Final Report

NEAR MISS INCIDENT ON CHANGI AIRPORT SKYTRAIN SYSTEM

15 JANUARY 2024

TIB/RAI/CAS.011

Transport Safety Investigation Bureau
Ministry of Transport
Singapore

8 January 2025

The Transport Safety Investigation Bureau of Singapore

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ABBREVIATIONS

APMS	Automated People Mover System Department
FM	Facilities Management Department
OCC	Operations Command Centre
SCD	Short Circuit Device
SFB	South Finger Building
T3	Terminal 3
WPA	Work Permit Application

SYNOPSIS

On 15 January 2024 three cleaners were cleaning a façade of the South Finger Building of Terminal 3 at Changi Airport. The façade was close to the guideway of a Skytrain track. The cleaning entailed the three cleaners rappelling down from the rooftop, cleaning the facade while being suspended on the rappelling ropes, and at times standing on the parapet of the guideway of a Skytrain track. Skytrain passenger service had been suspended for the cleaning and the track's traction power switched off. The Skytrain's Operations Command Centre (OCC) was aware that the façade cleaning was in close proximity to the Skytrain track, however, OCC was not aware that the cleaners would need to occasionally stand on the parapet of the Skyway track. Midway through the façade cleaning, the OCC informed the cleaning supervisor of the need to halt the cleaning for a train shunting movement and switched on the track's traction power for five minutes. The three cleaners who were then standing on the parapet of the guideway saw the train approaching and took actions to ensure they were not in the path of the moving train.

There was no injury due to the railway occurrence.

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

1 FACTUAL INFORMATION

(Note: Diagrams are not to scale)

1.1 Sequence of events

1.1.1 The Skytrain system is a network of driverless trains serving Terminals 1, 2 and 3 at Changi Airport. The airport operator's Automated People Mover System Department (APMS) oversees the planning of the maintenance work schedule. A contractor engaged by the airport operator was tasked with the operations and maintenance of the trains in the Skytrain network, including the operations of the Skytrain Operations Command Centre (OCC) in Terminal 3 (T3). The Skytrain network includes one route between Station A1 and Station AS1 at the South Finger Building (SFB) of T3. The Skytrain service between these two stations runs on a track, known as the S1 track, which is parallel to the façade of T3 SFB.

1.1.2 The Skytrain tracks are in the form of a guideway on which the tyres of the trains move. The guideway is flanked by parapets (see **Figure 1**).

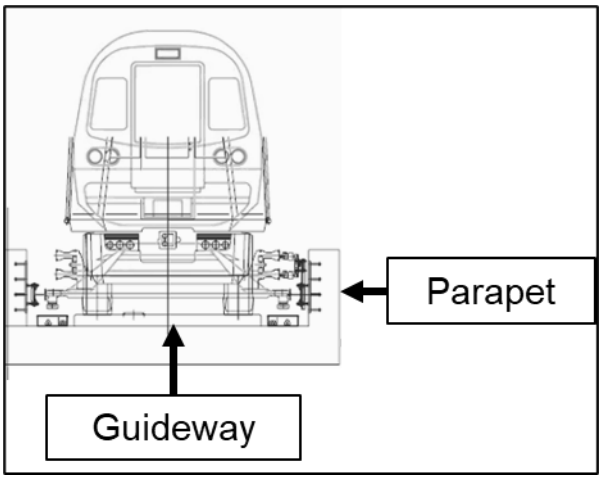


Figure 1: Typical cross-section of a track

1.1.3 A façade cleaning work at T3 SFB had been scheduled on 15 January 2024 between 0800 hours and 1500 hours. The work location corresponded approximately to the aircraft boarding gates A9 - A14 at T3 (see **Figure 2**).

