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BUREAU OF MANAGEMENT AUDIT

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Audit Report on New York City Transit Efforts to Inspect, Repair and Maintain Elevators and Escalators

MJ10-065A

July 23, 2010

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THE CITY OF NEW YORK
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John C. Liu
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July 23, 2010

To the Residents of the City of New York:

My office has audited the adequacy of the New York City Transit's (NYCT) efforts to maintain, inspect, and repair subway station elevators and escalators used by the public. The NYCT is the largest agency in the Metropolitan Transportation Authority's regional transportation network. We audit entities such as the NYCT as a means of ensuring that transportation infrastructure is adequately maintained and safe for use by the public.

The audit disclosed weaknesses and inefficiencies that inhibit or render inadequate NYCT's efforts to maintain, inspect, and repair all station elevators and escalators. Even though NYCT has a comprehensive program for the operation of subway station elevators and escalators, it does not ensure that all required preventive maintenance (PM) service and scheduled maintenance system (SMS) work is consistently performed. More than one-fourth of the scheduled PM assignments for sampled equipment were not performed as required, and SMS work was not consistently performed. NYCT performed a significant portion of required inspections for calendar years 2008 and 2009; however, five-year safety tests were lacking. In addition, NYCT does not have sufficient credible data to adequately assess its performance of repairs and maintenance.

The audit made 17 recommendations to address these issues, including that NYCT should: ensure that required PM and SMS work is performed and supported by work reports; keep track of and investigate repeated periods of nonperformance of PM and SMS work; ensure that all required documentation for work performed by work crews is completed and retained.

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 email my audit bureau at audit@comptroller.nyc.gov.

Sincerely,

John C. Liu

Table of Contents

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AUDIT REPORT IN BRIEF

This audit determined the adequacy of the New York City Transit's (NYCT) efforts to maintain, inspect, and repair subway station elevators and escalators used by the public.

The NYCT is the largest agency in the Metropolitan Transportation Authority's regional transportation network. NYCT operates 27 subway lines that connect 468 active stations throughout four of the City's five boroughs. The NYCT subway serves an average of 4.5 million riders daily. To enable passengers with physical mobility impairments to access the subway and to facilitate the movement of passengers through the system, elevators and escalators are installed at specific stations considered to benefit the most people, based on such factors as high ridership, presence of transfer points, and service to major areas of activity. As of September 23, 2009, there were 182 elevators and 176 escalators available to the public at stations throughout the City.

The NYCT Division of Infrastructure's Elevator and Escalator Department (EED) is responsible for ensuring that all elevators and escalators in subway stations and other NYCT facilities are clean, safe, and reliable. Specifically, the EED is responsible for inspecting and maintaining all elevators and escalators in NYCT facilities in safe operating order. This audit addressed only those station elevators and escalators available for use by the public.

Audit Findings and Conclusions

Our audit disclosed weaknesses and inefficiencies that inhibit and, at times, render inadequate EED efforts to maintain, inspect, and repair all station elevators and escalators.

While the NYCT EED has a comprehensive program for the operation of subway station elevators and escalators, it does not ensure that all required preventive maintenance (PM) service and scheduled maintenance system (SMS) work is consistently performed. Our review revealed that more than one-fourth of the scheduled PM service assignments for our sampled equipment were not performed. In addition, SMS work was not consistently performed or appropriately documented.

Our review of NYCT inspection records for calendar years 2008 and 2009 revealed that a significant portion of required inspections were performed. However, five-year safety tests were lacking. We noted that for both 2008 and 2009 the actual number of inspections performed fell short of the annual inspection goal, with the gap growing from 2008 to 2010.

Regarding its repair and maintenance of escalators and elevators, NYCT does not have sufficient credible data by which it can adequately assess its performance. Based on NYCT quarterly availability data for calendar year 2009, NYCT reported nearly meeting its elevator and escalator availability goals. However, our review indicated that not all outages were recorded in the Elevator and Escalator Reporting and Maintenance System (EERMS), raising questions about the reliability of the performance figures. Additionally, we found that the system used to record and track equipment outages may not be functioning properly, and EED did not ensure that it retained evidence of maintenance and repair work performed. For our sampled equipment, we found no open work orders for Type A (hazardous) deficiencies. However, there were open work orders for Type B and Type C deficiencies and defects that the EED did not address for an average of 153 days (ranging from 125 to 172 days), as of April 26, 2010.

Finally, our review revealed certain internal control weaknesses; specifically, that EED lacks formal operating procedures and that it needs to strengthen the supervisory oversight and monitoring of its work crews.

Audit Recommendations

To address these issues, we make 17 recommendations, among them that NYCT should:

- Ensure that required PM and SMS work is performed and supported by PM and SMS work reports that are signed off both by the work teams and their respective supervisors.

- For each elevator and escalator, keep track of and investigate repeated periods of nonperformance of PM and SMS work.

- Immediately perform the five-year safety tests on elevators that were scheduled but not tested in 2008 and 2009.

- Ensure that all required documentation reflecting work performed by field crews (inspection, PM and SMS reports and machine room logs) are completed by work crews and retained. Also, require that some record of repair crews' completed work assignments be regularly maintained.

INTRODUCTION

Background

The Metropolitan Transportation Authority (MTA) was created in 1965 to maintain and improve commuter transportation and related services within the Metropolitan Transportation Commuter District, which encompasses the City of New York as well as Dutchess, Nassau, Orange, Putnam, Rockland, Suffolk, and Westchester counties. MTA New York City Transit (NYCT) is the largest agency in the MTA regional transportation network.[1] It operates bus service throughout the five boroughs and rail service on Staten Island. NYCT also operates 27 subway lines that connect 468 active stations throughout four of the City's five boroughs. The NYCT subway serves an average of 4.5 million riders daily.

To enable passengers with physical mobility impairments to access the subway and to facilitate the movement of passengers through the system, elevators and escalators are installed at specific stations considered to benefit the most people, based on such factors as high ridership, presence of transfer points, and service to major areas of activity. As of September 23, 2009, there were 182 elevators and 176 escalators available to the public at stations throughout the City.

The NYCT Division of Infrastructure's Elevator and Escalator Department (EED) is responsible for ensuring that all elevators and escalators in subway stations and other NYCT facilities are clean, safe, and reliable. This audit addressed only those station elevators and escalators available for use by the public.

The EED consists of a central office, an Inspection Unit, and four zone shops. The zone shops are each overseen by a superintendent and are directly responsible for maintaining elevators and escalators within each of their respective geographic zones (Zones 1-4).[2] The EED central office oversees the status of elevators and escalators via the Lift-Net Remote Monitoring System (Lift-Net), dispatches emergency work crews to reported outages, and records and tracks the status of all equipment outages through its central control desk and related computerized systems. Most station elevators and escalators are connected through telephone lines to Lift-Net, which enables the central control desk to remotely monitor outages of connected equipment and to remotely trouble-shoot connected equipment. Lift-Net is designed to record all detected outage events in an automated event log. To respond to outages as they occur, the EED operates 24 hours a day, 365 days a year.

In Fiscal Year 2009 the EED employed a workforce of 309, consisting of a general superintendent, superintendents, supervisors, mechanical engineers (commonly referred to as

[1] The subsidiary or affiliated agencies of the MTA are: MTA New York City Transit, Long Island Rail Road, Metro-North Railroad, Long Island Bus, MTA Bridges and Tunnels, MTA Bus Company, and MTA Capital Construction Company.

[2] Zone 1 encompasses Bronx and upper Manhattan; Zone 2, most of midtown Manhattan; Zone 3, downtown Manhattan and Brooklyn; and Zone 4, Queens, Roosevelt Island, and a small part of midtown Manhattan.

maintainers), apprentices and administrative support staff. The EED's Fiscal Year 2009 operating budget totaled $30 million, consisting of $26 million in total labor costs and $4 million in other than personal service costs.

The EED Inspection Unit, located in Brooklyn, operates independently of the zone shops. Staffed with one supervisor, eight inspectors, and three apprentices, the unit is solely responsible for carrying out required safety inspections and tests of elevators and escalators, hoists, moving walks, and other related equipment in the stations and other NYCT facilities. NYCT elevator and escalator inspections are conducted in accordance with the "Safety Code for Elevators and Escalators" (§A17.1) established by the American Society of Mechanical Engineers (ASME), a nationally-recognized organization that establishes standards for elevator and escalator inspections and testing.[3] In accordance with ASME standards, elevators and escalators must undergo a safety (routine) inspection once each year and a "no-load" safety test once each year (one-year test). In addition, elevators must also undergo a "full-load" safety test once every five years (five-year test).[4] Accordingly, NYCT inspectors use ASME Standard A17.2, "Guide for Inspecting Elevators, Escalators, and Moving Walks" and related checklists to conduct and record the results of their equipment inspections and tests.

