NATIONAL TRANSPORTATION SAFETY BOARD

OFFICE OF RAILROAD, PIPELINE &

HAZARDOUS MATERIAL INVESTIGATIONS

WASHINGTON, D. C. 20594

DCA-13-MR-002

DERAILMENT WITH HARZARDOUS MATERIALS RELEASE

On Conrail Penns Grove Secondary

Paulsboro, New Jersey

November 30, 2012

SIGNAL GROUP FACTUAL REPORT

Prepared by: Timothy J. DePaepe, Signal Group Chairman

Accident:

NTSB Accident Number:	DCA-13-MR-002
Date of Accident:	November 30, 2012
Time of Accident:	Bridge Derailment with Hazardous Materials Release
Type of Train :	Freight Train CA-11
Railroad Owner:	Conrail
Train Operator:	Conrail
Fatalities:	0
Injuries:	23
Location of Accident:	Paulsboro, New Jersey

Signal Group:

Mr. Timothy J. DePaepe – Signal Group Chairman – NTSB
Mr. Douglas Tracy – Assistant Chief Engineer C&S – Conrail
Mr. Thomas Noon – Signal and Train Control Inspector – FRA

Synopsis:

On November 30, 2012, at about 6:59 a.m. EDT a southbound Conrail freight train FC4230 carrying hazardous materials consisting of two leading locomotives and 82 cars derailed seven cars, the 6th through the 12th, at about milepost 13.7 on the Penns Grove secondary track in Paulsboro, New Jersey. The cars derailed while traveling over the Paulsboro movable bridge, four of which fell into the waterway, Mantua Creek. Two cars south of the bridge derailed to the east side of the main and one car to the north of the bridge derailed to the east of the main. Conrail reported one of the tank cars released approximately 20,000 gallons of vinyl chloride into the environment. Eyewitnesses reported seeing a vapor cloud rise from the scene immediately following the accident.

Mantua Creek is a stream in the Mantua Township in Gloucester County. It flows northwest for about 18.6 miles to the Delaware River at Paulsboro across from the Philadelphia International Airport. The FAA reports airport operations were unaffected. Mantua Creek is approximately 150 feet wide at the location of the derailment. On the morning of the accident, there were 23 local residents transported to local hospitals for treatment of possible vinyl chloride exposure.

The initial damage estimates provided by Conrail are $ 450,654, which does not include environmental remediation. The weather at the time of the incident was cloudy skies with 34 degree temperature and calm winds[1].

Parties to the investigation include: Conrail, Federal Railroad Administration, the BLET and the UTU.

[1] Source: NOAA http://www1.ncdc.noaa.gov/pub/orders/72408013739-2012-11_7584466043346dat.html

Description of Railroad Signal System:

The Paulsboro moveable bridge is located on the Penns Grove Secondary at MP 13.7 in the Conrail's South Jersey District in Paulsboro New Jersey. The Pennsgrove Secondary is a single track that runs in a timetable north/south direction from CP Woodbury MP 8.8 to Deep MP 30.0. The speed over Paulsboro moveable bridge is 10 MPH.

Train movements on Conrail are governed by NORAC (Northeast Operating Rules Advisory Committee) Operating Rules with special instructions in Conrail's Timetable. NORAC DCS[1] rules govern train movement on the Penns Grove Secondary. The Paulsboro moveable bridge is equipped with a signal on both sides of the moveable span. The signals display a GREEN[2] aspect when the moveable bridge is lined and locked for rail traffic.

The signal displays a RED[3] aspect at all other times. The signals are color light type consisting of separate 5 1/2 inch diameter X ½ inch focal red lens with 8 3/8 inch diameter X 4 inch focal with a 40 degree deflecting bullseye clear lens and 5 1/2 inch diameter X ½ inch focal green lens with 8 3/8 inch diameter X 4 inch focal with a 40 degree deflecting bullseye clear lens.