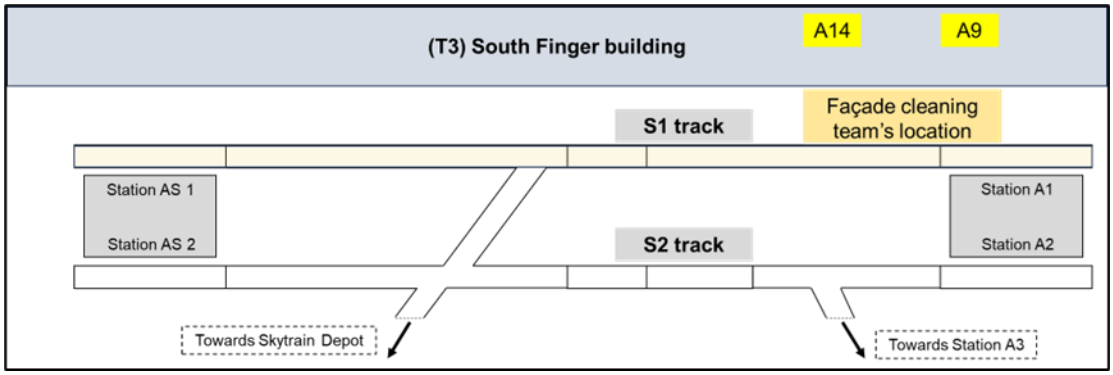


Figure 2: Location of facade cleaning work

1.1.4 The cleaning was to be carried out by a cleaning company contracted by the airport operator's Facilities Management Department (FM). The company's cleaning team comprised a cleaning supervisor and three cleaners. The cleaners would rappel down from the rooftop of T3 SFB and perform the façade cleaning work while being suspended on the rappelling ropes[1]. The cleaning supervisor would station himself at the rooftop to oversee the cleaning work (see **Figure 3**).

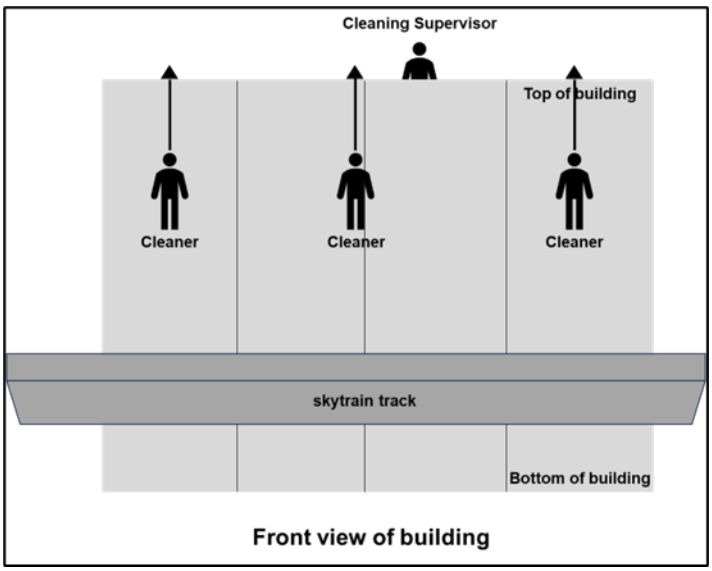


Figure 3: Cleaners suspended on rappelling ropes to perform cleaning work

[1] The cleaning team was accompanied by a rope access supervisor who oversaw the safety (in terms of working from height) of cleaners performing façade cleaning work while being suspended on the rappelling ropes.

The cleaning supervisor and the cleaners knew that at times the cleaners might have to step on or rest themselves on the parapet while doing the cleaning work (see **Figure 4**).

