INEFFECTIVE USE OF REMOTE MONITORING TECHNOLOGY FOR NEW YORK CITY TRANSIT ELEVATORS AND ESCALATORS

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OVERVIEW

With thousands of riders, especially the elderly and those who suffer physical disabilities, relying upon New York City Transit's (NYC Transit) elevators and escalators for their daily commutes, ensuring that equipment is well maintained and kept in service is a crucial management responsibility. When elevators and escalators fail to function, those who depend upon them are inconvenienced or, worse, unable to use the system at all.

Over the years, despite public concern, media attention, and demands for improvement by the MTA Board, elevators and escalators remain a serious problem. Of greatest concern are those incidents in which subway riders are literally trapped in elevators, forced to wait until NYC Transit personnel or emergency responders can come to their aid.

To address this continuing problem, in 2007 NYC Transit requested and received funding for the emergency procurement of a new automated monitoring system (Lift-Net) that it anticipated would improve its ability to maintain and keep in service its elevator and escalator equipment. In 2010, the Office of the MTA Inspector General (OIG) analyzed the effectiveness of this new system and its management. OIG's findings raise fundamental questions about the system's performance, the reliability of NYC Transit's maintenance records, and the overall effectiveness of NYC Transit's management of the elevator and escalator program.

Responsibility for maintaining, repairing and tracking the performance of all elevator, escalator and power walk equipment rests with the Elevator and Escalator Department (E&E) within NYC Transit. Central to E&E's operation is a Control Desk, located at the main E&E office, which handles information about equipment status from the field and dispatches maintenance staff as needed. The new Lift-Net universal remote monitoring system was designed to provide E&E with consistent and reliable information that would enable maintenance staff to address equipment outages in a timely manner and to diagnose problems effectively. NYC Transit augmented the system in 2009 with the addition of entrapment relays designed to automatically alert E&E staff to passengers trapped inside elevators.

Our review found that E&E management has failed to integrate and take full advantage of Lift-Net's capabilities, missing the opportunity to more efficiently manage its response to equipment outages. Regarding the critical issue of entrapments, the implementation of the remote

monitoring system has not been successful and E&E has been slow to respond to technical problems.

Summary of Findings

- Discrepancies between the Lift-Net automated monitoring system and manual records indicate that some 13 percent of reported inspections and maintenance work may not have been performed. Specifically, Lift-Net records reflect that equipment was actually running while manual records reflect the performance of maintenance tasks that should have shut down the equipment during that period.

- Although OIG's limited field observations determined that Lift-Net is capable of accurate reporting, OIG's analysis of a sample of 24 of 191 tasks reported in maintenance records but not reflected in Lift-Net, determined that records corroborating that maintenance work was done were missing in more than half of the sample.

- E&E officials were unaware of the occurrence and magnitude of data system discrepancies and could not explain with certainty why they occurred. While these officials suggested that technological limitations associated with the system may have resulted in some under-reporting, they agreed that the discrepancies found by OIG could indicate that reported maintenance work was not actually performed, and they could not rule out that some or all of the records showing work done may even have been falsified.

- Elevator entrapment relays, added to the Lift-Net system, transmitted thousands of false warnings. In July 2010 alone, more than 7,000 warnings were transmitted for elevators that had experienced 60 confirmed entrapments. Although E&E managers conceded that they knew the performance of some entrapment relays was problematic, they acknowledged in December 2010 that they were unaware of the magnitude of the false warnings.

- Because of the large number of false warnings, E&E's Control Desk made the decision to ignore all entrapment warnings received from Lift-Net. Rather, it waits until either NYC Transit personnel or a call from a subway rider indicates that passengers are trapped before notifying maintenance staff to respond, exactly the same approach taken by NYC Transit prior to the installation of electronic monitoring.

- As a further result of the false warnings, entrapment relays have actually been disconnected at certain elevators. In December 2010, during discussions about preliminary OIG findings, E&E managers revealed their mistaken belief that all Lift-Net reported entrapments were immediately responded to by NYC Transit personnel, and acknowledged they were unaware that entrapment relays had been disconnected.

- Some actual entrapments are not flagged by the Lift-Net monitoring system. For example, in one instance Transit's manual system reported that an elevator was out of service for 1 hour 40 minutes at the Clark Street station in Brooklyn with a passenger trapped inside for at least 21 minutes. Lift-Net data contained no indication of that

entrapment. Significantly, management acknowledged that it was unaware that some confirmed entrapments were not detected by Lift-Net.

- The impact of entrapments on some stations is particularly severe. Of 208 entrapments over a six month period in 2010, six stations experienced 67 or fully 32 percent of all entrapments for that period. In two of these six stations the elevators are the sole means of access. While E&E management stated that the problem was limited to four elevators, OIG's findings suggest that the problem, which hinders E&E's response capabilities, is more widespread.

- E&E intends to replace telephone lines with fiber optics based on its assumption that some discrepancies are the result of too much data being sent over telephone lines, even though E&E is not sure that replacement will address the problems we found. A pilot test of the fiber optic cables is planned for this year but, in our opinion, current plans for evaluating its success are insufficient.

