SIGNAL GROUP FACTUAL REPORT

Accident Report: HQ-2012-26

Signal Group:

Mr. Gabe Neal – Signal & Train Control Specialist – FRA Region 6
Mr. Doug Proffitt – Director of Signals – BNSF Railway Company
Mr. Steve Jones – Director of Signals – Kansas City Southern Railway

Description of Railroad Signal System:

BNSF

The BNSF Fort Scott Subdivision runs in a timetable east/west direction. The Fort Scott Subdivision which is located on the Springfield Division begins at Kansas City, Missouri, milepost (MP) 0.0 and continues westward to Nichols, MO, MP 198.6. The accident occurred at Arcadia Interlocking, rail crossing at grade, with the Kansas City Southern Railway Company (KCS) located at MP 118.4. The BNSF track structure in the vicinity of the interlocking consists of a main track and passing siding, converging within the limits of the absolute signals just west of the crossing diamond, and a single main track crossing the KCS continuing eastward to Springfield, Missouri. The maximum timetable speed approaching the interlocking is 45 mph.

The method of operation in the area of the accident is a traffic control system, supplemented by timetable and special instructions, operated by BNSF dispatchers stationed in Ft. Worth, Texas. The interlocking is also manually controlled by BNSF through their route and automatically controlled on the KCS route. BNSF signal equipment at the interlocking consists of color light type signals, Union Switch and Signal (US&S) M23 duel controlled power-operated switch machine, and electronically controlled track circuits; all three components are controlled through the use of a General Electric Transportation System (GETS) Vital Harmon Logic Controller (VHLC).

The operation of the interlocking is achieved by the BNSF dispatcher requesting a desired route through the interlocking. The route is stored and only executed once a BNSF train steps onto the approach circuit. The approach circuits extend out from the crossing to the intermediate signal located at MP 120.2 on the east side and North Arcadia Controlled Point MP 116.9 on the west side.