Defects observed during an inspection are categorized according to their severity: "Type A" defects are severe safety hazards that present an immediate danger to customers and require the equipment to be taken out of service until the defects are corrected; "Type B" defects violate the safety code but are considered minor, do not present an immediate danger to customers, and do not require the equipment to be taken out of service; and "Type C" are considered minor, do not violate the safety code, and do not require the equipment to be taken out of service. Defects observed during an inspection are communicated to the inspection supervisor who then forwards the inspection reports to the central office, where they are reviewed and work orders are created for each of the noted deficiencies.

Each zone shop is responsible for the planned (scheduled) and unplanned (unscheduled) maintenance or repairs of elevators and escalators at stations within the zone's geographic area. Planned maintenance includes both preventive maintenance and scheduled maintenance, such as replacement of major parts and components, and responding to open work orders. Unplanned maintenance involves responding to outages and defective conditions identified through Lift-Net and to complaints received from the public and MTA employees. Each zone is staffed with work crews to address each of these situations.

To address planned maintenance, each zone has preventive maintenance (PM) teams that perform prescribed maintenance tasks during scheduled monthly assignments. PM teams also replace worn components and perform minor repairs when necessary. All PM work is performed during the night shift between 11:00 p.m. and 7:00 a.m. In addition, each zone shop has

[3] As a New York State public authority, the MTA and its NYCT affiliate agency are not covered by the City's Administrative Code or the Department of Building's rules and regulations for elevator and escalator safety, which are also aligned with ASME standards.

[4] A "no-load" safety test involves running an elevator empty and unloaded, whereas a "full-load" test requires that the elevator be run at its maximum load capacity.

scheduled maintenance system (SMS) work crews that are responsible for replacing or overhauling major machine parts and components near or at the end of their useful life, based on a predetermined replacement schedule.

To address unplanned maintenance or outages and deficient conditions identified during an inspection, each zone has repair crews including: (1) Customer Complaint (CC) Teams that generally are the first to respond to an emergency or breakdown based on a customer complaint or report of an outage and (2) Repair Teams. There is a CC team on duty during each shift under the direction of the control desk. If the control desk receives a complaint or report of an equipment outage and it cannot be addressed remotely, the control desk operator will dispatch a CC team to restart the equipment. If a CC repair team is unable to remedy the problem, the equipment will remain out of service until a more substantive repair can be performed by a regular repair crew. Each zone also has repair teams that work during the day shift from 7:00 a.m. to 3:00 p.m. The repair team supervisors at each zone, on a daily basis, prioritize, plan, and schedule required corrective action work for the teams.

In 2009, the EED used two computer systems to record and track elevator and escalator outages and repairs: (1) the EE Outage database—an internally-developed Access database—and (2) the Elevator and Escalator Reporting and Maintenance System (EERMS), a more robust database with pull down menus, standardized defect and repair codes, a work order system and reporting capabilities—also internally-developed with the assistance of MTA Department of Telecommunications and Information Systems development personnel. EERMS was implemented on January 1, 2009, and ran parallel to the EE Outage database until November 4, 2009, when the latter system was discontinued. Through November 3, 2009, control desk clerks were required to manually record all reported equipment outages in both EE Outage and EERMS. Prior to November 4, 2009, to record and track deficiencies observed in inspections and by maintenance crews, EED maintained a Defect List database compiled by a supervisor at the central office using completed inspection checklists submitted by the inspection unit. Once a month a Defect List report was generated by a supervisor at the central office and forwarded to zone superintendents, who would then be responsible for taking appropriate action to address the defects.

With the full implementation of EERMS on November 4, 2009, defects identified through inspection and maintenance reports are now entered into EERMS, which then generates a work order for each defect that is then assigned to a repair crew in the appropriate zone. The repair crew supervisor is responsible for prioritizing and scheduling the corrective action work. All repair work is performed during the day shift (7:00 a.m. to 3:00 p.m.). At the end of the work shift, the repair teams return to their respective zone shops and orally report to the supervisor the status of assigned work. The supervisor then updates EERMS by entering the repair information and, if the repair is completed, closes out the work order.

NYCT maintains log books in each of the elevator and escalator machine rooms. Every time EED mechanics or work crews enter a machine room, for whatever reason, they are required to record the date and time of arrival and departure, the signature and pass number of each individual employee, and an explanation of the work that was performed, including the time equipment was removed from and returned to service.

Audit Objective

To determine the adequacy of NYCT efforts to maintain, inspect, and repair subway station elevators and escalators used by the public.

Scope and Methodology

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 objectives. 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 scope of our audit was January 1, 2008 through April 26, 2010. To accomplish our objective we performed the following procedures.

To gain an understanding of the NYCT departments involved in the inspection, repair and maintenance of station elevators and escalators and of their general roles and responsibilities, we reviewed Articles 5, 9, and 11 of the New York State Public Authorities Law, departmental organization charts, and various reports, publications, memoranda, and other relevant materials obtained from NYCT officials, the MTA Web site, and other sources. We also reviewed available budget data and personnel rosters to identify resources available for elevator and escalator inspection and maintenance.

Evaluation of Controls

To understand and evaluate applicable processes and controls pertaining to EED inspection, repair, and maintenance activities, we interviewed various EED officials. We also interviewed supervisory and staff personnel at the EED central office and at the four zone shops. We conducted walkthroughs of the EED and accompanied and observed supervisors, inspectors, maintainers, and control desk operators while they were performing their duties.

We reviewed available operating policies and procedures pertaining to the inspection and maintenance of elevators and escalators. In the absence of formal operating procedures, we ascertained procedures through observations, walkthroughs, and interviews with EED personnel, and confirmed our understanding with EED officials. To supplement our understanding, we reviewed assorted training materials, applicable MTA rules and regulations, and a report by Dewberry-Goodking Inc., (Dewberry) and Vertical Transportation Excellence (VTX, a division of Gannett Fleming Inc.,) issued on October 5, 2007, of their review and evaluation of the EED.[5]

[5] In 2007, NYCT retained Dewberry and VTX to analyze and evaluate NYCT's overall management practices with respect to their elevator systems. The Dewberry-VTX study focused on NYCT's policies, procedures, and management practices in the various phases of elevator installations and maintenance,

In addition, we referred to Articles 5 and 9 of the New York State Public Authorities Law and Comptroller's Directive #1, "Principles of Internal Control," for supplemental guidance. We tested compliance with EED operating procedures and determined whether supervisory oversight and segregation of duties were adequate.

Sample Selection

From the population of 182 elevators and 176 escalators in NYCT subway stations across the four boroughs as of September 23, 2009, we selected two samples. For Sample 1, we randomly selected 10 elevators and 10 escalators from their respective populations. For Sample 2, we judgmentally selected 10 elevators and 10 escalators that had the highest outage rates for the period January 1–June 30, 2009. One or both of these samples were used in audit tests. However, one elevator (#ES239) appeared in both samples and was therefore excluded from Sample 2 to avoid duplication of related data. Sample 1 and Sample 2 together yielded a total of 39 elevators and escalators. Source documentation (inspection reports, preventive maintenance schedules and reports, work orders, etc.) and other relevant records and data associated with the sampled equipment were used in audit tests discussed below.

Data Reliability Tests

To gain an overview of the capabilities, purposes, and uses of the EED's various databases—EERMS, Lift-Net, EE Outage, and Defect List database—we interviewed the EED General Superintendent, Administrative Assistant, and users of the systems. We reviewed available user manuals and associated supplemental information, reviewed reports, and ascertained the type of data recorded and tracked in each system. We were also provided with read-only access to the EERMS database and accessed the other databases with the assistance of EED personnel to obtain data and to generate reports relevant to the audit tests. On a limited basis, we evaluated the general controls and support of each application. Since the EED discontinued use of the Defect List and EE Outage databases early in the audit, our tests primarily focused on EERMS and Lift-Net.

We identified 155 actual outage events based on inspection and PM schedules and reports (source documentation) for the 20 devices (10 elevators and 10 escalators) in Sample 1 for the period of January 1–September 30, 2009. We traced the information associated with these outages (equipment number, date and time of outage, outage type, etc.) as reflected in source documentation to EERMS and the EE Outage databases to test the reliability and completeness of data processed in each system. We also compared information recorded in Lift-Net event logs to the outage time periods recorded on the inspection and PM reports to determine whether Lift-Net detected and recorded outage events as described in the source documentation. (This test discounted five pieces of equipment lacking "mechanic-on-site" (MOS) switches and their 40 related outages, leaving a net of 115 outage events traced to Lift-Net).

Since the EED used EERMS solely from November 4, 2009, we judgmentally selected the week of December 13–19, 2009 for testing to determine the accuracy and reliability of the

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including design, procurement, construction, testing, acceptance, and maintenance.

equipment outage data tracked by EERMS. We identified and traced 50 outages recorded in the machine room logs for 21 of the 39 sampled devices and traced them to EERMS to determine whether they were appropriately recorded in the system. We also compared the list of elevators and escalators reported as out of service on the MTA Web site to the outages reported by EERMS.

We had concerns about the completeness of the data; therefore, we generally relied on source documentation to perform our audit tests. However, for the purpose of completing other required audit tests, we determined that the data was sufficiently reliable for use therein.

