National Transportation Safety Board
Office of Railroad, Pipeline and Hazardous Materials
Washington, DC 20594

RRD22MR007 – SAN BRUNO, CALIFORNIA

SIGNAL & TRAIN CONTROL

Factual Report

September 6, 2022

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A. ACCIDENT

Location:	San Bruno, California
Date:	March 10, 2022
Time:	10:33 am (PST)
Train:	Southbound Caltrain 506
Vehicles:	3 Hyrail Maintenance Vehicles

B. SIGNAL & TRAIN CONTROL GROUP

Group Chair	R. Payan Electrical Engineer National Transportation Safety Board
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Group Member	J. Navarro Director of Operations & Maintenance Caltrain

Group Member	S. Cocke
	Director Signal & Rail Activation
	Caltrain

C. SUMMARY

For a summary of the accident, refer to the *Accident Summary Report* in the docket for this investigation.

D. DETAILS OF THE INVESTIGATION

1.0 Description of Caltrain Signal & Train Control System

The Caltrain Peninsula Corridor extends between milepost 0.0 in San Francisco, California and milepost 50.94 in San Jose, California in a timetable north/south direction. The Peninsula Corridor consists of sections with 1, 2, 3 and 4 main track territory and passing sidings. The maximum authorized timetable speed is 79 mph for passenger trains with permanent speed restrictions between posted timetable mileposts. Milepost numbering increases in the timetable southbound direction.[1]

Caltrain authorizes train movements with a traffic control signal system. Train movements are monitored and coordinated by a train dispatcher located at the Caltrain dispatch center in Menlo Park, California. Train movements are governed by operating rules, special instruction, timetable instructions, and the wayside signal indications of the traffic control system and supplemented with an overlaid I-ETMS positive train control system.

The signal system uses coded track circuits for train occupancy detection. Wayside signals are LED colorlight signals with upper and lower signal heads capable of displaying green, yellow, and red aspects for train movements in either direction.[2]

2.0 Signal System Data Logs

The dispatch center communicates with signal and train control equipment located along the railroad right of way. Field signal and train control equipment maintain logs of signal data locally and transmits the data to the dispatch center where it is displayed on a monitor for the dispatcher.

Following the accident, the dispatch center data logs, field signal and train control data logs for wayside signal locations between control point Scott and control point Center, PTC field data, and PTC data from train 506 (locomotive JPBX 919) were downloaded for the investigation.

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[1] Caltrain, Employee Timetable and System Special Instructions No. 8 (effective 0001, October 7, 2019)

[2] LED are light-emitting diodes.

2.1 Caltrain Dispatch Center Data Logs

The Caltrain dispatch center computer clock was used as the common time reference to synchronize all wayside field microprocessor times. Caltrain dispatch center clock time was pacific standard time. Table 1 summarizes the dispatch center data relevant to the accident sequence.

Table 1. Summary of Caltrain Dispatch Center Data Log

Time	Event
9:00 am	Form B (#7493) Track Bulletin is active between milepost 8.3 to milepost 9.8 (both main track 1 and 2)
9:32 am	• Dispatcher applies track block between control point Scott to control point Center • Dispatcher applies block to switches 1A and 1B • Dispatcher issues Track & Time #210 on main track 2
9:59 am	• Dispatcher releases Track & Time #210 on main track 2 • Dispatcher removes track block between control point Scott and control point Center • Dispatcher removes switch blocks for switch 1A and 1B

2.2 Locomotive JPBX 919 – PTC Data Log

The clock times for the locomotive PTC data was recorded in UTC time. The locomotive PTC clock time was synchronized with Caltrain dispatch clock time by adjusting the UTC times -8 hours to synchronize to PST time. Table 2 is a summary of events relevant to the accident sequence.

Table 2. Summary of Locomotive PTC Data Log

Time	Event	Speed (mph)	Milepost	GPS coordinates
9:41:29	Train crew begins locomotive PTC initialization	--	--	37°46'31.04"N 122°23'45.46"W
9:42:44	PTC transitions to Active mode	--	--	37°46'31.04"N 122°23'45.46"W
10:15:48	Train enters main track 3	10.5	0.2491	37°46'25.86"N 122°23'53.16"W
10:17:43	Train enters crossover to main track 2	31.5	0.8134	37°46'3.61"N 122°23'46.25"W
10:19:50	Train stops at 22nd St Station	0	1.66	37°45'22.47"N 122°23'32.63"W
10:27:53	Train enters crossover to main track 1	19.6	8.0214	37°40'5.35"N 122°23'35.43"W
10:28:41	Train enters work zone 7493	28.64	8.3	37°39'53.50"N 122°23'46.73"W
10:30:37	Train exits work zone 7493	54.29	9.8	37°38'50.20"N 122°24'42.72"W

10:31:09	Train enters crossover to main train 2	48.07	10.27	37°38'26.53"N 122°24'47.18"W
10:32:26	Tain crew begins pressing horn button	65.25	11.4	37°37'29.33"N 122°24'30.41"W
10:32:31	Emergency brake application	66.74	11.47	37°37'29.54"N 122°24'30.43"W
10:32:58	Train at stop	0		37°37'11.51"N 122°24'18.44"W

2.3 Wayside Signal & Train Control Data Logs

Data logs from control point Scott, control point Center and intermediate signal 114-2 were downloaded. The clock time for each field location are independent microprocessor clocks. Clock times for each location were compared with the Caltrain dispatch clock to synchronize all clock times. Table 3 is a summary of events relevant to the accident sequence.

