National Transportation Safety Board

The Role of Human Factors in Accident/Crash Investigation: The Legacy and Future

Robert L. Sumwalt, III

TRB Luncheon January 12, 2014

NTSB is an independent federal agency, charged by Congress to investigate transportation accidents, determine probable cause, and issue safety recommendations.

Our mission:

Prevent Accidents

Reduce Injuries

Save Lives

NTSB

NTSB

- Airport surface operations
- General Aviation safety
- Eliminate distraction
- Fire safety
- Bus safety
- Infrastructure
- Substance-impaired driving
- Pipeline safety
- Collision avoidance (highway vehicles)
- Positive Train Control

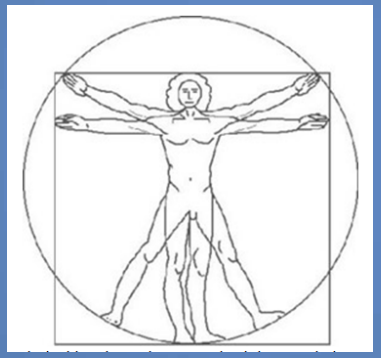
Critical changes needed to reduce transportation accidents and save lives.

Our legacy

NTSB

Our legacy

- Over time, the accident investigation community realized that since the majority of crashes involve human-related issues, we needed investigators with formal human factors background.
- In the early 1980's, NTSB established a Human Performance Division.
  - Now, mode-specific HF investigators

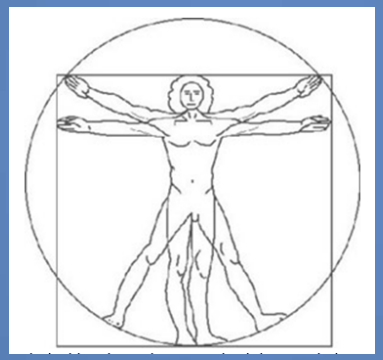


The Human

Organizational Influence
"Corporate Culture"

