Managing & Measuring Compliance: A Structured Approach to Visual Track Inspections

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Visual track inspections are an integral part of the process to assure that track adheres to track safety standards and can provide valuable information to be used in track maintenance planning. The successful and timely completion of these inspections as well as recording what is found during the course of these inspections is necessary to comply with FRA regulations.

This paper will provide an overview of the computerized work management system (WMS) at Amtrak which is used to manage the inspection process and which provides a structured approach to capturing inspection results using mobile computing devices.

Phase 1 of the system uses the WMS to schedule and monitor the completion of the numerous track inspections conducted in compliance with Amtrak standards as well as Federal regulations through the use of system generated inspection work orders. These work orders provide important information as to who is scheduled to conduct a given inspection, when the inspection is required to be completed to comply with standards, and what territory or track assets the inspection covers. Phase 1 of the system is fully implemented over the entire Northeast Corridor and has been in use for several years.

Phase 2 of the system provides a mobile computing platform to electronically capture inspection results in the field. This includes the real-time evaluation of measured
conditions against standards, the creation of inspection findings, and the storage of the findings in a centrally accessible data repository. Phase 2 of the system is implemented on two Northeast Corridor subdivisions where Track Inspectors are currently using the mobile device on their daily inspections and is being implemented on a third subdivision.

The paper will conclude with brief discussion on the next steps for future development efforts.
INTRODUCTION:
The safety of Amtrak customers and employees is Amtrak’s first and highest priority.
Visual track inspections, whether conducted on foot or in a hi-rail vehicle, are an integral part of the process to assure that track adheres to track safety standards. Further, while automated inspection technologies continue to advance at a fairly rapid pace, visual track inspections are a core component of Federal Track Safety Regulations and will continue to be so into the foreseeable future. Finally the findings associated with visual inspections can provide valuable information to be used in track maintenance planning if this information is readily available to track engineers and maintenance planners. Hence, the successful and timely completion of visual inspections as well as electronically recording what is found during the course of these inspections is a requirement for both track safety and productive track maintenance.

This paper will provide an overview of the computerized work management system (WMS) at Amtrak which is used to manage the inspection process and which provides a structured approach to capturing inspection results using mobile computing devices. The system and its underlying processes are commonly referred to as the “Compliance Management System” at Amtrak and utilizes IBM’s Maximo® WMS software platform.

COMPLIANCE MANAGEMENT OVERVIEW:
The introduction of Amtrak’s Compliance Management System (CMS) followed a two-phased approach for development and implementation. The first phase focused on managing the inspection process wherein track inspection requirements are defined and categorized; track inspections are scheduled and assigned to individual Track
Inspectors; and the completion of each track inspection is documented and recorded. For development purposes this phase was labeled “Basic Compliance Management”.

The second phase focused on managing the inspection results or “findings” wherein observed or measured conditions are recorded on portable electronic devices; are evaluated against established safety and maintenance standards; and where appropriate corrective or protective actions are initiated. For development purposes this phase was labeled “Advanced Compliance Management”.

Underlying the development of both the basic and advanced compliance management systems is an Engineering Infrastructure Management Data Warehouse (EIMD) which contains all track assets with relevant attributes and geographical reference.

It should be noted that the scope of this compliance management initiative does not include the various automated inspections and tests performed by Amtrak and others (e.g. track geometry measurements, rail flaw detection, etc.) which are managed separately at the present time. Integration of automated inspections and tests into the CMS will be discussed briefly at the end of the paper.

**Basic Compliance Management:**

*Inspection Requirements:*

Amtrak conducts numerous visual inspections which can broadly be categorized as Track Inspections, Switch & Frog Inspections and Miter Rail & Expansion Joint Inspections. Over the course of a year Track Department employees conduct nearly 32,000 inspections at an annual expense of $14.5M in direct labor costs. The detailed requirements for each inspection are found in Amtrak’s “MW1000 – Limits and Specifications for the Safety, Maintenance and Construction of Track” and for most
inspections in the FRA Track Safety Standards. The details of these inspections including frequency are shown in the Table 1 below:

