



Office of the Auditor General

Review of OC Transpo Bus Maintenance

Tabled at Audit Committee

October 27, 2020



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Acknowledgements

The team responsible for this review, comprised of staff from Virtus Consulting Inc., under the supervision of Ed Miner, Deputy Auditor General and the direction of Ken Hughes, Auditor General, would like to thank those individuals who contributed to this project, and particularly, those who provided insights and comments as part of this review.

Original signed by:

Auditor General

Executive summary

Purpose

This review was conducted as a result of a report to the Fraud and Waste Hotline. It assessed OC Transpo Bus Maintenance related to the safety of the bus fleet.

Background and rationale

Transit Fleet and Facilities Maintenance manages, maintains and ensures the upkeep of approximately 1,000 buses by providing regular and preventative maintenance to optimize the service life of OC Transpo's fleet. This includes:

- Annual and semi-annual legislative (Ontario Ministry of Transportation) and preventative maintenance inspections;
- Daily visual inspections;
- Unplanned repairs; and
- Warranty recovery and capital works.

These services are provided by approximately 225 mechanics at four maintenance facilities across the City. Maintenance activities are also carried out by third-party garages under contract.

Bus maintenance is managed and tracked through the FleetFocus M5 maintenance system (M5). Specifically, M5 tracks and forecasts annual, semi-annual and 60-day inspections, manufacturer scheduled maintenance, OC Transpo identified repairs, purchases of components and schedules campaign and recall requirements. M5 is also linked to the Equipment Master System (EQMS) which identifies buses available for service.

The Ontario Ministry of Transportation (MTO) conducts recurring audits of the OC Transpo fleet of buses.

Findings

The review focused on bus maintenance inspection and maintenance practices. The key findings associated with each area are as follows:

1. **MTO Legislated Inspections:** Inspections conducted by OC Transpo, on the due dates required by MTO, are occurring for the most part. However, some exceptions were noted.
2. **OC Transpo 60-day Inspections:** 60-day Inspections are occurring on time for the most part. However, some exceptions were noted.
3. **Cost-Benefit Analysis:** OC Transpo has not performed a full cost-benefit analysis of its 60-day inspection process.
4. **Inspections Conducted by MTO:** Inspections conducted by MTO show a very high degree of compliance: 100% compliance in 2018 and an 86% compliance in 2019, providing supporting evidence that required bus maintenance is occurring.
5. **Riskmaster Data:** 2015-19 preventable collisions data in Riskmaster indicates that almost all preventable collisions were from driver error and not mechanical failure.
6. **Work Order Due Dates:** While open work orders on defects and campaigns are closely monitored, they are not always updated to reflect revised desired dates of completion.
7. **Work Order Overrides/Suspensions:** OC Transpo does not track, trend or analyze overrides and suspensions of work orders. Explanations of the nature, reasons and originator of the overrides/suspensions could not be provided.
8. **Management Information:** Key management information exists and is provided at all management levels.

Conclusion

Bus collisions are occurring as a result of driver error and not mechanical failure, indicating that bus maintenance is being well managed regarding the safety of the bus fleet. Inspections conducted by MTO indicate high compliance on the part of OC Transpo supporting that required bus maintenance is occurring. Both MTO legislated and OC Transpo 60-day inspections are occurring, with minor exceptions.

The implementation of the recommendations made in this report will help OC Transpo address issues relating to ensuring work orders have desired due dates reflected in the system, ensuring controls are in place to set accurate inspection due dates and identifying inspections that are past due, monitoring appropriateness of overrides and suspensions of work orders and ensuring that OC Transpo is receiving maximum benefits for the cost of its inspection programs.

Potential savings

Potential savings are available to OC Transpo if it conducts a cost-benefit analysis of its current approach and interval for “60-Day” inspections.

Recommendations and responses

Recommendation #1

That the City implement controls and monitoring to ensure that all inspections are performed by their required due date for all in-service buses.

Management response:

Management agrees with the recommendation and it has been implemented.

