RAILER RED SPEEDS AND IMPROVES THE CONSISTENCY OF RAILROAD TRACK INSPECTION

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INTRODUCTION

What Is RAILER RED?

The RAILER Remote Entry Database (RED) is a computer software program for recording track inspection and inventory data. It was originally developed several years ago by the U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL), under the sponsorship of the U.S. Army Center for Public Works. RAILER RED is not a stand-alone program, but rather a program that interfaces with the RAILER® Engineered Management System (EMS). RAILER RED was originally conceived as a program that worked with pen-based tablet computers. Over the years, technology improvements in pen-based computer hardware rendered the original DOS-based RAILER RED program obsolete. The program simply would not work with the modern machines. Also, software technology improvements plus field experience dictated that RAILER RED be improved.

In 2001, the U.S. Navy (the Naval Surface Warfare Center, Crane, and the Naval Facilities Engineering Service Center), and ERDC-CERL co-sponsored an effort to totally rewrite the RAILER RED program to current standards. Additionally, this offered the opportunity to redesign the program and add a variety of new features and capabilities. Extensively tested in 2003, RAILER RED Version 4.0 was released in September 2003.

Why RAILER RED?

The development of RAILER RED was based on the premise that it would speed the overall track inspection process, reduce errors, and save money. Previously, data were collected on a variety of paper forms. This posed problems due to the sheer numbers generated, the inability to use in wet weather, illegible handwriting, lost forms, and the need to transpose the data into the RAILER® database for usage. This original version was demonstrated to improve total inspection productivity between 20% and 100% (depending on crew size and track layout) with improved accuracy (1).

TRACK INVENTORY

There are two distinct phases to RAILER® usage. The first is the implementation phase which requires the collection of both network and track inventory. The initial collection of this data can be somewhat extensive, but inventory will remain fairly stable over time. Typically the data are collected from “as built” construction drawings and field data collection. RAILER RED serves to edit “as built” data if found to be inaccurate upon field verification and to record field data not previously known. The second phase is a data maintenance phase whereby inventory changes found during track inspection can be recorded.

Network Inventory

Conducting a network inventory consists primarily of recording track names, track lengths, and track segment identification and boundary locations (stations). The procedures for conducting this inventory, including naming conventions, were first documented years ago (2), but the procedures and conventions have been improved over time. Typically, track segment boundaries are at turnout locations (point-of-switch) and at track begin and end locations.

Figure 1 shows the basic RAILER RED desktop. The various tracks and their respective segments are displayed for review and/or selection via the tree structure on the left. As tracks and segments are added they are displayed on the tree when saved.

Once RAILER® is implemented, the user will have a choice of which tracks to download to RAILER RED from RAILER®. Only those tracks will be displayed on the tree. Any of these tracks and their segments can be edited. This may be needed due to changes in name, length, or segment boundary. These changes are simply made from the “Identification” tab as displayed in Figure 1.

Initial Track Inventory

Once a track has been identified, the inventory for that track may be entered. Some may have been obtained from “as built” drawings and entered into RAILER® directly. If this has been done, that inventory will be downloaded to RAILER RED for field verification and the collection of all remaining data, as applicable. As Figure 2 illustrates, this includes structure, appliances, turnouts, curves, bridges, grade, grade crossings, rail crossings, clearance restrictions, and drainage.

Multiple data entries for each inventory item are possible. The record count for each item will be displayed on the applicable tab. This feature is displayed on Figure 2. Note that the structure for track F3 has 14 records and

displayed is the second record. Users may enter new records by first selecting the desired tab and then pressing the "New" button to bring up the blank data fields or pressing the "Copy" button to copy an existing record to a new location. All inventory options are chosen from pre-defined drop-down lists.

Inventory data can be uploaded to RAILER® at any convenient point-in-time. Typically, this is done daily. Also, different teams can collect data at the same time for different tracks in the same network. Uploading to RAILER® serves to merge the data into a single network database.

Track Inventory Updates

Changes to track inventory can occur throughout its history. This may involve such items as a rail weight increase, a change to the surface of a grade crossing, a relocation of an appliance (e.g. derail), or something else. Until this RAILER RED version, it was not possible to collect inventory update data electronically. This new feature makes updating inventory easy. This may be accomplished during a routine track inspection or during the final acceptance of the work that created the inventory change. To do this, the desired track would be downloaded from RAILER® and the affected inventory edited, deleted, or added, as necessary. Once done, the inventory is uploaded to RAILER®.

TRACK INSPECTION

The most frequent use for RAILER RED is for recording track inspection data. This includes routine detailed inspections and the more frequent safety inspections. RAILER RED supports both.

Detailed Inspections

Detailed inspections consist of identifying and recording all defects discovered in a track segment. These defects are used to analyze track segment condition against the applicable track standard (3,4,5), compute condition indexes (6,7), and plan maintenance and repair (8). The defects themselves are derived from the track standards, the definitions to support the condition index process, and experience.

The basic detailed track inspection screen is shown in Figure 3. It consists of a series of tabs to account for the various track components. Each tab has a series of data elements that pertain to that component. Tabs associated with track inventory that is not present in that track segment are grayed out (inactive). The various data elements for most of the components are shown in Figure 3. These are described further in the next paragraph. Ties, turnouts, grade crossings, and track geometry have separate and unique screens. Tie data are collected on a tally basis with emphasis placed on the various types of defective tie clusters (see Figure 4). The various types of clusters affect the condition assessment of the track segment and, thus, are tallied separately. The turnout tab consists of a series of sub-tabs that encompass general observations, tie inspection, specific component inspection, points and joints measurements, and frog and guardrail measurements. These are shown as Figures 5 through 9, respectively. Note that for specific components (see Figure 7) there is a further subdivision into switch defects, frog defects, and guardrail defects. Specific defects are selected from a drop-down list. Grade crossing inspections consist of two parts. The first is for the crossing defects and the second is for flangeway measurements. The grade crossing tab is illustrated in Figure 10. The manual track geometry tab (Figure 11) allows for the collection of the various types of manual track geometry data. Also, note that at the bottom of the RAILER RED desktop the inspector's name is displayed.

Using the "Fastenings and Other Track Material" tab as a general example (Figure 3), each defect is recorded along with its location, rail (or side of track), the optional length/density, and quantity. The defect and rail are chosen from drop-down lists. Length/density is mostly used with ballast since ballast defects generally encompass a specific length of track, but it can be used with other components if the defect is recurring in a regular manner. Length/density, when used, will result in an estimation of quantity. The first time a defect is found in a track segment, the recorder will enter it by first pressing the "New" button. Should this same defect be found again in the same track segment, the second defect can be entered like the first, or the recorder can use the "Copy" feature whereby all data for the current record is copied and only the new location is entered. All defect records for a given component are tallied and the count displayed on the tab. Referring again to Figure 3, the defect shown is number three of three. Users can see the other defect records by using the >, >|, <, and |< buttons. If no defects are found in the track segment for a given component, the "Defect Free" box is checked. Condition levels and the work order check box features are new features and described below.

Condition Levels

Referring again to Figure 3, a condition level of "Close to Traffic" is displayed for the defect shown. Condition levels are derived from the applicable primary track standard required for that particular track network. During the RAILER® data download the applicable track standard is set in RAILER RED. When a defect is entered, RAILER RED automatically sets the appropriate condition level as per the standard. Since track standards allow inspectors to use their judgment for "restricting" track, RAILER RED allows this too. If the inspector believes that a given defect in a given situation should result in a lower condition level, the inspector may choose a lower level from the condition level drop-down list. Note that in this example, "Close to Traffic" is as low as one can go. Inspectors cannot raise the condition level for a given defect. To do so would be in violation of the track standard.