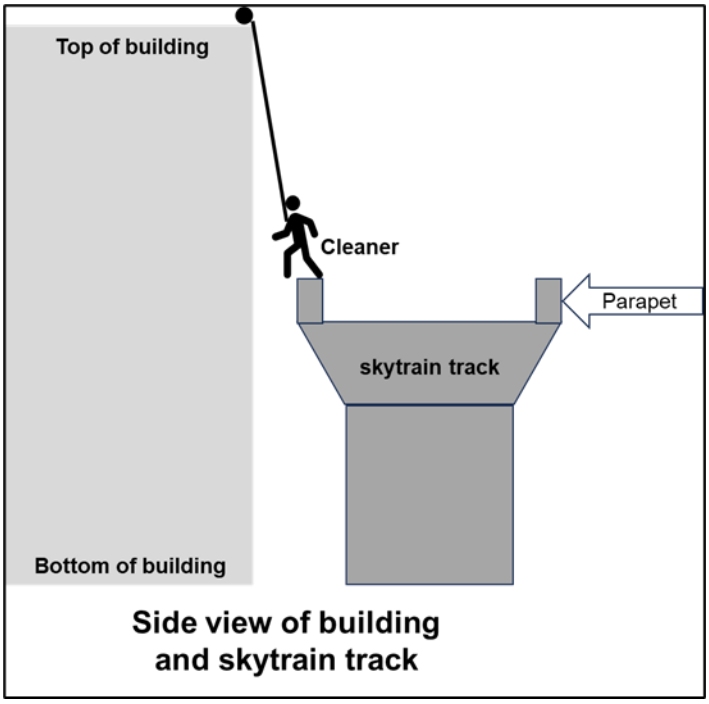


Figure 4: Cleaner stepping on the parapet

1.1.5 The cleaning supervisor did not consider that the façade cleaning work and the occasional stepping on the parapet of the guideway would constitute track access[2], but he was aware that the cleaning team would be working very close to the S1 track (the distance between T3 SFB and the parapet is about 0.6m). The cleaning supervisor was aware that all works (including façade cleaning works) within 6m of the outer edge of the parapet would need a work permit even if the works did not involve track access. Thus, he made an application to APMS for a work permit.

1.1.6 Before submitting the work permit application[3] (WPA) form for the façade cleaning work to OCC, the cleaning supervisor obtained an endorsement by FM[4] on the WPA form. After that, the cleaning supervisor submitted the WPA

[2] The airport operator did not specify in any document that stepping on the parapet would constitute track access.
[3] More on WPA in paragraph 1.6.
[4] FM personnel's endorsement on the WPA was to attest to OCC that the façade cleaning work was as planned by FM. The FM personnel was unaware that in the course of performing the façade cleaning, the cleaners might be stepping on the parapet of the guideway.

to OCC on 10 January 2024. The OCC duty controller of the day (hereinafter referred to as DC-A) approved the WPA[5]. He kept the approved WPA form in OCC for further processing on the day of the work. DC-A was aware that the cleaners would be rappelling down from the rooftop of T3 SFB to perform the façade cleaning work in close proximity to the Skytrain track but was not aware that the cleaners might be stepping on or resting themselves on the parapet during the cleaning work.

1.1.7 At about 0734 hours on 15 January 2024, the cleaning supervisor reported to OCC to book in for the façade cleaning work. The OCC duty controller of the day (hereinafter referred to as DC-B, a different person than DC-A) retrieved the WPA form kept in OCC by DC-A since 10 January 2024 to process the approval for their entry to the work location. Before approving the entry, DC-B asked the cleaning supervisor to mark on a supplementary form[6] (which showed a Skytrain track layout map) where the work location was. The cleaning supervisor indicated correctly the work location at T3 SFB. DC-B approved their entry to the work location on the WPA form[7]. DC-B was aware that the cleaners would be rappelling down from the rooftop of T3 SFB to perform the façade cleaning work in close proximity to the Skytrain track but was not aware that the cleaners might be stepping on or resting themselves on the parapet.

1.1.8 In approving the cleaning team's entry to the work location, DC-B also indicated on the WPA form that the S1 track's traction power needed to be switched off but that it was not necessary to install a short circuit device[8] (SCD). The safety precaution was in line with APMS's requirements (see paragraph 1.6.5). DC-B then went on to switch off the S1 track's traction power[9] and informed the cleaning team about this.

1.1.9 After obtaining the entry approval for the work location, the cleaning supervisor left the OCC to go to the work location. In the meantime, DC-B, whose shift duty ended at 0800 hours, handed over the shift duty to an incoming colleague

[5] The WPA form did not have a field for an applicant to indicate whether the work for which the WPA was being made would involve track access and there are differing accounts of this interaction between DC-A and cleaning supervisor over whether DC-A had asked the cleaning supervisor whether the work involved track access. More on this interaction in paragraph 2.3.1.
[6] More on supplementary form in paragraph 1.6.6.
[7] There are differing accounts of the interaction between DC-B and the cleaning supervisor, over whether DC-B had asked the cleaning supervisor whether the work involved track access. More on this interaction in paragraph 2.3.1.
[8] Typically, SCDs are installed to protect the work parties against premature restoration of traction power when works require working on the tracks. The installation of SCD provides an added safety assurance against electrical risk, in addition to the isolation of traction power.
[9] The switch for the S1 track's traction power is in OCC.

(hereinafter referred to as DC-C). DC-B conducted a handover briefing to DC-C and informed DC-C about the T3 SFB façade cleaning work in close proximity to the Skytrain track and that the work would not involve track access.

