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Test of Alerter/Emergency Braking System

FINAL REPORT
Task Order No. 2 of
Contract DTFR53-82-C-00254

L. Rohter
T. Jacobius
IIT RESEARCH INSTITUTE
10 West 35th Street
Chicago, Illinois 60616

Office of Research
and Development

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L. Rohter, T. Jacobius

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16. Abstract

The purpose of this alerting device test program was to obtain a base of data that can subsequently be used to determine the effectiveness of the tested equipment. The approach for accomplishing this was to use the Research and Locomotive Evaluator/Simulator (RALES) full-scale locomotive simulator at IIT Research Institute (IITRI) to create realistically simulated but controlled conditions. The RALES simulator, built and operated by IITRI for the Federal Railroad Administration (FRA), is recognized by experienced railroad personnel as offering the best available alternative to actual locomotive operation for training enginemen. This means that, under properly designed and controlled conditions, it offers an acceptable replica environment for testing the efficiency of new equipment. The basic experiment design strategy was to subject several experienced and active enginemen to simulator sessions that test the use of the alerting device. In order to develop a sufficient base of data, 16 test subjects were required. The 16 test subjects were randomly assigned to eight test groups. The groups were defined so that the variables having an influence on the measurement of alerting device effectiveness were properly controlled with or without alerting device equipment and with or without rest. The alerter/emergency braking system was then tested on the RALES simulator and the appropriate data bases were developed. Each subject was tested over the same track run a total of four times over a two-day period. Two runs were made back-to-back on the first day and two runs were made back-to-back on the second day. Each of the four runs lasted approximately one and one-half hours. The results of the exit interviews conducted with the enginemen are summarized.

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alerter, simulator, locomotive, vigilance, testing, human factors, foot pedal, cab controls

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FOREWORD

IIT Research Institute (IITRI) is pleased to submit this final report to the Federal Railroad Administration (FRA), U.S. Department of Transportation, under DOT/FRA Contract DTFR53-82-C-00254. This report documents the results of Task Order #2, entitled "Test of Alerter/Emergency Braking System", under the Research and Locomotive Evaluator/Simulator (RALES) contract. IITRI believes that the RALES simulator proved an effective research and demonstration tool in developing a comprehensive base of data to evaluate the effectiveness of a new alerting device for use by locomotive enginemen.

Respectfully submitted,

Laurence Rohter
Senior Research Engineer
Rail Simulation and Training

Approved:

Charles E. Radgowski
Manager
Rail Simulation and Training

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1. INTRODUCTION

IIT Research Institute (IITRI) undertook a program in 1987 to use the Research and Locomotive Evaluator/Simulator (RALES) full-scale locomotive simulator to test a new alerting device that could be used by locomotive enginemen. The RALES simulator was considered to be the most effective research tool to use for this purpose, since (a) it permits considerable flexibility in designing experiments that produce sufficiently realistic conditions, and (b) it precludes the need to use actual in-service locomotive equipment -- an expensive and complicated approach. This test program involved the use of the alerting device by a representative number of experienced and active locomotive enginemen under simulated and controlled operating conditions.

The test program consisted of the following efforts:

- Developing an experiment design strategy
- Preparing a test plan
- Organizing the simulator test sequence (including track film, train orders and train configuration)
- Installing the device
- Managing the testing and controlling the test subjects
- Compiling the data and documenting the results.

This report is organized in the following three sections, with supporting appendices:

- The Alerting Device
- The Alerting Device Test Program
- The Results.

The results of the program provide a comprehensive and usable base of data. These data may be used to evaluate the effectiveness of the new alerting device compared to existing alerting devices and operating rules. The data may also be used to determine the degree to which the new alerting device could be expected to improve control of a locomotive under various operating conditions.

2. THE ALERTING DEVICE

A new alerting device has been developed through the joint effort of Vapor Corporation and Mr. O.L. Williams. This new device has design improvements intended to make its use more effective and better received by locomotive enginemen than devices based on older designs. The following discussion provides a description of this new alerting device in the context of current industry practice. An additional summary of the functions of the alerting device is also included as Appendix A.

The RALES locomotive simulator, commissioned in 1983, used a Vapor Plus-One alerter. This device was installed because it had represented the state-of-the-art in techniques to assure that the engineman remains vigilant while operating the locomotive.

Alternatives to this type of device included the classic deadman pedal or a manual reset device. The deadman pedal has the significant disadvantage of restricting the position of the engineman. The manual reset device, while simple to operate, has the disadvantage of imposing an additional task on the engineman.

The Vapor Plus-One device as installed and used on the RALES simulator, had the advantage of using a make-and-break capacitor that would reset in response to any type of touch by the engineman. As it is combined with a flashing light and audible alarm, it was considered effective. One disadvantage, however, was that this device could be defeated by an occasional, contrived electrical short to the engineman's seat.

A new alerting device developed by Vapor Corporation and Mr. O.L. Williams, and the subject of this test program, is intended to accomplish the following in a more effective and convenient manner than currently available products:

- Monitor the state of alertness of the locomotive engineman,
- Free the hands of the engineman in task-busy situations by permitting him to sound the bell and horn with a foot pedal, and

- In an emergency situation, progressively activate certain functions, including the bell, horn, headlight and emergency brake.

This device is installed in the cab of the locomotive to monitor the use of the throttle, dynamic brake, automatic brake, independent brake, horn, bell and sander. The alerting device is connected to these controls so that when a control is used the appropriate electrical signal is transmitted to the device and the device is thereby reset. The premise is that regular movement of the controls is a positive indication that the engineman is at an acceptable level of alertness. The design approach permits convenient use, while inhibiting circumvention.

The second function of the device is to permit "hands free" progressive step-wise alerter reset and activation of the bell, horn, headlight and emergency brake. This is done by gradually depressing a foot pedal. Depressing the pedal to the first detent, activates the bell, and resets the alerter; with continued depression the horn blows. Finally, when the pedal is fully depressed, the emergency brake is activated in addition to the other systems. Activation of the foot pedal also insures that the headlight is on, (except the simulator's, which intentionally cannot be turned on). The intent is to save the engineman time in activating emergency functions, as well as let him concentrate more fully on properly managing the emergency situation.

An additional function of the new alerter design is the automatic recording of alerter device activity during a run. Such information would include the place and time of the alerter's first stage alert (i.e., alarm sounds) and second stage alert (i.e. penalty brake application). This could provide added information for supervisory use.

These design improvements are intended to improve the effectiveness of the alerting function and its acceptance by enginemen. The test program and results described in the following sections provide a base of data that can be analyzed to determine whether these improvements are likely to achieve the desired results.

3. THE ALERTING DEVICE TEST PROGRAM

3.1 EXPERIMENT DESIGN STRATEGY

The purpose of this alerting device test program was to obtain a base of data that can subsequently be used to determine the effectiveness of the device. The approach for accomplishing this was to use the RALES full-scale locomotive simulator at IITRI to create realistically simulated but controlled conditions. The RALES simulator, built and operated by IITRI for the FRA, is recognized by experienced railroad personnel as offering the best available alternative to actual locomotive operation for training enginemen. This means that, under properly designed and controlled conditions, it offers an acceptable replica environment for testing the efficacy of new equipment. A brief overview of the RALES simulator is included as Appendix B.

A formal Test Plan for the alerting device was drafted, reviewed, revised by IITRI and approved by the FRA, Vapor Corporation and Mr. O. L. Williams. The proposed program was also reviewed by IITRI's Human Experimentation Committee, and approval was granted.

The basic experiment design strategy was to subject several experienced and active enginemen to simulator sessions that test the use of the alerting device. The details of the simulated test conditions are described in subsequent parts of this test program discussion. They include the following:

- Selection of the enginemen sample
- Number of enginemen test subjects
- Number of simulator sessions
- Variables to be controlled to develop the appropriate data base
- Track (on film) to be traversed
- Train orders to be followed
- Configuration of the train to be controlled
- Control of other simulated effects
- Selection of type and format of data logging.

A fundamental aspect of the experiment design strategy is to reliably measure, independent of the new alerting device, the alertness of the enginemen test subjects as they progress through the simulator sessions. Data that reliably represents alertness is therefore obtained from an independent secondary source in the locomotive simulator. This data is then used to compare test subject response both with and without the new alerting device installed. A "within-subject" design was selected because it involves the test subjects in both sides of a controlled experiment. Therefore, the results are dependent only on controlled variations of the test conditions, and not also on the performance of other subjects in the test group. This experiment design helps remove the skewing effects that result when using test subjects with even slightly differing abilities and experience.

There are various conceptual approaches that can be considered for measuring alertness. They include using an additional signal detection device (to periodically test the subjects using external visual cues or mental recognition), or using such nonintrusive methods as remote sensing of movement, posture, or physiologic function. For various reasons, however, these approaches have limitations that suggest against their use. This includes concerns about introducing procedures that interfere with the test session, and therefore could affect the viability of the resulting data, as well as nonintrusive procedures that previous study indicates may not produce reliable results in a locomotive cab.

The strategy that was selected to measure alertness, with and without the alerting device, used information about the performance of the enginemen that was gathered while operating the locomotive simulator. By monitoring various performance measures under several controlled conditions, both with and without the alerting device installed, it is possible to determine the differential effect that the device can have.

Performance is influenced by ability, preparation and alertness. The test program was designed to neutralize the influence of ability and preparation. The adverse effects resulting from a lack of preparation were evaded by testing enginemen who routinely operate on the same length of track as that to be used in the simulator sessions, and who have the same relative degree of experience with the railroad and with use of the RALES simulator. The variation of ability from engineman to engineman was controlled by having each engineman perform the same run on separate days both with and without the equipment. Therefore, the dependent factor that varies across all conditions will be the alertness of the enginemen as they execute the simulator sessions.

There are two fundamental approaches that were used to develop a comprehensive base of performance data that could be analyzed in the context of the function of the alerting device: (1) the IITRI end-of-run summary (RCARD) methodology used extensively on RALES, and (2) a new methodology that is based on segmentation of the run into well-defined test segments with common performance task characteristics. These two approaches are summarized below, and the results are presented in Section 4 of this report.

RCARD Methodology

The RALES simulator is routinely used to evaluate engineman performance. This includes the gathering and presentation of data that characterize the way in which the engineman handles the train in response to simulated train and locomotive equipment actions, as well as visual and sound cues associated with the track. IITRI's end-of-run summary (RCARD) captures a range of information about the simulator session, including how the brakes were used, how the throttle was used, the train forces that were generated, and the execution of proper signals at crossings. This information can then be organized to indicate how well the enginemen test subjects controlled the train in the context of the RCARD variables, with and without the alerting device installed, and with and without rest.

Segmentation Methodology

The segmentation approach offers a way of organizing a simulator exercise with specific task performance measurement objectives that are indexed to particular segments of the track run. The task-specific performance measurements of comparable test segments can be combined to obtain average scores for each segment, as well as averages integrated over the entire run. Typical tasks associated with any point in the run (i.e. at any segment) include, for example, handling slack within appropriate force limits, or signaling properly at grade crossings.

When applied to the objectives of this test program, the segmentation scoring system provides a unique measure of the quality of engineman performance from one time sequence to another as each new task segment is encountered. These segmented measurements provide additional information about the deterioration of performance due to a lack of alertness over the course of a run. They are also used to document engineman handling of overload situations. This segmentation focuses and builds on RCARD scoring that is based on evaluating and weighting various performance factors over the course of a run.

This segmentation methodology has broad utility in simulator-based performance assessment by providing an additional, standardized tool that can benefit railroad training programs.

Other Measures of Alerting Device Effectiveness

There are additional sources of data that are useful to consider in evaluating the effectiveness of the alerting device. These include measuring the time-responsiveness of activating emergency indicators, and the qualitative feedback from the enginemen test subjects. These measures are described in greater detail in a later part of this section.

3.2 THE EXPERIMENT DESIGN

The Engineman Sample

The test subjects are enginemen working for the Soo Line Railroad, based in Minneapolis, Minnesota. These enginemen work on trackage that extends from Savanna, Illinois to Bensenville Yard, the ex-Milwaukee Road D&I Division. The Soo Line enginemen were selected because of their convenient access to the RALES simulator, their availability to create the proper size sample, their uniform experience and qualifications, and the availability of a film of the track on which they normally run, as described in a following part of this section.

The Test Structure

In order to develop a sufficient base of data, 16 test subjects were required. The 16 test subjects were randomly assigned to the eight groups shown in Table 1. The groups are defined so that the variables having an influence on the measurement of alerting device effectiveness are properly controlled:

- With or without alerting device equipment
- With or without rest.

TABLE 1. EXPERIMENT DESIGN: BY TEST SUBJECT AND CONTROL VARIABLE

	With Rest		Without Rest	
Test Subject	With Equip.	W/O Equip.	With Equip.	W/O Equip
#1	1	2		
#2	1	2		
#3	2	1		
#4	2	1		
#5			1	2
#6			1	2
#7			2	1
#8			2	1
#9	1		2	
#10	1		2	
#11	2		1	
#12	2		1	
#13		1		2
#14		1		2
#15		2		1
#16		2		1

Key "1" represents two runs in first session
Key "2" represents two runs in second session

This grouping resulted in the following distribution of test subjects:

	With Rest	Without Rest	Total
With Test Equipment:	7	9	16
Without Test Equipment:	8	8	16
Total:	15	17	32

The time-sequencing of the two prominent variable conditions was manipulated in order to control and subsequently assess the effect of each on the performance measurement data. That is, the subjects were tested either after a period of rest, or without any rest; and the alerting device was either installed in the cab or was absent from the cab.

Each subject was tested over the same track run a total of four times over a two-day period. Two runs were made back-to-back on the first day and two runs were made back-to-back on the second day. Each of the four runs lasted approximately one-and-one-half hours.

Another experimental condition involved testing of the emergency brake activation feature of the alerting device foot pedal. This was done by introducing the possibility of a head-on collision 16 times over the course of the experiments, i.e. an average of once for each of the 16 test subjects. Thus, one of each set of four runs ended with the potential danger of the hump engines lined for the same track.

Since each engineer made a total of four runs, the likelihood of being surprised was high. The actual occurrence of the potential collision event was randomized. In reality, there were no instances during the test program in which the enginemen were surprised. Their entry speed into the Bensenville Yard was always appropriate for the prevailing conditions.

A head-end brakeman was not included in the test program, since his role is traditionally passive and his presence could introduce additional test design controls. Thus the engineman rode alone. Dialog with the caboose was handled with the RALES simulator operator acting the role as necessary. For example, the RALES operator would acknowledge roll-by inspections (General Code Rule 109). The acting caboose operator did not initiate discussion, but only responded to requests for information from the engineman.

The "With or Without Rest" Test Variable

It had been suggested that a more powerful statistical design would incorporate tests with rest and tests without rest. The rested condition would be after at least eight hours of rest, and ideally more. The condition without rest would be immediately after having come off duty, as the enginemen are already quite tired.

When testing began, however, it became impossible to achieve the unrested condition, due to the enginemen's interpretation of the hours-of-service law. Subsequently, the unrested condition was defined as after at least four hours on the job or four hours running on a simulator. The simulator used was either the full-function RALES or IITRI's reduced-scale TS-2 model using a video projection visual system. Most of the unrested enginemen were tested in this manner. Test subjects 9, 13 and 14 were brought to an unrested condition using RALES.

The "With or Without Equipment" Test Variable

The equipment to be tested consisted of the following:

- A specially engineered foot pedal device used to first turn on the bell and headlight and reset the alerter; second, to blow the horn; and third, to latch the emergency brake such that the horn blows and the bell rings.
- A state-of-the-art Reset Sensing Control used as a vigilance (alerting) device that is reset by normal handle operations, or a special reset button. The period for required feeding is speed-sensitive.
- A management reporting system that keeps track of first stage (system prompts for attention via flashing light and later audible alarm) and second stage (penalty brake application) alerts.

In those test conditions where the equipment to be tested was to be installed, the above equipment (excluding the ability to turn on the headlight) was installed and operational. IITRI's simulator reporting system was used instead of the management reporting system that was provided. Pretesting the prototype foot pedal device insured that it provided an acceptable responsiveness to foot pressure. The resulting force to displacement relationship is included as Appendix C.

Each time that the test equipment was installed, it was checked for functionality according to the procedure described in Appendix D.

When sessions were needed without the equipment, the foot pedal was removed and the alerting device was deactivated.

Familiarization Run

None of the subjects to be tested had been involved in RALES training programs prior to this test program, and none had experience on the RALES simulator. Each test subject was therefore given an opportunity to familiarize themselves with the simulator by operating it with the same train over the first portion of test track. This familiarity was also sufficient to begin to induce a certain amount of monotony in the entire testing experience. The familiarization run is described in Appendix E.

3.3 SIMULATED TRACK/TRAIN CONDITIONS

Track Film

This territory had been filmed by IITRI with the cooperation of the Soo Line in August, 1986, specifically from Davis Junction (MP81) to Bensenville Yard (MP17). The entry to the yard continues to a nose-to-nose meet with the hump engines. IITRI also filmed an alternate event of a clear entry into the yard. The nose to nose meet was filmed by the camera running in reverse backing away from the hump engines who are also moving backwards. When played back normally, each sequential frame brings the hump engines closer, finally ending in a nose to nose meet. If the engineer runs at normal yard speed (10 mph or less) he will see the hump engines in time to stop his train. When the engineer stops his train, the approaching hump engines will also stop. The engineer first sees the approaching engines lined on his track around a bend after coming under the C&NW bridge. If the engineer ignores the visual of the approaching train or arrives at the yard entrance too fast, he will not be able to stop in time (i.e., before coming nose to nose with the hump engines).

RALES Film 3200 was made to maximize coverage of the Soo Line territory to meet the testing objectives of this program. The territory that was chosen is "home" to Chicago-based enginemen (specifically Bensenville) to allow test runs on familiar territory at inexpensive travel costs, as well as allow test scheduling without long lead times. This also permitted excellent flexibility in using the simulator to emphasize work cycle fatigue. There are 103 grade crossings in this film, which was also beneficial in creating a sufficiently dense operating environment for the enginemen.

