

Final Report

PASSENGER TRAPPED BETWEEN TRAIN AND STATION PLATFORM DOORS

11 MARCH 2024

TIB/RAI/CAS.012

Transport Safety Investigation Bureau of Singapore
Ministry of Transport
Singapore

12 December 2024

The Transport Safety Investigation Bureau of Singapore

The Transport Safety Investigation Bureau of Singapore (TSIB) is the air, marine and rail accidents and incidents investigation authority in Singapore. Its mission is to promote transport safety through the conduct of independent investigations into air, marine and rail accidents and incidents.

The TSIB conducts rail safety investigations in accordance with the Singapore Transport Safety Investigations Act 2018 and the Transport Safety Investigations (Railway Occurrences) Regulations 2023.

The sole objective of TSIB's rail safety investigations is the prevention of rail accidents and incidents. The safety investigations do not seek to apportion blame or liability. Accordingly, TSIB reports should not be used to assign blame or determine liability.

Table of Contents

ABBREVIATIONS	iv
SYNOPSIS	1
1 Factual information	2
1.1 Sequence of events	2
1.2 Injuries to persons	4
1.3 Damage	4
1.4 Personnel information	4
1.5 Operations requirement	4
1.6 Staff training	5
1.7 Emergency stop buttons at monorail stations	5
1.8 Platform gate doors	7
1.9 Gaps between monorail track and platform	8
2 Analysis	10
2.1 Emergency response training	10
2.2 Emergency stop buttons at BEA boarding platform	11
2.3 Availability of the PGD key	11
2.4 Falling through gaps between monorail track and platform	12
3 Conclusions	13
4 Safety actions	14
5 Safety recommendations	15

ABBREVIATIONS

ESB	Emergency Stop Button
OCC	Operations Control Centre
OJT	On-the-job Training
PGDs	Platform Gate Doors
SA	Service Ambassador
SIC	Station-in-charge
SOP	Standard Operating Procedures

SYNOPSIS

On 11 March 2024, a passenger attempted to board a monorail train of the Sentosa Express at Beach Station when the train doors started to close. The train doors closed before the passenger could get onto the train. The passenger did not back off from the closed train doors but remained standing in front of the train doors. Meanwhile, the platform gate doors (PGDs) started to close, yet the passenger did not move and ended up being trapped between the train doors and PGDs.

Two monorail operator's staff, who were in the vicinity, came to help the passenger hold onto the PGDs but they did not press the emergency stop button (ESB) to prevent the train from leaving the station. After the train had left the station, the passenger was clinging onto the PGDs precariously. Another staff eventually activated an ESB that stopped the next train from entering the station. The PGDs were opened after the PGD key was found, and the passenger was helped back onto the platform.

The Transport Safety Investigation Bureau of Singapore classified this occurrence as an incident.

1 **FACTUAL INFORMATION**

(Note: Diagrams are not to scale)

1.1 Sequence of events

1.1.1 The Sentosa Express is a monorail line from the mainland of Singapore to the Sentosa Island. The line has four stations, viz. VivoCity Station (VVC), Resorts World Station (RWS), Imbiah Station (IMB) and Beach Station (BEA). BEA station, being a terminus station had two platforms with platform gate doors (PGDs) on either side of the train. An alighting platform for passengers to exit on one side of the train and a boarding platform on the opposite side of the train.

1.1.2 At about 11:53 hours on 11 March 2024, after the Red Train¹ stopped at BEA, the train doors and PGDs (more on PGDs in paragraph 1.8) on the boarding platform² side opened for passengers to board the train.

1.1.3 At about 11:54 hours, the door closing buzzer sounded, accompanied by red flashing indicator lights on the PGDs³. The train doors started to close. At this moment, a passenger attempted to board the train. The train doors closed before the passenger could get onto the train, however she did not back off from the closed train doors but remained standing in front of the train doors. Meanwhile, the PGDs started to close. The passenger still did not back off to the platform but turned around and held onto the closing PGDs. She ended up being trapped between the train doors and PGDs.

1.1.4 A service ambassador of the monorail operator (hereinafter referred to as Service Ambassador 1 (SA1)), who was then standing next to the PGDs, went over to help the passenger hold onto the PGDs. She did not press the emergency stop button (ESB) which was just behind her (hereinafter referred to as the ESB B) (more on ESB in paragraph 1.7). Another service ambassador (hereinafter referred to as Service Ambassador 2 (SA2)) who was arranging the queue poles also went over to help the passenger hold onto the PGDs. He

¹ The Sentosa Express has seven train sets, each identified by a colour (Red, Orange, Green, Blue, Purple, Pink and Yellow).