Regulatory Influence

NTSB

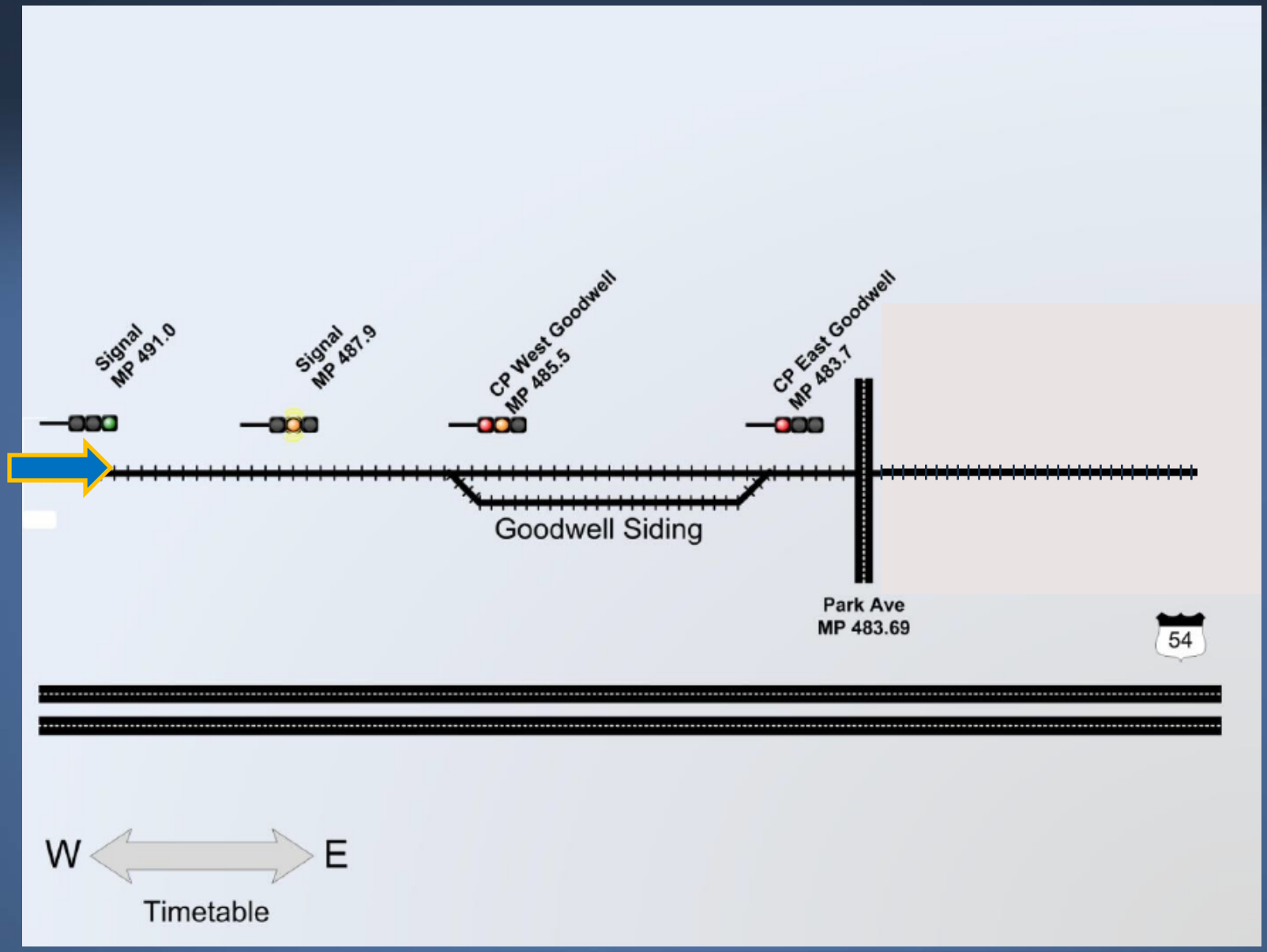


The Human

Head-On Collision of Two Union Pacific Freight Trains

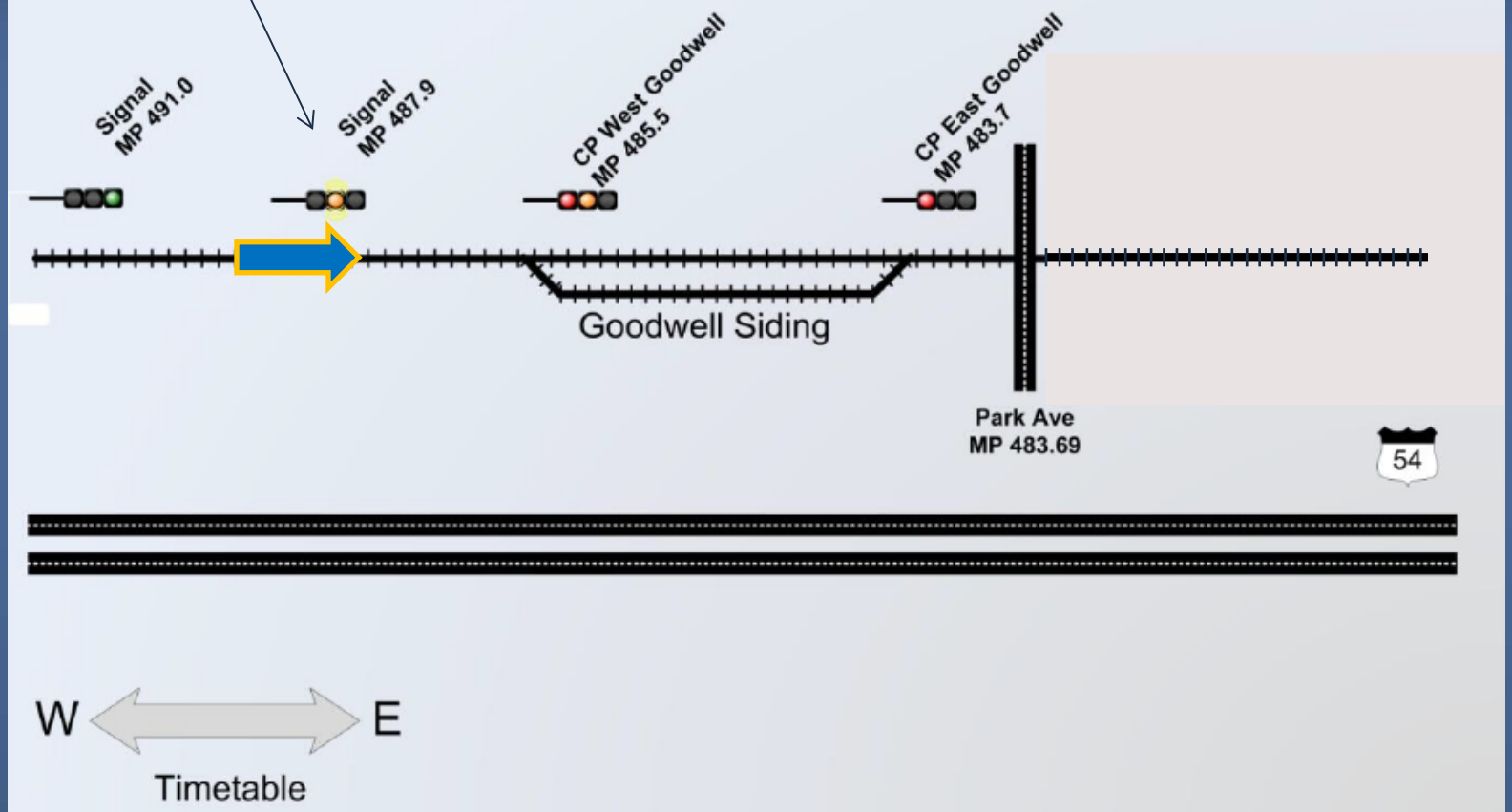
June 24, 2012

NTSB


Signal
MP 491.0
Signal
MP 487.9
CP West Goodwell
MP 485.5
CP East Goodwell
MP 483.7
Goodwell Siding
Park Ave
MP 483.69
54
W
E
Timetable