Work Order Check Box

Sometimes defects are found that require quick corrective action rather than in the future as part of a work plan. Usually, these are defects that result in a severe operating restriction (e.g. Close to Traffic). If train operations require that the restriction be alleviated soon, such defects should have the work order check box checked. This is illustrated in Figure 3. A Checked work order box results in a "Safety Defect" deficiency being generated and flagged for action back in RAILER® during the data upload. This feature is particularly handy for managerial review in the RAILER Geographical Information System (9).

Condition Levels and Work Orders for Ties and Turnouts

Ties and turnouts handle condition levels and work orders the same, but differently than described above. This is because condition levels are not readily displayed for ties and turnouts (see Figures 4 through 9). If condition levels for recorded defects need to be seen or edited or if work orders are desired for any of the recorded defects, the user must press the "W.O. Items" button on the button bar (see Figures 4 through 9). This brings up a window, Figure 12 that allows the user to view condition levels, change condition levels, and flag defects requiring work orders. All recorded defects are viewable on the defect drop-down list where they may be chosen for any of the aforementioned purposes.

Tie Defect Locations

All defects, except defective ties, are recorded with their location. Typically, the sheer number of defective ties in a track segment makes location recording impractical because it would slow the inspection to a crawl and provide little practical value. However, there are times when the recording of tie defect locations is desirable. For example, the presence of certain defective tie clusters will place operating restrictions on the track. To correct the problem the section gang needs to know precisely where to go. Track segments may approach a mile in length and if there are large numbers of defective ties present the crew is forced to search and guess. This is costly and the original defect may be missed. This version of RAILER RED solves that problem. Any tie defect found can have its location recorded by using the "W.O. Items" button. Figure 13 displays this feature. The recorder simply chooses the defect from the drop-down list and records the location. Condition levels can also be reviewed and/or changed and the work order checked as described above.

Past Inspection Data

A new RAILER RED feature is the ability to display the most recent past inspection findings. This data are downloaded from RAILER® when the tracks are selected for inspection. By pressing the "List" button on the button bar (see Figure 3) a listing of these defects, including ties if a location has been recorded, is displayed as shown in Figure 14. The past defect list window can remain open throughout the inspection, thus allowing the inspector to be alerted as to what may be coming up as he/she walks down the track. If a past defect is still present, the recorder can simply copy that defect into the current inspection. If the defect is no longer present, it is ignored. Any new defects found are recorded as described above. Also, the defects found during the current inspection are displayed. All of the last tie inspection results are viewed from the "Previous Inspection" button on the tie tab (see Figure 4).

Five-Day Inspection Period

There are occasions when an inspector cannot complete inspecting a track segment in a given day. In the past if the inspector were not careful it would be possible to have two inspection dates for the same inspection. Part of the inspection would be associated with one date and part on the other date. RAILER RED now has a built-in five-day inspection period. Thus, if for some reason an inspector cannot complete an inspection in a given day, he/she has five calendar days to complete it without a date penalty. RAILER RED automatically assumes that it is

all part of the same inspection for record purposes. Once past the five-day period, RAILER RED assumes that a new inspection is being conducted on that track segment. In the rare circumstance that a given inspection exceeds the five-day period, the data can be reconciled back in RAILER®.

Safety Inspections

Most track standards refer to the need for inspections that are based on train speed and/or train frequency. These inspections are sometimes called "safety" inspections and serve the purpose of locating and identifying only those defects that pose an unacceptable derailment risk at that train speed. The presence of these defects usually results in a speed restriction on that track segment. Certain defects (e.g. broken rail), if present, will necessitate a restriction as per the applicable standard, but virtually any defect could pose an unacceptable derailment risk under given circumstances.

Continuing the practice of previous versions, RAILER RED Version 4.0 may be used for recording defects found during safety inspections. However, the recording process is now improved. From the "Tools" list on the menu bar (see Figure 3), the safety inspection screen, Figure 15, is accessed. Recorders add individual safety defects by first pressing the "Insert" button and then filling out the row in the grid. All track defects are available for selection. The default condition level will be set based on the defect and the track standard, but like for detailed inspections the inspector may lower the condition if warranted. Generally, only those defects that pose an unacceptable safety risk are recorded. Past safety defects still present need not be recorded again. If none are found or no new ones are found during the inspection, the entry "No New Defects" will be recorded thus providing documentation that the track segment was inspected as required.

FIELD EXPERIENCE

RAILER RED Version 4.0 was extensively tested in both the laboratory and field throughout 2003. The first site was the Construction Battalion Center, Gulfport, MS, which was followed by the Naval Weapons Station, Earle, NJ. Navy personnel accomplished the majority of the testing. A pre-release version was also sent to the sponsors for testing. Minor problems were encountered at both locations, which were corrected and downloaded from ERDC-CERL during the field-testing period. Also, the evaluators desired some additional minor features. Revisions were made and a final testing at Fort Campbell, KY, was accomplished by Army personnel and a representative from NSWC Crane. No problems were reported, but a minor tweaking or two were desired. These were incorporated into the final release.

While RAILER RED was released with all known software problems fixed and planned features incorporated, there are two hardware issues that arose. Inasmuch as track inventory and inspection are performed outdoors, it is imperative that the pen-based screen be designed for outdoor use. Otherwise the sun will fade the screen making the text very difficult to read. Also, battery life is limited. At least two additional batteries are needed in a day.

Two of the original RAILER RED goals were to speed the total track inspection process and reduce errors. The field trials did not attempt to measure the speed improvement over the pervious versions, but the overall process speed was shown to be improved due to the added features of being able to collect inventory and inspection data on one pass of the track, the ability to do inventory updates, and to electronically review and copy past inspection findings that still remain in track. It is not necessary to reenter repeat data.

Recording errors can still exist. Screen fading will make the text hard to read resulting in wrong selections from drop-lists sometimes being made and pen-writing errors for numbers may occur. Also, recorders must be careful on their selections from the drop-lists when using the pen. Sometimes the pen may "slip" resulting in an incorrect choice being recorded. Thus, it is imperative that all data be reviewed to ensure correctness.

SUMMARY AND CONCLUSIONS

RAILER RED Version 4.0 has recently been released. This next generation application, designed for modern pen-based computer tablets with a Windows™ 98, 2000, or XP operating system, is significantly faster than its predecessors, and has a variety of new features. The technical approach was to allow full flexibility for users in support of inventory and inspection data gathering. RAILER RED V4.0 allows initial inventory, initial inspection, inventory updates, re-inspections, and safety inspections. These can be accomplished simultaneously if desired. The most recent track inspection data can be downloaded from RAILER® to further speed and improve inspection consistency through verification and copy.

Prior to release, RAILER RED was extensively field-tested. The program proved to be easy to use and the efficiencies gained over paper recording and later input to RAILER® were at least as good as with earlier versions, and likely improved. The need for a pen-based tablet with an outdoor screen is required as are spare batteries.

This version is not intended to be the final one. Some additional features and improvements have already been identified and others will become known as usage becomes more widespread.

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DISCLAIMER

The views of the authors do not purport to reflect the views or policies of the U.S. Army, U.S. Navy, or the Department of Defense.