RALES Film 3200 includes two sets of temporary-slow order flags, and two sets of conditional-stop signs located as follows:

Signs	Description	Milepost (Set #1)	Milepost (Set #2)
Yellow	Two miles to temp. slow	69	19
Green	End temp. slow	66	17
Yellow/Red	Two miles to cond. stop	77	40
Red	Conditional stop	75	38
Green	End cond. stop zone	74.7	37.9

RALES Film 3200 had already been tested and used in a Soo Line training program. A copy of the track chart profile is included as Appendix F.

Clearance and Train Orders

The clearance that the engineer received had no expected meets. The orders consisted of near-track-speed (45 mph) through the yellow and green flag pairs (temporary slow order) and appropriate FORM Y (conditional stop) for the yellow/red, red and green flag triplets. When the engineer was within specified miles of the FORM Y, upon his initiation of request to pass, the track foreman-in-charge gave him correct verbal authority to pass at normal track speed (50 mph). Appendix G includes the appropriate clearance and track orders, as well as the simulator operator's verbal dialog.

Train

A typical mix of loads and empties has been chosen as the train consist to be used for the test. The train is called 692KM. An actual train configuration report of 692KM from the RALES EDS library is included as Appendix H.

The train consisted of two 3000 hp locomotives, 57 loads, and 55 empties. The loads were principally blocked to the front of the train. Train total tonnage was 6393 and total length was 6799 feet. Horsepower per ton was 95 and tons per operative brake was 56. It is a fairly "forgiving" train configuration, although the various sags will cause slack action unless controlled properly. The train also has enough power to overcome the ruling grade, is not overpowered, is typical of those running this district, and meets the appropriate tonnage tables.

Since the experiments were to start "at speed" to achieve a monotonous condition quickly, a starting speed of 45 mph and initial throttle setting of "6" was used.

Video Tape Recordings

Two VHS video tape recordings were made of the entire run. One tape player recorded the Advanced Display of the entire run, with cab-monitoring audio. The audio track included radio transmissions, engine sounds, and other cab sound effects. The Advanced Display includes force/coupler displays, location of the train on the track, and brake systems status.

The second tape player recorded a view of the engineer inside the cab for the entire run. A split video of the forward and rear view camera was used with the digital superposition of clock time and film chainage.

These tapes also included:

- The introduction to the testing program that is included in the check list
- The time-line check of bell, horn and emergency brake, with and without using the foot pedal device
- The exit interviews of the test subjects.

The results of the time-line checks and the exit interviews are included as Appendices M and N and described in Section 4.

Other Simulated Effects

Comments were logged, for the most part, via the "log" utility of the RALES Experiment Operator's Terminal (EOT). These logs then became part of the data retained by the computer. The computer "log" can be accessed at the end of the run in order to post additional data. Checklists were also kept as written records of each run. A simulator procedural checklist form is included as Appendix I.

The simulator operator also played the role of various individuals: conductor, track foreman, and tower B17 operator.

The RALES "CPU" was configured with a mix of sounds consisting of FRA-supplied tests of actual locomotives. The loudest sounds peaked at an amplitude of approximately 90db. These loud sounds included Throttle "8", the air horn and the air vent.

The "Overload" Section

In a typical engineer's run, circumstances may combine to force a heavy workload. The 1% downhill section into Elgin is a challenge with several additional tasks for the engineer, blowing the horn for the frequent and blind highway crossings, as well as establishing radio communication with a track gang and approaching CTC. In the experiment design, segment 8 is designated the "overload" section, it is a very busy time for the engineer. An "overload" section was included in the experiment design to show the advantage of a device that could facilitate engineer's performance in such a busy time. Performance in this segment can then be specifically compared to less task demanding segments.

4. THE RESULTS

A comprehensive base of data was created by implementing various elements of the test program. The data base represents the deliverable results of the alerter/emergency braking system test program undertaken for the FRA. The discussion provided here summarizes the nature of the data that has been gathered and compiled. Subsequent analyses can then be completed with a complete understanding of the data structure, so that full value is derived from this program. The data can be analyzed in several ways to determine the relative effectiveness of the new alerting device, within the bounds of accepted statistical practice.

The test program created four distinct data bases for review and analysis based on the four data gathering and compilation techniques that were used:

- IITRI RCARD Performance Scoring Methodology
- Session/Task Segmentation Methodology
- Emergency Response Timing Test
- Enginemen Test Subject Exit Interviews.

The resulting data base that is associated with each of these techniques is presented in the remaining part of this section, and is supported by various appended data sets. The details of the methodologies employed were described in Section 3. A small number of runs were not completed due to computer outages or time constraints on the enginemen. Data to the point of ending has been included.

IITRI RCARD Performance Scoring Methodology

The use of IITRI's standard RCARD scoring technique resulted in data that are organized in terms of the following variables: the test subjects, the simulator runs performed by each subject, the rest or no-rest condition, the equipment or no-equipment condition, and four performance measures (braking, throttle, train forces, and crossings). The data were reduced to overall averages for convenient comparison of performance variation as a function of rest/no rest and equipment/no equipment conditions. These averages are summarized in Table 2, with the following detailed, supporting data tabulations included as Appendices J, K and L:

TABLE 2. RCARD PERFORMANCE AVERAGES UNDER SELECTED TEST CONDITIONS

A.	Average score of all test subjects with rest:	80.226%
B.	Average score of all test subjects with no rest:	80.076%
C.	Average score of all test subjects for 1st session:	79.643%
D.	Average score of all test subjects for 2nd session:	80.650%
E.	Average score of all test subjects for 1st run of each session:	80.281%
F.	Average score of all test subjects for 2nd run of each session:	80.012%
G.	Average score of all test subject runs that did not have alerting device:	80.518%
H.	Average score of all test subject runs that did have alerting device:	79.775%
I.	Average score of all test subjects that did not have rest and did not have the alerting device:	80.675%
J.	Average score of all test subjects that did not have rest and did have the alerting device:	79.544%
K.	Average score of all test subjects that did have rest and did not have the alerting device:	80.361%
L.	Average score of all test subjects that did have rest and did have the alerting device:	80.071%

Appendix J:

- RALES Locomotive Engineer Simulator Synopsis of Scoring

Appendix K:

- RALES Locomotive Engineer Simulator Grade Form (completed for each test subject)

Appendix L:

- Tabulation of Average Scores (%) by Test Subject, by Simulator Run, and by Test Condition.

Session/Task Segmentation Methodology

A data base that is complementary to the RCARD, and indeed is fundamentally based on the RCARD scoring approach, was developed using the segmentation technique. This led to the division of the session into 12 segments, as shown in Table 3.

The data resulting from this segmentation was compiled to show performance for specific groups of test subjects/conditions in the 12 specific segments along the run. This was done for two specific performance measures: train handling and grade crossing. To illustrate this segmentation approach, the compilation of data reflecting the train handling performance measure is discussed here and shown in Figures 1 and 2. Compilation of data related to grade crossing performance is then also shown in Figures 3 and 4.

TABLE 3. DIVISION OF SEGMENTS

Segment	Description	Start FRC	End FRC	Milepost Span
#1	Covers start from zero speed	404000	404070	From Begin to Begin -70 ft
#2	Covers from beginning to top of hill near MP 74	404070	437158	From -70 feet to MP 75-4600
#3	Covers downgrade from top of hill near MP 74 to bottom of hill near MP 71	437158	45126	From MP 75-4600 to MP 71-0000
#4	Covers slightly undulating grade from bottom of hill near MP 71 to MP 67	453126	474757	From MP 71-0000 to MP 67-0000
#5	Covers slightly undulating grade MP 67 to near MP 53 and upgrade to top of hill near MP 49	474757	573018	From MP 67-0000 to MP 49-4000
#6	Covers down grade from top of hill near MP 49 to near MP 47 and slight undulating grade to train length past Pingree Grove switch	573018	5999966	From MP 49-4000 to MP 44-2000
#7	Covers from train length past Pingree Grove switch to start of downgrade near MP 43	599966	602955	From MP 44-2000 to MP 43-1500
#8	Covers downgrade from near top of hill near MP 43 to bottom of hill near MP 36 to end of 3 deg curve at MP 34 the "Overload" section	602955	648780	From MP 43-1500 to MP 34-000
#9	Covers from end of 3 deg curve at MP 34 to top of uphill grade near MP 31	648780	666451	From MP 34-000 to MP 31-1500
#10	Covers slight down grade from top of hill near MP 31 to past MP 26	666451	694145	From MP 31-1500 to MP 26-4000
#11	Covers slight down grade from past MP 26 to the end	694145	779220	From MP 26-4000 to MP 16-000
#12	Covers the entry into the yard.			

Train Handling

For most of the 12 segments, a measure of gross poor train handling performance was determined. Poor performance was usually due to creating excessive run-in or run-out slack conditions. For example, the total number of excesses of run-in or run-out was determined for the selected segments that reflected this train handling aspect. The excesses were then divided into four test condition groups (where "equipment" refers to the alerting device):

- Rest/Equipment
- Rest/No Equipment
- No Rest/Equipment
- No Rest/No Equipment.

Data from the above four groups was then averaged for each test subject to define a value for comparing the differences in train handling performance. These averages, on a percentage basis, are shown on the vertical axes, with increasing value indicating increasing train handling performance.

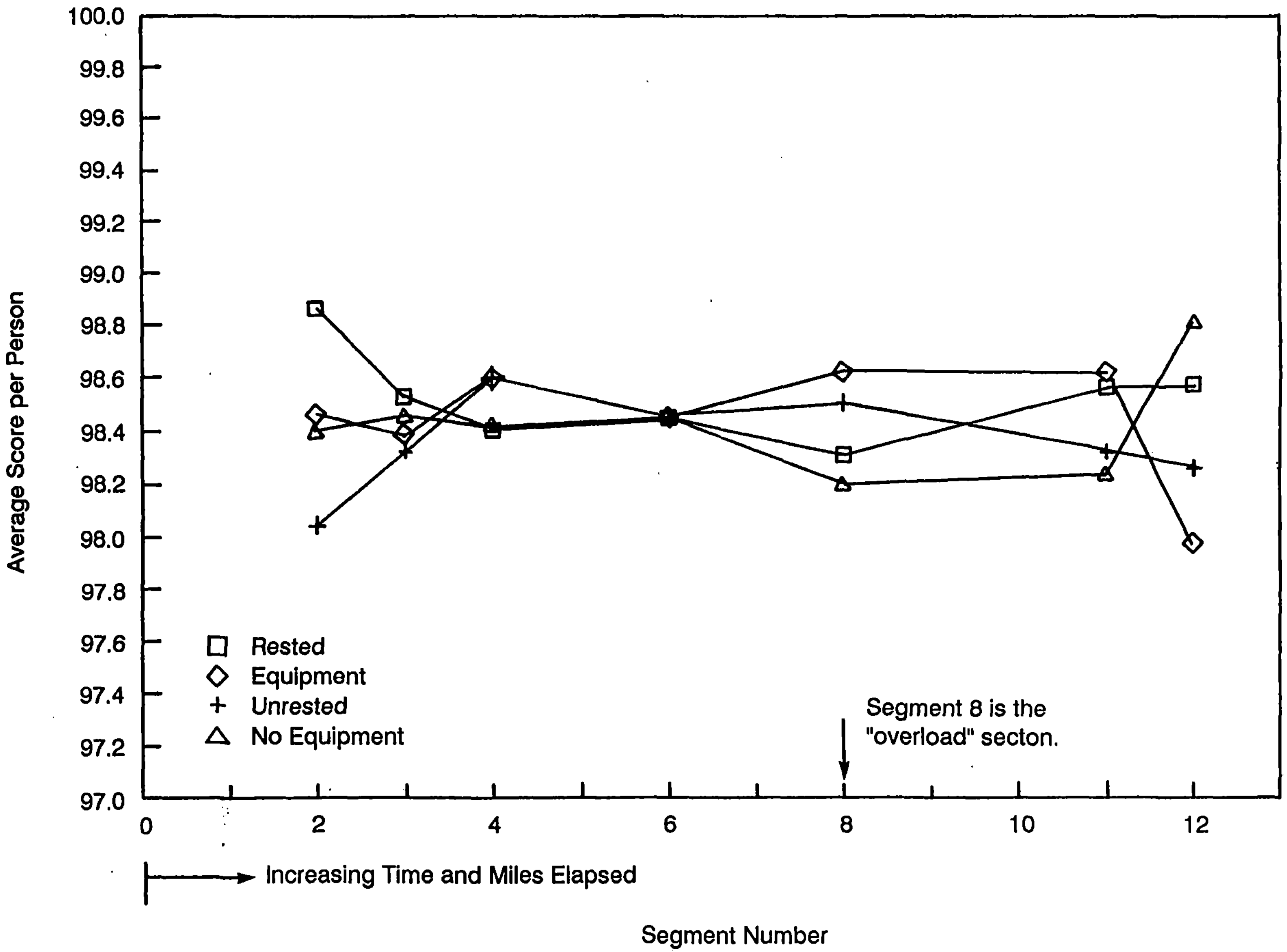


Figure 1. Train handling performance as average of individual scores for each test group vs. segment number. Segments are performed sequentially in a 63-mile run of approximately 2 hours.

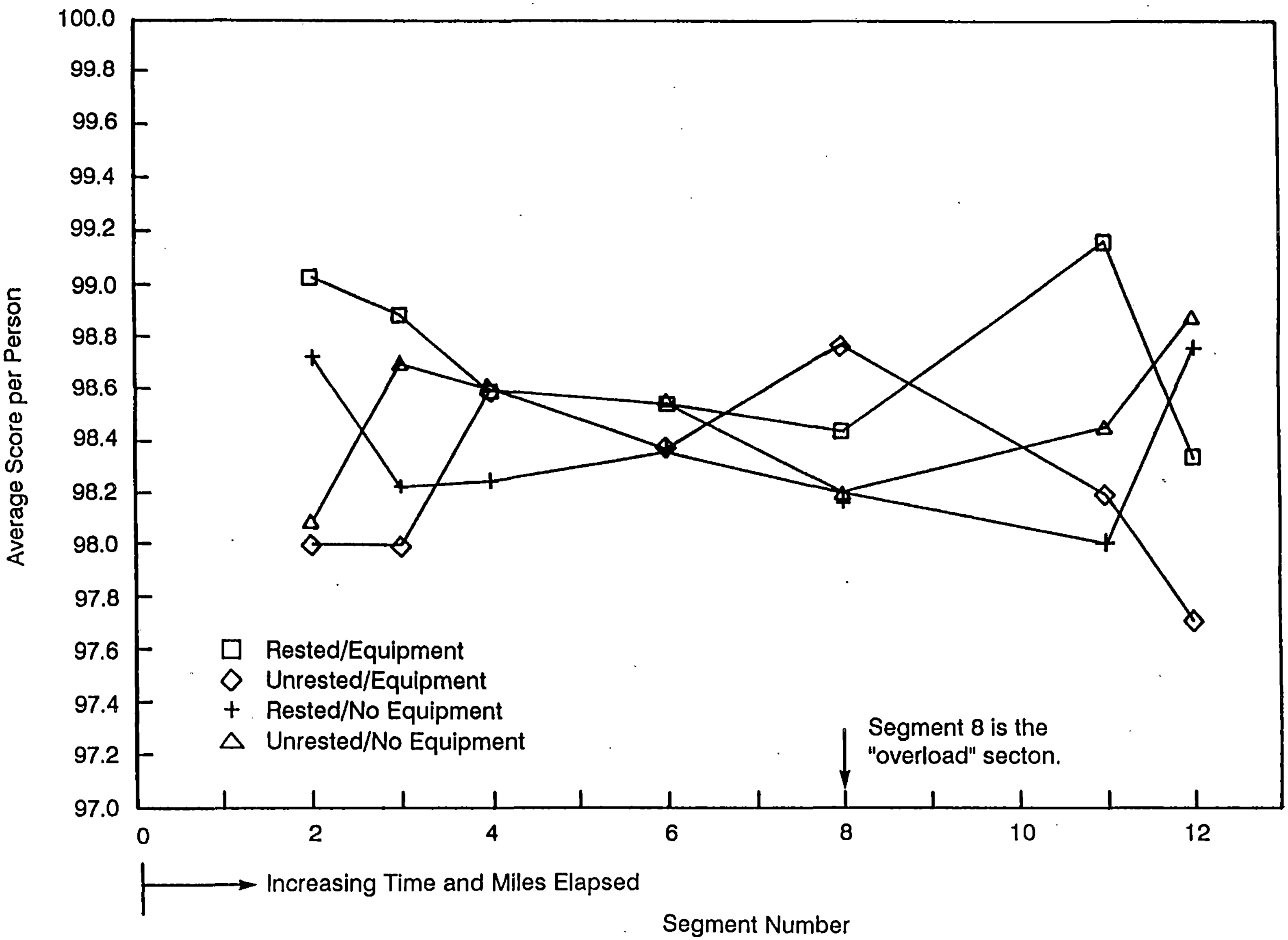


Figure 2. Train handling performance as average of individual scores for each test group vs. segment number. Segments are performed sequentially in a 63-mile run of approximately 2 hours.

Grade Crossing

Compilation of grade crossing performance data was prepared in a similar fashion. It should be noted that the significant discontinuity of performance at Segment 8 is due to a programmed overload in actions required of the engineman in this segment of the run. There is also a modest but perceptible deterioration in performance from the beginning to the end of the runs across all groups of conditions.

