City of New York

OFFICE OF THE COMPTROLLER

Scott M. Stringer

COMPTROLLER

MANAGEMENT AUDIT

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Deputy Comptroller for Audit

Audit Report on New York City Transit's Efforts to Inspect and Repair Elevators and Escalators

MD16-103A

May 1, 2017

http://comptroller.nyc.gov

THE CITY OF NEW YORK
OFFICE OF THE COMPTROLLER
SCOTT M. STRINGER

May 1, 2017

To the Residents of the City of New York:

My office has audited New York City Transit (NYCT) to determine whether it performs required preventive maintenance services and inspections on its escalators and elevators and makes timely associated repairs. We audit entities such as NYCT to help ensure that the City's transportation infrastructure is adequately maintained, safe and available for use by the public.

The audit identified multiple deficiencies in NYCT's preventive maintenance efforts. The audit found that only approximately one-fifth of the elevators and escalators in the audit sample received all of their scheduled preventive maintenance; in 31 percent of the instances where preventive maintenance for the sampled machines were cancelled, the basis for cancellation was either not supported or not in compliance with NYCT's policy. In addition, maintainers and supervisors did not complete nearly a quarter of the sampled checklists for preventive maintenance and inspections, and work orders were not created on average in 1 out of 4 instances where new defects were noted during such assignments. Further, NYCT does not have a system for tracking when or whether those defects that result in the creation of work orders are repaired.

The audit made 13 recommendations, including that NYCT should set realistic internal targets for preventive maintenance service, taking into consideration the needs and safety of the public as well as available staffing levels; require a review of "suspension memos" to ensure that suspensions of preventive maintenance are adequately justified; reinstruct all personnel regarding their responsibilities for completing and approving preventive maintenance and inspection checklists; and institute a procedure to ensure that work orders are created for all identified defects.

The results of the audit have been discussed with NYCT officials, and their comments have been considered in preparing this report. Their complete written response is attached to this report.

If you have any questions concerning this report, please e-mail my Audit Bureau at audit@comptroller.nyc.gov.

Sincerely,

Scott M. Stringer

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EXECUTIVE SUMMARY

The objective of this audit was to determine whether New York City Transit (NYCT) performs required preventive maintenance services and inspections on its escalators and elevators and makes associated repairs in a timely manner.

NYCT, part of the Metropolitan Transportation Authority (MTA) system, is responsible for subway and bus operations in New York City.[1] NYCT's Division of Elevators and Escalators (E&E) is responsible for the maintenance, repair, and inspections of the elevators and escalators located throughout the subway system. One of E&E's key objectives is to ensure that subway elevators and escalators (also collectively referred to herein as "machines") are functioning safely and available to the public, and that service outages (i.e., instances when machines are temporarily out of service) are kept to a minimum. Elevators and escalators are essential to ensuring that the stations they service are accessible to all patrons, especially to those who are mobility impaired.

E&E has set an aggregate goal of 96.5 percent availability on average for each of its elevators and 95.2 percent availability on average for each of its escalators. E&E measures the machines' "availability" by calculating the percentage of time that a unit is running and available for customer service. Thus, the time "available for customer service" excludes: (1) when a machine is located within a subway station that is closed for rehabilitation; or (2) when a machine is undergoing rehabilitation performed by an outside contractor. This means that a machine that is inoperable and being serviced by a private contractor (and, according to a NYCT official, generally removed from the station altogether) is not considered "unavailable" for the purpose of NYCT's calculation of availability percentages.

[1] NYCT is not responsible for the Staten Island Railway.

Each machine (elevator or escalator) requires preventive maintenance (PM) service, the frequency of which is based on the machine's age, condition and usage.[2] There are five levels of PM, with Level 1 being the least extensive and the other levels increasing in complexity up to Level 5. Under certain circumstances, Level 1 or 2 PM service for a machine can be suspended. According to E&E officials, Levels 3, 4 and 5 service assignments should not be suspended, with the exception of extenuating circumstances such as extensive work performed just prior to the scheduled maintenance. PM service is performed by Transit Electro-Mechanical Maintainers (maintainers).

In addition to PM service, there are two categories (1 and 5) of ASME (American Society of Mechanical Engineers) inspections, which are conducted by E&E's inspection teams. The PM service assignments and ASME inspections are scheduled in December for the upcoming calendar year.

Deficiencies identified during a PM service assignment or an ASME inspection are categorized as either Type A or Type B defects, depending on their severity.

- Type A defects are those that pose severe safety hazards; in such instances, NYCT immediately takes the machine out of service until the defect is corrected.

- Type B defects do not pose safety hazards, and E&E aims to correct them within 90 days.

To address the defects identified during PM service assignments and ASME inspections, supervisors are required to create work orders in the Elevator and Escalator Reporting and Maintenance System (EERMS), used by E&E for, among other things, asset management and to document work orders and repairs. In addition, E&E uses a computer system called LiftNet that remotely monitors safety devices in each machine. LiftNet regularly transmits information to EERMS. When a safety mechanism is triggered in a machine, LiftNet creates an "event," which is then recorded in EERMS as an "outage."

Audit Findings and Conclusion

We identified multiple deficiencies in NYCT's preventive maintenance efforts. Among other things, we found that:

- Only approximately one-fifth of the machines in our sample received all of their scheduled PM service assignments;

- In 31 percent of the instances where PM service assignments for the sampled machines were canceled, the basis for the cancellations as reported in the required memos explaining the reason for forgoing regularly scheduled PM service (suspension memos) was either not supported or not in compliance with E&E policy;

[2] PM service can be performed in 4, 6 or 8 week intervals.

- Maintainers and supervisors did not complete nearly a quarter of the sampled checklists for PM service and ASME inspections as required;
- Required work orders were not created on average in 1 out of 4 instances where new defects were noted during PM service assignments and ASME inspections; and
- E&E does not have a system for tracking when or whether the defects that result in the creation of work orders are repaired.

Audit Recommendations

Based on the audit, we make 13 recommendations, including:

- E&E should set realistic internal targets for PM service assignments, taking into consideration the needs and safety of the public, as well as available staffing levels, in order to track performance.
- E&E should require a review of suspension memos to ensure that suspensions of PM service assignments are adequately justified and that the information provided is accurate and matches the information in EERMS.
- E&E should reinstruct all personnel regarding their responsibilities for completing and approving PM and ASME checklists.
- E&E should institute a procedure to ensure that work orders are created for all identified defects and that supervisors record work order numbers on checklists for all listed defects.
- E&E should establish a procedure that ensures that supervisors record in EERMS the date each defect was addressed, as well as the specific repairs performed. This procedure should also instruct supervisors that work orders should not be closed until all required information is included.
- E&E should ensure that the new Enterprise Asset Management (EAM) system has the ability to track information by individual defects—including their associated codes and the date each defect is corrected—and to generate reports on defects. In the meantime, E&E should look into the feasibility of modifying EERMS to allow for the tracking of the defects associated with work orders.

Agency Response

In its response, NYCT does not acknowledge the audit's findings or directly address the audit's recommendations. However, portions of the response appear to indicate that the agency agrees with three of the 13 recommendations. NYCT attempts to minimize the audit's findings in its response. However, in its attempt to do so, NYCT relies on descriptions of the audit's methodology and findings that are simply inaccurate.

AUDIT REPORT

Background

The MTA is North America's largest transportation network, serving a population of 15.2 million people in the 5,000-square-mile area fanning out from New York City (City) through Long Island, southeastern New York State, and Connecticut. NYCT is part of the MTA system and is responsible for subway and bus operations in the City. NYCT subways operate 24 hours a day, seven days a week. The system includes 24 subway lines and 469 subway stations, accommodating an average 7.7 million weekday passengers.

E&E is responsible for the maintenance, repair, and inspections of the elevators and escalators (machines) located throughout the subway system. In that capacity, E&E is responsible for revenue and non-revenue machines. Revenue machines are used by paying customers of the subway system, while non-revenue machines are utilized by MTA and NYCT personnel at maintenance facilities and bus depots and other such locations. As of March 2016, NYCT operated 407 revenue machines located in 112 stations. There are also a limited number of elevators and escalators, called "outside developer machines," that are not the responsibility of E&E. Those machines are located in busy traffic hubs, such as Fulton Center, and are the responsibility of the owners of the buildings in which they are located. Neither the non-revenue nor outside developer machines are included as part of this audit.