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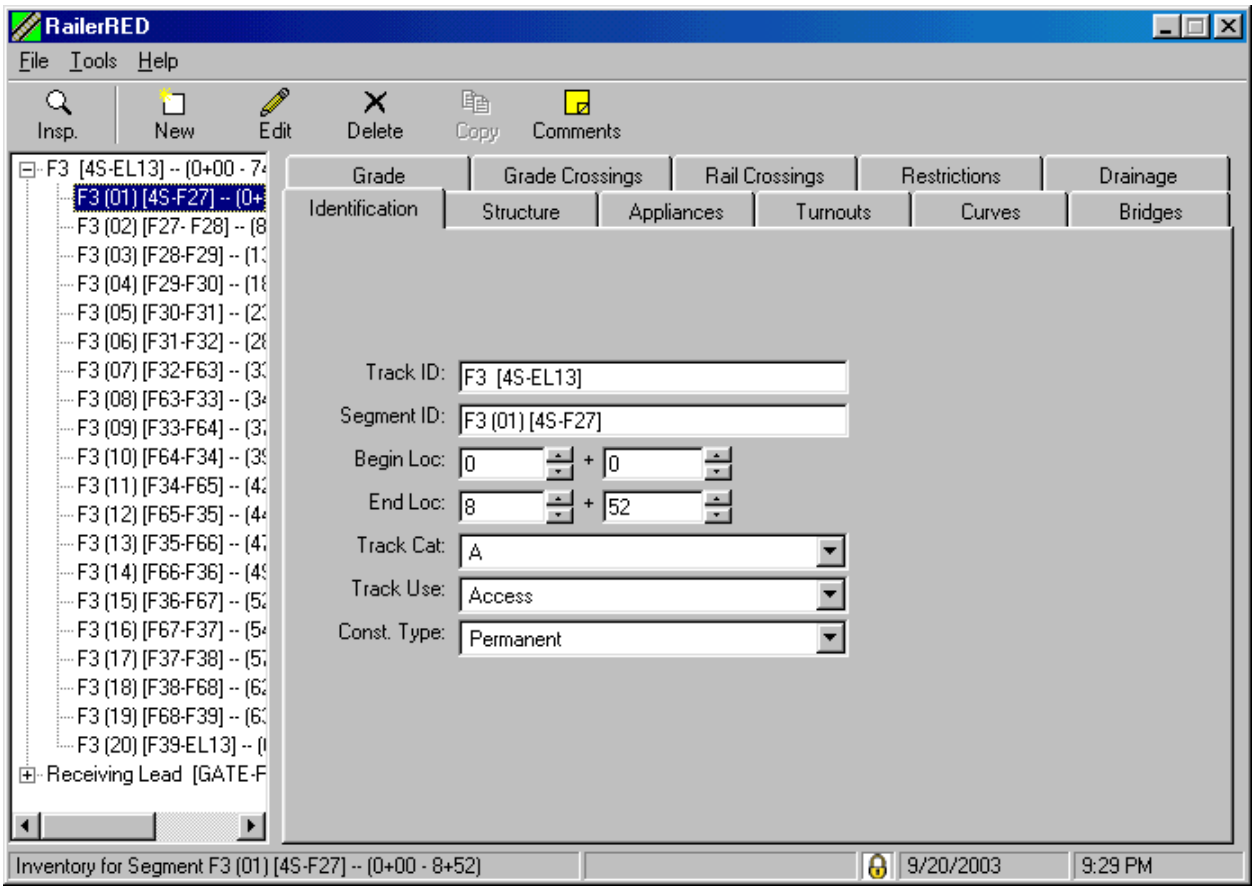

