Washington Metropolitan Area Transit Authority
Board Action/Information Summary

● Action ● Information	MEAD Number:	Resolution: ● Yes ● No

TITLE

PRESENTATION SUMMARY

An overview of the developments and improvements undertaken to ensure that the Automatic Train Control (ATC) system continues to be a reliable network that allows for the safe and efficient movement of trains throughout the system.

PURPOSE

To provide the Safety and Security Committee a status update on what has occurred toward the goal of returning the system to Automatic Train Control.

DESCRIPTION

Key Highlights:

- Development, implementation and approval of the Track Circuit Monitoring (TCM) tool has enabled us to close the important NTSB recommendation R-09-06 which required constant monitoring of loss of shunt conditions and real time alerts for insuring train separation.
- Implementation of the NTSB Recommendations is critical prior to returning to Automatic Train Operation (ATO).

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 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.

The foundation of the ATC network is the track circuit which determines occupancy of trains within a track section and, through the integrated logic, regulates speed to insure safe braking for trains approaching the train which is occupying that track section. Obviously, the performance of the track circuit is critical in insuring safe braking of following moves. Track circuits are designed under a “fail safe” system (as is the entire ATC network) so that failures of the system result in the most restrictive application.

Since the 2009 Fort Totten accident, there have been several parallel and integrated initiatives to insure a safe and reliable Automatic Train Control (ATC) network. These initiatives include:

- Restructuring the organization(s) to support continued improvement of ATC,
- Stabilizing the AF track circuit,
- Developing industry standard procedures,
- Addressing NTSB recommendations and
- Return to ATO.

Discussion:

Organizationally, the Engineering Department was previously separated from operations and maintenance with a focus on expansion and less on maintaining a “new” system. As the condition of the Metro system aged, engineering resources were required and the construct of the organization did not provide support in a “natural” process. With the establishment of the “TIES” organization, the engineering and maintenance functions have became a single point organization. This enables interaction of the cooperative effort between engineering/maintenance. This is critical in ATC maintenance as it is a very dynamic system that is influenced by multiple systems such as track, traction power, and the rail car. The Engineering organization was redesigned to allow for a discipline specific Deputy Chief who would focus on operational needs, working closely and deliberately with maintenance and safety.

One of the first initiatives that the new organization required was the development and implementation of industry standard procedures that focus on safety as a priority. Not all preventive maintenance instructions are created equal. Some items, which only focus on reliability such as greasing a switch, are not equitable with track circuit shunts which are focused on safe operation. By using FRA CFR 234/236 as a foundation for these new procedures, we have created the ATC-1000 which prioritizes “safe system” testing. These procedures were coordinated with maintenance as well as safety to ensure a comprehensive and well thought out plan was being implemented.

Also, immediate steps were taken to stabilize the performance of the track circuit. This included looking at performance comprehensively, as well as taking an integrated approach that looks at the entire infrastructure. We have not only installed ferrite chokes to mitigate parasitic oscillation, but also installed larger negative return cables to reduce traction imbalance as well as to reduce commensurate track circuit failures. Also, we have put in a program for rail grinding to minimize track circuit non-critical loss of shunt failures. Procurement of the proper tools was an essential part of this effort, with an investment of over $3 million in new technology maintenance equipment. The equipment includes infrared imaging, spectrum analyzers, frequency meters, and other high-end technology test and measurement equipment.

Obviously, addressing NTSB recommendations has been a priority. The major focus has been on the following:

- System Safety Analysis
- Generation II Track Circuit Replacement
- Loss of Shunt Detection

Hatch Mott MacDonald, our ATC General Engineering Consultant has been engaged in the System Safety Analysis which looks at the entire network of ATC components and external supporting infrastructure such as track and traction and determines the safe operation and hazard assessment of the entire system and subsystems. This was an NTSB recommendation and the final draft has been delivered. It should be noted that the major recommendations for improvement of the network had already been indentified and are being addressed, including replacement of the Gen II track circuit, testing and operational procedures; engineering/maintenance/safety integration through organizational changes; parasitic oscillation mitigation and testing, and Loss of Shunt (LOS) detection. Other recommendations are being vetted and will result in other initiatives.

The NTSB has determined that parasitic oscillation caused the Generation II track circuit to have what is known as a “wrong side” failure which is terminology that is opposite in theory of the “fail safe” principle previously discussed. A wrong side failure creates a situation where component failure results in a less restrictive command. Because of this failure we have initially mitigated the effects of parasitic oscillation through the use of a ferrite choke that collapses or “chokes” the field of electrical influence and reduces the parasitic oscillation effects to a non-risk status. In addition, we check the circuits on a semi-annual basis through extensive testing to insure that parasitic oscillation effect has not increased. So, while the Generation II failure has been effectively mitigated, we are replacing the track circuit with track circuit technology that has internally, and through deliberate engineering, mitigated effects of parasitic oscillation. Red Line replacement will be done in December and the Orange / Blue

contract has been initiated with work already begun on that line. To date over half of the Generation II track circuits have been replaced. The replacement of these track circuits is the most critical aspect of returning to ATO. However, the exact date of returning Red Line service to ATO cannot be positively determined as there are other issues with the system safety analysis which much be reviewed and completed prior to making a final determination.