² As a terminal station, BEA has separate platforms for boarding and alighting passengers. When a train stops at BEA, doors on the alighting platform side will open first for passengers to disembark. Doors on the boarding platform side will subsequently open for passengers to board the train.

³ Door closing buzzer will sound for about seven seconds before the train doors commence closing. The closing of train doors will take about three seconds. The PGDs will commence closing after the train doors are closed and locked.

also did not press any ESB. The train departed BEA six seconds later while the passenger was still clinging onto the PGDs.

- 1.1.5 SA1 then ran towards the cabinet located at the left end of the boarding platform⁴ to store a personal belonging⁵ and ran back to the PGD⁶. SA2 tried to contact via radio the staff in charge of BEA (hereinafter referred to as Station-in-charge 1 (SIC1), who was then at IMB⁷) for assistance. According to SIC1, he did not receive any radio call from SA2.
- 1.1.6 A staff of the monorail operator who was a station-in-charge for another station (hereinafter referred to as Station-in-charge 2 (SIC2)), and who had earlier alighted from the train and was on his way to his office near BEA, overheard the radio message and returned to BEA. When he arrived at the BEA alighting platform, the train had departed and SIC2 saw the passenger clinging onto the boarding platform PGDs across from him. He immediately shouted to SA1 to get her to try looking for the PGD key in the cabinet at the left end of the boarding platform. SA1 then ran to the cabinet. SIC2 also radioed the Operations Control Centre (OCC) to inform the OCC that a passenger was clinging onto the PGDs and requested the OCC to stop the inbound train.
- 1.1.7 SIC2 then quickly made his way from the alighting platform to the boarding platform. When he reached the boarding platform, he saw an inbound train and he pressed the ESB B to stop the train. The inbound train stopped about 24m from the trapped passenger. At this moment, four more staff of the monorail operator, who happened to be in the vicinity, came forward to help. One of them held onto the passenger, while the other three tried to help SA1 find the PGD key and to contact SIC1. Shortly after, the OCC shut down the traction power of the monorail line at 11:59 hours.
- 1.1.8 In the meantime, SIC1 informed SA1 via radio that the PGD key was in the cabinet. However, SA1 still could not find the PGD key in the cabinet. SIC2 then went to the cabinet, found the PGD key and quickly opened the PGDs and, with the help of the other staff, brought the passenger back onto the boarding platform.

⁴ Hereinafter the left and right of the boarding platform are referenced facing the PGDs on the platform.

⁵ There was no cabinet at the right end of the boarding platform.

⁶ According to SA1, she intended to free up her hands in order to be better able to assist the passenger. She had panicked and did not realise that she could have just put the personal belonging on the floor.

⁷ On the day of the incident, SIC1 was concurrently in charge of IMB.

1.2 Injuries to persons

1.2.1 According to the operator, the right forearm of the trapped passenger suffered a minor abrasion. First aid was offered to her but she declined and left the station.

1.3 Damage

1.3.1 There was no damage in this incident.

1.4 Personnel information

1.4.1 The table below shows the length of service with the monorail operator of the personnel involved as well as their experience.

Personnel	Age	Date employed	Length of service at time of incident	Experience in the role
SIC1	30	June 2023	9 months	9 months
SIC2	31	January 2015	9 years 3 months	7 years
SA1	24	August 2023	7 months	7 months
SA2	19	June 2023	9 months	9 months

1.5 Operations requirement

1.5.1 The monorail service would start at 7am and end at 12 midnight and all four monorail stations were open during this period. Each station had an SIC assigned⁸ to it. The SIC was assisted by at least one SA to manage the station operations. While platforms at VVC and RWS were always manned, platforms at BEA and IMB were manned from 9am to 10pm and were not manned from 7am to 9am and from 10pm to 12 midnight⁹ as there was less passenger traffic during these periods.

1.5.2 On the day of the incident, SIC1 was assigned to manage BEA and IMB stations as his colleague rostered for IMB had called in for sick leave. SA1 and SA2 were assigned to support him at BEA. SIC1 went to IMB at about 09:00 hours after his routine tasks at BEA. The two SAs were left to manage BEA

⁸ According to the monorail operator, there is one SIC assigned to each station. When there is a lack of manpower (e.g. when staff have to go on sick leave or urgent leave), one SIC may be assigned to cover two or more stations.