- Lift-Net staff lacked the knowledge and training to properly use the Lift-Net system. As one example, an electronic map of the entire Transit system displaying the Lift-Net status of all elevators and escalators was not being utilized because the staff did not know how to operate it. Even worse, one staff member described it as "dumb luck" when he "stumbled" upon the meaning of a Lift-Net code. He went so far as to note that he routinely ignored the code indicating a repair or service is completed and that a machine is ready to be placed back into service. His reason: he was unaware that such a step was expected of him.

Summary of Recommendations

OIG has made a series of recommendations that will help identify and eliminate deficiencies in the remote monitoring system, utilize the system's capabilities more effectively, and resolve problems with false entrapment warnings.

- Transit should definitively resolve discrepancies between the Lift-Net automated monitoring system and manual records to determine if records were falsified and/or work was not performed.

- E&E should fully test and ensure that the installation of fiber optic lines will reliably process communications between all equipment and the E&E's Control Desk. A critical component of the acceptance testing should include a comparison of Lift-Net and maintenance system data to ensure that the two sets of maintenance records are consistent and reliable.

- Control Desk staff should compare daily lists of planned maintenance work to information reported by Lift-Net in real time, to confirm that work is actually completed and ensure the accuracy of data used for MTA Board reports.

- The cause of entrapment relay failures must be diagnosed and resolved. The cause(s) must be identified before NYC Transit continues to purchase and install additional relays on elevators.

- E&E should ensure that Lift-Net staff is properly managed and trained so that they are capable of effectively maintaining and fully utilizing the Lift-Net system.

- Written procedures should be established setting out the duties and responsibilities of E&E Control Desk personnel and the Lift-Net staff.

Summary of Agency Response

In a cover letter to the agency response, the President of NYC Transit acknowledged that our preliminary report "highlighted numerous issues that require immediate attention" and that the agency views our findings and recommendations as another avenue to improve customer experience and overall station environment. Specifically, he recognized that:

> E&E personnel have not sufficiently utilized Lift-Net's full capabilities to more effectively manage the information received from the system. Consequently, we are in agreement that NYCT is not receiving the full benefit of this investment.

The president noted that E&E will now undergo a reorganization that will establish a direct reporting relationship to the Vice President of Maintenance. He also reported that the agency has introduced a variety of measures intended to tighten administrative controls on the performance of maintenance in the field, improve the efficient use of Lift-Net, and train department staff to better manage both field and technical information. Comprehensive operational changes within the department will affect staff responsibilities at all levels and include:

- Establishing and continue ensuring the reliability of Lift-Net performance as fiber optic technology is expanded and as NYC Transit explores linking Lift-Net directly to the manually recorded maintenance database;

- Establishing or enhancing procedures for Control Desk staff, Maintenance Supervisors and Maintainers as necessary to ensure that agency records are accurate, and that they reliably confirm that maintenance work is performed as reported;

- Reevaluating the functionality of entrapment relays to determine whether their continued use is feasible; and

- Providing effective training and leadership for Lift-Net gang and Control Desk employees on their responsibilities relating to Lift-Net.

The President of NYC Transit acknowledged that the OIG report highlighted numerous issues that required immediate attention. He pledged that "elevator and escalator issues are a top priority and that our management of these assets must improve."

BACKGROUND

E&E maintains 369 elevators, escalators and power walks[1] owned by NYC Transit.[2] This equipment provides passengers with access to 102 subway stations throughout the Bronx, Brooklyn, Manhattan and Queens. With employees organized into four geographic zones, E&E utilizes preventive maintenance and inspection strategies to ensure that its equipment is available for customer use. E&E has a staff of 328 and an annual budget of approximately $35M. The staff includes 9 managers, 40 supervisors, 267 maintainers, 8 inspectors, and 4 members of a specialized group responsible for maintaining the Lift-Net remote monitoring system.

The Advent of a Single Remote Monitoring System

The goal of the Lift-Net procurement was to provide E&E with consistent and reliable remote monitoring capabilities that would enable maintenance staff to make timely responses to equipment outages. As detailed in the justification for the Lift-Net contract that was presented to the MTA Board in 2007, Lift-Net was expected to "provide a constant stream of operational and diagnostic information on the condition of every elevator, escalator and power walk to a central monitoring station (Control Desk) located at the 34th St & 8th Ave office…" The Board approved the purchase and system-wide installation was completed in July 2009. Manufactured without the capability to detect elevator entrapments, Lift-Net was augmented with an add-on device, called an entrapment relay, which would alert E&E to passengers trapped inside elevators. The cost of the electronic monitoring system and its related expenditures was $2.7 million as of November 2010.

Two Sources of Maintenance Records

E&E maintenance work is recorded in complementary ways. Maintenance activity is captured automatically by the Lift-Net system, while also manually recorded by Control Desk staff in E&E's Elevator and Escalator Reporting and Maintenance System (EERMS).

According to E&E's General Manager, Lift-Net is expected to transmit event information for any planned maintenance activity being performed as well as for any unplanned disruption. When an outage is experienced, the system reports the event to a Lift-Net computer located at the Control Desk. This computer displays a button-like icon for each escalator and elevator, and uses color codes to indicate the status of each piece of equipment. For example, an escalator that is removed from service for planned maintenance would have its icon on the Lift-Net computer

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[1] A power walk, or moving sidewalk, is a mechanism used to transport people across horizontal surfaces at low speeds. Its surface resembles a conveyor belt. Power walks are located at the *23rd St & Ely/Court Square* station in Queens.