1.1.10 At 0800 hours, the cleaning team began the façade cleaning work at T3 SFB. The cleaning supervisor briefed the three cleaners before the start of the work about the hazards and risks involved in the façade cleaning work, including the hazards and risks of train movement and traction power when working near the Skytrain track.

1.1.11 At about 1145 hours, the cleaning supervisor received a phone call from DC-C informing that the façade cleaning work needed to stop for five minutes to allow for the shunting movement of a train from the T3 South Skytrain Depot Heavy Maintenance track (① in **Figure 5**) to Station A1 (② in **Figure 5**) and then to the T3 South Skytrain Depot Light Maintenance Track[10] (③ in **Figure 5**). The cleaning supervisor acknowledged the stop-work request from DC-C with an "OK" [11]. DC-C then ended the phone call with the cleaning supervisor[12].

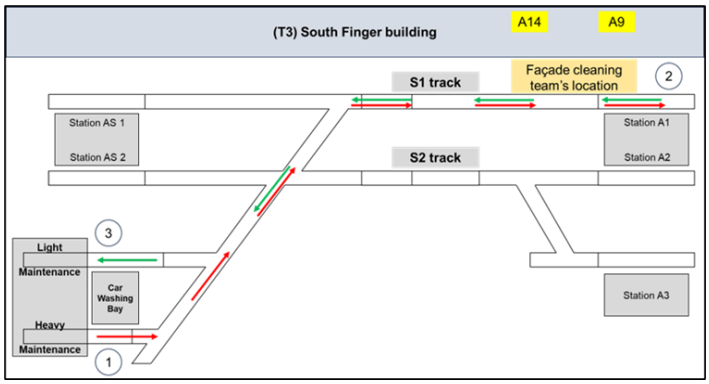


Figure 5: Train movement from ① to ② is shown by the red arrows, and that from ② to ③ by the green arrows

1.1.12 DC-C interpreted the cleaning supervisor's reply of "OK" as a confirmation on the latter's part that the work party had stopped work and cleared from the work location, and so DC-C proceeded to switch on the S1 track's traction power. Once the traction power was switched on, DC-C began the train's shunting

[10] The shunting movement was to facilitate the train to change end (i.e. change the direction of move).
[11] According to the cleaning supervisor, he expected to be given some time to stop the façade cleaning work and to clear the work party from the work location.
[12] There are differing accounts of the communication between DC-C and the cleaning supervisor. According to DC-C, before ending the phone call, she asked the cleaning supervisor whether the façade cleaning work had stopped and the work party had cleared from the work location. According to the cleaning supervisor, DC-C did not ask him. More on this communication in paragraph 2.1.1.

movement from the T3 South Skytrain Depot Heavy Maintenance track.

1.1.13 Meanwhile, the cleaning supervisor, after ending the phone call with DC-C, intended to make a phone call to one of the three cleaners to inform him to stop the façade cleaning work and clear from the work location in view of the impending train shunting movement. However, before the cleaning supervisor could make the phone call, the cleaning supervisor saw the train already moving towards the three cleaners, who were at that time standing on the S1 track's parapet (see **Figure 6**). The cleaning supervisor immediately shouted to the three cleaners to warn them about the approaching train.

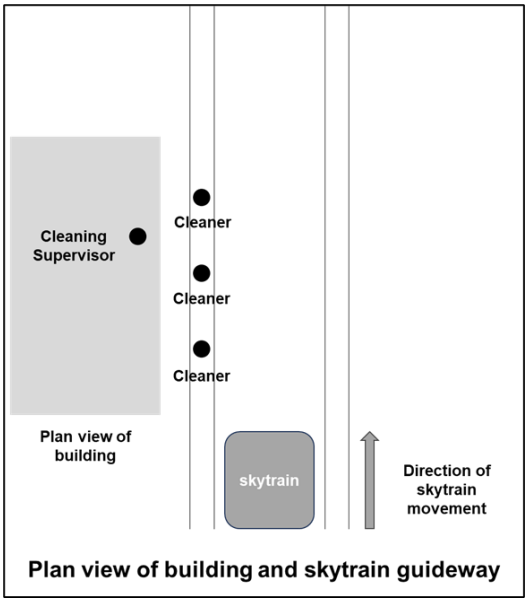


Figure 6: Positions of the cleaning supervisor, the three cleaners and the approaching train

1.1.14 The three cleaners took actions[13] to ensure they were not in the path of the moving train. After passing the location of the three cleaners, the train changed end at the Station A1 platform and proceeded back on the same S1 track to the T3 South Skytrain Depot Light Maintenance track.