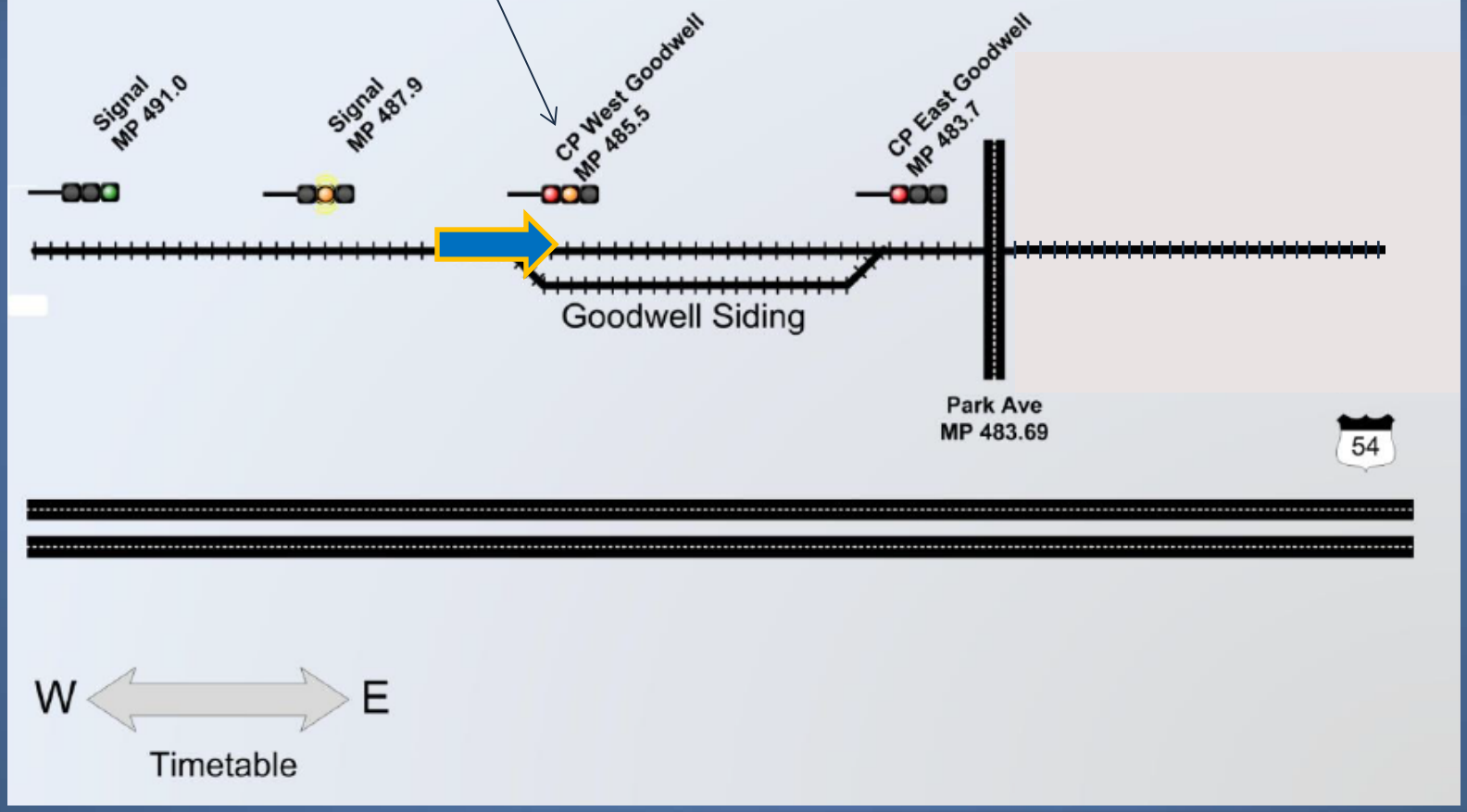
Expected Action: Reduce speed to 40 mph

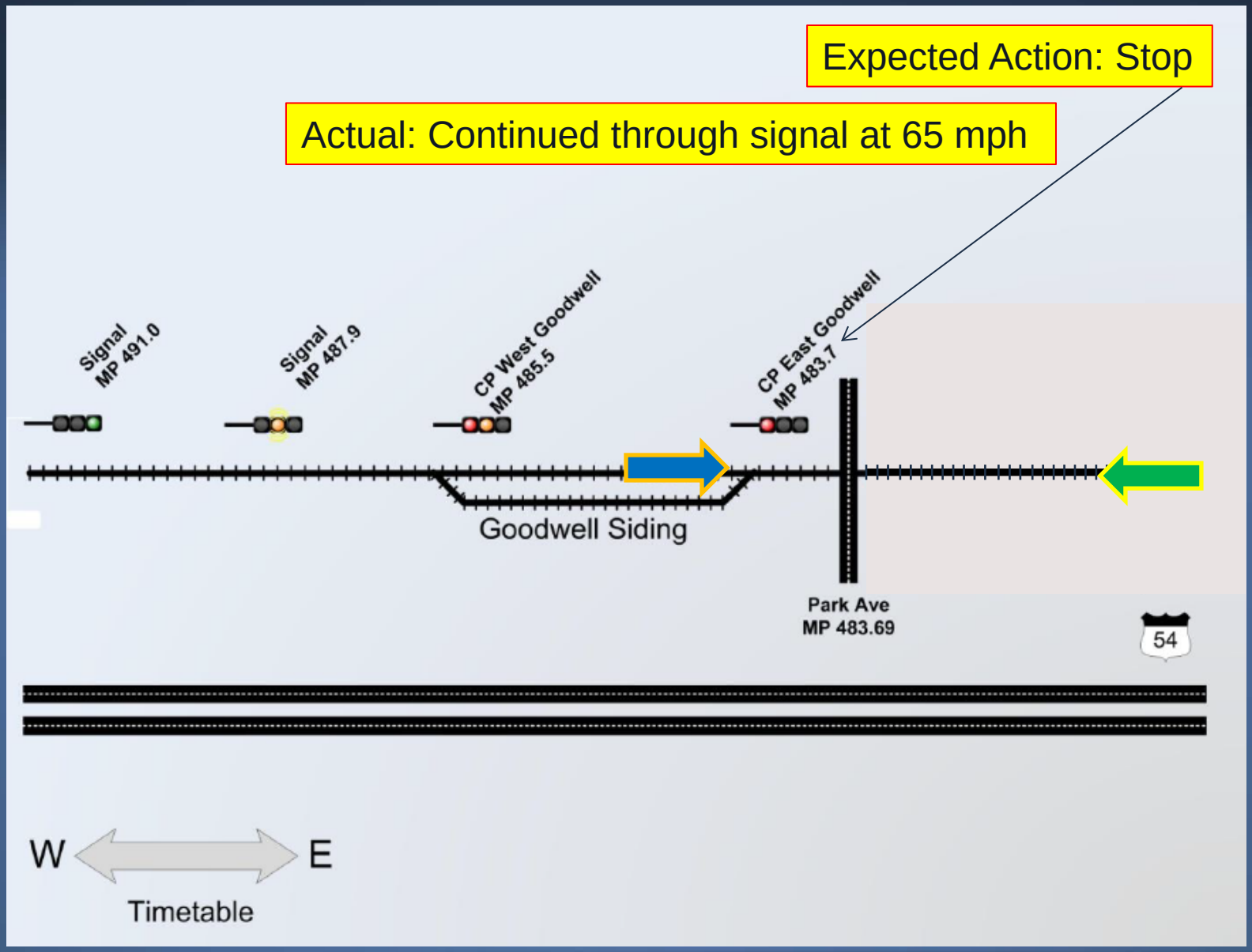
Actual: Did not slow.