Evaluation of Inspection, Repair and Maintenance Efforts

As detailed below, we tested the EED's general efforts to comply with adopted NYCT standards for inspection, repair and maintenance (planned and unplanned) for consistency of performance. As part of our testing, we also considered relevant administrative, operating, and management policies, procedures, and processes to support the EED mission of keeping elevators and escalators in safe, operating condition. We did not address the technical aspects of inspection and maintenance tasks or the procurement and inventory of related parts and components. Nor did we review the qualifications or training of EED maintenance personnel. These were considered outside the scope of this audit.

Inspections

We reviewed inspections for the 39 sampled units of equipment and subsequently expanded our test to include all 400 NYCT elevators and escalators supported by the EED so as to measure the frequency of inspections. Specifically, we reviewed NYCT elevator and escalator inspection records (inspection schedules and completed inspection reports) for calendar years 2008 and 2009. From the inspection schedules, we ascertained the total number of annual inspections and one-year safety tests required to be performed on all NYCT elevators and escalators for calendar years 2008 and 2009. We also determined the number of five-year elevator safety tests required. For all scheduled inspections, we assessed whether inspections were performed when required, based on inspection reports and completion dates. We also reviewed inspection goals and personnel resources for required safety inspections and tests to determine whether sufficient time and personnel were made available to ensure that all required inspections and tests were conducted.

Preventive and Scheduled Maintenance

To determine whether required monthly preventive maintenance was performed on the 39 sampled elevators and escalators, we obtained and analyzed the completed PM reports or checklists for Sample 1 devices for the 21-month period January 1, 2008–September 30, 2009, and for Sample 2 devices (those that were judgmentally selected because they had high outage rates) for the 9-month period January 1, 2009–September 30, 2009. Based on the results of this analysis, we determined the frequency of nonperformance of PM service across the sampled equipment. For individual elevators and escalators, we assessed trends of PM performance and

nonperformance and identified equipment lacking PM service for the longest time across the test periods.

For scheduled maintenance and parts replacement, we reviewed the annual SMS schedule for 2009 and available SMS reports of completed work for the same period for the 39 sampled units of equipment. To supplement limited reports, we reviewed the machine room logs for the sampled equipment to determine whether any notations of SMS work were recorded in the logs for 2009. We computed the total number of required SMS assignments for the sampled equipment in 2009, based on the 2009 schedule, and then determined the number of scheduled assignments that were performed based on available SMS reports and entries in the equipment logs.

Repair Activities

To determine whether deficiencies identified during a safety inspection were appropriately referred for repair, we identified 9 of the 39 sampled elevators and escalators for which a safety inspection was performed during November and December 2009. We traced the 89 deficiencies noted on the inspection reports to EERMS and determined whether a work order was generated for each defect. We also determined the status of the work orders (i.e., open or closed) and the length of time it took the EED to address each work order and correct the reported deficiencies.

Work Completion and Supervisory Oversight

To gain reasonable assurance that work crews carried out their assignments, we examined the arrival and departure times recorded on the PM and inspection reports for the 39 sampled elevators and escalators and compared them to the related dates and times entered on their respective logs. We corroborated that information by checking the date and time entries for those assignments that appeared in Lift-Net event logs as well as in the EERMS and EE Outage databases.

To ascertain whether field crews were at assigned worksites, on March 10, 2010, we identified three pieces of equipment that were out of service for inspection, visited their stations, and observed whether work crews were on site. At the end of the day, we visited the inspection shop in Brooklyn to verify that the crews reported back at the end of their shift. Further, to assess the adequacy of supervisory oversight, we determined through interviews and documentation review whether supervisors visited work crews at assigned work sites, reviewed work performed, and approved work crew reports.

Lastly, we reviewed EED performance statistics and management reports to assess the benchmarks and metrics used to measure and track the availability and reliability of the station elevators and escalators.

Our audit samples were not selected in a manner to enable them to be projected to their respective populations. Nevertheless, the sample test results provided a reasonable basis for us

to assess the adequacy of NYCT efforts to inspect, repair and maintain subway station elevators and escalators.

Discussion of Audit Results

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 officials and discussed at an exit conference held on May 27, 2010. On June 2, 2010, we submitted a draft report to NYCT officials with a request for comments. We received a written response from NYCT officials on June 24, 2010. In their response, NYCT officials agreed with all 17 audit recommendations.

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

FINDINGS AND RECOMMENDATIONS

Our audit disclosed weaknesses and inefficiencies that inhibit and, at times, render inadequate EED efforts to maintain, inspect, and repair all station elevators and escalators.

The NYCT EED has a comprehensive program focused on ensuring the safe and continuous operation of subway station elevators and escalators. However, NYCT does not ensure that all required PM service and scheduled maintenance (replacement of major parts) is consistently performed. Our review revealed that more than one-fourth of the scheduled PM service assignments required for the 39 sampled pieces of equipment were not performed. In addition, SMS work was not consistently performed as scheduled or appropriately documented.

Additionally, our review of NYCT inspection records for all elevators and escalators for calendar years 2008 and 2009 revealed that a significant portion of required inspections were performed. However, five-year safety tests were lacking. In 2009, less than 30 percent of required five-year safety tests were performed. Overall, we noted that for both 2008 and 2009 the actual number of inspections performed fell short of the annual inspection goal. Moreover, the gap between the target inspection goal and the number of required inspections grew from 2008 to 2010.

Regarding its repair and maintenance of escalators and elevators, NYCT does not have sufficient credible data by which it can adequately assess its performance. Based on quarterly availability data derived from the EE Outage and EERMS databases for calendar year 2009, NYCT reported nearly meeting its elevator and escalator availability goals for the same period. However, our review indicated that not all outages were recorded in EERMS, raising questions about the reliability of the performance figures. Additionally, we found that the system used to record and track equipment outages may not be functioning properly, and EED did not ensure that it retained evidence of maintenance and repair work performed. For our sampled equipment, we found no open work orders for Type A (hazardous) deficiencies. However, there were open work orders for Type B and Type C deficiencies and defects that the EED did not address for an average of 153 days (ranging from 125 to 172 days), as of April 26, 2010.

Finally, our review revealed certain internal control weaknesses. Specifically, we found that EED lacks formal operating procedures and that it needs to strengthen the supervisory oversight and monitoring of its work crews.

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

Weaknesses in Preventive and Scheduled Maintenance Activities

Preventive Maintenance Not Consistently Performed

NYCT does not ensure that all required PM service is consistently performed each month on passenger elevators and escalators. Our review revealed that more than one-fourth of the scheduled PM service assignments required for the 39 sampled devices (20 elevators and 19 escalators) were not performed.

NYCT requires PM service to be performed on each elevator and escalator at least once each month. Preventive maintenance includes adjustment, lubrication, and replacement of minor parts. Although required monthly, the PM tasks to be performed depend on whether the scheduled PM service is monthly, quarterly, or yearly. For example, monthly PM service includes inspection and adjustment of doors and brakes, observation and checks of safety devices, and communication with the NYCT control center. Quarterly PM service includes all monthly PM tasks along with checking oil levels, fuses, ropes, cleaning of all motors, brushes, etc. Yearly PM service includes all monthly and quarterly PM tasks along with the inspection of cables, insulation, switches, springs, wiring, etc.

PM teams are required to complete a PM report documenting the work performed for each scheduled PM assignment. At the end of each week, the PM supervisor prepares a status summary of PM service assignments for each team and submits it to the zone Superintendent.

As shown in Table I below, NYCT did not perform 152 (27%) of the 560 required PM service assignments for the 39 devices in our two audit samples during the specified test periods (21 months from January 1, 2008, through September 30, 2009 for Sample 1, and 9 months from January 1, 2009, through September 30, 2009, for Sample 2).

Table I

Planned Preventive Maintenance Assignment Performance

Sample	Total Scheduled PM Service Assignments for All 39 Sampled Devices	Total Scheduled PM Service Assignments Performed on 39 Sampled Devices		Total Scheduled PM Service Assignments Not Performed on 39 Sampled Devices	
		Number	Percentage	Number	Percentage
Sample 1 (Random) *(for the 21 months, 1/1/2008–9/30/2009)*	389	295	76%	94	24%
Sample 2 (High Outage Rates) *(for 9 months, 1/1/2009–9/30/2009)*	171	113	66%	58	34%
Total	560	408	73%	152	27%

For the 560 required PM assignments, NYCT had PM reports for 477 (85%), of which 408 evidenced PM service performed and 69 evidenced no PM service. One of the reasons noted on the reports for not performing the scheduled PM service was that a piece of equipment was out of service or under repair. Other reasons were that a PM team member was reassigned, in training, or on sick or vacation leave. NYCT did not have PM reports for the remaining 83 (15%) scheduled PM assignments; therefore, if a PM assignment had no corresponding report, we concluded that required PM work was not performed.

Table I appears to illustrate the importance of performing scheduled PM assignments. Specifically, as shown in the table, the required PM assignments were performed 76 percent of the time for the sampled machines that were randomly selected, versus 66 percent—10

percentage points lower—for the sampled machines that were selected based on high outage rates.