FIGURE 1 Basic RAILER RED Inventory Desktop

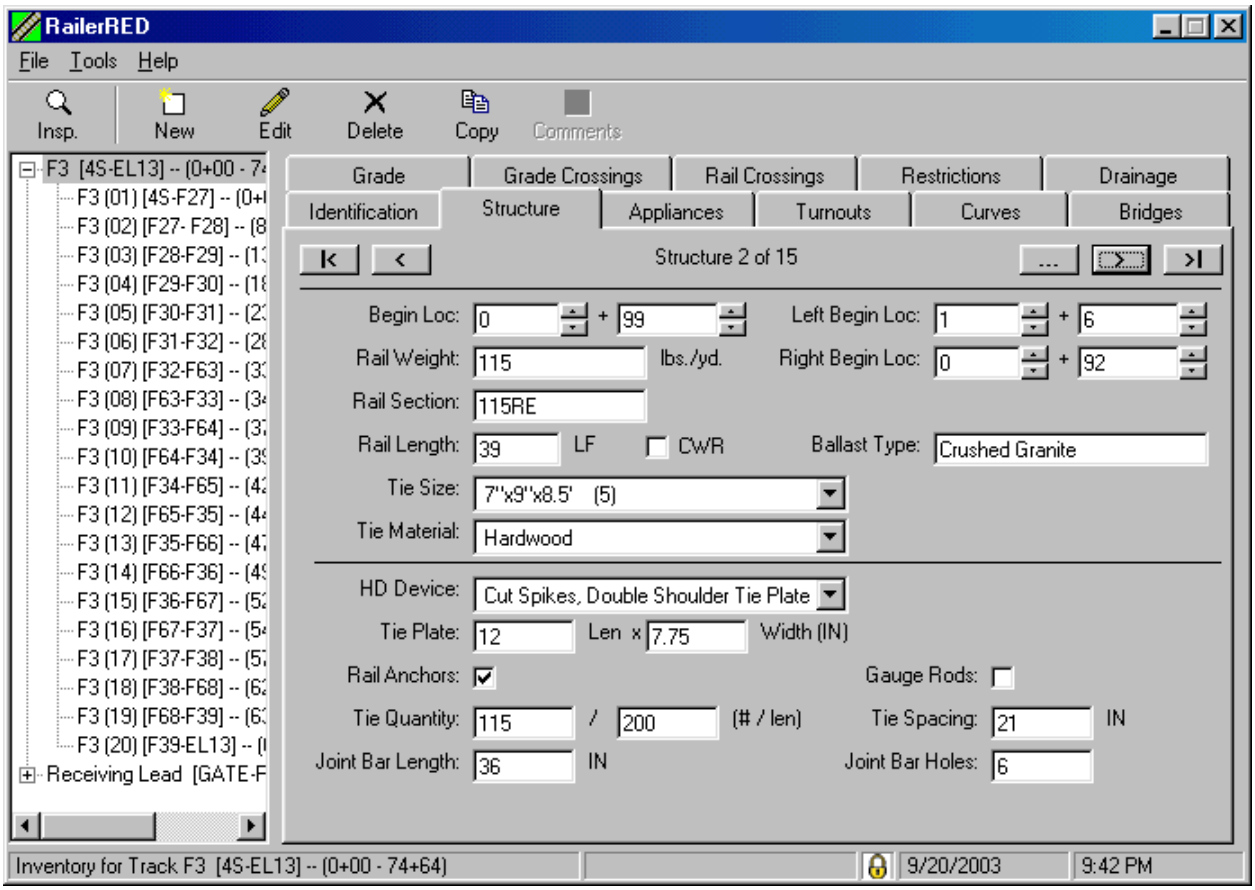

FIGURE 2 Track Inventory – Track Structure

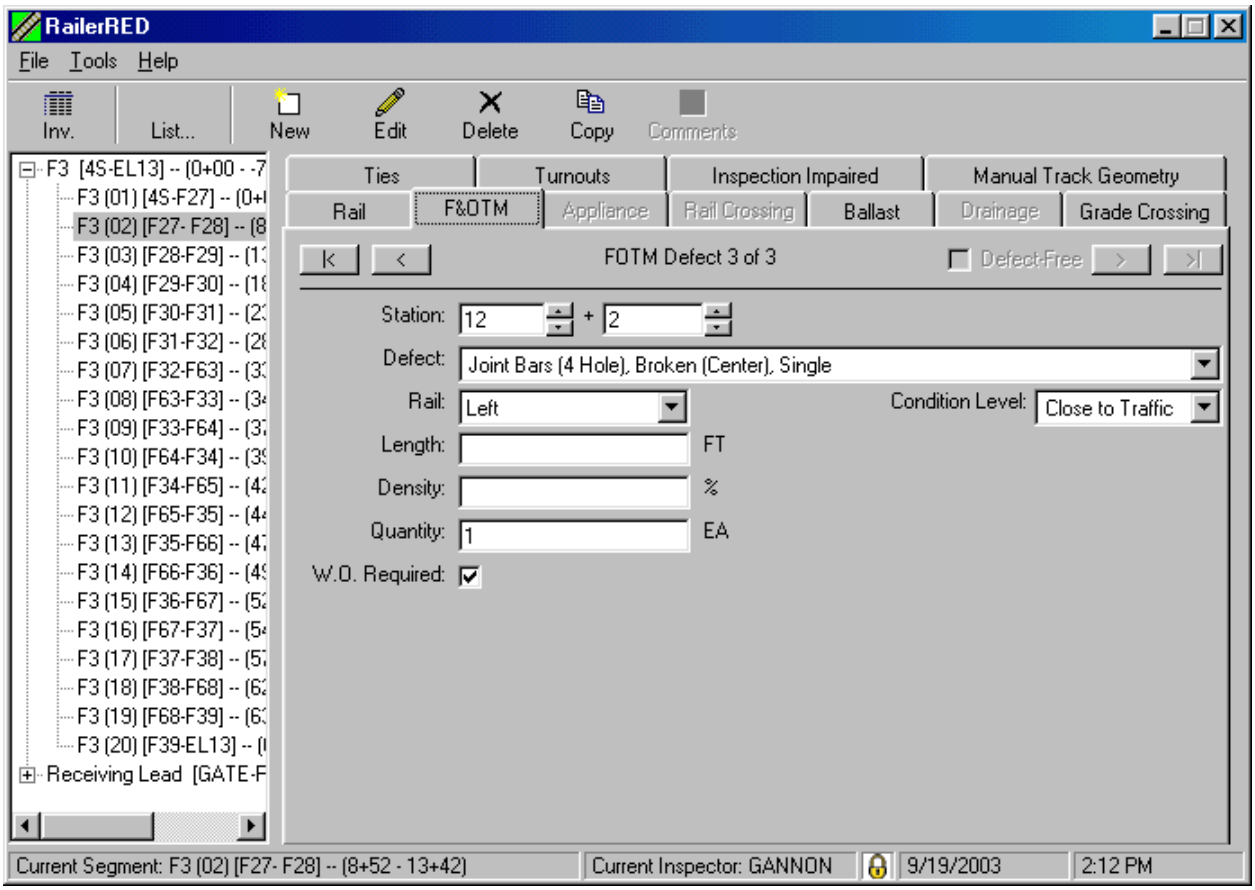

FIGURE 3 Basic RAILER RED Detailed Inspection Desktop

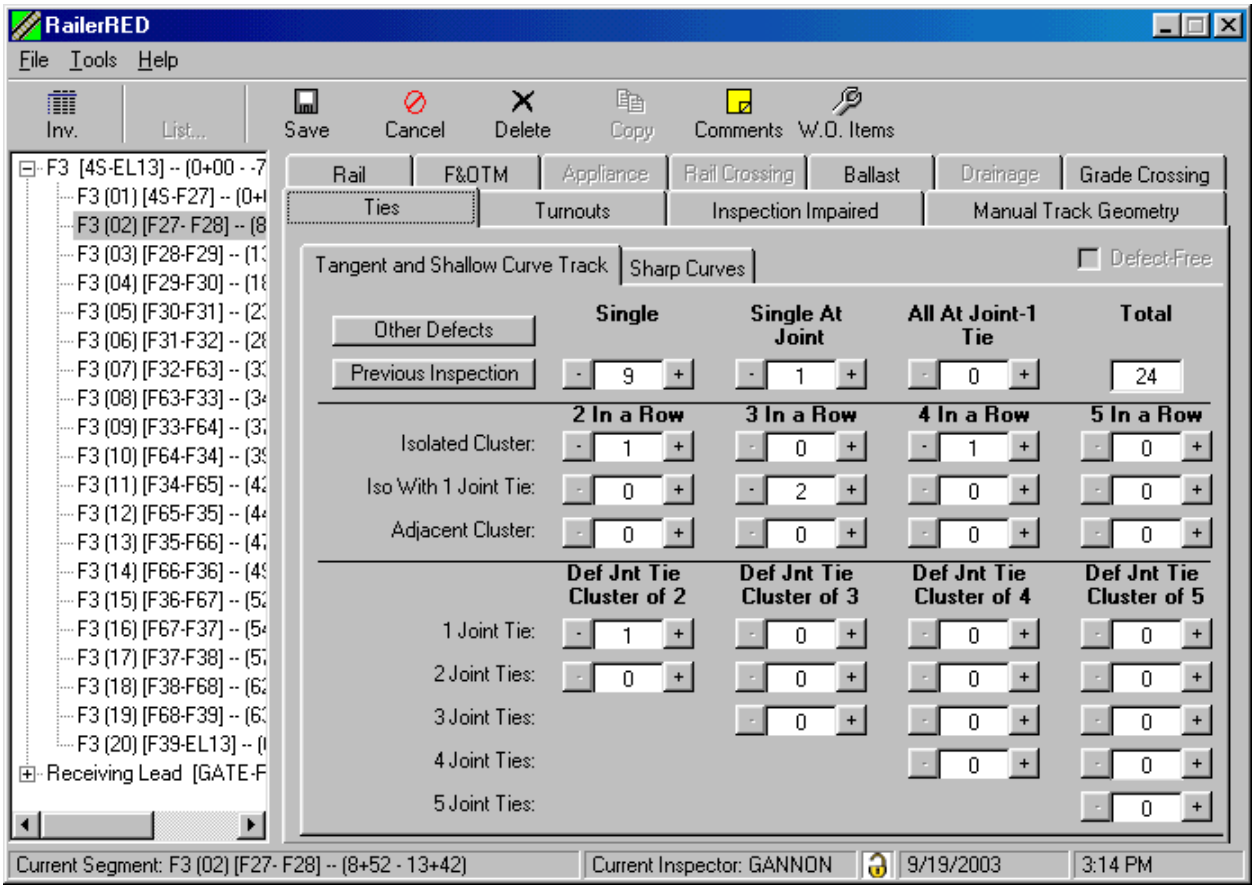