[2] E&E also maintains 38 non-passenger elevators in train yards and shops. Additionally, as of fall 2010, the NYC Transit system included 10 elevators and 25 escalators maintained by private building owners. This equipment serves as secondary and tertiary access points. While E&E maintains only equipment owned by NYC Transit, it provides availability information to the MTA Board on both agency and privately-owned passenger equipment.

change from green to red upon being removed from service. An event record of any outage, containing equipment number, date and time, is also stored automatically in the Lift-Net system.

The EERMS system serves as a data bank detailing all repair and maintenance work performed on E&E equipment. Control Desk staff use Lift-Net event data, along with information telephoned from on-site maintainers, to manually record outage data into EERMS. Once an elevator or escalator is fixed, the maintainer is expected to inform the Control Desk that the unit is back in service. The date and time is then entered into EERMS by Control Desk staff and made a part of the maintenance record.

This report analyses data from both the Lift-Net system and EERMS.

MANY PLANNED MAINTENANCE OUTAGES FAIL TO APPEAR ON LIFT-NET

To keep equipment in optimal working order, E&E administers several types of planned maintenance at defined intervals. According to E&E officials, escalators and elevators should be out of service for 2 to 4 hours during which planned maintenance or inspections are performed. While this work is being done, Lift-Net is designed to record all transmissions as equipment is turned on or off. OIG obtained databases of E&E maintenance events, and then compared EERMS records with electronic Lift-Net records for these events to determine if the Lift-Net system is accurately picking up outages. Our analysis reviewed all Preventive Maintenance (PM), Inspection (INS), and Scheduled Maintenance Service (SMS) outages completed from January to June 2010, as recorded by EERMS records.

Lift-Net Records Did Not Support 13 Percent of Planned Maintenance Tasks Reported in EERMS

During the first half of 2010, PMs were scheduled monthly for each piece of equipment in the system.[3] PMs are planned in advance and performed during the 11 pm – 7 am shift. Inspections are conducted twice each year by a specialized E&E gang. SMS tasks entail the replacement of equipment components at specific intervals over the service life of the equipment. During planned maintenance, equipment is taken out of service and unavailable to customers for at least two hours. Maintainers must complete a checklist following the performance of any of these three tasks, and are expected to detail all work in a log book located in the machine room at each unit.

To assess the accuracy of E&E's maintenance records, we compared data from EERMS with Lift-Net's data for the same period. As shown in Table 2 below, EERMS data show maintainers reporting 2,262 cases of planned maintenance work during the first half of 2010. However, Lift-Net data show equipment out of service on only 1,967 of these cases. Thus, nearly 13 percent of planned maintenance tasks cited by EERMS records are unsupported by the Lift-Net system.

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[3] The Preventive Maintenance schedule was modified in January 2011 so that each machine receives maintenance on a customized schedule, based on factors such as use, age, and manufacturer. While some machines will continue to be serviced monthly, others will be maintained on a 6-week or 8-week schedule.

**Table 2: EERMS Records of Maintenance Activity Not Supported by Lift-Net
January through June 2010**

Activity	Outages Recorded by EERMS	Outages Recorded by Lift-Net	Outages without Lift-Net Data	Percent of Outages Recorded by EERMS without Lift-Net Data
PM	1,324	1,133	191	14%
INS	337	292	45	13%
SMS	601	542	59	10%
Total	**2,262**	**1,967**	**295**	**13%**

Possible Reasons for the Discrepancy

Auditors accompanied E&E workers on consecutive nights to observe PM tasks being performed on an elevator and on an escalator. We witnessed equipment as it was taken out of service and subjected to maintenance tasks, and then later verified that the outages were correctly recorded by Lift-Net at the Control Desk. Our limited test showed that Lift-Net can accurately record planned maintenance tasks such as PMs.

When presented with the results of the OIG analysis, E&E officials could not explain why 191 PM tasks, 45 inspections, and 59 SMS tasks listed in EERMS records were unreported by Lift-Net. As discussed below, officials suggested that technological limitations may have contributed to underreporting by Lift-Net. They also acknowledged that underreporting may not be the only explanation, as will be discussed later in the report.

A Fiber Optics Upgrade May Help, but It Must Be Fully Tested

Currently, there are five telephone lines at the Control Desk dedicated to Lift-Net communications from 369 pieces of equipment. Although Integrated Display Systems (IDS), the maker of Lift-Net, recommended that the system operate on fiber optic lines to benefit from faster communications, NYC Transit elected in 2007 to use telephone lines to expedite the procurement and installation of the system.

According to E&E, one possible explanation for the discrepancy between the EERMS and Lift-Net records may be that data from outages is being lost in transmission to the Control Desk. E&E officials believe that data may be lost when two or more units transmit information simultaneously. Continuing the assumption of lost data, E&E management stated that some underreporting could be corrected if fiber optic lines were to replace the telephone lines currently used to transmit communications to the Control Desk. IDS officials stated that the use of telephone lines can potentially create situations where two or more pieces of equipment simultaneously call in, forcing one unit to incur a wait time. However, they maintained that calls are delayed, but should not be dropped by telephone lines, and that Lift-Net is designed to record all outages. The differing opinions lead OIG to conclude that while an upgrade would accelerate

communications, E&E should not focus on fiber optics as the sole solution for the discrepancy in reporting.