The M5 system interface was modified so that it now automatically populates necessary dates. The EQMS system was also reconfigured to automatically flag buses overdue for annual or semi-annual inspections.

OC Transpo’s Transit Fleet and Facilities Maintenance Reliability Team has run manual reports generated by the M5 system, since the issue was identified in late 2019, to ensure that all dates are correctly tracked in the system and that no buses are overdue for inspections.

As the Auditor General has noted, over the last two years there was only a 0.3% (12 out of 3,600 incidents) incidence rate of buses entering service while overdue for inspection. Nevertheless, staff are committed to making the necessary improvements to ensure compliance with requirements and the manufacturer’s guidelines and to ensure the safety of our staff and customers.

Recommendation #2

That the City implement changes to M5, together with supporting procedures, to ensure that correct due dates are set for annual and semi-annual inspections.

Management response:

Management agrees with the recommendation.

The M5 system was not properly updating scheduled inspection dates to ensure that inspections occurred no more than six months apart. An analysis revealed an issue where the system failed to link the dates of scheduled inspections with different inspection codes. To correct the issue, staff have changed the way inspections are input into the system so that now only one type of inspection code is used. This change is being piloted on one type of bus in the fleet. At the end of 2020, the effects will be reviewed and, if the change consistently resolves the issue of incorrect dates, the adjustment will be made throughout the fleet.

As part of ongoing supporting procedures, since the issue was identified in late 2019, OC Transpo's Transit Fleet and Facilities Maintenance Reliability Team have manually reviewed a monthly report produced by the M5 system to ensure that the annual and semi-annual inspection due dates are correct in the system. This procedure will continue as part of OC Transpo's commitment to ensure that correct due dates are established for inspections.

Recommendation #3

That the City identify the key controls that it believes to be functioning in M5 and EQMS and verify that they are functioning as expected.

Management response:

Management agrees with the recommendation and it has been implemented.

As of July 2020, the key features in M5 and EQMS were identified and validated by IT staff within OC Transpo. After changes were made to the EQMS system, they were validated to ensure they were functioning as expected.

As noted above, since the issue was identified in late 2019, OC Transpo's Transit Fleet and Facilities Maintenance Reliability Team reviews a manual report of required inspections on a monthly basis to ensure that key controls are functioning in M5 and EQMS.

Recommendation #4

That the City undertake a cost-benefit analysis of its Preventative Maintenance “A” (PMA) inspection program to ensure that it is cost-effective and optimized.

Management response:

Management agrees with the recommendation that a cost benefit analysis is important to ensure that the PMA inspections are effective.

The PMA process is constantly being reviewed and renewed as new fleet types are purchased by the City. With each new fleet type that OC Transpo purchases, an evaluation of the vehicle maintenance needs is completed to determine the appropriate inspection regime. OC Transpo aligns its preventative maintenance schedule with the original equipment manufacturer (OEM) maintenance timelines. The PMA process provides OC Transpo with the flexibility to schedule additional inspections that may be necessary to satisfy warranty requirements with the OEM. Failure to meet those requirements could result in voided warranties and increased costs to the City. As a result, retaining some form of supplemental inspection process will always be necessary.

OC Transpo’s Transit Fleet and Facilities Maintenance team will continue to look for opportunities to increase efficiency of its preventative maintenance programs to ensure cost effectiveness.

Recommendation #5

That the City implement practices and procedures to review outstanding work orders and revise desired dates of completion where appropriate.

Management response:

Management agrees with the recommendation and it has been implemented.

Starting in December of 2019, a monthly manual review process of outstanding work order requests has been put into place. A Reliability Analyst position has been created and staffed to ensure the proper oversight and prioritization of this process.

Recommendation #6

That the City track and analyze overrides and suspension of bus maintenance work orders.

Management response:

Management agrees with the recommendation.

OC Transpo's Maintenance Supervisory team, who are certified 310T mechanics, currently review and determine if a work order can be safely suspended and the work rescheduled. The safety of OC Transpo's staff and customers is the primary consideration when making such a determination.

