Synopsis

On Saturday, February 13, 2016, at approximately 10:31 p.m., the Train Operator (#1) of a southbound “N” train (interval 2202) stopped at the 14th Street Station and reported to the Rail Control Center (RCC) that while traveling in the tunnel south of the 23rd Street he heard an unusual noise and smelled an odor of smoke. The RCC instructed the Train Operator discharge the passengers to the station platform and inspect the train. The RCC issued a Stop and Stay (in station) order to all southbound trains on the Broadway Line, track A-1, from 34th Street Station to 14th Street Station until the cause of the unusual noise and odor could be determined.

At approximately 11:17 p.m., the Train Operator (#2) of a southbound “R” (interval 2139) who was holding in the 23rd Street Station, departed in service after he heard radio communications that the 2202 interval “N” train had departed the 14th Street Station, and observed the signals clearing ahead of him, but not with the proper RCC authorization. The Train Operator (#2) said he was traveling at restricted speed using extreme caution and was looking out for anything unusual. As the train traveled southbound on track A-1, the Train Operator (#2) heard a loud noise and felt the car rumble, so he brought the train to a controlled stop using service braking. He reported this incident to the RCC and went to the roadbed to investigate.

The Train Operator discovered a 4 foot 11 inch section of the west running rail had broken off the rail web at survey marker A1 107+45. He added that the R-2 wheel on the first truck of the second car (#9184) was derailed, suspended over the missing section of track, but not on the ground. The train was approximately two car lengths south of the 23rd Street Station with approximately 169 passengers onboard. There were no reported injuries to any of the passengers or crew members. A rescue reach train that was brought in behind the incident train. Transit personnel aided by members of the Fire Department (FDNY) evacuated the passengers from the incident train to the reach train. The passengers walked through the reach train back to the platform at the 23rd Street Station without any reported incidents.
The Train Operator (#2) and the Conductor from the derailed train (2139 interval “R” train) were escorted to the NYCT Medical Assessment Center for post incident drug and alcohol testing which by FTA standards should be administered as soon as practicable following an incident. The following chart shows the Drug and Alcohol test administration times for each transit employee tested:

<table>
<thead>
<tr>
<th>Employee</th>
<th>Alcohol Breath Test</th>
<th>Urinalysis Drug Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time</td>
<td>Within 2 Hours?</td>
</tr>
<tr>
<td>Train Operator (#2)</td>
<td>2:29 a.m.</td>
<td>No</td>
</tr>
<tr>
<td>Conductor</td>
<td>2:37 a.m.</td>
<td>No</td>
</tr>
</tbody>
</table>

The FTA alcohol testing was not promptly administered to the Train Operator (#2) and the Conductor due to the length of the RTO investigation. The results of the post incident drug and alcohol testing for the Train Operator and the Conductor, at the time of testing, did not meet concentrations equal to or greater than the cutoff requirement for a positive drug or alcohol test.

Investigation

The track involved in the derailment was last rebuilt in 1984 and was estimated to have another 6-10 years of useful life remaining as per the last Condition Survey conducted by NYCT Maintenance of Way Track Engineering in 2014. The most recent Track Geometry Car (TGC) inspection run through the area of the derailment occurred on January 26, 2016. It indicated the presence of Rolling Contact Fatigue (RCF) on the rail surface in the form of head checks. The defect was classified as a Priority 3 defect as per NYCT MW-1 Track Standards, Section 104.3., Conditions and Course of Actions, which reads, “Priority 3: Such designation alerts to a track condition that may affect the ride comfort qualities of the track and could potentially degrade to a worse condition if left uncorrected. Work programs should be established for the correction of these conditions on mainline revenue tracks.” Some types of RCF conditions may limit the capabilities of the current Ultra Sonic Testing technology onboard the Track Geometry Cars to identify potential internal rail defects. The most recent TGC Ultra Sonic Testing inspection run was conducted on January 5, 2016 and a review of that data revealed there was the possible existence of a small transverse defect which did not require manual verification under the current NYCT MW-1 Track Standard verification practices, but did warrant monitoring for growth on the next scheduled inspection run.

NYCT requires mainline track to be physically inspected by a Track Inspector at least two times during a seven-day period, and by a Track Supervisor every 14 days. The most recent track inspection by a Track Inspector walking the area prior to the derailment occurred on February 11, 2016. The last 14-Day Supervisory Inspection prior to the derailment occurred on February 9, 2016. A review of the track inspection data documented by the Track Inspector and the Track Supervisor noted no conditions in the vicinity of the derailment area that would required immediate actions. A review of the Track Inspection and 14-Day Supervisory Inspection reports for a period of one year prior to the derailment found documentation of water intrusion in the vicinity of the derailment area, and head checks were present on the rail.
that was involved which were categorized as a Priority 2 defect. Priority 2 defects require a supervisory inspection within 24 hours, speed restrictions if deemed necessary, and repairs should be made as soon as practical.

Sections of the fractured rail were submitted to Lucius Pitkin Inc. (LPI) for an independent metallurgist evaluation to validate the integrity of the rail. Their testing confirmed that the incident rail sample met NYCT and American Railway Engineering and Maintenance-of-Way Association (AREMA) Standards for High-Strength Rail. LPI concluded that the break in the rail was the result of a pre-existing Rolling Contact Fatigue (RCF) condition, in this case head checks, that had escalated into an internal rail defect at survey marker A1 107+45. Head checks are small cracks that initiate on the rail surface before propagating horizontally. They are caused by cyclic loading of metal which result in early fatigue damage. If left to propagate, they can result in internal rail defects.

The LPI report concluded that the broken rail was a result of a single-event overstress fracture which propagated from a pre-existing head check at the top-inboard edge of the rail head. It was evident that the contact fatigue crack propagated through the entire rail head until such time that remaining cross-section could no longer sustain the entire applied load and final, brittle overstress fracture occurred. The additional brittle fractures were sustained as the derailment occurred. Contributing to this incident was water intrusion in the vicinity of the derailment. Over a prolonged period of time this condition may have accelerated the progression of the RCF that was occurring on the surface of the rail head. LPI recommended that NYCT “identify all locations where substantial surface cracking is evident to be thoroughly assessed to determine the extent of crack propagation and the continued serviceability of the rail.”

Additional contributing factors to the derailment was the failure of Rapid Transit Operations (RTO) employees to follow operating rules and procedures, particularly the Train Operator who disregarded a Stop and Stay order, which placed customers, employees, and equipment in jeopardy. Also, the extreme cold temperatures on the night of the incident cannot be ruled out as a contributing factor.

New York City Transit reports that the total amount to replace various track components and restore track A-1 back to state of good repair amounted to $21,462.36.

**Conclusion**

The New York City Transit Office of System Safety (OSS) has determined that the causal factor in the derailment was a broken west running rail. The OSS reported the west running rail located at survey marker A1 107+45 was most likely fractured prior to the incident train negotiating the derailment site. The rail break was a result of pre-existing Rolling Contact Fatigue (RCF) in the form of head checks that had escalated into an internal rail defect, which propagated through the entire rail head until such time that the remaining cross-section could no longer sustain the entire applied load, and final brittle overstress fracturing occurred. Contributing to this incident was water intrusion in the vicinity of the derailment; which over a prolonged period of time may have accelerated the progression of the RCF that was occurring
on the surface of the rail head. The extreme cold temperatures on the night of incident cannot be ruled out as a contributing factor.

Actions Taken

On February 19, 2016 Rapid Transit Operations issued RTO Bulletin 40-16 “Reporting Unusual Noise or Condition” to All Train Service Employees.

In March 2016 Division of Infrastructure reported water abatement was performed at the location of the A2 defect located at survey marker A1 106+05, follow-up inspections performed in June of 2016 indicate the area remains dry. The Division of Infrastructure will continue to monitor the area.

Recommendations

Submitted for the review of the Public Transportation Safety Board members is the NYCT Office of System Safety Derailment Report, S/O 23rd Street Station Track A1, Final Report issued on July 20, 2016. Based upon the information presented in this report, the Public Transportation Safety Board staff concurs with its findings and the actions taken, and makes no additional comments or recommendations. The PTSB staff will adopt and monitor via the Corrective Action Plan process, the eight internal recommendations issued by the NYCT Office of System Safety in their Final Report, dated July 20, 2016, namely:

13527-1. Department of Subways (DOS) should create plausible corrective action plans to combat Rolling Contact Fatigue (RCF) (e.g. Rail Grinding, Rail Replacement). DOS should evaluate the MW-1 Track Standards Manual and weigh the need to re-prioritize the combination of conditions where RCF exists.

Response: Division of Subways response dated August 11, 2016 states:

Division of Track drafted a scope of work to reintroduce rail grinding services under Requisition #0000028436. Procurement is currently negotiating to obtain a rail grinding service from Loram Maintenance of Way Inc. It is estimated that the contract will be presented to the MTA Board for approval in September 2016. In addition, Track Engineering drafted changes to MW-1 Track Standards Manual, Section 108.7, Defective Rails and Rail Wear, regarding RCF defects, severity levels, and course of action. Refer to Attachments.

Division of Subways response dated November 22, 2016 states:

Negotiations with Loram Maintenance of Way Inc. are completed. Diesel emissions testing is being expedited and is anticipated to be performed so that the results can be included in the MTA Board package. The contract is scheduled to be presented to the MTA Board for approval in December 2016.