⁹ The operator would deploy platform staff as necessary basing on crowd build-up situation. When the platforms were not manned, passengers may contact the OCC using the emergency telephone at the platform or call 1800-Rangers or contact the Service Captain inside the train for assistance.

thereafter.

- 1.5.3 SIC1 had one set of keys for BEA and one set for IMB, including PGD keys. At the time of the incident, the monorail operator did not allow SAs to hold station keys. Thus, when SIC1 had to leave BEA for IMB, he left the BEA keys (including the PGD key) in the cabinet located at the left end of the boarding platform at BEA, although the standard operating procedures (SOP) of the monorail operator required SICs to carry the keys with them at all times when on duty, even if they needed to leave the stations that they were in charge of.
- 1.5.4 The monorail operator's SOPs required SAs to report emergencies to the SIC of the station concerned who would in turn report to the OCC. While there were training and briefings on general incident management and scenario handling, there were no specific SOPs pertaining to a scenario of passengers being trapped between train doors and PGDs. According to the monorail operator, there had been no such incident since the monorail line started operations.
- 1.6 Staff training
 - 1.6.1 The monorail operator required all newly joined SAs to complete two days of onboarding briefing and then two weeks of on-the-job training (OJT). There was refresher training for SAs. However, the scenario of passengers being trapped between train doors and PGDs was not covered in any briefings and training for SAs.
 - 1.6.2 During the onboarding briefings, SAs would learn about the function of ESB. During their OJT, they would be shown the location of ESBs at each station. The hands-on practice of operating the PGDs using the PGD key was not included in SA's training. Only SICs were allowed and trained to operate the PGDs using the PGD key.
 - 1.6.3 According to the monorail operator, the scenario of passengers being trapped between train doors and PGDs had not been envisaged. Hence it was not included as part of the training for SICs and SAs.
- 1.7 Emergency stop buttons at monorail stations
 - 1.7.1 All monorail stations were equipped with emergency stop buttons (ESBs). Pressing the ESBs would prevent a train from entering the station or leaving

the station. SAs as well as members of the public may activate the ESBs in an emergency.

1.7.2 At BEA, there were two ESBs at the boarding platform: ESB A and ESB B (see **Figure 1**). The ESB A was at the edge of the boarding platform near the PGDs on the right side whereas the ESB B was at the centre of the boarding platform. There were signboards above each ESB to facilitate them being identified. However, the ESB B was facing away from the platform waiting area (see **Figure 2**).