FIGURE 4 Tie Inspection Tally

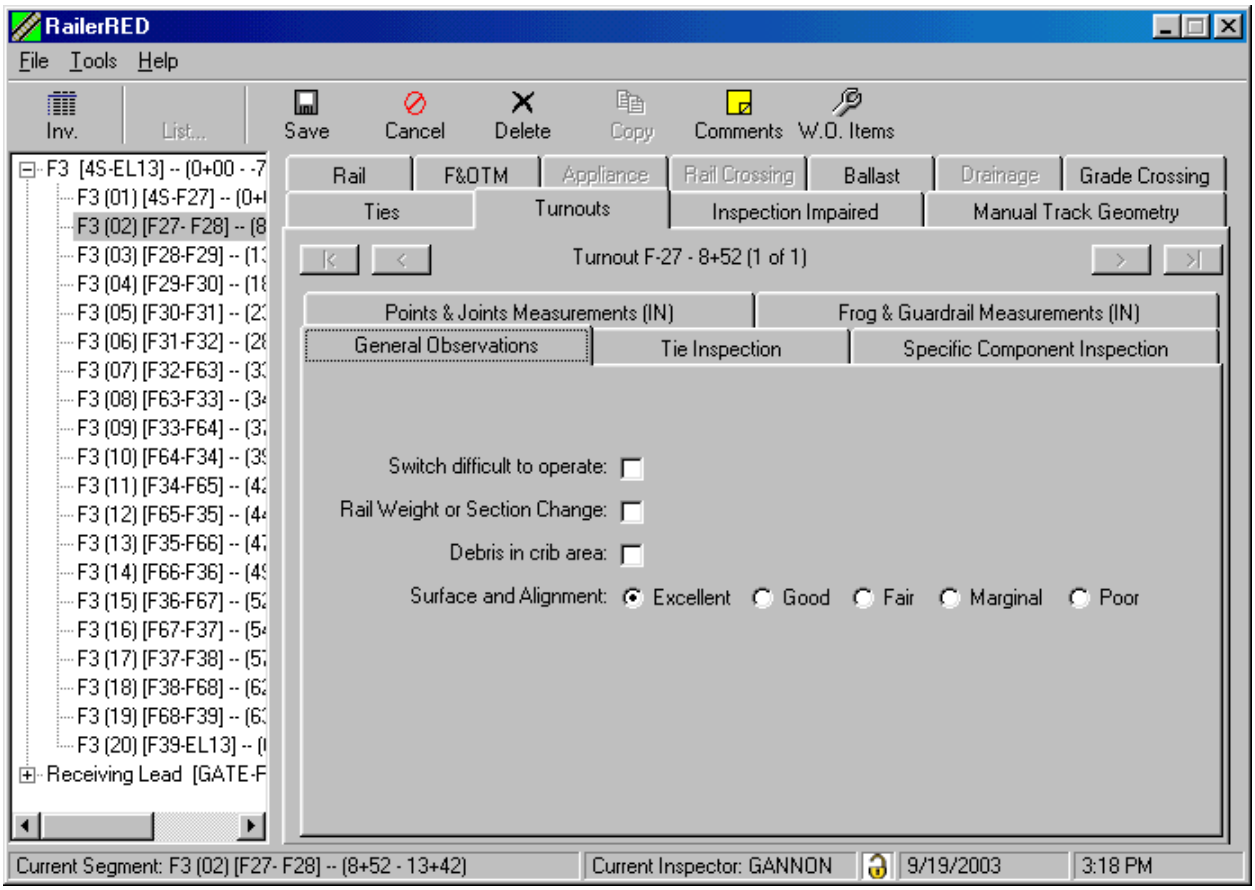

FIGURE 5 Turnout Inspection – General Observations

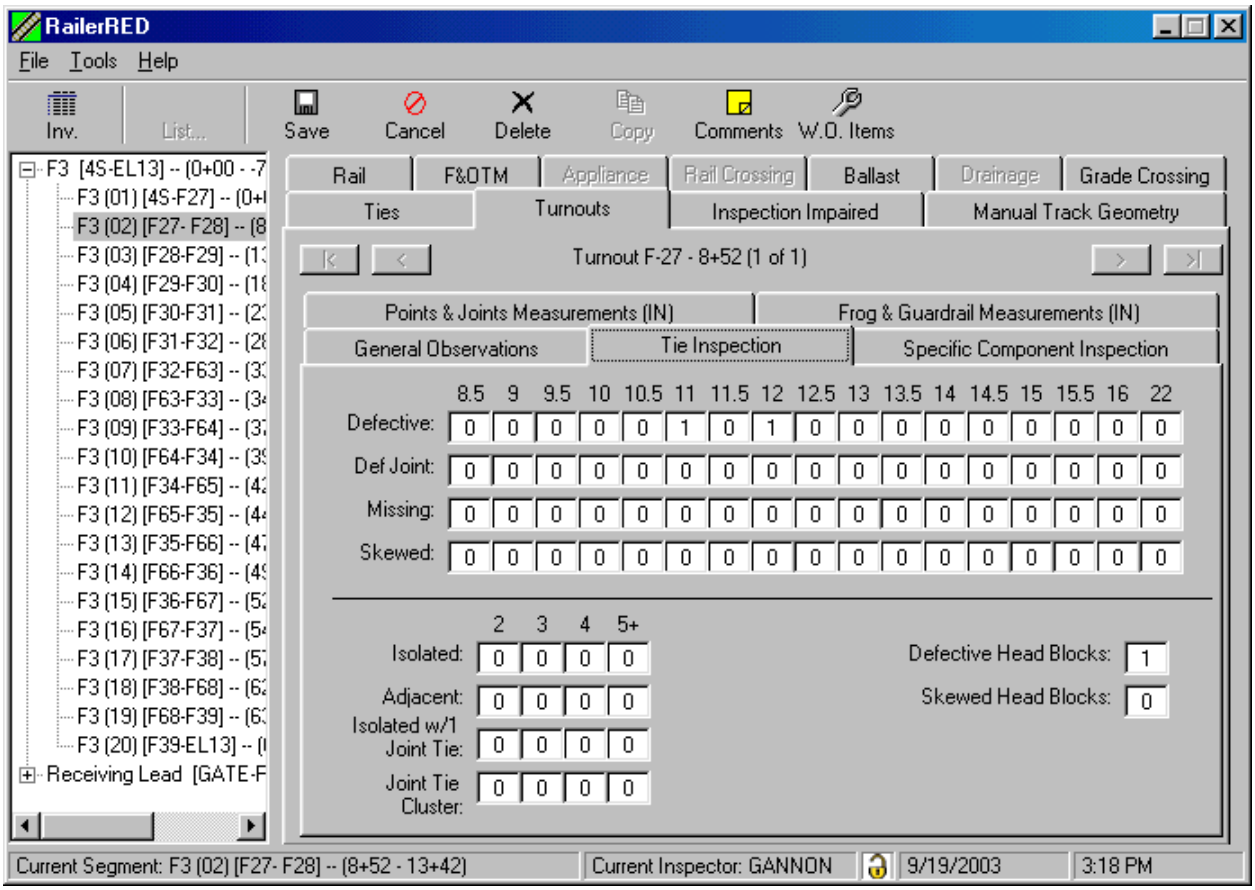

FIGURE 6 Turnout Inspection – Ties

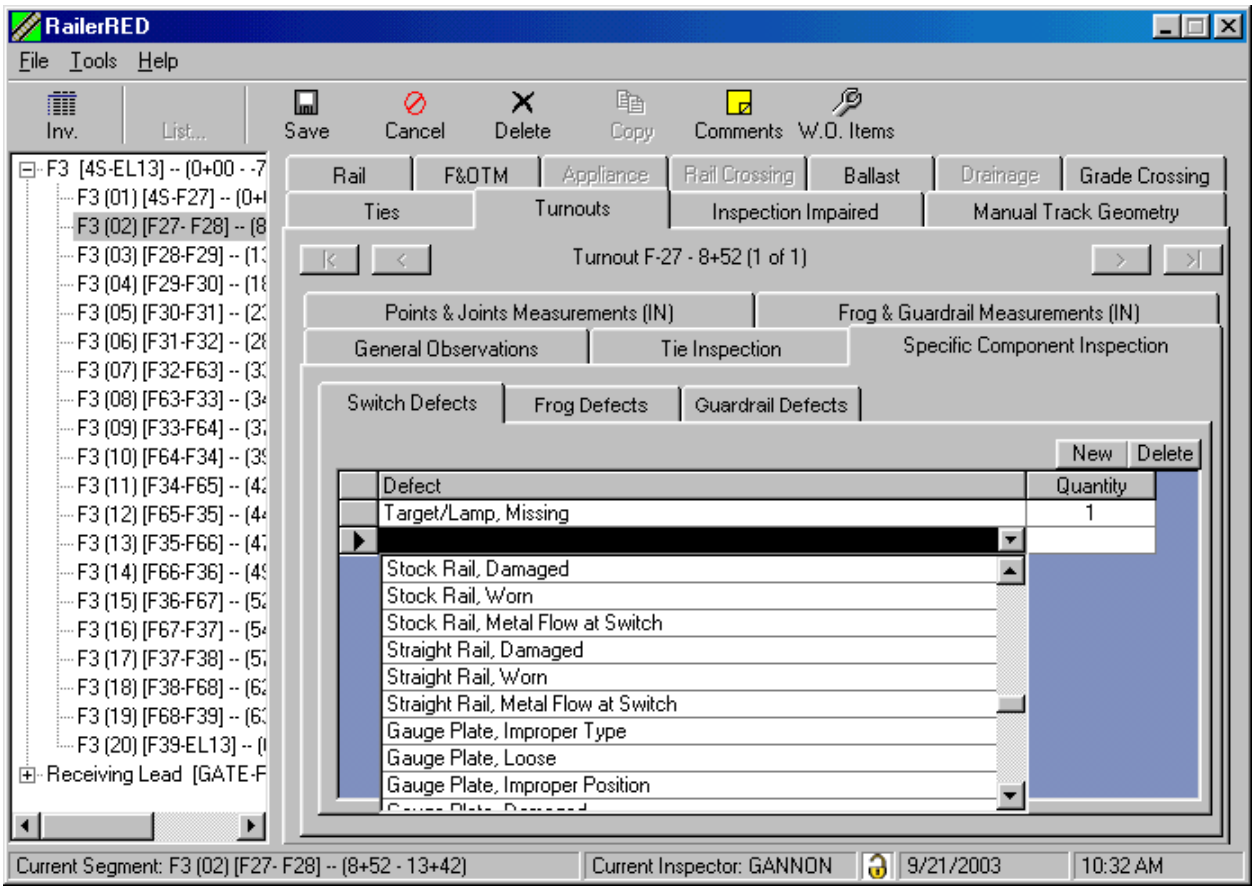