Division of Subways response dated February 4, 2017 states:

The LORAM contract was approved by the MTA Board in December 2016 and it is currently under review by the Office of the State Controller. Delivery
of the Rail Grinder is expected in mid-March for conformance testing. Once the testing is completed, rail grinding operations will commence by the close of April, 2017.

**CAP Recommendation Status: OPEN**

13527-2. DOS should arrange for increased RCF awareness and/or identification for all Division of Tracks employees engaged in track inspections.

**Response:** Division of Track distributed MOW Maintenance Gram #005-16 titled, “Rolling Contact Fatigue” to increase awareness and identification of Rolling Contact Fatigue. Refer to Attachments.

**CAP Recommendation Status: CLOSED**

13527-3. DOS should investigate the feasibility of alternate and additional inspection processes to identify potential internal rail defects masked by RCF (e.g. Eddy Current, etc.)

**Response:** Based on an investigation by Track Engineering, there is limited expertise and availability of eddy current inspection services currently in North America (there are only two prospective vendors in the U.S.). In addition, the eddy current inspection methods are all manual in nature, requiring portable equipment to be taken to the field and operated under a General Order, therefore not suitable to be used as a survey tool. The identification of RCF on rails is better suited to be performed by the Track Geometry Car Video Inspection and walking track inspection processes. The Division of Track will then replace the affected rails when the conditions reach a Priority 2 defect level.

**CAP Recommendation Status: CLOSED**

13527-4. RTO should evaluate the actions of Train Operator #1 and Train Operator #2 and take appropriate actions and/or corrective actions

**Response:** Train Operator #1 was not found culpable for this incident by Service Delivery management. An Incident Cover Sheet was generated for Train Operator #2 for reckless operation and failure to comply with a Stop and Stay order from the Rail Control Center and it was delivered to the NYCT Office of Labor Relations. However, the disciplinary charges were withdrawn and Train Operator #2 received an Improper Performance re-instruction. In addition, both Train Operator #1 and Train Operator #2 will be critiqued on the re-issued Bulletin 40-16, “Reporting Unusual Noise or Condition”. Train Operator #2 will also be critiqued on the proper actions to take when a Stop and Stay order is issued from the Rail Control Center.

**CAP Recommendation Status: CLOSED**
13527-5. RTO should ensure that all reports of loud and/or unusual noises are investigated thoroughly prior to the resumption of service.

Response: All RCC personnel were critiqued on RCC Directive 06-15 "Positive Communication Concerning Train Movement" which ensures that both the Train Operator and Conductor understand any instruction given to them by the RCC. In addition, RCC personnel were also critiqued on RCC Directive 07-16 "Reporting Unusual Noise or Condition" which explains how reported unusual noises are investigated before the resumption in service.

CAP Recommendation Status: CLOSED

13527-6. RTO Field Operations, Work Force Development and RCC Operating Directives should emulate each other, regarding the operation of service when an unusual noise is reported.

Response: RCC Directive 07-16, Reporting Unusual Noise or Condition, is consistent with Bulletin 40-16, Reporting Unusual Noise or Condition.

CAP Recommendation Status: CLOSED

13527-7. Work Force Development should implement documented training regarding the reporting of and operation of equipment, in regards to loud and unusual noises.


CAP Recommendation Status: CLOSED

13527-8. RTO should re-issue and reinforce all operating policies and instructions regarding operating employees' responsibilities when an unusual noise is reported along the right-of-way.

Response: Service Delivery will re-issue the following bulletins: 40-16, “Reporting Unusual Noise or Condition”, 1-13, “Trains Striking Objects/No Brakes in Emergency”, 88-12, “Reporting Car Defects or Unusual Conditions”, and 53-11, “Obstruction Incidents”.

CAP Recommendation Status: CLOSED
Attachments to PTSB Rail Transit Agency Report #13527:

- MW-1 Track Standards, Section 108.7, "Defective Rails and Rail Wear".
- MOW Maintenance Gram #005-16, "Rolling Contact Fatigue".
- RTO Bulletin 40-16, "Reporting Unusual Noise or Condition".  
  (Superseded by Bulletin No. 148-16)
- RCC Directive 06-15, "Positive Communication Concerning Train Movement".
- RCC Directive 07-16, "Reporting Unusual Noise or Condition".
- RTO Bulletin 1-13, “Trains Striking Objects/No Brakes in Emergency”.  
  (Superseded by Bulletin No. 149-16)
- RTO Bulletin 88-12, “Reporting Car Defects or Unusual Conditions”.  
  (Superseded by Bulletin No. 147-16)
  (Superseded by Bulletin No. 146-16)
Memorandum

New York City Transit

Date    July 20, 2016

To     Wynton Habersham, Senior Vice President, Department of Subways

From   Cheryl E. Kennedy, Vice President, Office of System Safety

Re     Final Report, Derailment, 23rd Street Track A1

On February 13, 2016, the Office of System Safety (OSS) investigated a derailment that occurred on Track A1 south of the 23rd Street Station on the Broadway Line.

Based on a review of the attached report, please provide a response to the recommendations within 30-days.

Cc: F. Jezycki
    S. Librera
    B. Greenblatt
    J. Angerami
    T. Abdallah
    D. Knights
    G. Rivera
    C. Hamann
    DOS SVPs Office
    File
Office of System Safety Derailment Report

S/O 23rd Street Station
Broadway Line

Occurrence Date:
February 13, 2016
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SYNOPSIS

At approximately 22:29 hours on February 13, 2016, the Train Operator (T/O) #1 aboard the 2202 ‘N’ DIT/STL (consist: S/M 9142-9141-9140-9139-9138-8653-8654-8655-8656-8657) reported to the Rail Control Center (RCC) that he heard a loud noise and smelled an odor of smoke, while traveling southbound on Track A1 south of the 23rd Street Station. T/O #1 did not accurately identify the location of the loud noise to the RCC nor did he bring the train to an immediate stop as instructed during T/O induction training. This resulted in an inadequate investigation of the area. The RCC ordered all trains in the area to “Stop and Stay.” At approximately 23:17 hours, the 2139 ‘R’ 179/CAN, (consist: S/M 9183-9184-9185-9186-9187-9847-9846-9845-9844-9843) departed the 23rd Street Station without RCC authorization. As the 2139 ‘R’ 179/CAN traveled southbound along Track A1 south of 23rd Street Station, T/O #2 brought the train to a stop and reported a loud noise and possible derailment. Upon inspecting the Right of Way to determine the cause of the loud noise, T/O #2 observed the R2 wheel of the #1 truck of the second south car (9184), suspended above a missing 4’ 11” section of the west running rail at survey marker A1 107+45.

The Office of System Safety (OSS) has determined that the causal factor in the derailment was a broken west running rail. The rail break was a result of pre-existing Rolling Contact Fatigue (RCF), in this case head checks that had escalated into an internal rail defect at survey marker A1 107+45. RCF is one of the various forms of rail wear and is important to consider, concerning rail maintenance and life-cycle matters. The RCF identified at the derailment site were head checks. Head checks are small cracks that will initiate on the rail surface edge before propagating horizontally, if left to propagate they can result in internal defects. The RCF conditions may limit the capabilities of the current UT technology onboard the TGC3 and TGC4 cars utilized to identify potential internal rail defects. Contributing to this incident was water intrusion in the vicinity of the derailment; over a prolonged period of time this condition may have accelerated the progression of the RCF that was occurring on the surface of the rail head. The extreme cold temperatures on the night of incident cannot be ruled out as a contributing factor. An additional contributing factor was the failure of RTO operating employees to follow operating rules and procedures, particularly disregarding a Stop and Stay Order, which placed customers, employees and equipment in jeopardy.

INVESTIGATION

Occurrence
At approximately 22:29 hours on February 13, 2016, a ten car train designated as the 2202 ‘N’ DIT/STL was traveling southbound on Track A1 in approach to the 14th Street Station on the Broadway Line, when T/O #1 reported to the RCC a loud noise beneath the train and an odor of smoke. T/O #1 did not stop his train immediately upon hearing the loud unusual noise, and continued operating until fully berthed within the 14th Street Station. T/O #1 also failed to accurately identify the location of the loud noise to the RCC, which resulted in an inadequate investigation of the area. T/O #1 inspected the area within the 14th Street Station and two (2) cars lengths north of the 14th Street Station, which did not encompass the area where he had heard the loud and unusual noise. At approximately 23:17 hours, T/O #2 aboard the 2139 ‘R’ 179/CAN,
previously holding at 23rd Street Station, began traveling south on Track A1 from the 23rd Street Station, without proper authorization from the RCC. Upon investigation OSS identified that although there was a formal RCC Directive (RCC Directive 08-10), regarding actions to be taken when hearing an unusual noise, train service personnel had no formal written procedure. At approximately 23:17 hours T/O #2 reported a loud noise and possible derailment. Upon inspecting the Right of Way to determine the cause of the loud noise, T/O #2 observed the R2 wheel of the #1 truck of the second south car (9184), suspended above a missing 4’ 11” section of the west running rail at survey marker A1 107+45. Upon being notified of the incident, the RCC dispatched a reach train to the scene. Approximately 169 customers onboard the incident train were walked through the reach train and onto the platform at the 23rd Street Station. There were no injuries reported as a result of this incident. The total incident costs were estimated to be $21,462.36.