When considering the frequency of PM service for individual elevators and escalators, as shown in Table II below, our tests revealed that all scheduled PM assignments for the related test periods were carried out on only one (3%) of the 39 pieces of sampled equipment. Scheduled PM assignments were not performed between 5 percent and 80 percent of the time for the remaining 38 (97%) sampled equipment.

Table II

Frequency Distribution of Nonperformance of
Scheduled PM Service Assignments for 39 Sampled Elevators and Escalators

Percentage Range of Scheduled PM Service Assignments Not Performed	Number of Elevators and Escalators			Percentage of Sample
	Sample 1 (Random)	Sample 2 (High Outages)	Total	
0%	0	1	1	3%
5%–25%	11	6	17	44%
26%–45%	6	10	16	41%
46%–65%	2	0	2	5%
66%–80%	1	2	3	8%
Total	20	19	39	100%

Overall, based on the above analysis, 53 percent (or 21) of the 39 sampled equipment was not consistently maintained by PM teams more than 25 percent of the time. Table II also illustrates the importance of performing PM assignments regularly. For example, PM assignments were not performed between 26 percent and 45 percent of the time for 10 of the high outage sampled machines as compared to six of the randomly sampled machines.

In the course of performing PM tasks, a PM team may come upon a minor defect that needs repair. If the team can make the repair, it will; however, there may not be sufficient time in their shift to complete both the repair and all scheduled PM tasks. Therefore, certain PM tasks may go unaddressed. In such cases, the team will note the modification on the PM report. This practice is of concern given the level of nonperformance discussed above and the fact that we found that 25 (64%) of the 39 pieces of sampled equipment had not been serviced for two or more consecutive months (see Appendix). For example, sample elevator #EL340 was not serviced for six consecutive months from November 2008 through April 2009, sample elevator #EL702 was not serviced for five straight months, from January through May 2009, and sample elevator #EL319 was not serviced for two four-month periods, from April through July 2008 and from September through December 2008, respectively.

Preventive maintenance is a scheduled activity that is necessary to maintain equipment in a state of good repair by conducting regular tasks of checking, testing, adjusting, and maintaining machine parts. As each NYCT commuter elevator and escalator operates almost continuously, preventive maintenance activities are critical for maintaining the equipment in good repair, reducing outages, and maximizing equipment life. Accordingly, failure to perform scheduled PM assignments consistently could results in more frequent breakdowns, inconveniencing the riding public.

SMS Work Not Always Completed or Appropriately Documented

Our review disclosed that scheduled SMS work is not consistently performed as scheduled or appropriately documented.

SMS was added to the EED maintenance program in January 2007. The purpose of the SMS is to (1) predict the useful life of the major components, based on equipment type, manufacturers' recommendations, historical data, and the potential impact of the failure; and (2) schedule replacement of these components before they are expected to fail.

According to the SMS schedule for calendar year 2009, the EED had 84 scheduled SMS assignments for 37 of the 39 sampled elevators and escalators. Two sampled escalators (#ES372 and #ES373) were new installations put into service on March 16, 2009; therefore, not requiring SMS parts replacement. Our review of SMS documentation found that only 32 (38%) of the 84 required SMS assignments were appropriately documented. SMS work varies from assignment to assignment; the tasks involved are dependent on the components being replaced. The tasks completed in an SMS assignment are documented on a work completion report. Zone shop procedures varied for documenting completed SMS work; not all zones had work completion reports. Consequently, the absence of these reports results in a lack of accountability and evidence to support the completion of SMS tasks.

To ascertain whether there was any evidence to indicate that the remaining 52 (84 – 32) SMS assignments were carried out, we reviewed the machine room logs for the relevant elevators and escalators. Our review provided evidence—log entries listing the time, date, crew, and type of service performed—to indicate that SMS teams had worked on 43 additional SMS assignments in 2009. For the purpose of this test, we accepted the machine room log entries as evidence of SMS work performed, even though the entries did not provide details of actual tasks carried out. Overall, between the available SMS reports and equipment room log entries, we found evidence to support that SMS teams performed some type of work for 75 (89%) of the 84 required and planned SMS service assignments. There is no evidence to demonstrate that the remaining 9 (11%) SMS assignments were ever completed.

Failure to ensure that all scheduled replacement of elevator and escalator components occur increases the risk of unplanned outages and breakdowns. It also undermines any management strategies for extending the life of equipment and increases inefficiencies and associated costs.

Recommendations

NYCT should:

1. Ensure that required PM and SMS work is performed and that all such work is appropriately supported by PM and SMS work reports that are signed off both by the work teams and their respective supervisors.

NYCT Response: NYCT officials generally agreed, stating: "[A]s of June 1, 2010 the SMS portion of the maintenance program has been modified . . . components that are beginning to show signs of wear will be identified and replaced as part of a more aggressive preventive maintenance program. Furthermore, in accordance with the recently revised American Society of Mechanical Engineers (ASME A17.1-2007) safety code for elevators and escalators (section 8.6.1.2) the Elevator and Escalator (E&E) subdivision will conform to the newly revised standard by revising the preventive maintenance frequencies of each individual machine . . . . Beginning in August 2010 the SMS workforce will focus on ASME inspections and performance of the revised preventive maintenance program, ensuring that we are in compliance with established intervals and schedules."

2. Document instances of and justifications for not performing scheduled PM and SMS work. These reports should be approved by a supervisor and communicated to the zone superintendents. The General Superintendent should also be notified of all instances in which PM and SMS work is not performed.

NYCT Response: "We concur. The current practice for documenting Preventive Maintenance that is not performed in the Elevator and Escalator (E&E) sub-division requires the responsible maintenance supervisor to submit a PM report which indicates in the remarks section an explanation for non conformance. These reports are required to be reviewed by the Zone Superintendents. A monthly maintenance compliance report will be submitted to the General Superintendent and the Assistant Chief starting September 2010. This report will enable management to know that required maintenance is being kept up to date."

3. For each elevator and escalator, keep track of and investigate repeated periods of nonperformance of PM and SMS work.

NYCT Response: **"**We concur. The E&E subdivision will implement a Departmental Policy of not missing two consecutively scheduled PM's on any machine. This effort will begin September 1, 2010."

4. Standardize SMS work crew reports and require that all zone shops use the same format.

NYCT Response: **"**We concur. The current SMS reports were standardized amongst all four zones; however there was no tracking of what SMS reports were received. Effective

September 2010, the SMS function will be incorporated into a restructured maintenance program. The scheduled replacement of components will be documented in the work order system."

Weaknesses in Inspections

Incomplete Safety Inspections and Tests

Our review of NYCT inspection records (inspection schedules and completed inspection reports) for all elevators and escalators for calendar years 2008 and 2009 revealed that a significant portion of required inspections were performed. However, we also noted the lack of five-year safety tests.

NYCT generally follows the ASME safety code for elevators and escalators. Accordingly, NYCT requires that each elevator undergo two safety inspections each year, six month apart—a routine (visual) inspection and a periodic inspection (no-load safety test)—and a five-year (full-load) safety test once every five years. NYCT also requires that each escalator undergo a routine and periodic inspection each year, also six months apart.

As reflected in Table III below, NYCT performed more than 90 percent of all scheduled inspections in 2008 and 2009. However, except for routine escalator inspections, there was a general decrease from 2008 to 2009 in the rate of all other scheduled inspections and tests actually performed, even though the number of inspections increased each year.

Table III

Elevator and Escalator Inspections Required and Performed
Calendar Years 2008 and 2009

Item	All Elevators			All Escalators		Total
	Routine Inspection	Periodic Inspection	Five-year Safety Test	Routine Inspection	Periodic Inspection	
CALENDAR YEAR 2008 SCHEDULED VS. PERFORMED INSPECTIONS						
Inspections Scheduled	203	198	39	165	159	764
Inspections Performed	200	194	32	151	143	720
Percent Performed	*99%*	*98%*	*82%*	*92%*	*90%*	*94%*
CALENDAR YEAR 2009 SCHEDULED VS. PERFORMED INSPECTIONS						
Inspections Scheduled	219	209	44	176	166	814
Inspections Performed	211	203	12	167	143	736
Percent Performed	*96%*	*97%*	*27%*	*95%*	*86%*	*90%*

In terms of the different safety inspections and tests, our analysis showed that 96 percent or more of the scheduled routine and periodic elevator inspections were performed in 2008 and 2009. Further, despite a small decrease in 2009, 86 percent or more of scheduled routine and

periodic escalator inspections were performed in both years. However, we are concerned about the five-year elevator safety tests of which 82 percent of scheduled tests were performed in 2008 and a significantly lower rate of 27 percent were performed in 2009. We noted that 32 (82%) of the 39 required five-year safety tests were performed in 2008, but the remaining 7 (18%) were not rescheduled for 2009. In addition, only 12 (27%) of the 44 required five-year safety tests that should have been performed in 2009 were actually performed.

According to EED officials the general decrease in the percentage of safety inspections and tests from 2008 to 2009, especially the decrease in five-year elevator safety tests and periodic escalator inspections, is attributed to budgetary constraints, cutbacks, and lack of overtime authorization.