The revenue machines that E&E maintains and repairs are divided geographically into divisions and zones. The North Division includes Zone 1, covering uptown Manhattan and the Bronx and Zone 2, covering midtown Manhattan. The South Division includes Zone 3, covering lower Manhattan and Brooklyn, and Zone 4, covering Queens and midtown Manhattan, from 63rd Street to Roosevelt Island. In addition, E&E's Support Operations and Asset Management oversees the ASME inspection team[3] and the Control Desk Operations Unit.

One of E&E's key objectives is to ensure that subway elevators and escalators are functioning safely and available to the public, and that service outages are kept to a minimum. These machines are essential to ensuring that the stations they service are accessible to all patrons, especially to those who are mobility impaired. E&E has set an aggregate goal of 96.5 percent availability on average for elevators and a 95.2 percent availability goal on average for escalators. E&E measures the machines' "availability" by calculating the percentage of time that a unit is running and available for customer service. Thus, in that calculation, E&E does not take into account either: (1) when a machine is located within a subway station that is closed for rehabilitation; or (2) when a machine is undergoing rehabilitation performed by an outside contractor. This means that a machine that is inoperable and being serviced by a private contractor (and, according to a NYCT official, generally removed from the station altogether) is not considered "unavailable" for the purpose of the NYCT's calculations of availability percentages.

[3] The team, comprised of NYCT employees, follows national guidelines established by ASME.

Each machine requires preventive maintenance (PM), which is performed by maintainers from E&E North and South Divisions. The frequency of such maintenance is based on the machine's age, condition and usage. There are five levels of preventive maintenance, each with a separate checklist to be completed by the maintainer based on the type of machine indicating through the use of various codes the work that needs to be done. Level 1 and Level 2 PM services are the least extensive and are intended to address a machine's overall condition and housekeeping issues. Level 3 and Level 4 PM services address different types of conditions, less comprehensive than Level 5, but requiring more attention than Levels 1 and 2. PM service for Levels 1 and 2 is conducted several times a year for each machine, and is typically completed in half a day. PM service for Level 5 is the most extensive work, and addresses emergency power and car safety issues. It can require 2 or 3 days to complete. Every NYCT machine must undergo at least one Level 3, Level 4 and Level 5 PM service each year. (See Appendix I for a list of the number of codes for each PM level, by machine type.)

In addition, there are two categories (1 and 5) of ASME inspections, which are conducted by inspection teams throughout the subway system. The same checklist is used for both types of ASME inspections. ASME procedures require one Category 1 inspection for each machine every year. However, E&E's policy is more stringent, calling for two Category 1 ASME Inspections per year. In addition, when a machine undergoes Level 3 or Level 5 PM service, E&E tries to perform an ASME Category 1 inspection approximately two weeks afterwards.[4] (An ASME inspection is not required after a Level 4 PM service assignment.) An ASME Category 5 Inspection—conducted for elevators alone—occurs only once every 5 years and tests an elevator's operation at 125 percent of its weight capacity.

Deficiencies identified during a PM service assignment or an ASME inspection are categorized as either Type A or Type B defects. Type A defects are those that pose severe safety hazards, including problems with machine emergency stop buttons, emergency escape hatch switches, and car stop switches. When a Type A defect is identified, NYCT immediately takes the machine out of service until the defect is corrected. Work to address a Type A defect is expected to occur as soon as possible, according to E&E officials. (See Appendix II for a complete list of Type A defects.) Type B defects do not pose safety hazards, and E&E aims to correct them within 90 days.[5] These include oil leaks and inoperative exhaust fans. If both Type A and Type B defects are identified during the service or inspection, two separate work orders are required to be created—one for the Type A defects and one for the Type B defects.

E&E utilizes two computer systems—LiftNet and EERMS. LiftNet remotely monitors safety devices within each machine. When a safety mechanism is triggered on a piece of machinery, the incident is transmitted by the LiftNet server to EERMS and the event is classified as an "outage." An E&E supervisor at the control desk confirms whether the event is in fact an outage and, if so, approves an outage record in EERMS, which is reflected in an "outage report." In most cases, the triggering of the safety mechanism causes the machine to stop operating. LiftNet also sends an alert of the event to EERMS, used by E&E for asset management and documenting

[4] The PM and ASME inspection schedules are created at the beginning of the year. In instances where PM service is delayed, ASME inspections will take place as scheduled to ensure that all ASME inspections are conducted as required.

[5] According to E&E officials, this goal is based on full staffing.

machine histories, including maintenance, inspections, work orders and repairs. It is also used for generating various management reports.

Objective

To determine whether NYCT performs required PM services and inspections on its escalators and elevators and makes associated repairs in a timely manner.

Scope and Methodology Statement

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective. This audit was conducted in accordance with the audit responsibilities of the City Comptroller as set forth in Chapter 5, §93, of the New York City Charter.

The audit scope was December 28, 2014 through July 2, 2016. Please refer to the Detailed Scope and Methodology at the end of this report for specific procedures and tests that were conducted.

Discussion of Audit Results with NYCT

The matters covered in this report were discussed with NYCT officials during and at the conclusion of this audit. A preliminary draft report was sent to NYCT and discussed at an exit conference held on March 16, 2017. On April 3, 2017, we submitted a draft report to NYCT with a request for comments. We received a written response from NYCT officials on April 17, 2017.

In its response, NYCT does not acknowledge the audit's findings or directly address the audit's recommendations. However, portions of the response appear to indicate that the agency agrees with three of the 13 recommendations.

NYCT attempts to minimize the audit's findings in its response. However, in its attempt to do so, NYCT relies on descriptions of the audit's methodology and findings that are simply inaccurate. These inaccuracies are discussed in the body of this report. Throughout the audit, we shared our findings with NYCT management, who generally agreed (both orally and in writing) with our audit results and indicated that certain procedures were consequently being modified, even in advance of their receipt of our draft report. NYCT's formal response, in contrast, does not reflect these many areas of agreement to such an extent that we question whether the parties responsible for preparing the response sufficiently communicated with the NYCT management officials we dealt with directly throughout the audit.

In summary, after carefully considering NYCT's response, we find no basis to alter the audit findings. Instead, we urge NYCT to carefully review the information provided in the final report and implement the audit's recommendations.

The full text of NYCT's response is included as an addendum to this report.

FINDINGS AND RECOMMENDATIONS

We identified deficiencies in NYCT's preventive maintenance and inspections efforts. Specifically, we found:

- only approximately one-fifth of the machines in our sample received all of their scheduled PM service assignments, and 34 percent of the assignments were not completed timely or at all;
- in 31 percent of the instances where PM service assignments for the sampled machines were canceled, the basis for the cancellations as reported in the suspension memos was either not supported or was otherwise not in compliance with E&E policy;
- nearly a quarter of the required sampled checklists for PM service and ASME inspections were not completed by the maintainers and supervisors;
- required work orders were not created for an average of 1 out of 4 instances where new defects were noted during PM service assignments and ASME inspections;
- cases where work orders were not closed in a timely manner, were backdated or where pending defects were inappropriately transferred to new work orders; and
- LiftNet defects were not consistently addressed in a timely manner.

As a result of these deficiencies, NYCT cannot ensure that its 407 elevators and escalators are presently, and will continue to be, in good operating condition. Our review of ASME Category 1 inspections revealed that 21 (32 percent) of the 65 machines we sampled did not pass one or more of the inspections that had been conducted. When scheduled maintenance and the repairs associated with such maintenance are not carried out, there is an increased risk of equipment breakdowns, physical injury and inconvenience to the public, especially to individuals with mobility impairments who rely on elevators and escalators to navigate the subway system.

These matters are discussed in the following sections of this report.

> ***NYCT Response:*** Regarding the audit's methodology, NYCT states: "The Comptroller's audit surveyed maintenance on 36 elevators and 29 escalators – a total of 65 machines – out of the 226 elevators and 184 escalators in revenue service in the NYCT system at the time of the Audit. It excluded from its sample all machines installed after 2011. As a result of excluding newer machines that have higher performance records, the Audit was skewed toward machines that are more likely to break down."
>
> ***Auditor Comment:*** NYCT's claim that we excluded machines installed after 2011 is simply incorrect. Our randomly selected audit sample did in fact include four machines placed in service *after* 2011. We shared the list of sampled machines with NYCT officials, but apparently, this information was not reviewed by the parties who drafted the NYCT response. It appears that NYCT's claim stems from a misunderstanding regarding our tests concerning Category 5 ASME inspections for elevators. As clearly stated in the report, for this particular test we ***did*** omit machines placed in service in 2011 or later. This

was due to the fact that, because they were less than five years old at the time of our testing, *these elevators were not required to have this inspection*. For all other tests, the sampled machines installed after 2011 were included in our analyses. Consequently, we find no basis to alter the audit's findings.