<table>
<thead>
<tr>
<th>INSPECTION CATEGORY</th>
<th>AMTRAK STANDARD (MW1000)</th>
<th>FRA REGULATION (TSS PART 213)</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRACK INSPECTIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall &amp; Spring Track Inspection</td>
<td>Subpart F, §213.234 Subpart F, §213.242(d) Subpart G6, §213.0234 Subpart G6, §213.0242(d) EP No. 1700</td>
<td>NONE</td>
<td>Fall, Spring</td>
</tr>
<tr>
<td>Supervisor/Track Inspector Joint Inspection Audit</td>
<td>Subpart F, §213.242(c) Subpart G6, §213.0242(c) EP No. 1700</td>
<td>NONE</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Rail Joint Inspections</td>
<td>Subpart A, §213.119 EP No. 1816</td>
<td>Subpart D, §213.119</td>
<td>Semi-Annually or Tri-Annually (by Track Class)</td>
</tr>
<tr>
<td><strong>SWITCH &amp; FROG INSPECTIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Turnout Inspection</td>
<td>Subpart A, §213.7.0(TO) Subpart C, §213.235(TO) EP No. 2000</td>
<td>Subpart A, §213.7 Subpart F, §213.235</td>
<td>Monthly</td>
</tr>
<tr>
<td>Annual Switch &amp; Frog Inspection</td>
<td>Subpart G6, §213.0233(h) Subpart C, §213.235(TO) EP No. 2000</td>
<td>NONE</td>
<td>Annually</td>
</tr>
<tr>
<td><strong>MITER RAIL &amp; EXPANSION JOINT INSPECTIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1

Amtrak Track Safety Standards are always equal to or more restrictive than the corresponding Federal Railroad Administration (FRA) Regulations; hence compliance
with the Amtrak Standard will ensure compliance with the corresponding FRA Regulation. It is the responsibility of the Deputy Chief Engineer Track to develop and maintain the Amtrak standards that encompass the requirements of the FRA Regulations.

Creating Inspection & Test Work Orders:

The “Inspection & Test Work Order” (ITWO) is the key component of the basic compliance management system. The ITWO contains all information required to schedule, assign, document and record the completion of each inspection performed on Amtrak owned or maintained tracks. Amtrak utilizes the Work Order Tracking, Job Plan, and Preventive Maintenance applications in Maximo to perform this function. Functionality from other Maximo applications is also used indirectly.

The process starts with the creation of an Inspection & Test Job Plan. Job Plans list the specific inspection tasks that must be completed in order to maintain compliance. They are associated to a specific track asset or group of assets as modeled in the EIMD. The creation of each Job Plan is a one time process which then serves as a template for the subsequent creation of each ITWO. Job Plans are revised only when the track asset to which it is associated changes or is retired.

For illustration purposes the job plan for a Monthly Turnout Inspection at Grace Interlocking in Havre Grace, MD is shown in Figure 1 below.
The job plan contains three (3) sections as follows:

- **Header**: Contains relevant information unique to this job plan including a system generated identifier as well as the type of inspection, the location where the inspection is to be performed, associated asset attributes and account coding information.

- **Responsibility Matrix**: Identifies primary and supporting responsibilities for the completion of the inspection work orders generated from this job plan. In the case of the monthly turnout inspection the Track and Signal departments conduct the inspection jointly with the Track department having the primary responsibility. The job plan provides for up to three (3) supporting disciplines in addition to the lead discipline. This is required in the case of miter rail inspections on movable bridges where all four Engineering disciplines (Track, Structures, Signal & Catenary are
involved.) When an inspection work order is generated, as will be described later in the paper, each identified discipline will notified of the upcoming inspection.

- **Job Plan Tasks:** Identifies the specific track assets to be included in the inspection.

  In the case of the turnout inspection shown in Figure 1 an inspection task is listed for each switch and movable point frog located within Grace Interlocking. Similarly a job plan for a Track Inspection would list each track segment in an inspector’s territory that would be included in the daily assignment.

  The process continues with the creation of a Preventive Maintenance (PM) Schedule which defines the frequency of each Inspection (daily, weekly, monthly, etc.) as determined by the governing standard or regulation for the associated Track Class where the inspection is to occur. As in the case of the Job Plan, the creation of the PM Schedule is a one time process which only needs to be revised as required inspection frequencies change or when track assets are added or retired. The PM Schedule associated with the Job Plan shown in Figure 1 is illustrated in Figure 2 below.

![Figure 2](image-url)
The PM Schedule is divided into sections that uniquely identify it; provide information regarding the timing of inspection work order creation; define a unique association with a specific job plan indicating the scheduling requirements; and provide account coding information for the tracking of inspection costs.

The Compliance Management System uses a time-based frequency to schedule inspections (as opposed to a metered or use-based frequency). Once the Inspection Job Plans and PM Schedules are loaded into the system and system operations begin, Inspection & Test Work Orders are generated automatically through the PM Scheduling module at the required frequency. The generation of new inspection work orders occurs on a nightly basis. Drawing upon the information contained in the Inspection Job Plans the new Inspection Work Orders are routed to the responsible Supervisor(s) and Track Inspector(s), appearing in their work queue each morning. While the creation of the Inspection Job Plans and PM Schedules seems an onerous task, once completed the benefits far outweigh the effort and provide Engineering Management and Field Supervision a powerful tool to ensure that all required inspections are completed in a timely manner.

It should be noted that system security restrictions limit access to the Job Plan and PM Schedule modules to those employees responsible for their creation or update. This prevents scheduling errors or oversights.