Inefficient Inspection Goals and Scheduling

NYCT has set annual inspection goals that fall short of required and scheduled safety inspections and tests. The EED Inspection Unit is expected to complete 62 safety inspections and tests each month or 744 per year.

As shown in Table IV below, for 2008, 2009, and 2010, the Inspection Unit's annual goal of 744 inspections and tests was inadequate to address those required and scheduled for each year. For both 2008 and 2009 the actual number of inspections performed fell short of the annual goal. Moreover the gap between the target inspection goal and the number of inspections required grew from 2008 to 2010.

Table IV

Comparison of Expected, Scheduled, and Performed Safety Inspections
For Calendar Years 2008 through 2010

Item	2008	2009	2010
(a) Inspections Required and Scheduled	764 *(100%)*	814 *(100%)*	841 *(100%)*
(b) Inspection Goal (62 per month) *(Percentage of (a) Scheduled Inspection)*	744 *(97%)*	744 *(91%)*	744 *(88%)*
Difference *(Item a less Item b)* *(Percentage of (a) Scheduled Inspections*	20 *(3%)*	70 *(9%)*	97 *(12%)*
(c) Actual Inspections Performed *Percentage of (a) Scheduled Inspections*	720 *(94%)*	736 *(90%)*	n/a
Difference *(Item b less Item c)*	24	8	n/a

If the general decrease in the rate of inspections performed from those required from 2008 to 2009 continues, the likelihood is that the EED Inspection Unit will fall short not only of its 2010 target goal, but also of the total required safety inspections and tests for 2010. This is of concern, since as currently configured, the Inspection Unit's level of personnel combined with the unit's work hours and the scheduling of inspections is inadequate to ensure that even the inspection goals would be met.

Inspection teams work during the day shift between the hours of 7 a.m. to 3 p.m., Tuesday through Saturday. However, NYCT rules prevent the inspection teams from taking equipment out of service for inspection before 10 a.m., three hours into the workday. This is an inefficient use of time that could be used more productively in carrying out inspections.

We recognize that NYCT works to reduce impediments to the movement of passengers during the morning and evening rush hours. However, according to EED personnel and our calculations, periodic and routine safety inspections take between 2.75 to 3.5 hours to complete. Therefore, if inspection were performed during the overnight shift from 11:00 p.m. to 7:00 a.m. and were arranged so that the assigned equipment was at the same or nearby stations, a work crew could conceivably complete two inspections within a work shift. However, under the current configuration, the NYCT incurs an estimated $257,400 each year in unproductive down time[6] plus any additional overtime that may be authorized to address inspection backlogs.

Inspections detect and predict future maintenance needs and assist in achieving more efficient management of resources and fewer unplanned outages. However, when scheduled inspections are not performed as prescribed, there is an increased risk that deficient conditions will go undetected and uncorrected, resulting in a greater likelihood of equipment breakdowns and inconvenience to the riding public, especially to individuals with mobility impairments who rely on elevators and escalators to access subway stations.

Recommendations

NYCT should:

5. Immediately perform the five-year safety tests on elevators that were scheduled but not tested in 2008 and 2009.

NYCT Response: **"**We concur. The referenced tests will be completed by end of July, 2010."

6. Explore the feasibility of rescheduling inspections to the overnight shift, assign equipment that are in the same or in nearby stations, and require work crews to perform two inspections per shift to ensure that all safety inspections and tests are performed on elevators and escalators.

NYCT Response: **"**We concur. On the new E&E subdivision job pick, the inspection team will perform their work on the 10:00 p.m. – 6:00 a.m. tour."

[6] The EED inspection unit has a total staff of 11, exclusive of the unit supervisor. At an average rate of $30 per hour multiplied by three hours per day x 5 days per week x 52 weeks per year, we calculated that NYCT incurred $257,400 of payroll expense for the hours between 7:00 a.m. and 10:00 a.m. during which, according to NYCT rules, inspections are not performed.

7. Reassess and restate its monthly and annual inspection goals to align them with the actual number of inspections required each year.

NYCT Response: ***"***We concur. The annual inspection goals will be set based on the actual number of required inspections. ***"***

Weaknesses in Repair Performance

Based on quarterly availability data derived from the EE Outage and EERMS databases for calendar year 2009, NYCT reported nearly meeting its elevator and escalator availability goals for the same period. However, our review indicated that not all outages were recorded in EERMS, raising questions about the reliability of the performance figures. Additionally, we found that Lift-Net—another system used by NYCT to record and track equipment outages—may not be functioning properly. Finally, EED did not ensure that it retained evidence of maintenance and repair work performed. Based on the above, we conclude that NYCT does not have sufficient credible data by which it can adequately assess its performance regarding its repair and maintenance of escalators and elevators.

Data Supporting Performance Reports May Not Be Reliable

NYCT has established various time-based performance indicators for measuring the EED's performance in repairing and maintaining elevators and escalators, including:

- Equipment availability: measures the percentage of time that an equipment unit is running and available for customer service out the total available hours. All service outages, regardless of the cause, count as downtime in the availability calculation. Units out of service for capital rehabilitation are excluded from the calculation.

- Equipment reliability: similar to availability, reliability measures the percentage of time an equipment unit is running out of the total available hours. Outages resulting from unplanned breakdowns, repairs, vandalism, and failures outside the control of a preventive maintenance program are included in the reliability calculation.

- Mean time between failures (MTBF): considers the number of failures an equipment unit has in a specific time frame and measures, in hours, the average number of hours occurring between failures for a specific period of time.

The EED has established availability goals of 97.1 percent (97.1%) for elevators and 96 percent (96.0%) for escalators against which to measure actual equipment availability rates. Goals have not been established for equipment reliability or MTBF. Instead, to analyze overall and individual equipment performance, the EED uses both availability rates and MTBF measurements so that the number of shutdowns and the duration of the outages are both considered. According to quarterly availability reports for calendar year 2009, the EED's annual

average elevator availability was 96.5 percent (within 1% of its goal) and the average annual escalator availability was 93 percent (within 3 percent of its goal.)

Through November 3, 2009, the EE Outage database and EERMS were used to record and track all equipment outages and to generate monthly and quarterly availability, reliability, and MTFB report data. Subsequently, since November 4, 2009, all performance data was generated through EERMS. According to the EERMS Users Guide, the system "will maintain detailed data for each Elevator and Escalator that is maintained and operated throughout New York City Transit Subway System." In addition, EED officials asserted that all equipment outages are supposed to be entered in EERMS by the control desk operators.

However, our review of EERMS indicated that not all outages were recorded; raising questions about the reliability of the performance figures. During audit survey, we found that data in the EERMS and EE Outage databases did not mirror each other as required. We found outage data recorded in EERMS that was not in EE Outage, and vice versa. This occurred because control desk clerks did not consistently enter outage events in both systems as required. A lack of data completeness is problematic since EERMS was supposed to collect all outage data from January 1, 2009.

EED discontinued using the EE Outage database and has relied solely on EERMS since November 4, 2009. Therefore, to assess the subsequent completeness of EERMS outage data we reviewed machine room logs for sampled equipment for the week of December 13–19, 2009, from which we identified 50 outages. We traced the date and time of these outages to EERMS and found that 7 (14%) of the outages were not recorded in EERMS; the other 43 (86%) were. While limited in scope, these results indicated that not all outage events are recorded in EERMS, even after discontinuance of the old EE Outage database.

We learned that the availability, reliability, and MTBF data are used at monthly/weekly management meetings among EED superintendents, during which maintenance strategies are discussed. The reports are also used to investigate and make recommendations for specific equipment problems. Further, elevator and escalator availability and reliability data is reported to the MTA Board on a quarterly basis, based on data obtained from EERMS.

If EERMS outage data is incomplete, as indicated by our test results, the equipment availability and reliability rates and MTBF hours derived from EERMS data are not reliable. Incomplete outage data is of concern since equipment availability and reliability rates and MTBF hours are used to measure performance, design maintenance strategies, identify problems with specific units of equipment, and report to the MTA Board of Directors.

The data reported in periodic reports are relied upon by various NYCT stakeholders for decision making purposes. For example, they are used by EED management to form maintenance strategies and they may be used in budgetary decisions regarding equipment replacement and rehabilitations. Further, elevator and escalator availability and reliability statistics are communicated to the MTA Board, which has the ultimate responsibility of approving capital and operating budgets. Therefore, NYCT must ensure that commuter elevator and escalator performance statistics are fairly reported.

Weaknesses with Lift-Net

Despite EED officials' assertions and Lift-Net documentation that the system automatically records and tracks all outages of all station elevators and escalators remotely connected to it, we found indications of potential problems with Lift-Net in recording all such outages.

We found that 45 (39%) of the 115 planned outages for PM service and inspection assignments that were scheduled and documented as performed in hardcopy reports did not appear in Lift-Net event logs. We followed up with EED officials, who provided additional reports for the days associated with the 45 untraced events. From these reports we found evidence to suggest maintenance crews worked on equipment for 6 (13%) of the 45 untraced events, but the other 39 (87%) remained untraceable to Lift-Net outage data.

