Washington Metropolitan Area Transit Authority

Precision Station Stopping Progress Update

Presented to: The Board of Directors;

Customer Service, Operations and Safety Committee

By

Planning • Development • Engineering • Construction

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March 31, 2005

I. Purpose

- To update the Board of Directors, **<u>Customer Service, Operations and Safety Committee</u>** on the status of the Precision Station Stopping Program for the Metrorail System.

II. Introduction

- WMATA, via its annual repairs and rehabilitation efforts, maintains its Automatic Train Control (ATC) system at the highest safety and repair condition.

- The ATC infrastructure consists of three separate subsystems which are responsible for controlling different train operations:

  – **Automatic Train Protection** (ATP) – subsystem that provides safety functions essential to Metrorail operations: interlocking control, train separation and door operations. The protection is in place for both automatic and manual operation.

  – **Automatic Train Operation** (ATO) – subsystem that controls the train in automatic operation, and controls station stopping and speed regulation.

  – **Automatic Train Supervision** (ATS) – subsystem that monitors system status and provides routing control and schedule maintenance.

II. Introduction (Continued)

- The ATP system will not allow a train to enter a station that is occupied by another train and/or exit a station while another train occupies a “block” of track in front of the station.

- The ATO station stopping system is composed of both equipment onboard the car and on the wayside (trackside).

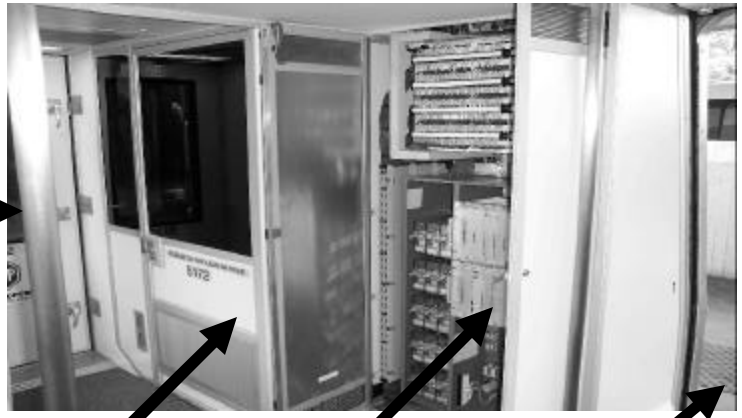
  – Wayside marker coils (located on the track side) transmits a programmed station stop, defines the distance to the platform and the type of stop to be made.

  – The onboard equipment receives the marker information and generates a station stopping “profile.”

II. Introduction (Continued)

- A "*handshake*" between the car and wayside equipment is required for an accurate ATO station stop.

- If a train does not detect the marker coil, the train does not "*handshake*" with the wayside, thus a station stopping overrun will occur unless the train operator intervenes.