Four proximity detectors are used to detect when the moveable bridge is linedand locked for rail traffic. The slide rails are located outside each rail on each end of the movable span. Efector® 100 inductive sensors (See Figure 1) are used to detect when the slide rails are properly positioned for rail traffic. One sensor is located adjacent to each rail on the land/stationary side of the bridge.

Figure 1. Efector® 100 inductive sensor.

[1] FORM D CONTROL SYSTEM (DCS): A block system, signaled or non-signaled, in which the movement of trains outside of yard limits is authorized by Form D.
[2] NORAC Rule 281 Fig.C2, meaning Proceed not exceeding normal speed.
[3] NORAC Rule 292 Fig.C2, meaning Stop.

Railroad Signal Event Recorders:

Information from the signal data event recorder was collected from the Invensys Rail Group Safetran Event Analyzer Recorder (SEAR II). The following chart is a nomenclature explanation of the event recorder data.

PTO	Permission to Open
RCI	Remote Closed Initiation
BOR	Bridge Open Relay (comes from bridge controller when the bridge is fully open)
PD	Proximity Detector
PDSR	Proximity Detector Stick Relay
BN	Bridge Normal
TS	Trap Stick
BRCSR	Bridge Crossing Stick
FTOR	Failure to Operate (comes from bridge controller)
BC	Bridge Closed (comes from bridge controller when the bridge is fully closed)
ROIR	Remote Open Initiation
A1TR	A1 Track Relay
B1TR	B1 Track Relay
C1TR	C1 Track Relay
D1TR	D1 Track Relay

The following data was downloaded for the movement of the accident train FC4230.

DAY	DATE	TIME	RELAY
Fri	11-30-2012	06:53:57.92	D1TR: D1TR OCC
Fri	11-30-2012	06:53:57:95	PTOR: PTOR DOWN
Fri	11-30-2012	06:53:57:96	ROIR: ROIR DOWN
Fri	11-30-2012	06:53:58.06	FTOR: FTOR UP
Fri	11-30-2012	06:54:30.83	RCIR: RCIR UP
Fri	11-30-2012	07:01:10.78	FTOR: FTOR DOWN
Fri	11-30-2012	07:01:11.79	RCIR: RCIR DOWN
Fri	11-30-2012	07:01:11.91	FTOR: FTOR UP
Fri	11-30-2012	07:03:06.33	C1TR: C1TR OCC
Fri	11-30-2012	07:03:06.35	C1TSR: C1TSR DOWN
Fri	11-30-2012	07:03:31.58	B1TR: B1TR OCC
Fri	11-30-2012	07:03:31.60	B1TRSR: DOWN
Fri	11-30-2012	07:03:31.93	BRCSR: BRCSR UP
Fri	11-30-2012	07:03:43.33	A1TR: A1TR OCC
Fri	11-30-2012	07:04:00.23	C1TR: C1TR CLEAR
Fri	11-30-2012	07:04:00.63	C1TR: C1TR OCC
Fri	11-30-2012	07:04:35.88	B1TR: B1TR CLEAR

The signal circuitry for the Paulsboro Moveable Bridge consists of four track circuits and two signals, one for southbound movement and one for northbound movement. (See Figure 2).