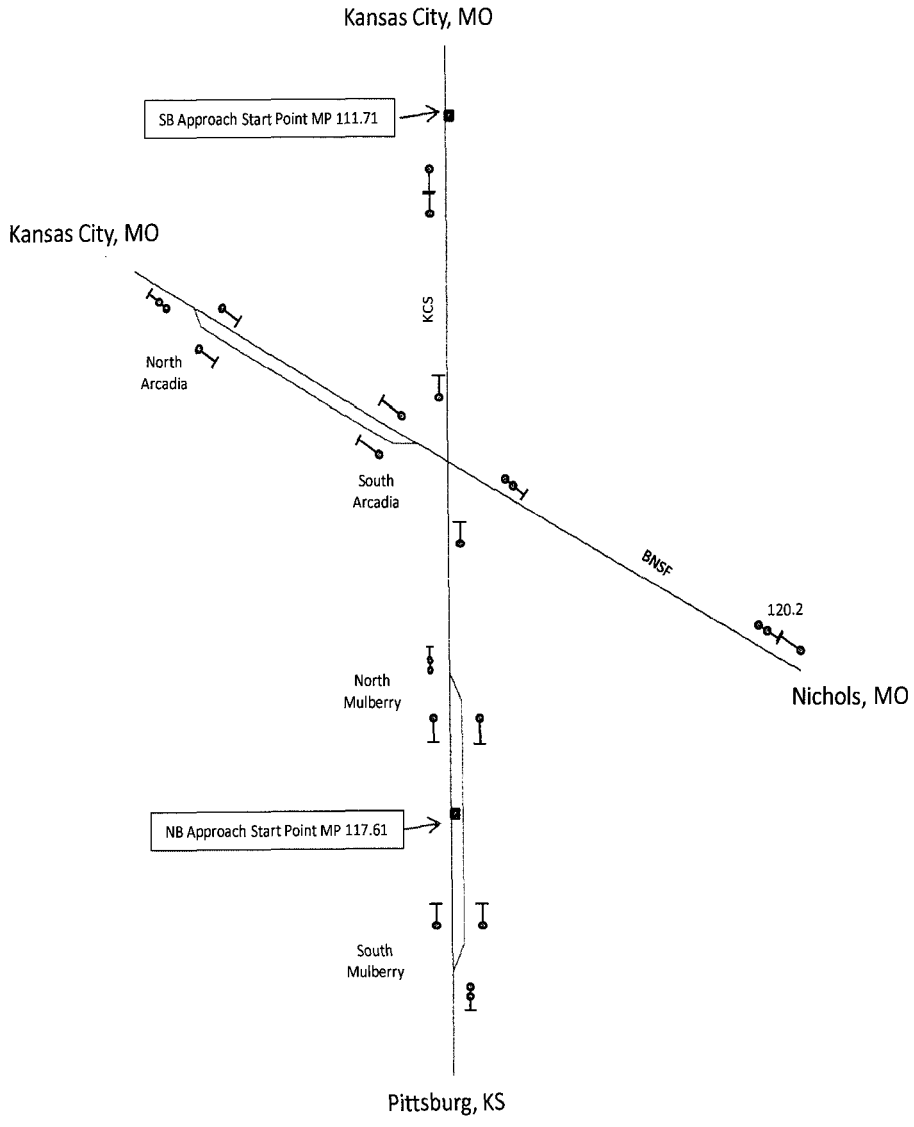
KCS

The KCS Pittsburg Subdivision runs in a timetable north/south direction. The Pittsburg Subdivision which is on the Midwest Division begins at Pittsburg, Kansas, MP 128.2 and continues north to Kansas City, MO, MP 3.7. The KCS denotes the accident location as the Ardath Automatic Interlocking located at MP 114.6. The KCS track structure in the vicinity of the interlocking consists of a single main track. The maximum timetable speed on the Subdivision is 55 mph, with a permanent 40 mph slow order through the interlocking.

The method of operation on the Pittsburg Subdivision is a traffic control system, supplemented by timetable and special instructions, controlled by the KCS dispatchers stationed in Kansas City, MO.

The Ardath Interlocking is automatically controlled on the KCS route. The KCS signal equipment at the interlocking consists of searchlight type home signals, electronically controlled track circuits, and a relay-based control system. The signal equipment at North Mulberry (NB approach signal) consists of color light type signals, electronically controlled track circuits, and General Railway Signal (GRS) Model 5H duel controlled power-operated switch machine; all three components are controlled through the use of a GETS Electro-Logic controller.

The operation of the interlocking is achieved when a KCS train steps onto the approach circuit. The approach circuits extend to MP 117.61 on the south side and MP 111.71 on the north side. Once a train enters the approach, the route is lined for their movement if no conflicting routes have been established.



Not To Scale

Railroad Signal Event Recorders:

Information from signal data event recorders was collected from six locations relevant to this accident. BNSF data was taken from the S. Arcadia (interlocking), and the dispatching system indications and controls; KCS data was from the Ardath (interlocking), North Mulberry (approach to interlocking), South Mulberry, and the dispatching system indications and controls. Members of the Signal Group performed an examination of the signal data with no exceptions noted. Please note that time corrections if needed are shown on the attached logs. The recorded data indicated the signal system functioned as intended at the time of the accident.

The recordings indicate the northbound KCS train received a "flashing Yellow" (Advanced Approach) signal at South Mulberry, a "Yellow" (Approach) signal at North Mulberry, and a "Red" (Stop) signal at the absolute home signal at the interlocking. The eastbound BNSF train received "Yellow over Yellow" (Approach Medium) signal at MP 120.2, and a "Red over Yellow" (Diverging Approach) signal at the interlocking. The BNSF train was in the process of entering the south siding switch at South Arcadia when the KCS train entered the interlocking limits and struck the side of the BNSF train. The data entries are as follows: (NOTE: recording device of which the entry was obtained denoted by parentheses)