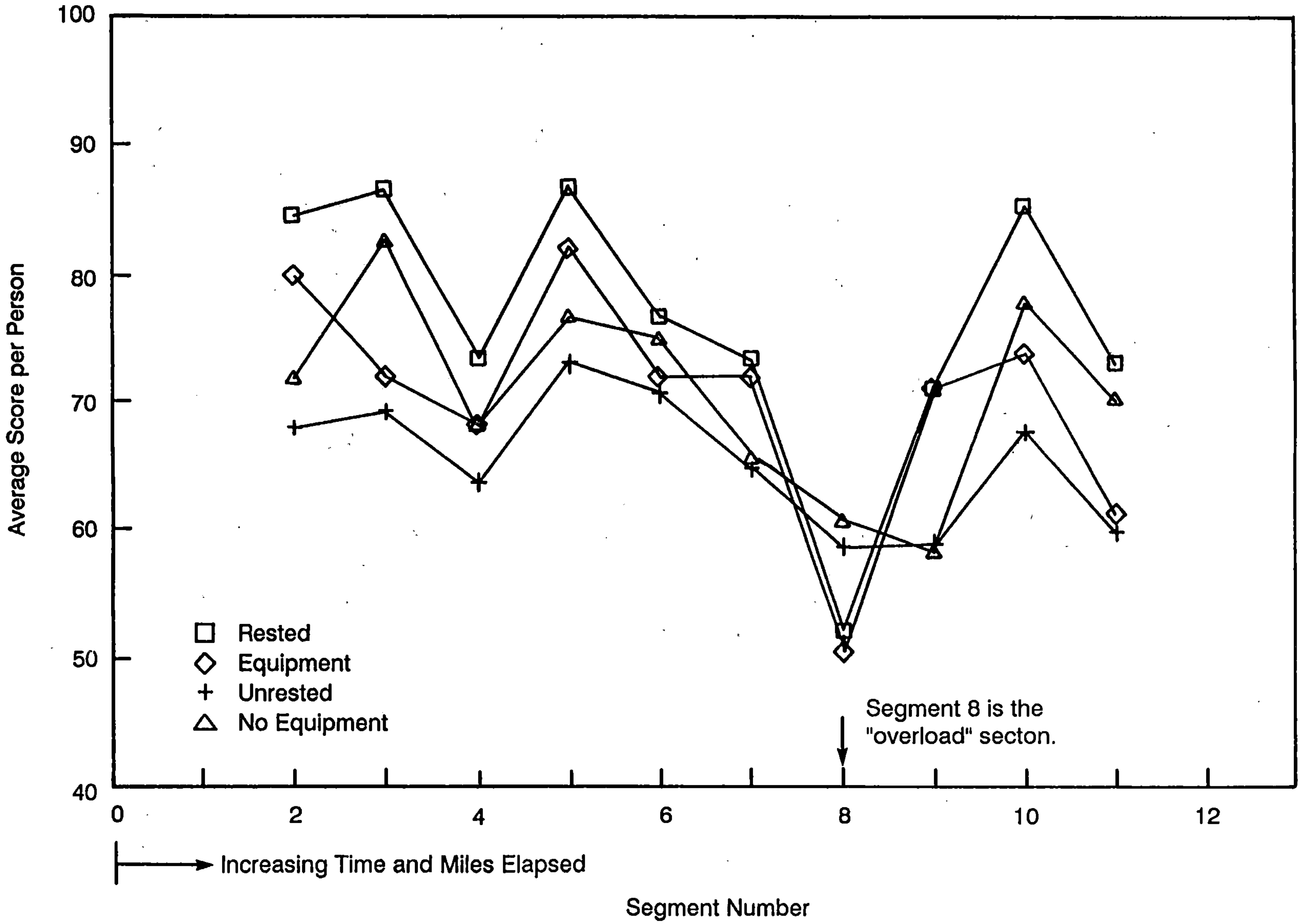


Figure 3. Horn blowing performance in response to upcoming grade crossing as average of individual scores for each test group vs. segment number. Segments are performed sequentially in a 63-mile run of approximately 2 hours.

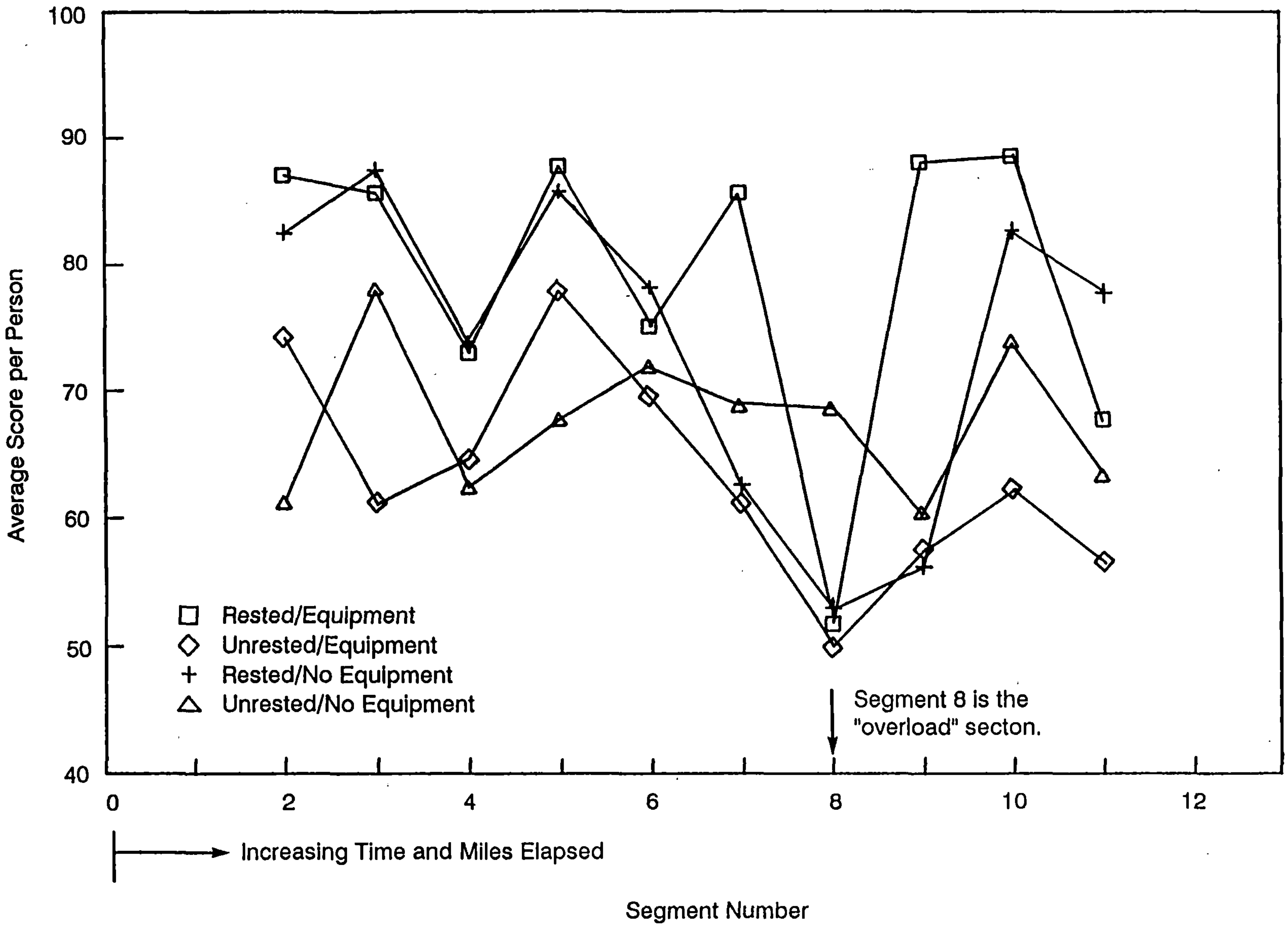


Figure 4. Horn blowing performance in response to upcoming grade crossing as average of individual scores for each test group vs. segment number. Segments are performed sequentially in a 63-mile run of approximately 2 hours.

Emergency Response Timing Test

A timing test was conducted once for each engineer at the end of the familiarization run, while a video recording was under way. There were three timed actions: activating the bell, activating the horn, and activating the bell/horn/emergency brake. The tests were performed using the foot pedal experimental equipment, if available. Otherwise, the normal complement of hand devices was used.

Timings were taken from the video tape record with a stop watch. A total of 12 enginemen were timed conclusively. The results of the timing tests are included as Appendix M.

Enginemen Test Subject Exit Interviews

An exit interview consisting of seven questions was given to each of the test subjects. The first four questions served to probe the enginemen concerning their perception of the realism of the simulated environment and acceptance of that environment. The last three questions related to the alerting device itself that was the object of the test program.

The results of the exit interviews indicate that the simulator represented a good research tool for replicating the locomotive control experience. There was also useful and generally favorable feedback regarding the utility and function of the foot pedal device. A detailed synopsis of the exit interviews is included as Appendix N.

Alerter Alarms

The installed test equipment had two stages of alerter intervention. In the first stage, if the alerter had not been appropriately "fed" in a certain time, (based upon speed; the higher the speed the less time allowed before feeding), the alarm would go off. The installed alarm was first a flashing light, flashing faster as time increased and then a siren, increasing in volume also as time passed. Appendix O, Recorded Occurrence of Alerter Alarms, summarizes the "stage one" data as experienced by the experimental subjects. Stage 2 intervention occurs, if after 23 seconds of stage 1 alarms, there is still no engineman feeding. Stage 2 intervention is a penalty brake application; the stopping of the train under a full service brake application, and cutoff of power.

As can be seen from Appendix O, in the unrested condition there were more stage 1 alarms. In the total subject testing there were no stage 2 alarms.

APPENDIX A - ALERTING DEVICE DESCRIPTION

APPENDIX A - ALERTING DEVICE DESCRIPTION

ALERTOR AND SAFETY SYSTEM

Background

Railroad use of alertness systems date back to the days of the "dead man pedal". Over the years, many different methods have been tried and all have had two things in common.

a. the desire to improve the safety of train operations and provide operating crews with the safest possible environment;

b. an operational nuisance to crews, intruding on their primary tasks of train operation (often requiring a reset/acknowledgement during important train control activities); this nuisance characteristic would inevitably lead to crew members circumventing and/or disabling the alertor safety system.

Another trend of recent years has been the addition of more and more new controls installed in the cab; e.g., end-of-train, fuel saver, remote operation. Each of these controls are hand operated. When added to all the other cab controls (throttle, brake, radio, bell, horn, etc.) the question becomes whether the engineman has too much to do with only two hands.

Purpose of Test

To evaluate the effectiveness of a new Alertor and Safety System. The system combines an alertness monitor with a foot pedal device designed to shift some of the control burden from the hands to the previously unutilized feet.

This is especially beneficial when the engineman is busy copying train orders or otherwise operating the locomotive controls and must then also blow the whistle for grade crossings.

More importantly, the foot pedal device can be used to actuate emergency braking and will also lock in the bell, whistle, and lights under emergency conditions, thereby avoiding the "engineman's dilemma"; i.e., once actuated in emergency all necessary external warning signals for the general public and/or train crew members are activated <u>and</u> the engineman has the opportunity to seek a place of safety.

Description of the Equipment

The Alertor determines engineman alertness by monitoring activity of the locomotive controls. The normal activity of the engineman's primary tasks; i.e, throttle changes, braking, horn, bell, sand, etc., signify that the engineman is active and not impaired or disabled. <u>This normal train handling activity is sufficient to keep the alertor from initiating an alarm sequence.</u>

If, however, the train handling requirements are such that the aforementioned control activity is not required, the alertor will sense this "inactivity" and ultimately initiate an alarm sequence prior to activating a penalty brake application. This timing period depends on the speed of the train: the slower the speed the longer the period of "inactivity" is allowed; as the speed of the train increases the allowed period of "inactivity" becomes shorter. During the alarm sequence - which consists of a flashing light followed by an audio alarm - the engineman may activate any of the controls, independent bail off, or a separate push-button switch which will: 1) nullify the alarm; 2) preempt penalty brake application; and 3) restart a new timing cycle.

The foot pedal safety control is used to activate three different functions: bell, whistle, and emergency brake. Furthermore, when the foot pedal is activated it will automatically ensure that the locomotive headlights are on. When released in the full "up" position all three functions are off. When depressed to the first position, the pedal will latch with the bell actuated. With the bell still sounding, further downward movement on the pedal will begin to sound the whistle. By varying the downward movement and easing up on the pedal the whistle will modulate. The sounding of the bell and whistle therefore is achieved without taking the engineman's hands away from the throttle, brake, or other controls. The spring force designed into the pedal is such that the engineman can easily sense the pedal position prior to engaging the emergency brake valve. The change in force required to go from whistle actuation to emergency is significant enough to prevent accidental emergency actuation but not too great a force that would make emergency actuation difficult.

By pressing the foot pedal completely down, an emergency brake valve will be activated and the foot pedal will latch in this position. When latched in this emergency position, not only will the train go to emergency brake but the bell, whistle, and lights will also be latched on providing warning for all persons ahead while also enabling the engineman to seek a place of safety.

A foot operated release lever at the top of the pedal will release the pedal from either the emergency or bell latched positions.

For maximum benefit we suggest you assume a comfortable position in relation to the foot pedal and other controls. You might consider placing your heel on the floor so that the ball of the foot contacts the pedal in a comfortable manner similar to operating the accelerator pedal of your car.

INSTRUCTIONS TO TESTED ENGINEMAN

WE WOULD LIKE TO THANK YOU FOR YOUR ASSISTANCE IN TESTING THE NEW ALERTOR AND SAFETY SYSTEM. WE SUGGEST THE FOLLOWING.

ASSUME A COMFORTABLE POSITION IN RELATION TO THE FOOT PEDAL AND OTHER CONTROLS.
WE MIGHT SUGGEST PLACING YOUR HEEL ON THE FLOOR SO THAT THE BALL OF THE FOOT CONTACTS THE PEDAL IN A COMFORTABLE MANNER SIMILIAR TO OPERATIONG THE ACCELERATOR PEDAL OF YOUR CAR.

OPERATION OF THE ALERTOR AND SAFETY SYSTEM IS SIMPLE AND DESIGNED TO BE UNINTRUSIVE ON YOUR JOB, AND IN SOME CASES MAY ACTUALLY ASSIST YOU.

AT THE END OF THIS TRIP, YOU MAY BE ASKED FOR YOUR SUBJECTIVE OPINION OF THE ALERTOR AND SAFETY SYSTEM.

HAVE A GOOD SAFE TRIP. THANK YOU

LETTER OF JUNE 28, 1987 OLW

APPENDIX B - RALES SIMULATOR OVERVIEW

Trainers set up operating conditions and monitor student performance from a remote operating console. This photo shows the RALES facility, a full-function locomotive simulator located at IITRI's Chicago headquarters.

The view from the cab includes forward, side and ballast views, all synchronized with the train's movement. In a survey of 53 engineers, 85% said that there were times they actually forgot they weren't operating the real thing.

This simulation puts you on track

The TS-3 full-function locomotive simulator couldn't be any more convincing. Students climb into an actual cab. As they start the run, synchronized projections show forward, side and ballast views. All appropriate track and engine sounds are heard. And the cab actually moves, duplicating the rock and roll, shock and vibrations of an actual train in motion.

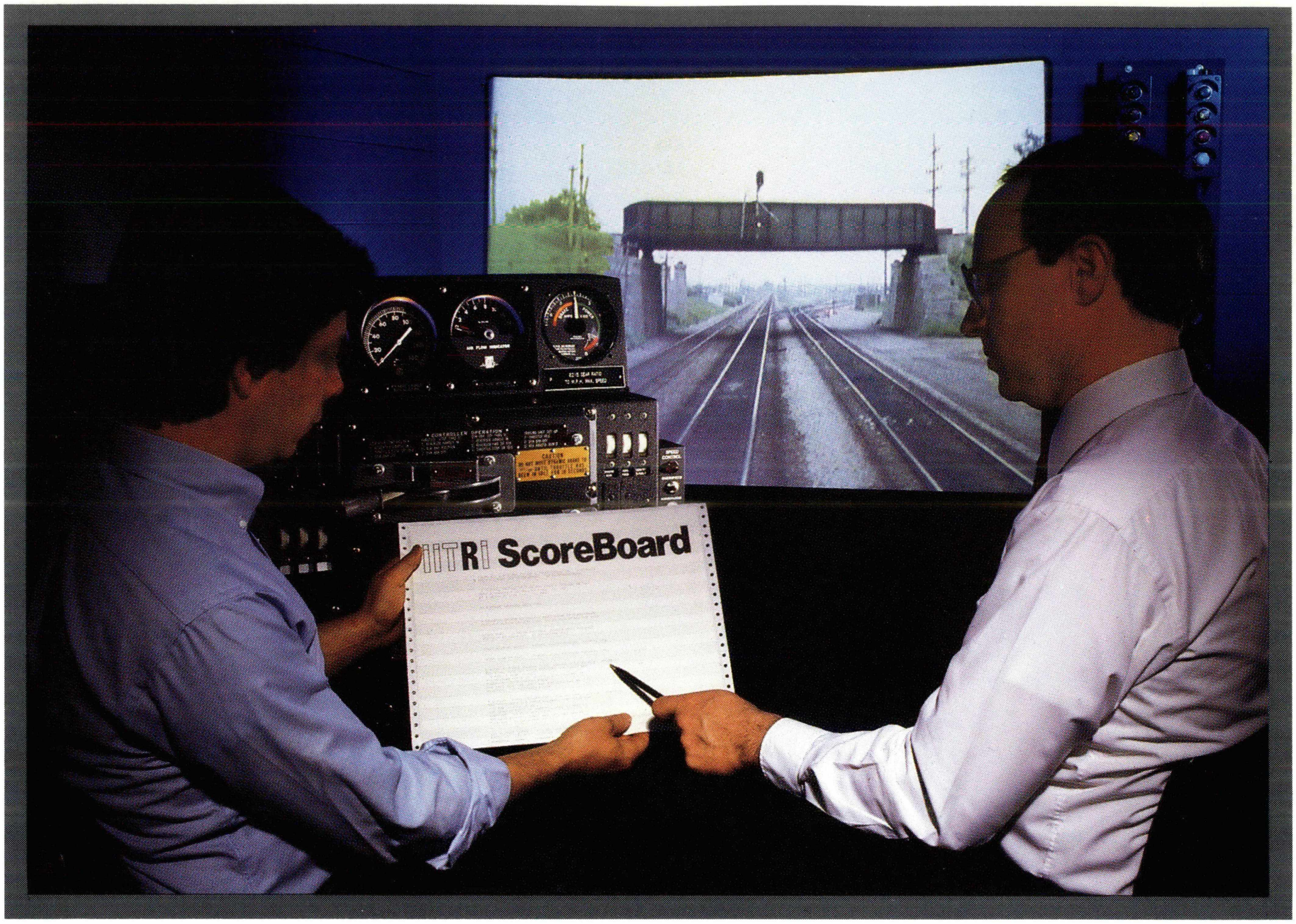
Like all IITRI Simulators, the TS-3 is easy to operate. Trainers simply "build a train" by punching in the consist and operating conditions of their choice. The rest is automatic, including a computerized evaluation, called ScoreBoard™, following each simulated run.

