

"RESULTS OF ALTERNATIVE TRAIN PRESENCE DETECTION SYSTEMS TESTS"

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Summary

Field tests completed by the Association of American Railroads on three manufacturers' alternatives to conventional track circuits for activation of grade crossing warning systems indicate that none performed to the overall level of systems already used in revenue service application.

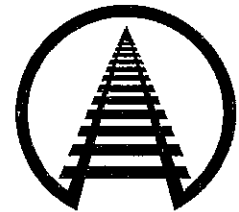
Each of the three technologies tested, however, appears to have sufficient potential for reducing or eliminating loss of shunt problems to justify further consideration, provided the manufacturers can correct the problems identified by the tests.

Accordingly, the Train Presence Detection Task Force recommends no further testing at this time, and that suppliers of these and any other promising systems be contacted during the second half of 1996 to determine whether any have been developed and improved sufficiently to justify further testing.

The primary objective of this test was to evaluate alternative technologies for detecting the presence of a train within an island. The goal was to determine if any could accurately and reliably verify train presence within the typical 120-foot island. The tests measured the consistency with which the systems could activate and release the island control relay when trains enter and leave the island, regardless of rail surface contamination.

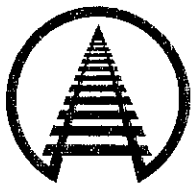
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INTRODUCTION AND CONCLUSIONS

Grade crossing warning systems utilizing traditional track circuits are in common use throughout North America. Typically the warning system is deactivated immediately after the last car has passed the crossing limits in order to avoid further delaying road traffic. Deactivation is controlled by a special circuit, usually about 120 feet long, and is commonly referred to as the "island." The island circuit is an integral part of most conventional state of the art crossing warning systems.

The detection of train occupancy within the island relies on the wheel and axle assemblies of the passing trains electrically shunting the two rails. Previous testing has shown that under certain circumstances the reliability of this shunting can be reduced by contaminants on the rail and/or wheels. Such occurrences are termed "loss of shunt" (LOS). Severe LOS conditions can lead to sporadic operation of the warning system, even when the train is physically occupying the island. Visual indications include "gate bob," intermittent flasher operation and premature release of the warning system before complete train passage. Short-length circuits also are used in turnout controls, interlockings and other areas where detection of train occupancy in a limited length of track is needed.

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and leave the island, regardless of rail surface contamination.

None of the alternative technologies evaluated exhibited field performance to the level of reliability of systems currently in revenue service. The Task Force recommends that the suppliers of these and any other promising systems be contacted in the future to determine whether these or other systems have developed and improved sufficiently to justify further testing.

SELECTION PROCEDURE

To select the technologies for test, the Train Presence Detection Task was formed. Task force members were drawn from Association of American Railroads member railroads, the Federal Railroad Administration and the Federal Highway Administration. The Task Force provided technical review and direction.

Through a Request for Information (RFI), alternative detection systems were solicited from a wide range of potential suppliers. Ten responses to the RFI were received. Each response was scrutinized for responsiveness to information requested in the RFI and additional information was requested by the Task Force where required.

On the basis of the Task Force review, four candidate systems were selected for screening at the Transportation Technology Center, Pueblo, Colorado. In cases where more than one vendor put forth solutions based on the same technology, the most developed system was selected. The four systems chosen were:

- ▶ Count-in/count-out using strain gages mounted on rail



- ▶ Count-in/count-out using magnetic wheel counters
- ▶ Modification (whetting current overlay) of existing island circuit
- ▶ Combination of movement detection and infrared presence detection.

The systems were installed and thoroughly tested. The test series simulated a wide range of potential train movements including stop and start, switching and leaving a car in the island. The first three systems passed the preliminary screening. The infrared system failed to exhibit reliable presence detection especially upon train departure.

FIELD TEST PROCEDURE

Three sites were selected for field testing. These sites were chosen to include a broad range of traffic including bulk commodity unit and intermodal trains, as well as switching movements. The three sites selected were:

- ▶ On CSX near Tampa, Florida—a 30-mile line used primarily for the transportation of phosphate between mines and docks.
- ▶ On BNSF at Sterling, Nebraska — a location where LOS has been documented in the past. This location handles loaded and empty unit trains and mixed freight.
- ▶ On UP at Columbus, Nebraska — site features frequent switching moves along with a high volume of traffic.

All three systems were installed at each site in parallel with a conventional grade crossing circuit that acted as a base line.

The systems were monitored remotely for six types of failure as shown in Figure 1.