During the audit, EED officials stated that telecommunication problems exist that may affect communication between Lift-Net and the connected elevators and escalators. Reportedly, there are insufficient circuits to handle all telecommunication traffic on the existing lines. Other EED personnel stated that if an elevator or escalator with a problem gets a busy signal when attempting to connect with Lift-Net, it will continue to call Lift-Net until it connects.

Despite this claim, the results of our test provided sufficient evidence of potential problems in Lift-Net's functionality and its ability to detect and report on all equipment outages. Another concern is that Lift-Net data is not backed up, which could be a problem in the event of a service disruption or system failure when all Lift-net outage event data could be lost.

Limited Evidence of Repair and Maintenance Work Performed

Comptroller's Directive #1 states: "All transactions and significant events need to be clearly documented and the documentation readily available for use or examination. All documentation should be properly managed and maintained in accordance with updated records retention schedules."

However, we found that the EED did not consistently maintain evidence to reflect the completion of various tasks. As part of our review of inspections and preventive and schedule maintenance reports, we found a number of inconsistencies in the availability of the records. Some of the inconsistencies noted include:

- The zone shops did not maintain standard SMS work reports. Consequently, 52 (62%) of 84 required SMS assignments for calendar year 2009 lacked evidence to support work completed.

- The EED did not have PM reports for 83 (55%) of 152 scheduled PM assignments that were not performed. Therefore, there was no record of the reason that PM work was not performed or evidence that PM work teams actually reported to the assigned sites.

- Machine room logs lacked entries for 13 (26%) of 50 planned outages for performing PM (selected from the 408 completed PM assignments discussed earlier), raising questions about the authenticity of PM work reports.

- The EED does not require work reports from the repair crews, so there was no documentation to follow-up on their completed assignments.

Recordkeeping—the creation and maintenance of records that provide evidence of the execution of various activities—is essential to a good internal control system. Without consistent and adequate records, NYCT lacks the accountability and evidence to support or document its repair and maintenance activities.

Recommendations

NYCT should:

8. Ensure that all outages and related deficiencies are recorded in EERMS.

NYCT Response: **"**We concur. The E&E subdivision's control desk functions including the Elevator Escalator Reporting Maintenance System known as **EERMS** will be relocated to a central area at 40 Sands Street. The E&E subdivision is currently working on developing procedures which will detail the control desk process and improve the process of reporting of outages and dispatching personnel. This consolidation will take place in conjunction with the 2010 employee job pick."

9. Periodically compare samples of availability and reliability data to source documents (inspection reports, PM and SMS reports, and machine room logs) to test the accuracy of performance data reflected in reports used by NYCT and MTA management.

NYCT Response: **"**We concur. The E&E subdivision will implement an internal process that will require each Zone Superintendent to perform one audit per month to ensure all maintenance, inspections and machine room log book entries are recorded accurately and each instance is consistently recorded in the EERMS and LiftNet applications."

10. Establish procedures and train all EERMS users in those procedures, particularly control desk clerks, supervisors, and others responsible for entering data into the database.

NYCT Response: **"**We concur. With the consolidation of the Electro-Mechanical Control Desk functions, procedures are being written for all tasks pertaining to the functionality of the control desk. This consolidation will take place in conjunction with the 2010 employee job pick. Electro-Mechanical is currently working with Human Resources Training to make the EERMS a part of the training curriculum for all new E&E employees."

11. Investigate, diagnose and take action to correct the shortcomings of Lift-Net, reporting outages including telecommunication issues, system problems, and inconsistencies in reporting outages.

NYCT Response: **"**We concur. As previously stated, the Electro-Mechanical subdivision control desk consolidation will be located at 40 Sands Street. This location currently has a fiber optic hub that will facilitate improved operation and response of the LiftNet remote monitoring system. The Electro-Mechanical ACIO will request permission for Electro-Mechanical equipment reporting to have fiber optic connectivity."

12. Immediately back up Lift-Net data and establish a standard back-up routine to ensure that the system data is saved on a weekly, monthly, and annual basis, as deemed appropriate by NYCT management and existing records retention policies.

NYCT Response: **"**We concur. E&E sub division is currently working with TIS to develop a plan of action for servicing the LiftNet remote monitoring system. This service will include automatically backing up the system on a consistent basis. "

13. Ensure that all required documentation reflecting work performed by field crews (inspection, PM and SMS reports and machine room logs) are completed by work crews and retained. Also, require that some record of repair crews' completed work assignments be regularly maintained.

NYCT Response: **"**We concur. Once the E&E subdivision implements the internal audit outlined in recommendation #9 we will be able to ensure that all documentation is tracked, recorded and stored for future reference."

Certain Deficiencies Not Addressed Promptly

Our review of the EED's handling of elevator and escalator deficiencies identified during safety inspections disclosed that the EED does not act quickly to address Type B and Type C deficiencies.

According to EED officials, defects observed during an inspection are categorized according to their severity: Type A defects are severe safety hazards that present immediate danger to customers and require the equipment to be taken out of service until the defects are corrected; Type B defects violate the safety code but are considered minor, do not present an immediate danger to customers, and do not require the equipment to be taken out of service; and Type C are considered minor, do not violate the safety code, and do not require the equipment to be taken out of service. The actual classification of deficiencies is judgmental, since there is no detailed list by which conditions are rated.

Deficiencies observed during an inspection are communicated to the central office, which forwards the reports to the respective zone superintendents for handling. However, there is no established time frame for addressing these deficiencies.

Nine of the 39 sampled elevators and escalators were inspected between November 5 and December 22, 2009 (after full implementation of EERMS). Our review of the inspection reports for this equipment showed that of the 89 deficiencies identified during the inspections, 63 (89%) were classified as Type B deficiencies and 8 (11%) as Type C. No Type A defects were noted in the nine inspection reports we reviewed.

We noted that work orders were created for 71 (80%) of the 89 cited deficiencies. No information was indicated on the documentation we reviewed to explain why work orders were not created for the remaining 18 deficiencies. Nevertheless, we noted that the work orders were not generally addressed promptly.

Specifically, for the 71 work orders issued, it took an average of 36 days (ranging from 10 to 57 days) from the inspection date for a work order to be created. As of April 26, 2010, the date of test, only 19 (27%) of the 71 work orders were completed. It took the EED an average of 59 days (from 35 to 138 days) from the inspection date and an average of another 31 days (from 11 to 115 days) from the date the work order was created to complete the 19 work orders.

As of April 26, 2010, 52 (73%) of the 71 work orders remained open for an average of 153 days (from 125 to 172 days) from the inspection date and 39 days (from 10 to 57 days) from the date the work order was created.

Through November 3, 2009, the EED procedures for processing inspection reports required that they be delivered to the central office where a supervisor would review, prioritize, and enter them in the Defect database. As the older databases were discontinued, according to EED personnel, a set of procedures had not been developed for processing inspection reports and creating work orders in EERMS for the inspection-identified deficiencies until late December 2009, resulting in delays in generating the work orders for deficiencies identified during inspections performed in November and December 2009.

These results strongly indicate that that the EED does not promptly address Type B and C deficiencies found during inspections. Even though these deficiencies are not considered urgent or hazardous, there is a possibility that, if left uncorrected, they could worsen over time and eventually contribute to a machine breakdown, especially if a specific machine has not been properly maintained (i.e., lacked regular PM and SMS service).

Recommendations

NYCT should:

14. Develop a standard goal for the timeframe within which deficiencies found during inspections are to be addressed; and develop procedures for identifying, prioritizing, assigning, and correcting deficiencies in work orders that remain open past the established time limit.

NYCT Response: "We concur. Defects found during the inspection process will be addressed as follows: Type A defects must be corrected before the machine is restored to service. The E&E subdivision will revisit the scheduling of B & C type defects so they are addressed in an appropriate timeframe. A comprehensive Type A defects listing will be developed and maintained by the E&E operation."

15. Ensure that work orders for Type B and Type C deficiencies are addressed in a reasonable amount of time.

NYCT Response: "We concur. Once the E&E subdivision implements the internal audit outlined in recommendation #9, we will be able to ensure that all documentation is tracked, recorded and stored for future reference, in addition to all defects being corrected in an appropriate timeframe. The current database will be evaluated to assure that we have adequate control functions."

Internal Control Weaknesses

The New York State Public Authorities Law (Article 9, Title 8, §2930-§2931) requires public authorities to establish and maintain a system of internal controls "designed to provide reasonable assurance that the organization will achieve its objective and mission." Comptroller's Directive #1 defines internal control activities as "the policies, procedures, techniques, and mechanisms used to enforce management's direction. They must be an integral part of an agency's planning, implementing, review and accountability for stewardship of its resources and are vital to its achieving the desired results."

However, our review disclosed certain internal control weaknesses that in addition to PM and inspection weaknesses create inefficiencies and may render inadequate the EED's maintenance efforts.

Lack of Formal Operating Procedures

Our review disclosed that while the EED had detailed procedures for performing elevator and escalator inspections and preventive maintenance, it lacks complete administrative and operating procedures for activities carried out by the zone shops, the handing of work orders, recordkeeping, data entry, etc.