FIGURE 7 Turnout Inspection – Specific Components

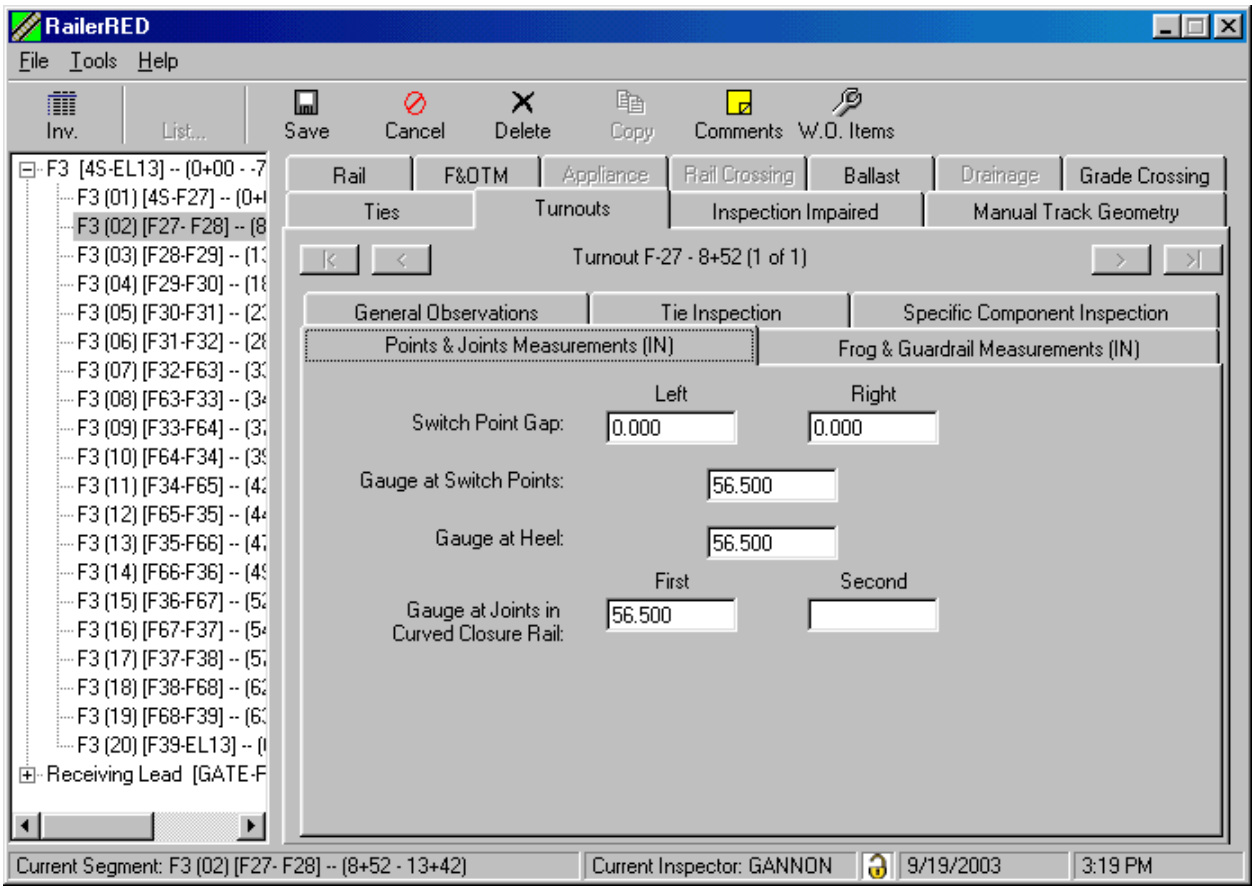

FIGURE 8 Turnout Inspection – Points and Joints Measurements

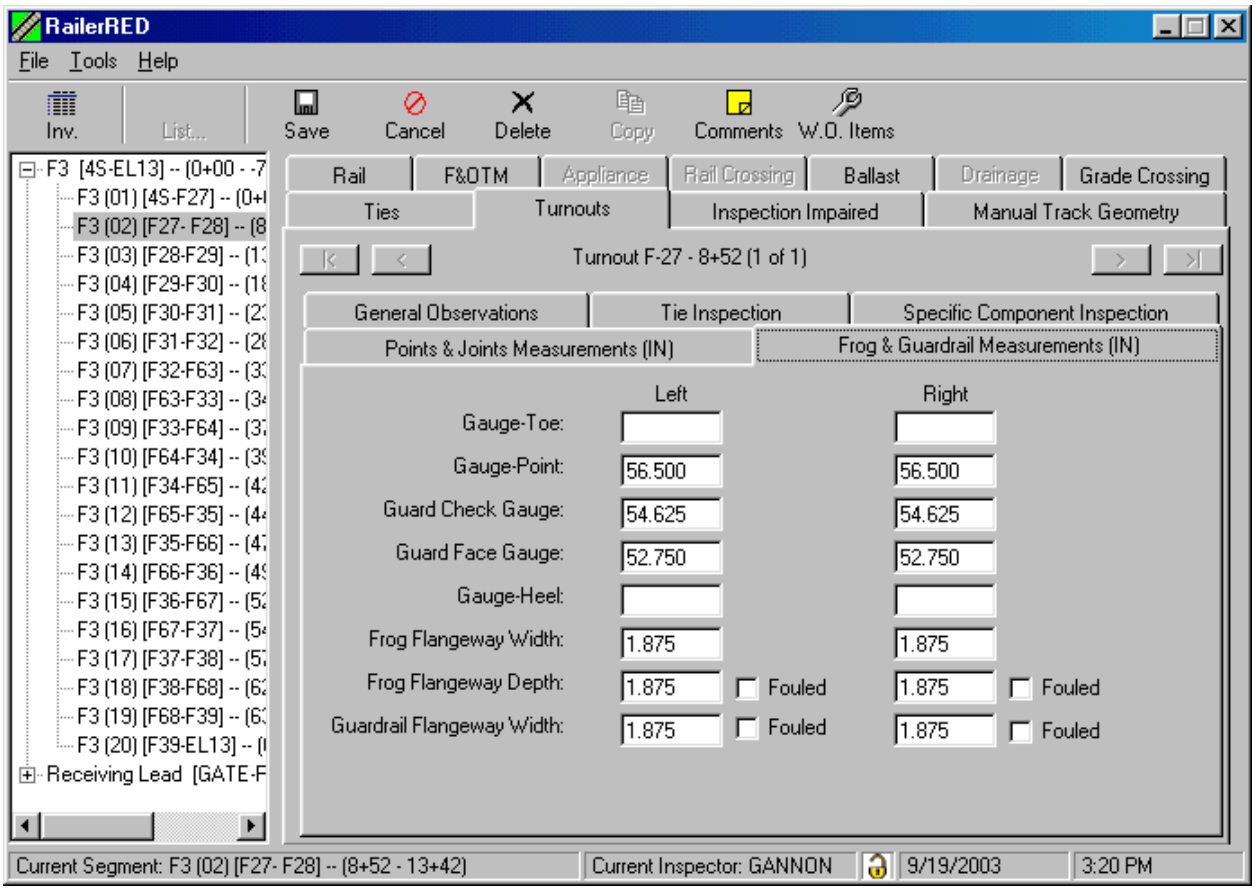

FIGURE 9 – Frog and Guardrail Measurements

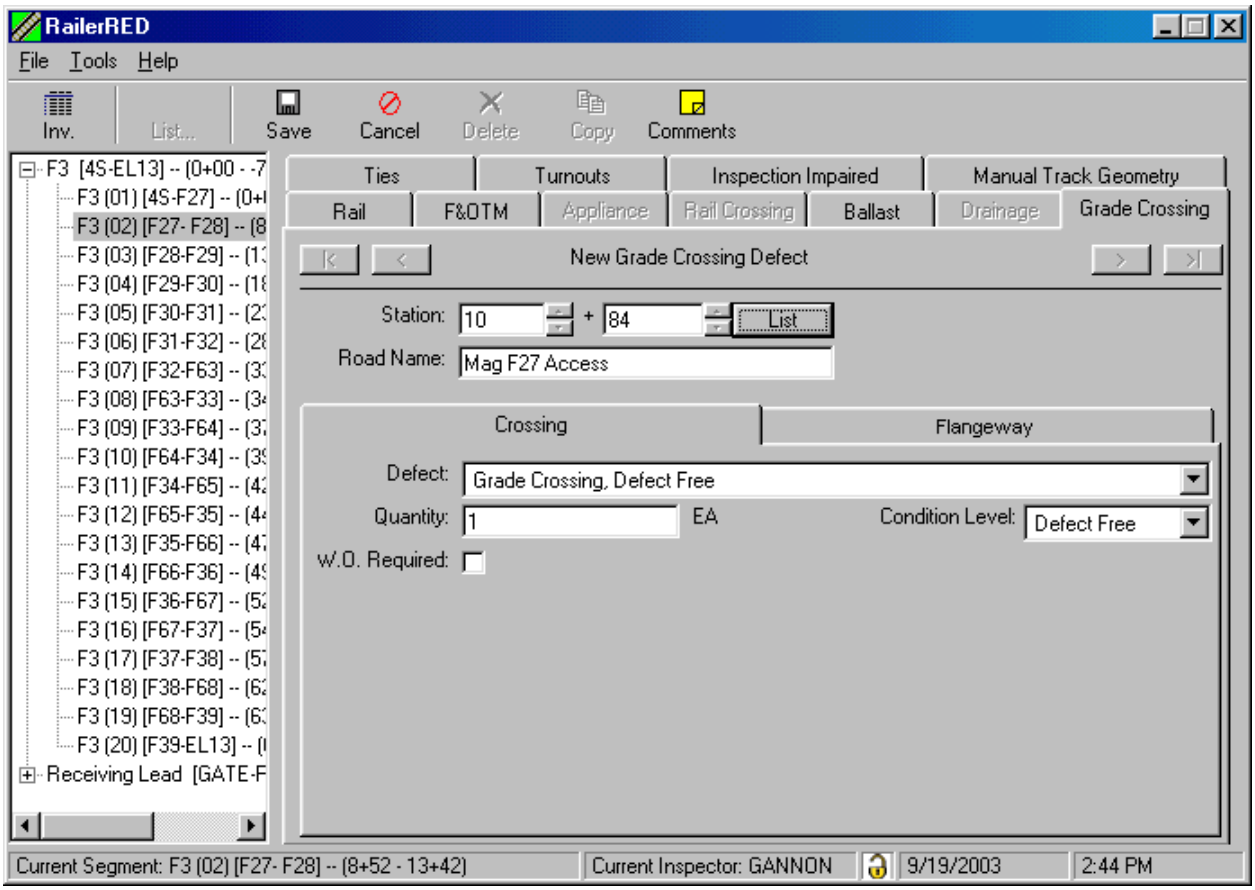