Currently M5 only has the ability to track and report on the numbers of overrides and suspensions of work orders. Staff have contacted Assetworks, the M5 vendor, to request a feature that will require staff to supply a rationale for all overrides and suspensions. Creating a rationale requirement would enable more comprehensive tracking and analysis of overrides and suspensions over time. Based on our past experience of requesting upgrades from this vendor, we anticipate that introducing such a feature could require a minimum of twelve months to design and implement. Therefore, implementation is anticipated by Q3 2021.

Detailed review report

Introduction

As a result of a Fraud and Waste Hotline report, the Office of the Auditor General (OAG) conducted a review of OC Transpo Bus Maintenance as it related to the safety of the bus fleet.

Background and context

Transit Fleet and Facilities Maintenance manages, maintains and ensures the upkeep of approximately 1,000 buses by providing regular and preventative maintenance to optimize the service life of OC Transpo's fleet. This includes:

- Annual and semi-annual inspections legislated by the Ontario Ministry of Transportation (MTO);
- OC Transpo 60-day preventative maintenance inspections;
- Daily visual inspections;
- Unplanned repairs; and
- Warranty recovery and capital works.

These services are provided by approximately 225 mechanics at four maintenance facilities across the city. Maintenance activities are also carried out by third-party garages under contract.

Bus maintenance is managed and tracked through the City's FleetFocus M5 maintenance system (M5). Specifically, M5 tracks and forecasts annual, semi-annual and 60-day inspections, manufacturer scheduled maintenance, OC Transpo identified repairs, purchases of all components and schedules campaign and recall requirements.

M5 interfaces with EQMS, OC Transpo's vehicle parking management system. EQMS determines the availability of buses for assignment into service. This determination is impacted by whether M5 indicates that work orders are still open or if critical work is required to be completed on the bus.

The MTO also conducts recurring audits of OC Transpo's fleet of buses.

Riskmaster Accelerator (Riskmaster) is a program used by the City, including OC Transpo. The system is used to input collisions and incidents (any damage to or involving a vehicle) information and investigative notes for a rating rationale. Fleet

Safety Action Point Registry (Action Point) is a database that tracks and rates the preventable collisions which have been identified in Riskmaster. Action Point also maintains the driver safety profile for operators involved in a preventable collision.

Review objectives and criteria

The overall objective of this review is to assess the City's management practices over OC Transpo bus maintenance related to the safety of the bus fleet. Other aspects of bus maintenance, such as the efficiency of operations, are not being assessed.

This overall objective was comprised of the following two review objectives:

Review objective #1

Assess the controls that ensure bus inspections occur on a timely basis and appropriate follow-up action occurs.

Criteria:

- Compliance with regular, annual, semi-annual and 60-day bus inspection requirements
- Bus inspection findings are followed up and corrective action taken

Review objective #2

Assess the controls to ensure that planned and unplanned bus maintenance occurs on a timely basis and appropriate follow-up action occurs.

- Scheduled preventative maintenance is performed on a timely basis
- Bus repairs, defects and recalls are identified and acted upon on a timely basis
- Practices exist to monitor and assess the effectiveness of bus maintenance

Scope

The scope of the review included an examination of bus maintenance inspection and maintenance practices and data over the period from 2017 to 2019 including:

- M5 data;
- Bus inspection practices for annual, semi-annual and 60-day bus inspection requirements;
- Bus repair, defect and recall practices;
- Management information and bus inspection and maintenance dashboards;

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- Accident information from Riskmaster over the period 2015 to 2019; and
- Accident information from Action Point.

Excluded from the scope of our review are the procedures to collect and maintain the information in Riskmaster and Action Point. Although we used data from Riskmaster and Action Point, we did not test or audit them.

Review approach and methodology

The review methodology includes the following activities:

- Interviews and process walkthroughs with City staff involved in bus maintenance;
- Data extractions and review of information from M5;
- Review and testing of relevant documentation, e.g. inspections, work orders, MTO audits; and
- Tour of one of the maintenance garage facilities.