Preventive Maintenance Not Completed Timely for A Third of Service Assignments

PM service assignments were not completed timely, if at all, for 289 (34 percent) of the 849 scheduled PM assignments for the machines we sampled.

> ***NYCT Response:*** "The audit inaccurately claims that preventive maintenance was not completed in a timely manner in nearly a third of service assignments."
>
> ***Auditor Comment:*** The figures cited in the report are correct. We arrived at the 34 percent by including the PM service assignments that were not performed timely or were not performed at all.

The E&E *Maintenance and Planning Operational Procedure* stipulates that on December 1 of each year, the Maintenance and Planning Supervisor must generate an annual maintenance calendar outlining all scheduled PM work for the coming year. According to the division's *Performance of Maintenance Audits Procedure*, PM service assignments that are completed within one week of the scheduled week are considered to be on time. However, E&E policy allows a scheduled Level 1 or Level 2 PM service for a machine to be suspended (i.e., canceled) under the following circumstances:

- when E&E has performed productive work on the machine for a repair or for an unscheduled outage in the 30 days prior to the scheduled PM;[6]
- when the machine has no pending defects; or
- when maintainers need to attend to a more critical issue on another machine, such as an accident, entrapment or to return an out-of-service machine to service.

When scheduled Level 1 or 2 PM service is suspended, supervisors or managers must prepare a suspension memo and are responsible for the accuracy of the facts and data in it. In addition, according to E&E officials, Levels 3, 4 and 5 service assignments should not be suspended, with the exception of extenuating circumstances such as extensive work performed just prior to the scheduled maintenance.

We sampled 36 elevators and 29 escalators and found that E&E scheduled 849 PM service assignments for these 65 machines to be performed during the scope period of our audit, December 28, 2014 to July 2, 2016. Of these 849 assignments, 104 were suspended with a suspension memo on file. Of the remaining 745 service assignments, 560 (75 percent) were completed on time. However, for the other 185 assignments, 164 were not completed on time

[6] According to E&E officials, work is considered productive if an hour or more is spent at the machine.

and another 21 were not completed at all. For the 164 assignments where work was eventually completed but not on time, the average lateness was 15 days. Sixty of the assignments were completed 14 or more days late, as shown in Table I below.

Table I

PM Service Assignments Completed Late

		Number of Days Late		
Type of Machine	PM Service Assignments that Were Late	1 to 13 Days	14 to 28 Days	29 or more Days
Elevator	84	50	19	15
Escalator	80	54	21	5
Total	164	104	40	20

In addition, our review of the 104 PM suspensions with suspension memos revealed that 32 (31 percent) of the memos did not substantiate that the PM assignments were suspended in accordance with E&E guidelines. Two of the 32 memos were for suspended Level 3 and Level 4 PM assignments, for which there is no evidence of extenuating circumstances. The 30 remaining suspension memos did not meet any of the three criteria established by E&E. Further, we found no evidence that E&E managers had adequately reviewed and verified information in the suspension memos to ensure that the facts they described met the established criteria. After we discussed this issue with E&E officials, they stated that they have initiated a new procedure requiring all suspension memos to be reviewed and approved by a General Superintendent.

At the exit conference, E&E officials provided us with outage reports that indicate that 23 of the 32 inadequately justified suspensions met the applicable criteria as evidenced by the fact that productive work was performed on the machines in question sometime within the 30 days preceding the scheduled PM. However, it is not apparent that the information contained in these outage reports was known by the supervisors at the time they created the suspension memos since none of the suspension memos cited the prior productive work reflected in the outage reports as the reason for the suspension. Moreover, we found a few instances where the information provided by E&E officials at the exit conference did not actually support their claims. For example, our review of outage reports for the dates in question found that the specific work cited in two of the memos did not meet the one hour minimum work-time threshold to be considered “productive.” In addition, we found that two memos cited prior work that we later learned consisted merely of previous PM service assignments (completing the previous PM service assignment is not a justifiable reason for canceling a subsequent PM service); and two additional memos cited prior work for which no corresponding record was found in EERMS for the dates referenced in the memos. We also found a number of instances where the suspension memos reported that the machine in question had no open work orders, yet our review of EERMS revealed that they did.

We found that as a result of PM service assignments that were suspended or simply missed, the 65 machines we sampled received only 85 percent of their scheduled PM service. As previously

noted, the 65 sampled machines should have received 849 scheduled PM assignments, but only 724 of them were completed, and 164 of those were late.[7]

In total, due to PM assignments that were suspended with adequate justification, PM assignments that were not conducted and PM assignments inappropriately suspended, only 14 (22 percent) of the 65 sampled machines received all of their scheduled PM service assignments. Another 15 machines received all but one service assignment and 36 machines did not receive two or more service assignments, as shown in Table II below.

Table II

Analysis of PM Service Assignments
for Sampled Machines

Type of Machine	No. in Sample	PM Service Assignments Scheduled	PM Service Assignments Completed	%	Number of Machines for which a Scheduled PM Assignment Was Not Completed			
					1 missed	2 missed	3 missed	4 or more missed
Elevator	36	418	368	88%	6	10	5	2
Escalator	29	431	356	83%	9	9	2	8
Total	**65**	**849**	**724**	**85%**	**15**	**19**	**7**	**10**

> ***NYCT Response:*** "The audit implies that only one-fifth (20 percent) of the equipment in its sample group received scheduled preventative maintenance services. . . . [P]lanned maintenance was carried out 96 percent of the time - not 20 percent as the audit implies." (Emphasis in original.)
>
> ***Auditor Comment:*** NYCT's response misstates the audit's findings. First, our report clearly states that only approximately one-fifth of the sampled machines received ***all*** of their scheduled PM service assignments. That remains an accurate finding based on our tests of the data provided by NYCT. Second, our report does not imply that 20 percent of PM service assignments were completed, as claimed by NYCT. Rather, our report clearly *states* that 85 percent of the sampled PM service assignments were performed. Consequently, we find no basis to alter the audit's findings.

E&E officials attributed the delays in completing PM service assignments to staffing issues. At our initial walkthrough meeting, they stated that there were 34 vacancies across all the E&E units that had been budgeted for 287 employees. An E&E official stated that when the staffing level shrinks, the maintenance workload is modified and spread out among existing employees, and when vacancies are numerous, the target number of scheduled PM assignments is lowered so staff can address outstanding repairs. However, the delays and failures to complete PM service

[7] A prior audit conducted by our office, *Audit Report on New York City Transit Efforts to Inspect, Repair and Maintain Elevators and Escalators* (Audit #MJ10-065A), issued July 23, 2010, also found that NYCT did not ensure that all required PM service was consistently performed.

assignments that we identified were based on the schedules that E&E provided to us. While E&E informed us that maintenance targets had recently been lowered for this year (2017), the division did not provide us with the new targets.

When E&E fails to perform scheduled PM assignments, defects in elevators and escalators may not be identified and addressed in a timely manner, increasing the risk of machine breakdowns, inconvenience to passengers, especially the elderly and disabled, and a risk to public safety. During the period of our audit, 21 (32 percent) of the 65 machines we sampled failed at least one of their Category 1 ASME inspections. A failed ASME inspection indicates that at least one Type A defect was identified, which can pose a safety hazard to the public. Our audit also revealed that 15 (71 percent) of those 21 machines had a Level 3 or 5 PM approximately two weeks prior to the ASME inspections that they failed. Among those 15 machines, 62 defects were still pending after the PM assignments were completed.[8] Moreover, of the 15 machines that failed an ASME inspection, one-third (five) of them did not meet E&E's availability goal during the audit scope period.