**Using Inspection & Test Work Orders:**

The Maximo Work Management System is used extensively within Amtrak’s Engineering organization with applications for timekeeping, work reporting, etc. in addition to compliance management. Accordingly each Track Inspector and Supervisor logs on to the system on a daily basis. Once in the system they are presented with a listing of all “active” inspection work orders for which they have some responsibility showing both the
completion status and compliance status for each inspection work order as well as other relevant information. Figure 3 below shows a typical Inspection Work Order List screen that would be seen when accessing the core system using a desktop or laptop computer.

Figure 3

The two right-hand columns of this list view indicate the compliance status and completion status respectively. For the Track Inspectors conducting inspections using mobile computing devices to record inspection results, the inspection work order details with status information is synchronized automatically to the mobile device assigned to
the inspector and is available remotely in the field. This will be described in more detail in a subsequent section

Selecting an inspection work order from the list view shown in Figure 3 displays the details of the selected inspection. The details for the monthly turnout inspection at Grace Interlocking are shown in Figure 4 below.

![Figure 4]

Similar to the detail view of the Job Plan and PM Schedule, the Inspection Work Order view contains seven (7) sections as follows:
- **Header**: Contains relevant information unique to this work order including a system generated identifier, the location where the inspection is to be performed, associated asset attributes, and account coding information.

- **Job Details**: Indicates the completion status of the work order, the target and actual completion dates, inspection type and identification of the Job Plan and PM Schedule that generated the Inspection Work Order.

- **Responsibility Matrix**: The same information shown in the Job Plan described previously.

- **Inspection Details**: Identifies the previous inspection completed at this location.

- **Task for Work Order**: Identifies the specific track assets to be included in the inspection. In the case of the turnout inspection shown in Figure 4 an inspection task is listed for each switch and movable point frog located within Grace Interlocking. This section also shows the date each task was completed, the name of the Track Inspector completing each task, and the compliance status for each task in the work order.

  It should be noted that the compliance status of the work order as a whole is determined by the compliance status of the tasks contained within the work order. If all tasks are compliant then the work order is deemed compliant. If only some of the tasks are compliant then the work order is deemed partially compliant. If no tasks are compliant then the work order is deemed non-compliant.

- **Resource Usage**: This section is where the Track Inspection records the time used to complete the inspection.
Basic Compliance Reporting:

The Basic Compliance Management System described above is fully deployed throughout the Amtrak system. Every inspector records the completion of the inspections that they are responsible for on a daily basis. In turn the Track Supervisor reviews each work order for completeness and updates the work order status to complete (COMP) once the inspection record is submitted and reviewed.

It is now possible to systematically monitor and report on both the completion status and compliance status of all inspection work orders on a routine basis. Several predefined reports are in the system and accessible to all users of the system. The Compliance Overview is one such report and an example is shown below in Figure 5:

![TK Inspection and Test Work Order Compliance Overview Report](image_url)

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This example shows the completion and compliance status of inspections performed on the Perryville Subdivision during the month of April 2011. When accessing this report through the system the user has the ability to drill-down to specific inspection work orders to evaluate compliance issues in more detail.

While evaluating the completion status of an inspection work order is a straightforward process, (i.e. an inspection has either been completed or it has not), evaluating the compliance status is a more complex process. This is due to the variety of frequency requirements for each inspection type. The daily track inspection (Inspection Type 1) is a case in point. The frequency requirements for this inspection type are twice per week with at least two days between inspections. While on the surface this appears to be a relatively simple process to determine compliance status it involves rather complex programming to accomplish on a systematic basis. System routines to determine compliance status are run on a nightly basis and are accessible to all users each morning.

Additional reports are also available which provide more details at the work order level or report on the cost of inspections. Reports can also be “rolled up” to view at the Division or even System levels.

**Advanced Compliance Management:**

Thus far we have focused on the Basic Compliance Management System which provides information to managers and supervisors to determine that each inspector completes all required inspections in a timely manner. Compliance issues at the Basic level revolve around whether an inspection was done and whether the standards and regulations concerning inspection frequency are met. While this is valuable information,
ultimately the purpose of track inspections is to evaluate the condition of the track assets through visual observations and quantitative measurements and to take appropriate action as conditions warrant maintaining a safe operating environment.

The Advanced Compliance Management system builds on the foundations provided in Basic system and focuses on the results or findings of the inspections, which in turn identify the condition of the track assets and whether they meet the quantitative standards and regulations for track safety. The key components of the advanced system are the Inspection Work Order, the Condition Logic Matrix (CLM), and the Inspection Findings all deployed on a mobile platform.

