RAILROAD SIGNAL & TRAIN CONTROL GROUP

FACTUAL REPORT OF INVESTIGATION

Collision of Southbound Amtrak #89 (Palmetto) with Maintenance of Way Equipment / Backhoe A48553 near MP 15.7 in the vicinity of Chester, Pa. April 3, 2016

DCA16FR007

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NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF RAILROAD, PIPELINE &
HAZARDOUS MATERIALS INVESTIGATIONS
WASHINGTON, D.C. 20594

A. ACCIDENT

Type:	Collision Amtrak train 89 with MOW Equipment / Backhoe A48553
Date:	April 3, 2016
Time:	07:50 am EDT
Location:	Chester, Pa.
Carrier:	National Railroad Passenger Corporation, AMTRAK
Train:	Amtrak 89 (Palmetto)
Fatalities:	2
Injuries:	41
NTSB #:	DCA-16-FR-007

B. SIGNAL & TRAIN CONTROL GROUP

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C. ACCIDENT SUMMARY

Accident Summary

For a summary of the accident, refer to the *Accident Summary* report, within this docket.

D. Details of the Investigation

1. Description and Method of Operation of the Mid-Atlantic Subdivision

1.1 Mid-Atlantic Subdivision

The PW (Philadelphia-Washington) line of the Mid Atlantic Subdivision of the Amtrak Northeast corridor extends from MP 0.0 at Control Point Zoo in Philadelphia, Pa. to MP 134.6 at Control Point Avenue, Washington Terminal in Washington DC in a timetable north-south direction. The maximum authorized timetable speed on the subdivision in the vicinity of the accident in the block between CP Baldwin and CP Hook is 110 mph for tracks two & three and 90 MPH for track one & four for passenger trains. In the vicinity of the accident area, Amtrak operates trains over four main tracks utilizing an Advanced Civil Speed Enforcement System(ACSES) supplemented by an Automatic Train Control System (ATC) controlled by a dispatcher located at the CNOC (Consolidated National Operations Center) in Wilmington, Delaware. Train movements on the Mid-Atlantic Subdivision between CP Phil MP 3.6 to CP Holly MP 20.3 are governed by operating rule 261[1]. Additionally, on tracks where rule 261[1] is in effect, ABS[2] rules & CSS[3] rules 550-561 are in effect for movements in both directions.

1. Amtrak defines operating rule 261; Track signaled in both directions. Signal indication will be the authority for a train to operate in either direction on the same track. At a hand operated switch that is not equipped with an electric lock, a train may clear the main track only where the maximum authorized speed on the main track over the switch is 20 MPH or less.

2. Amtrak defines ABS as a block signal system in which the use of each block is governed by an automatic block signal, cab signal, or both.

3. Amtrak defines CSS as a cab signal system that is interconnected with the fixed signal system to provide the Engineer with continuous information on the occupancy and/or condition of the track ahead.

2. Description of the Railroad Signal System

2.1 CP Phil MP 3.6 to CP Holly MP 20.3 Main Tracks 1-4

Amtrak utilizes an Automatic Train Control System[4] (ATC) in conjunction with an Advance Civil Speed Enforcement System (ACSES) to direct train movement between CP Phil and CP Holly. Additionally, Cab Signals[5] and Block Signals[6] apply within the ATC system. The ACSES system supplements the ATC by meeting all FRA requirements for high speed rail operation.

4. The Federal Railroad Administration defines Automatic Train Control System in the Code of Federal Regulations Title 49 Part 236.825 as; a system so arranged that its operation will automatically result in the following:
(a) A full service application of the brakes which will continue either until the train is brought to a stop, or, under control of the engineman, its speed is reduced to a predetermined rate.
(b) When operating under a speed restriction, an application of the brakes when the speed of the train exceeds the predetermined rate and which will continue until the speed is reduced to that rate.

