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RESEARCH RESULTS
FRA OFFICE OF RAILROAD POLICY & DEVELOPMENT

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POSITIVE TRAIN CONTROL TEST BED INTEROPERABILITY UPGRADES

SUMMARY

Transportation Technology Center, Inc. (TTCI) upgraded the Positive Train Control (PTC) Test Bed to support additional PTC testing configurations under Federal Railroad Administration (FRA) Task Order 270. The scope of work provided additional PTC Control Points (CPs), expanded the number of PTC-capable signal blocks, and upgraded existing grade crossings. The following features were added:

- **Two PTC switch CPs and associated signaling**
  - Two electronically controlled and remotely monitored switches
  - Two switch point indicator lights
  - Two Ansaldo STS Microlok II halfbox Wayside Interface Units (WIUs) for switch interoperable train control (ITC)-compliant communications
  - Five on-station circuits
  - Heavy duty relays
  - Power sources
  - Equipment housings
  - Surge arrestors, cabling, and miscellaneous installation hardware
- **Six 6,000-foot (~$1^1/_8$-mile) signal blocks with 4-aspect block signaling that is PTC capable**
  - Eight signal lights/masts/foundations
  - Six sets of PTC-capable block signaling electronics with integral ITC-compliant WIU
  - Six relays and lamp drivers
  - Surge arrestors, cabling, and miscellaneous installation hardware
- **Speed protection capability of 160 mph**
  - Two Tiefenbach grade crossing systems
  - Forty-four double wheel sensors
  - Two solid-state crossing controllers
  - Cabling, junction boxes, and miscellaneous installation hardware
- **Software Upgrade**
  - AutoCad and license
  - AutoCad Electric and license
  - MatLab and license

Figure 1. Railroad Test Track Block Signal Light

BACKGROUND

To assist the North American railroad industry with its implementation of Congressionally mandated PTC capabilities, FRA and TTCI have been investing in a PTC Test Bed at the Transportation Technology Center (TTC) in Pueblo, CO. The test bed was initially developed and subsequently upgraded to provide an industry resource for testing PTC-related systems, equipment, and technologies in a highly controlled environment free of the constraints associated with revenue service test activities.

The Rail Safety Improvement Act of 2008 requires the implementation of interoperable PTC on specified rail lines and on any additional lines identified by the U.S. Secretary of Transportation. Interoperability is the ability of a controlling locomotive to communicate with and respond to any railroad's approved PTC system.

OBJECTIVES

This project upgraded the infrastructure and testing capabilities of the PTC Test Bed at TTC to support testing of PTC systems, components, and related equipment. More specifically, the upgrades enabled testing for interoperability, functionality verification, and performance/stress characterization. TTCI installed the required equipment and performed an initial check of the enhanced test bed's PTC testing capabilities to ensure that the upgrades would provide railroads and suppliers with a highly controlled, dedicated PTC test environment free of the challenges normally associated with testing on revenue service routes.

METHODS

Switch CPs

Electronically controlled switches were installed at two exiting track switch locations, Switch 301 and Switch 304. There are now a total of five switch CPs, including one pair of interlocked switches, available to support PTC testing. The switches are configured to function as two PTC CPs on the Railroad Test Track (RTT). Switches 301, 302, 602A, and 602B are combined to function as one CP, and Switches 304 and 305 work together for the other CP. All these switches are remotely monitored in nearby equipment bungalows by Ansaldo STS Microlok II halfbox WIUs, which were added at the locations for each of the new switches. The WIUs send data to the locomotives, as well as to the Back Office Server (BOS) and Computer-Aided Dispatch (CAD) system. Additionally, controlled switch point indicator lights and stands were added to the switch locations in the core area near the RTT siding.

Block Signaling

Before block signaling was installed, TTCI was using GE Transportation Systems Global Signaling (GETSGS) Electrified Electro Code 4+ rail break detection hardware connected to the RTT, which was electrically isolated into twelve 6,000-foot broken rail detection/traffic occupancy detection blocks.

As part of a previous project (Task Order 256), TTCI changed the physical configuration of the electrically isolated blocks from twelve 6,000-foot blocks to six 12,000-foot blocks to better represent signal block lengths found in revenue service for those tests requiring such a block length.