In addition to the TS-3, IITRI also offers complete engineer training courses, including both classroom and simulator instruction, at its Chicago facility. Or you can arrange for training time on RALES (Research and Locomotive Evaluator/Simulator), a full function simulator in Chicago which is available on a contract basis.

Both RALES and the TS-3 feature an actual locomotive cab mounted on a six-axis motion base.

iiTRi
SIMULATION
TRAINING

It's our business to help you train better engineers.



The Buff Stops Here.

With an IITRI locomotive simulator, your new engineers will perform like old hands... *before* they even leave the training center.

An IITRI simulator lets your students experience whatever consists, operating conditions and track profiles you want. After the run, IITRI's exclusive computerized evaluation system, ScoreBoard™, will rate their performance on factors such as rules compliance and train handling skills: whatever criteria you want.

Whatever your budget, IITRI has a simulator or training program to match it. Choose the TS-2 (a transportable, room-size unit) or the realistic TS-3 with cab motion. Or send trainees to IITRI's Chicago facility for a training program that can include classroom, simulator and even field instruction on operating equipment.

No matter how IITRI helps you train new engineers, you'll save fuel, increase safety and—in the long run—turn out better engineers. For more information write to the IIT Research Institute, Rail Simulation and Training Group, 10 West 35th Street, Chicago, Illinois 60616. Fax (312) 567-4608.

IITRI SIMULATION TRAINING

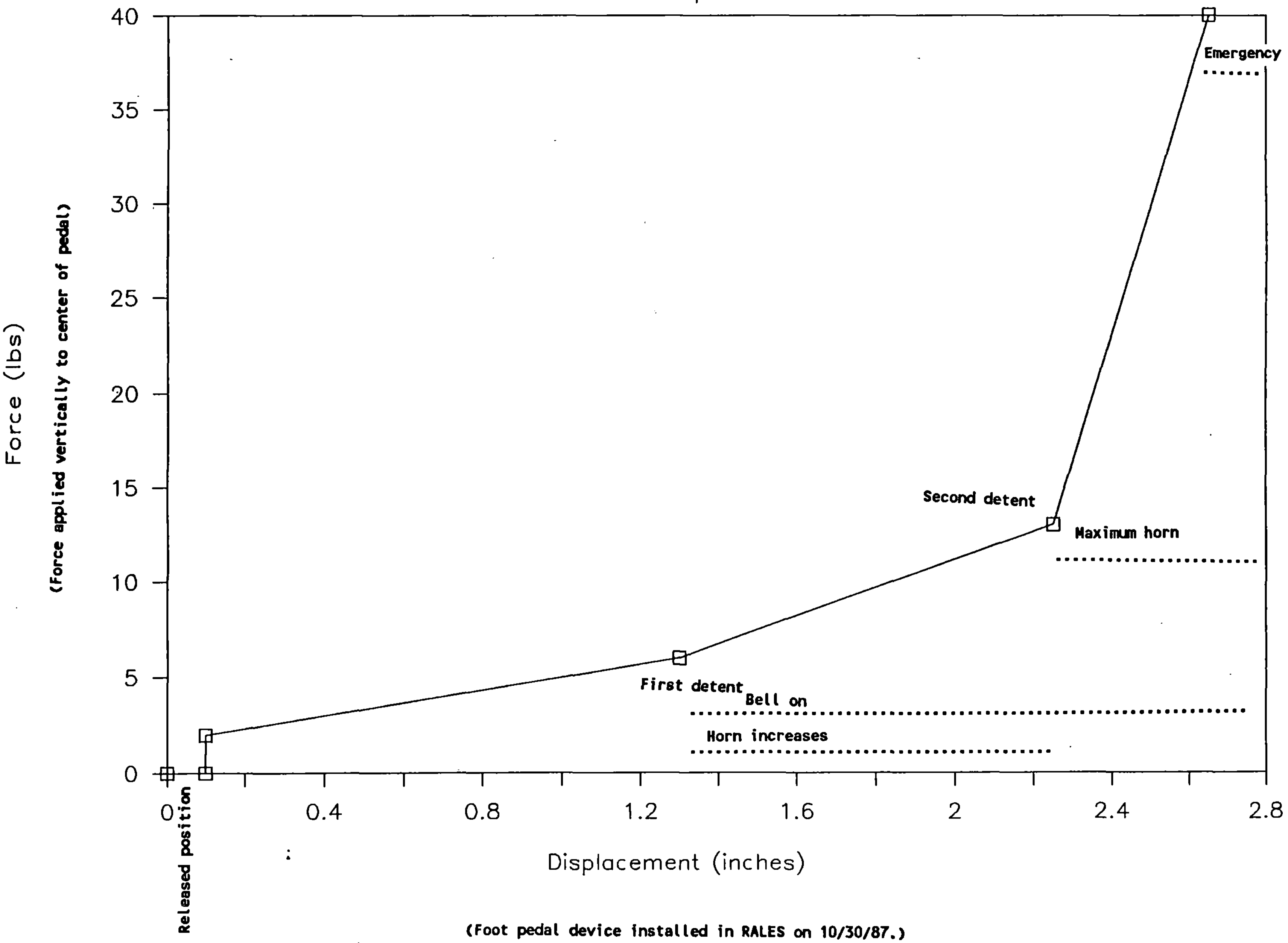
It's our business to help you train better engineers.

MEMBER RPI RAILWAY PROGRESS INSTITUTE

APPENDIX C - FOOT PEDAL DEVICE: FORCE VS DISPLACEMENT

Alerter Device Foot Pedal Actuation

Force vs. Displacement



(Foot pedal device installed in RALES on 10/30/87.)

APPENDIX D - ALERTING DEVICE FUNCTIONALITY CHECK

O.L. Williams
Rt. 11 Mt. Pleasant Rd. Box 482
Evansville, In. 47711

December 11, 1987

Mr. Laurence Rohter
IIT Research Institute
10 West 35th Street
Chicago, Illinois

Dear Laurence,
Here are some simple guidelines to confirm that the simulator action is coordinated with the foot pedal control position as we discussed earlier.

1. Depress foot pedal into first, or bell position, listen to make sure bell is ringing and pedal is locked.

2. Release bell position of pedal, bell should stop ringing and pedal should return itself to its off position.

3. Blow and modulate horn by depressing the foot pedal from its released position directly into the horn range. The action should be smooth and the horn blowing at its loudest permissible volume at or before the pedal travel reaches the heavy spring resistance representing the safety area befor the emergency brake notch is reached.

4. The heavy resistance representing the safety area should be entered by depressing the foot pedal with approximately 3½ times the force needed to blow the horn to maximum volume. The pedal should be depressed and released repeatedly and taken through the safety area intentionally to the verge of the emergency notch. Special note should be taken that the electronic switches of the simulator do not activate the emergency brake before the emergency brake position is reached by the foot pedal.

5. Sharply depress the foot pedal through the safety area and into the locked emergency position. Make sure the bell, horn, and emergency brake are locked in operation by the foot pedal.

6. Adjust the simulator if needed to insure that its control actions are coordinated with the foot pedal activity.

Although these procedures will not be needed when the actual pneumatic version is installed on a locomotive, they are being furnished to meet the needs of the simulator and equipment interaction, as per your request of December2, 1987 at IITRI.

Sincerely,
O.L. Williams
O.L. Williams

cc Gerold Thomas
cc Rick Stumpf

APPENDIX E - FAMILIARIZATION BRIEFING FORMAT (WITH RADIO CALL CHECKLIST)

ENGINEER DATA: Arrival Time_______ Date__________ Session #_______

Name:_________________ Subject #_______ Last Tie Up__________

Condition: REST: with without Rest Since___________

EQPT: with without TIME BACK TO SOO or U.S.________

INTRO FIRST TIME ONLY USER #2 = TIME OF DAY

You are here to help evaluate a new alerter system in your capacity as an operating engineer. To best conduct an unbiased study not all subjects will have the alerter installed. You will first get to familiarize yourself with the simulator on the beginning part of your run from Davis Junction eastward. Here is the consist make up, NOTE that there are two SD40-2's without dynamics

ALERTER INTRO: (Show Alerter Tape) - Ask if any questions about equipment?

START FAM RIDE and go up in cab. Emphasize that too great a pressure on the pedal will cause an unwanted emergency. After stop for MP 75 flag give OK to continue. Insure that foot pedal is being used if equipped. Call projectionist near yellow flag (MP68) and have projectionist insert screen to prepare for a stop and come to EOC to record briefing with SOUND LEVEL =60% After EMERG go to FREEZE and continue the briefing.

******** SEE BRIEFING PAGE*************

BRIEFING AT END OF FAM

START TAPE (State mans name & date) We need to make a time line check of your useing the bell, horn, & emergency. When I say the word "NOW" ,use each one.

NO ALERTER	or	IF USING ALERTER
Ring the bell NOW		Ring the bell NOW
Blow the horn NOW		Blow the horn NOW
Ring bell,blow horn & go to emercency NOW		Go to emergency NOW

SINCE the time this movie was made in August,1986, several important changes have occurred in the territory covered. The most visible is the move of the spring switch for Pingree Grove from MP 44.9 to the current MP41.9. Also, the possible signal aspects at Sig 37.2 are new from the time the films was made.

For the sake of experimental realism, we would prefer that you treated both situations as they were at the time the film was made.Pingree Grove is where it was. Sig37.2 when yellow/yellow indicates a clear ahead.

The quality of the signals as photographed is not super realistic. There are no dark or "trick" signals. Any signal other than green is CLEARY SHOWN ! Any signal you cannot interpret should be considered a green. For the purposes of this ~~this~~ film, variable speed control is achieved by the use of signs and warrants. STUDY THESE WARRENTS Please operate the train just as if you were out on the tracks, with the exception that you do not have a fireman,but the conductor is in the rear.

IF ALERTER EQUIPED: Please use the foot pedal as questions will be asked later When using the foot pedal to blow the horn, note the maximun horn loudness.For various reasons the horn will not be as loud as you may be used to. Note the maximun loudness of the hand operated horn versus when using the foot pedal. Practise finding the max horn position with the pedal and espically NOTE where the pedal puts it in emergency. We should be ready to start the run in about five minutes. Thanks for all your help, we appreciate you co-operation.

Checklist for Engineer X2006 East

**** before prelim run (FIRST DAY ONLY) REMOVE FOOT PEDAL if No Equip.

_ Train Consist - TAPE INTRO - Notes on Movie - Track Profile & Tell changes

- 2 page and 1 page handout on EQPT if apropos after tape show

**** before test run

_ Warrant "One" - Bulletins "101","340","401","517" - Consist - Profile

RUN ____ a   **** PAUSE VCR'S **** ** between a & b **   RUN ____ b

Begin________ End________   Begin________ End__________

Video Sw - Disable Cab Dsply - Prep VCR's - @CLEAN7100 - TH =0 - Ind Brk On

Snd =Hi - Enable Data Storage - DYC: 694KM - Q:3281, S:AL81 or NO81

Frz = 746050. - If Crash change AE 51 to 0 **** User 2 =Elapsed Time****

RADIO CALL CHECKLIST

MP 80 Form "Y" order No. 101

	Time clock	elapsed	FRC	Time clock	elapsed	FRC
called by engineer						
OK'd by Jackowiak						

MP 59 rollby "Genoa" (film) train crew both sides

	Time clock	elapsed	FRC	Time clock	elapsed	FRC
called by engineer						
Cond OK'd MP 57.7 = (plus train length)						

MP 51 rollby "HAMPSHIRE" (signal) maintainers at depot, both sides

	Time clock	elapsed	FRC	Time clock	elapsed	FRC
called by engineer						
Cond OK'd MP 49.7						

MP 40   Form "Y" order 401

	Time clock	elapsed	FRC	Time clock	elapsed	FRC
called by engineer	______	______	______	______	______	______
OK'd by Foley	______	______	______	______	______	______

MP 39.5 rollbye "Big Timber" track gang, both sides

	Time clock	elapsed	FRC	Time clock	elapsed	FRC
called by engineer	______	______	______	______	______	______
Cond OK'd MP 38.2	______	______	______	______	______	______

MP 33 rollbye "SPAULDING" switcher train crew(PATROL), both sides

	Time clock	elapsed	FRC	Time clock	elapsed	FRC
called by engineer	______	______	______	______	______	______
Cond OK'd MP 31.7	______	______	______	______	______	______

MP 22 entry to ending at Bensenville Yard

	Time clock	elapsed	FRC	Time clock	elapsed	FRC
called by engineer	______	______	______	______	______	______
OK'd by Yardmaster	______	______	______	______	______	______

MP 17 rollby   "BENSENVILLE YARD" trainmaster, right side

	Time clock	elapsed	FRC	Time clock	elapsed	FRC
called by engineer	______	______	______	______	______	______
Cond OK'd MP 15.9	______	______	______	______	______	______

LOG Coment -SAVECOM - RCARD - @MOVE2DA - POSTALRT - RNSUM10 - TAPE exit -Score

@DABACKUP (VVVVW#WXYZ) V=Setup,W=inital, #=1 or 2,X=R or U, Y=E or N, Z=1 or 2
Session   Run

------- Departing Checklist--

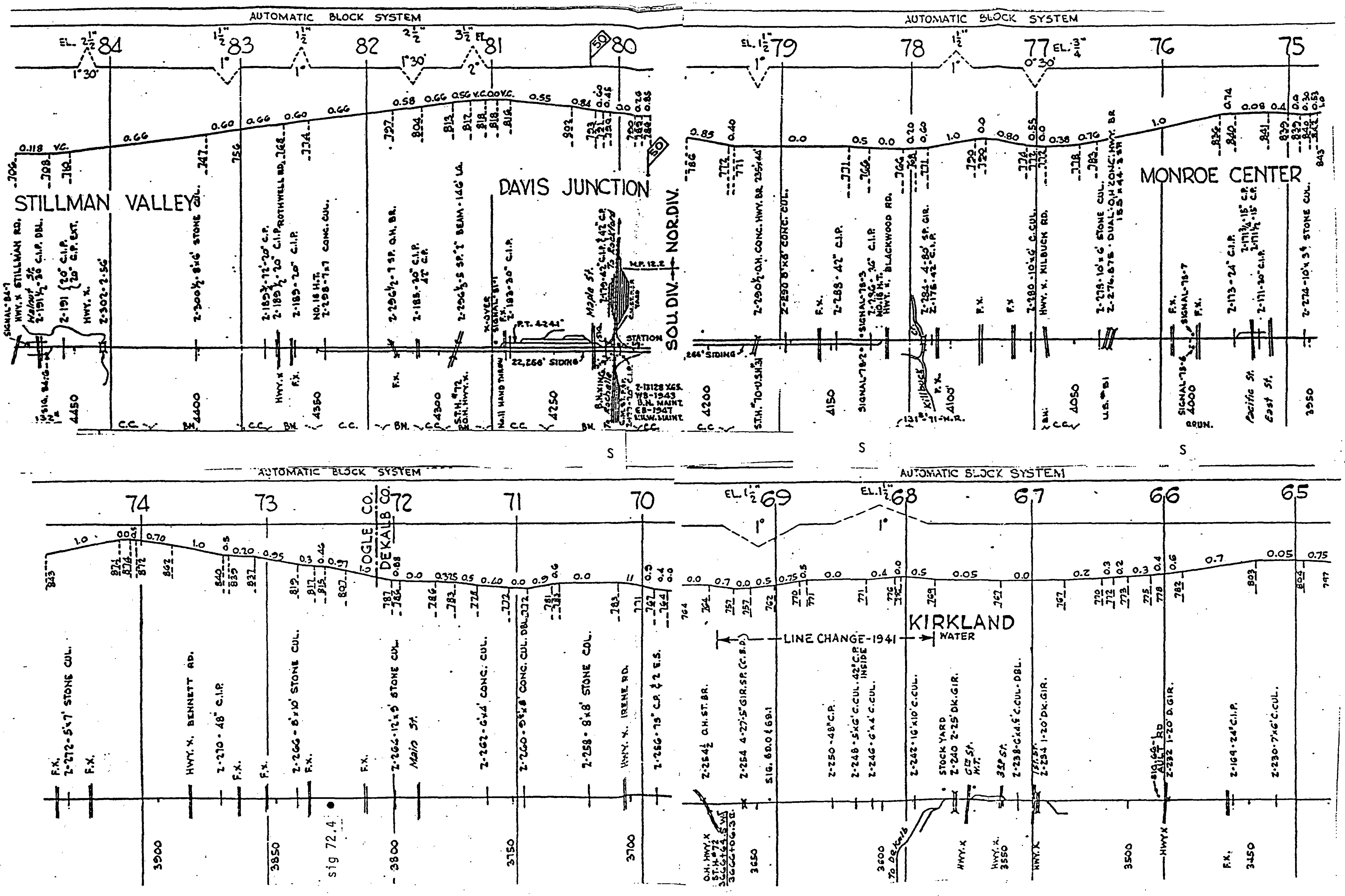
Debriefing on video tape   Hat   Limo

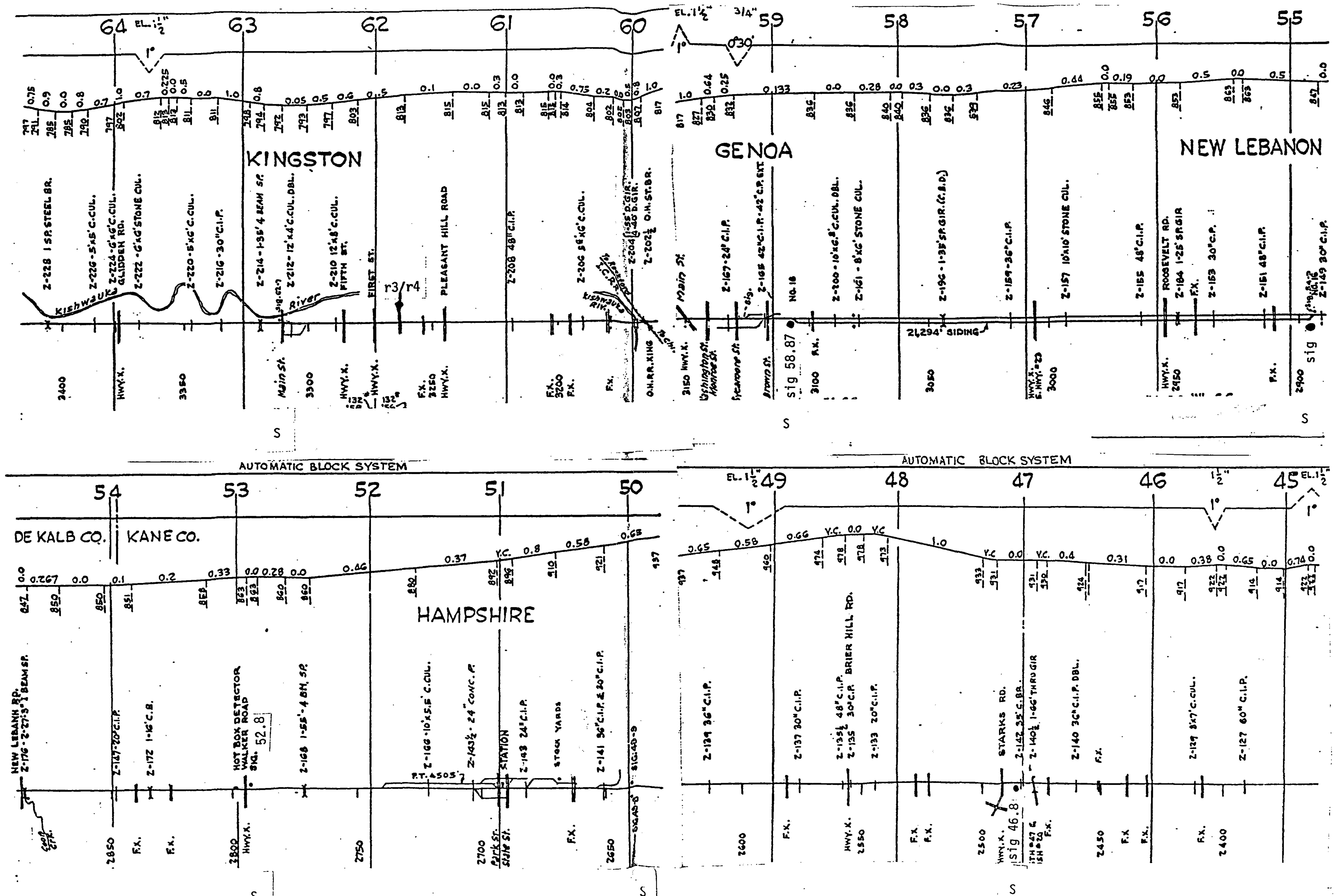
Send copy of your time sheet to Dennis Mogen