Table 3. Summary of Wayside Signal Data Logs

Time[3]	Location	Event
10:22:34	Intermediate 114-2	• Signal indicates clear. • Signal aspect is Green/Red • CP Center indicates lined for southbound train move
10:23:52	CP Scott	• Switch 1 indicates lined Reverse • Switch 3 lined indicates lined Normal • 1 RWK relay indicates True (crossover switches lined reverse for crossover move from main track 1 to main track 2)
10:24:21	CP Scott	• Signal 2S indicates clear • Signal aspect is Flashing Green for main track 1 (2SGBFL relay indicates True)
10:32:12	CP Scott	• 1NT track circuit relay indicates occupied • Train 506 on approach track circuit to CP Scott
10:33:35	CP Scott	• 1T track circuit relay indicates occupied • Train 506 occupying OS • Signal 2S at Stop (2SGBFL indicates False - southbound main track 1 signal aspect is Red)
10:33:37	CP Scott	• T1 track circuit relay indicates occupied (train 506 occupies crossover)
10:33:39	CP Scott	• T2 track circuit relay indicates occupied (train 506 on crossover)
10:33:46	CP Scott	• 1T track circuit relay indicates unoccupied (train 506 in advance of OS)
10:33:48	CP Scott	• T1 track circuit relay indicates unoccupied

[3] Contol Point Scott and Control Point Center clock times matched Caltrain clock time and did not require to be synchronized. Intermediate signal 114-2 was synchronized with the dispatch center clock by subtracting 1 minute to the field data times.

10:33:50	CP Scott	• T2 track circuit relay indicates unoccupied
10:33:41	CP Scott	• 2ST track circuit relay indicates occupied (Train 506 locomotive south of CP Scott)
10:33:58	CP Scott	• OS indicates unoccupied (rear of train passed 4N signal)
10:33:02	Intermediate 114-2	• Signal 114-2 aspect is Red/Red (Train 506 south of intermediate signal)

2.4 Wayside PTC Data Log

PTC wayside data logs from control point Scott, control point Center and intermediate signal 114-2 were also downloaded. Table 4 is a summary of events relevant to the accident sequence.

Table 4. Summary of Wayside PTC Data Logs

Time	Wayside Location	Event
9:50:04	Intermediate 114-2	Signal indicates Stop & Proceed
9:54:31	Intermediate 114-2	Signal indicates Advance Approach
10:05:33	CP Center	9 Switch indicates Normal
10:05:41	CP Center	2N Signal indicates Clear
10:06:21	CP Center	2N Signal indicates Stop
10:07:57	Intermediate 114-2	Indicates Clear
10:21:25	CP Scott	1 Switch indicates Reverse
10:21:51	CP Scott	2S Signal indicates Stop
10:21:53	CP Scott	2S Signal indicates Limited Clear
10:31:08	CP Scott	2S Signal indicates Stop
10:32:22	Intermediate 114-2	Signal indicates Stop & Proceed

3.0 Postaccident Examination

The postaccident examination found the wayside signal equipment and appurtances between control point Sierra and control point Center locked and secured with no indications of tampering or vandalism that could affect the functionality of the signal system.

Signal indications were determined to be in accordance with the physical location of the accident wreckage. No terrain or physical structures were identified during the examination of the alignment of the signal heads that could obstruct the signal aspect preview at the wayside locations between control point Sierra and control point Center.

4.0 Caltrain Signal System Maintenance, Inspection and Test Records

Caltrain signal system maintenance, inspection and test records were reviewed as part of the accident investigation. Caltrain records indicated the signal system was

maintained in accordance with Federal requirements and did not indicate any conditions or problems that could affect the operation of the signal system. A summary of the Caltrain maintenance, inspection and test records is contained in Table 5.

Table 5. Caltrain, Signal & Train Control Maintenance Records

Location	Test	Date
CP Scott Main House	Insulation Resistance Test	1/25/2017
CP Scott Main House	Locking Tests & Inspections	3/22/2021
CP Scott Main House	Relay Tests & Inspections	6/18/2021
CP Scott Main House	Grounds Tests & Inspections	2/22/2022
CP Scott Main House	Timing Tests & Inspections	5/16/2021
CP Scott Remote House	Insulation Resistance Test	1/28/2017
CP Scott Remote House	Relay Tests & Inspections	5/5/2019
CP Scott Remote House	Grounds Tests & Inspections	1/10/2022
Intermediate Signal 11.45	Insulation Resistance Test	2/5/2017
Intermediate Signal 11.45	Grounds Tests & Inspections	3/6/2022
CP Scott Switch 1	Switch Test & Inspection	2/13/2022
CP Scott Switch 1A	Switch Test & Inspection	2/13/2022
CP Scott Switch 3	Switch Test & Inspection	2/13/2022
CP Scott Switch 3A	Switch Test & Inspection	2/13/2022

5.0 Postaccident Signal & Train Control System Estimate of Damages

No wayside signal devices were damaged or destroyed as a result of the collision.

Signal & Train Control
End of Factual Report