13:37:17 - (KCS Ardath) -	KCS absolute signals at the interlocking at stop with a Red aspect displayed. Signal remained at red up to the accident time.
15:24:04 - (BNSF Arcadia) -	BNSF North Bound Control Signal (NBCS) at South Arcadia cleared with a Red over Yellow aspect displayed.
15:26:12 - (KCS N Mulberry) -	KCS NBCS at North Mulberry lights (approach lighting) with a Yellow aspect displayed.
15:26:27- (BNSF Arcadia) -	BNSF train is located at the approach signal at MP 120.2.
15:26:27- (BNSF Arcadia) -	KCS train steps on interlocking approach at MP 117.61.
15:28:03- (KCS N Mulberry) -	KCS train enters the Over Switch (OS) circuit at North Mulberry.
15:28:14- (KCS N Mulberry) -	KCS train enters circuit between North Mulberry and the interlocking.
15:29:37 - (BNSF Arcadia) -	BNSF train enters the interlocking with the NBCS displaying Red over Yellow.
15:29:45 - (BNSF Arcadia) -	KCS train enters the interlocking passing the absolute signal displaying a Red aspect.
15:29:46 - (BNSF Arcadia) -	KCS equipment destroyed indicating time moments after collision.

Signal Aspects and Indications

BNSF

Aspect	**Indication**	**Definition of Indication**
Green	Proceed	Proceed
Red	Stop	Stop
Yellow over Yellow	Approach Medium	Proceed prepared to pass next signal not exceeding 40 mph and be prepared to enter diverging route at prescribed speed.
Red over Yellow	Diverging Approach	Proceed on diverging route not exceeding prescribed speed through turnout; approach next signal preparing to stop, if exceeding 30 mph immediately reduce to that speed. (Note: Speed is 40 mph for Amtrak and

Commuter trains)

KCS

Aspect	Indication	Definition of Indication
Green	Proceed	Proceed
Red	Stop	Stop
Flashing Yellow	Medium Approach	Proceed reducing speed to 35 mph before passing next signal.
Yellow	Approach	Proceed immediately reducing speed to 35 mph, and be prepared to stop at next signal.

Post Accident Inspection/Testing Of Signal System:

Representatives from the BNSF, KCS, and the FRA participated in the inspection and testing of the signal system. The post-accident inspection found all signal units and signal cases with no indications of tampering or vandalism that would interfere with the design and intended operation of the signal system. No exceptions were identified with either the design or operation of the signal system.

Post-accident testing began with a visual inspection of equipment. The visual inspection found the signal case for the KCS portion of the interlocking was destroyed during the accident. However, a data recorder was retrieved from this case and relevant data was obtained. The KCS absolute signals for the interlocking were not damaged. The BNSF only experienced minimal damage to the signal system with the loss of the push button control cases used by train crews and the maintenance -of-way department (MOW).

KCS

The initial physical testing began at South Mulberry (approach to interlocking) with the verification of the remaining intact track circuits utilizing a 0.06-ohm shunt, ground tests (with the use of an external 22 volt d.c. battery), and the confirmation of signal aspects relevant to the designed track codes. Cases were then sealed until the arrival of the NTSB. Upon approval of the NTSB, testing resumed the next morning. Applicable routing tests were performed with the use of simulated track codes. Once again, this was done because of the loss of the KCS signal case at the interlocking where the designed codes would have been initiated. Ground tests and search light signal mechanism were performed on the absolute signals. Lamp voltage readings were obtained from the northbound signals at South Mulberry and North Mulberry. The Yellow signal head at North Mulberry was 9.1 volts d.c. and the Yellow signal head at South Mulberry was 9.4 volts d.c. The signal system operated as intended during the tests performed.