As E&E now considers fiber optic upgrades, we recommend that it reflect on its past experiences testing Lift-Net to learn valuable lessons. Its efforts to identify a universal remote monitoring system included a three-year trial of 44 elevators beginning in 2004. At that time, equipment was tested in isolation, not under the real world conditions of multiple Lift-Net signals being sent from different equipment at the same time. E&E has now initiated plans to pilot test fiber optic lines for equipment at Grand Central Terminal and Bowling Green stations that includes 6 elevators and 19 escalators.[4] OIG believes that this pilot test is a step in the right direction, but recommends a rigorous and formal evaluation at the end of the pilot period.

OIG emphasized in conversations held with E&E officials during and at the end of 2010 that the evaluation of the pilot test must be thorough as it addresses the discrepancies uncovered by our audit. OIG suggestions included establishing "error rates" which would determine the frequency of discrepancies between Lift-Net and EERMS data and the frequency with which Lift-Net fails to establish communication with equipment. These error rates for equipment still using telephone lines and those using fiber optic cables should be compared, as part of an evaluation criterion. Upon revisiting this issue in the spring of 2011, OIG was informed that E&E management intends to repeat the same type of limited testing used when Lift-Net was first installed to assess the fiber optic pilot. Given that the sole purpose of this investment is to facilitate Lift-Net transmissions in real conditions, E&E needs to administer more comprehensive tests to ensure that Lift-Net accurately reports all outages, faults, and status codes prior to investing in a system-wide upgrade.

Lift-Net May Be Accurately Revealing that Some Planned Maintenance Is Not Being Performed

A second possible explanation for the discrepancy between Lift-Net and EERMS is falsification of records in the EERMS system. Specifically, discrepancies lead us to question EERMS since it relies on workers self-reporting, while Lift-Net monitors work automatically. To investigate the possibility of record falsification, OIG looked more closely at the supporting maintenance documentation for 24 of the 191 cases of unsupported EERMS PMs discussed earlier. We examined the checklists and log book entries that maintainers submit for each PM, and found that records were missing in more than half of the 24 cases. Fourteen cases lacked PM checklists, 13 cases lacked log book entries, and four cases lacked both checklists and log book entries. This lack of support further calls into question whether the maintenance work was actually performed.

E&E management acknowledged both possibilities and could not provide definitive information to confirm or refute either of them. To minimize the risk that maintenance tasks are not being performed, OIG urged E&E officials to use Lift-Net in a proactive fashion. Control Desk staff

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[4] E&E estimates the cost of the fiber optics pilot at $30,000 to $40,000.

members receive a list of planned maintenance activities before each overtime shift begins and therefore have a list of expected Lift-Net outages each evening. We recommended that Lift-Net activity be monitored and checked against this list. In this way, Control Desk staff can ensure that maintenance work is being performed by checking that appropriate Lift-Net event codes are received. When appropriate codes are not received, Control Desk staff could contact zone supervisors to confirm that maintainers are, in fact, working on-site. If Lift-Net fails to register the appropriate code after work is confirmed by a zone supervisor, management would need to investigate further.

Although E&E officials indicated that Lift-Net was not originally designed to function as such a management tool, they agreed that OIG's recommendation would provide immediate confirmation that work is being done and that Lift-Net is operating properly.

RECOMMENDATIONS

E&E is currently installing fiber optic lines as part of a pilot test, but how much of the discrepancies between the remote monitoring system and maintenance records will be resolved by this technology is unknown. E&E still needs to determine if the use of telephone lines, workers failing to complete tasks or other Lift-Net technical problems account for the discrepancies and then develop strategies to address those causes.

1. E&E should make certain that fiber optic lines accurately transmit all Lift-Net data prior to investment in a system-wide upgrade.

   Agency Response:
   NYC Transit concurs with the recommendation. The agency pointed out that they have had positive results with seven elevators that already have fiber optic technology.

2. E&E should establish procedures whereby Control Desk staff verify through Lift-Net that preventive maintenance, scheduled maintenance service, and inspections are being performed on a nightly basis. In this way, the accuracy of EERMS data can be verified.

   Agency Response:
   NYC Transit concurs with the recommendation. Management has revised procedures to require that the Control Desk Supervisor ensure that Lift-Net data, EERMS entries, and proposed work listed on Daily Assignment Sheets are consistent. As an added measure, maintenance personnel must now record the name of Control Desk personnel contacted when equipment is called out of service.

3. Maintenance Supervisors must ensure that hard copy maintenance records are completed, including PM checklists and machine logs.

   Agency Response:
   NYC Transit concurs with the recommendation. Supervisors must now sign machine room logs in addition to preventive maintenance checklists. Compliance will be monitored and reported on a weekly basis.

4. If fiber optics are installed system-wide and the Control Desk is used to track workers, E&E should carefully compare Lift-Net (automated) and EERMS (manual) data following six months of activity, to ensure that the two sets of maintenance records are consistent and reliable.

