

## **Executive Summary**

### **TRA's Train No. 2721 at Zhuoshui Station**

At 16:09 on June 1, 2020, Train No. 2721 of Taiwan Railways Administration (TRA), consisting of three type DR1000 diesel railcars, departed from Changhua Station at 05:20 in the morning and ran between the sections from Tianzhong & Ershui Station to Checheng Station of Jiji Line. Before the occurrence, the train was first returned to Eishui Station with Train No. 2716B at Tianzhong Station, and then continued to run as the Local Train from Eishui Station to Checheng Station with Train No. 2721. After departing from Ershui Station at 16:00, the Driver found the Oil Pressure indicator on the bridge was off at 16:05, stopped the train immediately and made the train inspection, when running between Yuanquan Station and Zhuoshui Station on Jiji Line. A fire was found at the bottom of the first compartment (on the hood of turbocharger) and the Driver instructed the Train Master to assist in getting the fire extinguishers from the car to extinguish the fire, and the Train Master evacuated total 12 passengers to the safety place.

At 16:13, the Train Master reported the train fire to the Station Master of Zhuoshui Station. After confirming the approximate stopping point with the Train Master, the Station Master notified the fire brigade and the railway police to rush to the scene at 16:14. When the fire brigade just located the accident site, the Driver had successfully extinguished the fire. After the residual heat had dissipated and the underframe equipment of the other two cars was confirmed as normal condition, the Train Master was informed that the train could continue the journey to Zhuoshui Station. After the Train Master notified the Station Master of Zhuoshui Station at 16:35 and guided passengers board the train, the operation was continued

with the engine of the first car (No. DR1012) off and arrived at Zhuoshui Station at 16:45 to change the trainset. There were no casualties in this occurrence.

According to the Transportation Occurrences Investigation Act, the Taiwan Transportation Safety Board (hereafter referred to as “the Board”) is responsible for investigating major transportation occurrences that arise in the territory of the ROC. This incident is classified as a fire disaster that occurred on the main line and is considered a major transportation occurrence. The Board launched an investigation in accordance with the act. The TRA and Railway Bureau were invited to participate in the investigation.

The draft of the investigation report was completed on November 10, 2021. According to relevant procedures, the draft was subjected to initial review and revisions by the 33rd Board Committee Meeting on December 3, 2021, before its submission to relevant parties for opinions. The related opinions were compiled, and the report was approved by the 35th Board Committee Meeting on February 11, 2022. Confirmation was obtained from the relevant parties indicated in the report, and the report was published on March 7, 2022.

There are eleven conclusions and five suggestions shown detailed as follow:

### **Investigation findings**

#### **Findings related to probable causes**

1. During the train operation between trip No. 2716B and No. 2721, the outer bolt at the joint between the oil returning pipe and turbocharger on the trainset was loosed and lost. The lubricating oil leaked from the joint, adhered to the inner heat shield of the turbocharger, and caused the fire when over-temperature. The temperature of the inner layer

could reach 364°C and surpass the fire point 266°C of the lubricating oil according to the measurement on-site.

2. The loose bolt may be caused by inadequate maintenance, without following the pre-fastening method and torque value required from the maintenance manual suggested by the manufacturer during the latest Level 3 Maintenance Process. Additionally, the bolt tightening checking process has not been clearly defined within Level 1 Maintenance and the loose condition of the bolt could not be noticed in time before the occurrence happens.

### **Findings related to risk**

1. The TRA does not fully comply with the requirement according to the maintenance manual suggested by the manufacturer and failed to require the maintenance staff to fasten the bolt between the joint of the oil returning pipe and turbocharger with the suggested torque value to ensure the required fastening of the bolt of trainset DR1000.
2. The TRA has adopted the non-original manufacturer spare part for the bolt with removable washer when performing the maintenance job to the oil returning pipe and the turbocharger of trainset DR1000. It is possible that the loosen bolt was caused by failing to apply the washer.
3. The TRA maintenance staff evaluates the adequate fastening of the bolts mainly by knocking on the bolts during the Level 1 and 2 Maintenance, and it is not an ideal method for determining the loosened bolt.
4. The TRA failed to clearly define the troubleshooting procedures and the conditions to restart the engine under low lubricating oil pressure conditions on trainset DR1000. In this occurrence, the driver pushed the reset button to restart the engine without confirming the lubricating oil volume and pressure level. This might cause damage to the engine

and affect operational safety.

5. The contents of inspection item lists, inspection records, and inspection procedures for Level 1 to 4 Maintenance are not consistent, the practical work could not be performed properly by following the standard operational procedures.
6. The TRA failed to define the job responsibilities and function clearly for the supervisor, inspector, and technical assistant in the depot and main workshop for Level 1 to 4 Maintenance, and this might cause difficulty to manage and ensure the maintenance quality.

### **Other Findings**

1. The firefighting process performed by the Train Master and Station Master in the occurrence is consistent with the relevant procedures of TRA.
2. In the current inspection records for Level 1 to 4 Maintenance of TRA, only the name of the devices and inspection items are provided, together with a simple checkbox for marking, but the implementation procedures and qualification criteria are not specified for each inspection item.
3. In the current Level 4 Maintenance inspection records of TRA, the adopted gap allowance standards for assembling the turbocharger parts are not consistent with those suggested in the manufacturer's maintenance manual.

### **Safety Recommendations**

#### **For the TRA, Ministry of Transportation and Communications**

1. Enhance the inspection procedures for trainset DR1000, especially the necessity of the bolts which must be fastened by using a torque wrench for the key facilities, marking the fastened position, and the relevant

confirmation procedures during the maintenance for ensuring the bolt fastening performance.

2. Introduce the proper checking and verification procedures before adopting non-original manufacturer spare parts for the bolt and enhance the procedures to ensure the bolt fastening with the washer for eliminating the risk of a loosen bolt.
3. Amend the current work contents, inspection methods, used tools, and pass-fail criteria defined in the Level 1 to 4 Maintenance documents of trainset DR1000 by referring to the manufactured maintenance manual in order to attain the maintenance quality suggested by the manufacturer.
4. Clearly define the job responsibilities and functions for the supervisor, inspector, and technical assistant in the depot and main workshop in each maintenance level to ensure the quality of maintenance and supervision.
5. Clearly define the trainset DR1000 Driver's troubleshooting procedures under low lubricating oil condition/pressure to ensure the work could be done properly.

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