TRA's Train No.6046 at Fenglin Station Occurrence Investigation

Executive Summary

At about 10:58, June 11, 2022, Train No. 6046, the Future Express tourist train of the Taiwan Railways Administration (TRA) had an abnormal motion when traveling through K31+916.5 and K31+925.5 between Nanping Station and Fenglin Station. There were no fatalities or injuries in this occurrence.

In accordance with the Transportation Occurrences Investigation Act, R.O.C., and the definition of major transportation occurrences specified therein, the Taiwan Transportation Safety Board is the independent agency in charge of investigating the railway accident. The agencies (institutions) invited to participate in the investigation include the Ministry of Transportation and Communication (MOTC), Railway Bureau, TRA, CECI Engineering Consultant, Inc. (CECI), and Kung Sing Engineering Corporation (KSECO). This final report was reviewed and approved by the 51st TTSB Board Committee Meeting on June 2, 2023, and published on June 30, 2023.

On the basis of comprehensive factual information and analyses, TTSB proposes the following 17 findings and 9 recommendations:

Findings

Findings Related to Probable Causes

1. The construction workers did not fill the ballast at the sleepers where the optical fiber cable passed when performing sleeper replacement in the turnout area, and used an excavator instead of a medium-sized ballast tamping vehicle, which could not properly compact the ballast underneath the sleepers, resulting in loose ballast at the bottom and inadequate lateral resistance; after the construction completed, the section of the railroad bed was subject to the load of 18 operating trains, resulting in visible partial sinking of the steel rails.
2. The weight of the two locomotives of the accident train was about twice that of an ordinary Electric Multiple Unit, and it was traveling at a speed of 83 km/h, exceeding the 50 km/h speed limit; finally, the train clearly shook up and down, and there was a risk of train derailment.

Findings Related to Risk

1. KSECO personnel did not survey the path and length of the optical fiber cables on

site before construction and incorporated them into the construction plan.

2. CECI construction supervisor agreed to change the construction method on-site. The area around the sleepers where the optical fiber cable passed was not filled with ballast, resulting in the lateral resistance of the ballast decreased.
3. Neither the construction risk management plan nor the construction plan includes the medium-sized tamping vehicle in the list of equipment to use in the laying of turnouts, but the construction details in the construction plan indicated that a medium-sized tamping vehicle should be used for tamping.
4. The engineer on duty of the Eastern Region Engineering Office of the Railway Bureau, CECI construction supervisor, and KSECO engineering personnel knew in advance that a medium-sized tamping vehicle was not available; without the agreement of personnel of TRA's Construction Department, they used an excavator bucket for tamping, different to the tamping method approved in the original construction plan.
5. In CECI's supervision record, the use of a medium-sized tamping vehicle conformed, which is inconsistent with the facts; CECI failed to perform a supervision function, resulting in the construction supervisor agreeing with the misinterpretation of the specifications by KSECO, which did not fill the ballast at the end of the sleepers.
6. The Eastern Region Engineering Office of the Railway Bureau, CECI, and KSECO failed to establish personnel training and safety operation guidelines for ballast bed defect identification, resulting in construction personnel failing to understand the importance and risks of the tamping process and ballast filling's effect on the structural support of the ballast bed.
7. The Railway Bureau did not refer to the existing track maintenance specifications of the MOTC, or the practices of other agencies to establish a completion judgment standard for the quantifiable data of the disturbed ballast bed, nor did it expressly require construction personnel to stay on site after completion of construction to confirm the status of the track after operation, which meant they were unable to check the supporting capacity of the ballast bed to withstand the dynamic load of trains after construction.
8. KSECO failed to include risk items that may affect operation after completion (such as track irregularities, subsidence of the ballast bed, etc.) and contingency measures (such as personnel standby, contact, emergency repairs, etc.) in the construction plan; as a result, after the accident, the TRA had to mobilize emergency repairs on its own, which affected the handling time.
9. TRA failed to establish related regulations on the basic checking and abnormality handling of the station master on duty for construction personnel applying for

track possession; as a result, no personnel from the TRA's Construction Department were present to supervise when construction items that affected railway operation were carried out, construction items were inconsistent with the train operation notification and the tamping vehicle was not present.