Insuring the safety and integrity of the track circuits is critical as it is the foundation of securing train separation. This is why the NTSB recommended the loss of shunt detection and redundant monitoring system. We are pleased to report that the NTSB has closed a recommendation that specifically dealt with redundant monitoring of loss of shunt conditions and provision for real time alerts. The track circuit monitoring tool that was the foundation of this closure not only insures that integrity, but also, just as importantly, has broken down “silos” within the various departments and allows the organization to work together to a common goal. The introduction of a “technology” has created a greater spirit of teamwork across departments. Safety, operations, maintenance, engineering and IT have all worked together and continue to work together to insure that the Metro is safe and reliable for our customers. This application, which was conceived, developed and implemented by WMATA personnel is a significant advancement in determining track circuit integrity. Besides establishing a new best practice, the tool is the first of its kind, and as such, WMATA has applied for a patent to insure consistent methodology throughout the industry for others who might want to utilize this important monitoring tool.

Parallel efforts are underway with the Silver Line to ensure the alignment meets the revised criteria, new technology is integrated with existing systems and safety and reliability remain the key focus.

Since 2009, many steps have been taken to improve the safety and reliability of the ATC system. We are pleased that these changes represent, not just improvements to the technology and equipment, but also institutional changes which will be able to serve customers for many years in the future.

ALTERNATIVES

None

FUNDING IMPACT

TIMELINE

Previous actions	**March 11, 2010**: Presentation to the Customer Service and Operations Committee on “Manual vs. Automatic Train Operation and Operational Restrictions”

Anticipated actions after presentation	

ELECTRONIC ATTACHMENTS

None

OTHER SUPPORT MATERIALS

None

RECOMMENDATION (for Action Items only)

Automatic Train Control (ATC) Update

Safety and Security Committee

November 1, 2012

ATC System

- Automatically controls speed, braking and station stops
- Benefits:
  - Operationally provides ability to run close headways
  - Customer experience a smoother ride
- June 2009 Metro began manual mode

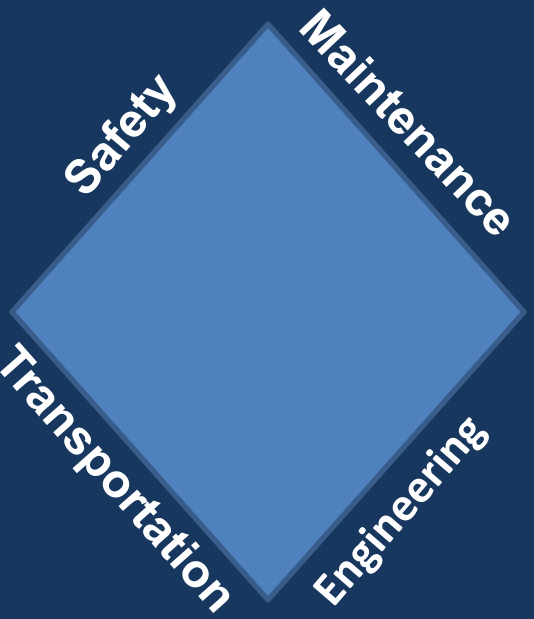
Required Initiatives

- Restructuring Organization
- Stabilizing AF Track Circuit
- Developing Industry Standard Procedures
- Addressing NTSB Recommendations

Ansaldo 800W AF Track Circuit

Organization

- Reorganization to be more "discipline specific"
- Safety, Transportation, Maintenance and Engineering working together

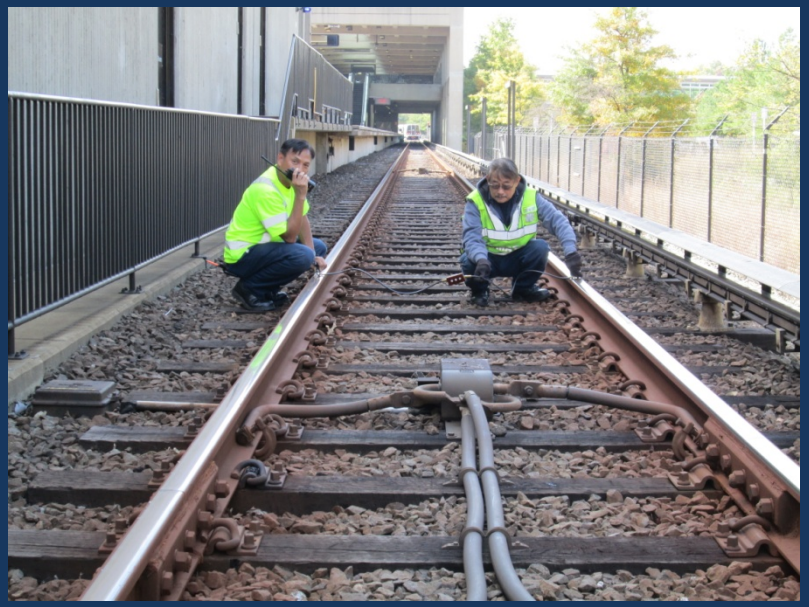


Stabilization and Procedures

- Development of ATC-1000, ATC-2000, and ATC-3000
  - Defines “regulatory” requirements (modeled after industry standards and FRA CFR 236/234 requirements)
  - Parasitic Oscillation Testing – semi-annual testing to determine presence of parasitic oscillation