> ***NYCT Response:*** Regarding the 62 pending defects, NYCT states, "[t]his statement implies that defects must be corrected as a result of preventative maintenance on-the-spot. While NYCT addresses defects during the inspection when possible, many repairs cannot be addressed at an inspection because parts need to be ordered, etc. When a preventative maintenance event is scheduled, the supervisor will review pending work orders for the specific machine and determine the amount of additional work that can be accomplished. The supervisor must balance what work can reasonably be done without delaying the entire planned preventive maintenance schedule for the zone."
>
> ***Auditor Comment:*** According to NYCT's own procedures, maintainers are required to repair or replace any defect noted during higher level PM service assignments. When we shared these findings with NYCT, officials provided no evidence of any factors, including a need to order parts that prevented maintainers from repairing the defects in question during the PM assignments. Additionally, NYCT fails to note that Level 3 and 5 PM service assignments commonly take multiple days to complete, which provides for more time than "on the spot" to correct existing defects. Consequently, we find no basis to alter the audit's finding.

An additional ten of the 65 sampled machines did not meet E&E's availability goal, bringing the total number of machines in our sample that were unavailable for periods in excess of E&E's goal to 15 (23 percent).[9] Of the 36 elevators in our sample, seven failed to meet E&E's availability goal, with availability rates ranging from two to 10 percent below the goal of 96.5 percent. For

[8] According to E&E officials, to ensure that the PM work is performed properly, the ASME inspection is generally scheduled to be conducted within 2 weeks following a machine receiving Level 3 or Level 5 PM service.

[9] This 15 only includes machines for which availability was one percent or more below the goal.

the 29 escalators in our sample, eight failed to meet the availability goal, with availability rates ranging from one to 20 percent below the goal of 95.2 percent.[10]

Recommendations

1. E&E should set realistic internal targets for PM service assignments, taking into consideration the needs and safety of the public, as well as available staffing levels, in order to track performance.

   NYCT Response: NYCT did not address this recommendation in its response.

2. E&E should require a review of suspension memos to ensure that suspensions of PM service assignments are adequately justified and that the information provided is accurate and matches the information in EERMS.

   NYCT Response: NYCT did not address this recommendation in its response.

3. E&E should institute a procedure to prevent PM service assignments from being suspended if a machine is failing to meet availability goals at the time the machine is scheduled for PM service.

   NYCT Response: NYCT did not address this recommendation in its response.

Nearly 25 Percent of Preventive Maintenance and ASME Inspection Checklists Were Incomplete

According to E&E officials, maintainers are required to use checklists that specify exactly what needs to be covered when they conduct PM service assignments and ASME inspections. Areas of the machine (e.g., inside of an elevator car, top of car, etc.) and machine parts are identified on the checklists by codes that reflect the individual area or part to be serviced or inspected. According to an E&E official, all codes on the checklists pertaining to PM services or ASME inspections are to be completely filled out and identified as "good," "no good – NG," or N/A. For codes designated as "no good – NG," maintainers must provide a detailed explanation in the remarks section. The maintainers who conduct PM assignments and the inspectors that conduct ASME inspections are required to sign the checklists and include their work dates and starting and ending times.

Supervisors, in turn, are responsible for reviewing the checklists for completeness and approving them. They are also responsible for creating work orders for newly-identified defects and recording the corresponding work order numbers for both new and existing defects on the checklists. PM checklists also require the signature of the superintendents.

Our review of 949 PM and ASME inspection checklists completed during our audit revealed that 233 (25 percent) were inadequately completed by maintainers and that 143 (15 percent) lacked the work order numbers that supervisors are required to note. Without work order numbers, it is

[10] The availability percentages for these sampled elevators and escalators ranged from 86.6 to 94.9 percent and 75.9 to 94.0 percent, respectively.

difficult to track whether work orders were created for identified defects. A breakdown of the reviewed inspection checklists can be seen in Table III.

Table III

Inspection Checklists Reviewed

Type of Inspection	# of Checklists Reviewed	Incomplete by Maintainer	Percentage	Checklists with Missing Work Order Numbers	Percentage
Elevators PMs	368	81	22%	76	21%
Escalator PMs	356	59	17%	64	18%
Elevator ASME (Category 1)	108	58	54%	0	0%
Escalator ASME (Category 1)	89	31	35%	3	3%
Elevator ASME (Category 5)	28	4	14%	0	0%
Totals	**949**	**233**	**25%**	**143**	**15%**

Deficiencies included the following:

- required codes identifying parts or areas to be serviced or inspected were not checked off on 120 checklists (13 percent), with the number of unchecked codes on individual checklists ranging from one to 26 (for example, one inspection checklist had four of its ASME codes filled in with question marks);
- required remarks to explain codes that were checked as "no good," were missing from 50 checklists;
- contradictory information (e.g., code checked off as both "good" and "no good") was noted on 87 checklists; and
- maintainers failed to sign off on 21 checklists.

NYCT Response: "The audit suggests that maintainers did not complete inspection checklists for nearly a quarter of the inspections. This statement is misleading, because it incorrectly implies that entire checklists were missing. In some instances, there were missed items within a long checklist, but the checklist itself was completed. For example, there are 85 checkboxes for a Level 5 elevator inspection. While some of these checkboxes were not properly checked off in a portion of the sample, it is inaccurate to claim that the checklists were not completed."

Auditor Comment: The report neither states nor implies that entire checklists were missing. Rather, the report clearly states that checklists were *incomplete* and goes on to describe the checklist deficiencies, including missing codes, which NYCT itself acknowledges in its response. NYCT's argument that incomplete checklists should be deemed as complete is presented without a logical basis. Consequently, we find no basis to alter the audit's findings.

When auditors asked whether some codes are more critical than others, an E&E official stated that safety switches are the most important equipment to maintain in good working order; the 233

incomplete checklists in our sample contained 46 unchecked safety switch codes. (See Appendix II for a list of safety switches.) However, the official added that every code is important in its own way, so that, except for safety switches, it is difficult to say categorically that any one code is more important than another code.

Despite the deficiencies noted above, supervisors and superintendents signed off on all 140 incomplete PM checklists, and supervisors signed off on all but two of the 93 incomplete ASME checklists we identified. The high percentage of supervisory sign-offs of incomplete checklists raises questions about the adequacy of supervisory reviews. When checklists are incomplete and required codes are not checked off the risks that defects in the machines will go undetected and unrepaired increase.

Recommendations

4. E&E should reinstruct all personnel regarding their responsibilities for completing and approving PM and ASME checklists.

   ***NYCT Response**:* While NYCT did not directly address this recommendation, it does state that "NYCT is reinforcing compliance with existing policy which requires that all items on checklists be inspected and properly recorded."

5. Checklists with incomplete or contradictory information should be returned to the maintainers.

   NYCT Response: NYCT did not address this recommendation in its response.

Weaknesses Related to Work Orders

No Work Orders Were Created for Defects Noted in 27 Percent of Sampled Checklists

E&E did not adequately ensure that work orders were created for defects identified during PM service assignments and ASME inspections. According to the *Elevator & Escalator Operational Procedure*, supervisors should create work orders for such defects.

In analyzing 724 PM and 225 ASME checklists for the 65 machines we sampled, we identified 331 checklists where new defects were noted, but we found no evidence in EERMS that work orders were created to address the newly identified defects in 89 (27 percent) of those checklists.[11] In the absence of such work orders, some defects identified during PM service assignments and ASME inspections were not addressed timely, if at all.

For example, an elevator car alarm defect identified during a PM service assignment was again noted during the machine's next PM service five weeks later; nonetheless, the PM supervisor

[11] We designated defects as new if they did not have an existing work order.

neglected to create a work order for its repair in both instances.[12] A work order to repair the defect was finally created by an ASME supervisor following an ASME inspection seven weeks later. In a second case, an elevator communications defect was identified four times during four consecutive PM service assignments that took place over five months, yet there is no evidence in EERMS that the PM supervisor created a work order for its repair during our scope period. In a third case, a work order was not created to correct an escalator handrail deficiency although the defect had been noted during two consecutive prior PM service assignments.

E&E's failure to consistently create work orders when new defects are identified results in an increased risk of machine breakdowns, inconvenience to the riding public and safety hazards, especially to individuals with mobility impairments who rely on elevators and escalators in subway stations. Our prior audit also found that NYCT lacked sufficient oversight and monitoring to provide assurance that assigned work was appropriately carried out.

NYCT Does Not Track When or Whether All Defects Have Been Corrected

E&E does not have formal time requirements for repairing Type A and B defects. As previously noted, officials said their goal is to correct Type A defects as soon as possible and Type B defects within 90 days. E&E officials also stated that supervisors are expected to make efforts to close work orders within 72 hours after the work is completed.