   Agency Response:
   NYC Transit concurs with the recommendation. In addition to revised procedures issued in response to recommendation #2, E&E is exploring the creation of a live feed between EERMS and Lift-Net, which would allow for automatic population of the EERMS database. The agency intends to update OIG on this objective by December 31, 2011.

E&E'S ENTRAPMENT RELAYS HAVE NOT BEEN EFFECTIVE

Elevator entrapments are, necessarily, a major MTA concern. The MTA Board requires E&E to report the reason for each entrapment and its effect on passengers affected. To improve its response time, E&E began a major upgrade to Lift-Net in 2009 by installing entrapment relays on the older models of its 190 elevators. An entrapment relay monitors the opening and closing of elevator doors, and determines whether an elevator has moved between landings within a preset time frame. If elevator doors do not open within an allotted time period, the relay should immediately report that an entrapment condition exists. These relays are designed to enable Lift-Net to report passenger entrapments in real time and allow E&E to more quickly dispatch rescue teams that will free trapped passengers. The relays could also provide E&E with early notification that doors are having trouble closing even before an entrapment occurs.

Control Desk Personnel Do Not React to Lift-Net Entrapment Warnings

E&E officials stated that maintainers responding to Lift-Net entrapment warnings often found the elevators in question operating properly. Although the department does not track the frequency of these events, Control Desk personnel told us that they occur so often that staff do not immediately respond to Lift-Net entrapment warnings. Instead, as done prior to the installation of Lift-Net, they await indication from Maintenance of Way staff, the public, or Rail Control Center to confirm that passengers are trapped. Upon such notification, the closest maintenance team is immediately dispatched to free riders.

The E&E Lift-Net Supervisor was aware of the entrapment relay problem, but told us that it was limited to four elevators--EL 126, EL 142, EL 320, and EL 710. E&E personnel offered the following two scenarios to explain the false warnings.

- The entrapment relays issue a warning whenever elevator doors do not open within a specific time period. However, if the doors open seconds later, the system does not cancel the warning.

- A passenger pushes a button other than that corresponding to a floor, such as the door close button, or fails to push a button at all. The passenger may panic when the elevator does not move and then press the alarm button. Eventually, the passenger realizes the error, presses his or her desired floor button, and exits the elevator upon arrival. A maintainer arriving after the passenger has departed will find an empty unit operating properly. This is considered an unfounded entrapment.

Further analysis by OIG, as described below, determined that, despite the E&E Supervisor's claim, problems with relay warnings were widespread and negatively impacted response capabilities. The scenarios offered by E&E above, in our opinion, cannot explain the extent of these problems.

A Highly Significant Number of Entrapments Reported by Electronic Monitoring are False

To determine the extent of false reports, OIG reviewed all entrapment events in Lift-Net for July 2010. During this period, 7,100 entrapment event warnings covering 103 elevators were reported. For this period, 60 actual entrapments were reported in EERMS. Although an entrapment can lead to multiple Lift-Net entrapment warnings (as data is transmitted repeatedly), a significant number of Lift-Net event warnings did not relate to any actual entrapment. Table 3 shows the 12 elevators in which over-reporting was most excessive. Three of the four elevators previously reported as problematic by E&E (see above) are included in this table.

Table 3: Elevators with Highest Entrapment Warnings
Transmitted by Lift-Net during July 2010

Unit	Total Lift-Net Entrapment Warnings	Total Entrapments Reported in EERMS	Average Daily Entrapment Warnings
EL126*	1,381	0	45
EL229	1,284	0	41
EL142*	1,248	0	40
EL391	619	0	20
EL240	461	1	15
EL206	283	0	9
EL301	203	0	7
EL323	182	2	6
EL303	146	3	5
EL105	135	0	4
EL227	92	0	3
EL320*	84	0	3
Total	**6,118**	**6**	**197**

Over-reporting units detected by E&E

In addition to the three problematic elevators identified by E&E, OIG analysis identified nine units that each transmitted between 92 and 1,284 false entrapment warnings during July 2010. For this group of 12 elevators as a whole, the Control Desk received an average of 197 false warnings per day. We therefore conclude that the problem of false positives goes well beyond what management claimed and its pervasiveness causes Control Desk staff to delay response until actual confirmation of an entrapment is received.

Some True Entrapments Are Not Flagged by Lift-Net

The reporting of false entrapments is not the only problem with relays. Comparing entrapment data in EERMS with Lift-Net data for April to June 2010, OIG found that 16 of 139 actual entrapments (12 percent) manually recorded in EERMS were not captured by Lift-Net. In most of these instances, EERMS narrative descriptions indicated that E&E had been notified of trapped passengers by NYC Transit station personnel or Maintenance of Way employees. For example, in one instance, EERMS noted that an elevator was out of service for 1 hour 40 minutes at the Clark Street station in Brooklyn with a passenger trapped inside for at least 21 minutes. Lift-Net data contained no indication of an entrapment.

The Impact at Some Stations Is Severe

OIG examined EERMS data for the first six months of 2010 and identified 208 actual entrapments at 58 subway stations. Table 4 below shows the six stations reporting the highest incidence of entrapments during this period. Riders at these stations, including some in which the elevator is the only means of access, are at greatest risk of being trapped inside an elevator while Lift-Net warnings are ignored at the Control Desk.