The review plan was finalized in October 2019, and the review fieldwork was substantially completed by December 31, 2019.

Review observations and recommendations

Review Objective #1

Assess the controls that ensure bus inspections occur on a timely basis and appropriate follow-up action occurs.

MTO legislated inspections

The Ontario Highway Traffic Act (HTA) requires that bus operators such as OC Transpo have each of their vehicles inspected semi-annually by a licensed motor-vehicle inspection mechanic. The mechanic checks to ensure that the buses comply with all maintenance requirements and component performance standards detailed in the applicable regulations and schedules of the HTA.

Consistent with the HTA, the City's Maintenance Statement states, *"In order to comply with the maintenance standards required by the Highway Traffic Act of Ontario, section 107, the City of Ottawa adopts the following inspection criteria and frequency of inspection...Buses and Accessible Vehicles will be inspected on an Annual and Semi-Annual frequency."*

OC Transpo schedules and tracks, in M5, the semi-annual inspections and the more detailed annual inspections. These are to be completed before a bus is put into service. Each of the four OC Transpo maintenance locations has OC Transpo licensed bus mechanics, under the supervision of licensed supervisors, who have been delegated MTO safety signing authority. These mechanics and supervisors, under their delegated MTO safety signing authority, are responsible for performing the mandated inspections required by MTO. A team of OC Transpo analysts track the inspections being completed, the average time the work takes, and the hours spent on each type of inspection. MTO inspections are required to be completed in the calendar month during which the inspection is due, or the vehicle cannot be used for service.

As such, we expected to see controls that ensure bus inspections occur on a timely basis and appropriate follow-up actions occur. We found that inspections are occurring, for the most part, on or before the due dates required by MTO. In addition, the status of MTO mandated inspections are reported to OC Transpo management on a regular basis. However, we found 12 exceptions over the last two years where a bus was in-service past the due date of its inspection and, therefore, not compliant with MTO requirements. These cases were due to:

- A control feature within the EQMS system was not working as expected. We were told by management that M5 would automatically “flag” in the system when a bus inspection due date had passed, and that once flagged, the bus was not available for service. This control was not working. As a work around, staff on site were manually flagging buses as being unavailable for service. However, on five occasions, the manual intervention failed to flag buses that were past due.
- M5 did not set the correct due dates for annual and semi-annual inspections. This resulted in 374 instances where the inspection due date was set too late. Given that there is a “grace period” up to month-end to complete an MTO required inspection, most of these inspections were completed on time. However, we found seven cases where a bus was in-service past the allowable month-end grace period (i.e. the following month).

OC Transpo 60-Day inspections

In addition to the MTO mandated inspections, OC Transpo also inspects buses every 60 days. These inspections are referred to as Preventive Maintenance "A" (PMA) inspections and have been in place for more than 10 years. PMAs are designed by OC Transpo’s engineering team based on manufacturer’s recommendations and the bundling of work for efficiency. The 60-day interval was set to optimize the number of

visits a bus has to the garage for the non-legislative preventative maintenance work. Operationally, the PMAs have a 30-day grace period subsequent to the 60 days within which the PMA is to be completed. This grace period allows for workforce and workload deviations, inclement weather events, defect volumes, fleet defects and acute service requirement increases.

We expected to find PMAs completed on a timely basis. We found that most PMAs were occurring on time and that the compliance with the 60 days requirement and the 30-day grace period is monitored daily by management. However, 1,056 PMAs (roughly 10% of all PMAs), over the last two years, were not completed within 90 days as required. That said, as at December 16, 2019, there was only one PMA past the 90-day mark.

We also expected to find a cost-benefit analysis for performing the PMA at the 60-day interval as opposed to some other time interval or basis of inspection (example kilometres driven). OC Transpo, however, has not performed such an analysis of the PMA inspection process. OC Transpo management informed us that they do question the costs and benefits of the current PMA approach and recognize that there may be an opportunity to tailor the inspection process to the individual fleet types and on a basis other than time.

