

## **TRA's Train No.177 at Zhunan Station Occurrence Investigation**

### **Executive Summary**

On May 28, 2022, Train No. 177, Tze-Chiang Limited Express Train (hereafter referred to as "occurrence train") of Taiwan Railways Administration, MOTC (hereafter referred to as "TRA"), departed from Hualien Station at 1446, estimated to arrive at the terminal station Dounan Station at 2129. The underframe of Car No.11 was on fire and discharged with smoke when the occurrence train entered Zhunan Station at 1929. The station staff put out the fire with a dry powder extinguisher. No casualties were reported in this occurrence.

The previous utilization of the occurrence train was train No. 170, operating from Chiayi Station to Hualien Station. While passing through the Axle Temperature and Pantograph Automatic Detection Device located to the north of Qidu Station, abnormalities in the 2nd axle (hereafter referred to as "faulty axle") of the 2nd bogie of the 11th car (hereafter referred to as "incident bogie") were detected. The device recorded an axle temperature of 86°C and a mountain-side wheel tread surface temperature of 258°C on the faulty axle at the incident bogie. The personnel on duty at the passenger car dispatch office of Qidu Rolling Stock Division notified the train inspectors at Yilan Station to inspect the train upon its arrival.

Upon the train's arrival at Yilan Station, the train inspectors measured the faulty axle mountain-side wheel tread temperature at 179°C and determined it might result from a malfunction of the service brake. Consequently, the train inspectors isolated the brake cylinder cock of the incident bogie to release the service brake. After the inspection, Yilan Station train inspectors informed Hualien Station train inspectors to conduct an inspection when the train arrived.

Upon the train's arrival at Hualien Station, the train inspectors visually inspected the mountain-side of the faulty axle. They found that the color of the axle temperature sticker did not change, and the brake shoe was loose. They determined that under these conditions would not obstruct the train's operation and, therefore, did not request maintenance personnel from the Hualien Rolling Stock Division to carry out repairs. After a brief train cleaning at Hualien Rolling Stock Division, the train was assigned to operate as train No. 177, departing from Hualien Station towards Dounan Station.

While traveling north of Qidu Station, the personnel on duty at the passenger car dispatch office of Qidu Rolling Stock Division received another high-temperature alert from the monitoring device. This alert indicated that the mountain-side wheel tread surface temperature of the faulty axle had risen to 172°C. As the train entered Qidu Station, the train inspectors measured the faulty axle's temperature at 49°C and

visually inspected the mountain-side brake shoe of the incident bogie, all found to be loose. They reported to the General Dispatch Office that the train could continue operating and informed the train inspectors at Hsinchu Station and Changhua Station to monitor the train's condition upon its arrival.

Upon the occurrence train's arrival at Hsinchu Station, the train inspectors measured the mountain-side wheel tread surface temperature of the faulty axle, which was approximately 160°C, and visually assessed that the brake shoe was not loose. They concluded that the elevated wheel tread surface temperature was due to the parking brake (hereafter referred to as "PB") not being released. Subsequently, the PB of the incident bogie was isolated, resulting in the PBs at the coast-side of the 1st axle (hereafter referred to as "incident axle") and the mountain-side of the faulty axle applied. The train inspectors manually released the PB at the mountain-side of the faulty axle and enlarged the gap between the brake shoe and the wheel tread surface. However, they did not release the coast-side PB at the incident axle. Upon the occurrence train's arrival at Zhunan Station, the station personnel observed smoke and fire beneath Car 11. They extinguished the fire, evacuated passengers, and notified the train dispatcher.

In accordance with the Transportation Occurrences Investigation Act, R.O.C., the Taiwan Transportation Safety Board established an investigation team to conduct the occurrence investigation. The agencies (institutions) invited to participate in the investigation include the Railway Bureau, MOTC and TRA. This report analyzes the causes related to high wheel and axle temperatures of the occurrence train, the causes of the train fire, procedures of train inspection and troubleshooting, training and the responsibilities of train inspectors, as well as train operation decisions and post-occurrence management.

