



TTC Top Risks Update - Exposure to Internal Combustion Engine Gases in Subway Tunnel

Date: July 10, 2018
To: Audit and Risk Management Committee
From: Chief Safety Officer

Summary

The TTC has identified the risk associated with the use of internal combustion engine gases in the subway tunnel as a Corporate Risk. The TTC uses internal combustion engines in the subway tunnel during maintenance activities to provide traction power for a number of workcars, portable tools, and auxiliary power units mounted on several flatbed workcars. These engines are powered primarily by diesel fuel; however, gasoline and propane are also used as a fuel in limited applications. The operation of internal combustion engines in an enclosed work area may result in hazardous exposure to exhaust gases, including carbon monoxide and nitrogen dioxide.

The attachments contain a full analysis of the risk of Exposure to Internal Combustion Engine Gases in Subway Tunnel.

Recommendations

It is recommended that:

1. The TTC Audit and Risk Management Committee receive the report for information.

Financial Summary

This report has no financial impact. Ultimately Enterprise Risk Management (ERM) will be used to prioritize funding requirements. The business case process will be used should additional resources be required.

The Chief Financial Officer has reviewed this report and agrees with the financial impact information.

Equity/Accessibility Matters

This report has no equity or accessibility issues.

Decision History

On December 13, 2017, the Risk Management Office presented the list of Corporate Risks to the TTC's Audit and Risk Management Committee (ARMC). During discussion, interest was expressed to receive further details regarding the risks identified in the list.

Issue Background

The TTC applies ERM to support the achievement of its five-year Corporate Plan. The TTC uses a structured approach for the identification, assessment and treatment of risk.

The TTC has identified 56 Corporate Risks that represent the highest risks facing the organization and which comprise the TTC's Corporate Risk Register. All will benefit from in depth assessment, risk mitigation and review by the TTC's internal Executive Committees as well as the ARMC.

Comments

On February 7, 2006, eight TTC employees were exposed to high concentrations of carbon monoxide while working on tunnel maintenance just north of Eglinton Station. They were rescued by Toronto Fire Services and taken to hospitals by Emergency Medical Services. Four firefighters were also treated and released. On December 12, 2007, the TTC pleaded guilty and was fined for failing to take reasonable steps for the protection of a worker.

Gasoline powered engines generate higher levels of carbon monoxide than comparable diesel powered equipment. For this reason, the TTC Subway Infrastructure Department has significantly reduced the use of gasoline powered equipment in the subway tunnel. Technical challenges exist to replace gasoline powered rail saws and impact guns. However, efforts are underway to source alternative technology and control the use of the exceptions. It is not currently practical to replace diesel or propane powered equipment, consequently, the TTC must rely on engineering and administrative controls to limit the exposure of employees to carbon monoxide and nitrogen dioxide while they are working in the subway tunnel.

Work crews using internal combustion engines in the subway tunnel monitor the levels of both carbon monoxide and nitrogen dioxide in their work zone. The sensors incorporate two stages of alarm. At the second stage alarm, employees are required to shut off the equipment and leave the immediate work area. The alarmed sensors are a critical control to provide advanced warning that gases are accumulating to dangerous levels. For this reason, through a centralized web based computer monitoring system, the monitors are required to be closely managed to ensure that they are properly

calibrated and maintained. Corporate and departmental portable gas monitor standard operating procedures (SOPs) have been reviewed and updated, enforcement expectations have been incorporated into safety and rules compliance checks. As a refresher, June 2018 safety meetings have covered the hazardous gas monitoring topic throughout the entire Subway Infrastructure Department. A designated co-ordinator has been assigned for the gas monitors and a new staff orientation manual/program is set to commence in June 2018.