Rapid Transit Operations
Train Operator # 1 Statement:
T/O #1 operating the 2202 ’N’ DIT/STL interval stated that north of the 14th Street Station, he heard a loud and unusual noise from beneath the train, and smelled an odor of smoke. T/O #1 upon berthing the train in the 14th Street Station, informed the RCC of the incident and was instructed to investigate. T/O #1 reported that he investigated beneath the train, and approximately two (2) cars lengths north of the 14th Street Station. T/O #1 stated he was aware he heard the unusual noise further north of the area inspected, but stated he was guided by the RCC’s instructions.

Human Factors
T/O #1 was originally hired by New York City Transit on July 14, 2008 in the title of Train Operator. T/O #1 was critiqued on January 16, 2016 on all aspects of train operation by his assigned TSS. He received an overall rating of “Satisfactory” in all areas including proper train control, judgment of speed, proper station stop and signal comprehension. A review of his disciplinary action history revealed one (1) operational infraction.

T/O #1 worked the following hours on the day of the incident and the seven days prior to the incident:

<table>
<thead>
<tr>
<th>Incd. Day</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>5:31</td>
<td>13:14</td>
<td>RDO</td>
<td>7:47</td>
<td>Absent</td>
<td>7:47</td>
<td>7:56</td>
<td>7:56</td>
</tr>
</tbody>
</table>

Total: hours: 50:10

The hours worked by T/O #1 on the day of the incident and the seven days prior, were within NYCT’s current Hours of Service policies.
Fitness for Duty
Occupational Health Services (OHS) personnel did not perform post incident testing on T/O #1 as his actions were not deemed contributory at the time by RTO management.

Train Operator #2 Statement:
T/O #2 operating the 2139 “R” 179/CAN interval stated that he was instructed to “Stop and Stay” at the 23rd Street Station, due to a report of a loud noise and possible smoke condition between the 23rd Street and 14th Street Stations. T/O #2 stated that after holding for approximately thirty (30) minutes and upon hearing the train at the 14th Street Station had begun to depart the area, he proceeded in service, without authorization from the RCC. T/O #2 while traveling south from 23rd Street Station heard a loud and unusual noise from beneath the train. T/O #2 informed the RCC of the loud noise, and stated he believed the train had derailed. T/O #2 was instructed by the RCC to investigate, subsequently identifying the fractured rail, and suspended R2 wheel of car 9184.

Human Factors
T/O #2 was originally hired by New York City Transit on December 4, 2006 in the title of Conductor. T/O #2 was promoted to his present title of Train Operator on April 22, 2012. T/O #2 was critiqued on January 30, 2016 on all aspects of train operation by his assigned TSS. He received an overall rating of “Satisfactory” in all areas including proper train control, judgment of speed, proper station stop and signal comprehension. A review of his disciplinary action history revealed five (5) operational infractions since his promotion to T/O and prior to the date of this incident.

T/O #2 worked the following hours on the day of the incident and the seven days prior to the incident:

<table>
<thead>
<tr>
<th>Incd. Day</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:14</td>
<td>8:14</td>
<td>RDO</td>
<td>RDO</td>
<td>Absent</td>
<td>Absent</td>
<td>8:29</td>
<td>8:31</td>
</tr>
</tbody>
</table>

Total: hours: 31:28

The hours worked by T/O #2 on the day of the incident and the seven days prior, were within NYCT’s current Hours of Service policies.

Fitness for Duty
Occupational Health Services (OHS) personnel performed post incident testing on T/O #2 approximately three hours and forty five minutes after the incident occurred. OHS personnel administered alcohol testing at 02:29 hours. Drug testing occurred at 02:35 hours. The reason cited for the testing not being performed within the two hour window was attributed to the on scene incident investigation and the time consumed
transporting the employee to the Medical Assessment Center #1 (MAC). The results of the post incident testing for T/O #2 were negative.

Rapid Transit Operations (RTO) was a contributing factor in this incident.

**Division of Track**
The track in the area of the derailment is a Modified Type II design, which is a concreted type of track, utilizing 14” spike plates and wooden ties, specially designed for use in subway locations. The track in the derailment area was last rebuilt in 1984 and is estimated to have 6-10 years of useful life remaining as per the last Condition Survey conducted by MOW Track Engineering during calendar year 2014.

The rail involved in the February 13, 2016 derailment was installed in 2008. The Vacuum Treated (VT) Head Hardened (HH) 100 lb. running rail, was manufactured by Mittal in February of 2008. As part of the post incident activities, sections of the fractured rail were submitted to Lucius Pitkin Inc. (LPI) for an independent evaluation and will be discussed further in the body of this report.

Division of Track (DT) personnel are required to regularly perform track inspections to identify conditions that deviate from the standards established in the MW-1 Track Standards Manual. DT Track Inspectors (T/I) are tasked with the inspection of main line tracks in their geographical area twice during a seven day period. T/I's are also responsible for documenting defects affecting the condition of track components based upon the “Codes for Track Inspector Reporting Form,” e.g. deteriorating, mud condition, water condition, pumping, rotted, etc. Additionally, a DT supervisor must inspect main line tracks on an average of twice each month, which is referred to as the 14 day Supervisory Inspection. DT personnel had performed the required inspections on a consistent basis leading up to the derailment. The most recent TI inspection occurred on February 11, 2016 and the last Supervisory 14 day inspection occurred on February 9, 2016. OSS reviewed the most recent inspections performed and no defects in the vicinity of the incident area were noted. OSS also reviewed the TI and 14 day track inspection reports for a period of one (1) year prior to the derailment which revealed documentation of water intrusion in the vicinity and RCF (head checks) on the rail involved in the derailment. The TI inspections performed on June 2, 2015 and December 15, 2015 identified the RCF, on the rail involved in the derailment, as a Priority 2 defect. The Priority 2 categorization required supervisory inspection within 24 hours, speed restrictions if deemed necessary, and repair as soon as practical. Supervisory inspections were completed as required on June 3, 2015 and December 16, 2015. On both occasions the supervisor concurred with the TI and maintained the defect status as a Priority 2.

**Track Engineering (TE)**

TE personnel perform a variety of functions in support of DT, including the monitoring of the automated track inspections. Automated track inspections are intended to supplement the manual inspections and aid in identifying internal rail flaws and track defects. The automated track inspections include Track Geometry Car (TGC) and Ultra
Sonic (UT) testing, which is performed by NORDCO Rail Services (NRS)

**Track Geometry Cars**
The most recent TGC run prior to the derailment was performed in the incident area on January 26, 2016. Video from the TGC run indicated RCF was present and did not identify recognizable water “dripping on or around” the rail. These findings resulted in the RCF defect being identified as a Priority 3 defect as per MW-1 Track Standards. A Priority 3 designation is used to identify a track condition that may affect the ride comfort qualities of the track and can potentially degrade to a worse condition if left uncorrected. No other defects were noted in the vicinity.

**NORDCO Rail Services (NRS)**
OSS requested and was provided with the three (3) most recent UT inspections with the analysis. The area south of the 23rd Street Station on Track A1 was previously inspected by NRS on April 15, 2015, October 6, 2015 and January 5, 2016 and no defects were reported. As a result of the derailment a Service Failure Investigation (SFI) review of the UT inspection of the running rails in the incident area was also requested and performed by NRS. The data analysis included the review of these three (3) inspections. The SFI showed an increase in RCF on the incident rail prior to the derailment on February 13, 2016. The analysis also indicated that on the January 5, 2016 inspection, there was a possible existence of a small Transverse Defect (TD). The potential TD did not require manual verification under the current verification practices, but did warrant monitoring for growth on the next scheduled run. It should be noted that the RCF conditions may limit the capabilities of the current UT technology onboard the TGC3 and TGC4 cars utilized to identify potential internal rail defects.

**Metallurgist Report Lucius Pitkin Inc. (LPI)**
Sections of the fractured rail involved in the derailment were submitted to LPI for an independent evaluation to validate the integrity of the rail. Extensive testing of the rail, including metallurgical, chemical, strength and hardness analysis, and detailed electron microscope scanning of the fractured surfaces at the point of the break were performed. LPI concluded that the broken rail was a result of “a single-event overstress fracture which propagated from a pre-existing RCF crack at the top-inboard edge of the rail head. It was evident that the contact fatigue crack propagated through the entire rail head until such time that that remaining cross-section could no longer sustain the applied loads and final, brittle over stress fracture occurred. The additional brittle fractures were sustained as the derailment occurred.” LPI reported the metallurgical testing confirmed the incident rail met NYCT and AREMA Standards for Standard Rail, but failed to meet the surface hardness or the yield strength for High-Strength Rail. LPI noted the AREMA surface hardness specifications are for rail samples tested in the new, as manufactured condition, and that the segment of the incident rail tested met the minimum requirements for internal hardness of High-Strength Rail. LPI further recommended NYCT “identify all locations where substantial surface cracking
is evident to be thoroughly assessed to determine the extent of crack propagation and the continued serviceability of the rail.”

DT was the causal factor in this derailment.

**Division of Infrastructure**
The Division of Infrastructure (DI) conducted a post incident inspection of the area in the vicinity of the derailment. DI reported there was no damage as a result of this incident.