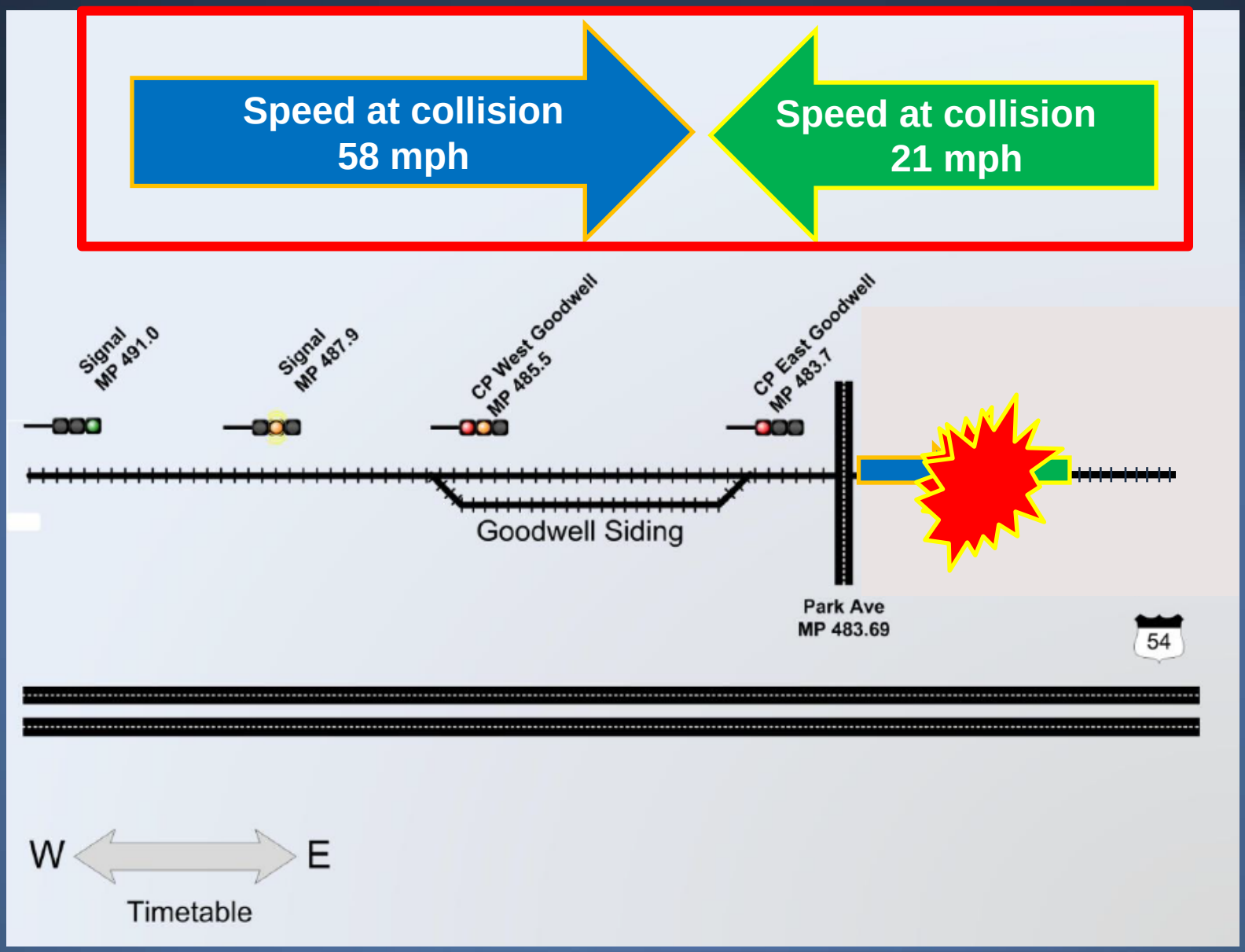


Expected Action: Reduce speed to 30 mph; be prepared to stop at next signal.

Actual: Did not slow.