1.1.15 After the train's shunting movement was completed, DC-C, unaware of the incident, proceeded to switch off the traction power to the S1 track, before calling the cleaning supervisor at 1150 hours to inform the latter that the train's shunting movement had ended. The cleaning supervisor did not inform DC-C

[13] Two of the cleaners jumped from the parapet onto the gap between the T3 SFB façade and the parapet, while the third cleaner leaned his body towards the T3 SFB façade while still standing on the parapet.

about the incident as the cleaning supervisor had the understanding that OCC had the authority to move the trains as and when required[14]. The façade cleaning team then continued their work. They finished the façade cleaning work and booked out at 1322 hours.

1.2 Injuries to persons

1.2.1 No one was injured in the incident.

1.3 Damage

1.3.1 No property was damaged in the incident.

1.4 Personnel information

1.4.1 The table below shows the number of years of service of the people involved, as well as their experience.

Personnel	Employment since	Length of service at time of incident	Years of experience
DC-C	June 2008	16 years	16 years
Cleaning supervisor	November 2015	9 years	2 years
Cleaner 1	May 2017	7 years	4 years
Cleaner 2	November 2015	9 years	4 years
Cleaner 3	December 2018	6 years	3 years

1.5 The cleaning company

1.5.1 The airport operator had been contracting out the cleaning of T3 to the cleaning company since 2018. The airport operator had never briefed its cleaning contractors about the Skytrain system and what would constitute track access.

1.5.2 On its part, the cleaning company had conducted a risk assessment for the cleaning work at T3, including the T3 SFB, and identified the following two hazards when its workers were working on or near a Skytrain track:

[14] On the reverse of the WPA form, it is mentioned that OCC reserves the rights to stop the work activity of a contractor at any time for safety/operational reasons.

(a) Being hit by a moving train; and

(b) Coming into contact with traction power.

However, the cleaning company had not identified stepping on the parapet as a hazard. According to the cleaning company, it did not consider that stepping on the parapet as a hazard and it had never been told by the airport operator that stepping on the parapet would constitute track access.

1.6 Work permit application

1.6.1 APMS controls the entry into the Skytrain tracks and maintenance areas. APMS requires contractors who are to carry out the following works to apply for a work permit from OCC[15]:

(a) Works involving track access

APMS considers that:

(1) working on a structural part of the Skytrain track constitutes track access; and

(2) the parapet of a Skytrain track is part of the Skytrain track structure and, thus, stepping on the parapet constitutes track access.

APMS requires a WPA to be made to OCC for works that involve track access. Such works are only allowed to be carried out during engineering hours, when there is no Skytrain service.

(b) Works not involving track access but within close proximity of the Skytrain track

APMS requires a WPA to be made to OCC for works within 6m from the outer edge of the parapet[16].

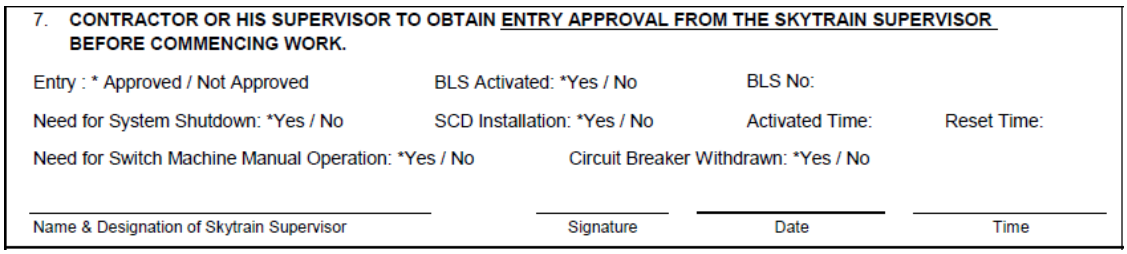
1.6.2 The WPA form did not have a field for an applicant to indicate whether the work

[15] This is so that OCC can make the necessary precautionary and coordination arrangements with other entities concerned to ensure that the works will be carried out safely.

[16] The APMS has taken into consideration the risk that tools, equipment or personnel could drop or slip onto the track when working within 6m from the outer edge of the parapet.

concerned would involve track access. There is no evidence that APMS had made it known to its contractors, either verbally or through documentation, what would constitute track access. APMS did not have a documented procedure requiring OCC duty controllers to ask the applicant whether the work concerned would involve track access or not.