The objectives of Advanced Compliance Management are to enhance the Maximo Inspection and Test Work Management System in order to:

- Record Inspection and Test measurements, observations and conditions currently captured on paper forms directly to an electronic system and ultimately to Maximo which will then be the system of record.
- Provide mobile devices that operate in a disconnected mode to interface with Maximo and eliminate the need for writing results and entering at a later time in the computer.
- Provide regular management reports to monitor regulatory compliance and forecast inspection requirements.
- Provide Track Standard Compliance reports based on inspection measurements, observations, and conditions.
• Provide track defect and condition history via mobile device based on previous inspection results.

The Conditional Logic Matrix (CLM):

The Conditional Logic Matrix (CLM) is a software tool that is used to evaluate quantitative measurements of track conditions against maintenance and safety standards to determine compliance and recommend protective or corrective actions. The CLM is composed of nine (9) levels of data. The data hierarchy is:

• Category (track, turnout, miter rail or right-of-way)
• Component (geometry, structure, appliances or roadbed)
• Aspect (ballast, crossties, etc.)
• Condition
• Measurement / Observation
• Amtrak/FRA Code Citation (number)
• Amtrak/FRA Code Citation Description
• Recommended Corrective Action
• Corrective Actions Taken

In addition each recorded measurement includes the track asset and the location of the condition used to determine the Track Class and configuration. The measurement to be recorded is defined in the CLM.

Once measurements are recorded the CLM is run and a determination is made whether the condition meets standards. One of three (3) results is possible. If the recorded measurement meets standards the inspector is prompted to either save or discard the recorded measurement. If the recorded measurement exceeds the maintenance threshold but meets the safety standard a maintenance level Finding is
created containing the details of the measurement and evaluation. The inspector is also prompted to select from a predefined set of Recommended Corrective Actions. If the recorded measurement exceeds the safety standard a safety level Finding is created. The inspector is then advised of the appropriate Protective Action to take (e.g. speed restriction, remove from service, etc.) and prompted to select from a predefined set of Recommended Corrective Actions. The created Findings are then stored in the system and referenced to both the Track Asset involved and the Inspection Work Order associated with this inspection.

*Inspection Findings:*

An inspection Finding is the record of an observed or measured condition of a track asset. A Finding is created upon the completion of CLM evaluation when the condition of the track asset exceeds maintenance thresholds or safety limits. At the discretion of the inspector a Finding can also be created for a condition within standards but where the inspector chooses to record and monitor a condition that may be approaching maintenance thresholds.

Each Finding has a “life”, beginning with its first observation and continuing until corrective actions are taken and the associated track asset is restored to a condition within standards. Each active Finding (Status = INPRG) is carried forward to the next scheduled inspection work order where it is verified by the inspector during the inspection process and recorded measurements and observations are updated. Hence the recorded measurements over time provide a history of the condition of the asset and deterioration trends can be monitored.
Within Maximo the details and history of a Finding can be accessed through the Inspection Work Order application or the Finding applications. The Findings from a Daily Track Inspection Work Order for a section of track in Perryville, MD are shown in Figure 6 below.

Figure 6

This list view provides information relating to the location of each Finding, the nature of each Finding with applicable measurements, the level of each Finding (S = Safety, M = Maintenance, W = Within Standards), the date of first observation and current status. As with most Maximo views the data can be downloaded to an Excel spreadsheet.
The choice of a mobile computer platform involves numerous selection criteria as well as the “hands on” evaluation from the inspectors who will be using the system in the field. These include the operating system, processing power, memory capacity, and ability for remote network connectivity. Ergonomic criteria include the overall ruggedness of the device, input methods, and the ability to read the screen in bright sunlight. Throughout the mobile development effort and after testing several devices in the field the Panasonic H-1 Toughbook was chosen (see Figure 7 below).

Figure 7
To simplify the data input drop down lists are used for measurement data with lists defined with applicable value ranges associated with each measurement. Figures 8 and 9 show the list of active work orders on the mobile device and one of the input screens for a Monthly Turnout Inspection.
Figure 8

Figure 9

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**Advanced Compliance Reporting:**

At the present time report generation in the Advanced Compliance Management application are limited to providing a printed copy of the inspection reports in a format similar to the existing paper-based inspection process. As the implementation of the advanced system progresses throughout the system additional reports will be designed drawing on the asset condition information residing in the Findings application.

**System and Safety Considerations:**

Throughout the development process system security and data integrity maintained the highest of priorities. Access to the system is through a secure login process with each user having a unique system ID and password. This serves as their electronic identification and an auditable electronic history log is maintained for all transactions created by each user of the system. Further the system has been designed to comply with all FRA regulations concerning management of electronic records (see FRA Regulation 49 CFR 213.241).

Lastly the use of portable electronic devices while on the right-of-way could create a safety hazard. Accordingly specific instructions governing their use were issued which prohibits their use when in the foul of an active track.