A review of DI inspection records for the period of two (2) years prior to the derailment indicated three (3) water intrusion defects between 50’ and 140’ north of the incident site had been identified and documented. Based on DI Structural Inspection Policy Instruction (P/I) for the Department of Subways issued in July 2013; one (1) defect, located at survey marker A1 106+95, was classified as a B1 defect requiring no special mitigation, continued annual monitoring and repair based on priority, resources and location accessibility. The second defect, located at survey marker A1 106+50, was classified as a C defect requiring the condition to be reported and recorded for use in future annual inspections. The third defect, located at survey marker A1 106+05, was classified as an A2 defect. This classification (A2) required the defect to be addressed within one (1) year, continued monitoring, and repaired to downgrade the defect within three (3) years.

DI reported water abatement had been performed in this area in March 2016. This was after the derailment but within the three (3) year time frame required by the P/I.

The DI is not a contributing factor in this derailment.

The water is a contributing factor in this incident.

**Division of Signals**
Division of Signals (DS) conducted a post incident investigation of the signal system in the vicinity of the derailment. All signal equipment was found to be operating as designed. DS reported there was no damage to the signal equipment as a result of this incident.

DS was not a contributing factor in this incident.

**Division of Car Equipment**
Car Involved in the Derailment:
The car involved in this incident is of the R-160 car class. The car was built between 2005 and 2008 by the Kawasaki Rail Corporation/Alstrum. The car is 60’ 6” long overall and weighs 85,471lbs.
Car Case History:
Car 9184:
A review of the car case history for car 9184 revealed no car equipment defects that would have contributed to this incident.

On February 14, 2016, Car Equipment Engineering and Technical Support (CEE&TS) recorded wheel, axle, and flange measurements on the No. 1 truck of car 9184 utilizing Finger Gauge No. 336, Back-To-Back Gauge No. 160, and Flange Gauge No. 230. All measurements were found to be within NYCT standards.

<table>
<thead>
<tr>
<th>No. 160 Back-to Back Gauge</th>
<th>No. 336 AAR Finger Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1 Axle: 53 5/16”</td>
<td>No. R1 Wheel: 30 X 2”</td>
</tr>
<tr>
<td>No. 2 Axle: 53 5/16”</td>
<td>No. R2 Wheel: 30 X 2”</td>
</tr>
<tr>
<td>No. 3 Axle: 53 5/16”</td>
<td>No. R3 Wheel: 36 X 2”</td>
</tr>
<tr>
<td>No. 4 Axle: 53 5/16”</td>
<td>No. R4 Wheel: 35 X 2”</td>
</tr>
</tbody>
</table>

CEE&TS reported no damage to car 9184 as a result of this incident. As part of the investigation OSS requested CEE&TS perform additional inspections on the three (3) train consists in advance of the 2139 ‘R’ 179/CAN. CEE&TS reported the presence of minor gash marks on the right side wheels on both the 2150 ‘N’ DIT/STL and the 2202 ‘N’ DIT/STL, which were the two (2) consists preceding the incident train. These gash marks posed no mechanical issues to the wheels, but are indicative of the trains traversing a broken west side running rail. The 2123 ‘R’ 179/95, which was the third consist in advance of the 2139 ‘R’ 179/CAN, presented no undercar or car body damage during inspection.

DCE was not a contributing factor in the derailment.

Interagency Emergency Response
NYPD, FDNY and EMS personnel were notified of the incident and responded to the 14th Street and 23rd Street stations. The coordination of the emergency response between personnel from NYCT and external agencies was reviewed. OSS determined that the required interagency protocols were followed and the response was efficient and effective.

Injuries
There were no reported injuries as a result of this derailment.

Weather
Although this incident occurred in the subway; the incident location was directly beneath street ventilation shafts. At the time of the incident, National Oceanic and Atmospheric Administration (NOAA) recorded a -1 degree temperature in Central Park. OSS also observed formations of ice in the vicinity of the derailment site, as well
as in the subway troughs. Due to the presence of the RCF, water and ice in the area, OSS cannot definitively rule out weather as a possible contributing factor in this incident.

**Damages Costs:**

**DT Damage**
Various track appurtenances were replaced in order to restore Track A1 to a state of good repair.

- **DT Labor Costs:** $1,249.84
- **DT Material Costs:** $2,377.52
- **Total DT Costs:** $3,627.36

**DI Damage**
No damage was reported as a result of this incident, these cost were associated with the manpower and equipment used to illuminate the area of the derailment.

- **DI Labor Costs:** $16,835.00
- **DI Material/Lighting Costs:** $1,000.00
- **Total DI Costs:** $17,835.00

**DCE Damage:**
No damage was reported as a result of this incident:

- **DCE Labor Costs:** $00,000.00
- **DCE Material Costs:** $00,000.00
- **Total DCE Costs:** $00,000.00

**Total Incident Costs:** $21,462.36

**Rules and Regulations**
DT personnel regularly inspect track to identify conditions that deviate from the standards established in the MW-1 Track Standards Manual. These deviations are categorized based upon their severity, reported to the appropriate Subdivision, and acted upon as prescribed below:

**NYCT MW-1 Track Standards (2015): Section 104.3 Conditions and Course of Action**

(A) **Priority 1:** Conditions requiring immediate action. The qualified person detecting the condition shall make every effort to correct it immediately and must also evaluate whether to allow operation to continue under supervision or to place the track out of service immediately.

(B) **Priority 2:** Conditions that require inspection by a supervisor-or Deputy Superintendent of Track of the Staten Island Railway – within 24 hours of the time of detection of the condition. The investigating person shall immediately
determine whether a slow speed may be necessary and what work is required, and shall base these decisions on findings and other factors, such as type of condition, its location and the permanent speed of the track where the condition was found. Every effort shall be made to correct these conditions as soon as practicable.

(C) Priority 3: Such designation alerts to a track condition that may affect the ride comfort qualities of the track and that could potentially degrade to a worse condition if left uncorrected. Work programs should be established for the correction of these conditions on mainline revenue tracks.

NYCT MW-1 Track Standard (2015): Section 104.3 Conditions and Course of Action
(F) THE COMBINATION OF RAIL SURFACE DEFECTS, NON-CRITICAL INTERNAL RAIL FLAWS OR BASE CORRODED RAIL AND PRIORITY 2 TRACK GEOMETRY DEFECTS at the same track location shall be investigated and evaluated by a Track Supervisor or Superintendent as soon as either type of defect has been detected and reported to the Sub-Division.

Part 1 – Page 7
The Supervisor (or Superintendent) shall determine if the combination of defects requires the placement of a slow speed or other type of immediate action based on the findings, the severity of the defects, the existing amount of rail wear at the location and the speed and traffic levels at the location where the defects were found.
For this purpose, “rail surface defects” shall include: numerous visible head checks, large wheel burns, significant spalling, flaking or shelling (“squats”) of the head of the rail, including any visible crack on the rail head, especially at the gauge corner of the rail; “Priority 2 track geometry defects” shall include profile or alignment defects. Correction of this type of combination of defects shall be prioritized based on the location of the defects, their magnitude, the environment (wet vs. dry areas) and traffic levels. In general, subway areas where corrosion or water infiltration is present and where traffic levels are high (two or more services operating on the same track) shall be targeted for immediate repair first, within no more than two weeks after the inspection and evaluation of the combination of defects found.

Structural Inspection Policy Instruction for the Department of Subways (2013)
XIII. Time Limits to Address Conditions.
• IA -- IMMEDIATE ACTION CONDITIONS (Safety and Structural)
The following steps should be implemented for an “Immediate Action” Defect.
- The Assistant Chief Officer or his representative shall immediately report the identified defect to the appropriate maintenance general superintendent. If necessary train service in the area shall be stopped or a slow speed order instituted.
- The defects must be repaired and/or shored by responsible maintenance subdivision within 24 hours of the reported time.
- Upon completion of the temporary shoring and/or repairs or permanent repairs, the defect shall be re-inspected and shall be reclassified under the appropriate defect criteria.

• A (Structural) and A1 Conditions
  - Address: Within 90 days
  - Monitor/Reinspection: as necessary
  - Repairs: Repair sufficient to downgrade the condition to A3 or better shall be performed within one year. The reclassified condition shall be repaired within the time constraints of the revised defect classification.

• A2 Conditions
  - Address: Within 1 year
  - Monitor/Reinspect: as necessary.
  - Repairs: Repair sufficient to downgrade the condition to A3 or better shall be performed within three (3) years. The reclassified condition shall be repaired within the time constraints of the revised defect classification.

• A3
  - Address: No additional mitigation is necessary. By definition, conditions listed in this class are IA, A1 or A2 defects that have been temporarily addressed.
  - Monitor: monitor conditions during subsequent regular annual inspections to determine if condition needs to be upgraded.
  - Permanent repairs: Major work required within 5 years under the capital program.

• B (Structural) and B1 Conditions
  - Address: No special mitigation necessary.
  - Monitor: monitor conditions during subsequent regular annual inspections to determine if condition needs to be upgraded.
  - Permanent repairs: Repairs of conditions in this class are to be performed when possible based on priority, availability of resources and opportunity for access to the location. Repair by infrastructure maintenance forces during routine maintenance or when performing repairs to adjacent structure at the discretion of General Superintendent of the relevant discipline. Can also be included in capital contracts performing other work in the vicinity or line structure rehabilitation contracts when economical to do so at the discretion of the Vice President, Subways Capital Programs.

