

Joint News Release

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Weak Electrical Resistance of Third Rail Insulator the Root Cause of the 7 July 2015 Rail Service Disruption

The Land Transport Authority (LTA) and SMRT Corporation (SMRT) have ascertained the cause of the rail service disruption on the North-South and East-West Lines (NSEWL) that occurred in the evening of 7 July 2015.

2. The disruption was caused by intermittent tripping of the rail power system at multiple locations, due to the lower electrical resistance pathway at a third rail¹ insulator. When functioning properly, the third rail insulators insulate the electrified third rail from the ground and ensure that the electricity from the third rail only flows to the trains via the trains' current collector shoes.

3. However, the weak resistance of an insulator can allow electricity to flow through the insulator to the ground, resulting in a higher than normal voltage difference between the running rail (which has a negative voltage relative to the ground) and the ground. This higher than normal voltage difference, which was exacerbated by the movement of the trains, resulted in the activation of the 64P² safety mechanism at multiple locations in the network. The activation of the 64P safety mechanism is what tripped the power system.

System-Wide Checks Conducted

4. LTA and SMRT, together with specialists from Parsons Brinckerhoff and Meidensha Corporation³, have carried out comprehensive system-wide checks across more than 200 km of train track and components such as the third rail, power cables and the signalling system to identify the root cause of the disruption. These included checks

¹ The third rail supplies electrical power to the trains; while the running rail is the surface on which the train wheels run and through which the electricity "returns" to the source to complete the circuit.

² The 64P, or the Touch Voltage Protection Relay, a safety feature on the NSEWL network, is used in rail systems all over the world. The 64P is activated when the voltage difference between the running rail and the ground becomes too high.

³ On 14 July 2015, LTA appointed a team of five experts from Sweden's Parsons Brinckerhoff and Japan's Meidensha Corporation to identify the root cause of the power trip and propose areas for improvement to prevent recurrence.

on individual components. The team also checked all the 141 trains and analysed train logs from the day of the incident.

5. These checks and trackside investigations found that a confluence of factors had triggered the incident. In the stretch of tunnel between Tanjong Pagar and Raffles Place, water was found to be dripping onto the third rail cover near an insulator. Test results on the sample residue from the third rail cover, and on water collected from the tunnel leak, found mineral deposits with high chloride content. The presence of chloride on the insulator, coupled with a wet environment, would have significantly reduced the effectiveness of the insulator.

6. The specialists from Parsons Brinckerhoff and Meidensha Corporation concur with these conclusions on the root cause of the disruption.

Change-out of Insulators and Installation of Permanent Data Loggers

7. SMRT has combed through the NSEWL tunnels to ensure that there are no other leaks with water dripping onto trackside installation. To minimise the possibility of a similar recurrence, SMRT has also started progressively replacing all the third rail insulators, starting with the insulators which have shown signs of electrical resistance weakness. The remaining insulators will be changed as part of the ongoing planned renewal of the third rail system, to be completed by the first quarter of 2017.

8. To better monitor the condition of the insulators, SMRT will be installing data loggers at all 47 traction power substations on the NSEWL within the next two months. The 64P setting will also be raised from the current 136V to 200V which will make the network less susceptible to such power trips. The 200V setting is in line with international standards, and the setting on our newer MRT lines like the Circle and Downtown Lines⁴. Commuter safety is not compromised.

9. These measures will be monitored closely by the LTA-SMRT Joint Team⁵.

⁴ The 64P on the CCL and DTL are set such that if 200V is sustained at 0.1 seconds, the power will trip.

⁵ The LTA-SMRT Joint Team was formed in June 2012 with the task of improving the reliability of the rail lines operated by SMRT.