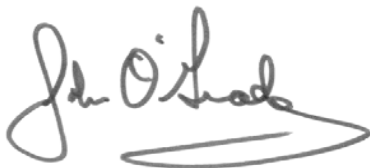
The engineering controls the TTC has in place focus on the use of diesel oxidation catalytic converters (DOC's) to help reduce carbon monoxide emissions from the diesel workcars. With a few exceptions, TTC's entire fleet of diesel workcars is equipped with DOC's. The exceptions are for diesel workcars that do not operate in the tunnel environment (push snow throwers, for example) or self-propelled snow throwers that see occasional service in the tunnel using other attached equipment. The TTC is in the process of equipping these exceptions with DOC's. A project is also currently underway to upgrade this equipment with technology better suited to TTC's operational requirements. New workcar procurements and rebuilds specify that the latest emissions control technology be incorporated not only to control carbon monoxide but also nitrogen dioxide. Portable diesel powered tools used in the subway tunnel are currently being upgraded to include emission controls.

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John O'Grady
Chief Safety Officer

Attachments

Attachment 1 - Risk Summary: Exposure to Internal Combustion Engine Gases in Subway Tunnel

Attachment 2 - Presentation: Exposure to Internal Combustion Engine Gases in Subway Tunnel

TTC Risk Summary & Listing

Exposure to internal combustion engine gases in subway tunnel

RISK IDENTIFICATION		TTCRK16040018
Register Subway Infrastructure	Risk Owner Head of Subway Infrastructure	
Description		
<p>The TTC uses internal combustion engines in the subway tunnel during maintenance activities to provide traction power for a number of workcars, portable tools, and auxiliary power units mounted on several flatbed workcars. These engines are powered primarily by diesel fuel; however, gasoline and propane are also used as a fuel in limited applications.</p> <p>The operation of internal combustion engines in an enclosed work area may result in hazardous exposure to exhaust gases, including carbon monoxide and nitrogen dioxide. Unconsciousness and death may result from carbon monoxide overexposure as the concentration in the bloodstream rises. On February 7, 2006, Track and Structure Man-Made Mineral Fibre (MMMF) insulation removal crew employees were overcome by carbon monoxide during subway maintenance activities. Eight employees were taken to hospital as were four Toronto Fire Service (TFS) employees involved in the rescue. In this case, the TTC pleaded guilty to failing to properly ventilate the carbon monoxide produced by the gas-powered equipment.</p>		

RISK MITIGATION	
<p>Gasoline powered engines generate higher levels of carbon monoxide than comparable diesel powered equipment. For this reason, the TTC Subway Infrastructure Department has significantly reduced the use of gasoline powered equipment in the subway tunnel. Technical challenges exist to replace gasoline powered rail saws and impact guns; however, efforts are underway to source alternative technology and control the use of the exceptions. Regulation 833, Control of Exposure to Biological or Chemical Agents specifies the exposure limits that the TTC must adhere to.</p> <p>Before crews carry out their work assignment in the subway tunnel, the work is planned by the crew's foreperson. The Subway Infrastructure Production Planner(s) then examines the work plan to ensure that the necessary measures to protect workers from internal combustion engine gases (such as workcar placement and ventilation requirements) have been considered.</p> <p>Prior to the crews commencing work, the Track Access Controller (situated in the Transit Control Center) ensures, based on the approved work plan, that the required ventilation fans have been activated. A fan ventilation protocol is in place at Transit Control outlining the proper configuration of the various fans and dampers.</p> <p>Work crews using internal combustion engines in the subway tunnel monitor the levels of both carbon monoxide and nitrogen dioxide in their work zone. The sensors incorporate two stages of alarm. At the second stage alarm, employees are required to shut off the equipment and leave</p>	

RISK ASSESSMENT						
	Minimal	Minor	Moderate	Major	Catastrophic	Disastrous
Frequent						
Probable						
Occasional						
Remote						
Improbable						
	Residual		Current		Inherent	
Assessment Type		Likelihood	Impact	Risk Score		
Inherent Overall Assessment		Frequent	Catastrophic (I)	192		
Residual Overall Assessment		Remote	Catastrophic (I)	24		
Current Risk Score				49		

TTC Risk Summary & Listing

Exposure to internal combustion engine gases in subway tunnel

the immediate work area and monitor until the levels decrease to below the low level alarm level.

During the use of propane powered equipment, the work zone is monitored using a sensor which is also capable of measuring the explosive limits of propane.