• B2 and C Conditions
  - No action is required, but the condition is reported and recorded for use in future annual inspections in order to ensure that the condition has not progressed to a more serious defect. These conditions are not a priority for operating budget repairs but may be made part of capital project work in the area of opportunity and if funding is available.

• A and B Structural Safety Conditions
  - Address: Safety items must be addressed within 90 days of the initial reporting date.
Rule 9.02b – which states: “They must take every precaution for the safety of their trains and customers. When a train is in motion the responsibility for safe running rests entirely upon the Train Operator.”

**ANALYSIS**

From the physical evidence gathered at the scene of the accident, a review of the NRS and TGC inspection reports, DT inspection records, LPI Inc. metallurgical analysis, as well as the results of employee interviews the following sequence of events is considered to have been most probable:

- At approximately 22:31 hours on February 13, 2016, a ten car train designated as the 2202 ‘N’ DIT/STL was traversing southbound on Track A1 south of the 23rd Street Station on the Broadway Line.
- T/O #1 reported an unusual loud noise and an odor of smoke. The T/O #1 reported the condition to the RCC upon berthing the train within the confines of the 14th Street Station.
- T/O #1 failed to stop immediately as instructed during T/O induction training.
- T/O #1 failed to properly report and identify the location when the loud and unusual noise was heard. This failure resulted in an inadequate inspection of the area, and may have permitted the broken rail to remain unidentified.
- The ineffective investigation resulted in an unidentified fractured west running rail, which upon the arrival of the 2139 ‘R’ 179/CAN gave rise to the catastrophic failure of the rail resulting in the derailment.
- At approximately 23:15 hours, a ten car train designated as the 2139 ‘R’ 179/CAN previously ordered to STOP and STAY departed the 23rd Street Station traveling southbound on Track A1, in violation of Rule 9.02B.
- At approximately 23:17 hours as the 2139 ‘R’ 179/CAN while traversing southbound on Track A1 south of the 23rd Street Station the TO #2 heard an unusual loud noise, and applied a full service brake.
- At approximately 23:17 hours the T/O #2 reported to the RCC that he had heard an unusual loud noise and that the train may have derailed.
- The T/O #2 upon inspecting the origin of the unusual noise discovered a 4’ 11” section of the west running rail located at survey marker A1 107+45 missing beneath the second south car (9184). The head and web of the rail had separated from its base.
- As a result of the head and web of the rail separating from its base, the R2 wheel of the #1 truck of second south car (9184), was suspended above the missing 4’ 11” section of the west running rail at survey marker A1 107+45.
- Upon being notified of the situation, the RCC dispatched a reach train to the scene, which permitted approximately 169 customers onboard the incident train to walk through the reach train onto the platform at the 23rd Street Station.
- The post incident inspections performed by CEE&TS identified the presence of minor gash marks on the wheels of the two (2) preceding consists which were consistent with the marks on the wheels of the incident train.
- T/O #2s failure to wait for RCC authorization to resume service directly resulted in the derailment, since the area was not inspected by MOW, as required under RCC Directive 08-10.
- Post incident investigation determined the actions of RTO operating personnel as contributing factors in this incident.
- Post incident investigation of this incident identified the broken west running rail as the causal factor of this incident.
- The rail break was the result of a pre-existing RCF defect (head checks) at survey marker A1 107+45. In addition, in this instance the presence of water intrusion in the area may have accelerated the progression of the RCF.
- TI inspections performed on June 2, 2015 and December 15, 2015 identified the RCF, on the rail involved in the derailment, as a Priority 2 defect. The Priority 2 categorization required supervisory inspection within 24 hours, speed restrictions if deemed necessary, and repair as soon as practical.
- Supervisory track inspections of the reported Priority 2 defects, were conducted as required, on June 3, 2015 and December 16, 2015. On both occasions the supervisor concurred with the TI and maintained the defect status as a Priority 2.
- DI records indicate documented water intrusion, classified as an A2 defect, in the area approximately two (2) years and five (5) months prior to the derailment.
- Water intrusion although present in the vicinity, was not visible in the TGC inspections on April 15, 2015, October 6, 2015 and January 5, 2016, which as per MW 1 standards permitted the RCF defect to remain categorized as a Priority 3 defect by Track Engineering.
- DI repaired the A2 water intrusion defect within the three (3) year time frame from when the defect was reported, as per the P/I. The repair was made after the derailment incident.
- Post incident investigation identified water intrusion as a contributing factor in this incident.
- Due to the proximity of the street ventilation shafts to the derailment site, the extreme cold and the presence of water, weather cannot be ruled out as a contributing factor in the broken rail.
- There were no injuries reported as a result of this incident.
- The total incident costs were estimated to be $21,462.36.

CONCLUSION
OSS has determined that the causal factor in the derailment was a broken west running rail. OSS believes the west running rail located at survey marker A1 107+45 was most likely fractured prior to the incident train negotiating the derailment site. The rail break was a result of pre-existing RCF (head checks) that had escalated into an internal rail defect at survey marker A1 107+45. The RCF conditions may limit the capabilities of the current UT technology onboard the TGC3 and TGC4 cars utilized to identify potential internal rail defects. Contributing to this incident was water intrusion in the vicinity of the derailment; over a prolonged period of time may have accelerated the progression of the RCF that was occurring on the surface of the rail head. The extreme cold temperatures on the night of incident cannot be ruled out as a contributing factor.
An additional contributing factor was the failure of RTO operating employees to follow operating rules and procedures, particularly disregarding a Stop and Stay Order, which placed customers, employees and equipment in jeopardy.

**ACTIONS TAKEN**

1. On February 19, 2016 RTO issued RTO Bulletin 40-16 Reporting Unusual Noise or Condition to All Train Service Employees.
2. In March 2016 DI reported water abatement was performed at the location of the A2 defect located at survey marker A1 106+05, follow-up inspections performed in June 2016 indicate the area remains dry. DI will continue to monitor.

**RECOMMENDATIONS**

1. DOS should create plausible corrective action plans to combat RCF (e.g. Rail Grinding, Rail Replacement). DOS should evaluate the MW-1 Standards and weigh the need to re-prioritize the combination of conditions where RCF exists.
2. DOS should arrange for increased RCF awareness and/or identification for all DI employees engaged in track inspections.
3. DOS should investigate the feasibility of alternate and additional inspection processes to identify potential internal rail defects masked by RCF (e.g. Eddy Current, etc.)
4. RTO should evaluate the actions of T/O #1 and T/O #2 and take appropriate actions and/or corrective actions.
5. RTO should ensure that all reports of loud and/or unusual noises are investigated thoroughly prior to the resumption of service.
6. RTO Field Operations, Work Force Development and RCC Operating Directives should emulate each other, regarding the operation of service when an unusual noise is reported.
7. Work Force Development should implement documented training regarding the reporting of and operation of equipment, in regards to loud and unusual noises.
8. RTO should re-issue and reinforce all operating policies and instructions regarding the operating employees responsibilities when an unusual noise is reported along the Right of Way.

**SUBMITTAL**

Prepared by
This report was prepared by Michael Sullivan, Superintendent, Rapid Transit Investigations, OSS.

Signature: __________ Date: __________
Reviewed by
This report was reviewed by Michael Sullivan, Acting Manager, Rapid Transit Investigations, OSS.
Signature: [Signature] Date: 7-30-2016

Submitted by
This report is submitted by Carl Hamann, Acting Senior Director, Operations, OSS.
Signature: [Signature] Date: 7/20/16
INCIDENT RAIL PHOTOGRAPHS

This photograph shows Division of Track personnel measuring the missing 4'11" piece of running rail beneath the incident train, which when fractured resulted in the mainline derailment on February 13, 2016, south of the 23rd Street Station on the Broadway Line.
INCIDENT RAIL PHOTOGRAPHS

This photograph is of the located pieces of the incident rail involved in the mainline derailment that occurred on February 13, 2016, south of the 23rd Street Station on the Broadway Line. This photograph was taken by Track Engineering at 130 Livingston on February 14, 2016.
the rail temperature is equal to or exceeds 100 °F, paying particular attention to periods of
temperature fluctuations, and looking for signs of rail in high thermal stress. In the
event that daily cycles of extreme temperature fluctuations occur, repeated
inspections during those periods shall be performed.

(D) MINIMUM ANCHORING REQUIREMENTS for CWR are prescribed by Section 203.16, Part
2 of this Manual.

108.7 Defective Rails and Rail Wear

(A) GENERAL. In cases of defective running rails and guard rails, action to correct defects
shall be taken as indicated by the following table. In all cases, defective rail should be
changed out as soon as possible, as determined by the Track Superintendent (or
Deputy Superintendent of Track of the Staten Island Railway). Any rails changed out as
prescribed by this section should be noticeably damaged by a cutting torch to prevent
reinstallation. Emergency clamp-on bars may be applied as per Table 108.7B to
continue operation over defective rails. Emergency carry-over bars shall be installed
to continue operation over rail-head breakouts as per Table 108.7B, except that no
operation will be permitted when a breakout exceeds 4 inches; operation may
continue if carryover bars are installed.