Table 4: NYC TRANSIT Stations Incurring the Most Entrapments
January 1 to June 30, 2010

Station	Total # of Elevators	Entrapments Reported in EERMS	Entrapments that Received *Advanced* Lift-Net Warning(s)	Total Lift-Net Entrapment Warnings
191st Street/St. Nicholas	4	13	6	836
59th Street/Columbus Circle	4	12	11	1,551
181st Street/Broadway*	4	12	5**	239**
181st Street	3	10	5**	70**
Gun Hill Road	2	10	4	56
168th Street Broadway*	4	10	0**	0**
Total	**21**	**67**	**31**	**2,752**

   * Access to these stations is by elevator only.
   ** Entrapment relays were removed at 168th Street and on 3 elevators at the two
      181st Street stations because of excessive entrapment reporting.

The six stations above suffered 67 of the 208 system-wide entrapments (32 percent) during this six-month period. Because entrapment relays were sending so many false warnings, E&E resorted to disconnecting the relays on all elevators at the 168th Street station and on three elevators at the 181st Street stations. Significantly, elevators are the only means of access at two of these stations.

OIG examined Lift-Net data to determine whether the remote monitoring system had issued any prior notifications indicating trouble with the elevator doors that could have alerted staff to the possibility that passengers are at risk of entrapment. As noted in the table, entrapment relays were disconnected on seven units due to excessive entrapment reporting. We found that in two-thirds of cases where relays were still connected, the relay issued one or more door-related warnings to the Control Desk within a half hour *before* an entrapment was reported by an observer or Rail Control.

However, since Control Desk personnel could not distinguish true reports from those that were false at these heavily used elevators, maintainers were not dispatched to determine if there was a problem with the doors. Whether these warnings definitively predicted true entrapments is unknown because of all the false warnings.

These early notifications are critical. The purpose of the relay, in our opinion, should not just be notification of likely entrapments but a call to early action before a customer is actually trapped.

Malfunctioning Entrapment Relays Are Neglected by Management

Although E&E managers were aware of false entrapment reports and expressed frustration regarding the problem, they admit that they did not know its full extent. They expected that Control Desk staff would investigate each and every entrapment warning issued by Lift-Net which was not being done. Furthermore, they did not know that E&E staff responded to the problem by disconnecting relays at some locations.

Several factors have led to E&E's failure to install entrapment relays that function properly on all elevators. Lift-Net is serviced by a dedicated E&E worker gang that is comprised of a supervisor and three maintainers, a much smaller force than originally planned. The gang is currently without leadership at the superintendent level, making it difficult to work on broad solutions.

In 2008, representatives of IDS (the manufacturer) provided a user manual and trained staff including the Lift-Net gang, which at the time consisted of approximately 10 E&E employees. The Lift-Net supervisor, in turn, trained Control Desk staff in the use of Lift-Net. The former superintendent of Zone 2 served as the project manager for the Lift-Net contract; he spearheaded installation, developed the entrapment relay, and managed the Lift-Net gang. Department officials report that he played an integral role in Lift-Net efforts. However, this superintendent resigned from NYC Transit in early 2010 and his Lift-Net responsibilities have not yet been reassigned. As a result, we found that the Lift-Net gang now responds to Lift-Net problems in a reactive and fairly unsupervised manner, with little oversight from senior management at E&E. The lack of strategic direction is apparent in the absence of quality assurance measures in ensuring the overall functioning of the system.

The process for organizing Lift-Net maintenance work is informal. Rather than use a problem-ticket system in which deficiencies are identified, reported, and tracked electronically, the Lift-Net supervisor uses a rudimentary method to identify issues requiring his attention. A blank sheet of paper is affixed to the wall near the Lift-Net computer screen at the Control Desk.

Control Desk staff make brief notes on the paper listing Lift-Net problems that they could not resolve. The supervisor then refers to this list to prioritize work for each shift. If a Lift-Net condition is not recorded by Control Desk staff, it may not come to the attention of the supervisor, and might well be overlooked, since the focus is on individual tasks catalogued manually. The false entrapment warnings issue was identified in this manner for only four elevators, failing to capture the full extent and seriousness of the problem.

Lack of leadership also hinders the department's ability to resolve the entrapment problem. The current supervisor has informally proposed adjusting information programmed into relays so they can better identify an entrapment, but his proposal has not yet been assessed by management.

He also believes that customized adjustments to relays must be carried out by maintainers in the field rather than by his four-member team. As of May 2011, following previous discussions of OIG's preliminary findings, E&E management reports that recent efforts have diminished but not eradicated the number of false reports. Management states that it intends to continue efforts to resolve relay issues.

RECOMMENDATIONS

5. E&E should ensure that relays accurately report entrapments and serve as an early warning
    system where feasible. If this cannot be done, then an alternative needs to be identified that
    provides reliable early detection and quick notification of entrapments to the Control Desk.

    Agency Response:
    NYC Transit concurs with the recommendation. NYC Transit noted the entrapment relay
    was an effort to solve a critical problem. However it also noted "that the desired results
    were not achieved as the operation of this circuit has proven to be very unreliable…. Action
    to address this issue should have occurred in real-time when the false indications first
    became evident rather than allowing the relay to continue to function while disregarding the
    data it was providing." A reevaluation of the functionality of relays is underway. Once
    completed, the agency will determine whether it will continue to use these add-on devices.