5. The Federal Railroad Administration defines a Cab Signal in the Code of Federal Regulations Title 49 Part 236.805 as; a signal located in engineman's compartment or cab, indicating a condition affecting the movement of a train and used in conjunction with interlocking signals and in conjunction with or in lieu of block signals.

6. The Federal Railroad Administration defines a Block Signal in the Code of Federal Regulations Title 49 Part 236.804 as; a roadway signal operated either automatically or manually at the entrance to a block.

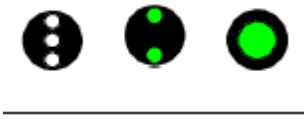
> **Note: 1.** The Federal Railroad Administration defines Traffic Control System in the Code of Federal Regulations Title 49 Part 236.828 as; A block signal system under which train movements are authorized by block signals whose indications supersede the superiority of trains for both opposing and following movements on the same track.

Below are signal rules, aspects, and indications that apply to Amtrak # 89 the day of the accident between CP Baldwin and CP Hook.

NORAC Signal Rules:

RULE	ASPECT	INDICATION	
281	**Clear**	**Proceed not exceeding Normal Speed**	
292	**Stop Signal**	**Stop**	

279. Cab Signal Aspects

Clear 

Stop Signal 

The following chart identifies the cab signal(s) that must be displayed to conform to each fixed signal, in accordance with Rule 552, "Conformity between Cab Signals and Fixed Signals."

Fixed Signal	Conforming Cab Signal(s)
Clear	Clear
Cab Speed	Clear, Cab Speed, Approach Limited, Approach
Limited Clear	Approach Limited, Approach Medium

Medium Clear	Approach Medium
Approach Limited	Approach Limited, Approach Medium
Approach	Approach Limited, Approach Medium
Advance	Approach Limited, Approach Medium
Medium	Approach
Approach	Approach
Approach Slow	Approach
Slow Clear	Restricting
Slow Approach	Restricting
Restricting	Restricting
Stop & Proceed	Restricting
Stop Signal	Restricting

When the movement of a train is governed solely by the cab signal, the indication of the fixed signal with the same name (i.e. Clear, Cab Speed, Approach Limited, Approach Medium, Approach, or Restricting) will apply. Movements are governed solely by cab signals when:

1. The train is operating in territory where cab signals are used without fixed automatic block signals (Rule 562).

2. The cab signal changes between fixed signals (Rule 553).

3. The cab signal is more restrictive than the fixed signal when the train enters a block (Rule 552).

3. Post-accident Signal Data Logs

Field signal data recorder is not synchronized with the AIM dispatcher system. Therefore, field signal data log and the dispatcher log will reflect different times. Additionally, field signal log had not been set for additional day of February 29, 2016 (Leap Year) nor daylight savings time that became effective at 2:00 am on March 13, 2016. In summary, the field signal log will differ in the approximate amount of 1-hour Table 1 summarizes field signal events recorded for Amtrak Train #89 as it precedes south bound from CP Baldwin MP 11.7 to CP Hook MP 16.8

TRAIN	EVENT	SB aspect @ CP BALDWIN on 3 trk	INDICATION	FIELD TIME	AIM TIME
AMTRAK 89	#3TRACK BLOCK REMOVED	STOP SIGNAL	STOP	06:30:34:AM	7:31:15 AM
AMTRAK 89	3S SIGNAL CLEARED	CLEAR	PROCEED	06:34:02:AM	7:34:41 AM
AMTRAK 89	3N1 TRK IND	CLEAR	PROCEED	06:45:33:AM	7:46:12 AM
AMTRAK 89	OCCUPIES 3TRACK @ Baldwin	STOP SIGNAL	STOP	06:46:39:AM	7:47:17 AM
AMTRAK 89	OCCUPIES 3S1TRACK @ Baldwin	STOP SIGNAL	STOP	06:46:50:AM	7:47:28 AM

Table 1. *Amtrak post-accident TCS signal data log*

3.1 Aim Dispatcher Log

The data recorded events of the dispatcher AIM system were retrieved from the dispatcher office from the CETC4 in Wilmington, Delaware. Table 2 summarizes the dispatcher data event recorder.