Second session will be: REST: with   without

Call Add Whattam, or Bob Foley 567-4709 for arangements

APPENDIX F - RALES 3200 TRACK CHARTS


AUTOMATIC BLOCK SYSTEM
84
83
82
81
80
STILLMAN VALLEY
DAVIS JUNCTION
SOU. DIV.
NOR. DIV.
22,266' SIDING
STATION
AUTOMATIC BLOCK SYSTEM
79
78
77
76
75
MONROE CENTER
AUTOMATIC BLOCK SYSTEM
74
73
72
71
70
OGLE CO.
DEKALB
sig 72.4
AUTOMATIC BLOCK SYSTEM
69
68
67
66
65
KIRKLAND
LINE CHANGE-1941
WATER


64
63
62
61
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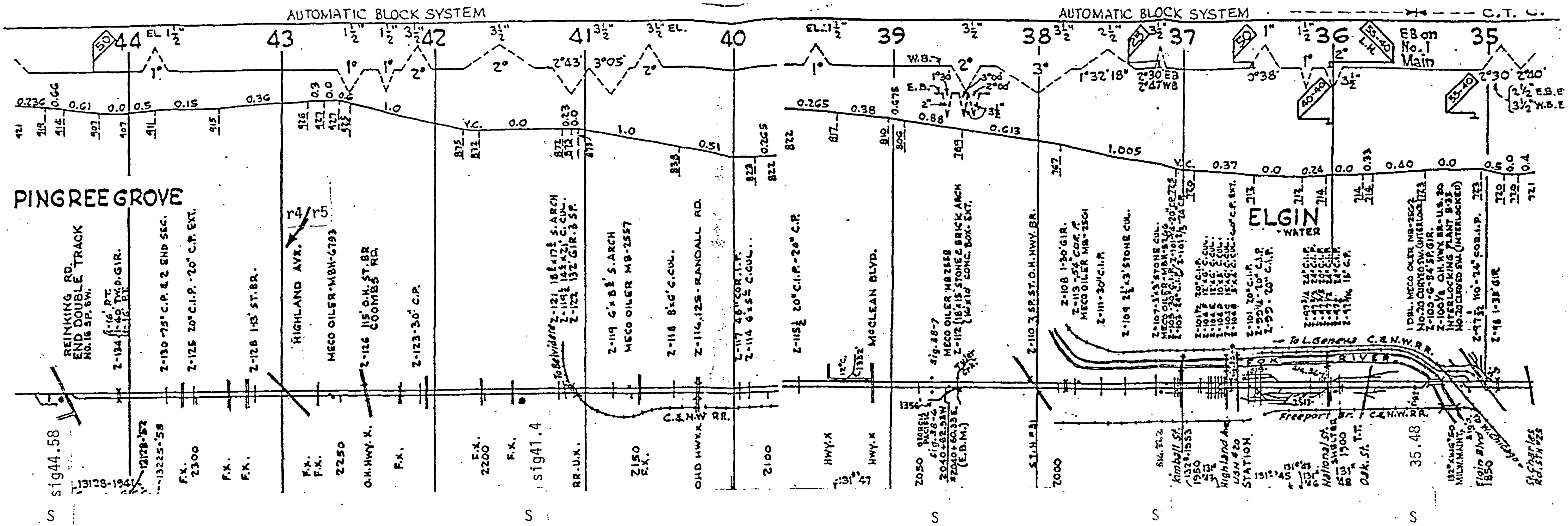
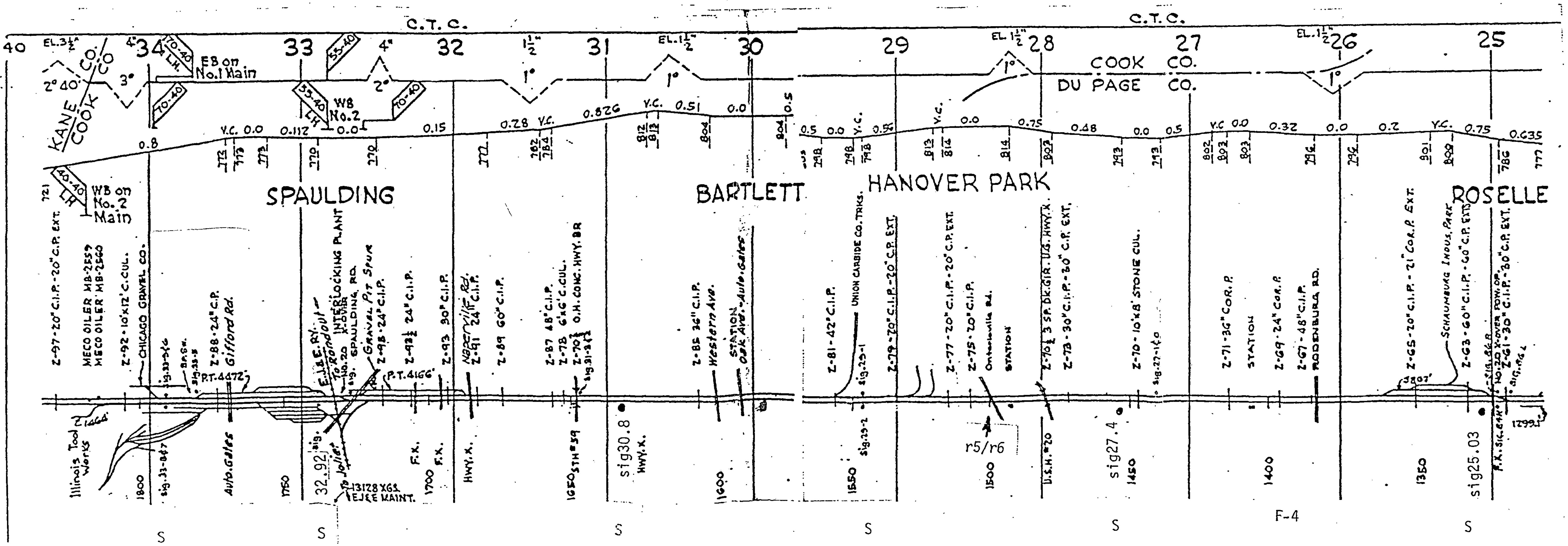
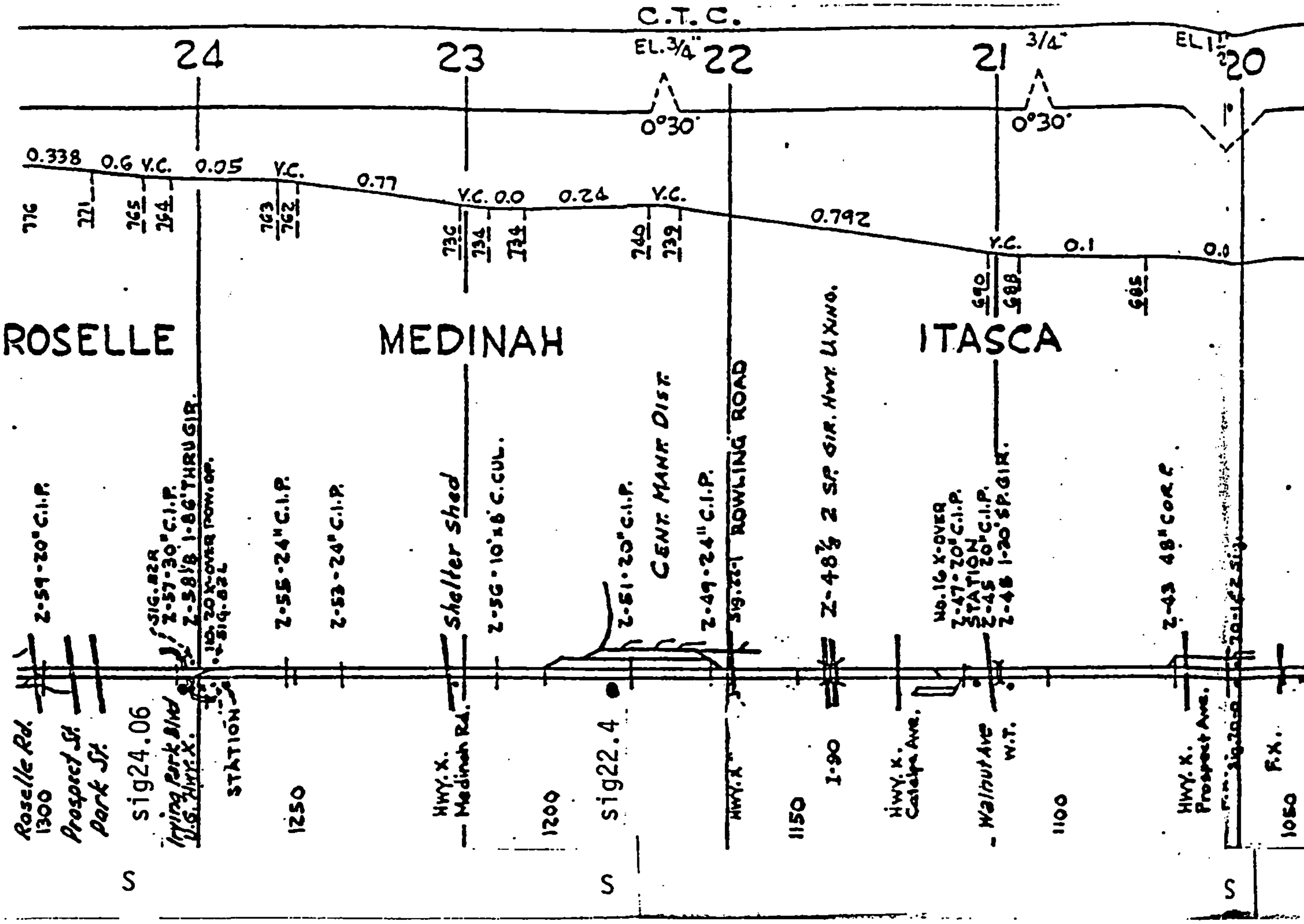
59
58
57
56
55
KINGSTON
GENOA
NEW LEBANON
Kishwaukee River
Z-228 1 SP. STEEL BR.
GLIDDEN RD.
PLEASANT HILL ROAD
FIRST ST.
FIFTH ST.
Main St.
r3/r4
sig 58.87
21,294' SIDING
ROOSEVELT RD.
sig
AUTOMATIC BLOCK SYSTEM
54
53
52
51
50
49
48
47
46
45
DE KALB CO.
KANE CO.
HAMPSHIRE
NEW LEBANON RD.
HOT BOX DETECTOR
WALKER ROAD
SIG. 52.8
STATION
STOCK YARDS
BRIER HILL RD.
STARKS RD.
sig 46.8
S


AUTOMATIC BLOCK SYSTEM
AUTOMATIC BLOCK SYSTEM
C.T.C.
44
43
42
41
40
39
38
37
36
35
EB on No.1 Main
PINGREE GROVE
REINKING RD.
END DOUBLE TRACK
HIGHLAND AVE.
MECO OILER MBH-6793
MECO OILER MB-2557
RANDALL RD.
McCLEAN BLVD.
ELGIN
WATER
FOX RIVER
To L.Geneva C.&N.W.RR.
Freeport Br. C.&N.W.RR.
C.&N.W. RR.
STATION
sig44.58
sig41.4
35.48
r4/r5
S
S
S
S
S


C.T.C.
C.T.C.
34
33
32
31
30
29
28
27
26
25
KANE CO.
COOK CO.
EB on No.1 Main
WB No.2
WB on No.2 Main
SPAULDING
BARTLETT
HANOVER PARK
ROSELLE
COOK CO.
DU PAGE CO.
CHICAGO GRAVEL CO.
INTERLOCKING PLANT
Illinois Tool Works
UNION CARBIDE CO. TRKS.
RODENBURG RD.
STATION
sig30.8
sig27.4
sig25.03
32.92
r5/r6
S
S
S
S
S
S



C.T.C.
24
23
22
21
20
EL.3/4"
3/4"
0°30'
0°30'
1°
0.338
0.6 V.C.
0.05
V.C.
0.77
V.C. 0.0
0.24
V.C.
0.792
V.C.
0.1
0.0
ROSELLE
MEDINAH
ITASCA
Z-59-20" C.I.P.
Z-57-30" C.I.P.
Z-55-24" C.I.P.
Z-53-24" C.I.P.
Shelter Shed
Z-56-10'x6' C.CUL.
Z-51-20" C.I.P.
CENT. MANF. DIST.
Z-49-24" C.I.P.
ROWLING ROAD
Z-48⅞ 2 SP. GIR. Hwy. U.XNG.
STATION
Z-43 48" COR. P.
Rosselle Rd.
1300
Prospect St.
Park St.
sig24.06
Irving Park Blvd
STATION
1250
HWY. X.
Medinah Rd.
1200
sig22.4
HWY. X.
1150
I-90
HWY. X.
Catalpa Ave.
Walnut Ave
W.T.
1100
HWY. X.
Prospect Ave.
F.X.
1050
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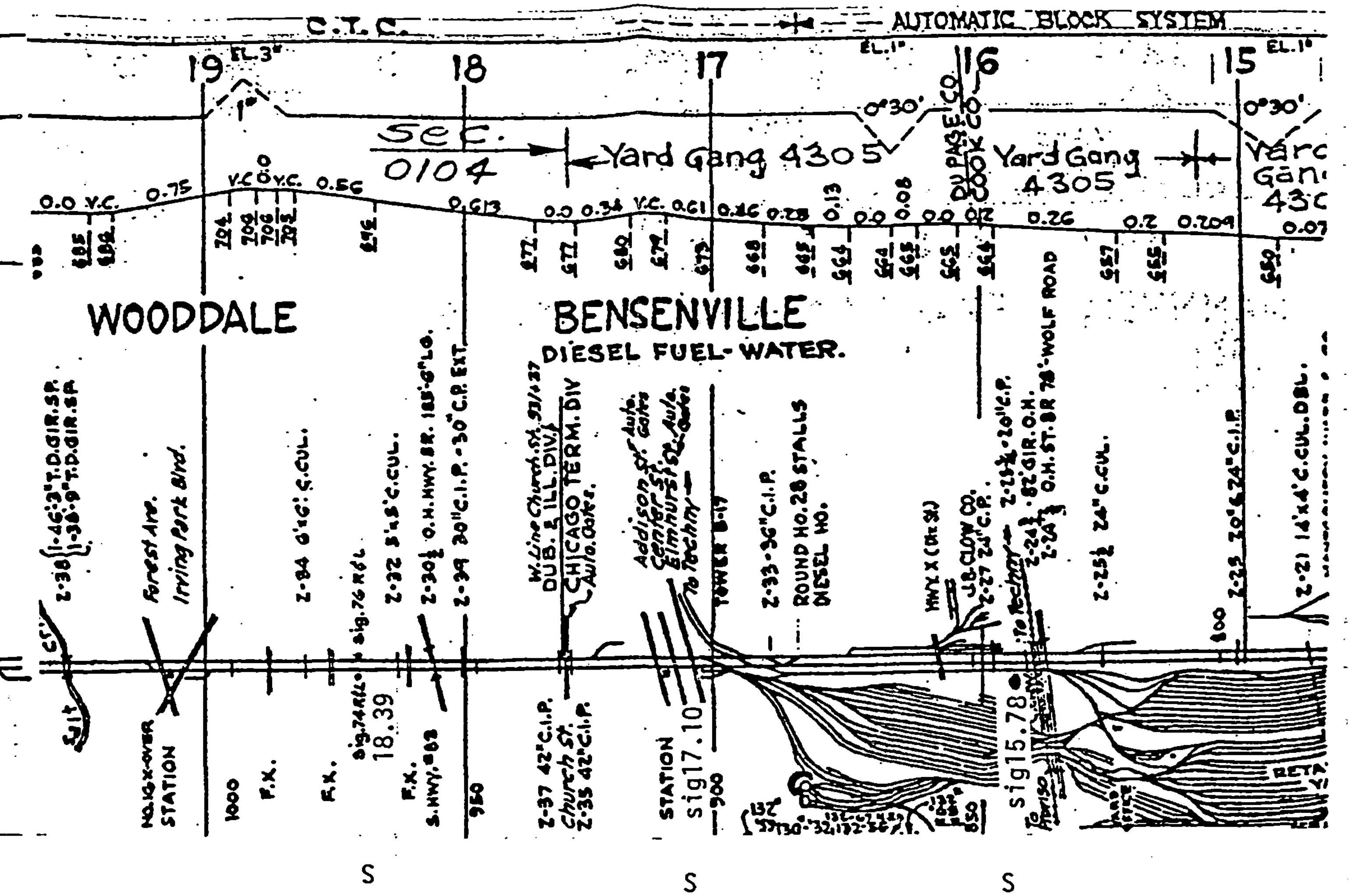

