Train Operation (ATO) and Automatic Train Protection (ATP). ATO is a system that uses integrated logic between the wayside system where the train speeds and braking are regulated automatically without required intervention from the operator. ATP is the system that provides safe train separation through the same network but where the operator is in direct control of the train speed and braking. It should be noted that while the train is in “manual” control, the ATP is still active and any violation of speed command by the operator will cause the train to automatically reduce speed, thereby resulting in the safe separation of trains or automatic train protection. ATO is desirable because of the efficiency and consistency of accelerating and braking provided by the trains on-board ATC system. Therefore, Metro is taking a systematic and calculated approach to returning to ATO.

Discussion:

Metro has been undertaking major steps to return to Automatic Train Operation (ATO) for the safe and efficient movement of trains throughout the system. The major steps include:

- Addressing National Transportation Safety Board (NTSB) recommendations:
  - System Safety Analysis
  - Ferrite chokes
  - Track Circuit Monitoring Tool or Loss of Shunt detection
  - ATC-1000, 2000 and 3000
- Deployment of the right equipment and tools
- Organizational changes
- Development and implementation of processes, equipment, and procedures
FUNDING IMPACT:
None

TIMELINE:

<table>
<thead>
<tr>
<th>Previous Actions</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>March 11, 2010: Presentation to the Customer Service and Operations Committee on &quot;Manual vs. Automatic Train Operation and Operational Restrictions&quot;</td>
</tr>
<tr>
<td></td>
<td>November 01, 2012: Presentation to the Safety and Security Committee on &quot;Automatic Train Control (ATC) Update&quot;</td>
</tr>
<tr>
<td></td>
<td>June 13, 2013: Presentation to the Safety and Security Committee on &quot;Automatic Train Control System Update&quot;</td>
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</tbody>
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Automatic Train Control (ATC) Safety Analysis Update

Safety and Security Committee

January 9, 2014
Automatic Train Control (ATC) Safety Analysis Update

**ATC** – “To provide for the safe and efficient movement of trains”

The track circuit is the foundation of that principle. Metro uses audio frequency track circuits (AFTC) which provide for:

- Train detection
- Train separation
- Speed control
- Integrated routing logic
Major National Transportation Safety Board (NTSB) Recommendations

- **R-10-08:** Replace Generation II track circuit  
  Status: CLOSED

- **R-10-09:** Establish periodic inspection to examine for pulse-type parasitic oscillation  
  Status: CLOSED

- **R-10-14:** Implement cable resistance testing

- **R-09-006:** Develop real-time loss of shunt detection  
  Status: CLOSED

- **R-10-012:** Perform System Safety Analysis (SSA) on ATC network

- **R-10-013:** Implement programs to resolve findings of R-10-12
R-10-12: Perform System Safety Analysis (SSA) on ATC network

“Conduct a comprehensive safety analysis of the Metrorail automatic train control system to evaluate all foreseeable failures of this system that could result in a loss of train separation . . .”
R-10-13: Implement programs to resolve findings of R-10-12

- Organizational alignment
- Ferrite chokes
- Track circuit monitoring:
  - Performance
  - Loss of shunt detection
- Process/Procedure improvement
  - ATC-1000
  - ATC-2000
  - ATC-3000
- Investment in tools/equipment
- Replace generation II track circuits
- Cable insulation testing
NTSB Recommendations

System Safety Analysis (SSA) Methodology

- ATC Onboard Subsystem Hazard Analysis
- ATC Product System Hazard Analysis (SHA) and Interface Hazard Analysis (IHA)
- ATC Wayside Subsystem Hazard Analysis

- ATC System Product Safety Application Constraints
- WMATA ATC System Safety Strategy
- WMATA ATC System Interface Hazard Analysis
- WMATA ATC System Safety Requirements
- WMATA ATC System Test Procedures
- WMATA ATC System Hazard Log
- WMATA ATC System Operating & Support Hazard Analysis (O&SHA)
- WMATA ATC System Safety Evaluation
Items of Interest

- Generation II and III track circuits
- 4000 Series

1980’s Failure Modes List

Current Failure Modes List

MITIGATION

- LOS detection
- Periodic check
- Prescribed tests for overall performance
- Current on-board performance

REPLACE
Railroad systems are symbiotic