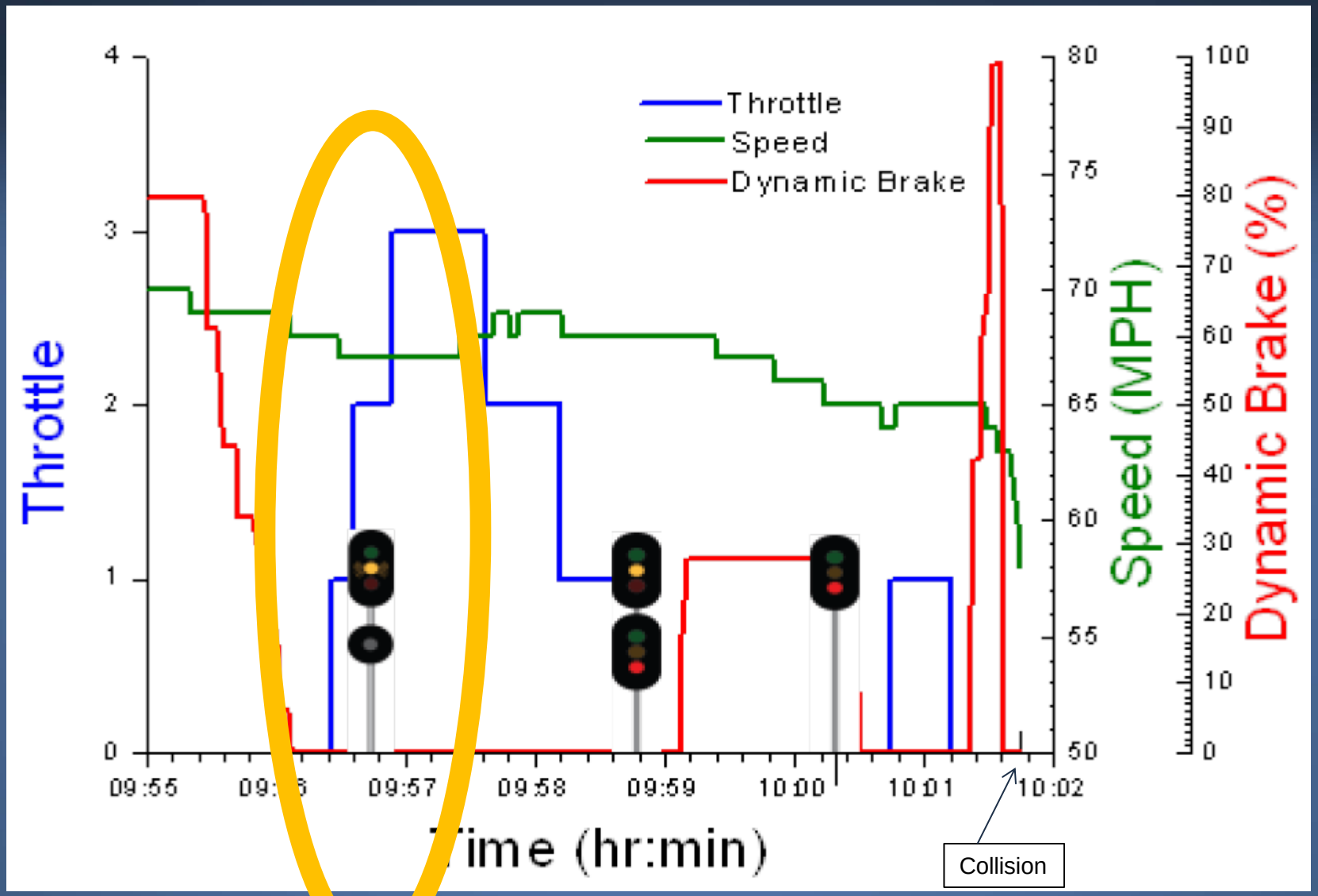

Expected Action: Stop
Actual: Continued through signal at 65 mph
Signal
MP 491.0
Signal
MP 487.9
CP West Goodwell
MP 485.5
CP East Goodwell
MP 483.7
Goodwell Siding
Park Ave
MP 483.69
54
W
E
Timetable


Speed at collision
58 mph
Speed at collision
21 mph
Signal
MP 491.0
Signal
MP 487.9
CP West Goodwell
MP 485.5
CP East Goodwell
MP 483.7
Goodwell Siding
Park Ave
MP 483.69
54
W
E
Timetable

NTSB

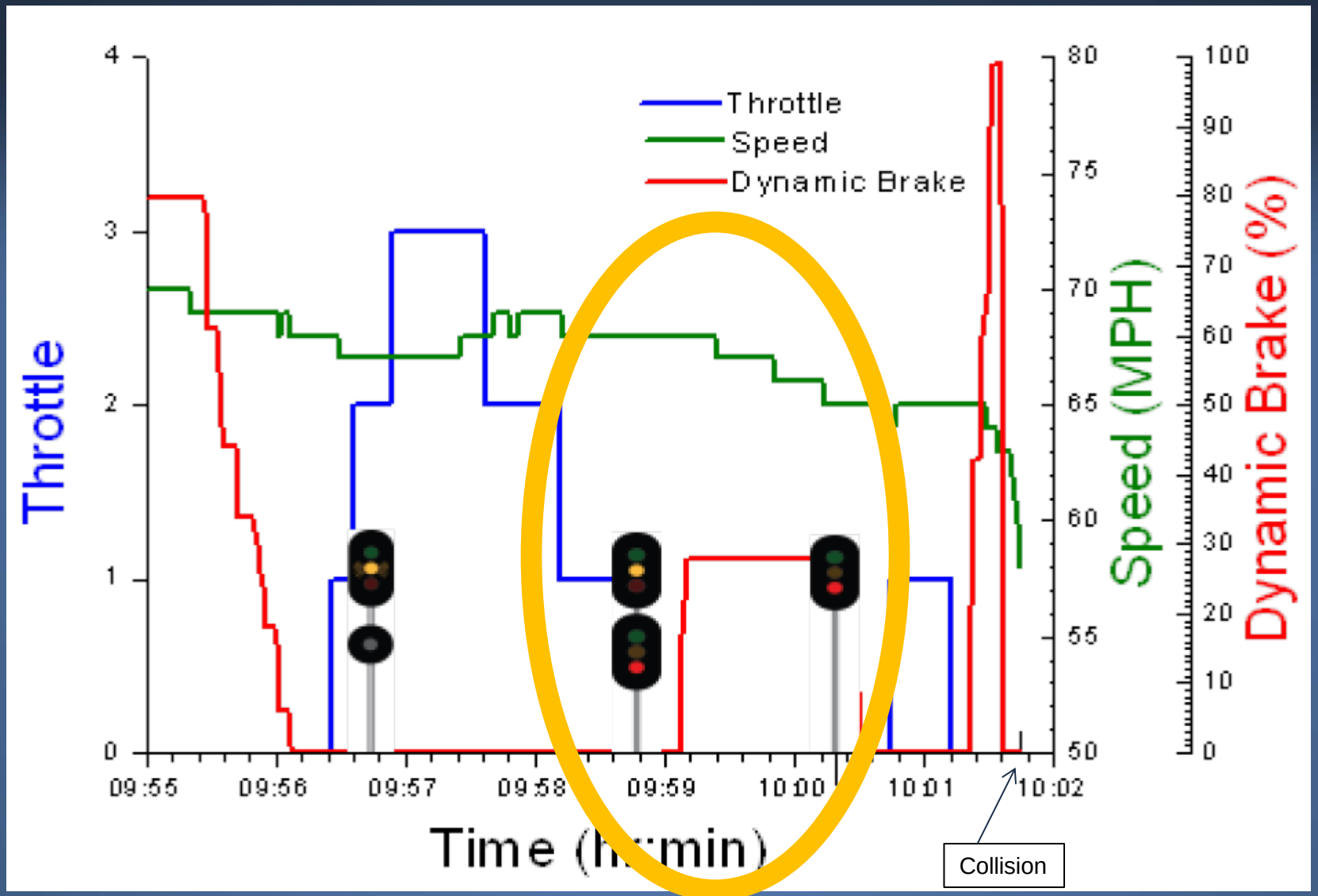
Why?

- Asleep??
- Incapacitated??
- PED distractions??
- Brake problems??
- Track issues??
- Intentional act??
- Atmospheric/meteorological conditions??
- Signal problems??
- Dispatcher error??
- Crew medical condition??