The KCS maintenance test and inspection records were collected and reviewed. The signal test records reviewed consisted of the results from testing performed in accordance with: Title 49 Code of Federal Regulations (CFR) Part 236 Rules, Standards, Instructions Governing the Installation, Inspection, Maintenance and Repair of Signal and Train Control Devices and Appliances. No exceptions were noted to test records obtained. A review of failure reports (Trouble Tickets) for the previous 6 months prior to the accident for the area of the accident revealed three failure reports; the NB Signal at North Mulberry going from Green to Yellow to Red with no trouble found after being investigated, track light/indication staying on behind a train with an adjustment made to the switch

circuit controller at MP 112.3, and another track light staying on after a train with a broken rail was found within the North Mulberry OS circuit.

The recording device at the interlocking did not show on the locations circuit plan. The KCS signal supervisor stated the recorder was placed in service around 3 years ago. This was done because the local signal maintainer suspected repetitive trouble calls were the result of the BNSF performing work at the interlocking. He stated the recorder disproved this assumption; however, it assisted them in finding an Electro-Code II decoder card intermittently failing. The card was replaced eliminating the re-occurring failures. The KCS decided to leave the recording device in service as it was in the best interest of the railroad to monitor the location.

BNSF

Due to the derailed cars the initial testing was delayed and limited to a grounds test and signal aspect verification. Once the track was cleared and track with circuits reinstalled, testing resumed. The physical testing began at the interlocking with a ground test, verification of all track circuits utilizing a 0.06-ohm shunt, confirmation of signal aspects relevant to designed track codes, and applicable locking tests. Lamp voltage readings were obtained, for the aspects given during the accident, from the approach signal and South Arcadia. The involved signal heads (EA & EB) at Arcadia was 9.34 volts d.c. and the involved signal head at the approach signal (signal 120.2 EA & EB) was 9.20 and 9.15 volts d.c. The signal system operated as intended during the tests performed.

The BNSF maintenance test and inspection records were collected and reviewed. The signal test records reviewed consisted of the results from testing performed in accordance with: Title 49 Code of Federal Regulations (CFR) Part 236 Rules, Standards, Instructions Governing the Installation, Inspection, Maintenance and Repair of Signal and Train Control Devices and Appliances. No exceptions were noted to test records obtained. A review of failure reports (Trouble Tickets) for the previous 6 months prior to the accident for the area of the accident revealed a single failure report. This was the accident ticket/report.

Signal Damages

The BNSF engineering personnel estimated the total signal damage at under $6,550.00. After the damaged track was repaired signal personnel replaced all bonded electrical connections and the small signal housings containing the push buttons used by train crews and MOW.

The KCS experienced the loss of the signal case and operating cabling at the interlocking. They estimated the total signal damage as $55,000.00.

Positive Train Control

Positive Train Control (PTC) refers to technology that is capable of preventing train-to-train collisions, over speed derailments, movement through a switch improperly lined, and casualties or injuries to roadway workers (e.g., maintenance-of-way workers, bridge workers, signal maintainers) operating within their limits of authority as a result of unauthorized incursion by a train. The PTC systems vary widely in complexity and sophistication based on the level of automation and functionality they implement, the system architecture utilized, the wayside system upon which they are based (i.e., non-signaled, block signal, cab signal, etc.), and the degree of train control they are capable of assuming.

Prior to October 2008, PTC systems were being voluntarily installed by various railroads. However, the Rail Safety Improvement Act of 2008 (RSIA)[1] has mandated the widespread installation of PTC systems by December 31, 2015.

The FRA is supporting all rail carriers that have statutory PTC reporting and installation requirements, as well as rail carriers that are continuing to voluntarily implement PTC, through a combination of regulatory reform, project safety oversight, technology development, and financial assistance.

At the time of this accident, PTC was not installed at the accident site for either railroad. However, the BNSF's Fort Scott and the KCS's Pittsburg Subdivisions will have PTC systems installed. In fact, each railroad is currently working on implementing the PTC systems by the mandated dates contained in the RSIA of 2008. In this case, a red absolute signal was displayed at the interlocking for the KCS train crew. An installed and operational PTC system would have recognized the red absolute signal as a braking target. The system would have initiated the braking system stopping the train before it passed the absolute signal.

[1] Signed by the President on October 16, 2008, as Public Law 110-432.