Article 9 of the New York State Public Authorities Law requires public authorities to make available to each employee "a clear and concise statement of . . . applicable managerial policies and standards with which he or she is expected to comply." In addition, Comptroller's Directive #1 states that management administrative policies or operating manuals should be communicated to appropriate personnel and periodically reviewed and updated as needed.

Although the EED and its zone shops have baseline procedures in place, they are not promulgated in an operating procedures manual. Moreover, except for a memo dated April 26,

2004, that addressed requirements for machine room log entries, we found that training materials did not cover EED administrative or operating procedures.

Formal, written operating procedures can help to ensure that every person involved in a process understands the tasks that are to be accomplished and the acceptable methods to be used in performing those tasks. They also provide an effective mechanism for training and evaluating the performance of staff. In the absence of comprehensive, written operating procedures, NYCT management cannot be certain that operating policies and procedures are properly communicated and consistently followed. Also, there is no assurance that new personnel have adequate guidance in carrying out their assigned duties.

Improvements Needed in Supervisory Oversight and Monitoring of Work Crews

NYCT lacks sufficient supervisory oversight and monitoring of inspectors, repair workers, and maintainers to provide assurance that assigned work is appropriately carried out and that the workers report to their assigned field sites.

MTA Rules and Regulations (Rule 12.21) for Maintenance Supervisors (MS) of elevators and escalators states that MS Level I "is in immediate charge of assigned maintainers and helpers" and MS Level II are "in charge of an assigned group of subordinate employees engaged in the maintenance, installation, inspection, testing, alteration, and repair of elevators, escalators . . . and all allied electrical and mechanical equipment." In addition, the EED General Superintendent asserted that, while it is not expressly stated, supervisors should follow up with work crews in the field to verify that work is being appropriately performed.

Since maintainers do not consistently submit documentation attesting to work performed and completed on assignments, there is a lack of accountability for the work performed. For example, the EED had no PM reports to document and justify the nonperformance of 83 PM assignments. Additionally, we were unable to trace 39 of 45 planned outages for PM service that were recorded as completed in PM reports to data in Lift-Net. In addition, 16 of those 39 outages that did not appear in Lift-Net also did not appear in the machine room logs.

Contributing to this problem is that there is inadequate oversight of work performed. Supervisors are not expressly required to conduct random, unannounced visits of work teams in the field during the course of the workday; nor are they required to document any field visits they may perform. As a result, the risk that assigned work is not appropriately completed as reported is increased.

Accountability and supervisory review are fundamental to an effective internal control system and provide management and other stakeholders with assurance about the adequacy and completeness of employee work performance. In the absence of adequate employee accountability and supervisory monitoring, NYCT management cannot be certain that assigned elevator and escalator repairs and maintenance are appropriately completed.

Recommendations

NYCT should:

16. Develop a comprehensive policies and procedures manual that addresses all internal processes and functions carried out by the EED supervisors and personnel at the central office and zone shops, and distribute the manual to appropriate personnel. The manual should be updated periodically to address newly implemented or revised procedures.

NYCT Response: **"**We concur. The E&E subdivision is currently working on developing procedures to address all internal processes and functions carried out by the E&E subdivision personnel, and will ensure all procedures are available to all E&E subdivision employees once implemented. As internal processes and functions are changed, they will be reflected in the procedures."

17. Formally require supervisors to perform unannounced visits of work teams during the work shift and document those visits, and to periodically compare PM and inspection reports submitted by work crews to the outages recorded in Lift-Net.

NYCT Response: **"**We concur. Supervisor's field inspections are currently recorded in the "Work Order" section of EERMS. Once the internal audit as outlined in recommendation #9 is implemented, this will address the accuracy of the LiftNet data and the PM and inspection reports."

Preventive Maintenance of 39 Sampled Elevators and Escalators

(Sample 1 equipment for 21 months, January 2008–September 2009)

Equip#	1/08	2/08	3/08	4/08	5/08	6/08	7/08	8/08	9/08	10/08	11/08	12/08	1/09	2/09	3/09	4/09	5/09	6/09	7/09	8/09	9/09	Tot PM Done	%	Tot No PM	%
EL137	Q	M	M	M	Q	M	M	Q	M	Q	M	M	Q	M	M	M	Q	M	NO PM	Q	M	20	95%	1	5%
EL192	Q	M	M	Q	M	M	Q	M	M	Q	M	M	Q	M	M	Q	M	M	NO PM	M	M	20	95%	1	5%
EL213	Q	M	M	Q	M	M	M	Q	M	Q	M	M	NO PM	M	Q	M	M	Q	M	M	M	20	95%	1	5%
EL219	Q	M	M	Q	M	M	Q	M	M	NO PM	NO PM	M	Q	NO PM	M	Q	M	M	Q	M	M	18	86%	3	14%
EL319	Q	M	M	NO PM	NO PM	NO PM	NO PM	Q	NO PM	NO PM	NO PM	NO PM	Q	NO PM	M	NO PM	NO PM	M	Q	M	NO PM	9	43%	12	57%
EL340	M	M	Q	NO PM	NO PM	Q	M	NO PM	M	M	NO PM	NO PM	NO PM	NO PM	NO PM	NO PM	Q	M	M	M	Q	12	57%	9	43%
EL701	M	M	NO PM	M	NO PM	Q	M	NO PM	Q	NO PM	M	NO PM	NO PM	NO PM	Q	NO PM	NO PM	Q	NO PM	M	Q	11	52%	10	48%
EL401	NO PM	NO PM	M	M	Q	M	NO PM	NO PM	M	M	NO PM	NO PM	M	Q	M	M	Q	NO PM	M	NO PM	NO PM	12	57%	9	43%
EL429	M	Q	M	M	NO PM	NO PM	M	NO PM	M	M	Q	NO PM	M	Q	M	NO PM	Q	NO PM	M	NO PM	M	14	67%	7	33%
EL433	NO PM	M	Q	M	M	Q	M	M	Q	M	M	Q	NO PM	M	Q	M	M	Q	NO PM	NO PM	NO PM	16	76%	5	24%
ES123	M	M	Q	M	M	NO PM	M	M	Q	M	M	Y	M	M	Q	M	NO PM	M	M	M	M	19	90%	2	10%
ES214	M	M	Q	M	M	Q	M	M	Q	M	M	Y	NO PM	NO PM	Q	M	M	Q	M	M	Q	19	90%	2	10%
ES223	M	Q	M	M	NO PM	M	M	M	NO PM	NO PM	Q	M	NO PM	Q	M	M	Y	M	M	Q	M	17	81%	4	19%
ES239	M	M	Q	M	M	NO PM	M	NO PM	NO PM	NO PM	Y	NO PM	M	NO PM	Q	M	NO PM	Q	M	M	Q	14	67%	7	33%
ES336	M	Q	NO PM	M	Q	M	M	NO PM	M	NO PM	Q	M	M	Q	M	M	Q	M	M	NO PM	M	17	81%	4	19%
ES348	M	M	Q	M	M	Q	M	M	Q	NO PM	M	Y	M	M	Q	M	M	Q	M	M	Q	20	95%	1	5%
ES352	M	M	Q	M	M	Y	NO PM	M	Q	M	NO PM	M	NO PM	NO PM	NO PM	M	M	Y	M	NO PM	Q	15	71%	6	29%
ES372*																	M	NO PM	NO PM	NO PM	NO PM	1	20%	4	80%
ES373*																M	Q	NO PM	M	NO PM	M	4	67%	2	33%
ES442	NO PM	Q	M	M	Y	M	M	Q	M	M	M	M	M	Q	M	M	Y	NO PM	M	NO PM	NO PM	17	81%	4	19%
																			Sub Total (Sample 1)			295	76%	94	24%

Type of Service- M = Monthly PM Service Performed, Q= Quarterly PM Service Performed, Y=Yearly PM Service Performed, NO PM = No PM Service Performed

*Note: Equip # ES372 and ES373 were put into service on March 16, 2009. The first scheduled PM service for these devices was in May 2009, and April 2009, respectively, as evidenced by the PM reports submitted by PM teams.