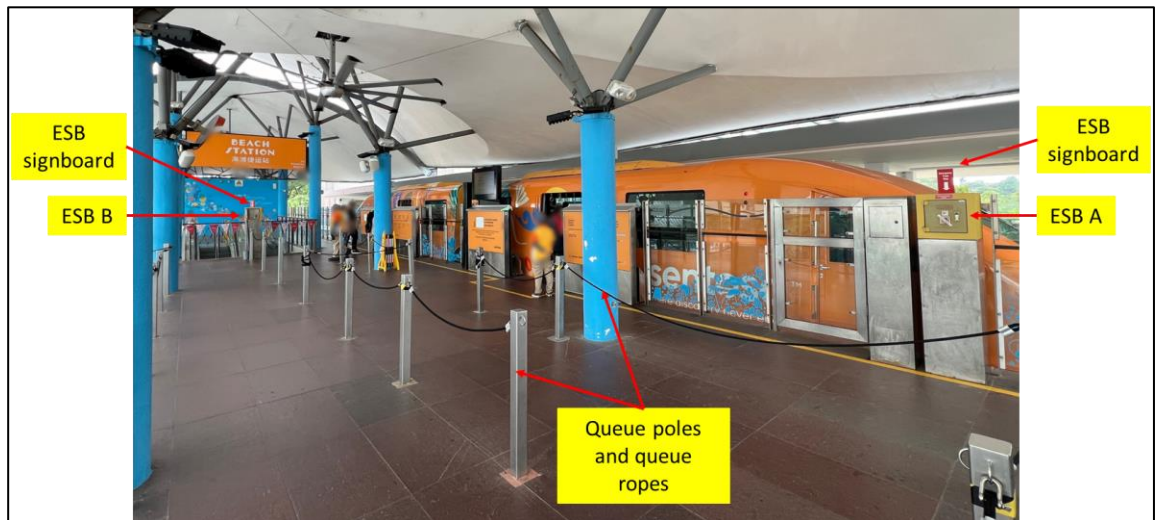


Figure 1: Layout of BEA boarding platform

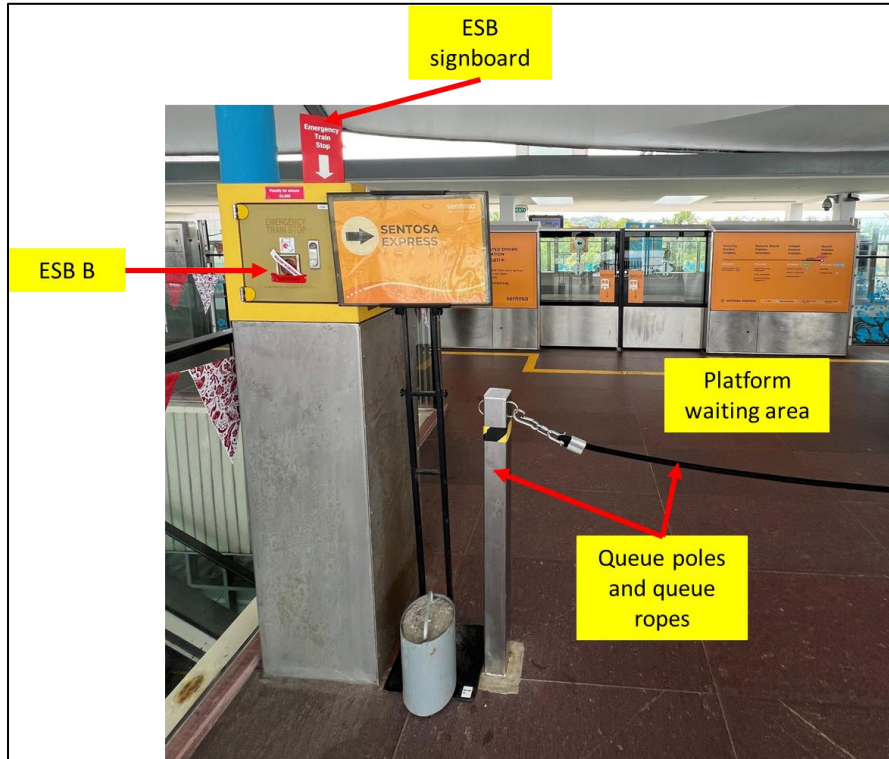


Figure 2: ESB B at BEA boarding platform facing away from platform waiting area

- 1.7.3 For passenger flow management, queue poles and queue ropes were used to outline a “snaking” passenger queue path from the ESB B location to the platform waiting area.

- 1.8 Platform gate doors
 - 1.8.1 The PGDs provided a barrier between the platform and the train. They were interlocked with the train signalling system to prevent the train from departing when any train doors or PGDs were not closed and locked.
 - 1.8.2 In 2016, the monorail operator added an anti-clamber (see **Figure 3**), a protruding steel plate at the bottom of the PGDs to reduce the gap between the PGDs and the train. Closing PGDs would reopen when the PGDs (including the anti-clambers) came into contact with an obstacle of more than 5mm in diameter and the train would not depart, even if the train doors were closed.

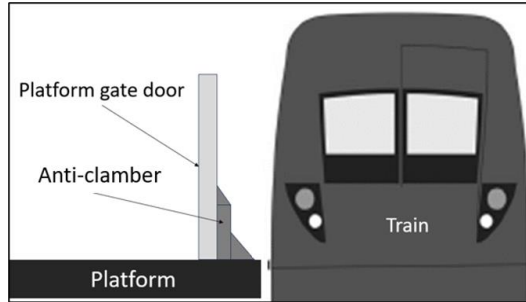


Figure 3: Anti-clamber

1.8.3 In 2022, the monorail operator further enhanced safety by upgrading the PGDs with door closing buzzers and indicator lamps (see **Figure 4**). The PGDs would sound a buzzer alarm and have its red indicator lights flashing when the PGDs were closing. Signs were also put up to remind passengers not to rush into closing train doors.



Figure 4: Red flashing lights on PGDs

1.8.4 In this incident, the closing PGDs did not come into contact with the passenger as she had manoeuvred out of the way of the closing PGDs and managed to hold onto the top of the PGDs and stand on the lower part of the anti-clamber.

1.9 Gaps between monorail track and platform

1.9.1 The monorail travelled on an elevated beam of track which was above ground. There were gaps of about 1m between the monorail track and the platforms on either side of the track (see **Figure 5**). The height between the platform and the ground was about 4m.