C.T.C.
AUTOMATIC BLOCK SYSTEM
19
18
17
16
15
Sec. 0104
Yard Gang 4305
Yard Gang 4305
DU PAGE CO.
COOK CO.
WOODDALE
BENSENVILLE
DIESEL FUEL-WATER.
CHICAGO TERM. DIV
ROUND HO. 28 STALLS
DIESEL HO.
TOWER B-17
WOLF ROAD
J.B. CLOW CO.
STATION
NO.10 X-OVER
sig 18.39
sig17.10
sig15.78
S
S
S

APPENDIX G - CLEARANCE AND TRAIN ORDERS

SOO

TRACK WARRANT

NO. one TODAY 19__

TO: C&E 2006 East AT: Bensenville

1. ☐ TRACK WARRANT NO.________IS VOID.
2. ☒ PROCEED FROM Davis Jct TO Pingree Grove ON MAIN TRACK.
3. ☒ PROCEED FROM Pingree Grove TO Bensenville ON #2 TRACK.
4. ☐ WORK BETWEEN________AND________ON________TRACK.
5. ☐ NOT IN EFFECT UNTIL________M.
6. ☐ THIS AUTHORITY EXPIRES AT________M.
7. ☐ NOT IN EFFECT UNTIL AFTER ARRIVAL OF________
   AT________.
8. ☐ HOLD MAIN TRACK AT LAST NAMED POINT.
9. ☐ DO NOT FOUL LIMITS AHEAD OF________.
10. ☐ CLEAR MAIN TRACK AT LAST NAMED POINT.
11. ☐ BETWEEN________AND________MAKE ALL MOVEMENTS AT RESTRICTED SPEED LIMITS OCCUPIED BY________.
12. ☐ DO NOT EXCEED____MPH BETWEEN________AND
    ________.
13. ☐ DO NOT EXCEED____MPH BETWEEN________AND
    ________.
14. ☐ PROTECTION AS PRESCRIBED BY RULE 99 NOT REQUIRED.
15. ☒ TRACK BULLETINS IN EFFECT 101, 340, 401, 517, ____, ____, ____,
    ____, ____, ____, ____, ____, ____, ____, ____, ____, ____, ____,
16. ☐ OTHER SPECIFIC INSTRUCTIONS:________
    ____
    ____

OK early am M DISPATCHER ROHTER

RELAYED TO________ COPIED BY________

LIMITS REPORTED CLEAR AT____M BY________

(Mark "X" in box for each item instructed.)

FORM 1214

FORM "Y"
TRAIN ORDER NUMBER '101'
STATION 'SAVANNA'   DATE 'TODAY'
TO 'EASTWARD TRAINS'

MEN AND EQUIPMENT ON 'MAIN' TRACK
BETWEEN 'MP75.2' AND 'MP74.8'
BETWEEN '   ' AND '   '
FROM   '0700A'M UNTIL '1159P'M

ALL TRAINS ON THIS TRACK PROCEED THROUGH THESE LIMITS AT RESTRICTED SPEED UNLESS A DIFFERENT SPEED IS VERBAL AUTHORIZED BY EMPLOYE IN CHARGE OR ENTIRE TRAIN HAS PASSED A GREEN FLAG
FOREMAN 'JACKOWIAK' IN CHARGE OF THIS ORDER

MADE COMPLETE TIME 'EARLY A'M   'JAW' OPERATOR

TRAIN ORDER FORM

TRAIN ORDER NUMBER '340'
STATION 'SAVANNA'   DATE 'TODAY'
TO 'C&E EXTRA 2006 EAST'

TEMPORARY SLOW ORDER

MP 67 TO MP 66

FLAGS DISPLAYED EASTBOUND

DO NOT EXCEED 45 MPH

MADE COMPLETE TIME 'EARLY A'M   'JAW'OPERATOR

FORM "Y"
TRAIN ORDER NUMBER '401'
STATION 'SAVANNA'   DATE 'TODAY'
TO 'EASTWARD TRAINS'

MEN AND EQUIPMENT ON 'MAIN' TRACK
BETWEEN 'MP38.2' AND 'MP37.8'
BETWEEN '   ' AND '   '
FROM   '0700A'M UNTIL '1059P'M

ALL TRAINS ON THIS TRACK PROCEED THROUGH THESE LIMITS AT RESTRICTED SPEED UNLESS A DIFFERENT SPEED IS VERBAL AUTHORIZED BY EMPLOYE IN CHARGE OR ENTIRE TRAIN HAS PASSED A GREEN FLAG
FOREMAN 'FOLEY' IN CHARGE OF THIS ORDER

MADE COMPLETE TIME 'EARLY A'M   'JAW' OPERATOR

TRAIN ORDER FORM

TRAIN ORDER NUMBER '517'
STATION 'SAVANNA'   DATE 'TODAY'
TO 'C&E EXTRA 2006 EAST'

TEMPORARY SLOW ORDER

MP17

FLAGS DISPLAYED EASTBOUND

DO NOT EXCEED 45 MPH

MADE COMPLETE TIME 'EARLY A'M   'JAW'OPERATOR

APPENDIX H - TRAIN CONFIGURATION FILE REPORT

APPENDIX H -

TRAIN CONFIGURATION FILE REPORT

DATE: 12-APR-89 PAGE: 1

TRAIN ID 692KM DESCRIPTION ALA 695KM EXCEPT 2 LOCOS FOR ALERTER TES
DATE OF RECORD CREATION 06-NOV-87
DATE OF LAST MAINTENANCE 09-NOV-87
REMOTE CONSIST SPECIFICATION 0 0=LEAD ONLY, 1=LOCOTROL, 2=HELPER
CONSIST SIZES: LEAD 2 REMOTE 0 ---LEAD (1 -> 10)--- REMOTE(1 -> 5)
1 2 3 4 5 6 7 8 9 10 1 2 3 4 5
DYNAMIC BRAKING (0=OFF, 1=ON): 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
ALERTER SYSTEM 0 0=INACTIVE, 1=ACTIVE
CCS/SCS SIGNAL SYSTEM 1 0=INACTIVE,1=SIG ONLY, 2=SIG+SPEED CONTROL
TRAIN LINE PRESSURE 80. 0. -> 110. PSI
BRAKE PIPE LEAKAGE RATE 4.0 0.0 -> 10.0 PSI/MINUTE
SPEED LIMIT DUE TO EQUIPMENT 50. 10. -> 120. MILES PER HOUR
AVERAGE COUPLER STATE 2 0=BUFF, 1=SLACK, 2=DRAFT

POSITION OF REMOTE CONSIST 0 TOTAL NUMBER OF VEHICLES 114

POS	VEHICLE	WEIGHT	POS	VEHICLE	WEIGHT	POS	VEHICLE	WEIGHT	POS	VEHICLE	WEIGHT
001	D402-1C	400000	002	D402-1C	400000	003	A432-03	70000	004	A432-03	70000
005	A432-03	74000	006	E500-01	206000	007	E500-01	206000	008	E500-01	206000
009	E500-01	208000	010	E500-01	208000	011	E500-01	214000	012	E500-01	66000
013	C113-01	242000	014	B314-01	60000	015	B314-01	58000	016	B314-01	60000
017	E500-01	214000	018	E500-01	208000	019	E500-01	214000	020	E500-01	206000
021	E500-01	208000	022	E500-01	208000	023	E500-01	206000	024	E500-01	208000
025	E500-01	214000	026	E500-01	208000	027	C113-01	244000	028	C113-01	244000
029	E500-01	190000	030	E500-01	188000	031	B314-01	62000	032	B314-01	62000
033	B314-01	62000	034	C113-01	242000	035	A402-01	80000	036	B314-01	62000
037	A230-01	70000	038	A406-01	76000	039	B314-01	62000	040	B314-01	60000
041	B314-01	62000	042	B314-01	60000	043	B314-01	60000	044	B417-01	80000
045	B314-01	66000	046	B314-01	60000	047	T105-01	70000	048	B304-01	66000
049	B314-01	56000	050	A230-01	68000	051	A230-01	68000	052	T105-01	60000
053	B314-01	58000	054	B424-04	64000	055	B314-01	60000	056	B314-01	58000
057	A406-01	72000	058	F353-01	84000	059	F353-01	84000	060	B314-01	58000
061	F353-01	84000	062	T564-01	82000	063	C113-01	70000	064	B434-01	66000
065	B424-04	74000	066	G613-04	78000	067	B314-01	58000	068	B424-04	68000
069	A230-01	66000	070	A230-01	66000	071	B434-01	62000	072	F342-01	58000
073	B424-04	68000	074	C113-01	60000	075	B314-01	58000	076	B314-01	60000
077	A432-01	74000	078	A432-01	82000	079	B424-04	76000	080	A406-01	70000
081	B314-01	60000	082	B314-01	58000	083	E500-01	204000	084	E500-01	208000
085	B314-01	56000	086	B314-01	56000	087	B417-01	70000	088	A406-01	72000
089	A406-01	72000	090	B417-01	70000	091	B414-01	64000	092	C113-01	62000
093	B314-01	60000	094	B314-01	58000	095	T105-01	104000	096	E500-01	208000
097	E500-01	210000	098	B314-01	60000	099	E500-01	208000	100	B417-01	74000
101	E500-01	206000	102	A302-01	72000	103	A406-01	76000	104	B417-01	70000
105	A302-01	74000	106	A406-01	76000	107	B424-04	74000	108	B314-01	58000
109	B314-01	60000	110	E500-01	208000	111	E500-01	66000	112	E500-01	210000
113	E500-01	208000	114	N100-01	54000						

VEHICLE CODE: D402-1C DESC: EMD SD40-2 3000HP 645E DIESEL, IPS, STD RNG.,FLAT CONTROL
001 002

VEHICLE CODE: A432-03 DESC: IC 11389 ,CUSHIONED BOX ,70 TON JAW
003 004 005

VEHICLE CODE: E500-01 DESC: BN 586897 WOOD CHIP CAPACITY 95TON LER
006 007 008 009 010 011 012 017 018 019
020 021 022 023 024 025 026 029 030 083
084 096 097 099 101 110 111 112 113

VEHICLE CODE: C113-01 DESC: ICG 764543 ,COVERED HOPPER, 100 TON, JAW REV LER
013 027 028 034 063 074 092

VEHICLE CODE: B314-01 DESC: BM 300963 (Boston & Maine)BOX, 77 TON REV.LER CRE.JAW
014 015 016 031 032 033 036 039 040 041
042 043 045 046 049 053 055 056 060 067
075 076 081 082 085 086 093 094 098 108
109

VEHICLE CODE: A402-01 DESC: BM 80012,(Boston & Maine)CUSHIONED BOX ,95 TON JAW
035

VEHICLE CODE: A230-01 DESC: AMADOR CENTRAL RR 2017 '80 CLCL P.104 70 TON BOX REV LER
037 050 051 069 070

VEHICLE CODE: A406-01 DESC: BN 376505 CUSHIONED BOX, 92 TON JAW REV LER (MIN.WGTH)
038 057 080 088 089 103 106

VEHICLE CODE: B417-01 DESC: ICG 531837,CUSHIONED BOX,77 TON JAW
044 087 090 100 104

VEHICLE CODE: T105-01 DESC: DOT 111A100W1 20,000 GAL TANK (GENL SERVICE) CLCL P.212
047 052 095

VEHICLE CODE: B304-01 DESC: CNIS 417022 "B3" 97 TON CAP LER
048

VEHICLE CODE: B424-04 DESC: CNW 152040 ,CUSHIONED BOX, 75 TON, CRE.JAW REV.LER
054 065 068 073 079 107

VEHICLE CODE: F353-01 DESC: TTPX 81088(Trailer Train Co.), FLAT, 88 TON, 73'-4" JAW
058 059 061

VEHICLE CODE: T564-01 DESC: HCPX 1231 "TS" 90TON CAP LER
062

VEHICLE CODE: B434-01 DESC: SM 2126 (Saint Mary's RR) BOX ,75 TON, JAW REV LER
064 071

VEHICLE CODE: G613-04 DESC: CBQ 197259 "G6" 70 TON CAP LER
066

VEHICLE CODE: F342-01 DESC: BCOL 1130 "FB5" 81TON CAP LER
072

VEHICLE CODE: A432-01 DESC: UP 509114, CUSHIONED BOX ,70 TON REV.LER(LENGTH) JAW
077 078

VEHICLE CODE: B414-01 DESC: CCR 6307(Cornith & Counce),BOX, 77 TON JAW
091

VEHICLE CODE: A302-01 DESC: MPA 31045,(Maryland & Penn.)BOX,77 TON JAW
102 105

VEHICLE CODE: N100-01 DESC: CABOOSE C3925 '80 CLCL P.290 (Weight cap. upped for ICG.)JAW
114

THERE ARE 0 AXLES UNDER DYNAMIC BRAKING

GROSS TONNAGE	6393.0 TONS
POWERED TONNAGE	400.0 TONS
TRAILING TONNAGE	5993.0 TONS
BRAKE LOAD	7.0 TONS/OPERATIVE BRAKE
TRAIN LENGTH	6799.8 FEET
EMPTY CARS	55
LOADED CARS	59

APPENDIX I - SIMULATOR PROCEDURAL CHECKLIST

Preparation before each run:

Install equipment to be tested, if required

a) give out prepared handout on equipment to be tested

b) show prepared tape describing use of new equipment

c) give operational demonstration on simulator

Disable projectors

No data acquisition

Q/6055 S/1870 (zero speed)

d) make direct comparison of the time needed to activate time controls:

	conventional	equipment test
bell	________	________
whistle	________	________
emergency	________	________

e) answer questions

Remove equipment to be tested if not required

Configure for video recording

Initialize video tape with pictured and audible slate

Turn off cab displays

Provide Advanced Display to Experiment Operator's Console

Give engineman clearance and train orders

Check to see that cab controls are initialized: TH=6, brakes off

Set sound level to CPU

Start computers:

Clean Data Disk: @CLEAN7100

SET Dynamics Controller (DYC)

Loco: SD40.DAT

Eng Eval: 694KM.DAT

SETUP:

Enable both projectors

Give frame number and reel number for projector 1

Give frame number and reel number for projector 2

Enable Data Acquisition Controller storage

Give QUEUE(6055)

Give SETUP(6055) without test equipment

(3261) with test equipment

BEFORE RUN:

Log engineer, operator, projectionist name and other slated data

Bring up Advanced Display: Track and Stream 77

Enable Alternate Event of "no head on crash" if appropriate

During Test Run

Start video tape and insure end-to-end coverage

Mount new reels as required

	PROJ (1 or 2)	Reel from	Switchover FRC	Reel to
mounted		3	502253	4
mounted		4	601749	5
mounted		5	676751	6
mounted		6		5 if no head on crash

EOT operator acting as track foreman correctly responds as required and makes logged comment of time for the following:

Flag set	After MP No.	Order No.	yellow/red MP	red & green MP
1	80	101	77	75
2	40	401	40	38

EOT operator acting as conductor correctly responds as required and makes logged comment of time for the following:

Roll by inspections:

MP 59 "Genoa" (film) train crew both sides

MP 51 "Hampshire" (signal) maintainers at depot, both sides

MP 39 "Big Timber" track gang, both sides

MP 33 "Spaulding" switcher train crew, both sides

MP 17 "Bensenville Yard" trainmaster, right side

Overload section: MP 40 until MP 35

Dispatcher Spaulding Patrol and Tower B17 (CTC operator) all coordinate location of 2006 East.

Dispatcher:	Chicago Dispatcher calling X2006
2006:	Here
Disp:	Please contact Tower B17
2006:	Tower B17 we're at
B17:	Let me contact Spaulding Patrol for location
Spaulding Patrol:	Calling X2006
2006:	Here
Spaulding:	What's your location?

Engineer initiated calls

EOT operator acting as Tower B17 (entrance to Bensenville Yard) or yardmaster correctly gives engineer instructions for entering yard on Lunar at C&NW bridge and makes logged comment.

After each run:

Freeze simulator

Log final comments

Save commons

Save all data

Generate ATP84 RCARD

Move all necessary data to Data disk and rename

Rename extension to engineer's unique initials

Generate RNSUM at 10sec (20tick) rate

Store all acquired data on tape

use @DABACKUP

in VVVVWWWXYZ where VVVV is the SETUPvvvv code (6055 or 3261)

WWW is the engineer's unique initials

X is the order of test (1 or 2)

Y is rested or unrested (R or U)

Z is equipped or not (E or N)

Exit Interview: If equipment to be tested is installed: fill out questionnaire.

Arrange for transportation for engineer back to Bensenville Yard or home.

Action Items:

Finalize test subject calling procedures with Soo Line.

Finalize necessary data collection and experimental software distinguishing use of foot/hand controls, first stage and second stage alerter results.

Obtain approval of the IIT Research Institute Human Experimentation Committee.

Calibration of Food Pedal Tension.

APPENDIX J - RALES RCARD SCORING SYNOPSIS

APPENDIX J - RALES RCARD SCORING SYNOPSIS

The grading system is divided into four areas: Brakes, Throttle, Train Forces, and Crossings. Each area is further divided into weighted portions. Each weighted portion is a fixed deduction based on the seriousness of the error and the number of times the error occurs. Each error that is penalized is described below.

