

Executive Summary

TRA's Train No. 3501 and 333 at Jiadong Station

On August 28, 2019, local train 3501 of Taiwan Railways Administration, MOTC (TRA), departed at 05:20 a.m. from Chaozhou Station, bound for Taitung Station. While leaving Jiadong Station, train driver 3501 found that the front level crossing block was not actuated and stopped the train immediately. Subsequently, the Tze-Chiang Limited Express 333, a non stop train at Jiadong station, passed a wayside indicator showing proceed indication. However, the driver saw train 3501 stopped on the platform track which should be clear for train passing on, and applied brake immediately. Both train 3501 and 333 were safe. No one on board was injured.

According to the Transportation Occurrences Investigation Act, the Taiwan Transportation Safety Board is responsible for investigating major transportation occurrences that arise in the R.O.C. territory. This accident is considered as a major transportation occurrence within the scope of investigation. The Railway Bureau, TRA, Nippon Signal, MITAC Information Technology Corp., CECI Engineering Consultants, Inc., Taiwan and RICARDO Singapore Pte. Limited Taiwan Branch (Singapore) were invited to participate in the investigation.

The investigation report was approved by the 22nd Board Meeting on February 5, 2021, and published on February 9, 2021.

After comprehensive investigation and analysis of the factual data, a total of sixteen findings and thirteen safety recommendations were obtained, which are detailed as follows:

Findings

Findings related to probable causes

1. Before the switch test on the accident day, some axel counters could not display train occupation signals. The Railway Bureau contractor decided to exclude the axel counters from this test. Therefore, before withdrawing, when the axel counter supplier personnel switched the stage two connection back to stage one, the physical circuit of axel counter two at entrance of Jiadong Station track section 1RAT and 1RBT was mistakenly connected, probably causing short circuit between the safety relay and the electronic interlocking system, with the result that track section A1T could not display occupation signal; after redintegration following testing, the Railway Bureau contractor did not recheck the axel counter system, with the result that, after starting operation on the day, the electronic interlocking system suffered the following malfunction.
2. After southbound train 3501 entered Jiadong station block section 1RAT, resulting from the mistaken pressing of the axel counter wiring, the occupation signal disappeared at 0556:25; due to the design logic of the electronic interlocking system, the warning at Fuxing Road level crossing was automatically canceled and the barrier was raised 64 seconds after the occupation signal disappeared in block section 1RAT, which caused the train driver to stop immediately upon discovering that the barrier had been raised when departing from the station.
3. After the duty station master at Jiadong Station had been informed that the driver of train 3501 had encountered a problem with the boom barrier raised at the level crossing when departing from the station, he asked a nearby station how to deal with the boom barrier and did not attach importance to the various CVDU axel counter warning

messages, warning sounds, and the disappearance of the occupation signal. The duty station master did not notify the dispatcher in the General Dispatch Office and the duty station master in neighboring station according to TRA signal malfunction regulations to halt the approaching train 333.

4. A dispatcher in TRA's General Dispatch Office found that the route for train 3501 was released, he then set the route manually for the following train 333, and the southbound station entry signal for Jiadong Station turned to proceed; the dispatcher then noticed that train 3501 had stopped in the station for a long period; after being asked, Jiadong Station master reported that the train had left the station; without confirming the actual position of train 3501, without canceling the station entry route for train 333, and without notifying train 333 by radio not to enter the same block section as train 3501 had stopped.
5. According to an official document from the TRA, the Railway Bureau requested the contractor to build dual axel counter operation and occupation logic according to the regulations of the Railway Bureau and the TRA. According to this logic design, if the axel counter malfunction is not found and reported, reset, and handled by station operation personnel, there will be a possible risk of collision between the preceding and following trains.

Findings related to risk

1. On the day of the accident, a southbound work train entered Jiadong Station and stopped, northbound train 3504 and southbound train 3042A passed Jiadong Station before southbound train 3501 stopped by. The station operation office work station (CVDU) issued axle counter warning messages and warning sounds when the trains passed through or stopped by the station. Jiadong Station master said he didn't

notice the CVDU warnings so was unable to reset the axel counter or notify maintenance personnel as required by regulations.

