Automated People Mover Train Collision with Passenger Terminal Wall at Miami International Airport

November 28, 2008
NTSB Team

- Ruben Payan  Investigator-in-Charge
- Dave Watson  Mechanical
- Russ Gober  Operations
- Chris Babcock  Video Recorders
Parties

• Miami-Dade Aviation Department

• Johnson Controls, Inc.

• Bombardier – Automated People Mover Division
Automated People Movers

- Fully automated operations
- Exclusive right-of-way
- Smaller vehicles
- No operators or station attendants
Automated People Movers
Miami International Airport

- Main E concourse building
- Guideway
- Satellite E concourse building
Main Concourse E Building

Automated People Mover

Satellite Concourse E Building
**Injuries**

- 1 passenger serious injury
- 2 passengers minor injuries
- 2 passengers treated and released
- 1 maintenance technician treated and released
Damages
Safety Issues

- Maintenance practices and procedures
- Safety oversight of fixed guideway systems
Train Control System

Ruben Payan
Electrical Engineer
Automatic Train Control System

- Automatic Train Operation
- Automatic Train Supervision
- Automatic Train Protection
Automatic Train Operation

• Train Tone
  – Information from the train
  – Door operation

• Safe Tone
  – Commands to the train
  – Interfacing with propulsion power

• Program Stop
  – Station stop
Train Tone

ATO-SYSTEM
- Safe Tone
- Train Tone
- Program Stop

Propulsion and Braking

Guideway
Train Tone
Safe Tone

ATO-SYSTEM
- Safe Tone
- Train Tone
- Program Stop

Propulsion and Braking

MT

Guideway

ST
Program Stop

ATO-SYSTEM

Safe Tone
Train Tone
Program Stop

Propulsion and Braking

MT
ST

Guideway

575 feet
575 feet
Automatic Train Supervision

Central Control

Send Out Technician

Alarm

ATO-SYSTEM
- Safe Tone
- Train Tone
- Program Stop

Guideway
Automatic Train Protection

Overspeed/Overshoot system

- Vital system
- Monitor train speed
- Monitor brake air pressure
Automatic Train Protection

Guideway
Events Preceding Accident

- South train experienced intermittent failures
- Train Tone antenna replaced
- South train stopped on guideway because of loss of train tone
- Maintenance technicians assigned to ride trains during passenger service
Events Preceding Accident

• Installed November 21, 2008

• Installed to keep south train in service

• Remained in place from November 21 to November 28
Findings

• Overspeed/Overshoot relay testing determined relay was performing within manufacturer’s specifications

• Program stop module testing determined a crystal failed, which disabled the program stop module
Findings

• Jumper wire prevented overspeed/overshoot system to function as designed

• System designed to command brake application if train goes above allowed speed or if train moves beyond stopping point
Maintenance Practices & Procedures

Dave Watson
Mechanical Group Chairman
Events Preceding the Accident

• APM began operation in 1980

• Bombardier manufactured and maintained the system for 28 years

• Bombardier raised safety concerns

• Bombardier recommended APM operations be halted
Events Preceding the Accident

• MDAD consultants inspected and identified requirements to continue operations for 5 additional years

• Bombardier did not agree with the assessment

• MDAD issued invitation to bid for maintenance of APM system
Events Preceding the Accident

• Maintenance contract awarded to Johnson Controls, Inc. in 2008

• No coordination between Johnson Controls, Inc. and Bombardier prior to transfer of maintenance operations

• Incomplete transfer of maintenance records and spare parts
Vital Relay

• Vital relay previously disabled on north train

• Same solution applied to south train

• No evaluation of possible detrimental effects or plan to remove the jumper wire
Vital Relay

- Train could not stop under certain conditions

- Johnson Controls, Inc., maintenance technician instructed to leave jumper wire in place

- Johnson Controls, Inc., had no procedures against disabling safety-critical systems
Train Maintenance Procedures

• Daily brake tests

• Program stop module testing

• Deactivation of safety-critical systems during passenger service

• Incomplete maintenance manuals
Train Maintenance Procedures

Auxiliary control panel
Postaccident Events at Miami Airport

- Johnson Controls, Inc., withdrew from Miami Airport maintenance operation
- Miami-Dade County Transit provides technical supervision
- North train continues in operation
- MDAD considering replacing south train
Safety Oversight of Fixed Guideway Systems

Ruben Payan
Electrical Engineer
MDAD Safety Oversight

- MDAD operated the Miami International Airport for Miami-Dade County
- Investigation revealed that MDAD was not providing appropriate safety oversight
MDAD Safety Oversight

- Johnson Controls, Inc assumed maintenance responsibility 10 months prior to the accident.

- Passenger risk increased when the overspeed/overshoot system was disabled.

- MDAD was unaware of maintenance practices, failing to fulfill its safety oversight role.
MDAD Safety Oversight

- Johnson Controls Inc., had no procedures for testing brake systems
- Brake tests were not being conducted
- Brake system test procedures were available in maintenance manuals
MDAD Safety Oversight

• Vital relays not tested

• Tests required every 4 years

• MDAD did not verify testing of vital safety-critical components
State of Florida Safety Oversight

- Florida Department of Transportation provides safety oversight of some fixed guideway systems

- The Miami-Dade airport APM does not receive Federal or State funds

- Florida does not provide oversight
Federal Safety Oversight

- Federal Transit Administration
  - No statutory authority to promulgate safety regulations
  - State safety oversight regulation requires each state to establish an oversight agency
- No direct Federal funds received for the APM at Miami Airport
Safety Oversight

• FTA does not provide oversight agency with any authority

• State oversight agencies limited in ability to compel fixed guideway systems

• Not all fixed guideway systems are subject to state oversight
Federal Safety Oversight

Unregulated Fixed Guideway Systems
Current Miami Airport APM Oversight

- E concourse, APM train operates without oversight
- Skytrain began service September 2010 without oversight
- Miami Mover began service September 2011 has Florida DOT oversight