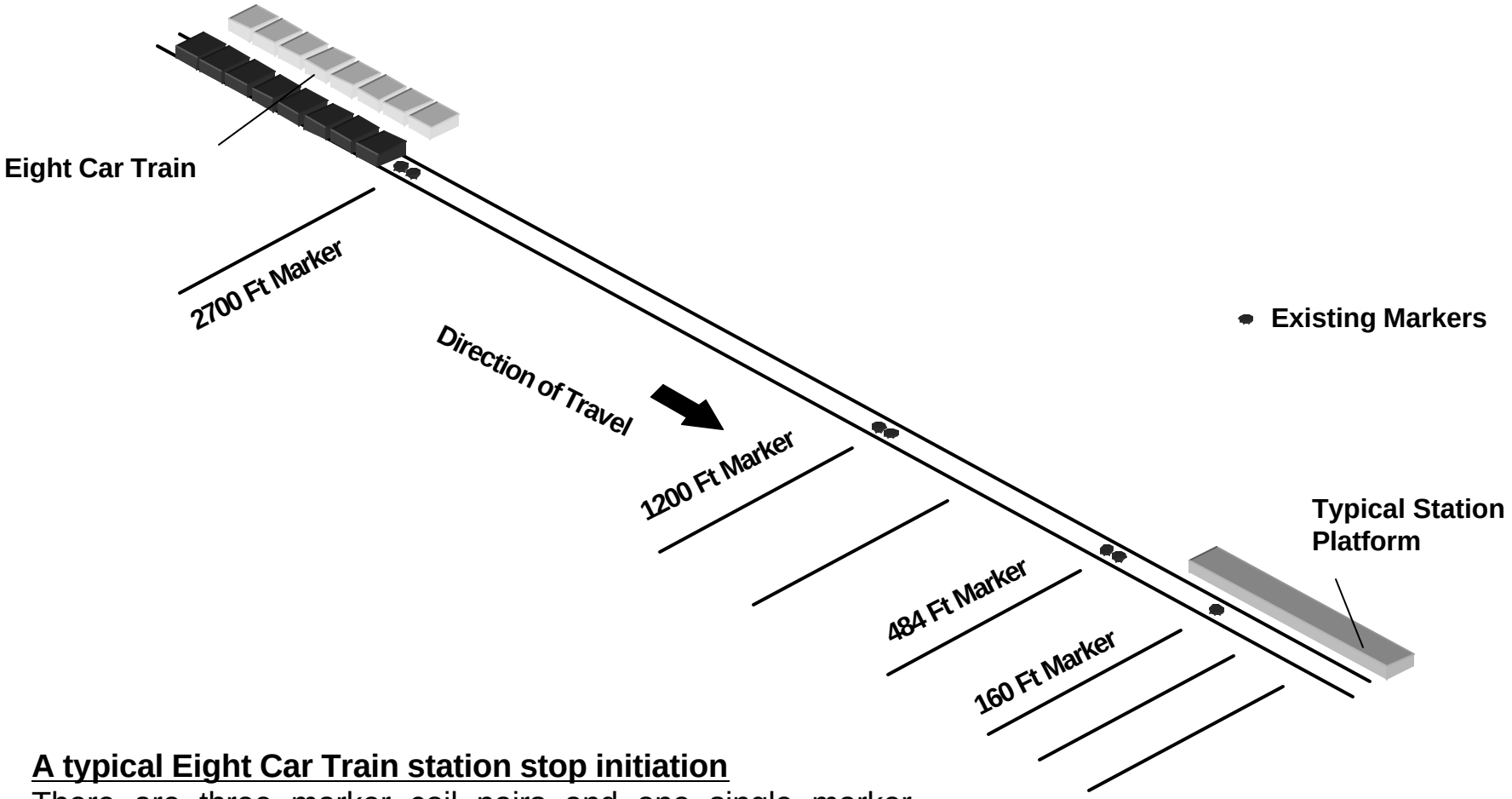
Marker Coil

Operator Cab

ATO/ATS Module

Train (front) door

II. Introduction (Continued)



A typical Eight Car Train station stop initiation

There are three marker coil pairs and one single marker governing the station stopping accuracy at 2700ft. 1200ft. 484ft. and 160ft. (Stations closer than 2700ft. do not have the 2700ft. marker).

II. Introduction (Continued)

- WMATA's automatic train control system is one of the most sophisticated and well-proven systems in the world that has safely and reliably accommodated more than **10 Billion** railcar miles for the last 30 years. The system design allows for **four** station overruns for every million railcar miles operated.

- In 1996, WMATA operated 45M railcar miles; today WMATA operates over 60M railcar miles – an increase of approximately 33%. Due to ATC system performance and design issues, Metrorail has been overrunning station platforms at a rate higher than the ATC design tolerance allows.

YEAR	RAILCAR MILES OPERATED (Millions)	STATION STOPS MADE (Millions)	STATION OVERRUNS			
			TOTAL	ALLOWED BY DESIGN	EXCEED DESIGN	ALLOWED-TO-EXCEED % SPLIT
1996	45	8	322	180	142	56% - 44%
2004	60	11	583	240	343	41% - 59%
Increase	33%	38%	81%			

- Although between 1996 and 2004 the number of station overruns has been increasing, the system station stopping accuracy has been relatively constant in the 99.995% to 99.996% range.