2. Owing that Jiadong operation office personnel did not confirm whether the block section was occupied by a train or not, as required by regulations, before resetting the axle counter through CVDU, the maintenance personnel had to reset the track occupation status from the relay room, which affecting trains dispatching in the station.
3. Although TRA operational divisions sent personnel to the Railway Bureau's dual axel counter system, CVDU, and electronic interlocking system training, the education and training content within TRA has not been updated to keep up with the latest equipment and technologies. Jiadong Station duty master was not familiar with the latest system and also could not connect the relationship between level crossing boom barrier problem and the signal malfunction, affecting malfunction handling time effectiveness.
4. The Railway Bureau and its contractor agreed to bring forward the completion of electrification of the track between Chaozhou and Fangliao from the end of 2020 to the end of 2019 according to a request from the Executive Yuan and MOTC, with the result that the construction and testing schedule for Nanzhou, Jiadong and Fangliao stations was reduced from 120 days to 30 days, with the result that the contractor did not fully complete the testing of the electronic interlocking system following the normal procedure and in sequence.
5. The Railway Bureau did not deal with the matter when told by the supervising company and IV&V that the contractor had not carried out or merged some processes that should be done due to the tight schedule, increasing safety risk.
6. On the day of the accident, the contractor did not submit a test procedure proposal to the supervising company for review as required

by the contract, and the supervising company did not object. If, on test day, the test forms within the test procedure proposal had been followed step by step, it is likely that the abnormal axel counter could have been discovered and could be responded to in advance.

7. The contractor did not fully complete axel counter self-inspection, the axel counter system had not been included in the joint test, and the merger of the supervision inspection and owner's joint test, none of all had met the requirements of the normal public construction testing process.
8. The supervising company failed to exercise its contractual powers and requested directly the contractor to complete its self-inspection and put forward a self-inspection form.
9. TRA did not require that the General Dispatch Office and duty station master take part in confirmation procedure after restoration, with the result that they were unable to discover system abnormality in a timely way before normal operation begins.
10. TRA did not require the duty station master should confirm the track to be clear, unobstructed, and ready for operation after track possession work had been completed.

Other findings

1. The Railway Bureau is responsible for engineering and for engineering management at the same time, which is not favorable for implementation of the construction supervision and management system.

Safety Recommendations

To Railway Bureau, MOTC

1. Review the logic and regulations of train occupation status for the electronic interlocking system to ensure the system design meets the requirement of fail-safe mechanism and to avoid trains operating in the same block section.
2. Enhance the advance work completion assessment mechanism to ensure that contractors can complete work in order within reasonable work time to avoid rushed work affecting safety and quality.
3. Demand that contractor and supervising company work management pay special attention to the contract demands for the supplier to handle installation checks and single machine tests, supervision inspection, TRA joint checks, tests by the Railway Bureau and TRA (signal system integration test,)all necessary documents for switch activation tests such as test procedure proposal and self-inspection form and avoid merged execution, order reverse or simplification of the test items to ensure construction quality.
4. Stipulate that contractors must carry out restoration checks and include them in supervising company inspection items to ensure the system can operate normally.
5. Enhance the response mechanism for suggestions from the independent verification and supervising company.
6. Review organizational functions, formulate feasible construction and construction supervision management division of labor to ensure implementation of the engineering supervision management function.

To TRA

1. Review the logic and regulations of train occupation status for the electronic interlocking system to ensure the system design meets the requirement of fail-safe mechanism and to avoid trains operating in the same block section.

2. Implement General Dispatch Office and station operational personnel training, with emphasis on CVDU axel counter operation, monitoring and malfunction resetting procedure to ensure personnel have sufficient knowledge and skills to operate and handle the new system.
3. Implement and enhance regulations for immediately reporting and handling of signal malfunction by General Dispatch Office and station operational personnel to avoid the risk of train collisions.
4. Stipulate that General Dispatch Office and station operational personnel should carry out signal restore confirmation procedures in cooperation with construction personnel to ensure operation safety after construction is completed.
5. Enhance and implement the regulation of confirming train position by General Dispatch Office personnel before route setting to avoid trains entering the same block section.
6. Enhance the instant monitoring function of the General Dispatch Office dispatch computer systems, such as axel counter or train occupation signal disappearance warning, to provide dispatchers with necessary information.
7. Stipulate that the duty station master must keep abreast of the number of construction personnel onsite and their movements and should confirm the track to be clear, unobstructed, and ready for operation after track possession work had been completed.

Note: The language used in the occurrence investigation Final Report is in Chinese. To provide a general understanding of this investigation for the non-Chinese reader, the Executive Summary of the Final Report was translated into English. Although efforts are made to translate it as accurately as possible, discrepancies may occur. In this case, the Chinese version will be the official version.