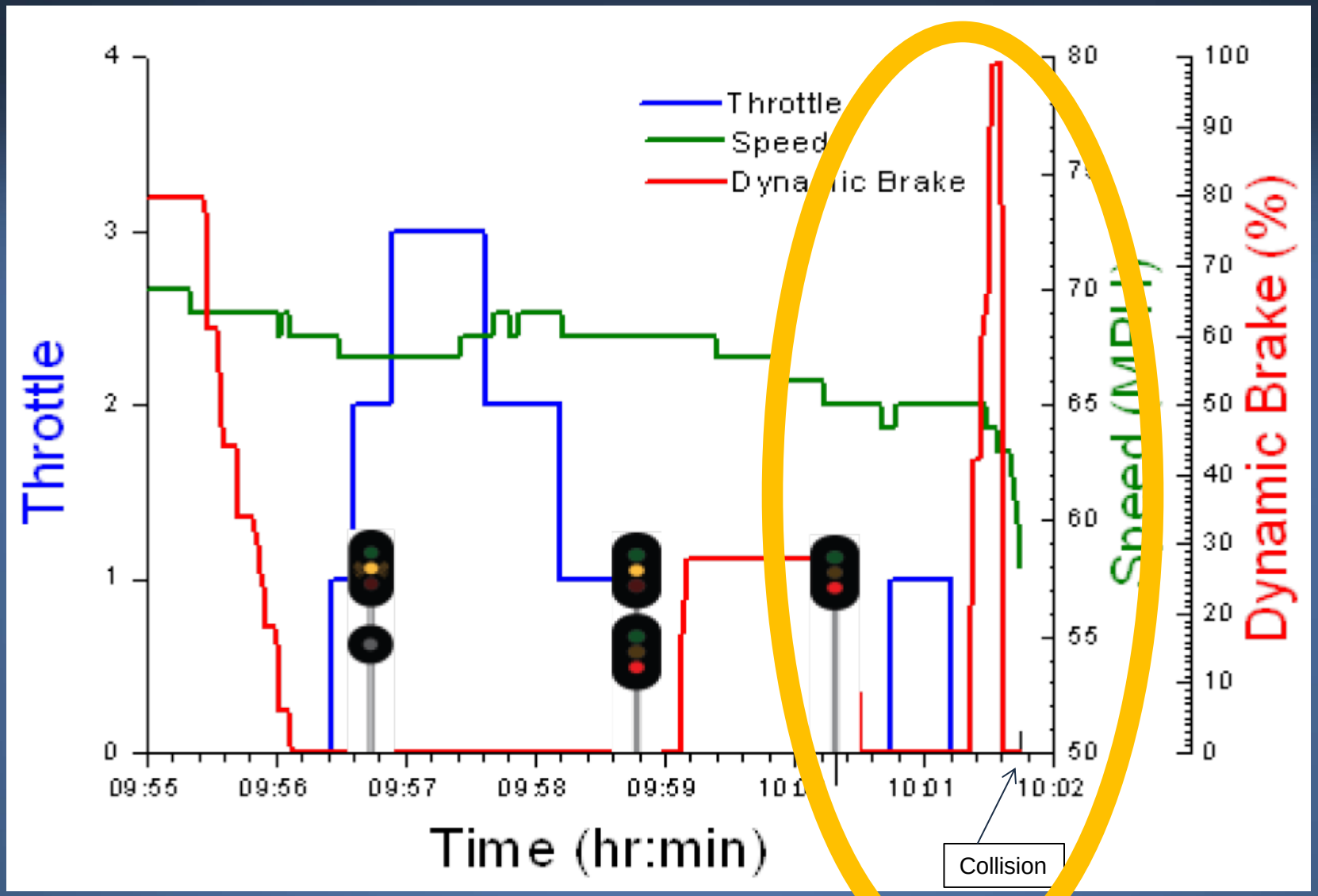
Expected Action: Reduce speed to 40 mph

NTSB



Expected Action: Reduce speed to 30 mph; be prepared to stop at next signal.

NTSB


Throttle
Speed
Dynamic Brake
Throttle
Speed (MPH)
Dynamic Brake (%)
Time (hr:min)
09:55
09:56
09:57
09:58
09:59
10:01
10:02
Collision

Why?

- ~~Asleep??~~
- Incapacitated??
- PED distractions??
- ~~Brake problems??~~
- ~~Track issues??~~
- Intentional act??
- ~~Atmospheric/meteorological conditions??~~
- ~~Signal problems??~~
- ~~Dispatcher error??~~
- Crew medical condition??

Eastbound Engineer: Vision Problems

- Cataract surgery as a child
- Required contacts and glasses <u>at the same time</u>
- Between 2006 and 2009, underwent a series of medical and surgical interventions for uncontrolled glaucoma.
- Uveitis
- Vitreitis
- Retinal detachment right eye 2002

Eastbound Engineer: Vision Problems

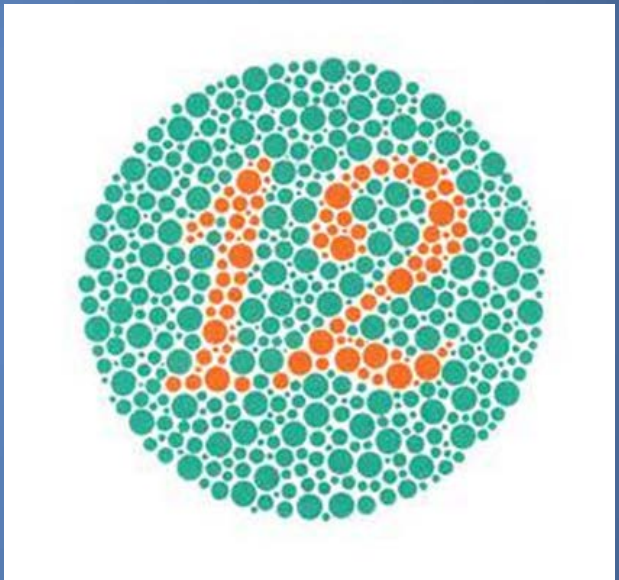
- Cystoid macular edema
- Epiretinal membranes
- Eye care:
  - Optometrist
  - Ophthalmologist
  - Retinal Specialist

Eastbound Engineer: Vision Problems

- August 2010 – Texas Dept. of Motor Vehicles restricted driver's license to daytime driving only.