6. The E&E Lift-Net gang should establish an effective system for reporting and tracking Lift-
    Net defects that will inform management of shortcomings and ensure they are corrected in a
    timely manner.

    Agency Response:
    NYC Transit concurs with the recommendation. Management has established procedures
    mandating that all Lift-Net defects be recorded in a designated section of the EERMS
    database. Lift-Net repairs are assigned the highest priority in terms of ensuring that they are
    promptly scheduled, closely monitored, and performed by appropriate personnel.

7. E&E should establish effective leadership for the Lift-Net gang that provides strategic
    oversight and ensures that the system is effectively used by Control Desk staff.

    Agency Response:
    NYC Transit concurs with the recommendation. The E&E General Superintendent will
    provide direction and oversight to the Lift-Net group and ensure that Control Desk staff
    process Lift-Net data according to established procedures.

CONTROL DESK STAFF NEED MORE TRAINING AND DIRECTION

OIG's audit identified operational shortcomings that highlight the need for E&E management to provide additional training and direction to Control Desk staff on the use of Lift-Net and to the Lift-Net group on its reporting capabilities.

Control Desk Personnel Are neither Fully Trained nor Familiar with Lift-Net

As frontline users, Control Desk personnel are essential to any efforts to fully integrate Lift-Net into department operations. And yet, they lack confidence in Lift-Net and do not rely effectively on it to carry out their duties. As discussed above, Control Desk skepticism has led staff to ignore relay warnings as they are inundated with thousands of false Lift-Net entrapment reports. However, OIG believes that the staff's lack of confidence also results from not understanding how the Lift-Net system works.

We found no written policies and procedures detailing Lift-Net responsibilities and duties at the Control Desk. Consequently, some staff members respond to Lift-Net in an ineffective manner. One Control Desk employee described it as "dumb luck" when he "stumbled" upon the meaning of a Lift-Net code. He stated that the Control Desk would benefit from a book that listed and explained all codes. This employee also stated that he routinely ignored the Lift-Net event code, "Close Time Out." This code typically indicates that a repair or service is completed and that a machine is ready to be placed back into service. According to the Lift-Net Supervisor, Control Desk staff should remotely test equipment when this code appears to ensure that the unit is, in fact, operable. The employee with whom we spoke stated that he had never received comprehensive training on Lift-Net and was thus unaware that such a step was expected of him.

We also found that Control Desk staff members did not use the electronic schematic map of the subway system available to them. This map displays the Lift-Net status of each piece of equipment by geographic location, making it easier to visually identify and track outages throughout the system. When we first saw the map, it was inactive. We asked personnel on duty why the map was not relaying information from Lift-Net and they responded that an IDS contractor was scheduled to arrive within a month to fix the problem. During three subsequent visits to the Control Desk over the next seven months, OIG continued to observe the dormant map. Ten months after our first observation, we noticed that the map was now active and asked who had activated it. It turned out that the Lift-Net supervisor had done so, and he explained that the Lift-Net system reboots every 24 hours. When this occurs, a password must be entered to allow the map to graphically display the location of Lift-Net events. He had simply logged in and used a password to "reactivate" its operation. E&E officials later explained that the map had, in fact, been operable during the seven-month period, but had to be periodically activated. Control Desk staff, however, were not aware that it could be readily activated and simply ignored the tool, demonstrating again the need for formal training.

Finally, OIG found that, on occasion, field employees will be temporarily assigned to the Control Desk due to medical restrictions. Although these employees receive some training from Lift-Net staff, they cannot be expected to be fully aware of the resources available to them.

Lift-Net Group Shortcomings

E&E's four member Lift-Net gang is responsible for maintaining the remote monitoring system. During our audit, we asked the Lift-Net supervisor to generate a report that would provide a history of when Lift-Net was not communicating with specific units. He stated that Lift-Net could not produce a retroactive communications report in this way. Subsequently, we contacted IDS officials who stated that Lift-Net does, in fact, have such capabilities and that E&E personnel can readily generate a report detailing when and where units are failing to communicate. IDS further directed us to the specific page in the Lift-Net user manual that provides the instructions for issuing this very report.

Our audit also found that the Lift-Net group does not perform any meaningful tests to ensure that the system is operating effectively and accurately. For example, in our analysis of elevator entrapments for June and July 2010, we identified 351 instances of "blanks," or uncleared events, in the "Return to Service" data field. An uncleared event occurs when an initial outage is reported, but the Return-to-Service time remains unrecorded by Lift-Net. Quality assurance testing, such as that called for in this example, could be routinely performed by the Lift-Net group to ensure proper system operation.

The examples noted in this section indicate that E&E staff members lack the understanding and direction needed to implement the Lift-Net system effectively. Collectively, they underscore the need for unified Lift-Net training for Control Desk staff and a more comprehensive understanding of the system's capabilities for the Lift-Net gang.

RECOMMENDATIONS

8. E&E should provide additional training to its Lift-Net group to ensure that it is fully knowledgeable about Lift-Net capabilities, including its ability to generate communications reports.

    Agency Response:
    NYC Transit concurs with the recommendation. Management intends to procure formal training services from the Lift-Net vendor to increase staff proficiency with the system. Management will also seek additional maintenance contracts for servicing the software and hardware-related components.