TRAIN	EVENT	AIM TIME
AMTRAK 89	#3TRACK BLOCK REMOVED	7:31:15 AM
AMTRAK 89	3S SIGNAL CLEARED @ CP HOOK	7:31:28 AM
AMTRAK 89	3S SIGNAL CLEARED @ CP BALDWIN	7:34:41 AM
AMTRAK 89	3N1 TRK IND OCCUPIED@ CP BALDWIN	7:46:12 AM
AMTRAK 89	OCCUPIES 3TRACK @ CP BALDWIN	7:47:17 AM
AMTRAK 89	OCCUPIES 3S1TRACK @ CP BALDWIN	7:47:28 AM
AMTRAK 89	OCCUPIES 3N2 TRACK @ CP HOOK	7:47:57 AM
AMTRAK 89	OCCUPIES 3N1 TRACK @ CP HOOK	7:48:54 AM
AMTRAK 89	TRACK 4N1 INDICATES OCCUPIED	7:49:48 AM

Table 2. Amtrak post-accident AIM data log

3.2 Dispatcher Console Playback log

The CETC-4 Dispatcher Console playback was retrieved to verify authorizations of Foul Time and Train Movements on tracks 1, 2, 3 & 4 from CP Baldwin to CP Hook. Table 3 summarizes video events recorded by the dispatcher console.

Video EVENT	Console Time
Track 2 OOS, TRACKS 1,3,4 Fouled Time Block	Blocked prior to Playback video time beginning @ 07:31:05
Block on track 3 removed	7:31:16
3S Signal Cleared Track @ CP Hook	7:31:31
3S Signal Cleared Track @ CP BALDWIN	7:34:43
OCCUPIES 3N1TRACK @ Baldwin	7:47:11
OCCUPIES 3TRACK @ Baldwin	7:47:19
OCCUPIES 3S TRACK South oF Baldwin	7:47:29
OCCUPIES 3S 2 TRACK South of Baldwin	7:47:59
OCCUPIES 3N1TRACK @ HOOK (Acc Scene Trk Section)	7:48:55
Track 4 is Displaying Track Occupied	7:49:49
Track 4 is Displaying Tripped Cantenary & track occupied	7:50:48

Table 3 CETC-4 Dispatcher Console event timeline

3.3 Highway Grade Crossing Warning System

Highway Grade Crossings are non-existent in this section of affected track.

4. Post-Accident Signal System Examination and Testing

Signal inspection was performed of affected equipment pertaining to the route of train No. 89. Inspected, verified and shunted all associated track circuits. Inspected all signal locations and verified they were free of grounded circuits, verified all signal lamp units were working as intended with proper voltage levels. Performed signal sequence testing between Baldwin and Hook interlocking, including automatic signal locations 127 and 141. Verified proper signal aspect and cab signal code rate at all locations. Verified cab signal code change points and high speed cab signal code change points were working as intended. No defects were found for units inspected.

5. The On-Board ATC and ACSES System

The ATC and ACSES bypass switches onboard Amtrak ACS 64 locomotive No. 627 were properly sealed and active. The cab signal inductive pick-up detector units on the front of the locomotive were damaged during the accident. The data from the On-board ATC/ACSES ADU unit has been received for analysis.

6. **Signal System Trouble Reports**

Signal system trouble reports logged by the Communication & Signal trouble desk located in the CNOC were provided between Control Point Baldwin to Control Point Hook were obtained for the 12-month period preceding the accident.

7. Railroad Signal Maintenance Records

Railroad Maintenance, inspections and tests records were provided for monthly, quarterly, semi-annual, annual, 2 year, 4 year, and 10 year inspections for Control Point Baldwin to Control Point Hook.

8. Signal Damages

There was no damage to the Amtrak signal system as a result of this collision of Amtrak Train # 89 (Palmetto) with Maintenance of Way / Backhoe.

END OF SIGNAL GROUP FACTUAL REPORT