A. Brakes. This area has a relative value of 30% of the engineer's grade. The total score for this area is found by multiplying the total deductions by 0.18 and subtracting the product from 30 points.

1. Each occurence of an emergency application of the air brakes.
2. Each occurence of a penalty application of the brakes.
3. Each failure to use a split service reduction when braking.
4. Each time that more than 2 PSI reduction is taken while moving at a speed of 11 MPH or higher.
5. Each occurence of cycle braking on a single application.
6. Each occurence of power braking for a single application.
7. Each occurence of a heavy reduction during a single application.
8. Each occurence of a running release from a brake application.
9. Each occurence where the brake pipe pressure falls below 55 PSI.
10. Each use of the air brakes prior to a use of dynamic braking.

B. Throttle. This area has a relative value of 30% of the engineer's grade. The total score for this area is found by multiplying the total deductions by 0.15 and subtracting the product from 30 points.

1. Each occurence of a rapid movement of the throttle through two or more throttle positions.
2. Each track speed violation of more than 5 MPH.
3. Each track speed violation (including violations of more than 5 MPH).
4. Each train speed violation of more than 5 MPH.
5. Each train speed violation (including those more than 5 MPH).
6. Each time the ammeter exceeds +1075 amps.
7. Each time the ammeter exceeds -700 amps.
8. Each occurence of wheel slip.
9. Each minute that the run time exceeds 1:50:00.

C. Train Forces. This area has a relative value of 30% of the engineer's grade. The total score for this area is found by multiplying the total deductions by 0.40 and subtracting the product from 30 points.

1. Each time that draft forces exceed 200,000 pounds.
2. Each time that draft forces exceed 300,000 pounds.
3. Each time that buff forces exceed -100,000 pounds.
4. Each time that buff forces exceed -200,000 pounds.
5. Each time that run out forces exceed 100,000 pounds.
6. Each time that run out forces exceed 200,000 pounds.
7. Each time that run in forces exceed -100,000 pounds.
8. Each time that run in forces exceed -200,000 pounds.

D. Crossings. This area has a relative value of 10% of the engineer's grade. The total score for this area is found by multiplying the total number of failures to signal at crossings by 0.10 and subtracting the product from 10 points.

APPENDIX K - RALES RCARD GRADE FORMS (BY TEST SUBJECT)

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: ______________________ RAILROAD: ______________

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8				
2. Penalty Application -5				
3. No Split Service Red. -2				
4. Overspeed Braking -1				
5. Cycle Braking -1				
6. Power Braking -2				
7. Heavy Reduction -2				
8. Running Release -1				
9. Brake Pipe <55 PSI -3				
10. Air Before Dynamic -1				
30 - (Total Deductions x 0.18) =				
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1				
2. Track Speed >5 MPH -5				
3. Track Speed Violation -2				
4. Train Speed >5 MPH -5				
5. Train Speed Violation -2				
6. Ammeter Exceeds +1075 -2				
7. Ammeter Exceeds -700 -2				
8. Wheel Slip Occurance -1				
9. Run Time/Min >1:50 -1				
30 - (Total Deductions x 0.15) =				
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1				
2. Draft Forces >300 KLB -3				
3. Buff Forces >100 KLB -1				
4. Buff Forces >200 KLB -3				
5. Run Out Over 100 KLBS -1				
6. Run Out Over 200 KLBS -3				
7. Run In Over -100 KLBS -1				
8. Run In Over -200 KLBS -3				
30 - (Total Deductions x 0.40) =				
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1				
10 - (Total Deductions x 0.10) =				
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.				

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: ______________

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: 1 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-18	-16	-16	-8
4. Overspeed Braking -1	-8	-16	-10	-7
5. Cycle Braking -1	0	0	0	-1
6. Power Braking -2	-10	-14	-12	-10
7. Heavy Reduction -2	-8	-4	-4	-2
8. Running Release -1	-1	0	0	0
9. Brake Pipe <55 PSI -3	-9	0	0	-3
10. Air Before Dynamic -1	-7	-5	-4	-4
30 - (Total Deductions x 0.18) =	19.02	20.10	21.72	23.70
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-20	-13	-17	-18
2. Track Speed >5 MPH -5	0	-15	-15	-15
3. Track Speed Violation -2	-10	-12	-18	-22
4. Train Speed >5 MPH -5	0	-5	-10	0
5. Train Speed Violation -2	-4	-4	-8	-10
6. Ammeter Exceeds +1075 -2	0	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	0	0
9. Run Time/Min >1:50 -1	0	0	0	0
30 - (Total Deductions x 0.15) =	24.90	22.65	19.80	20.25
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	-1
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-2	-3	-2	0
6. Run Out Over 200 KLBS -3	-3	0	0	0
7. Run In Over -100 KLBS -1	-6	-5	-5	-3
8. Run In Over -200 KLBS -3	-3	0	0	0
30 - (Total Deductions x 0.40) =	24.40	26.80	27.20	28.40
D. CROSSINGS (10 POINTS MAX) 1. Fail To Signal (Each) -1	-13	-21	-29	-18
10 - (Total Deductions x 0.10) =	8.70	7.90	7.10	8.20
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	77.02	77.45	75.82	80.55

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 77.71

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: 2 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-14	-8	0	-2
4. Overspeed Braking -1	-18	-9	-9	-3
5. Cycle Braking -1	0	-1	0	0
6. Power Braking -2	0	-2	0	-4
7. Heavy Reduction -2	-6	-6	-2	-4
8. Running Release -1	-1	0	-1	-1
9. Brake Pipe <55 PSI -3	-3	-3	0	0
10. Air Before Dynamic -1	-8	-7	-3	-3
30 - (Total Deductions x 0.18) =	21.00	23.52	27.30	26.94
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-22	-4	-12	-7
2. Track Speed >5 MPH -5	0	0	0	0
3. Track Speed Violation -2	-4	-4	-6	-4
4. Train Speed >5 MPH -5	0	0	0	0
5. Train Speed Violation -2	0	0	0	0
6. Ammeter Exceeds +1075 -2	0	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	0	0
9. Run Time/Min >1:50 -1	-9	0	-6	0
30 - (Total Deductions x 0.15) =	24.75	28.80	26.40	28.35
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	-1	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-7	-7	-3	-2
6. Run Out Over 200 KLBS -3	0	0	0	0
7. Run In Over -100 KLBS -1	-13	-17	-8	-11
8. Run In Over -200 KLBS -3	0	-6	0	0
30 - (Total Deductions x 0.40) =	22.00	17.60	25.60	24.80
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-9	-17	-14	-26
10 - (Total Deductions x 0.10) =	9.10	8.30	8.60	7.40
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	76.85	78.22	87.90	87.49

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 82.62

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: 3 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-26	-28	-24	-24
4. Overspeed Braking -1	-14	-10	-6	-13
5. Cycle Braking -1	-2	-1	-2	-2
6. Power Braking -2	-8	-10	-8	-8
7. Heavy Reduction -2	-8	-4	-8	-6
8. Running Release -1	-1	0	0	0
9. Brake Pipe < 55 PSI -3	0	-3	0	-3
10. Air Before Dynamic -1	-10	-8	-7	-9
30 - (Total Deductions x 0.18) =	17.58	18.48	20.10	18.30
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-23	-22	-14	-21
2. Track Speed > 5 MPH -5	0	0	0	0
3. Track Speed Violation -2	-16	-10	-14	-16
4. Train Speed > 5 MPH -5	0	0	0	0
5. Train Speed Violation -2	-6	-4	-6	-6
6. Ammeter Exceeds +1075 -2	0	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	0	0
9. Run Time/Min > 1:50 -1	0	-1	-1	-1
30 - (Total Deductions x 0.15) =	23.25	24.45	24.75	23.40
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces > 200 KLB -1	0	0	0	0
2. Draft Forces > 300 KLB -3	0	0	0	0
3. Buff Forces > 100 KLB -1	0	0	0	0
4. Buff Forces > 200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-9	-7	-1	-5
6. Run Out Over 200 KLBS -3	0	0	0	-3
7. Run In Over -100 KLBS -1	-11	-15	-9	-11
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	22.00	21.20	26.00	22.40
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-13	-13	-19	-17
10 - (Total Deductions x 0.10) =	8.70	8.70	8.10	8.30
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	71.53	72.83	78.95	72.40

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 73.93

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: ______ 4 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	0	0	-4	-2
4. Overspeed Braking -1	0	-1	-3	-1
5. Cycle Braking -1	0	0	0	0
6. Power Braking -2	-2	-2	-4	-4
7. Heavy Reduction -2	0	0	-4	-2
8. Running Release -1	0	0	0	0
9. Brake Pipe <55 PSI -3	0	0	0	0
10. Air Before Dynamic -1	-1	-3	-3	-1
30 - (Total Deductions x 0.18) =	29.46	28.92	26.76	28.20
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-18	-35	-25	-26
2. Track Speed >5 MPH -5	0	0	0	-5
3. Track Speed Violation -2	-6	-10	-8	-12
4. Train Speed >5 MPH -5	0	0	0	0
5. Train Speed Violation -2	0	-4	-2	-2
6. Ammeter Exceeds +1075 -2	0	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	0	0
9. Run Time/Min >1:50 -1	0	0	0	0
30 - (Total Deductions x 0.15) =	26.40	22.65	24.75	23.25
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	0	-3	-1	-1
6. Run Out Over 200 KLBS -3	0	0	0	0
7. Run In Over -100 KLBS -1	-5	-7	-1	-1
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	28.00	26.00	29.20	29.20
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-8	-22	-15	-20
10 - (Total Deductions x 0.10) =	9.20	7.80	8.50	8.00
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	93.06	85.37	89.21	88.65

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 89.07

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: _ 5 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-24	-18	-14	-14
4. Overspeed Braking -1	0	0	0	-1
5. Cycle Braking -1	-5	-1	-2	-1
6. Power Braking -2	-4	-4	-8	-4
7. Heavy Reduction -2	-12	-6	-6	-6
8. Running Release -1	-1	0	0	-1
9. Brake Pipe <55 PSI -3	-3	-3	-3	0
10. Air Before Dynamic -1	-11	-7	-6	-5
30 - (Total Deductions x 0.18) =	19.20	22.98	22.98	24.24
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-10	-11	-12	-5
2. Track Speed >5 MPH -5	0	-5	-10	0
3. Track Speed Violation -2	-16	-22	-26	-16
4. Train Speed >5 MPH -5	0	0	0	0
5. Train Speed Violation -2	-8	-6	-12	-8
6. Ammeter Exceeds +1075 -2	0	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	0	0
9. Run Time/Min >1:50 -1	0	0	0	0
30 - (Total Deductions x 0.15) =	24.90	23.40	21.00	25.65
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-12	-4	-2	-3
6. Run Out Over 200 KLBS -3	-3	0	0	0
7. Run In Over -100 KLBS -1	-13	-10	-6	-16
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	18.80	24.40	26.80	22.40
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-8	-34	-20	-29
10 - (Total Deductions x 0.10) =	9.20	6.60	8.00	7.10
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	72.10	77.38	78.78	79.39

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 76.91

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: _______ 6 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-8	-12	-14	-6
4. Overspeed Braking -1	-12	-9	-9	-8
5. Cycle Braking -1	0	0	-1	-1
6. Power Braking -2	-10	-10	-12	-18
7. Heavy Reduction -2	-6	-4	-2	-4
8. Running Release -1	-1	-1	0	-1
9. Brake Pipe <55 PSI -3	0	-3	0	0
10. Air Before Dynamic -1	-6	-2	-2	-4
30 - (Total Deductions x 0.18) =	22.26	22.62	22.80	22.44
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-17	-10	-3	-4
2. Track Speed >5 MPH -5	0	-15	-20	-10
3. Track Speed Violation -2	-10	-14	-14	-14
4. Train Speed >5 MPH -5	0	0	-5	0
5. Train Speed Violation -2	-6	-10	-8	-6
6. Ammeter Exceeds +1075 -2	0	0	-2	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	-1	0
9. Run Time/Min >1:50 -1	-7	0	0	0
30 - (Total Deductions x 0.15) =	24.00	22.65	22.05	24.90
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-5	-3	0	-5
6. Run Out Over 200 KLBS -3	0	0	0	0
7. Run In Over -100 KLBS -1	-6	-2	-4	-5
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	25.60	28.00	28.40	26.00
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-18	-27	-12	-15
10 - (Total Deductions x 0.10) =	8.20	7.30	8.80	8.50
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	80.06	80.57	82.05	81.84

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 81.13

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: ______________ 7 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-6	-16	-16	-18
4. Overspeed Braking -1	-2	-4	-3	-2
5. Cycle Braking -1	0	0	0	0
6. Power Braking -2	-2	-2	-2	-4
7. Heavy Reduction -2	-4	-4	-6	-4
8. Running Release -1	-1	-1	-1	-1
9. Brake Pipe <55 PSI -3	0	0	0	0
10. Air Before Dynamic -1	-6	-6	-6	-4
30 - (Total Deductions x 0.18) =	26.22	24.06	23.88	24.06
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-12	-14	-13	-20
2. Track Speed >5 MPH -5	0	0	0	0
3. Track Speed Violation -2	-8	-6	-2	-16
4. Train Speed >5 MPH -5	0	0	0	0
5. Train Speed Violation -2	-2	0	0	0
6. Ammeter Exceeds +1075 -2	0	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	-1	0
9. Run Time/Min >1:50 -1	-4	-4	0	0
30 - (Total Deductions x 0.15) =	26.10	26.40	27.60	24.60
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-2	-6	-12	-6
6. Run Out Over 200 KLBS -3	0	0	0	0
7. Run In Over -100 KLBS -1	-12	-10	-22	-9
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	24.40	23.60	16.40	24.00
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-32	-23	-20	-13
10 - (Total Deductions x 0.10) =	6.80	7.70	8.00	8.70
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	83.52	81.76	75.88	81.36

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 80.63

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: _ 8 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	0	-2	-2	-2
4. Overspeed Braking -1	-1	-1	0	0
5. Cycle Braking -1	0	0	0	0
6. Power Braking -2	-2	0	0	-2
7. Heavy Reduction -2	-6	-4	-2	-2
8. Running Release -1	0	-1	0	-1
9. Brake Pipe <55 PSI -3	0	0	0	0
10. Air Before Dynamic -1	-1	-2	-2	-2
30 - (Total Deductions x 0.18) =	28.20	28.20	28.92	28.38
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-7	-6	-8	-6
2. Track Speed >5 MPH -5	-5	-10	-10	-10
3. Track Speed Violation -2	-8	-12	-14	-10
4. Train Speed >5 MPH -5	0	-5	-5	0
5. Train Speed Violation -2	0	-2	-6	-2
6. Ammeter Exceeds +1075 -2	0	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	0	0
9. Run Time/Min >1:50 -1	0	0	0	0
30 - (Total Deductions x 0.15) =	27.00	24.75	23.55	25.80
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	-1
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-1	-4	0	-4
6. Run Out Over 200 KLBS -3	0	0	0	0
7. Run In Over -100 KLBS -1	-12	-10	-14	-5
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	24.80	24.40	24.40	26.00
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-24	-15	-15	-7
10 - (Total Deductions x 0.10) =	7.60	8.50	8.50	9.30
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	87.60	85.85	85.37	89.48

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 87.08

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: _ 9 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-14	-20	-16	-16
4. Overspeed Braking -1	-16	-12	-12	-11
5. Cycle Braking -1	-1	-2	-1	0
6. Power Braking -2	-2	-2	-2	-2
7. Heavy Reduction -2	-6	-10	-4	-6
8. Running Release -1	0	0	0	-1
9. Brake Pipe <55 PSI -3	0	0	0	-3
10. Air Before Dynamic -1	-6	-8	-5	-6
30 - (Total Deductions x 0.18) =	21.90	20.28	22.80	21.90
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-28	-30	-20	-19
2. Track Speed >5 MPH -5	-5	0	0	0
3. Track Speed Violation -2	-14	-14	-14	-12
4. Train Speed >5 MPH -5	0	0	0	0
5. Train Speed Violation -2	-4	-6	-6	-2
6. Ammeter Exceeds +1075 -2	0	-2	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	-1	0	0
9. Run Time/Min >1:50 -1	0	-5	0	0
30 - (Total Deductions x 0.15) =	22.35	21.30	24.00	25.05
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	-1
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-7	-6	-5	-6
6. Run Out Over 200 KLBS -3	0	-3	0	0
7. Run In Over -100 KLBS -1	-9	-14	-6	-10
8. Run In Over -200 KLBS -3	-3	0	0	-3
30 - (Total Deductions x 0.40) =	22.40	20.80	25.60	22.00
D. CROSSINGS (10 POINTS MAX) 1. Fail To Signal (Each) -1	-20	-19	-24	-26
10 - (Total Deductions x 0.10) =	8.00	8.10	7.60	7.40
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	74.65	70.48	80.00	76.35

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 75.37

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: _ _ 10 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	0	0	-8	-16
4. Overspeed Braking -1	-3	-3	-3	-3
5. Cycle Braking -1	0	0	0	0
6. Power Braking -2	0	0	0	0
7. Heavy Reduction -2	0	-2	-2	-4
8. Running Release -1	-1	0	-1	-1
9. Brake Pipe <55 PSI -3	0	0	0	0
10. Air Before Dynamic -1	-2	-1	-3	-5
30 - (Total Deductions x 0.18) =	28.92	28.92	26.94	24.78
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-5	-8	-13	-21
2. Track Speed >5 MPH -5	-10	-10	-5	-5
3. Track Speed Violation -2	-16	-24	-12	-14
4. Train Speed >5 MPH -5	0	0	0	0
5. Train Speed Violation -2	-2	-6	-4	-4
6. Ammeter Exceeds +1075 -2	0	0	0	-2
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	0	-1
9. Run Time/Min >1:50 -1	0	0	0	0
30 - (Total Deductions x 0.15) =	25.05	22.80	24.90	22.95
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-4	-4	-3	-4
6. Run Out Over 200 KLBS -3	0	0	0	0
7. Run In Over -100 KLBS -1	-11	-14	-15	-14
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	24.00	22.80	22.80	22.80
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-33	-25	-15	-3
10 - (Total Deductions x 0.10) =	6.70	7.50	8.50	9.70
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	84.67	82.02	83.14	80.23