The test bed was also upgraded to a PTC-capable 4-aspect block signaling system with signal lights and WIUs installed at six locations.

For this project, Task Order 270, TTCI reconfigured the RTT back to twelve 6,000-foot (~$1^1/_8$-mile) blocks and made each of them a signal block for the purpose of interfacing with PTC equipment during testing. (Now, the RTT can be configured for either six or twelve blocks, depending on the needs of the test).

Subsequently, TTCI made modifications to the PTC Test Bed to accomplish this objective. Six new signal blocks were added. At each new block, and at two additional locations, a 4-aspect signal light/stand/foundation was installed. The 4-aspect signals are capable of displaying a green, yellow, red, or flashing yellow light. A PTC upgrade electronics kit with an integrated ITC-compliant WIU was installed in each block's associated track signal circuit's electronic equipment case. The WIU reads the status of the block and communicates it to the BOS CAD. Equipment from GETSGS for controlling the block signal lights was installed, along with lamp drivers, cabling, and lightning protection.

Speed Protection (Grade Crossing Systems)

TTCI removed the existing grade crossing systems at Post 85 and Post 100 and replaced them with more reliable grade crossing advance warning systems that can handle train speeds up to 160 mph. The systems have sensors installed along the track to detect the direction of travel and speed of the train. The sensors send an electrical current through the cables that run along the track. The cables are terminated into specialized equipment near the crossings, and the crossing arms are lowered accordingly.

A Tiefenbach crossing system, complete with rack and equipment, was designed, purchased, and installed in the equipment bungalows for the crossings. A solid-state crossing controller was purchased and installed in each bungalow. For both systems, a total of 44 double wheel sensors were installed along the inside of the rail on the RTT and the entrance and exit tracks. In addition, 44 junction boxes, cabling, and necessary hardware were installed.

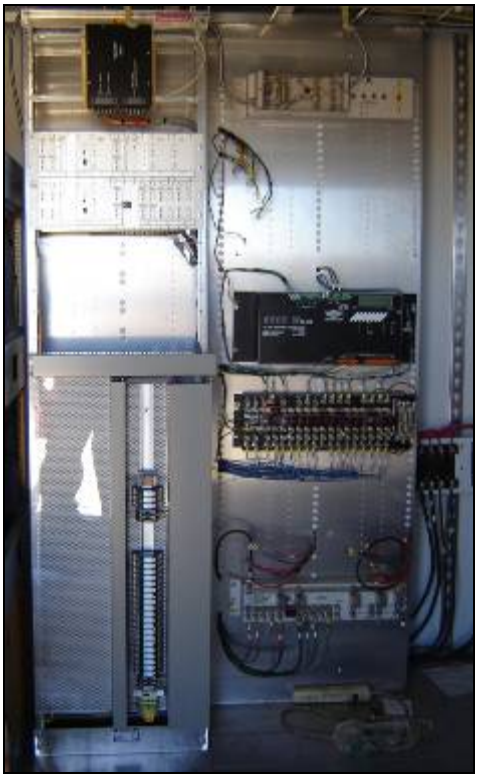

Figure 2. Tiefenbach Rack and Equipment

RESULTS

TTCI purchased and installed the required equipment and verified correct functional operation. Now the test bed can support either

of two signaling configurations: six 12, 000-foot blocks or twelve 6,000-foot blocks. Two remotely monitored and controlled switches have been added to the test bed, and the speed protection capability has been upgraded to 160 mph on the RTT. WIUs now yield an average density of a little less than 1 mile per WIU along the entire route of the RTT.

TTCI documented the new equipment installations and provided the documentation to the TTC facility manager's site documentation library.

CONCLUSIONS

The objective of this task order was achieved. TTCI designed upgrades for the TTC PTC Test Bed to provide an operationally representative PTC test environment for supporting development of PTC systems, for conducting performance evaluations of PTC system segments, and for performing interoperability and compliance testing.

FUTURE ACTION

Overall system integration testing will be performed when PTC 220 MHz radios become available. Wayside message servers will interface between the WIU and the switch or signal light. The PTC Test Bed is configured to accept PTC communications equipment when it becomes available.

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KEYWORDS

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