These failure modes are:

- (I) Premature release of the island relay
- (II) False release of the relay during island occupancy (LOS)
- (III) Multiple releases during occupancy (LOS)
- (IV) Delayed release or failure to release
- (V) Late detection of train entering the island limit
- (VI) Failure to detect the train

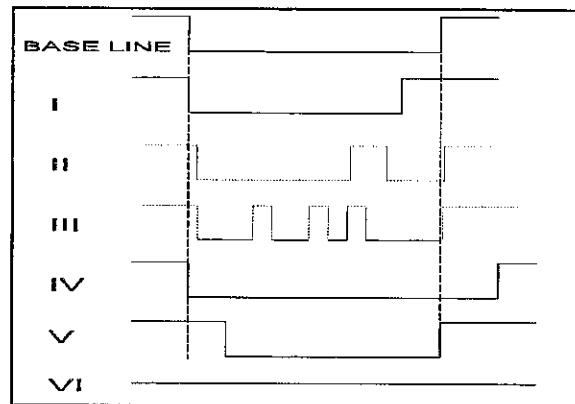


Figure 1. Typical Failure Modes

The data collected consisted of island relay voltage versus time for each of the test systems and the conventional base system. Comparisons of the total time the island relay was activated provided the primary performance measure. The time differences between the base and test systems were calculated and recorded for a maximum of 10 minutes. This data was summarized by placing the differences into half-second intervals from + 10 to - 10 seconds. A negative time difference indicates the test system held the relay longer than the conventional base system.

Figure 2 shows a typical chart of the time differences. The two bars indicate whether



the overlay circuit was on or off. In this example, most of the values fall within plus or minus two seconds. However, for a significant number of train passes, the system failed to release immediately after the passing of the train, as evidenced by the bars between -10 seconds and -2 seconds.

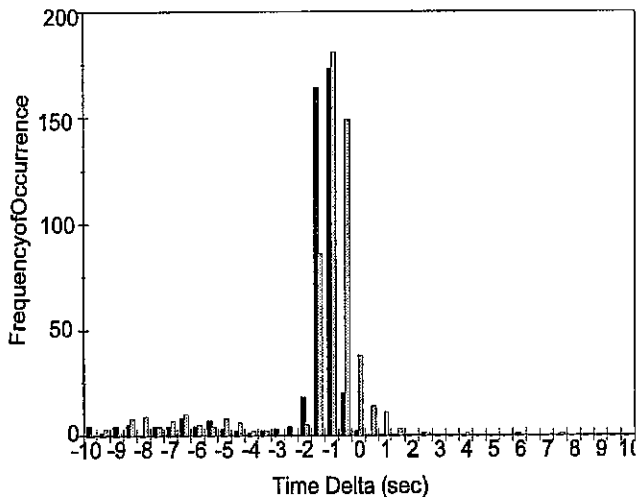


Figure 2. Sample Test Results

FIELD TEST RESULTS

The count-in count-out system based on the use of strain gages counted the number of axles entering and exiting the island. When the number exiting the island reached the number entering, the island relay was released. During the field tests, the system had three types of performance problems:

- ▶ **Slow Release** — On a significant number of train passes, the system did not release the island relay within 2 seconds of the train leaving the island.
- ▶ **Missed Trains** — On many occasions the system missed a train entering the island due to system failure.
- ▶ **Loss of detection** — During one train pass the system had a false release while the train was still in the island.

The count-in count-out system based on magnetic wheel detectors counted the number of axles entering and exiting the island. When the number exiting the island reached the number entering, the island relay was released. During the field tests, the system had three types of performance problems:

- ▶ **Missed Trains**— On many occasions the system missed a train entering the island due to system failure.
- ▶ **Failure to Release** — The system failed to release the island relay after the passing of a train on multiple occasions.

The modified island circuit based on a overlay current used the overlay current to perforate the film between the wheel and rail to facilitate shunting of the base island circuit. Following are the test results for the overlay current:

- ▶ **Incompatibility** — This system was incompatible with the island circuit at Columbus, Nebraska. The addition of the overlay circuit interfered with the existing track circuit. The system was also incompatible with the frequency of the base circuit at the Tampa location; however, the system functioned properly after the frequency of the base circuit was changed.
- ▶ **Loss of shunt** — Minor loss of shunt occurred at both test locations where this system was installed. Although the occurrences of LOS were not sufficiently severe to cause release of the island, occurrences were detectable in the data collected.

Note: Contact Thomas S. Guins at (202) 639-2259 with questions or comments about this document.