Eastbound Engineer: Vision Testing

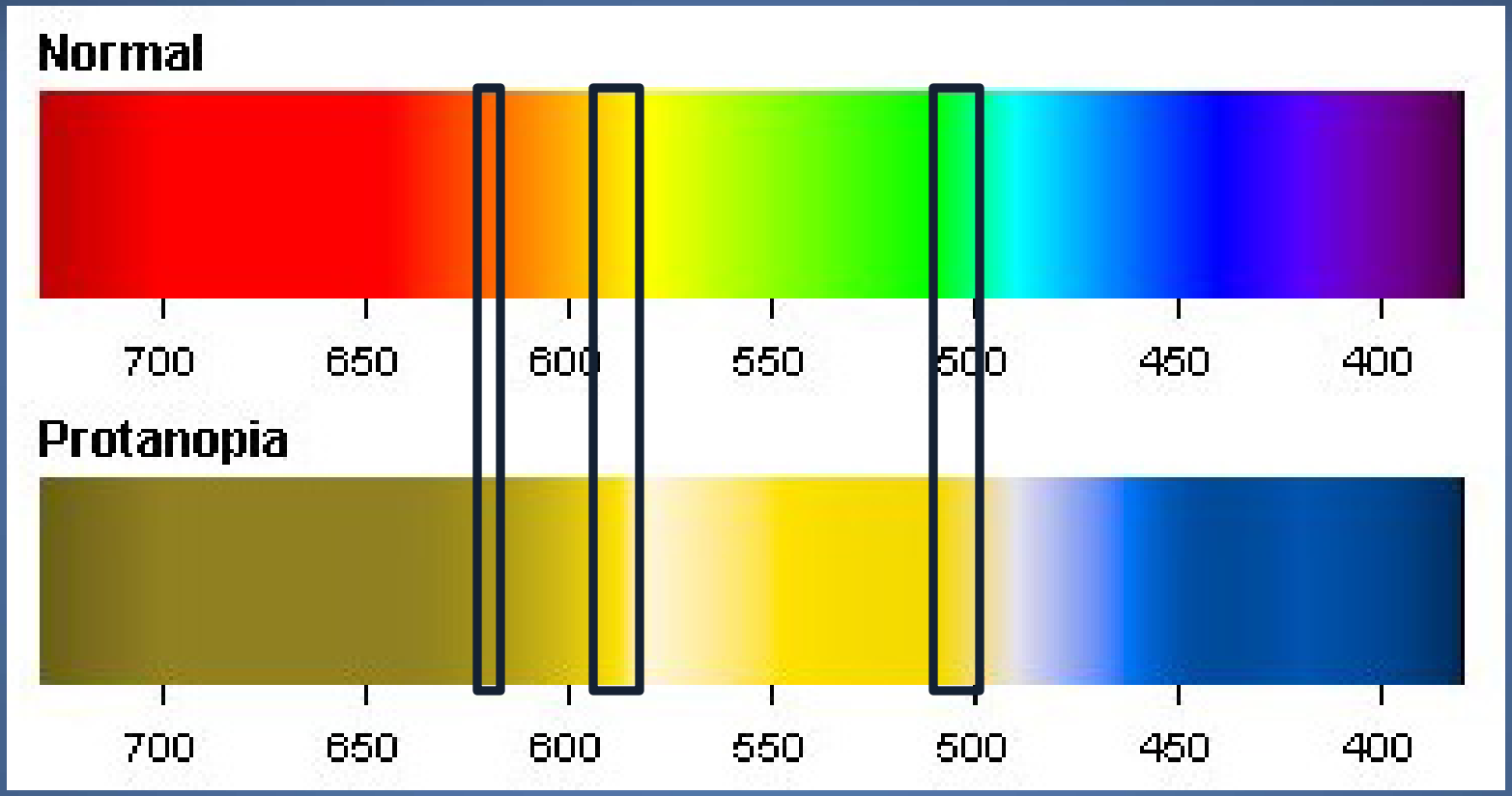
- Color vision August 2009:
  - Missed 10 out of 17 Ishihara plates



Eastbound Engineer: 2009-2012

- More than 50 visits for eye care
- 12 separate eye procedures
- Fluctuating visual acuity
  - Right: 20/40 to 20/80 with glasses + contacts
  - Left: 20/80 to 20/200 with glasses + contacts
- July 2010: the engineer reports “difficulty reading train signals”

August 2010: Unable to see red or green



Wavelength, nm

Probable Cause

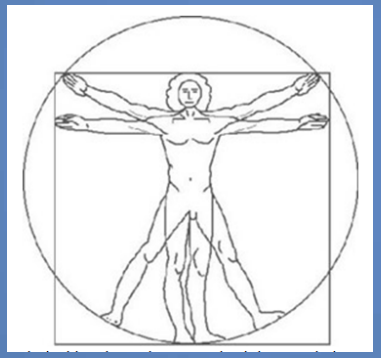
- “The eastbound Union Pacific Railroad train crew’s lack of response to wayside signals because of the engineer’s inability to see and correctly interpret the signals;
- the conductor’s disengagement from his duties;
- and the lack of positive train control, which would have stopped the train and prevented the collision regardless of the crew’s inaction.”

Probable Cause

- “Contributing to the accident was a medical examination process that failed to decertify the engineer before his deteriorating vision adversely affected his ability to operate a train safely.”