**NEXT STEPS:**

Full implementation of the Advanced Compliance Management System throughout the Amtrak system has the highest priority. During the roll-out period additional reports and analysis tools will be developed to effectively use the asset condition information for maintenance planning purposes. Once roll-out is complete the findings from automated
inspection processes will be integrated with the Maximo Compliance Management System including the transfer of automated inspection results to the field via the mobile computing devices. This will provide the Track Inspectors with near real-time results of automated inspections over their respective territories.
ACKNOWLEDGEMENTS:

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- Greg Heape – SAIC Mobile Developer
- Maximo Development Team – Amtrak, SAIC & others
- Frank Vacca – Amtrak Chief Engineer
- Dave Staplin – Amtrak Deputy Chief Engineer Track
- Bill Bates – Amtrak Sr. Officer Business Development
- Bill Broughton – Amtrak Sr. Program Director EAM Systems
Managing & Measuring Compliance:
A Structured Approach to Visual Track Inspections

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Asst. Deputy Chief Engineer Track
Amtrak
Outline

- Track Inspections on the Northeast Corridor
- Compliance Management Overview
- Track Inspection Process Details
- Current Status / Next Steps
- Challenges Faced and Met
- Concluding Remarks
Amtrak’s Northeast Corridor

Northeast Corridor
- Amtrak NEC Spine
- Amtrak NEC Non-Spine
- CDOT-MTA or MBTA Owned Spine
- Commuter on Spine*
- Other NEC Commuter
* Includes Commuter trains terminating in Washington Union Station and New York Penn Station, and using upper level of Philadelphia 30th Street Station
Visual Track Inspections
Track Inspection Categories

**Track Inspections**
- Daily walking / hi-rail inspections (main, yards & sidings)
- Fall & spring right-of-way inspections
- Supervisor audit inspections
- Rail joint inspections

**Turnout Inspections**
- Weekly visual inspections
- Monthly turnout inspection (joint with C&S)
- Annual switch & frog inspections

**Miter Rail & Expansion Joint Inspections**
- Twice weekly visual inspections
- Monthly / Quarterly with all Engineering disciplines
Key Inspection Statistics

- CY2010 – 31,500+ Inspections Conducted
- Total Cost of Inspections = $15M
- Average Cost per Inspection = $475

NOTE: This DOES NOT include any automated Inspections (e.g. Track Geometry, GRMS, Internal Rail Flaw Detection)
Compliance Management Overview

Managing the Inspection PROCESS (Basic):

- What inspections are required?
- What do we need to inspect?
- Who is responsible to conduct & complete?
- What is inspection frequency?
- When are inspections due?
- What is our compliance performance?
- What does it cost to comply?
Managing the Inspection RESULTS (Advanced):
- What conditions did we find?
- Where are the conditions located?
- What is the class of track?
- What assets are affected?
- Do we meet standards?
- Is corrective or protective action required?
- How do we fix the condition?
Managing the Inspection PROCESS

- Use Maximo to schedule & record completion of all track inspections through the use of Inspection Work Orders
- Collect data needed to determine compliance
- Provide reports to monitor compliance down to the task level
- Provide reports on the costs of inspections
Managing the Inspection RESULTS

- Record measured and observed conditions (quantitative & qualitative) on mobile device
- Create inspection FINDINGS in real-time
- Store results in central data repository
- Create and distribute inspection reports
- Provide a time history record of findings for use in Maintenance Planning
- Comply with all FRA regulations for electronic inspection records (49 CFR 213.241)
Work Order Creation Process

- Inspection
- Job Plan
  - Inspection type
  - Track assets
  - Inspection tasks
  - Responsibilities
  - Duration
- Inspection
  - Schedule
  - Start date
  - Frequency
  - Lead time
  - Finish date
  - Next date
- Inspection
  - Work Order
  - Assignment
  - Location
  - Inspection tasks
  - Target start & finish
  - Completion date/status
  - Labor costs
- Inspection
  - Findings
  - Daily report of accomplishments & findings
The Inspection Job Plan (JP)

- **Header**
  - Inspection type
  - Location
  - Status
- **Responsibility Matrix**
  - Primary
  - Secondary
- **Inspection Tasks**
  - Territory covered
  - Assets involved
  - Expected duration
The Inspection Scheduler (PM)

- Header
  - Description
  - Status
- Details
  - Location
  - Lead time
- Work Order Info
  - Related Job Plan
  - Last complete date
- Resource Info
The Inspection Work Order (WO)

From the JOB PLAN
- Header
- Job Details
- Responsibility Matrix
- Inspection Tasks
- Record of completion
- Compliance status

From the SCHEDULER
- Inspection Details
- Resource Usage
Taking it to the Field
What is an Inspection FINDING?