The monitors are a critical control to provide advanced warning that gases are accumulating to dangerous levels. For this reason, through a centralized web based system, the monitors are required to be closely managed to ensure that they are properly calibrated and maintained. After use, these sensors are returned by the work crews to their docking stations where the instruments download their data, recharge and undergo “ bump” and calibration tests. These monitoring results are reported daily to Supervisory, group safety personnel and the administrator of the iNet program.

Corporate and departmental portable gas monitor standard operating procedures (SOPs) have been reviewed and updated, enforcement expectations have been incorporated into safety and rules compliance checks. As a refresher, June 2018 safety meetings have covered the hazardous gas monitoring topic throughout the entire Subway Infrastructure Department. A designated co-ordinator has been assigned for the gas monitors and a new staff orientation manual/program is set to commence in June 2018.

The engineering controls that the TTC has in place focus on the use of diesel oxidation catalytic converters (DOC’ s) to help reduce carbon monoxide emissions from the diesel workcars. With a few exceptions, the TTC’ s entire fleet of diesel workcars is equipped with DOC’ s. The exceptions are for diesel workcars that do not operate in the tunnel environment (push snow throwers, for example) or self-propelled snow throwers that see occasional service in the tunnel using other attached equipment. The TTC is in the process of equipping these exceptions with DOC’ s. A project is also currently underway to upgrade this equipment with technology better suited to TTC’ s operational requirements. New workcar procurements and rebuilds specify that the latest emissions control technology be incorporated not only to control carbon monoxide but also nitrogen dioxide. Portable powered tools used in the subway tunnel are currently being upgraded to include emission controls.

AREAS ASSESSED
Emissions from workcars
Emissions from portable tools
Emissions from workcar aux power units and gensets



Exposure to Internal Combustion Engine Gases in Subway Tunnel

Fort Monaco,
Head of Subway Infrastructure (Acting)

July 10, 2018



| Background

The TTC uses internal combustion engines in the subway tunnel during maintenance activities to provide traction power for a number of workcars, portable tools, and auxiliary power units mounted on several flatbed workcars. These engines are powered primarily by diesel fuel; however, gasoline and propane is also used as a fuel in limited applications.



| Background

The exhaust gases which are emitted as a result of the combustion of fuel can be hazardous. For example, internal combustion engines can cause high levels of carbon monoxide in enclosed work areas, such as a subway tunnel.



| History

On February 7, 2006, Track and Structure Man-Made Mineral Fibre (MMMMF) insulation removal crew employees were overcome by carbon monoxide during subway maintenance activities. Eight employees were taken to hospital as were four Toronto Fire Service (TFS) employees involved in the rescue.

Risk Assessment

Subway Infrastructure Department (SI) staff has worked with the TTC Risk Management Office (RMO) to identify and examine the controls in place and the controls which are needed to mitigate the hazards associated with internal combustion engine gases.

In addition to the work of the RMO, Internal Audit also looked closely at the compliance of specific controls. For example, it was identified that more rigorous enforcement of portable gas monitor usage and scrutiny of high alarm incidents was required to ensure track level worker exposure to hazardous gases is minimized.

| Actions

A new position referred to as the Track Access Controller was introduced to Transit Control. This position is responsible for ensuring that the required ventilation is provided in the subway tunnel. The Controllers also conduct site-specific quality assurance audits to verify that gas monitoring is available at the work location.

A Visual Work Planning Tool is also in development that will allow the Track Access Controller to determine the availability of fans and dampers.



| Actions Continued

Diesel workcars, aux power units and permanently fixed diesel gensets operating in the subway tunnel are already equipped with controls designed to reduce the emissions of carbon monoxide. However, a project is currently underway to upgrade this equipment with technology better suited to TTC's operational requirements.

Portable powered tools used in the subway tunnel are currently being upgraded to include emission controls.

Awareness and Training

- Corporate and departmental portable gas monitor standard operating procedures (SOPs) have been reviewed and updated. Enforcement expectations have been incorporated into safety and rules compliance checks.
- As a refresher, June 2018 safety meetings have covered the hazardous gas monitoring topic throughout the entire SI Department;
- A designated co-ordinator has been assigned for the gas monitors.
- A new staff orientation manual/program is set to commence in June 2018.



Risk Assessment Summary