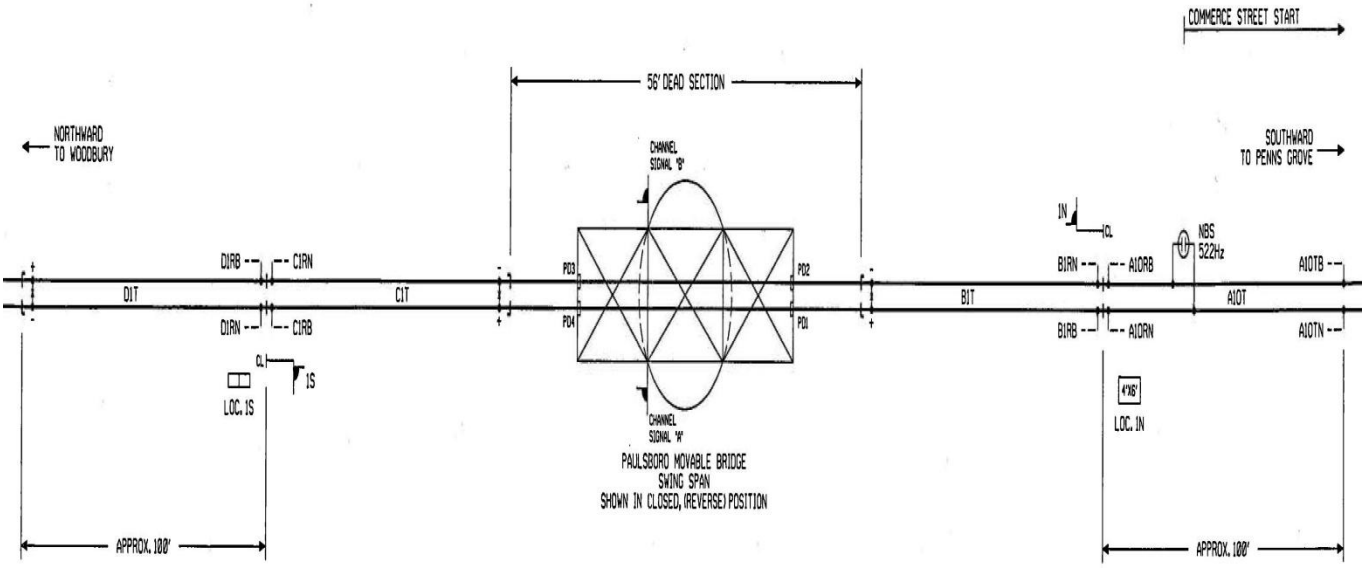

Figure 2. Diagram of Signal System Layout for Paulsboro Moveable Bridge. ***(Not to Scale)***

Instructions Governing the Operation of Moveable Bridges:

9.B Moveable Bridges – Not part of an Interlocking Radio Controlled Operation[4]

Bridge	**Location**	**Request Code**
Paulsboro	MP 13.7	137

Instructions Governing the Operation of Moveable Bridges Shown:
Normal position of moveable bridge is OPEN.

1. Trains must approach moveable bridge prepared to stop.
2. Verify river traffic is clear of moveable bridge.
3. To close moveable bridge for rail traffic, key in request code and *using the keypad of the locomotive or portable radio.
4. Warning message will be broadcast over radio and loudspeakers on bridge announcing closing of bridge.
5. When moveable bridge is completely closed, message will be broadcast over radio and loudspeakers confirming closing. A signal to proceed will then be displayed.
6. To stop the bridge at any time, key in the request code and #. A message will be broadcast over the radio and loudspeakers indicating process has been halted. To restart the closing sequence, again key in the request code and *.

[4] Contained in Conrail Timetable Number 9, dated June 20, 2011

7. After train proceeds and is clear of bridge circuit, the moveable bridge will automatically open. A message will be broadcast over radio and loudspeakers confirming the opening. **NOTE:** Failure to display a proceed indication or failure of system to broadcast messages announcing bridge opening must be reported immediately to the South Jersey Train Dispatcher.

Failure of Moveable Bridge to close when requested by Radio Command:

1) Open control panel case marked T/E using switch key. Control panel case is located on west side of track on both sides of bridge.
2) Press "CLOSE" button; radio and loudspeaker warning broadcast will commence.
3) To stop the bridge, press the "CLOSE" button. A message will broadcast over the radio and loudspeakers indicating process has been halted. To restart the closing sequence, again press the "CLOSE" button.
4) Once bridge is closed, close and lock case.
5) When signal indication to proceed is displayed, train may proceed across moveable bridge.
6) After train proceeds and is clear of bridge circuit, the moveable bridge will automatically open. A message will be broadcast over the radio and loudspeakers confirming the opening.