- A record of an observed or measured condition in the track at a specific location.
- Directly related to unique track asset(s) or components AND to Inspection Work Orders.
- Has a “life” from the time it is first recorded until marked corrected by the inspector.
- Verified by each inspection over the territory.
- Retained in a history file once corrected.
Each measured or observed condition is recorded at a specific **Track Location** & is associated to a unique **Track Asset** location defined by Line Code, Track#, Milepost & Foot Offset plus GPS location establishes **Track Class**

all track assets needing to be inspected are stored in the **Track Asset Database**
Each measured or observed condition is evaluated against Track Standards for the Track Class.

- **Compliance Level** is determined (Safety, Maintenance or Within Standards).
- Inspector is provided with results in real-time and is provided with Required Protective Action in the case of Safety Level Findings.
- Inspector records Recommended Corrective Actions at the time of inspection.
Creating an Inspection Finding

- Observe a condition in the track
- Record location and asset information
- Measure or evaluate and record
- Process through the CLM on mobile device
  - establish level of condition (safety, maintenance or within standards)
  - prompt Inspector for required protective and corrective action(s) required
- Verify & re-evaluate on subsequent inspection
- Synch data to Core Maximo database
Structured Data Entry

**Category**
- Track
- Turnout
- Miter Rail
- Right-of-Way

**Component**
- Geometry
- Structure
- Appliances
- Roadbed

**Aspect**
- Gage (geometry)
- Crossties (structure)
- Derails (appliances)
- Drainage (roadbed)
- ...

**Condition**
- Related to Aspect
Logging in to the System

User Name: 90002806
Password: ********

Cancel  Login
### Conducting the Inspection (continued)

#### 11480297, TNO, Conway Gaddy (AB) Turnout, #10: Measurements

<table>
<thead>
<tr>
<th></th>
<th>A - Main</th>
<th>B - Turnout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gage “X”</td>
<td>56 1/2</td>
<td></td>
</tr>
<tr>
<td>Gage “Y”</td>
<td>56 3/8</td>
<td>56 1/4</td>
</tr>
<tr>
<td>Max Gage</td>
<td>56 5/8</td>
<td>56 3/4</td>
</tr>
<tr>
<td>Frog Condition</td>
<td>Fair</td>
<td>Fair</td>
</tr>
<tr>
<td>Frog Track Gage</td>
<td>56 1/4</td>
<td>56 3/4</td>
</tr>
<tr>
<td>Guard Rail Gage</td>
<td>54 1/2</td>
<td>54 7/8</td>
</tr>
<tr>
<td>Back to Back Gage</td>
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<td>53 5/16</td>
</tr>
<tr>
<td>Guard Rail Bolts (Loose/Missing)</td>
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<td>0</td>
</tr>
<tr>
<td>Frog Bolts (Missing)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Surface Condition</td>
<td>1/2</td>
<td>5/8</td>
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<tr>
<td>Frog Timbers Condition</td>
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<tr>
<td>Hold Down Devices</td>
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<tr>
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**Remarks**

**Save**

**Evaluate**

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*September 18-21, 2011 | Minneapolis, MN*
Conducting the Inspection (continued)

### Finding Actions

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<td>Replace Rail (feet)</td>
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</tr>
<tr>
<td>Plug &amp; Respike (each)</td>
<td></td>
</tr>
<tr>
<td>Replace Insulators (each)</td>
<td></td>
</tr>
<tr>
<td>Replace Ties (each)</td>
<td></td>
</tr>
<tr>
<td>Replace Tie Plates (each)</td>
<td></td>
</tr>
</tbody>
</table>

Remarks:
Conducting the Inspection (continued)

![Image of a software interface displaying findings]

### Findings

<table>
<thead>
<tr>
<th>MP + Offset</th>
<th>Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>35+1923</td>
<td>Track 3</td>
<td>W</td>
</tr>
<tr>
<td>35+2297</td>
<td>Track 2</td>
<td>W</td>
</tr>
<tr>
<td>35+2750</td>
<td>TKL, 1</td>
<td>S</td>
</tr>
<tr>
<td>35+3365</td>
<td>Track 1</td>
<td>W</td>
</tr>
</tbody>
</table>