Recommendation #1

That the City implement controls and monitoring to ensure that all inspections are performed by their required due date for all in-service buses.

Management response:

Management agrees with the recommendation and it has been implemented.

The M5 system interface was modified so that it now automatically populates necessary dates. The EQMS system was also reconfigured to automatically flag buses overdue for annual or semi-annual inspections.

OC Transpo's Transit Fleet and Facilities Maintenance Reliability Team has run manual reports generated by the M5 system, since the issue was identified in late 2019, to ensure that all dates are correctly tracked in the system and that no buses are overdue for inspections.

As the Auditor General has noted, over the last two years there was only a 0.3% (12 out of 3,600 incidents) incidence rate of buses entering service while overdue for inspection. Nevertheless, staff are committed to making the necessary improvements to

ensure compliance with requirements and the manufacturer's guidelines and to ensure the safety of our staff and customers.

Recommendation #2

That the City implement changes to M5, together with supporting procedures, to ensure that correct due dates are set for annual and semi-annual inspections.

Management response:

Management agrees with the recommendation.

The M5 system was not properly updating scheduled inspection dates to ensure that inspections occurred no more than six months apart. An analysis revealed an issue where the system failed to link the dates of scheduled inspections with different inspection codes. To correct the issue, staff have changed the way inspections are input into the system so that now only one type of inspection code is used. This change is being piloted on one type of bus in the fleet. At the end of 2020, the effects will be reviewed and, if the change consistently resolves the issue of incorrect dates, the adjustment will be made throughout the fleet.

As part of ongoing supporting procedures, since the issue was identified in late 2019, OC Transpo's Transit Fleet and Facilities Maintenance Reliability Team have manually reviewed a monthly report produced by the M5 system to ensure that the annual and semi-annual inspection due dates are correct in the system. This procedure will continue as part of OC Transpo's commitment to ensure that correct due dates are established for inspections.

Recommendation #3

That the City identify the key controls that it believes to be functioning in M5 and EQMS and verify that they are functioning as expected.

Management response:

Management agrees with the recommendation and it has been implemented.

As of July 2020, the key features in M5 and EQMS were identified and validated by IT staff within OC Transpo. After changes were made to the EQMS system, they were validated to ensure they were functioning as expected.

As noted above, since the issue was identified in late 2019, OC Transpo's Transit Fleet and Facilities Maintenance Reliability Team reviews a manual report of required

inspections on a monthly basis to ensure that key controls are functioning in M5 and EQMS.

Recommendation #4

That the City undertake a cost-benefit analysis of its Preventative Maintenance “A” (PMA) inspection program to ensure that it is cost-effective and optimized.

Management response:

Management agrees with the recommendation that a cost benefit analysis is important to ensure that the PMA inspections are effective.

The PMA process is constantly being reviewed and renewed as new fleet types are purchased by the City. With each new fleet type that OC Transpo purchases, an evaluation of the vehicle maintenance needs is completed to determine the appropriate inspection regime. OC Transpo aligns its preventative maintenance schedule with the original equipment manufacturer (OEM) maintenance timelines. The PMA process provides OC Transpo with the flexibility to schedule additional inspections that may be necessary to satisfy warranty requirements with the OEM. Failure to meet those requirements could result in voided warranties and increased costs to the City. As a result, retaining some form of supplemental inspection process will always be necessary.

OC Transpo’s Transit Fleet and Facilities Maintenance team will continue to look for opportunities to increase efficiency of its preventative maintenance programs to ensure cost effectiveness.

Review objective #2

Assess the controls that ensure planned and unplanned bus maintenance occurs on a timely basis and appropriate follow-up action occurs.

MTO on-site inspections

MTO inspectors visit OC Transpo’s four transit maintenance garages, at a minimum, on an annual basis and more frequently depending upon the results of prior inspections. MTO selects a sample of buses and performs a physical inspection. Each garage can have a different inspection interval as determined by the inspectors. If defects are observed during an inspection, MTO will usually return for a subsequent inspection within three months. The performance of the fleet during the second inspection will then dictate when the next visit will be. If inspections continue to find defects, the duration

between inspections continues to reduce and could result in a garage losing its delegated MTO safety signing authority. This would leave the garage without the ability to perform MTO safety inspections.