FIGURE 10 Grade Crossing Inspection

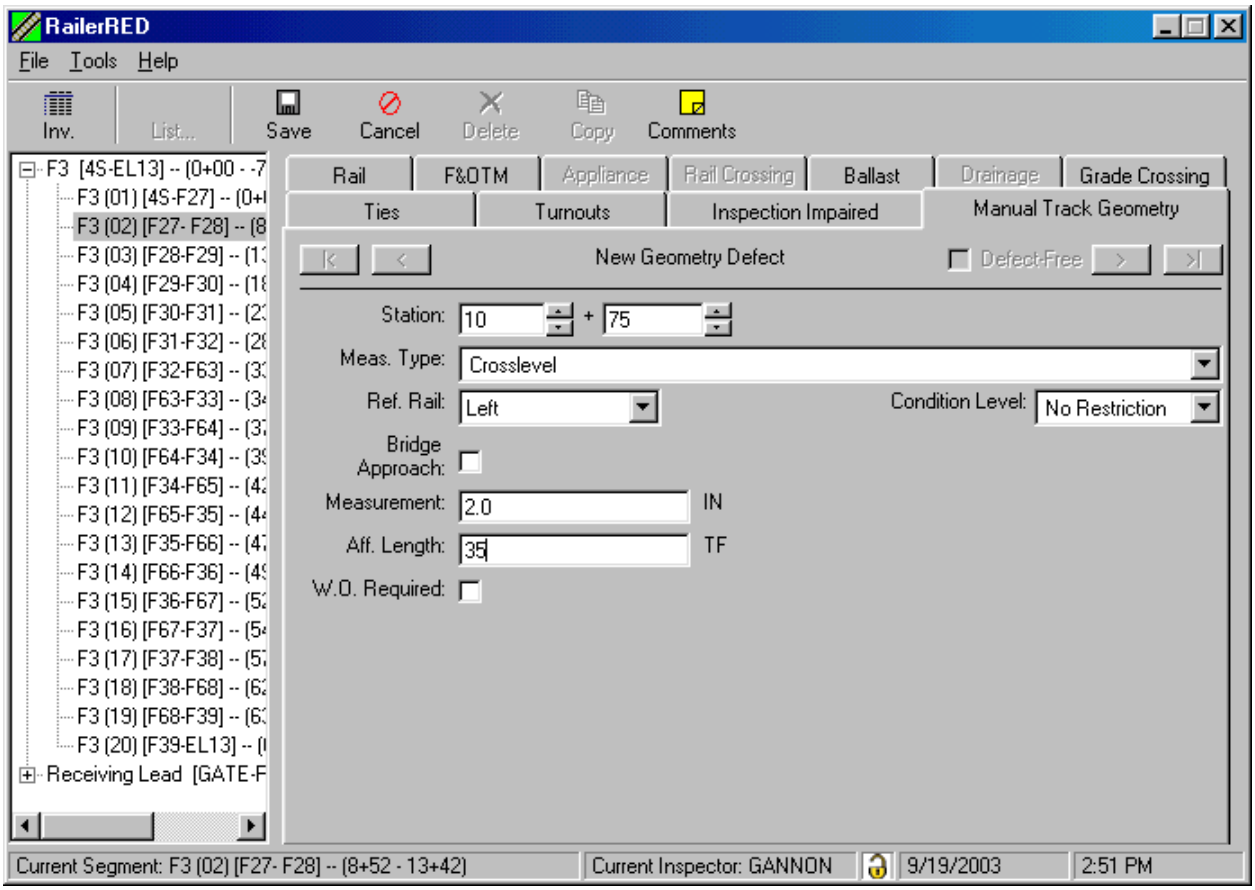

FIGURE 11 Manual Track Geometry Inspection

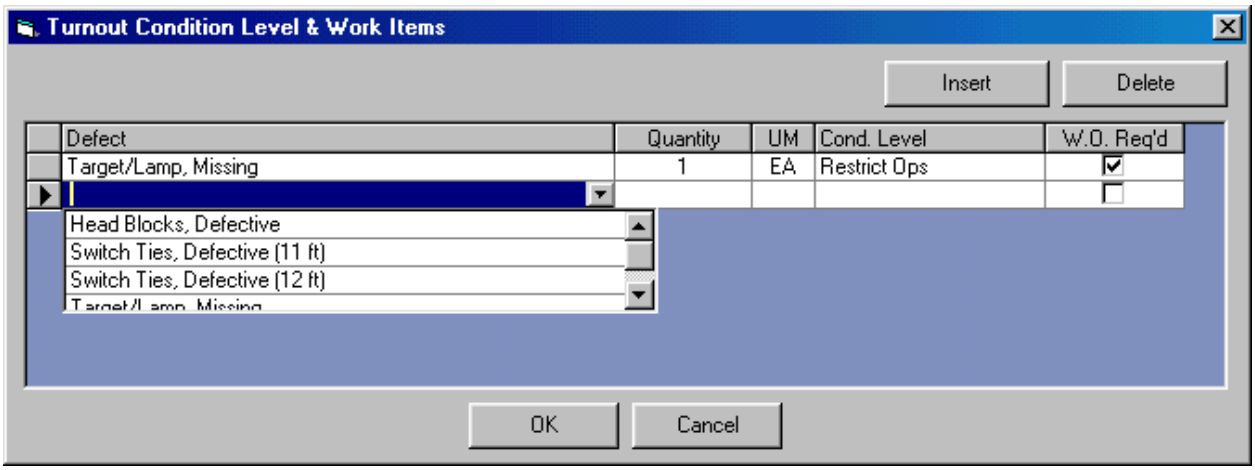

FIGURE 12 Condition Levels and Work Orders for Turnout Defects