We found, however, that E&E does not have a system for tracking when or whether the defects that result in the creation of work orders are repaired. EERMS does not have dedicated data fields in which the specific defects that need to be corrected can be listed. Instead, EERMS can provide an aggregate report on the status of its work orders, including the date created, date closed, and the type of work order (whether it is Type A or Type B). Without dedicated data fields to record individual defects, EERMS cannot provide a report that shows their status. As a result, it is difficult to determine which defects, if any, listed in E&E's work orders—whether open or closed—have actually been corrected.

According to E&E officials, an open work order does not necessarily mean that the defects relating to that work order are still outstanding. In some instances, they said, defects may have been addressed, but the work order was not closed until a later date. By the same token, however, a closed work order does not necessarily mean that the defects relating to that work order have been corrected. While EERMS allows users to read remarks that supervisors may have made regarding specific defects, such information is not entered into EERMS on a consistent basis. For example, we identified a case where a work order was created in April 2016 to correct six defects and closed in June 2016. The remarks in the closed work order record in EERMS, however, refer to only two of the six defects as being corrected. Although the work order was closed, the EERMS record did not contain information regarding the status of the remaining four defects.

[12] A car alarm is a button in the elevator that is used to signal if a passenger is stuck.

Agency Response: "The audit claims that NYCT does not have a system for tracking work orders and repairs. This is incorrect. NYCT has a robust system for tracking defects and implementing corrective actions. Defects are captured in inspection reports and those defects are incorporated in work orders. As the defects are corrected, they are moved into a separate section of the work order. In order to provide more in-depth information regarding such work order and repair reports, such reports now include greater detail regarding the times such defects were corrected and the type of work conducted. NYCT is also currently investing in a system that will improve this tracking effort."

Auditor Comment: Again, NYCT misstates the audit's findings. The report does not state that NYCT does not have a system for tracking work orders. Rather, the report states that the agency does not have a system for tracking when the ***defects*** that result in the creation of those work orders are repaired. NYCT's contention that the agency has a "robust" system for tracking defects appears to be based on the procedures stated in its response. However, NYCT does not indicate when these procedures were implemented. We note that these procedures were ***not*** in place during our audit, so we are unable to comment on the degree to which they are being followed.

In theory, information on whether specific defects identified on work orders have been corrected may be obtained, independently of EERMS, from hard-copy corrective action reports and PM checklists prepared by the maintainers who perform the work.[13] However, that information can only be obtained on a case by case basis, and obtaining it to track defects systematically appears impractical based on our experience attempting to learn whether specific defects had been repaired. While the PM checklists are available at E&E's central office, the corrective action reports are maintained only at the individual zone offices. However, they do not appear to be readily accessible; we attempted to obtain 17 such reports, but NYCT could locate only three of them.

As a result of NYCT's inability to track the status of the defects listed in its work orders, neither we nor the agency can have reasonable assurance that all such defects were actually corrected as of the dates those work orders were closed. Several months after we presented our concerns about missing information in work orders, E&E informed us in January 2017 that NYCT had implemented changes to their systems and procedures, including: E&E staff are now required to add a remark when adding labor (work performed) and when changing the work order status in EERMS. In addition, a hidden "Remark Created On" date field was added to capture when a remark was actually added by the user. We note, however, that the changes that E&E described will still not provide E&E with a reliable system for tracking, on an aggregate level, the dates on

[13] A corrective action report is completed by the maintainer and includes information on the actual work performed on a specific machine. It is used to update and close work orders.

which those defects that result in the creation of work orders are repaired since EERMS is still unable to track defects.

Analysis of Work Order Closing Dates

The audit identified delays in E&E's closing of work orders in EERMS that further impede its ability to track whether defects are corrected in accordance with its time goals. We obtained from E&E a list of 2,824 ASME and PM work orders created between December 28, 2014 and July 2, 2016 for all NYCT machines. Our review revealed that 450 of those work orders (16 percent) remained open in EERMS as of November 3, 2016—the date the list was generated by E&E. Two of the open work orders involved Type A defects—the category involving safety hazards—and the remaining 448 related to Type B defects. Of the two Type A work orders—both resulting from ASME inspections—one had been open 210 days and the other 408 days. Regarding the 448 Type B work orders, relating to ASME and PM related work, all had been open in EERMS for more than 90 days, as seen in Table IV.

Table IV

Open Type B Work Orders Created between December 28, 2014 to July 2, 2016

Type B Open: Work Order Timeliness	Number	Percentage
91 - 180 Days	77	17%
181 - 270 Days	120	27%
271 - 360 Days	71	16%
361 - 450 Days	60	13%
451 - 540 Days	54	12%
541 - 630 Days	49	11%
631 - 720 Days	17	4%
Total	**448**	**100%**

Of the remaining 2,374 (2,824 – 450) work orders that were closed, 108 were related to Type A defects and 2,266 were related to Type B defects. The 108 Type A work orders (which indicate safety hazards that E&E seeks to have addressed "as soon as possible") remained open, on average, 43 days. Half of them (54) were open for more than one day.

To determine the degree to which work order closing dates correlate to the dates when specific defects were corrected, if at all, we conducted more detailed testing for the Type A work orders found on sampled machines. As stated previously, 21 machines in our sample failed a total of 23 ASME inspections because a Type A defect was identified during the inspection. Two of the 21 machines each failed two inspections during the period we analyzed. We found that work orders had been created following 18 of these 23 inspections. We found no evidence that work orders were created following the remaining five inspections. As of November 3, 2016, 17 of the 18 work orders had been closed and one was still open and had been for 551 days as of that date.

The 17 closed work orders were open an average of 29 days; eight were open for two days or less, four were open for more than 30 days, with two of the four having been open for more than

150 days. To determine whether the Type A defects on the 17 closed work orders had all been addressed—and whether the associated work orders had been closed within 72 hours of the work being completed and the machines restored to service—we reviewed the outage reports for those machines.[14] We targeted outage dates that correlated with when the work orders were initially generated.[15] We found that E&E generally failed to close out work orders within 72 hours in accordance with the expectations of E&E management. According to the outage reports, the average length of time these machines were out of service (while the defect was being repaired) was less than a day. As for the work order that had been open for 551 days as of November 3, 2016, the outage report for that machine indicated that it had actually been out of service for less than a day. The results of our analysis for the 17 outages are shown in Table V below.

Table V

Timeliness in Closing Type A- related Work Orders
for Sampled Machines

Equipment Number	Number of days work order was open[A]	Number of days machine out of service as per outage report[B]	Difference
EL103	0	0	0
EL107	0	1	0[C]
EL123	160	0	160
EL123	0	0	0
EL230	0	0	0
EL306	26	3	23
EL431	1	0	1
ES101	153	0	153
ES112	8	0	8
ES115	36	2	34
ES206	69	0	69
ES305	0	1	0[C]
ES316	0	0	0
ES324	25	0	25
ES442	12	0	12
ES448	2	2	0
ES448	6	0	6
Average	**29**	**>0**	

[A] - 0 indicates that the work order was open and closed on the same day.

[B] - 0 indicates that the machine was out of service for less than 24 hours.

[C] – In these instances the creation of the outage record preceded the work order creation date by one day.

Regarding the 2,266 closed Type B work orders, they remained open an average 85 days. Of those, 689 (30 percent) remained open in EERMS beyond the 90-day goal that E&E established for completing Type B-related work orders. As stated previously, EERMS does not track the status

[14] Outage reports show the times that machines are taken out of service, the reason, the work performed and the time it is restored to service.

[15] A Type A defect results in a machine being taken out of service and is reflected in the outage report.

of the defects associated with these work orders, so we do not know when the conditions were actually repaired, if at all.

According to E&E officials, work orders are not closed in a timely manner due to the workload of supervisors. An official stated that since a large part of the work force is inexperienced, they require more oversight and guidance, requiring supervisors to be in the field more than preferred. As a result, the administrative work falls behind. E&E officials acknowledged that improvement is needed with regard to closing work orders for Type A defects and stated that they have added to their daily conference call a review of the status of work orders for Type A defects that remain open. Our prior audit also found that work orders were generally not addressed promptly.[16]

Work Order Backdating

We identified 22 instances where work orders for the sampled machines were backdated, although we were unable to determine the full extent of the backdating. According to E&E officials, work orders should not be backdated and should be closed only when the actual repair work is completed.[17]

In the above-mentioned 22 instances, the backdating ranged from 2 to 543 days. In two instances we found evidence in corrective action reports that defects were not corrected as of the work order closing date reflected in EERMS. In those two instances the closed work orders created the appearance that work was completed when in fact it had not been. In 14 instances, due to inadequate recordkeeping and storage, E&E could not provide evidence that defects were corrected by the work order closing date reflected in EERMS.[18] As a result, NYCT's productivity numbers, especially regarding the number of days it takes to close work orders, may not be reliable, and could adversely affect the agency's decision-making.