10. Fenglin Station of the TRA confirmed the abnormality of the route at 10:00 but did not announce the temporary speed restriction to 30 km/h as required.
11. The existing procedures and practices of the TRA cannot enable the station master on duty to make full use of construction information. To shorten the time for confirming abnormality locations, possible locations for inspection might be included in a route anomaly notification.
12. The TRA found that the driver had improper speed control according to the ATP onboard recorder assessment several times. They only gave verbal warnings and did not provide specific corrective measures such as reinforcement training or re-assessment. In addition, the locomotive assistant could not visually view the ATP speedo meter display from their seat. The speed could not be confirmed while the train was passing the temporary speed restriction approach signal.
13. The TRA only notified its construction units of the temporary speed restriction balises installation regulations in the temporary speed restriction area by means of an internal letter and did not clearly define the review standards, with the result that, the Hualien Construction Branch's temporary speed restriction controllers believed that the same turnout construction was less than a week, therefore, when the Eastern Region Engineering Office of the Railway Bureau applied for the temporary speed restriction area, it did not set up a temporary speed restriction balises with the Hualien Electrical Engineering Department. As a result, it was impossible to ensure that all trains entering the temporary speed restriction area could be controlled under the speed limit.

Other Findings

1. KSECO's construction personnel drove the excavator without the permission of the TRA on the mainline track. The person in charge of the construction of the Eastern Region Engineering Office of the Railway Bureau and CECI construction supervisor failed to confirm in detail during the pre-construction and pre-work education for personnel. As a result, other dispatch vehicles could have entered the mainline, causing the risk of collision with the excavator.
2. The driver and the locomotive assistant of Train No. 6046 are qualified to drive electric locomotives. They both passed the blood pressure and alcohol test on the day of the accident and met the duty requirements.

Safety Recommendations

To the Railway Bureau, MOTC

1. The route of the optical fiber cable was not surveyed before construction, with the result that the construction method was changed due to insufficient length when it was intended to be buried deep, without filling up ballast, and an excavator's flat bucket was used instead of a tamping vehicle, causing rail sinking in the construction area, with risk of train derailment. The TTSB believes that the Railway Bureau should strengthen construction safety management for high-risk construction operations that disturb the ballast bed, and include the following specific improvements:
   (1) Implement pre-construction route survey and tamping procedure and the use of tamping equipment stipulated in the construction plan.
   (2) Stipulate that before construction time, construction procedure, equipment, and other items of the construction plan are changed, risk assessment and hazard identification should be carried out, and corresponding handling measures formulated.
   (3) Establish a completion test mechanism, which should be confirmed by at least the personnel of the owner and TRA, and refer to the regulations of the MOTC or other agencies to establish a completion judgment standard with quantifiable data.
   (4) Set up procedures to require contractors to include checking items that may affect operation safety (such as track irregularities, ballast subsidence, etc.) and response measures (such as personnel standby, contact, emergency repairs, etc.) in the construction plan.
   (5) Establish relevant personnel training and safety operation guidelines for ballast bed defect identification.
   (6) Supervise the construction supervisor and contractor's implementation of on-line movement of construction equipment so that it is in compliance with the regulations of working vehicles of the TRA.

To Taiwan Railways Administration, MOTC

1. Strengthen the corrective measures for drivers with assessment abnormality, at least including reinforcement training and assessment guidelines for resuming duty to correct the improper speed control; Optimize the equipment of the assistant seat of locomotives with two crew members, to ensure the implementation of real-time speed confirmation.
2. Specify the installation requirements for temporary speed restriction balises and

review criteria for temporary speed restriction controllers, and incorporate them into construction specifications to ensure that trains enter the temporary speed restriction area within the speed limit.

3. The TRA has not established a construction safety inspection mechanism for operation personnel, leading to failure to discover the safety risks, such as the absence of Construction Department personnel and track maintenance vehicles. Therefore, it is necessary to strengthen the procedures for requesting and reopening track possession on the mainline by personnel of the General Dispatch Center and the station, at least including informing the personnel of the Construction Department to be on site for supervision, the construction items must be consistent with the content of the train operation notification, and the important machinery and equipment should be on site.; and, after receiving route abnormality notification, the construction information should be included in the possible locations for inspection, etc., and measures for train speed reduction in response to abnormal reports should be effectively implemented.

To CECI Engineering Consultant, Inc.

1. Implement checking of the contractor's construction documents and operating procedures to ensure they comply with the construction specifications, and strengthen contractor management in the construction area, at least including the assessment of high-risk projects affecting the railway operation, notification of the TRA before construction, and risk assessment and handling principles for construction-change items, etc.
2. Implement high-risk construction safety inspections to ensure that discrepancies between the contractor's entry application and the original construction plan are detected and addressed when necessary.

To Kung Sing Engineering Corporation

1. Carry out pipeline investigation and trial excavation in the construction area, and include the operation risk items in the construction items and floor plans in the construction plan for checking.
2. Carry out tamping according to the Railway Bureau construction specifications.
3. Accurately implement applications for vehicles and equipment in accordance with the regulations of the TRA to avoid construction equipment that does not have permission to drive on the main line.

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.