(B) RAIL SURFACE DEFECTS REQUIRE CLOSE MONITORING AND ACTION in accordance with
Table 108.7A below and may require replacement if so determined by a qualified
person. Surface defects are: shelly spots or “squats”, head checks, wheel burn (but
not fracture), mill defect, flaking, spalling, corrugation, and corrosion. See paragraphs
(H) to (K) below for base corroded rail requirements, and paragraph 207.5 (D) in Part 2
of this Manual, for wheel burn requirements. At locations where a combination of a
Priority 2 track geometry defect and a rail surface defect or a non-critical rail flaw
defect does exist, immediate inspection and action is required; see section 104.3
“Course of Action”, paragraph (F) for more details.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Priority 3</th>
<th>Priority 2</th>
<th>Priority 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTION</td>
<td>MONITOR CLOSELY</td>
<td>SCHEDULE RAIL REPLACEMENT</td>
<td>REPLACE RAIL AS SOON AS POSSIBLE</td>
</tr>
<tr>
<td>WHEEL BURNS/ SQUATS/SHELLS (1)</td>
<td>Small size (&lt;1”), light severity</td>
<td>Medium size (&gt;1” and ≤2”), moderate severity</td>
<td>Large size (&gt;2”), 1/8”+ deep and broken piece, severe</td>
</tr>
<tr>
<td>HEAD CHECKS (Crack Length and Flaking/Spalling)</td>
<td>Less than 1” long, light flaking/spalling</td>
<td>1”+ long, medium flaking/spalling, DRY conditions</td>
<td>1”+ long, severe flaking/spalling, WET conditions</td>
</tr>
<tr>
<td>BASE CORROSION</td>
<td>Slight</td>
<td>Medium</td>
<td>Severe (2)</td>
</tr>
</tbody>
</table>

(1): APPLIES TO LOCATIONS WHERE A WATER CONDITION, INCLUDING DRIPPING ON TOP OF THE RAIL, DOES EXIST.
(2): SEVERELY BASE CORRODED RAILS WITH ANY CRACK(S) OF ANY SIZE SHALL BE REPLACED IMMEDIATELY.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Priority 3</th>
<th>Priority 2</th>
<th>Priority 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPEED</strong></td>
<td>UNRESTRICTED SPEED</td>
<td>SLOW SPEED 1-10 mph (*)</td>
<td>SUPERVISE OPERATION</td>
</tr>
<tr>
<td><strong>ACTION</strong></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>DEFECT</td>
<td>TRANSVERSE FISSURE (1)</td>
<td>COMPOUND FISSURE (1)</td>
<td>DETAIL FRACTURE (1)</td>
</tr>
<tr>
<td>SIZE</td>
<td>S</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>DEFECT</td>
<td>HORIZONTAL SPLIT HEAD (1)</td>
<td>VERTICAL SPLIT HEAD (1)</td>
<td>SPLIT WEB (1)</td>
</tr>
<tr>
<td>LENGTH</td>
<td>&lt; 2&quot;</td>
<td>2&quot; to 4&quot;</td>
<td>&gt; 4&quot;</td>
</tr>
<tr>
<td>ORDINARY BREAK (1)</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>DAMAGED RAIL (1)</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

(1): ALSO APPLIES TO WORKING GUARD RAILS.
(2): A “BREAK OUT” IS DEFINED AS A FULL SEPARATION OF THE RAIL SECTION IN ANY DIRECTION.

**ACTION:**
A: APPLY JOINT BARS IF NOT REPLACED IN 15 DAYS, IF FOUND SAFE FOR OPERATION.
B: INSPECT IN 15 DAYS OR AS REQUIRED IN HIGH TRAFFIC AREAS (2 OR MORE TRAIN SERVICES OPERATING ON THE SAME TRACK).
C: LIMIT SPEED TO 10 MPH IF DETERMINED BY QUALIFIED PERSON. REPLACE DAMAGED RAIL WITHIN 30 DAYS OF ITS DETECTION.
D: LIMIT SPEED TO 10 MPH; REPLACE RAIL WITHIN 5 DAYS.
E: SUPERVISE OPERATION AND REPLACE RAIL AS SOON AS POSSIBLE; REPLACE BASE CORRODED RAIL WITHIN 48-HRS. (SEE PARAGRAPH 108.7 (I) BELOW).
F: APPLY JOINT BARS, CARRYOVER BARS AND/OR NON-CONDUCTIVE PLATES IMMEDIATELY; REPLACE RAIL AS SOON AS POSSIBLE.

**SIZE:**
L = LARGE (41-100%); M = MEDIUM (21-40%); S = SMALL (0-20%)

**NOTES:**
1. "Transverse Fissure" means a progressive crosswise fracture starting from a crystalline center or nucleus inside the head from which it spreads outward as a smooth, bright or dark, round or oval surface substantially at a right angle to the length of the rail. The features that distinguish a transverse fissure from other types of fractures or defects are the crystalline center or nucleus and the nearly smooth surface of the development which surrounds it.

2. "Compound Fissure" means a progressive fracture originating in a horizontal separation near the head which turns up or down, or in both directions to form a transverse separation progressing substantially at a right angle to the length of the rail. Compound fissures require examination of both faces of the fracture to locate the horizontal split head from which they originate.

3. "Horizontal Split Head" means a horizontal progressive defect originating inside of the rail head, usually 1/4 inch or more below the running surface and progressing horizontally in all directions, and generally accompanied by a flat spot on the running surface. The defect appears as a crack lengthwise of the rail when it reaches the side of the rail head.
4. "Vertical Split Head" means a vertical split through or near the middle of the head, and extending into or through it. A crack or rust streak may show under the head close to the web, or pieces may be split off the side of the head.

5. "Split Web" means a lengthwise crack along the side of the web and extending into or through it.

6. "Head Web Separation" means a progressive horizontal defect originating in the fillet area between the underside of the head and the web. Separation may occur at the rail end or in open rail progressing horizontally.
7. "Piped Rail" means a vertical split in a rail, usually in the web, due to failure of the sides of the shrinkage cavity in the ingot to unite in rolling.


9. "Detail Fracture" means a progressive fracture that typically originates from a crack at or near the surface of the rail head; the crack turns down and progresses transversely at right angles to the running surface of the rail. These fractures should not be confused with transverse fissures, compound fissures or other defects which
have internal origins. Detail fractures may arise from shelling, head checks or flaking.

10. "Wheel (Engine) Burn Fracture" means a progressive fracture originating in spots where driving wheels have slipped on top of the rail head. In developing downward they frequently resemble the compound or even transverse fissure with which they should not be confused or classified.

11. "Ordinary Break" means a partial or complete break in which there is no sign of a fissure, and in which none of the other defects described in this subsection are found.

12. "Damaged Rail" means any rail broken or damaged by wrecks; broken, flat or unbalanced wheels, or similar causes.

* 13. "Shelling" means a condition where a thin (usually $\frac{3}{8}$ inch in depth or less) shell-like piece of surface metal becomes separated from the parent metal in the rail head, generally at the gauge corner. It may be evidenced by a black spot appearing
on the rail head over the zone of separation or a piece of metal breaking out completely, leaving a shallow cavity in the rail head. In the case of a small shell there may be no surface evidence, the existence of the shell being apparent only after the rail is broken off or sectioned. Shelling normally occurs on the upper gauge face of the rail head, extending longitudinally; shells originate under the surface of the rail head. Shelling occurs from high contact stresses from wheel-rail interaction, especially when severe non-conformal wheel-rail contact occurs. Shell propagation can develop into a transverse defect (TD); most often, they are not visible on the rail surface until they reach advance stages of development. The horizontal component of the shell can mask the detection of the transverse component of the defect that leads to a detail fracture.

* 14. "Squats" means a surface defect on the head of the rail commonly associated with areas of high tractive effort. It is characterized as a shallow depression located more or less in the center of the rail head. This depression is the result of shallow subsurface cracking, reduced strength of the steel and deposit of debris in the depression, giving it the appearance of a dark spot. Squats generally develop in one rail only, as discreet defects, at irregular intervals along the rail.

* 15. "Head Checks" means hair-line cracks which appear in the gauge corner of the rail head, at any angle with the length of the rail. When not readily visible, the presence of the checks may often be detected by the raspy feeling of their sharp edges. Head checks are a result of cold working of the metal surface due to the interaction between the wheels and the rail, usually at the gauge corner; this is also referred to as a form of rolling contact fatigue (RCF). Head checks can progress into more severe rail surface conditions such as the initiation point for detail fractures or compound defects. Severe head checking can also interfere with the detection of internal rail defects.
16. "Flaking" means small shallow flakes of surface metal generally not more than $\frac{1}{4}$ inch in length or width, that break off the gauge corner of the rail head, usually when head checks join each other. Flaking takes place only on the running surface of the rail, usually near its gauge corner, and it is not as deep as shelling. Flaking is the result of surface metal friction, flow and plastic deformation, caused by concentrated wheel loads, resulting in severe compressive shear deformation of the rail surface. This surface condition can progress in depth and could also become the origin point for detail fractures; severe flaking can also interfere with the detection of internal rail defects.