II. Introduction (Continued)

- A detailed analysis and evaluation of the "station overruns" trends using data from the Rail Operational Computer System (ROCS) reveals the following:

  – Over 70% of the overruns were caused by a failure between the wayside/car "*handshake*" caused by aging trackbed equipment and the imperfections of the new ATC system design that is being installed in our new railcar programs (5000, 6000, 2000/3000 rehab). The remaining 30% are caused by failures of marker coils, track equipment and track conditions.

  – The new ATC design in our recent railcar procurements (5000, 6000, 2000/3000 rehab) has been problematic and has been contributing to the recent spike in station overruns. Software revisions have been underway to correct the problem. We believe that the most recent system update from ALSTOM has a strong potential to resolve this design problem.

III. Background

- From the beginning of Metrorail operations in 1975, there have always been station overruns. To allow for successful 8-car train operations, WMATA is investing in 8-car precision station stopping which will allow only one station overrun every three days. This equates to **two** overruns for every million railcar miles – a 50% improvement over the ATC system design of **four** overruns per million miles.

- Precision station stopping is the most critical aspect of the upcoming 8-car train operations because the length of the 8-car train (600 feet) is the same length as the platform.

- On July 17, 2003, the Board approved a pilot program to award a competitive procurement for the 8-Car Precision Station Stopping Program. On October 20, 2003, a single proposal was received from ALSTOM Signaling.

- On January 16, 2004, ALSTOM completed feasibility testing on the 5000 series cars. On March 4, 2004, WMATA/ALSTOM conducted accuracy tests that demonstrated stopping at ±3.5 feet with an accuracy of 99.999% was attainable. This compares to our previous design capability of ±6 feet with an accuracy of 99.988%. On October 1, 2004, WMATA awarded a contract to ALSTOM.

- The new 8-car Precision Station Stopping Program will help significantly to reduce the number of station overruns.

III. Background (Continued)

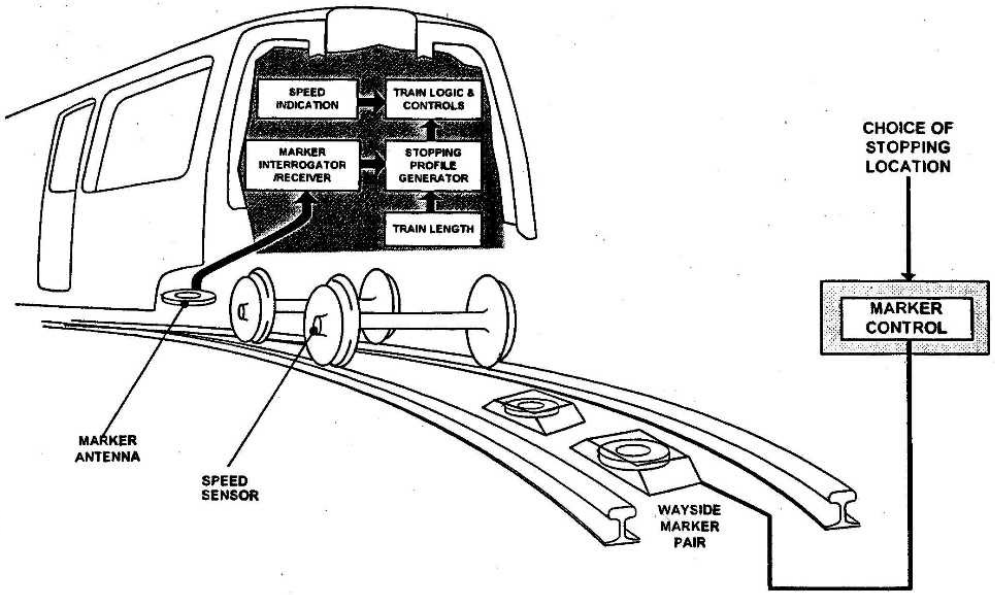
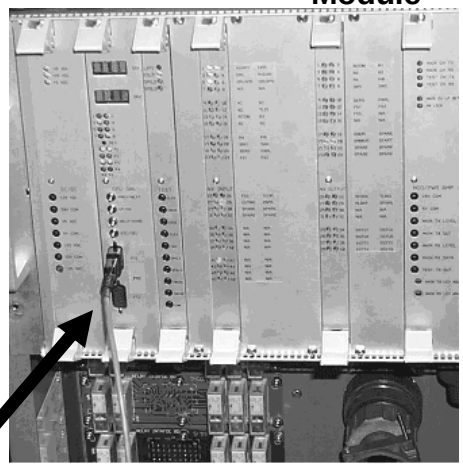