Track Gage Wide
57 5/16 IN - West
Back in the Office
Daily Start Center

2011 ANNUAL CONFERENCE | September 18-21, 2011 | Minneapolis, MN
## Inspection Findings

### Work Order: 12265227

<table>
<thead>
<tr>
<th>Finding</th>
<th>Asset ID</th>
<th>Asset Type</th>
<th>Asset Name</th>
<th>Category</th>
<th>Component</th>
<th>Aspect</th>
<th>Condition</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>7019 AP</td>
<td>61.37</td>
<td>61.37</td>
<td>Turnout</td>
<td>Geometry</td>
<td>Surface</td>
<td>Profile 31 foot</td>
<td>0.6250 W M</td>
<td>Verified 5/23/11 CORRECTED</td>
</tr>
<tr>
<td>7015 AP</td>
<td>61.37</td>
<td>61.37</td>
<td>Turnout</td>
<td>Structure</td>
<td>Switches</td>
<td>Excessive lateral or vertical movement of switch point</td>
<td>W M</td>
<td>Verified 10/20/10 INPRG</td>
</tr>
<tr>
<td>4063 AP</td>
<td>61.37</td>
<td>61.37</td>
<td>Turnout</td>
<td>Structure</td>
<td>Turnouts &amp; Track Crossings</td>
<td>Loose, worn or defective switch rod</td>
<td>W M</td>
<td>Verified 5/23/11 INPRG</td>
</tr>
<tr>
<td>4062 AP</td>
<td>61.37</td>
<td>61.37</td>
<td>Turnout</td>
<td>Structure</td>
<td>Switches</td>
<td>Excessive lateral or vertical movement of switch point</td>
<td>W M</td>
<td>Verified 5/23/11 INPRG</td>
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<tr>
<td>4061 AP</td>
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<td>61.37</td>
<td>Turnout</td>
<td>Structure</td>
<td>Switches</td>
<td>Any defect found will be treated as a rail defect</td>
<td>W M</td>
<td>Verified 4/14/11 INPRG</td>
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<tr>
<td>4053 AP</td>
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<td>61.37</td>
<td>Turnout</td>
<td>Structure</td>
<td>Railway Fastening System</td>
<td>Concrete tie resilient fastener, insulator or tie past missing-maintenance</td>
<td>M</td>
<td>Verified 10/26/10 INPRG</td>
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<tr>
<td>5525 AP</td>
<td>61.37</td>
<td>61.37</td>
<td>Turnout</td>
<td>Structure</td>
<td>Railway Fastening System</td>
<td>Profile 62 foot</td>
<td>0.6250 W M</td>
<td>Verified 12/13/11 INPRG</td>
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<td>Turnout</td>
<td>Structure</td>
<td>Railway Fastening System</td>
<td>Profile 62 foot</td>
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<td>Verified 12/13/11 INPRG</td>
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<td>61.37</td>
<td>Turnout</td>
<td>Structure</td>
<td>Railway Fastening System</td>
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<tr>
<td>4071 AP</td>
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<td>61.35</td>
<td>Turnout</td>
<td>Structure</td>
<td>Railway Fastening System</td>
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<td>4075 AP</td>
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<td>Structure</td>
<td>Turnouts &amp; Track Crossings</td>
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<td>W M</td>
<td>Verified 10/26/10 INPRG</td>
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<tr>
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<td>Turnout</td>
<td>Structure</td>
<td>Railway Fastening System</td>
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<td>M</td>
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<td>61.35</td>
<td>Turnout</td>
<td>Structure</td>
<td>Railway Fastening System</td>
<td>Profile 62 foot</td>
<td>0.5000 W M</td>
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</tr>
<tr>
<td>5197 AP</td>
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<td>61.58</td>
<td>Turnout</td>
<td>Geometry</td>
<td>Gage</td>
<td>Gage change</td>
<td>0.3750 W M</td>
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<td>4060 AP</td>
<td>61.52</td>
<td>61.52</td>
<td>Turnout</td>
<td>Structure</td>
<td>Turnouts &amp; Track Crossings</td>
<td>Loose, worn or defective switch rod</td>
<td>W M</td>
<td>Verified 10/26/10 INPRG</td>
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<tr>
<td>4058 AP</td>
<td>61.52</td>
<td>61.52</td>
<td>Turnout</td>
<td>Structure</td>
<td>Railway Fastening System</td>
<td>Profile 62 foot</td>
<td>0.6250 W M</td>
<td>Verified 10/26/10 INPRG</td>
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<tr>
<td>4057 AP</td>
<td>61.52</td>
<td>61.52</td>
<td>Turnout</td>
<td>Structure</td>
<td>Railway Fastening System</td>
<td>Concrete tie resilient fastener, insulator or tie past missing-maintenance</td>
<td>M</td>
<td>Verified 10/26/10 INPRG</td>
</tr>
</tbody>
</table>

### Protective Measures

- **No rows to display...**

### Recommended Corrective Actions

- **No rows to display...**

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2011 ANNUAL CONFERENCE | September 18-21, 2011 | Minneapolis, MN
### Inspection and Test Cost Report

<table>
<thead>
<tr>
<th>Discipline: TRACK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

| Date Range: 1/1/2008 to 3/31/2008 | ResCen: 9008 - SUMM MAINT OF WAY NEW ENGLAND DIV |