1.6.3 In conjunction with the granting of entry approval, OCC duty controllers would need to indicate on the WPA form the safety precautions to be provided to a work party. A set of such safety precautions is in the WPA form (see **Figure 7**), e.g. whether to switch off a track's traction power, whether to install an SCD on a track.



7. **CONTRACTOR OR HIS SUPERVISOR TO OBTAIN ENTRY APPROVAL FROM THE SKYTRAIN SUPERVISOR BEFORE COMMENCING WORK.**

Entry : * Approved / Not Approved | BLS Activated: *Yes / No | BLS No:

Need for System Shutdown: *Yes / No | SCD Installation: *Yes / No | Activated Time: | Reset Time:

Need for Switch Machine Manual Operation: *Yes / No | Circuit Breaker Withdrawn: *Yes / No

Name & Designation of Skytrain Supervisor | Signature | Date | Time

Figure 7: List of safety precautions on WPA form

1.6.4 APMS expected OCC duty controllers to find out from the WPA applicant about track access and thereafter refer to the set of safety precautions in Figure 7 and with a view to determine the necessary safety precautions before granting the entry approval. This expectation was not reflected in any documented work procedure for OCC.

1.6.5 At the time of the incident, OCC required the following safety precautions when granting the entry approval:

(a) For works involving track access (to be carried out only during engineering hours), the traction power needed to be switched off and SCDs installed as safety precautions; and

(b) For works not involving track access but within 6m of the guideway, the traction power needed to be switched off as a safety precaution. However, SCDs were not required to be installed.

1.6.6 Also, in conjunction with the granting of entry approval, OCC duty controllers would ask an WPA applicant to indicate (e.g. by circling or shading) on a supplementary form the work location. OCC duty controllers would verify the

work location marked on the supplementary form against the work location as indicated on the WPA form. OCC duty controllers would establish if track access was involved in order to determine the necessary safety precautions to be provided.

2 ANALYSIS

The investigation looked into the following

(a) Communication between OCC duty controller and cleaning supervisor

(b) Meaning of track access

(c) Work permit application form

2.1 Communication between OCC duty controller and cleaning supervisor

2.1.1 DC-C had contacted the cleaning supervisor on his mobile phone to inform him of the train movement. According to DC-C, she asked the cleaning supervisor if the cleaning works had stopped temporarily to facilitate the train shunting, and the cleaning supervisor had replied “OK”, giving DC-C the impression that it was safe to re-energise the track briefly for the train shunting. However, according to the cleaning supervisor, he only acknowledged the stop-work request from DC-C with an “OK” and he expected to be given time to thereafter communicate with the cleaning team via his mobile phone to pass down the stop-work instruction. It is not known if the DC-C was aware of the cleaning supervisor’s need to call the cleaning team after her stop-work request to the cleaning supervisor. However, since DC-C had proceeded to re-energise the track immediately after the phone conversation, the cleaning supervisor did not have an opportunity to call the cleaning team. It could not be ascertained if the cleaning supervisor understood the information that DC-C conveyed to him or if he had heard the entire message from DC-C. The cleaning supervisor’s reply of “OK” to DC-C could have been to acknowledge the stop-work request to facilitate the train shunting movement, not in response to the question, as claimed by DC-C, on whether the cleaning team was clear from the work location. The investigation team opines that the near miss incident could have been prevented if DC-C had given the cleaning supervisor time to pass down the stop-work request to his cleaners or if the cleaning supervisor had informed the DC-C that he would need some time to stop the work and clear the party from the work location instead of replying with an “OK”.

2.1.2 It cannot be over-emphasised that proper communications between parties containing critical information should not be taken lightly. Appropriate safety communication protocols should be established between the OCC and the personnel working on site.

2.2 Meaning of track access

2.2.1 Works that involve track access could only be carried out at night during engineering hours, when there is no Skytrain service. The airport operator considers the parapet of a track as part of the track structure and, thus, stepping on the parapet constitutes track access. It was to the airport operator's credit that, even for work that did not involve track access, it exercised prudence by having control access for work within close proximity of the guideway (6m in this case) to mitigate the risk of tools, equipment or personnel dropping or slipping onto the track.