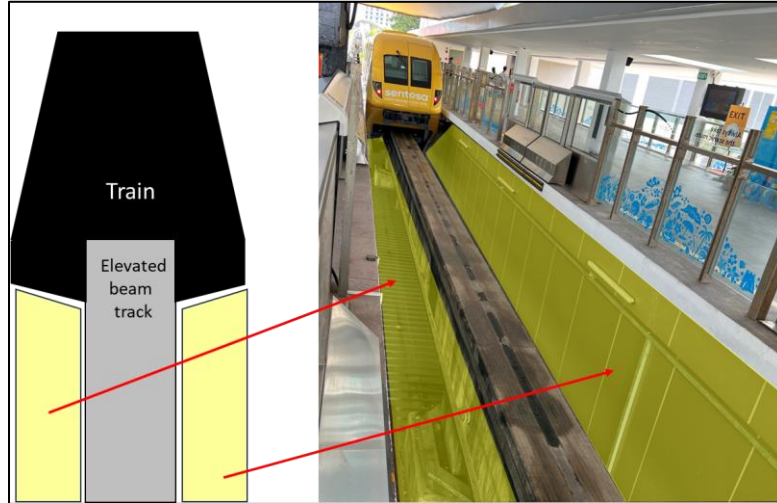


Figure 5: Gaps between monorail track and platforms as highlighted in yellow

2 ANALYSIS

The trapped passenger had managed to cling onto the PGDs for about four minutes before the PGD key was found and the PGDs opened. Had the passenger let go of the PGDs, she would have fallen through the gaps between the monorail track and the boarding platform. It was fortuitous that she did not suffer more than a minor abrasion. The outcome could have been more severe if the circumstances had been different.

The investigation looked into the following:

- (a) Emergency response training
- (b) Emergency stop buttons at BEA boarding platform
- (c) Availability of the PGD key
- (d) Falling through gaps between monorail track and platform

2.1 Emergency response training

2.1.1 To its credit, the monorail operator upgraded the platforms with anti-clamber and door closing buzzers and indicator lamps in 2016 and 2022 respectively to reduce the likelihood that a passenger would end up being trapped between train doors and PGDs. The anti-clamber, buzzers and indicator lamps did not prevent a passenger from holding onto the PGDs. While it was understandable that SA1 and SA2, went over to help the passenger cling on to the PGDs, out of concern for her safety, it would have been desirable if they had thought of activating the ESB or asking others around to activate the ESB.

2.1.2 SA1 was so panicked that she did not simply put down her personal item on the floor before going to help the trapped passenger. This incident highlights that, in an emergency, staff may not perform as expected, even if they have been trained, let alone if the emergency scenario has never been envisaged, or has been envisaged but never exercised. It cannot be over-emphasised that emergency scenario planning and regular exercises are necessary activities of any operational organisation whose business involves public safety.

- 2.2 Emergency stop buttons at BEA boarding platform
 - 2.2.1 During the incident, SA1 and SA2 did not, nor did the other people at the BEA boarding platform, press any ESB at the BEA boarding platform to prevent the train from leaving.
 - 2.2.2 The ESB A was very much further away than the ESB B from the trapped passenger. It was not unexpected that SA1 and SA2 did not call to mind to press the ESB A.
 - 2.2.3 The ESB B was nearer SA1 and SA2 but was facing away from the platform waiting area and was thus not amenable to be noticed and used by the people (passengers as well as monorail operator's staff) congregated at the platform waiting area near the PGDs. The signboard for the ESB B was not conspicuous as the words on the signboard were of a relatively small font size. In addition, the queue poles and queue ropes around the ESB B would suggest instinctively to the people standing near the PGDs that the area around the ESB B was a cordoned-off area and they would unlikely call to mind that there was an ESB there.
 - 2.2.4 The investigation team suspects that these could be the reasons that SA1 and SA2 did not call to mind to use the ESB B. The TSIB opines that emergency devices such as ESBs, being crucial for public safety, should be sited in such a way as to ensure accessibility and visibility of these devices, which would facilitate a quick response, thereby preventing unnecessary accidents or mitigating the severity of accidents.
 - 2.2.5 That SA1 and SA2 did not call to mind to use of the ESBs during this emergency incident suggests the need to stress the importance of the use of ESBs during station staff training, apart from ensuring that staff are familiar with the location of the ESBs.
- 2.3 Availability of the PGD key
 - 2.3.1 The SICs were expected by the monorail operator to hold the PGD key at all times when on duty as only the SICs were allowed to operate the PGDs using the PGD key. At the time of the incident, SAs were not allowed to hold the PGD key.
 - 2.3.2 The choice by SIC1 to leave the PGD key at BEA, although not in accordance

with the monorail operator's requirement, appeared to be fortuitous in this incident. Had SIC1 carried the PGD key to IMB, it would have taken a longer time to have the PGDs opened to rescue the trapped passenger because of the need to wait for SIC1 to come back to BEA or for a spare PGD key to be fetched.