When we asked about E&E's work order processing, an official stated that efforts made to improve the existing system were delayed due to the anticipated arrival of the EAM system, which will replace EERMS. The official added that the EAM Team will begin working on the E&E component sometime this year but does not know when the migration from EERMS to EAM will take place.

Recommendations

6. E&E should institute a procedure to ensure that work orders are created for all identified defects and that supervisors record work order numbers on checklists for all defects.

   NYCT Response: NYCT did not address this recommendation in its response.

7. E&E should establish a procedure that ensures that supervisors record in EERMS the date each defect was addressed, as well as the specific repairs performed.

[16] *Audit Report on New York City Transit Efforts to Inspect, Repair and Maintain Elevators and Escalators* (Audit #MJ10-065A), issued July 23, 2010.

[17] Backdating is closing a work order on an earlier date than the actual date the work was completed.

[18] Due to E&E's poor recordkeeping, we did not attempt to locate the documentation for the five remaining instances.

This procedure should also instruct supervisors that work orders should not be closed until all required information is included.

NYCT Response: While NYCT did not directly address this recommendation, it does state that "As the defects are corrected, they are moved into a separate section of the work order. In order to provide more in-depth information regarding such work order and repair reports, such reports now include greater detail regarding the times such defects were corrected and the type of work conducted."

8. E&E should ensure that work order information is timely and correctly entered into EERMS.

   NYCT Response: NYCT did not address this recommendation in its response.

9. E&E should ensure that the new EAM system has the ability to track information by individual defects—including their associated codes and the date each defect is corrected—and to generate reports on defects. In the meantime, E&E should look into the feasibility of modifying EERMS to allow for the tracking of the defects associated with work orders.

   NYCT Response: While NYCT did not directly address this recommendation, it does state that "Defects are captured in inspection reports and those defects are incorporated in work orders. As the defects are corrected, they are moved into a separate section of the work order. In order to provide more in-depth information regarding such work order and repair reports, such reports now include greater detail regarding the times such defects were corrected and the type of work conducted. NYCT is also currently investing in a system that will improve this tracking effort."

Other Matters

Defects Inappropriately Transferred to New Work Orders

According to E&E officials, duplicate work orders for the repair and maintenance of NYCT machines should not be created. If a duplicate work order is mistakenly created for an existing defect, the new work order should be closed with a note referencing the older work order number.

However, we identified 14 instances where duplicate work orders were created and where defects were inappropriately transferred to new work orders, although we were unable to determine the full extent to which this occurred. Based on the dates of the original work orders, the defects in those 14 instances were not addressed for anywhere from 20 to 536 days after the original work order was created.

EERMS does not have a mechanism to prevent duplicate work orders from being created for defects with existing work orders. According to an E&E official, there is no real benefit to creating duplicate work orders because the defects will still be open. However, creating a duplicate work order could allow a supervisor to close out the original work order before correcting one or more of the defects listed in the work order, which would create the appearance that the work order had

been completed, when in fact defects on that machine had not been corrected. The official also stated that, in some instances, supervisors did not understand the instructions clearly and consolidated defects from multiple work orders into fewer work orders. E&E officials stated that E&E staff will be re-instructed through a memorandum not to do so.

Recommendation

10. E&E should instruct supervisors that duplicate work orders should not be created and explore the feasibility of developing a mechanism in EERMS to prevent duplicate work orders from being created.

    NYCT Response: NYCT did not address this recommendation in its response.

LiftNet Defects Are Not Addressed in a Timely Manner

NYCT's LiftNet system remotely monitors safety devices within each machine and transmits an incident report to the LiftNet server when a safety mechanism on a machine is triggered. When maintainers are on site to perform an inspection or maintenance, they are required to activate the MOS (Mechanic on Site) button located in the machine room and call the Control Desk to determine whether LiftNet has recorded the MOS communication.

According to E&E Officials, LiftNet work orders should be created by a supervisor when the LiftNet automatic alert system is found not to be operating properly, or by Control Desk personnel when other MOS button errors have occurred.[19] Repairs based on these LiftNet work orders should be made within the next eight-hour shift after being ordered, according to E&E's *Control Desk Procedures*. The LiftNet repair team operates on an eight-hour day shift, Monday through Friday.

We found that LiftNet work orders are not consistently created for LiftNet defects (that is, failure of the LiftNet system to operate properly). We identified 47 LiftNet defects (14 existing and 33 new) connected to our 65 sampled machines.[20] LiftNet work orders were not created for 16 (48 percent) of the 33 new defects. Moreover, we were unable to determine from our review of EERMS whether a LiftNet work order was created for an additional defect—we could not find a work order in EERMS.

From the 16 new LiftNet defects where no work order was created, 10 were identified as "MOS not communicating" on the EERMS outages report. If LiftNet is not communicating, the Control Desk Supervisor is required to note that inactivity on a 5:30 A.M. E-mail report.[21] We reviewed the ten 5:30 A.M. E-mail reports related to these cases and determined that in each instance the MOS communication problems were not listed. The absence of those listings hinders the LiftNet

[19] The MOS button is connected to LiftNet and is activated by maintainers to alert the Control Desk that they are at the machine. LiftNet errors include instances where the MOS button does not light up in the field.

[20] We categorized defects as existing if there was a work order already created for them prior to the PM or ASME date. We categorized defects as new defects if the work order was created on or after the date of the PM or ASME.

[21] An E&E official explained that there may be delayed communications due to limitations of the communication infrastructure. A majority of the machines connect using dial-up phone service through the same communication pipeline which causes a bottleneck.

Supervisor's ability to follow-up and generate work orders for the affected machines. The remaining six defects had other MOS errors, as noted on the PM checklists.

In addition, we found that defects were not addressed timely even for those LiftNet work orders that were created. Work orders were created for 30 LiftNet defects in our sample. However, the time to repair 21 of them ranged from 4 to 66 working days. We could not determine whether two additional defects had been corrected because their status was not indicated in the remarks on the work orders.

The information contained in the 5:30 A.M. E-mail reports is collected and entered manually. As a result, instances of "MOS not communicating" do not always make it into the report. For example, as mentioned previously, none of the 10 instances we reviewed where the MOS was not communicating were included on the 5:30 A.M. E-mail reports. Furthermore, even in those cases where work orders were created, there was inadequate planning and monitoring by LiftNet Supervisors to ensure that the defects were being addressed timely. Such defects can affect how NYCT machines communicate with the Control Desk, because LiftNet may not be able to report machine outages and other safety malfunctions to the Control Desk.

After we shared this issue with E&E officials, they recognized that the Control Desk staff did not have MOS activity listed on the 5:30 A.M. E-mail reports and said they would utilize the MOS Report data in the future to expand the information in those reports. E&E officials also said Control Desk procedures erroneously call for LiftNet work orders to be repaired within the next tour (next eight hour shift). They added that procedures will be modified, but did not provide a timeframe in which LiftNet repairs should be completed.

Recommendations

11. E&E should ensure that the Control Desk Supervisors include all instances of MOS not communicating on the 5:30 A.M. E-mail report so that proper follow-up can be performed.

    NYCT Response: NYCT did not address this recommendation in its response.

12. E&E should identify the time frame within which LiftNet repairs should be completed, update its policy to reflect that expected performance standard, and monitor whether it is being met.

    NYCT Response: NYCT did not address this recommendation in its response.

13. E&E should ensure that the Control Desk personnel and LiftNet Supervisors are creating work orders for all LiftNet defects in EERMS and that the defects are being addressed timely according to E&E procedures.

    NYCT Response: NYCT did not address this recommendation in its response.

DETAILED SCOPE AND METHODOLOGY

We conducted this performance audit in accordance with Generally Accepted Government Auditing Standards (GAGAS). Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective. This audit was conducted in accordance with the audit responsibilities of the City Comptroller as set forth in Chapter 5, §93, of the New York City Charter.

The primary audit scope was December 28, 2014 through July 2, 2016.

To obtain an initial understanding of NYCT's organizational structure and the units involved with maintaining elevators and escalators we reviewed the organization charts provided by E&E officials.

