Executive Summary

At 22:15 on September 29, 2020, a tractor truck owned by Gaoqi Express Co., Ltd., which was towing a hydrogen tank semitrailer, departed from the Guanying Factory (located in Taoyuan) of Linde Lienhwa Industrial Gases Co., Ltd. for Tree Valley Park (located in Tainan). At 0013:19 on the following day, the truck overturned while traveling at 87 km/h when it exited from the southbound ramp of Changhua System Interchange (sta. 196k) of National Freeway 3. Both the tractor and its semi-trailer overturned, resulting in the hydrogen tank falling over the ramp and starting a fire beneath it. The driver of the truck fell next to the hydrogen tank and was dead when found. This report was reviewed and approved at the 32nd TTSB Board meeting on November 5, 2021.

Findings:

1. The accident vehicle changed to the deceleration lane before the ramp on the right side of the main lane of National Freeway 3 and entered before the ramp. However, the driver did not slow down on the deceleration lane and maintained a speed of 91 km/h after entering the ramp. During the turn, the driver swerved the vehicle sharply to the right, which might have resulted in the centrifugal force of the vehicle exceeding its centripetal force and causing the vehicle to tilt. Despite the driver's attempt to brake, the vehicle continued tilting and eventually toppled over.

2. The detachable hydrogen tank was separated from the semitrailer when the vehicle toppled over. After falling off the viaduct, the tank hit the bridge pier beneath the viaduct, the impact of which might have generated sparks that reacted with the leaking hydrogen gas and started a fire.

3. During the accident, the driver seat might have separated from the vehicle because of the compression deformation of the driver's compartment. Additionally, because the driver might have failed to fasten his seat belt, he fell off the ramp when the vehicle overturned.

4. No evidence indicates that the driver made the sharp right turn because of fatigue or distractions.

5. The distance from the start of the deceleration lane of the southbound exit of the Changhua System Interchange to the ramp exit is approximately 800 m. On this stretch of the interchange, no ramp speed limit signs or other warning signs are present. This might have contributed to the driver's failure to slow down in time, resulting in the vehicle passing through the accident section at an overly high speed.

6. The accident vehicle was already starting to tilt leftward before it collided with the guardrail. The guardrail failed to deflect the wayward truck while the tires did not make

contact with the rails. Additionally, the center of gravity of the vehicle was 83 cm higher than the guardrail, and because the hydrogen tank separated from the semitrailer, the rail failed to stop the tank from falling over the viaduct and landing below the ramp.

7. The tank semitrailer was attached to the tractor truck by using a stacking cone and stacking pin. However, only a thin metal strip was welded onto the stacking pin component, rendering it incapable of firmly coupling with the stacking pin. When the vehicle toppled over, the stacking pin might have been ejected from the corner fitting of the tank semitrailer or snapped because of the sideswipe collision of the vehicle, resulting in the separation of the tractor truck and tank semitrailer.

8. Taiwan's regulations of road safety and vehicle inspection currently lack clear inspection regulations for the coupling components used to couple semitrailers and detachable tank semitrailers to tractor trucks. Relative to the international standards and regulations that have been established to ensure container transportation safety, Taiwan's regulations for the coupling systems of semitrailers that transport dangerous goods should be improved.

9. The driver of the accident vehicle had completed training courses and obtained training certification by the relevant regulations.

10. The transported container was a DOT-3AAX steel cylinder tank containing hydrogen. The structural strength of the tank complied with the regulations specified in ISO 1496-3. Additionally, the tank complied with the regulations stated in Title 49, Section 173.301 of the United States Code of Federal Regulations.

Safety Recommendations

To Gaoqi Express Co., Ltd.:

1. Gaoqi Express Co., Ltd. should increase its efforts to promote safe driving and provide educational training courses for employees, and it should establish clear requirements that its drivers must fasten their seatbelts and follow the speed limit when driving.

To Ministry of Labor:

1. The Ministry of Labor should review and discuss the accident with the Ministry of Transportation and Communication and amend the Road Traffic Safety Regulations and other relevant regulations to ensure employee safety concerning the transportation of high-pressure gas. Additionally, to ensure the safe transportation of dangerous goods, the ministry should establish regulations requiring the coupling system of semitrailer vehicles that transport dangerous goods to comply with the Vehicle Safety Test Direction.

2. The ministry should reference the regulations of International Organization for

Standardization (ISO) and establish clear inspection criteria for the coupling systems of tractor trucks and detachable tank semitrailers. Additionally, it should establish safety inspection regulations for such vehicles to ensure that semitrailer manufacturers produce vehicles that meet its safety certification standards.

To Freeway Bureau:

1. The Freeway Bureau should evaluate the necessity of introducing speed limit signs, road surface markings (lines or worded markings), or other supplementary features at the deceleration zone before the ramp to warn drivers of ramp speed limits and remind them to slow down and follow the newly introduced speed limit.
2. The bureau should review the Manual on Highway Traffic Engineering and determine whether to upgrade highway guardrails, to increase the type and suitability of guardrail options.

To Directorate General of Highways:

1. The Directorate General of Highways should require vehicles that are temporarily registered to transport dangerous goods to install global positioning system tracking devices, such that their transportation status can be monitored.