Executive Summary

TRA's Train No. 125 at Chiayi Station

On June 25, 2020, Train No. 125, southbound Tze-Chiang Limited Express Train of Taiwan Railways Administration (TRA), MOTC, was composited by 14 cars; the first and last cars were electric locomotives, and the other 12 cars were passenger cars. The train departed from Qidu Station at 1230 and was scheduled to arrive at Pingtung Station at 1819. When departing from Changhua Station at 1546, a staff on the station platform noticed that the rear electric locomotive was releasing smoke and emitting the smell of burning brake pads. The staff on the platform immediately notified the train driver, the train master and the Changhua Station train control room. The train driver opened the window to verify the reported situation but did not observe the heavy smoke and therefore assumed the situation was caused by a stuck brake. Accordingly, the train driver decided to continue the operation to Yuanlin Station and keep monitoring the situation.

After arriving at Yuanlin Station at 1557, the train driver applied and released the emergency brake trying to operate the pneumatic valve so as to resolve the problem of the stuck brake. After taking this action, the train driver did not observe heavy smoke and decided to continue the operation. After arriving Douliu Station at 1621, the train driver walked into the rear electric locomotive and isolated the brake system, moreover, verified no smoke was emitting. When the train passing Minxiong Station, the station master on duty reported that smoke was being emitted from the underframe of electric locomotive. The train driver decided to continue the operation and requested the train rider to handle the problem at Chiayi Station.

When arriving Chiayi Station at 1653, the ventilation chamber at the underframe of electric locomotive had clearly burning circumstances and emitted thick smoke. The train rider sprayed the underframe of the rear

locomotive with a fire extinguisher. Knowing that the firefighters may need to spray water to extinguish the fire, the train driver lowered down the pantographs of the trainset at 1700. Afterwards, the thick smoke began to emit from the air intake of the blower chamber on the upper-side of the electric locomotive. The train rider subsequently removed the maintenance panel of the air filter and sprayed the fire extinguisher dry powder into the chamber, which brought the thick smoke under control and dissipated smoke away. The occurrence resulted in burn damages to the inductor and the underframe ventilation chamber of the rear electric locomotive. There were no casualties in the accident.

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

The draft of the investigation report was completed on October 28, 2021. According to relevant procedures, the draft was submitted for initial review and revised by the 32nd Board Committee Meeting on November 5, 2021, and subsequently submitted to relevant facilities and institutions for review and comment. After coordinating the comments, the report was approved by the 34th Board Committee Meeting on January 7, 2022. After approval, the final report was confirmed by the relevant organizations as well as institutions, and subsequently published on February 9, 2022.

The investigation results of the factual data and analysis yielded six conclusions and five safety recommendations, which are detailed as follows:

Investigation findings

Findings Related to Probable Causes

1. The rated current of inductor for the locomotive in the occurrence was smaller than that of the motor. When the motor requires a higher current such as starting, acceleration and climb slopes, the current of the inductor may have become fully loaded or overloaded and easily cause the inductor to overheat. When departing from Changhua Station, the inductor was overheated and resulted in the melting of the surface insulation of the inductor coils.
2. The troubleshooting manual of the E1000 electric locomotive series does not clearly outline the handling procedures for DC link overcurrent case. Therefore, the train driver could not conduct troubleshooting and result in the overcurrent protection mechanism failed to activate. As a result, the train continued traveling when its inductor was experiencing an overcurrent, leading to the temperature increasing continuously.
3. The inductor of the locomotive in the occurrence did not equip with the over-temperature protection device. Therefore, the operation of inductor could not be force-stopped when the temperature became overly high; this resulted in the inductor burning due to continuous over-temperature operation.

Findings Related to Risk

1. The inductor of the locomotive in the occurrence is dismounted for full cleaning, maintenance and conducting reinforced insulation overhaul every 12 years. Long-accumulation dust and moisture cause the inductor to have current leakage phenomenon and result in overheating, which rapidly bring the insulation degradation of the coil surface. Furthermore, long-term vibrations during the train operation also exacerbated the level of the degradation.
2. The underframe of locomotive in the occurrence did not equip with smoke or fire detection devices. Therefore, the train driver is not alerted or received fault codes in the case of smoke or fire. This disadvantage disable the train driver from identifying the reason of smoking evoked

from the underframe and take the correct action in the first place.

Other findings

1. TRA does not clearly define the accreditation standards for non-original spare parts manufacturer and also not require the manufacturers to provide the third-party certification. This is disadvantageous for the quality control of the non-original manufacturer spare parts.

Safety Recommendations

To TRA

1. Determine whether smoke or fire detectors should be installed on the underframe of newly procured trainset in the future, in order to immediately identify the cause of failure and take the correct action by the train drivers.
2. Determine whether the over-temperature protection device should be installed on the inductor to force-stop the operation when the temperature is overly high, thereby preventing the inductor from melting due to overheating.
3. Establish regulations for the management of the spare parts and clearly define the accreditation standards for the manufacturers as well as the adoption of third-party certification in order to ensure the quality of non-original manufacturer spare parts.
4. Adjust the maintenance cycles for inductor to increase the frequency of full cleaning, and focus on removing the dust accumulated on the inductor surface to prevent current leakage, which can in general result in overheating.
5. Amend the troubleshooting manual for the E1000 series electric locomotive to include descriptions and troubleshooting procedures for the fault code of DC link overcurrent case to assist train drivers in conducting the troubleshooting and activating the protection mechanism.

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.