2.2.2 The airport operator did not state clearly to its contractors that standing on the parapet requires track access. A layman would not know that stepping on the parapet is considered as track access, given that trains do not travel on the parapet. The airport operator could have developed clearer guidance as reference for its contractors prior to the application of a work permit through the use of pictures or diagrams to indicate what constitutes track access.

2.3 Work permit application form

2.3.1 In the course of its investigation, the investigation team received differing accounts as to whether DC-A and DC-B had checked with the cleaning supervisor if the façade cleaning work would or would not involve track access. As mentioned in Footnotes 5 and 7 in paragraphs 1.1.6 and 1.1.7 respectively, according to DC-A and DC-B, they asked the cleaning supervisor whether the façade cleaning work would or would not involve track access and the cleaning supervisor indicated that the work would not involve track access. According to DC-B, the cleaning supervisor reiterated that the cleaning was only on the building façade and no track access was necessary. DC-B also did not query further as his understanding was that, if track access was required, the work would not have been scheduled to be carried out in the day. However, according to the cleaning supervisor, DC-A and DC-B did not ask him whether the work would or would not involve track access respectively.

2.3.2 Despite track access being an important consideration for APMS to decide whether a work task should only be carried out during engineering hours, the WPA form did not have a field to require an applicant to indicate whether the work concerned would involve track access or not. According to APMS, the WPA form had a "Remarks" field for contractors to record whether the work

concerned would involve track access or not. APMS relied on the OCC duty controllers to ask an applicant whether the work concerned would involve track access or not and believed that the set of safety precautions in the WPA form (see Figure 7 in paragraph 1.6.3) would be sufficient for OCC duty controllers to be prompted to ask the applicant. However, APMS did not have a procedure that would ensure that the OCC duty controllers would pose this question to the applicant. As there were differing accounts from the OCC duty controllers and the cleaning supervisor, it could not be determined if the OCC duty controllers involved had asked the cleaning supervisor the question. The investigation team opines that such conflicting accounts would not have arisen if the WPA form had a field that required the applicant to declare if track access was required and had a reminder to the OCC duty controllers to ask an explicit question on whether track access was required had been included.

2.3.3 As regards the supplementary form used by OCC duty controllers for verifying the work location marked on the supplementary form against the work location as indicated on the WPA form, APMS seems to believe that the marked work location on the supplementary form would help OCC duty controllers in establishing if track access was involved in order to determine the necessary safety precautions. The investigation team had difficulty appreciating how the marked work location could help OCC duty controllers to establish whether track access is involved. This incident has shown that the supplementary form system needs to be reviewed and improved in order to help OCC duty controllers in establishing whether track access was involved.

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 The cleaning supervisor had replied “OK” to DC-C over the impending train shunting movement and had not informed the DC-C that some time would be needed to stop the façade cleaning work and clear the work party from the work location. As a result, the DC-C proceeded to switch on the S1 track’s traction power and began the train movement. The three cleaners, who were standing on the parapet of the guideway, had to take actions to ensure they were not in the path of the train after noticing the approaching train.

3.2 The airport operator considered that stepping on the parapet would constitute track access but had never made this known to its cleaning contractors.

3.3 Track access is an important consideration for OCC to decide whether a work should only be carried out during engineering hours. The WPA form did not have a field asking an applicant to indicate whether the work concerned would involve track access. The supplementary form also did not prove to be helpful to OCC duty controllers in establishing whether track access is involved or not.

4 SAFETY ACTIONS

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

4.1 APMS had completed a review of its existing safety assurance system for works within 6m of a Skytrain track and its standard operating procedures for the startup and shutdown of the Skytrain track concerned. The changes made include the following:

(a) Any work within 6m of a Skytrain track is now treated as work requiring track access and thus can only be carried out during engineering hours, when there is no train movement.

(b) The WPA form has been revised to include a photograph of a typical guideway, which shows that parapets are part of a guideway.

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.

It is recommended that:

5.1 The airport operator brief its contractors to ensure that they are aware of and understand the airport environment, in particular the hazards that they may be exposed to when performing works on or in proximity to the Skytrain track. [TSIB Recommendation RR-2025-001]

5.2 The airport operator establish, for its work permit granting process, a mechanism that is documented to ensure that its personnel ask its contractors where works are to be performed in relation to the Skytrain track. [TSIB Recommendation RR-2025-002]