The final investigation report was published on July 19 and was approved by the 52nd Board Committee Meeting on July 7, 2023. On the basis of comprehensive factual information and analyses, TTSB proposes the following 10 findings and 5 recommendations:

## **Findings**

### **Findings Related to Probable Causes**

1. During the troubleshooting of an overheated axle at Hsinchu Station, the inspectors isolated the PBs of the incident bogie. They only released the PB of the faulty axle but did not release the other PB on the incident axle. As a result, the brake shoe remained in contact with the wheel tread, causing continuous friction and leading to the generation of visible flames before reaching Zhunan Station.

2. Due to continuous contact and friction between the brake shoe's iron accumulation and the wheel tread on the mountain-side of the faulty axle, excessively high temperatures were detected for both the wheel and axle at Qidu Station.

### **Findings Related to Risk**

1. The TRA has no criteria for determining and handling procedures for overheating of wheel tread and does not consider the factor of iron accumulation, which is not conducive to maintenance personnel identifying the actual cause of an overheating wheel.
2. The TRA staff in charge of monitoring the detection device only notified the train inspectors that the axle was overheating, but did not pass the information that the wheel tread was also overheating, which affected the train inspectors to conduct a complete inspection.
3. The troubleshooting procedure for the PB does not fully indicate the amount and location of the mechanical release device that must be released after isolating the parking brake, which is not conducive to the complete implementation of the isolation procedures by the inspectors.
4. The content of the train inspector's troubleshooting training course for parking brakes does not provide detailed explanations and practical operations for each type of train, which makes it easy for train inspectors to make omissions when dealing with trains that are not maintained by their own depot.
5. The TRA has not regulated a work party supervisor system for train inspectors when performing troubleshooting, and cannot clearly assign tasks before work and conduct completion inspections after work.
6. The "Axle Temperature and Pantograph Automatic Detection Device Management Instructions" issued by the TRA does not stipulate that the train driver should be notified when the axle and wheel tread is overheating, the driver may easily fail to respond in a timely aspect, thereby increasing the risk of axle overheating.
7. The TRA does not establish the replacement standard for the axle temperature sticker, resulting in stickers failing to indicate the actual axle temperatures when the temperature is raised.

### **Other Finding**

1. The locomotive dispatcher should have notified TTSB for investigation when they learned that the train was on fire. However, they still contacted the train inspectors to carry out troubleshooting; in addition, the wheel of the occurrence train had been trued by the depot personnel before the investigation was completed. These two events caused damage to the evidence, which affected investigators' evidence

collection and further analysis. This shows a lack of clarity among TRA dispatchers, inspectors, and related personnel regarding the scope and regulations of major railway accident investigations. The incomplete preservation of accident trains hinders the subsequent investigation in clarifying the causes of the accident.

## **Safety Recommendations**

### **To Taiwan Railways Administration, MOTC**

1. Urge manufacturers to prevent brake shoe iron accumulation. To reduce the risk of wheel overheating and tread damage caused by friction of iron accumulation, if iron accumulation cannot be completely evitable, additional procedures for inspecting and addressing iron accumulation should be implemented.
2. Clarify the procedure to stipulate that the train driver should be notified when the axle is overheating, and the mechanism for axle temperature sticker inspection and maintenance to ensure effective monitoring. This will prevent situations where train drivers continue operating trains without timely warning information, which could lead to axle overheating. Meanwhile, reduces the risk that the train inspectors cannot correctly verify the axle's temperature due to the failure of axle temperature stickers.
3. Enhance the education and training of parking brake troubleshooting for train inspectors and establish the work party supervisor mechanism to prevent train inspectors from being unfamiliar with the parking brake troubleshooting procedures and mitigate the risk of operational errors due to the absence of a work party supervisor who is responsible for overseeing the operations. Such measures will contribute to ensuring the accuracy and completeness of the troubleshooting process.
4. Disseminate the “Transportation Occurrences Investigation Act” and the “Scope of Major Transportation Occurrence”, and establish a mechanism for preserving accident evidence to prevent destruction during the investigation, which is not conducive to investigations.

### **To the Railway Bureau, MOTC**

1. In accordance with Article 41 of the Railway Law, the Railway Bureau of the Ministry of Communications may include safety recommendations related to training and regulation revision in regular and irregular inspections and supervise the TRA to execute the safety recommendations.

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.