NOTE: Failure to display a proceed indication or failure of system to broadcast messages announcing bridge opening must be reported immediately to South Jersey Train Dispatcher.

General Signal Rules[5], 241. Passing a Stop Signal

To pass a Stop Signal, a train must have verbal permission of the Dispatcher (or Operator when authorized by the Dispatcher). Permission must not be given or accepted until the train has stopped at the signal. A member of the crew must contact the Dispatcher or Operator and follow his instructions.

d. Stopped at a Signal Protecting Moveable Bridge

Under the following conditions, a qualified employee must determine that the rails are properly lined and the bridge is safe for movement before verbal permission is given to pass the signal:

1) When the signal cannot be displayed for the first movement over a bridge after the bridge has been closed, regardless of bridge lock indication.

Or

2) At any a bridge unlock indication is received.

[5] Contained in the 10th Edition, NORAC Operating Rules, effective date November 6, 2011

Bridge Voice Annunciation Explanations:

Voice Annunciation Explanations:

- "Conrail Paulsboro New Jersey Moveable Bridge Closing Out" means bridge has received a command to close.
- "Conrail Paulsboro New Jersey Moveable Bridge Closing Halted Out" means an emergency stop was initiated.
- "Conrail Paulsboro New Jersey Moveable Bridge Closed Out" means bridge is closed, all limit switches are engaged according to Bridge Controller.
- "Conrail Paulsboro New Jersey Moveable Bridge Failed to Operate Out" means the bridge did not reach its intended position.
- "Conrail Paulsboro New Jersey Moveable Bridge Open Out" means that after a movement the bridge is fully open.

The 1S signal is pictured below. (See Figure 3.)

Figure 3. View of 1S Signal at Paulsboro Moveable Bridge

Proposed Post Accident Inspection/Testing Of Signal System:

Due to the extreme danger involved in the removal of hazardous materials released and the recovery of the derailed tank cars representatives from Conrail, NTSB and the FRA were not allowed access to the Paulsboro Moveable Bridge accident site during the on-scene accident investigation.

The signal group members developed a document describing the procedures on what signal data and photographs should be collected when access to the accident site is permitted.

Pre-removal documentation:

- Check for evidence of tampering or vandalism with any of signals; signal cases; and appurtenances. If any evidence is discovered, photograph it and immediately report it to the NTSB. *Once the site was secured post-accident inspection did not reveal any evidence of tampering or vandalism.*
- Photograph 1S signal with red lamp lit. Photo should be taken from the track facing the signal. *Once the site was secured post-accident, a photograph of the red aspect was taken.*
- Photograph 1S signal with green lamp lit. Photo should be taken from the track facing the signal. *Once the site was secured post-accident, a photograph of the green aspect was taken.*
- Get a close up photograph of the red lens from the front of the signal. *Once the site was secured post-accident, a close up photograph of the red aspect was taken.*
- Get close up photographs of the rear doors of the 1S green and red signal housing. *Once the site was secured post-accident, photographs of 1S green and red signal housing were taken.*
- Get close up photographs documenting the condition of the 1S green and red signal lamps from the perspective of standing on the ladder with the signal housing doors open. *Once the site was secured post-accident, photographs of 1S green and red signal lamps from the perspective of standing on the ladder were taken.*
- If there is a junction box on the base of 1S signal take a photograph of the interior of the junction box to document the condition of the wires and the terminals. *There was no junction box.*
- Illuminate the 1S red signal lamp and record the lamp voltage. *This was not done because A/C power is not restored.*
- Illuminate the 1S green signal lamp and record the lamp voltage. *This was not done because A/C power is not restored.*
- Document and record what type of lenses are in place in 1S signal. Both red lens, clear lens, green lens and clear lens. *The lenses were originally installed according to the ConRail Standard Plan. The Green lens is a Lexan 5½" x ½" focal Safetran Part #042257-4G; the Red lens is a Lexan 5½" x ½" focal Safetran Part #042257-4R; and both Clear lenses are 8 and 3/"8 diameter X 4" focal with a 40 degree deflecting bullseye Lexan Safetran Part #042257-2.*
- Photograph all insulated joints for the D1T, C1T, B1T, and A10T track circuits. *Once the site was secured post-accident, photographs of all insulated joints were taken except for the 4 joints at the movable span.*
- Photograph all signal cases both inside and outside. *Once the site was secured post-accident, photographs of all signal cases were taken.*
- If proximity detectors are recovered, photograph the location where they were found, and tag them as evidence and turn them over to the NTSB for laboratory testing. *Once the site was secured post-accident, all proximity detector photographs were taken.*
- If possible, photograph where 1N signal is resting, due to being crushed by a derailed car. *It was not possible to get photographs of 1/N signal.*
- If possible, when the derailed car is removed, photograph the resting place of 1N signal. *It was not possible to get photographs of 1/N signal.*