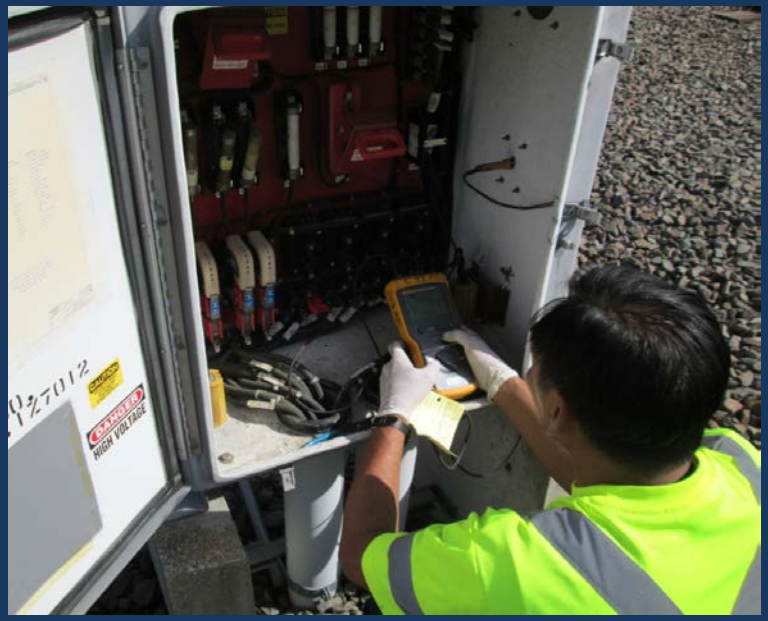
NTSB Recommendations

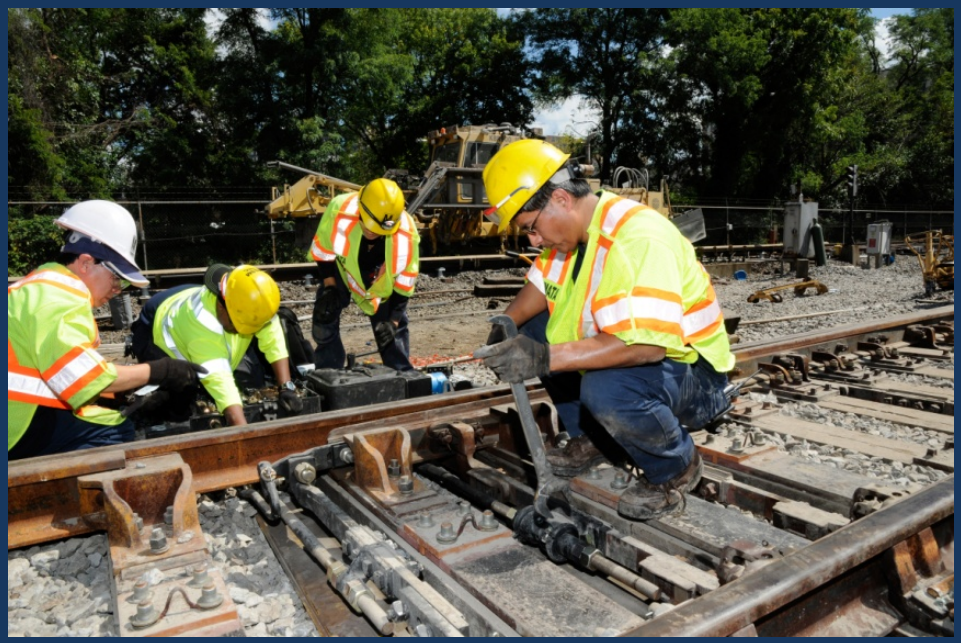
- Development of a comprehensive system safety analysis NTSB Recommendation R-10-12
  - Multiple initiatives in report have been addressed
  - Conclusions will dictate the requirements



NTSB Recommendations

- R-10-08: Replaced 1185 of 2317 Generation II track circuits
- R-09-06:Track Circuit Monitoring Tool / Loss of Shunt Detection and Constant Monitoring Alarm





Silver Line

- Parallel efforts not only on current systems
- Steps taken to ensure new alignment meets new criteria
- Must integrate newer technology with existing systems
- Safety and reliability are key effort