2.3.3 The TSIB opines that there may be merits in making keys important for station platform operations (e.g. PGD key) easily available in the vicinity of the platforms to ensure there will not be unnecessary operational delay. For example, such a key may be kept in a "break-glass" or "number combination lock" cabinet so that it can be retrieved by any monorail staff for quicker response.

2.4 Falling through gaps between monorail track and platform

2.4.1 There are gaps between the monorail track and the platform. A person who has fallen off the platform will likely fall through such a gap onto the ground below and will likely suffer serious injury. The investigation team believes it is desirable for the monorail operator to conduct a risk assessment on how such a consequence may be mitigated.

3 CONCLUSIONS

From the information gathered, the following findings are made. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- 3.1 SAs were trained to press the ESBs during emergencies to stop trains from entering or leaving the stations. The SAs involved in this incident did not press the ESBs that were at the BEA boarding platform to stop the train from leaving BEA after they had noticed that a passenger had been trapped between train doors and PGDs. The investigation team opines that the training provided to the SAs for handling emergencies needs to be enhanced.
- 3.2 The ESB B at BEA boarding platform, which was nearer the SAs than the ESB A, was facing away from the platform waiting area and was thus not amenable to be noticed and used by the people (passengers as well as monorail operator's staff) waiting there. In addition, the queue poles and queue ropes around the ESB B would suggest instinctively to the people standing near the PGDs that the area around the ESB B was a cordoned-off area and they would unlikely call to mind that there was an ESB there. The investigation team suspects that these could be the reasons the SAs did not call to mind to use the ESB B.
- 3.3 The monorail operator had not envisaged a situation of passengers being trapped between train doors and PGDs and did not include in its emergency response training for staff such a scenario.
- 3.4 The Station-in-charge of Beach Station had to go to another station and left his PGD key in the station without telling his staff where he had kept the key. This incident has shown that there is a need for an arrangement whereby operational keys can be obtained quickly.
- 3.5 A person who is trapped between the track and platform and has failed to cling onto the PGDs will fall through the gap between the track and platform onto the ground below and will likely suffer serious injury.

4 SAFETY ACTIONS

Arising from discussions with the investigation team, the organisation(s) has/have taken the following safety action.

- 4.1 The monorail operator included in its emergency response training the scenario of passengers being trapped between train doors and PGDs.
- 4.2 The monorail operator arranged for PGD keys to be immediately available at station platforms with a view to avoiding delay to emergency response actions.
- 4.3 The monorail operator modified the anti-clamber to reduce the likelihood of passenger entrapment between the PGDs and train.
- 4.4 The monorail operator is installing infrared sensors on the existing PGDs to enhance the obstacle detection system.
- 4.5 The monorail operator relocated the emergency stop button (i.e. ESB B) at the boarding platform of BEA so that it is more noticeable to and accessible for use by monorail staff as well as passengers during emergencies.
- 4.6 The monorail operator carried out refresher training to all SICs and SAs on the use of ESB. Staff were shown the locations of the ESBs and briefed on the function of the ESB.
- 4.7 The monorail operator has implemented three-monthly refresher training to all SAs to keep them current.
- 4.8 According to the monorail operator, it had conducted a risk assessment in response to the investigation team's view in paragraph 2.4.1 concerning the risk of a person falling off the platform through the gap between the monorail track and the platform after a train has left the station. The monorail operator is confident that its safety actions in paragraphs 4.1 – 4.5 above will mitigate against the risk of a train leaving a station when a person has been trapped between train doors and PGDs and also that the aforesaid safety actions will reduce to an acceptable level the risk of a person falling through the gap between the monorail track and the platform onto the ground.

5 SAFETY RECOMMENDATIONS

A safety recommendation is for the purpose of preventive action and shall in no case create a presumption of blame or liability.

In view of the safety actions taken by the rail operator, the investigation team did not have any safety recommendation to propose.