To obtain a general understanding of how elevators and escalators are maintained, inspected, and repaired by E&E, we conducted walkthrough meetings with E&E officials in charge of daily operations. To understand daily operations and how equipment is maintained and repaired at the zone level, we conducted walkthrough meetings with personnel at Zone 2 and Zone 3.

We also reviewed the following materials:

- *Escalator Maintenance Procedures* for Level 1 and 2
- ASME Procedures and Checklists
- Preventative Maintenance (PM) Schedules for Zone 1 , Zone 2 , Zone 3 and Zone 4
- *Procedure for Updating Maintenance Procedures*
- *Hydraulic Elevator Maintenance Procedures* Levels 1 through 5
- *Escalator Maintenance Procedures OTIS Escalator* procedures for levels 3 through 5
- *Escalator Maintenance Procedures KONE Escalator* procedures for levels 3 through 5
- *Escalator Maintenance Procedures Fujitec Escalator* procedures for levels 3 through 5
- *Schindler Maintenance Level III- revised, IV- revised, V- revised*
- *Traction Elevator Maintenance Procedures* for levels 1 through 5
- *Elevator and Escalator Quarterly Reports* for 2015
- *E&E Operational Procedure: Maintenance and Planning*
- *E&E Operational Procedure: Performance of Maintenance Audits*
- Corrective Action Reports
- Maintainers Log Sheets
- MS-1 (Supervisor) Daily Activity Report

- MTA/NYCT Internal Control Policy

In addition, we reviewed the instructions for suspension of Level 1 and 2 PM service.

To obtain an understanding of how maintenance and repairs are tracked and reported, we conducted walkthrough meetings with the Control Desk Manager to obtain an overview of LiftNet and EERMS. In addition, we reviewed *EERMS Corrective Action Work Orders*, which provides guidelines for creating Corrective Action work orders in EERMS database. We asked E&E officials to confirm our understanding of key operations in writing.

To obtain an understanding of Control Desk operations and how machine outages are recorded and managed, we conducted a walkthrough meeting of the Control Desk operations and reviewed E&E's *Control Desk Procedures*. In addition, we conducted a walkthrough meeting with the General Superintendent and the Deputy Superintendent of Asset Management, to understand how ASME inspections are conducted. We also reviewed the Availability/Reliability Report Summary.

To obtain an understanding of the findings and recommendations made by previous audits we reviewed the Comptroller's audit report, *Audit Report on New York City Transit Efforts to Inspect, Repair and Maintain Elevators and Escalators* (#MJ10-065A), issued July 23, 2010, and *Follow-up Audit Report on New York City Transit's Efforts to Inspect, Repair, and Maintain Elevators and Escalators* (#MJ12-129F), issued September 25, 2013. In addition, we reviewed a report issued by MTA's Office of the Inspector General (OIG), *Ineffective Use of Remote Monitoring Technology for New York City Transit Elevators and Escalators* issued in July 2011 and a follow-up report, *Elevator and Escalator-Follow Up on Recommendations MTA/OIG #2012-09*, issued in July 2013.

We obtained a list of all revenue machines from E&E, which included 223 elevators, 184 escalators and two powerwalks. For the purposes of this audit, we focused on elevators and escalators only. We tested the list for accuracy and completeness by randomly selecting (1) 21 machines from the list and determining whether a hardcopy file of PM and ASME checklists existed; and (2) the hardcopy files for another 21 machines and determined whether the machines were included in the list we received. Further, we compared the current list to the list previously provided by NYCT during the recent prior follow-up audit (#MJ12-129F). The goal was to determine whether all machines listed in connection with the prior audit were included on the new list, and whether the newly installed machines were added to the list. Moreover, we visited 10 stations and determined whether the revenue elevators and escalators in these stations were included on the list provided.

We selected a random sample of 15 percent of the elevators and escalators from each of the four designated zones in the City. The sample included: 3 of 20 escalators and 10 of 61 elevators from Zone 1; 8 of 53 escalators and 8 of 47 elevators from Zone 2; 9 of 57 escalators and 12 of 79 elevators from Zone 3, and 9 of 56 escalators and 6 of 36 elevators in Zone 4. We determined whether: 1) PM service, ASME inspections, and repairs were performed in a timely manner; 2) all PM and ASME inspections forms had been completed and signed off by maintainers and supervisors; 3) work orders were created to repair defects identified during PM service and ASME inspections; and 4) all work details resulting from PM service and ASME inspections were entered

into EERMS. In addition, we determined whether there were any associated work orders already open prior to the time of our review and if they were closed in a timely fashion. We determined whether any of the sampled work orders were backdated or whether defects associated with work orders were transferred to other work orders. In addition, to obtain information on work performed for the machines with backdated work orders, we reviewed corrective action reports in the field offices in each of the four zones. Our total sample size was 65 machines, 36 elevators and 29 escalators.

We reviewed a total of 724 PM documents, 197 Category 1 ASME and 28 Category 5 ASME inspection documents for the sampled elevators and escalators for the scope period. In addition, we reviewed 104 suspension memos for suspended PMs for the sampled machines.

From the list of 223 elevators, we excluded the elevators installed from 2011 and on (because ASME Category 5 inspections are performed every five years), and we randomly selected 15 percent of the remaining elevators for a sample size of 27 machines. We determined whether Category 5 ASME Inspections were performed every five years as required on passenger elevators. We also determined whether ASME inspection forms were on file, completed and signed by maintainers and the appropriate supervisor. Based on results found during the Category 5 ASME Inspections, we determined whether all applicable defects were entered into EERMS by the supervisor.

To determine whether zone supervisors conducted field visits in each of the four zones, we randomly selected five days during our scope period and obtained and reviewed the Daily Activity Reports completed by the supervisors. We then expanded the sample based on the most current randomly selected date, and obtained and reviewed the Daily Activity Reports for the remaining days in that week.

To determine whether NYCT's Availability Rates for the revenue machines are accurate, we first judgmentally selected eight machines in total (the first randomly selected elevator and escalator from each zone). Next we identified the service times and outage codes recorded in EERMS which spanned the period covering the PM assignments conducted during our audit scope period.[22] Then we reconciled that data with the machine's Availability Report for the same time period.

We identified the machines within our sample that failed ASME inspections and determined whether a Level 3 or 5 PM had been performed prior to the failed ASME inspections. Using the information on the PM documentation and EERMS, we determined the number of hours worked during each PM, whether defects were pending at the conclusion of each PM, and whether the machines met E&E's availability goals.

We requested from E&E officials a list of all work orders created during our scope period to determine the total number of work orders for Type A and B defects, the number that were open, the number that were closed, and E&E's timeliness in closing work orders.

[22] The outage codes indicate the reason the machine is out of service (e.g., PM service or ASME inspection).

The results of the above tests, while not projectable to their respective populations, provided a reasonable basis for us to evaluate the controls over the repair and maintenance of elevators and escalators.

APPENDIX I

PM Checklists with Number of Codes Checked by Machine Type

Type of Machine	PM Level	Number of Codes Listed on Checklist
Traction Elevator	Level 1	26
Traction Elevator	Level 2	27
Traction Elevator	Level 3	55
Traction Elevator	Level 4	47
Traction Elevator	Level 5	85
Hydraulic Elevator	Level 1	26
Hydraulic Elevator	Level 2	27
Hydraulic Elevator	Level 3	52
Hydraulic Elevator	Level 4	46
Hydraulic Elevator	Level 5	82
All Escalators	Level 1	8
All Escalators	Level 2	9
Fujitec Escalators	Level 3	29
Fujitec Escalators	Level 4	13
Fujitec Escalators	Level 5	33
Schindler Escalators	Level 3	29
Schindler Escalators	Level 4	11
Schindler Escalators	Level 5	32
Kone Escalators	Level 3	26
Kone Escalators	Level 4	11
Kone Escalators	Level 5	30
Otis Escalators	Level 3	27
Otis Escalators	Level 4	12
Otis Escalators	Level 5	30