Post-removal testing and documentation:

- Perform meggar (insulation resistance) tests on all signal cables. Record same and provide documentation to the NTSB. *Once the site was secured post-accident, the cable to 1S signal was meggered. All other cables were too damaged or destroyed to megger.*
- Perform relay drop away and pick up value tests of all relays. Record same and provide documentation to the NTSB. *Once the site was secured post-accident, the relays were tested and the results were documented.*
- Perform .06 ohm shunting tests of all track circuits. Record same and provide documentation to the NTSB. *During the securing and clean up of the accident site, the insulated joints were removed prior to signal personnel having access to the bridge.*

Testing and documentation of the signal system when it is restored:

- Notify the NTSB and FRA prior to the Paulsboro Moveable Bridge signal system being put into service so representatives from each agency can attend cutover and testing of the signal system.
- Simulate a train movement through the use of rolling shunts[6] for a southbound train movement for 1S signal. Drop the D1T track circuit, then initiate a radio request for the bridge to close, wait for signal to clear, then drop the C1T track circuit, then drop the B1T track circuit, then drop the A10T track circuit. Verify signal operation, record same and provide documentation to the NTSB.
- Simulate a train movement through the use of rolling shunts for a northbound train movement for 1N signal. Drop the A10T track circuit, then initiate a radio request for the bridge to close, wait for signal to clear, then drop the B1T track circuit, then drop the C1T track circuit, then drop the A1T track circuit. Verify signal operation, record same and provide documentation to the NTSB.

As of June 20, 2013, the moveable bridge has not been replaced. When ConRail replaces the moveable bridge they will notify the Federal Railroad Administration and the National Transportation Safety Board.

Figure 4. North End Proximity Switch Back View (L) and Overhead View (R).

[6] Signal personnel place shunts on the track deactivating track circuits simulating the movement of a train from one location to another.

Figure 5. North End Proximity Switch Side View (L) and Overhead View (R).

While access to the accident site was limited, Conrail maintenance test and inspection records were collected for the Paulson Moveable Bridge signal system. The maintenance records indicate all signal tests and inspections were conducted in accordance with Conrail requirements. Signal trouble reports for the previous 12 months for the Paulsboro Moveable Bridge were reviewed.

As a result of the examination of the trouble tickets the signal group conducted multiple interviews. On December 4, 2012 the signal group interviewed three signal supervisors and one B&B supervisor. On December 5, 2012, the signal group interviewed three signal employees, one electrician; one track employee and six track B&B employees.

Signal Damages

The ConRail engineering personnel estimated the total signal damages at $10,000. This figure included costs for the repair of the signals; all bonded electrical connections that were repaired after the track was repaired; and labor costs associated with the testing of the signal system.