Preventive Maintenance of 39 Sampled Elevators and Escalators

(Sample 2 equipment for 9 months, January 2009–September 2009)

Equip#	1/08	2/08	3/08	4/08	5/08	6/08	7/08	8/08	9/08	10/08	11/08	12/08	1/09	2/09	3/09	4/09	5/09	6/09	7/09	8/09	9/09	Tot PM Done	%	Total No PM	%
EL103													NO PM	Q	M	M	Q	M	NO PM	NO PM	M	6	67%	3	33%
EL107													M	Q	NO PM	M	Q	M	M	Q	NO PM	7	78%	2	22%
EL131													M	Q	M	M	Q	NO PM	M	NO PM	NO PM	6	67%	3	33%
EL132													M	NO PM	M	M	Q	M	M	NO PM	M	7	78%	2	22%
EL144													M	Q	NO PM	M	Q	M	NO PM	Q	NO PM	6	67%	3	33%
EL334													NO PM	NO PM	Q	NO PM	M	Q	M	M	Q	6	67%	3	33%
EL335													M	Q	NO PM	NO PM	M	M	Q	M	M	7	78%	2	22%
EL343													Q	NO PM	NO PM	Q	M	M	Q	M	M	7	78%	2	22%
EL425													NO PM	M	M	Q	NO PM	M	Q	NO PM	NO PM	5	56%	4	44%
EL702													NO PM	NO PM	NO PM	NO PM	NO PM	M	M	NO PM	NO PM	2	22%	7	78%
ES101													M	M	Q	NO PM	NO PM	Q	M	NO PM	NO PM	5	56%	4	44%
ES104													M	Q	M	M	Y	NO PM	NO PM	Q	NO PM	6	67%	3	33%
ES106													M	Y	M	M	Q	M	M	Q	M	9	100%	0	0%
ES115													M	Q	M	M	Y	Q	NO PM	NO PM	NO PM	6	67%	3	33%
ES122													M	Y	M	M	Q	NO PM	M	Q	NO PM	7	78%	2	22%
ES249													M	Q	M	M	Q	NO PM	M	Y	M	8	89%	1	11%
ES325													M	NO PM	Q	M	NO PM	Q	NO PM	NO PM	Q	5	56%	4	44%
ES326													NO PM	M	NO PM	NO PM	NO PM	NO PM	Y	NO PM	NO PM	2	22%	7	78%
ES333													NO PM	M	Q	NO PM	M	Q	NO PM	M	Q	6	67%	3	33%
																					Sub-Total(Sample 2)	113	66%	58	34%
																					Grand Total (All 39 Units)	408	73%	152	27%

Type of Service- M = Monthly PM Service Performed, Q= Quarterly PM Service Performed, Y=Yearly PM Service Performed, NO PM = No PM Service Performed

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Metropolitan Transportation Authority
State of New York

June 24, 2010

Ms. Tina Kim
Deputy Comptroller for Audits
The City of New York Office of the Comptroller
1 Centre Street - Room 1100
New York, NY 10007-2341

Re: Report #MJ10-065A New York City Transit Efforts to Inspect, Repair and Maintain Elevators and Escalators

Dear Ms. Kim:

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

I have attached for your information the comments provided by Mr. Thomas Prendergast, President of MTA New York City Transit, which address this report.

Sincerely,

Michael J. Fucilli
Auditor General

Attachment

Memorandum

New York City Transit

Date June 25, 2010

To Tina Kim, Deputy Comptroller for Audits, Office of the Comptroller

From Thomas F. Prendergast, President

Re Audit Report on the New York City Transit Efforts to Inspect, Repair and Maintain Elevators and Escalators - MJ10-065A

New York City Transit (NYCT) Senior Management has reviewed your draft report on its Efforts to Inspect, Repair, and Maintain Elevators and Escalators (MJ10-065A). They found the report provided a thorough review of the NYCT Elevator and Escalator subdivision function which pointed out several areas of deficiency where improved performance was necessary. They have concurred with all of the recommendations your staff have made and consider most of them to offer meaningful ways to improve the overall performance of its expansive elevator/escalator network.

As I am sure you will acknowledge, the importance of a safe, reliable, and available elevator and/or escalator for many of our passengers as they use the NYCT system is something that cannot be overstated. Any/all efforts focused on ensuring that this critical responsibility is met are helpful. It is in that spirit that we have reviewed your draft report and provided our comments on it.

Following are our specific comments.

Recommendation 1

When the Scheduled Maintenance System (SMS) was instituted in 2007, there was an increase in the Material Budget, but no increase in manpower. The Preventive Maintenance workforce was restructured to perform the required SMS activities. Over the last three years, there has been no substantial improvement in equipment availability (see chart below) therefore as of June 1, 2010 the SMS portion of the maintenance program has been modified as follows: components that are beginning to show signs of wear will be identified and replaced as part of a more aggressive preventive maintenance program. Furthermore, in accordance with the recently revised American Society of Mechanical Engineers (ASME A17.1-2007) safety code for elevators and escalators (section 8.6.1.2) the Elevator and Escalator (E&E) subdivision will conform to the newly revised standard by revising the preventive maintenance frequencies of each individual machine based upon the following criteria:

a) Equipment age, condition and accumulated wear
b) Design and inherent quality of the equipment
c) Usage
d) Environmental conditions
d) Improved technology
e) Manufacturer recommendations

Since the SMS program has been modified in order to institute an aggressive accelerated maintenance plan the workforce will be redeployed. For June and July 2010, this workforce will be utilized to comply with recommendation #5 of this audit and complete the five-year elevator tests that were scheduled, but not performed in 2008 & 2009 (39 total inspections). Beginning in August 2010, the SMS workforce will focus on ASME inspections and performance of the revised preventive maintenance program, ensuring that we are in compliance with established intervals and schedules.

Equipment Availability					
Elevators			Escalators		
2007	2008	2009	2007	2008	2009
95.9%	96.5%	96.7%	92.8%	92.8%	92.9%

Recommendation 2

We concur. The current practice for documenting Preventive Maintenance that is not performed in the Elevator and Escalator (E&E) subdivision requires the responsible maintenance supervisor to submit a PM report which indicates in the remarks section an explanation for non-conformance. These reports are required to be reviewed by the Zone Superintendents. A monthly maintenance compliance report will be submitted to the General Superintendent and the Assistant Chief starting September 2010. This report will enable management to know that required maintenance is being kept up to date.

Recommendation 3

We concur. The E&E subdivision will implement a Departmental Policy of not missing two consecutively scheduled PM's on any machine. This effort will begin September 1, 2010.

Recommendation 4

We concur. The current SMS reports were standardized amongst all four zones, however, there was no tracking of what SMS reports were received. Effective September 2010, the SMS function will be incorporated into a restructured maintenance program. The scheduled replacement of components will be documented in the work order system.

Recommendation 5

We concur. The referenced tests will be completed by end of July 2010.

Recommendation 6

We concur. On the new E&E subdivision job pick, the inspection team will perform their work on the 10:00 p.m. – 6:00 a.m. tour.

Recommendation 7

We concur. The annual inspection goals will be set based on the actual number of required inspections.

Recommendation 8

We concur. The E&E subdivision's control desk functions including the Elevator Escalator Reporting Maintenance System known as **EERMS** will be relocated to a central area at 40 Sands Street. The E&E subdivision is currently working on developing procedures which will detail the control desk process and improve the process of reporting outages and dispatching personnel. This consolidation will take place in conjunction with the 2010 employee job pick.

Recommendation 9

We concur. The E&E subdivision will implement an internal process that will require each Zone Superintendent to perform one audit per month to ensure all maintenance, inspections and machine room log book entries are recorded accurately and each instance is consistently recorded in the EERMS and LiftNet applications.

Recommendation 10

We concur. With the consolidation of the Electro-Mechanical Control Desk functions, procedures are being written for all tasks pertaining to the functionality of the control desk. This consolidation will take place in conjunction with the 2010 employee job pick. Electro-Mechanical is currently working with Human Resources Training to make the EERMS a part of the training curriculum for all new E&E subdivision employees.

Recommendation 11

We concur. As previously stated, the Electro-Mechanical subdivision control desk consolidation will be located at 40 Sands Street. This location currently has a fiber optic hub that will facilitate improved operation and response of the LiftNet remote monitoring system. The Electro-Mechanical ACIO will request permission for Electro-Mechanical equipment reporting to have fiber optic connectivity.

Recommendation 12

We concur. E&E subdivision is currently working with TIS to develop a plan of action for servicing the LiftNet remote monitoring system. This service will include automatically backing up the system on a consistent basis.

Recommendation 13

We concur. Once the E&E subdivision implements the internal audit outlined in recommendation #9, we will be able to ensure that all documentation is tracked, recorded and stored for future reference.

Recommendation 14

We concur. Defects found during the inspection process will be addressed as follows: Type A defects must be corrected before the machine is restored to service. The E&E subdivision will revisit the scheduling of B & C type defects so they are addressed in an appropriate timeframe. A comprehensive Type A defects listing will be developed and maintained by the E&E operation.

Recommendation 15

We concur. Once the E&E subdivision implements the internal audit outlined in recommendation #9, we will be able to ensure that all documentation is tracked, recorded and stored for future reference, in addition to all defects being corrected in an appropriate timeframe. The current database will be evaluated to assure that we have adequate control functions.

Recommendation 16

We concur. The E&E subdivision is currently working on developing procedures to address all internal processes and functions carried out by the E&E subdivision personnel, and will ensure all procedures are available to all E&E subdivision employees once implemented. As internal processes and functions are changed, they will be reflected in the procedures.

Recommendation 17

We concur. Supervisor's field inspections are currently recorded in the "Work Order" section of EERMS. Once the internal audit as outlined in recommendation #9 is implemented, this will address the accuracy of the LiftNet data and the PM inspection reports.

We appreciate the opportunity to review and comment on the draft audit report. If you require any further information, please do not hesitate to contact me.