Safety Recommendations

- 9 safety recommendations issued
  - 5 pertaining to improved color vision testing



The Human

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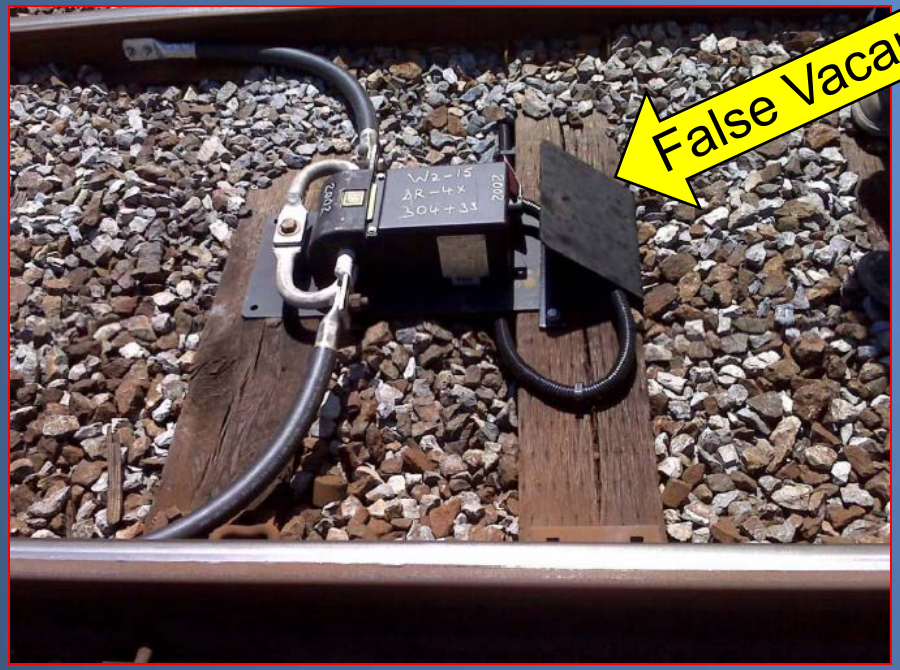
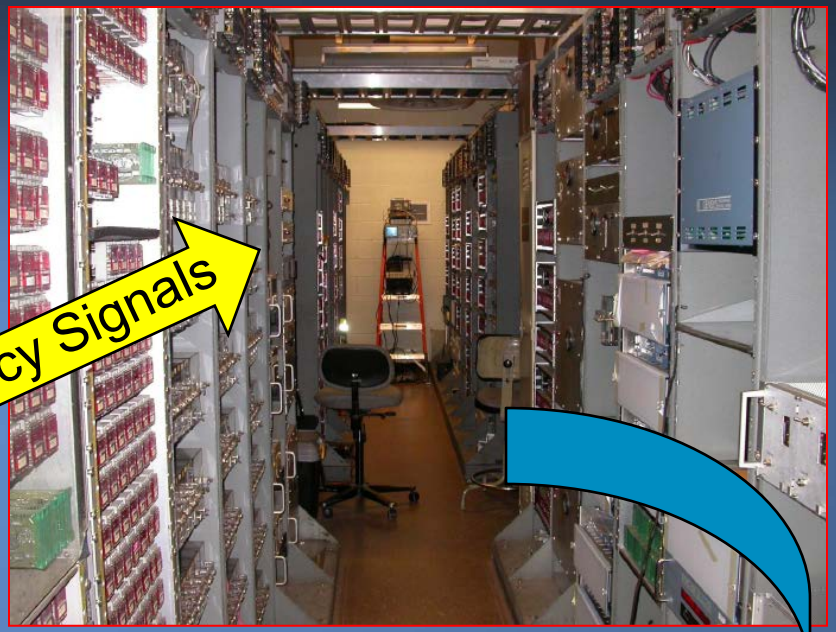
Washington DC Subway (WMATA)

June 22, 2009

Technical failure





False Vacancy Signals

Probable Cause

- Failure of the track circuit modules that caused the automatic train control system to lose detection of the first train and thus transmit speed commands to second train up the point of impact

- WMATA's failure to ensure that an enhanced track circuit verification test was institutionalized and used system-wide after a 2005 precursor event (near-collisions), which would have identified the faulty track circuit before this accident

Contributing to the Accident

- WMATA's lack of a safety culture
- WMATA's failure to effectively maintain and monitor performance of the ATC system
- GRS/Alstom failure to provide a maintenance plan to detect spurious signals that could cause a malfunction
- Ineffective oversight by WMATA Board of Directors
- Ineffective oversight by State Safety Oversight agency and its lack of safety oversight authority
- FTA's lack of statutory authority to provide Federal safety oversight

Driver Fatigue:
Our Legacy, Present, and Future

PAST

- Hours of service limits that did not account for circadian variation; sleeper berths; rest areas; manning/crewing redundancy.

Driver Fatigue:
Our Legacy, Present, and Future

Present

- Fatigue Risk Management Systems that incorporate scheduling, education, call-in-fatigued policies, incident reporting, sleep disorder screening and treatment.

- Technology such as speed bumps, in-vehicle lane departure warning systems and collision avoidance systems.

Driver Fatigue:
Our Legacy, Present, and Future

Future

- Biomathematical modeling systems that can predict operator safety and performance.
- Integration of actigraphy and other bio-monitoring systems into work planning.
- Advanced on-board monitoring systems to detect fatigue, impairment, and performance degradation, improved collision avoidance through V2V and I2V systems.

Our future

- I have long believed that we should provide very basic HF training to everyone involved in crash investigation.
- Doesn’t discount the need of the HF specialists.

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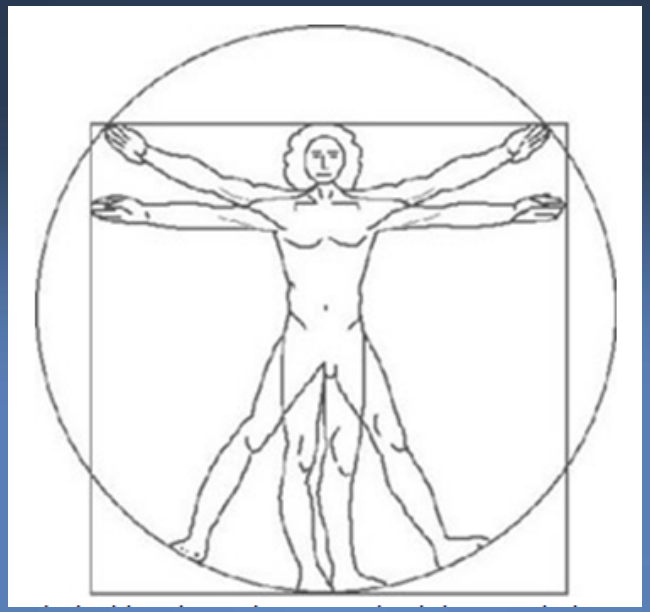

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