9. E&E should establish written procedures that cover all Control Desk operations and the responsibilities of the Lift-Net gang.

    Agency Response:
    NYC Transit concurs with the recommendation. Current procedures will be expanded to reflect a comprehensive description of the Lift-Net responsibilities of all relevant staff. The agency is to update OIG on this objective by December 31, 2011.

10. The Lift-Net gang should perform regular quality assurance testing to ensure that the reporting of all Lift-Net events is accurate and complete.

    Agency Response:
    NYC Transit concurs with the recommendation. Lift-Net operational capabilities are currently checked as part of preventive maintenance activities. If a defect is discovered during the test, it will be tracked in the work order system as a priority repair until completed.

CONCLUSION

The Office of the MTA Inspector General found discrepancies in the Lift-Net automated monitoring system records indicating that some 13 percent of reported inspections and maintenance work was not performed. While Transit officials suggested that technological limitations associated with the system may have resulted in some under-reporting, they could not rule out an alternative explanation: that some or all of the records showing work done were actually falsified. Transit must promptly and definitively resolve these discrepancies and we will continue to monitor their efforts accordingly.

Electronic relays added to the Lift-Net monitoring system to alert Transit to passenger entrapments have had a significant failure rate. Most often the problem is a succession of "false positives" – no passenger is actually entrapped. Although the numbers of such events are not clear, they occur often enough that Lift-Net staff no longer immediately responds to Lift-Net entrapment alerts. Even worse, because entrapment relays were sending so many false warnings, Transit staff resorted to disconnecting the relays on all elevators at the 168th Street station and on three elevators at the 181st Street stations. Significantly, elevators are the only means of access at two of these stations. Obviously, this approach is completely unacceptable.

Also highly disturbing is that some actual entrapments are not flagged by the Lift-Net monitoring system. For example, in one instance Transit's manual system reported that an elevator was out of service for 1 hour 40 minutes at the Clark Street station in Brooklyn with a passenger trapped inside for at least 21 minutes. Lift-Net data contained no indication of that entrapment.

We also found that Lift-Net staff lacked the knowledge and training to adequately use the Lift-Net system. As one example, an electronic map of the entire Transit system displaying the Lift-Net status of all elevators and escalators was not being utilized because the staff did not know how to operate it. Even worse, one staff member described it as "dumb luck" when he "stumbled" upon the meaning of a Lift-Net code. He went so far as to note that he routinely ignored the code indicating a repair or service is completed and that a machine is ready to be placed back into service. His reason: he was unaware that such a step was expected of him.

To date, NYC Transit has invested $2.7 million to procure and install Lift-Net, an electronic monitoring system designed to improve its overall equipment monitoring and response capabilities. In response to our audit, the agency unequivocally concurred with all of our findings and recommendations to improve departmental operations that involve Lift-Net .

The President of NYC Transit himself candidly acknowledged that our preliminary report "highlighted numerous issues that require immediate attention" and that the agency "views [our] findings and recommendations as another avenue to improve … customer experience and overall station environment." The president also reported that a reorganization of the Elevators and Escalators department is now underway.

Given the importance of elevators and escalators to NYC Transit customers, especially those who are the elderly or disabled and must rely on the equipment working properly, it is unacceptable that it has taken NYC Transit so long to address flaws in its remote monitoring

system. We are encouraged, however, by the quick action and candid response of NYC Transit to this report and its recommendations. NYC Transit has acted by making substantive changes in management, by planning for the strategic use of the monitoring software, and by introducing multiple layers of internal controls over maintenance reporting. We will, as always, continue to appropriately monitor NYC Transit's efforts to implement the recommendations in this report.

RECAP OF RECOMMENDATIONS

1. E&E should make certain that fiber optic lines accurately transmit all Lift-Net data prior to investment in a system-wide upgrade.

2. E&E should establish procedures whereby Control Desk staff verify through Lift-Net that preventive maintenance, scheduled maintenance service, and inspections are being performed on a nightly basis. In this way, the accuracy of EERMS data can be verified.

3. Maintenance Supervisors must ensure that hard copy maintenance records are completed, including PM checklists and machine logs.

4. If fiber optics are installed system-wide and the Control Desk is used to track workers, E&E should carefully compare Lift-Net (automated) and EERMS (manual) data following six months of activity, to ensure that the two sets of maintenance records are consistent and reliable.

5. E&E should ensure that relays accurately report entrapments and serve as an early warning system where feasible. If this cannot be done, then an alternative needs to be identified that provides reliable early detection and quick notification of entrapments to the Control Desk.

6. The E&E Lift-Net gang should establish an effective system for reporting and tracking Lift-Net defects that will inform management of shortcomings and ensure they are corrected in a timely manner.

7. E&E should establish effective leadership for the Lift-Net group that provides strategic oversight and ensures that the system is effectively used by Control Desk staff.

8. E&E should provide additional training to its Lift-Net gang to ensure that it is fully knowledgeable of Lift-Net capabilities, including its ability to generate communications reports.

9. E&E should establish written procedures that cover all Control Desk operations and the responsibilities of the Lift-Net gang.

10. The Lift-Net gang should perform regular quality assurance testing to ensure that all reported Lift-Net events are accurate and complete.