FIGURE 2-12 BASIC MARKER OPERATION

ATO/ATS Module



Connection for programming via laptop.

- The accuracy of the ±3.5 feet is achievable at 99.999% reliability by modifying the vehicle software; there is no need to install additional marker coils or other wayside hardware.

IV. Progress to Date – Accuracy

FRONT OF TRAIN

REAR OF TRAIN

- Completed conceptual design of system improvements – March 1, 2005.
- Determined 1000 series hardware capable of supporting upgrade
- Testing of upgraded software on 1000 series cars is in progress.

IV. Progress to Date – Station Overruns

- The onboard railcar engineering technology has advanced from discrete electronics to a fully digital computer based infrastructure. These technology advancements introduced in our most recent railcar procurements (i.e. 5000, 6000, 2000/3000 rehab) allow WMATA to enhance the wayside train control system to enable trains to identify current platform location and which platform is next by building an onboard, on-line database.

- Under the 8-car Precision Station Stopping Program, a Metrorail "System Map" is being coded to build a redundant system to minimize station overruns. The database catalogues each wayside marker coil. If a marker coil is not detected, the database will create a virtual marker coil. This will eliminate station overruns caused by missing the wayside/train *"handshake"*.

- Furthermore, in a recent breakthrough, ALSTOM has provided us with a software revision to their ATC design on the new and rehabilitated railcars that has the strong potential to correct flaws in the current ATC system performance. We will closely monitor this situation.

- Two other initiatives are underway to help further reduce the number of station overruns:

  - The signal strength of wayside marker coils is being increased by replacing the tuning capacitor.

  - Train Operator Awareness is being reinforced.

V. Next Steps

- Complete testing of upgraded ATC software for 1000 series cars – scheduled completion – **May 2005**
- Testing upgraded ATC software for the 2000/3000 series rehab cars and 5000 series cars – scheduled completion **August 2005**
- Complete by **September 2005** software verification and quality audit to allow for phase-in to start with the 5000 series and rehabilitated Breda cars.
- Complete installation and testing and be prepared to provide precision station stopping by **December 2006** when the first eight car trains go into revenue service.
- This Fall we should begin to see a reduction in the number of station overruns.

VI. Summary

- The Precision Station Stopping Program currently underway will improve station stopping reliability by
  - modifying the current car stopping tolerance from ±6 feet to ±3.5 feet
  - enhancing the carborne/wayside "*handshake*" that will eliminate the predominate cause of station overruns
- The software corrections by ALSTOM to the ATC design in our new and rehabilitated railcars is another key factor in improving our station stopping reliability.
- By the end of 2005, the results in terms of number of station overruns should be as follows, as compared to the 1996 and 2004 benchmarks.

YEAR	RAILCAR MILES OPERATED (Millions)	STATION STOPS MADE (Millions)	STATION OVERRUNS			
			TOTAL	ALLOWED BY DESIGN	EXCEED DESIGN	ALLOWED-TO-EXCEED % SPLIT
1996	45	8	322	180	142	56% - 44%
2004	60	11	583	240	343	41%-59%
2005	66	12	633*	264	369	42%-58%
2006	68	12	253**	272		

Forecast * This is a forecast based on an actual 433 overruns as of February 28, 2005;
** This is based on a 60% improvement, rather than the planned 70% (see page 8).