APPENDIX II

"A" DEFECTS

Safety Switches/Conditions Escalators	Safety Switches/Conditions Traction Elevators	Safety Switches/Conditions Hydraulic Elevators
1.Emergency Stop Buttons	1. Top Car Stop Switch	1. Top Car Stop Switch
2. Handrail Inlet Monitors	2. Top Final Limit	2. Top Final Limit
3. Comb Stop Switch	3. Top Normal Limit Switch	3. Top Normal Limit
4. Comb Impact Switch	4. Emergency Escape Hatch Switch	4. Emergency Escape Hatch Switch
5. Carriage Switches	5. Bottom Final Limit	5. Bottom Final Limit
6. Skirt Switches	6. Bottom Normal Limit	6. Bottom Normal Limit
7. Step Sag Monitor	7. Pit Stop Switch	7. Pit Stop Switch
8. Missing Step Monitor	8. Governor Switches	8. Governor Switches
9. Broken Handrail Monitor	9. Plank Switch	9. Plank Switch
10. Handrail Speed Monitor	10. Slack Rope Switch	10. Slack Rope Switch
11. Step Up Thrust Monitor	11. Car Stop Switch	11. Rupture Valve
12. Step-Chain Locking Device Switch	12. Car Glass Panels Switches	12. Car Stop Switch
13. Handrail Throw Off Device	13. Counter Weight Safety Switch	13. Top Car Safety edge Switch
14. Step Band Speed Sensor	14. Compensating Rope Safety Switch	14. Car Glass Panels Switches
15. Brake Lift Monitor	15. Gate Switches	15. Pressure Switch
16. Pit Stop Switch	16. Door Interlocks	16. Controller Stop Switch
17. Motor Stop Switch	17. Door Zone Locks/Door Restrictors	17. Gate Switches
18. Broken Main Drive Chain Switch	18. Not Properly Leveling (exceeds 0.5 inch)	18. Door Interlocks
19. Stopping Distance Fault	19. Both Alarm Bell and Car Intercom Inoperable	19. Door Zone Locks/Door Restrictors
	20. Shattered Glass/Vision Panels	20. Not Properly Leveling (exceeds 0.5 inch)
		21. Both Alarm Bell and Car Intercom Inoperable
		22. Shattered Glass/Vision Panels

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New York, NY 10004
212 878-7200 Tel

Veronique Hakim
Interim Executive Director

Metropolitan Transportation Authority
State of New York

April 17, 2017

Ms. Marjorie Landa
Deputy Comptroller for Audit
The Office of the City Comptroller
Bureau of Audit
1 Centre Street, Room 1100
New York, NY 10007

Re: Draft Report #MD16-103A (New York City Transit's Efforts to Inspect and Repair Elevators and Escalators)

Dear Ms. Landa:

This is in reply to your letter requesting a response to the above-referenced draft report.

I have attached for your information the comments of Darryl C. Irick, Acting President, NYC Transit, which address this report.

Sincerely,

Veronique Hakim
Interim Executive Director

c: Donna M. Evans, MTA Chief of Staff
Michael J. Fucilli, Auditor General, MTA Audit Services

Attachments

Memorandum

New York City Transit

Date April 17, 2017

To Veronique Hakim, Interim Executive Director

From Darryl C. Irick, Acting President, New York City Transit

Re **NYCT Response: City Comptroller Audit Report #MD16-103A – NYCT's Efforts to Inspect and Repair Elevators and Escalators**

This information is being provided in response to the City Comptroller's draft audit report on "Efforts to Inspect and Repair Elevators and Escalators" (MD16-103A) (Audit). The stated purpose of the audit was to determine whether New York City Transit (NYCT) performs required preventative maintenance services and inspections on its escalators and elevators, and whether it makes associated repairs in a timely manner.

Background

NYCT has 248 elevators and 224 escalators and carries almost 6 million people each day on the subway system. Elevator and escalators operate 24 hours a day, 7 days a week under strenuous conditions.

NYCT has an exceptionally strong elevator and escalator inspection and maintenance program. Even so, given the 24/7 nature of NYCT's operations, elevators and escalators – no matter how reliable they are – cannot be available for uninterrupted customer use; they must be taken out of service to preform maintenance activities. Taking into account the planned outages necessary for preventative maintenance, elevators and escalators are still available for customer use approximately 96% of the time.

Audit's Faulty Methodology

The Comptroller's audit surveyed maintenance on 36 elevators and 29 escalators – a total of 65 machines – out of the 226 elevators and 184 escalators in revenue service in the NYCT system at the time of the Audit. It excluded from its sample all machines installed after 2011. As a result of excluding newer machines that have higher performance records, the Audit was skewed toward machines that are more likely to break down.

Audit Inaccuracies

NYCT has carefully reviewed the audit and found a significant number of inaccuracies in the report and recommendations based on those inaccuracies, including:

1. The audit implies that only one-fifth (20 percent) of the equipment in its sample group received scheduled preventative maintenance services.

The audit conflates the number of machines (65) with the number of planned service events on those machines (849). At the beginning of each year, preventative maintenance schedules are created for the upcoming 12 month period. Of course, conditions change over time, and it often becomes apparent that a preventative maintenance event planned at the beginning of the year is no longer necessary when the scheduled time arrives. NYCT policy provides that where an elevator or escalator has received service within 30 days prior to a scheduled preventative maintenance event, there is no longer a need to perform the scheduled service, which is then canceled. During the audit period, 849 service events were planned, but 95 of them were canceled because they were no longer necessary due to the aforementioned policy. Of the remaining 754 events, all but 30 were performed. In other words, planned maintenance was carried out 96 percent of the time – not 20 percent as the audit implies.

2. The audit suggests that maintainers did not complete inspection checklists for nearly a quarter of the inspections.

This statement is misleading, because it incorrectly implies that entire checklists were missing. In some instances, there were missed items within a long checklist, but the checklist itself was completed. For example, there are 85 checkboxes for a Level 5 elevator inspection. While some of these checkboxes were not properly checked off in a portion of the sample, it is inaccurate to claim that the checklists were not completed. Regardless, NYCT is reinforcing compliance with existing policy which requires that all items on checklists be inspected and properly recorded.

3. The audit says 62 items were still pending after the maintenance assignments were completed.

This statement implies that defects must be corrected as a result of preventative maintenance on-the-spot. While NYCT addresses defects during the inspection when possible, many repairs cannot be addressed at an inspection because parts need to be ordered, etc. When a preventative maintenance event is scheduled, the supervisor will review pending work orders for the specific machine and determine the amount of additional work that can be accomplished. The supervisor must balance what work can reasonably be done without delaying the entire planned preventive maintenance schedule for the zone.

4. The audit claims that NYCT does not have a system for tracking work orders and repairs.

This is incorrect. NYCT has a robust system for tracking defects and implementing corrective actions. Defects are captured in inspection reports and those defects are incorporated in work orders. As the defects are corrected, they are moved into a separate section of the work order. In order to provide more in-depth information regarding such work order and repair reports, such reports now include greater detail regarding the times such defects were corrected and the type of work conducted. NYCT is also currently investing in a system that will improve this tracking effort.

5. The audit claims that NYCT cannot ensure that its 407 elevators and escalators in service at the time of the Audit will continue to be in good operating condition based on their sample review. It also claims the machines sampled did not pass one or more of the inspections that had been conducted.

Once again, that is not a complete account as it conflates the number of machines with the number of inspections performed on them. Many machines underwent more than one inspection and passed.

6. The audit inaccurately claims that preventive maintenance was not completed in a timely manner in nearly a third of service assignments.

As discussed above, preventative maintenance is scheduled system-wide at the beginning of year, and this schedule is modified during the course of the year to account for instances where when personnel have been in contact with the machine within 30 days prior to the planned maintenance event. As noted above, there were 754 preventative maintenance events during the audit period on the sampled machines. 560 of those assignments (74%) were completed on time. In addition, all 233 American Society of Mechanical Engineers (ASME) code inspections were completed on time.

Efforts for Improvement

A number of steps are already underway to improve NYCT's existing robust elevator and escalator maintenance program, including:

- The replacement of 42 elevators at 19 stations and the installation of 39 new ADA-compliant elevators at 16 stations through over $500 million in the MTA's 2015-2019 Capital Program will have significant impact on riders. This investment will complete NYCT's commitment under the Key Station program to make 100 stations fully accessible by 2020 and also will expand accessibility to selected stations beyond the Key Station program;
- The replacement of 30 escalators at 13 stations using $157 million in the 2015-2019 Capital Program;
- Dedicated resources to develop a new maintenance management system that will improve NYCT's ability to collect and analyze detailed information about specific assets and help guide maintenance and investment decisions.
- A pilot program to bolster and strategically realign managerial resources to improve performance of equipment and efficiency of maintenance practices, particularly during the evening rush.
- Expansion of the apprentice program to supplement maintenance staff and ensure expertise in the future.