

Executive Summary

TRA's Train No. 3218 at Chenggong Station

On May 19, 2020, at 19:00, Driver of Train No. 3218, a northbound local train of Taiwan Railway Administration (TRA), heard an abnormal sound when passing through the west main line at K204+295 (a curve section with a radius of 650 meters). After the driver reported through the radio in group mode, staffs of Chenggong station were sent to patrol the track, and it was confirmed that the rail of the west main line had a 44-cm crack. There was no fatalities and injuries in this occurrence.

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 and TRA were invited to participate in the investigation.

The investigation report was approved by the 32nd Board Meeting on November 5, 2021, and published on December 9, 2021.

After comprehensive investigation and analysis of the factual data, a total of fourteen conclusions and ten safety recommendations were obtained, which are detailed as follows:

Findings

Findings related to probable causes

1. Between Chenggong Station and Dadu River South signal station on the TRA West Main Line, a 50-meter standard rail with a 650-meter

curve radius had worn on the outer rail. In July 2012, the TRA Construction Department replaced the outer rail, with bond wire weld points, with the inner rail. The aluminothermic welding method was used for welding the rail joints, causing the copper of the bond to permeate into the rail and leading to tiny cracks in the rail due to recrystallization. The cracks enlarged by the weight of passing trains over time.

2. On March 3, 2020, the track inspectors found rail cracks at K204+295. A temporary joint bar was used as a secure connection and regarded as a normal steel rail joint. There was no white paint marking to remind the track patrol personnel to pay attention and arrange for immediate replacement of the rail. Inspection personnel found the railhead was fractured and the rail web had separated by 44cm after the driver of train NO.3218 reported a significant impact noise when passing the location on May 19.

Findings related to risk

1. TRA has not stipulated determination criteria for fractured rails, allotted processing time, and operating restrictions, increasing the safety risk of the inspectors misjudging the grade of track defects and mishandling.
2. The TRA personnel failed to confirm the torque value of the bolts according to the regulations when fastening the joint bar, which may cause the joint bar to become loose after locking due to insufficient or over-torqueing of the bolts, resulting in reduced strength of the structure on the joint bar.
3. TRA has not, according to regulations, established a reporting mechanism for maintenance and malfunctions that might affect operating safety for General Dispatch Office and the other

maintenance units (Construction Department, Electrical Engineering Department,) failing to implement appropriate measures such as reducing train speed or track possession.

4. TRA has not established a complete digital management system for malfunction reporting and track maintenance planning, with the result that track defects and rail replacement maintenance plans can be changed at will and are not listed and followed up until work is complete.
5. TRA has not provided suitable checking equipment (e.g., ultrasonic inspection vehicle) for preventive track defects checking mechanism, resulting in rail crack not being discovered until it fractured.
6. TRA has not established maintenance specifications for rail and accessory precision inspection items nor executed the regular annual inspection.
7. TRA's reused rail regulations do not stipulate pre-installation quality inspection, suitable installation conditions, internal defects testing, and other safety testing mechanisms, increasing the risk of rail fracture after installation.
8. TRA has not set a verification mechanism for its flash-butt welding, increasing the risk of welding defects such as welding cracks in the rail after welding.
9. After the driver reported the track abnormality information to Chenggong Station, the duty station master did not notify the dispatcher immediately by regulations when track abnormality is found and ordered passing trains to proceed within 30 km/h, showing that frontline staff lack operating safety and danger awareness.
10. Even though TRA allows drivers to report information to the nearby station and then the station transfers the information to the dispatcher of the General Dispatch Office, the safety instructions failed to repeat

correctly and to confirm in the indirect reporting procedure and radio communication in this accident resulted in insufficient, incorrect, or delayed information transmission.

Other findings

1. TRA's rail bond welding work procedure does not regulate welder's qualifications, construction work checklist, and record forms, and does not formulate by the department-level units, making it difficult to ensure consistency in construction quality and traceability of welding defects.
2. Currently in TRA, non-destructive test training is insufficient and qualifications are not certified by an independent verification unit, making it difficult to ensure the consistency of learning results and testing standards.

Safety Recommendations

To TRA

1. Stipulate the track's defects determination criteria, allotted process time, and principles to ensure that defects such as fracture rails are fixed within the required period.
2. Implement confirmation of rail bolt torque to ensure the force of the join between joint bar splices.
3. Establish an equipment abnormality reporting mechanism between the General Dispatch Office and the maintenance department to ensure operating safety.
4. Establish the digital management mechanism for construction to be tracked, including reciprocation of malfunction condition, and maintenance plan management to ensure that construction is tracked until improvements are completed.

5. Establish a preventive rail defect inspection mechanism such as using inspection equipment (e.g., ultrasonic inspection vehicle) to ensure that defects are found and handled before rails are fractured.
6. Stipulate regulations for rail welding and reused rail pre-installation inspection to ensure the quality of rail.
7. Review the non-destructive inspection personnel qualification certification procedure to ensure rail welding inspection quality.
8. Revise rail bond welding key procedure and log sheet, such as welder qualifications, regulations for welding mold use, and environmental restrictions; the standard operating procedure should be issued by the department-level unit.
9. Execute the standard operation procedure properly according to the incident.
10. Establish the standard radio communications manual, that clearly defines communication terminology, procedures for issuing and confirming messages.

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.