As such, our review expected to see positive results from MTO inspections. We found that MTO conducted recurring inspections of the OC Transpo fleet of buses at all four garages. Inspections conducted by MTO found a compliance rate of 100% in 2018 and 86% in 2019. These results provide us with additional assurance that proper bus maintenance is occurring.

Riskmaster data

We also analyzed data from Riskmaster, a program used by the City and managed by Legal Operations and Support Services, to track collisions and incidents. It includes any damage to or involving a vehicle, information and investigative notes and a rating rationale. As such, we expected to find that Riskmaster provided indications of whether OC Transpo bus collisions were due to driver error, to equipment failure or to other causes. We reviewed Riskmaster collisions for the period 2015-19 and found that almost all collisions were from driver error and not from mechanical failure.

Work orders

We also expected to find that scheduled preventative maintenance and bus repairs are performed on a timely basis. We found that while open work orders on defects and campaigns are closely monitored, they are not always updated to reflect revised desired dates of completion. For example, we found 84 open work orders relating to defects, recalls and campaigns that were more than one year past due. This indicates that some due dates in M5 need to be updated in order to provide more accurate information for maintenance planning purposes.

Also, we found that OC Transpo was not tracking and analyzing overrides and suspensions of work orders. OC Transpo processed approximately 200,000 work orders over the last two years. Approximately 4% of these work orders were overridden or suspended. There can be legitimate reasons to override or suspend a work order. For example, a supervisor may decide to delay very minor repairs and return the bus into service. Suspensions and overrides of work orders provide staff with the ability to bypass controls that have been built into the system. As such, bypassing controls can increase the risk that repairs and maintenance are not completed on a timely basis thereby resulting in mechanical failure while buses are in-service.

Explanations of the nature, reasons and originator of the overrides/suspensions were not available in the system and could not be provided by staff. We were informed by Transit Fleet Facilities Maintenance that they have since introduced some limited analysis of overrides/suspension of work orders.

Management information

We expected to find practices in place to monitor and assess the effectiveness of bus maintenance. We found that key management information exists and is provided at all management levels. Discussions with management indicate that these reports are reviewed and acted upon. Key information tracked include:

- MTO inspections results;
- Open work orders;
- Monthly Mean Distance Between Failures;
- Weekly Nova bus reliability update;
- Daily repeater defects emails;
- Weekly upcoming inspections reports;
- Daily fleet inspection completion reports;
- Daily completed PMA reports;
- PM vs Defect jobs, labour and parts report;
- Monthly actual spending versus budget;
- Monthly tire defects; and
- Monthly fuel consumption.

Recommendation #5

That the City implement practices and procedures to review outstanding work orders and revise desired dates of completion where appropriate.

Management response:

Management agrees with the recommendation and it has been implemented.

Starting in December of 2019, a monthly manual review process of outstanding work order requests has been put into place. A Reliability Analyst position has been created and staffed to ensure the proper oversight and prioritization of this process.

Recommendation #6

That the City track and analyze overrides and suspension of bus maintenance work orders.

Management response:

Management agrees with the recommendation.

OC Transpo's Maintenance Supervisory team, who are certified 310T mechanics, currently review and determine if a work order can be safely suspended and the work rescheduled. The safety of OC Transpo's staff and customers is the primary consideration when making such a determination.

Currently M5 only has the ability to track and report on the numbers of overrides and suspensions of work orders. Staff have contacted Assetworks, the M5 vendor, to request a feature that will require staff to supply a rationale for all overrides and suspensions. Creating a rationale requirement would enable more comprehensive tracking and analysis of overrides and suspensions over time. Based on our past experience of requesting upgrades from this vendor, we anticipate that introducing such a feature could require a minimum of twelve months to design and implement. Therefore, implementation is anticipated by Q3 2021.