17. "Spalling" means cracking and chipping of the rail head surface, usually at the top of the head of the rail; spalling is a progression of head checking and flaking. It is usually caused by high horizontal wheel-rail creeping forces, transverse frictional forces and extreme wheel-rail contact stresses resulting in micro-cracking and head chipping. Spalling can interfere with the detection of internal rail defects.
These defects shall be protected as shown in Table 108.7A.

(D) RAILS WITH BURNED BOLT HOLES ARE PROHIBITED for use in any track. Torch-cut rails may be used in main tracks only in emergency conditions, but, if used, they must be replaced within 24 hours, and protected by a slow speed order under "Supervise Operation" conditions until replaced.

(E) ALL DEFECTIVE RAILS REQUIRING REPLACEMENT must be recorded in the "Report of Rail Failure" forms shown in Part 5 of this Manual. All information shall be properly and fully completed. The forms shall be promptly forwarded to the System Maintenance Officer or Subway Maintenance Officer and kept on file for at least one year.

(F) RAIL WEAR. As a general guide, when wheel flanges strike joint bars or filler blocks due to the rail wear, rails must be renewed. Mainline, Yard Lead and Ladder tracks’ running rails and guard rails (except all switch points and stock rails, see Table 109.3) shall conform to the following table:

<table>
<thead>
<tr>
<th>TABLE 108.7C RAIL WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACTION</strong></td>
</tr>
<tr>
<td>Condition</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Running Rail Top (1)</td>
</tr>
<tr>
<td>Remaining</td>
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<tr>
<td>Running Rail Side (1)</td>
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<td>Remaining</td>
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<tr>
<td>Guard Rail Side</td>
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<td>Remaining</td>
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<td>Running Rail Top (1)</td>
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<td>Running Rail Side (1)</td>
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<tr>
<td>Guard Rail Side</td>
</tr>
<tr>
<td>Remaining</td>
</tr>
</tbody>
</table>

(< : less than; > : greater than; $\leq$ : less than or equal to; $\geq$ : greater than or equal to)

NOTES: (1) For switch stock and point rail wear, see Table 109.3

(*) If there are signs of severe head checking, shelling, flaking or spalling, then the rail shall be replaced.

Running and guard rails installed in Yard lay-up tracks only may be replaced when either their top wear, side wear or both equal or exceed ¾ inch, if so determined by the Track Supervisor in charge. Ladder and Yard Lead track rails, as well as all switch rails, must conform to Tables 108.7C above and 109.3 respectively.
(G) RAIL CORRUGATION is generally found in curves and should be programmed for surface grinding to extend the service life of the rail, decrease noise and minimize load impact. Rails with corrugations of a depth of $\frac{1}{8}$ inch or greater shall be replaced. Criteria for rail wear are to be met as per paragraph 108.7 (F).

(H) RAIL CORROSION CONSISTS OF THE DETERIORATION AND DISINTEGRATION of the rail steel starting at its surface, due to chemical reactions, oxidation and electrolysis effects in the presence of water containing salts or other impurities. It is therefore paramount to divert any water away from the track elements (rails, fasteners and ties) so that they are not affected by electrolysis and corrosion; in addition, rail corrosion could lead to rail breaks and signal system failures. Levels of rail corrosion shall be classified as follows:

- Slight (minimal): rusting of the steel rail surfaces, perhaps with some minor flaking of surfaces; surface pitting is small (pin-head size or smaller typically) and/or sporadic; loss of any section of the rail at the web or base is minimal (less than $\frac{1}{16}$”); no visible cracks are present at the deteriorated surfaces.

- Medium: heavy rusting and flaking of rail surfaces; surface pitting is medium-sized (approximately $\frac{1}{8}$” in diameter on average) and more prevalent; loss of any section of the rail at the web or base is small (less than $\frac{1}{4}$”); small cracks, if present, on the deteriorated surfaces are less than $\frac{1}{8}$” in length.

- Severe (significant): surface pitting is large-sized (more than $\frac{1}{8}$” on average) and extensive; rail base or web have loss of section equal to or larger than $\frac{3}{4}$”, either on a uniform basis or concentrated at point or points on the base; cracks in the deteriorated surfaces, if present, are $\frac{1}{8}$” or larger in length.

The above corrosion levels shall be treated in accordance with the actions shown in Table 108.7A above, except otherwise as specified in the following paragraphs. For examples of corrosion conditions see Appendix on Part 5 of this Manual.

(I) BASE CORRODED RAILS MUST BE INSPECTED AND VERIFIED by a Track Supervisor – or the Deputy Superintendent of Track (or his qualified designee) of the Staten Island Railway. The base corroded rails shall be marked with highly visible paint in the web of the rail only, so that they can be easily monitored. The Track Supervisor shall inspect all base corroded rails in the section as part of the twice a month supervisory inspection (as per section 102.2 (D) of this Manual), and a written record of each inspection must be forwarded to the Assistant Chief Track Officer. The Track Inspector of the section shall monitor and report the condition of the base corroded rails found during each and every inspection performed in the Section.

(J) REPLACEMENT OF BASE CORRODED RAILS SHALL BE SCHEDULED AS FOLLOWS:
1. In general, severely based corroded rails shall be replaced within no more than 48-hrs. of their detection, or immediately if there are any cracks of any size at the location where the corrosion is most severe. If the severely base corroded rail cannot be replaced within 48 hrs., either joint bars, carryover bars and/or non-conductive plates shall be installed at the location of the most severe corrosion, or the rail shall be cut and joint bars installed if there are any cracks at that location.

2. Base corroded rails of medium severity shall be replaced within 90 days of their detection. If they can not be replaced within 90 days, then either joint bars, carryover bars and/or non-conductive plates supporting the base of the corroded rail section shall be installed in each case to the rail at the location where the base corrosion is found to be significant.

3. Base corroded rails of slight severity shall be monitored by the Track Inspector and the Track Supervisor of the section where they are found, and their condition must be periodically reported as per paragraph (I) above.

4. If there are any Priority 2 visual, rail flaw or track geometry defects present at locations where rails of medium or severe base corrosion do exist, then immediate action shall be taken, consisting of placement of a slow speed order, immediate replacement of the corroded rail and correction of the Priority 2 defect.

(K) REPLACEMENT OF BASE CORRODED RAILS SHALL BE PRIORITIZED AS FOLLOWS:

1) any rails with severe base and/or web corrosion, especially at fastener locations;
2) any rails with medium corrosion and any cracks of any size in the corroded areas;
3) base corroded rail of medium severity at locations with any Priority 2 defects;
4) base corroded rails of medium severity in under river tubes;
5) base corroded rails of medium severity in all tracks in high traffic volume areas, such as:
   - Lexington Ave. Line (IRT), from 125th St. to Atlantic Ave.;
   - Queens Blvd. Line (IND), S/O 5th Avenue to 71st – Continental Aves.
   - 6th Avenue Line (IND), Broadway-Lafayette to 59th St. & 8th Ave.
   - 8th Avenue Line (IND), 168th St. to Hoyt-Schermerhorn St.
   - Broadway-7th Ave. Line (IRT), 96th St. to Chambers St.
   - Broadway and Brighton Lines (BMT), 57th St. & 7th Ave. to Prospect Park.

(L) SPECIAL ATTENTION MUST BE PAID TO CONTAINER PLATE INSTALLATION IN SUBWAY AREAS, as they are conducive to the development of base corroded rails by trapping moisture in their rubber rail seats. In wet subway areas, rails resting on container plates must be inspected, at a minimum frequency of every three months, by removing a minimum of five non-consecutive container plates per every 39-ft. of rail and closely examining the condition of the rail base. In dry subway areas, a minimum of two non-consecutive plates per 39-ft. of rail shall be removed for examination of the rail. If the rail exhibits any signs of corrosion, it shall be handled as prescribed in paragraph (H) above.

(M) RAILS (BOTH RUNNING AND GUARD) INSTALLED IN WATER SPRAY LUBRICATION AREAS must be replaced after no more than 18 months from their original installation date, or
less if so determined by the Superintendent of the Section. Any other hardware found to be corroded or deteriorated due to the wet conditions present in the water spray lubrication areas shall also be replaced.

(N) WORN CONTACT RAIL SHALL CONFORM to the standards shown in Table 300.4B, Part 3 of this Manual.

(O) DEFECTIVE CONTACT RAIL SHALL CONFORM to the standards shown in Table 300.4C, Part 3 of this Manual.

(P) DEFECTIVE WELDS REQUIRE ACTION as prescribed in Table 108.7B. However, simple flaws in the transverse plane may remain in service without restriction provided that the joint has been fully drilled and joint bars have been applied. Such action shall be as determined by the Superintendent, based on the traffic, location and wear of the CWR in question.
BULLETIN NO.: 148-16  (Supersedes Bulletin No.: 42-12 & 40-16)  September 2, 2016

TO: ALL TRAIN SERVICE PERSONNEL (ESPECIALLY TRAIN CREWS)

SUBJECT: REPORTING UNUSUAL NOISE OR CONDITION

Train Crews are an important part of New York City Transit’s operation safety program. Observations of unusual conditions along the right-of-way, if immediately reported to the Rail Control Center, may avert a more serious incident.