<table>
<thead>
<tr>
<th>Inspection Type</th>
<th>Total Inspections</th>
<th>ST Hours</th>
<th>OT Hours</th>
<th>Labor Hours</th>
<th>Labor Dollars</th>
<th>Total Time Reported</th>
<th>% Labor Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Track, Class 6 - 8, Twice Weekly, 2-Day Interval</td>
<td>174</td>
<td>377.90</td>
<td>12.00</td>
<td>399.90</td>
<td>8,201.11</td>
<td>41</td>
<td>23.8%</td>
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<tr>
<td>Daily Track, Class 4 - 6, Twice Weekly 1-Day Interval</td>
<td>242</td>
<td>977.60</td>
<td>10.00</td>
<td>987.60</td>
<td>20,554.94</td>
<td>59</td>
<td>28.5%</td>
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<tr>
<td>Weekly Siding &amp; Track, Class 1 - 3, Once Weekly 5-Day Interval</td>
<td>208</td>
<td>48.00</td>
<td>8.00</td>
<td>56.00</td>
<td>1,243.72</td>
<td>26</td>
<td>12.5%</td>
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<tr>
<td>Monthly Siding &amp; Track, Class 1 - 3, Once Monthly, 20-Day Interval</td>
<td>204</td>
<td>166.00</td>
<td>0.00</td>
<td>166.00</td>
<td>3,442.34</td>
<td>56</td>
<td>27.0%</td>
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<tr>
<td>Spring / Fall Track</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td>Supv / Inspector Joint Audit</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
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<tr>
<td>Tri-Annual Rail Joint, Class 4 &amp; Above, 90-Day Interval</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td>NA</td>
</tr>
<tr>
<td>Twice-Annual Rail Joint, Class 2 &amp; 3, 120-Day Interval</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
<td>0</td>
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<tr>
<td>Weekly Visual Switch, Class 6 - 9</td>
<td>832</td>
<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
<td>0</td>
<td>0.0%</td>
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<tr>
<td>Monthly Switch &amp; Frog, Class 1 - 9</td>
<td>309</td>
<td>223.60</td>
<td>0.00</td>
<td>223.60</td>
<td>4,632.51</td>
<td>81</td>
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<td>Annual Switch &amp; Frog</td>
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<td>0.00</td>
<td>0</td>
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<tr>
<td>Twice-Weekly Miter Rail &amp; Expansion Joint</td>
<td>130</td>
<td>0.60</td>
<td>0.00</td>
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<td>199.57</td>
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<td>Monthly Miter Rail &amp; Expansion Joint</td>
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<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
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<td>Quarterly Miter Rail &amp; Expansion Joint</td>
<td>5</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>Special Inspection</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td><strong>TOTAL SCHEDULED INSPECTIONS:</strong></td>
<td><strong>2,119</strong></td>
<td><strong>1,801.00</strong></td>
<td><strong>30.00</strong></td>
<td><strong>1,831.00</strong></td>
<td><strong>33,274.27</strong></td>
<td><strong>272</strong></td>
<td><strong>12.3%</strong></td>
</tr>
</tbody>
</table>

| Undefined Inspection Activities                       | **24,936.00**     | **3,523.80** | **28,458.80** | **852,505.96** | **272**               | **12.3%**         |
Current Status / Next Steps

- Basic Compliance Management fully implemented throughout all of Amtrak
  - 14 subdivisions on the NEC divisions
  - 4 subdivisions on Central division
  - end user base of 250+ Inspectors & Supervisors

- Advanced Compliance Roll-Out Underway
  - Implementation completed at Perryville and Washington Terminal subdivisions.
  - Implementing on Baltimore subdivision

- Follow-on work order process for corrective actions in development
Challenges Faced and Overcome

- Get the process logic right from the start
  - determining compliance status
  - establishing the Condition Logic Matrix
- Find the right devices for use in the field
  - can I read it in bright sunlight?
  - how much does it weigh?
  - how fat can my fingers be?
- Overcome the learning curve and initial resistance to new technology and change
  - inspectors involved in development & design
  - be patient & receptive to their suggestions
Concluding Remarks

- Visual track, turnout, & special trackwork inspections provide a foundation for safety.
- A structured approach to record observations & measurements is essential for accurate and consistent condition assessment.
- A structured approach also provides a knowledge base for the next generation of Track Inspectors.
- Secure & accessible storage of inspection findings improves both track safety performance and maintenance planning.
Acknowledgements

- Jim Cisneros – Amtrak Track Lead
- Jim Bennett – Amtrak ADE Track
- Bill Boykin – SAIC Functional Lead
- Greg Heape – SAIC Mobile Developer
- Maximo Development Team
- Frank Vacca – Amtrak Chief Engineer
- Dave Staplin – Amtrak DCE Track
- Bill Bates – Amtrak Business Improvement
- Bill Broughton – Amtrak Engineering Systems
Thank you for your attention

rupperc@amtrak.com