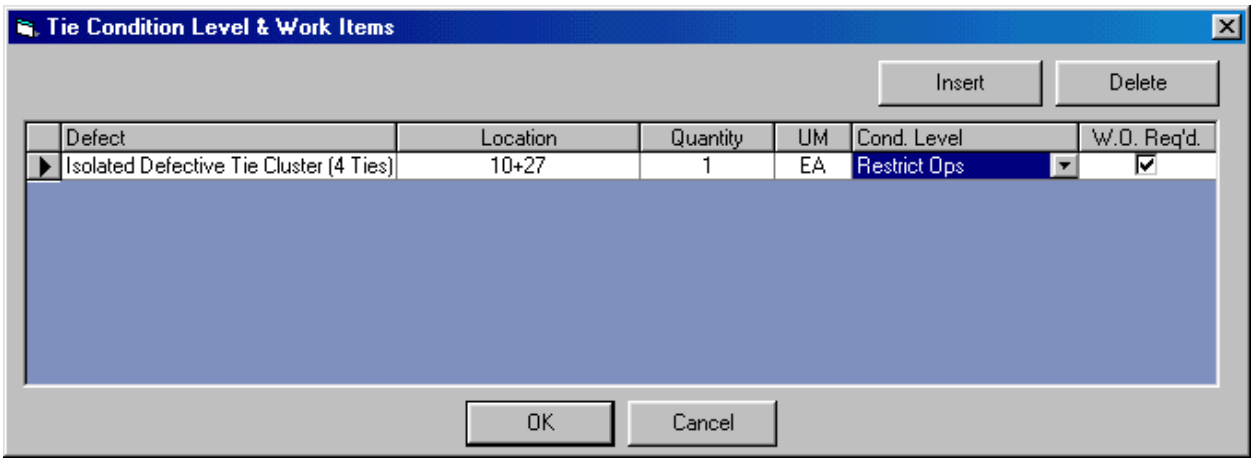

FIGURE 13 Condition Levels, Work Orders, and Locations for Tie Defects Form

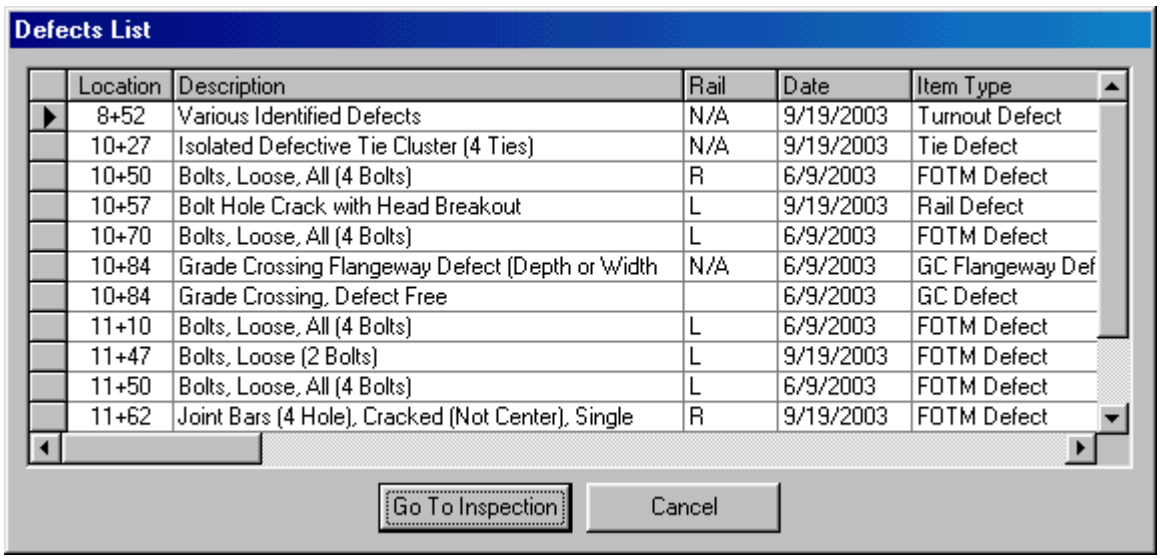

FIGURE 14 Most Recent Inspection Defects List

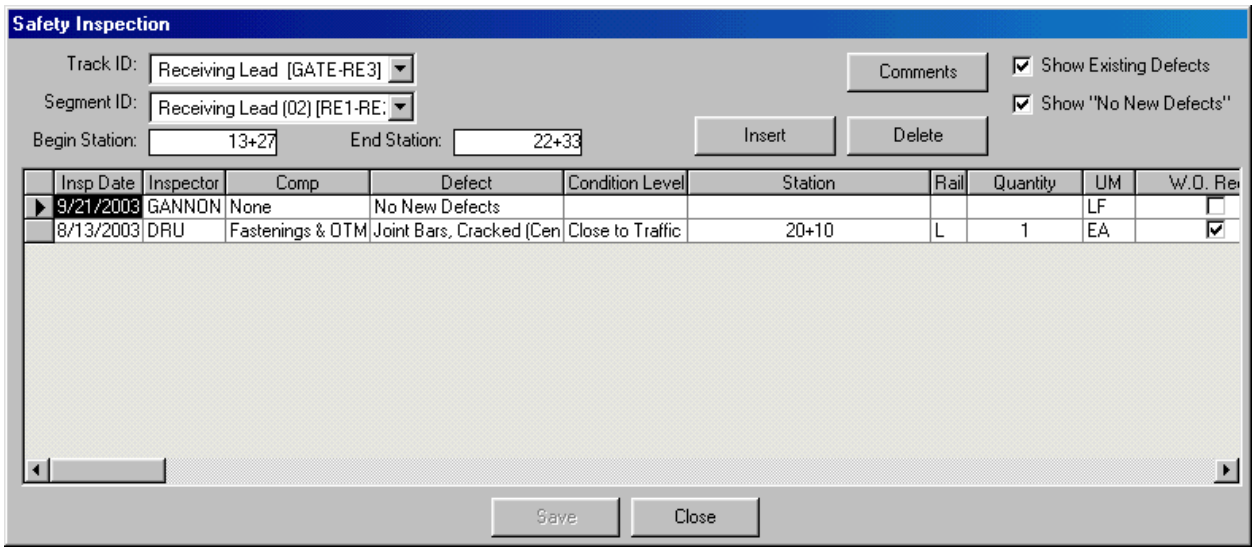

FIGURE 15 Safety Inspection