Train Crews are advised that any time you hear an unusual or loud noise or observe an unusual condition (broken rail, suspected broken rail, defects in the infrastructure, signals, car equipment or other equipment) you must be governed by the following procedure;

1. Bring the train to a controlled stop immediately.
2. Call the Rail Control Center via radio or telephone to report the condition.
3. Report the location of the condition to the Rail Control Center by supplying a survey marker number, signal number, track number, station, etc.
4. Secure the train, descend to the roadbed, thoroughly inspect the tracks and underneath the train for any breaks or unusual conditions and continue inspecting the trackway for a distance 600 feet behind the train.
5. Report your findings to the Rail Control Center and be governed by their instructions.

In addition, all Train Service Employees are reminded of Rule 2.44(a), which states:

"Employees noting defects in the structure, tracks, signals or other equipment, or any unusual conditions that would delay or make unsafe the movement of trains, must report them at once to the Rail Control Center."

NOTE: Train Operators on trains ordered to “Stop and Stay,” by the Rail Control Center MUST obtain permission from the Rail Control Center before proceeding.

Line Managers and Train Service Supervisors must monitor for strict compliance with this directive.

Paul J. McPhee
Acting Chief Officer, Field Operations
Service Delivery
"EVERY SECOND COUNTS"

BULLETIN NO.: 148-16  (Supersedes Bulletin No.: 42-12 & 40-16)
Date: March 31, 2015

To: All Rail Control Center Desk Superintendents and Console Dispatchers

From: Pamela Elsey, Assistant Chief Transportation Officer, Rail Control Center

Re: POSITIVE COMMUNICATION CONCERNING TRAIN MOVEMENT
(Supersedes Rail Control Center Directive 11-14 dated September 16, 2014)

The Rail Control Center is responsible for the safe movement of trains. Communicating the intentions of changing the route or direction of a train(s) is of the utmost importance.

Effective immediately, the following procedure must be adhered to when the Rail Control Center is communicating with train(s) and or Towers concerning the movement of trains other than its scheduled route. The Rail Control Center will obtain:

- The identity the train (full call letters)
- The operating motor of the train
- The name of the Train Operator/Crew Member receiving the instructions

The Rail Control Center will then give specific instructions to that Train Operator/Crew Member concerning the change of route or direction of the train.

The Rail Control Center will then ask the Train Operator/Crew Member to repeat back those instructions. Then ask the Train Operator/Crew Member if they understand the instruction just given to them.

When the Rail Control Center is satisfied that the instructions were received correctly, permission will be given to that train to proceed.

In areas controlled by local towers, the Rail Control Center must ascertain that the field Supervisor/Tower Operator understands the instruction as outlined above.
DATE: February 18, 2016

TO: All Rail Control Center Desk Superintendents and Console Dispatchers

FROM: Pamela K. Elsey, Assistant Chief Officer, Rail Control Center

RE: REPORTING UNUSUAL NOISE OR CONDITION
(Supersedes Rail Control Center Directive 08-10 dated February 03, 2010)

Effective immediately, in conjunction with Service Delivery Bulletin 40-16 when Train Crews report an unusual or loud noise or observe an unusual condition (broken rail, suspected broken rail, defects in the infrastructure, signals, car equipment or other equipment) you MUST instruct the Train Operator to stop the train immediately secure the train and descend to the roadbed and investigate. The Train Operator must inspect the rails and the roadbed underneath the train for any breaks or unusual conditions and continue walking 600 feet beyond the end of the train. While investigating, the Train Operator should check the surrounding area (bench wall, rubbing board etc.) for damage and anything that the train could have made contact with.

The exact location of the train should be determined by asking the Train Operator for a signal number, survey marker and track number. The nearest Tower, ATS-A display or CBTC display will be utilized to assist in verifying the location of the incident train. All effected towers and gap stations will be instructed to hold back and reroute service around the train.

If the Train Operator does not find a broken rail or other unusual condition, he/she will be instructed to proceed at restricted speed with extreme caution. If the cause of the noise cannot be determined, no other trains will be permitted through the area until Maintenance of Way reports their findings. If the investigation reveals that the Loud Noise was due to a Car Equipment Defect, the following trains that were holding in stations can resume operating through the area.

If the Train Operator reports he/she is unable to proceed due to the track condition, the Desk Superintendent will determine the best course of action to remove customers from the train, and will institute appropriate service adjustments. Service Delivery supervision must be dispatched to the area immediately and given all pertinent information pertaining to the incident. 6-wire notification must be made to all divisions, requesting an immediate response from Maintenance of Way for an evaluation. Feedback and an estimated times of arrival from all responding divisions must be requested. Maintenance of Way must inform the Rail Control Center when the roadbed is safe to resume regular service or if there are any restrictions.

At the request of Maintenance of Way, a “Lite” train with the Maintenance of Way personnel aboard will be used as a test train and allowed to proceed at restricted speed with extreme caution. Rail Control Center must have positive communication with the Lite test train.

All information must be incorporated into the Train Incident Letter.

Desk Superintendent will monitor for compliance.
BULLETIN NO.: 149-16  (Supersedes Bulletin No.: 1-13)  

TO:        ALL TRAIN SERVICE PERSONNEL (ESPECIALLY TRAIN OPERATORS)  

SUBJECT:   TRAINS STRIKING OBJECTS/NO BRAKES IN EMERGENCY  

Train Operators are advised that any time you suspect that your train has come in contact with any object, or person along the right-of-way and the emergency brakes do not apply, you must do the following:  

STOP IMMEDIATELY.  

1. Call the Rail Control Center via radio or telephone to report the incident.  
2. Report the location of the incident to the Rail Control Center by supplying a survey marker number, signal number, track number, station, etc.  
3. Secure the train and go to the roadbed to investigate. Check for injured person(s) and/or possible equipment damage.  
4. Report your findings to the Rail Control Center and be governed by their instructions.  

Line managers and Train Service Supervisors will monitor for strict compliance with this directive.  

[Signature]

Paul J. McPhee  
Acting Chief Officer, Field Operations  
Service Delivery  

"EVERY SECOND COUNTS"
BULLETIN NO.: 147–16  (Supersedes Bulletin No.: 88-12) September 2, 2016

TO: ALL EMPLOYEES

SUBJECT: REPORTING CAR DEFECTS OR UNUSUAL CONDITIONS

Train crews are an important part of New York City Transit’s safety program. Observations of unusual conditions en route, if immediately reported to the Rail Control Center, may avert a more serious incident.

To ensure the safety of customers and employees, Rule 2.44(b) “DEFECTS FOUND ON THE TRAIN,” paragraph one states:

“The Train Crew must report as soon as possible any train defects with a revenue train that would delay service. When the train arrives at the terminal/yard, all defects to the train known to the crew must be entered on the Car Defect Sheet, and reported to the Dispatcher and Road Car Inspector. On equipment with Train Operator’s Display (TOD) screens, Train Operators will include all defects on the trouble screens.”

This rule applies to all Conductors and Train Operators in road service or in yard terminal service (including those who transfer, store, prepare, put in, or otherwise service trains).

In addition, all employees are reminded that they must comply with Rule 2.44(a), which states:

“Employees noting defects in the structure, tracks, signals or other equipment, or any unusual conditions that would delay or make unsafe the movement of trains, must report them at once to the Rail Control Center.”

Train Dispatchers and Yard Dispatchers will provide “CAR DEFECT REPORT SHEETS,” prominently displayed, for use by the train crews. At the end of each day, they will distribute the filled in “CAR DEFECT REPORT SHEET” as follows:

- Original--Line Manager
- One copy--Division of Car Equipment, Superintendent, Maintenance Shop

The timely reporting of car defects will minimize service delays and injuries to customers and employees.

Superintendents and Train Service Supervisors must see that the “CAR DEFECT REPORT SHEET” is prominently displayed and being used at every terminal and yard location under their jurisdiction.

Paul J. McPhee
Acting Chief Officer, Field Operations
Service Delivery

“EVERY SECOND COUNTS”

BULLETIN NO.: 147–16 (Supersedes Bulletin No.: 88-12)
BULLETIN NO.: 146-16 (Supersedes Bulletin No.: 53-11)

September 2, 2016

TO: ALL TRAIN SERVICE PERSONNEL

SUBJECT: OBSTRUCTION INCIDENTS

An obstruction incident is defined as any incident in which any part of a fixture, cable, wire, or structure is physically touching or has come into contact with any part of a train. When an obstruction incident occurs, the train must not be moved and the Train Operator must notify the Rail Control Center (RCC) immediately. The RCC will notify all the necessary divisions including the Office of System Safety (OSS) regarding the incident.

Upon arrival, Supervisors must immediately contact the RCC with details of what is touching the train and damage if any.

Supervisory personnel on the scene will ensure that trains involved in obstruction incidents do not move until the obstruction is cleared or it can be determined that the movement of trains will not affect the safety of customers and employees or cause further damage to NYCT property. Field supervision on the scene will inform the RCC when he/she has determined that it is safe to move the train.

Following the release of the equipment by OSS, the RCC will give the field supervisor permission to move the train. If OSS cannot be reached, the Desk Superintendent under the advice of the field supervisor will give permission to move the train if other immediate safety issues warrant it.

Line Superintendents and Train Service Supervisors must monitor for strict compliance with this directive.

Paul J. McPhee
Acting Chief Officer, Field Operations
Service Delivery

"EVERY SECOND COUNTS"