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 82.52

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: ___ 11 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-10	-8	-14	-22
4. Overspeed Braking -1	-10	-7	-7	-3
5. Cycle Braking -1	-2	0	-3	-3
6. Power Braking -2	-14	-16	-22	-26
7. Heavy Reduction -2	-6	-4	-12	-16
8. Running Release -1	0	0	0	-1
9. Brake Pipe <55 PSI -3	-3	0	0	0
10. Air Before Dynamic -1	-7	-6	-11	-13
30 - (Total Deductions x 0.18) =	20.64	22.62	17.58	14.88
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-17	-24	-15	-12
2. Track Speed >5 MPH -5	0	-5	0	0
3. Track Speed Violation -2	-18	-18	-12	-8
4. Train Speed >5 MPH -5	0	0	0	0
5. Train Speed Violation -2	-6	0	0	0
6. Ammeter Exceeds +1075 -2	0	-2	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	-1	-2	0	0
9. Run Time/Min >1:50 -1	0	0	0	0
30 - (Total Deductions x 0.15) =	23.70	22.35	25.95	27.00
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-2	-1	-5	-4
6. Run Out Over 200 KLBS -3	-3	0	-3	0
7. Run In Over -100 KLBS -1	-12	-7	-7	-6
8. Run In Over -200 KLBS -3	0	0	-3	0
30 - (Total Deductions x 0.40) =	23.20	26.80	22.80	26.00
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-17	-23	-21	-26
10 - (Total Deductions x 0.10) =	8.30	7.70	7.90	7.40
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	75.84	79.47	74.23	75.28

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 76.21

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: ____ 12 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	0	0	0	-2
4. Overspeed Braking -1	-11	-12	-6	-5
5. Cycle Braking -1	0	0	0	0
6. Power Braking -2	-8	-8	-14	-8
7. Heavy Reduction -2	-4	0	0	-2
8. Running Release -1	-1	0	0	0
9. Brake Pipe <55 PSI -3	0	0	0	-3
10. Air Before Dynamic -1	-3	-3	-2	-2
30 - (Total Deductions x 0.18) =	25.14	25.86	26.04	26.04
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-26	-1	-5	-13
2. Track Speed >5 MPH -5	-5	-10	-5	0
3. Track Speed Violation -2	-16	-10	-14	-14
4. Train Speed >5 MPH -5	0	-5	0	0
5. Train Speed Violation -2	-10	-6	-6	-2
6. Ammeter Exceeds +1075 -2	0	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	0	0
9. Run Time/Min >1:50 -1	0	0	0	0
30 - (Total Deductions x 0.15) =	21.45	25.20	25.50	25.65
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	-1
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-5	0	-2	-1
6. Run Out Over 200 KLBS -3	0	0	0	0
7. Run In Over -100 KLBS -1	-6	-11	-9	-8
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	25.60	25.60	25.60	26.00
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-12	-29	-19	-25
10 - (Total Deductions x 0.10) =	8.80	7.10	8.10	7.50
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	80.99	84.06	85.24	85.19

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 83.87

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: ___ 13 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-28	-18	-16	-16
4. Overspeed Braking -1	-10	-5	-12	-8
5. Cycle Braking -1	-2	0	-1	0
6. Power Braking -2	-10	-10	-2	-6
7. Heavy Reduction -2	-10	-6	-6	-14
8. Running Release -1	-1	0	0	0
9. Brake Pipe <55 PSI -3	-3	0	0	-3
10. Air Before Dynamic -1	-10	-8	-7	-9
30 - (Total Deductions x 0.18) =	16.68	21.90	22.08	19.92
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-30	-43	-43	-52
2. Track Speed >5 MPH -5	0	0	-5	-5
3. Track Speed Violation -2	-10	-22	-14	-22
4. Train Speed >5 MPH -5	0	0	0	0
5. Train Speed Violation -2	-2	-8	-4	-8
6. Ammeter Exceeds +1075 -2	-8	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	-3	0	0	0
9. Run Time/Min >1:50 -1	-8	0	0	0
30 - (Total Deductions x 0.15) =	20.85	19.05	20.10	18.45
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-5	-3	-7	-14
6. Run Out Over 200 KLBS -3	0	-3	0	-6
7. Run In Over -100 KLBS -1	-17	-9	-19	-14
8. Run In Over -200 KLBS -3	-3	0	-3	-6
30 - (Total Deductions x 0.40) =	20.00	24.00	18.40	14.00
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-12	-17	-22	-21
10 - (Total Deductions x 0.10) =	8.80	8.30	7.80	7.90
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	66.33	73.25	68.38	60.27

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 67.06

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: 14 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-14	-14	-8	-12
4. Overspeed Braking -1	-1	-2	0	0
5. Cycle Braking -1	0	0	0	0
6. Power Braking -2	-4	-2	-4	-6
7. Heavy Reduction -2	-4	-2	0	0
8. Running Release -1	0	0	-1	0
9. Brake Pipe <55 PSI -3	0	0	0	0
10. Air Before Dynamic -1	-4	0	-2	-2
30 - (Total Deductions x 0.18) =	25.14	26.40	27.30	26.40
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-5	-1	-1	-3
2. Track Speed >5 MPH -5	0	0	0	0
3. Track Speed Violation -2	-10	-10	-16	-12
4. Train Speed >5 MPH -5	0	0	0	0
5. Train Speed Violation -2	-2	-6	-6	-6
6. Ammeter Exceeds +1075 -2	0	0	0	0
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	0	0	0
9. Run Time/Min >1:50 -1	-5	0	0	0
30 - (Total Deductions x 0.15) =	26.40	27.45	26.55	26.85
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	0	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-3	-3	-3	-3
6. Run Out Over 200 KLBS -3	0	0	0	0
7. Run In Over -100 KLBS -1	-10	-15	-10	-10
8. Run In Over -200 KLBS -3	-3	0	0	0
30 - (Total Deductions x 0.40) =	23.60	22.80	24.80	24.80
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-20	-11	-13	-10
10 - (Total Deductions x 0.10) =	8.00	8.90	8.70	9.00
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	83.14	85.55	87.35	87.05

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 85.77

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: 15 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-6	-2	0	0
4. Overspeed Braking -1	-4	-2	0	-1
5. Cycle Braking -1	0	-1	0	0
6. Power Braking -2	-2	-10	-10	-10
7. Heavy Reduction -2	-8	0	-2	-2
8. Running Release -1	0	0	0	0
9. Brake Pipe < 55 PSI -3	-6	0	0	-3
10. Air Before Dynamic -1	-5	-3	-1	-1
30 - (Total Deductions x 0.18) =	24.42	26.76	27.66	26.94
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-21	-18	-27	-20
2. Track Speed > 5 MPH -5	0	-10	-5	-25
3. Track Speed Violation -2	-6	-18	-20	-16
4. Train Speed > 5 MPH -5	0	0	0	-5
5. Train Speed Violation -2	0	-6	-4	-8
6. Ammeter Exceeds +1075 -2	0	-2	-2	-2
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	-1	-2	-1
9. Run Time/Min > 1:50 -1	-2	0	0	0
30 - (Total Deductions x 0.15) =	25.65	21.45	21.00	18.45
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces > 200 KLB -1	0	0	0	0
2. Draft Forces > 300 KLB -3	0	0	0	0
3. Buff Forces > 100 KLB -1	0	0	0	0
4. Buff Forces > 200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-6	-1	-2	-6
6. Run Out Over 200 KLBS -3	-3	0	0	0
7. Run In Over -100 KLBS -1	-9	-10	-5	-7
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	22.80	25.60	27.20	24.80
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-18	-16	-20	-21
10 - (Total Deductions x 0.10) =	8.20	8.40	8.00	7.90
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	81.07	82.21	83.86	78.09

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 81.31

RALES LOCOMOTIVE ENGINEER SIMULATOR
GRADE FORM

NAME: __ 16 RAILROAD: SOO

	RUN 1	RUN 2	RUN 3	RUN 4
A. BRAKES (30 POINTS MAX.)				
1. Emergency Application -8	0	0	0	0
2. Penalty Application -5	0	0	0	0
3. No Split Service Red. -2	-8	-14	-4	-8
4. Overspeed Braking -1	-2	-2	-2	-2
5. Cycle Braking -1	0	-1	0	-1
6. Power Braking -2	0	0	-2	0
7. Heavy Reduction -2	-6	-4	0	0
8. Running Release -1	-1	0	-1	0
9. Brake Pipe <55 PSI -3	0	-3	0	0
10. Air Before Dynamic -1	-6	-7	-3	-3
30 - (Total Deductions x 0.18) =	25.86	24.42	27.84	27.48
B. THROTTLE (30 POINTS MAX.)				
1. Rapid Throttle Chng. -1	-1	-2	-7	-6
2. Track Speed >5 MPH -5	0	0	-20	-15
3. Track Speed Violation -2	-12	-10	-14	-20
4. Train Speed >5 MPH -5	0	0	-5	-5
5. Train Speed Violation -2	-4	-6	-8	-6
6. Ammeter Exceeds +1075 -2	0	0	0	-2
7. Ammeter Exceeds -700 -2	0	0	0	0
8. Wheel Slip Occurance -1	0	-1	0	-2
9. Run Time/Min >1:50 -1	-9	-5	0	0
30 - (Total Deductions x 0.15) =	26.10	26.40	21.90	21.60
C. TRAIN FORCES (30 POINTS MAX)				
1. Draft Forces >200 KLB -1	0	0	0	0
2. Draft Forces >300 KLB -3	0	0	0	0
3. Buff Forces >100 KLB -1	0	-1	0	0
4. Buff Forces >200 KLB -3	0	0	0	0
5. Run Out Over 100 KLBS -1	-6	-4	-7	-6
6. Run Out Over 200 KLBS -3	0	-3	0	0
7. Run In Over -100 KLBS -1	-11	-14	-11	-12
8. Run In Over -200 KLBS -3	0	0	0	0
30 - (Total Deductions x 0.40) =	23.20	21.20	22.80	22.80
D. CROSSINGS (10 POINTS MAX)				
1. Fail To Signal (Each) -1	-16	-19	-17	-13
10 - (Total Deductions x 0.10) =	8.40	8.10	8.30	8.70
PERCENTILE GRADE EQUALS THE SUM OF A + B + C + D FOR EACH RUN.	83.56	80.12	80.84	80.18

THE AVERAGE SCORE FOR THE RUNS MADE BY THIS ENGINEER IS: 81.18

APPENDIX L - SUMMARY OF RCARD SCORING AVERAGES

COMPARISON OF OVERALL GRADE BETWEEN FIRST AND SECOND RUNS OF EACH SESSION

ENGINEER	(-) RUN #1 (%)	(+) RUN #2 (%)	DIFF.
1	77.02	77.45	
1	75.82	80.55	
2	76.85	78.22	
2	87.90	87.49	
3	71.53	72.83	
3	78.95	72.40	
4	93.06	85.37	
4	89.21	88.65	
5	72.10	77.38	
5	78.78	79.39	
6	80.06	80.57	
6	82.05	81.84	
7	83.52	81.76	
7	75.88	81.36	
8	87.60	85.85	
8	85.37	89.48	
9	74.65	70.48	
9	80.00	76.35	
10	84.67	82.02	
10	83.14	80.23	
11	75.84	79.47	
11	74.23	75.28	
12	80.99	84.06	
12	85.24	85.19	
13	66.33	73.25	
13	68.38	60.27	
14	83.14	85.55	
14	87.35	87.05	
15	81.07	82.21	
15	83.86	78.09	
16	83.56	80.12	
16	80.84	80.18	
	2568.99	2560.39	
AVERAGE	80.281%	80.012%	

ENGINEERS SCORED HIGHER ON RUN #1 BY 0.269%

COMPARISON OF FIRST SESSION TO SECOND SESSION BY ENGINEER

ENGINEER	1ST SESSION	2ND SESSION
1	77.02	75.82
1	77.45	80.55
2	76.85	87.90
2	78.22	87.49
3	71.53	78.95
3	72.83	72.40
4	93.06	89.21
4	85.37	88.65
5	72.10	78.78
5	77.38	79.39
6	80.06	82.05
6	80.57	81.84
7	83.52	75.88
7	81.76	81.36
8	87.60	85.37
8	85.85	89.48
9	74.65	80.00
9	70.48	76.35
10	84.67	83.14
10	82.02	80.23
11	75.84	74.23
11	79.47	75.28
12	80.99	85.24
12	84.06	85.19
13	66.33	68.38
13	73.25	60.27
14	83.14	87.35
14	85.55	87.05
15	81.07	83.86
15	82.21	78.09
16	83.56	80.84
16	80.12	80.18
	-------	-------
	2548.58	2580.80
AVERAGE	79.643%	80.65%

ENGINEERS SCORED HIGHER FOR SECOND SESSION BY 1.007%

COMPARISON OF NO REST TO WITH REST BY ENGINEER

ENGINEER	(–) NO REST	(+) WITH REST
1		77.02
1		77.45
1		75.82
1		80.55
2		76.85
2		78.22
2		87.90
2		87.49
3		71.53
3		72.83
3		78.95
3		72.40
4		93.06
4		85.37
4		89.21
4		88.65
5	72.10	
5	77.38	
5	78.78	
5	79.39	
6	80.06	
6	80.57	
6	82.05	
6	81.84	
7	83.52	
7	81.76	
7	75.88	
7	81.36	
8	87.60	
8	85.85	
8	85.37	
8	89.48	
9	80.00	74.65
9	76.35	70.48
10	83.14	84.67
10	80.23	82.02
11	75.84	
11	79.47	
11	74.23	
11	75.28	
12	80.99	85.24
12	84.06	85.19
13	68.38	66.33
13	60.27	73.25
14	87.35	83.14
14	87.05	85.55
15	81.07	83.86
15	82.21	78.09
16	83.56	80.84
16	80.12	80.18
	2722.59	2406.79
AVERAGE	80.076%	80.226%

ENGINEERS WITH NO REST SCORED HIGHER BY 0.150%

COMPARISON OF NO EQUIPTMENT TO ALERTER USE BY ENGINEER

ENGINEER	NO ALERTER	WITH ALERTER
1	75.82	77.02
1	80.55	77.45
2	87.90	76.85
2	87.48	78.22
3	71.53	78.95
3	72.83	72.40
4	93.06	89.21
4	85.37	88.65
5	78.78	72.10
5	79.39	77.38
6	82.05	80.06
6	81.84	80.57
7	83.52	75.88
7	81.76	81.36
8	87.60	85.37
8	85.85	89.48
9		74.65
9		70.48
9		80.00
9		76.35
10		84.67
10		82.02
10		83.14
10		80.23
11		75.84
11		79.47
11		74.23
11		75.28
12		80.99
12		84.06
12		85.24
12		85.19
13	66.33	
13	73.25	
13	68.38	
13	60.27	
14	83.14	
14	85.55	
14	87.35	
14	87.05	
15	81.07	
15	82.21	
15	83.86	
15	78.09	
16	83.56	
16	80.12	
16	80.84	
16	80.18	
	-------	-------
	2576.58	2552.79
AVERAGE	80.518%	79.775%

ENGINEERS WITH NO ALERTER SCORED HIGHER BY 0.743%

COMPARISON OF ENGINEERS (WITH NO REST) THAT HAVE NO EQUIPMENT TO THOSE WITH ALERTER

NO REST ENGINEER	NO ALERTER	WITH ALERTER
5	78.78	72.10
5	79.39	77.38
6	82.05	80.06
6	81.84	80.57
7	83.52	75.88
7	81.76	81.36
8	87.60	85.37
8	85.85	89.48
9		80.00
9		76.35
10		83.14
10		80.23
11		75.84
11		79.47
11		74.23
11		75.28
12		80.99
12		84.06
13	68.38	
13	60.27	
14	87.35	
14	87.05	
15	81.07	
15	82.21	
16	83.56	
16	80.12	
	-------	-------
	1290.80	1431.79
AVERAGE	80.675%	79.544%

NO ALERTER SCORED HIGHER FOR NO REST ENGINEERS BY 1.131%

COMPARISON OF ENGINEERS (WITH REST) THAT HAVE NO EQUIPMENT TO THOSE WITH ALERTER

RESTED ENGINEER	NO ALERTER	WITH ALERTER
1	75.82	77.02
1	80.55	77.45
2	87.90	76.85
2	87.49	78.22
3	71.53	78.95
3	72.83	72.40
4	93.06	89.21
4	85.37	88.65
9		74.65
9		70.48
10		84.67
10		82.02
12		85.24
12		85.19
13	66.33	
13	73.25	
14	83.14	
14	85.55	
15	83.86	
15	78.09	
16	80.84	
16	80.18	
	1285.79	1121.00
AVERAGE	80.361%	80.071%

NO ALERTER SCORED HIGHER FOR RESTED ENGINEERS BY 0.291%

APPENDIX M - TIMING TEST DATA (BY TEST SUBJECT)

APPENDIX M - TIMING TEST DATA (BY TEST SUBJECT)

The results of the timing tests are shown below. These were conducted once for each engineer, at the end of the familiarization run, while a video recording was underway. Timings were made from the video tape by stopwatch. A total of twelve engineers were conclusively timed. There are 3 timings:

1) time to turn on the bell,
2) time to blow the horn,
3) time to turn on bell, blow horn, and set emergency.

The tests were performed on the foot pedal experimental equipment, if provided. Otherwise, the normal complement of hand devices was used. The results are shown in the follwing tables.

Subject(1)	Equipment (Foot Pedal)	Bell (only) secs	Horn (only) secs	Bell,Horn & Emergency secs
#15	NO	.85	1.11	3.92
#13	NO	.40	.42	3.25
#04	NO	1.08	.91	2.87
#16	NO	.83	.13	2.01
#14	NO	.87	.10	1.89
#08	NO	.78	.99	.87
avg	NO	.80	.61	2.46
median	NO	.84	.66	2.44
#12	YES	.90	1.13	1.26
#09	YES	.10	.95	.84
#06	YES	.82	1.0	.81
#01	YES	.46	NA	.32
#05	YES	1.0	1.08	.05
#10	YES	.78	.05	.05
avg	YES	.67	.84	.55
median	YES	.80	.95	.56

(1) Engineman Key

APPENDIX N - EXIT INTERVIEW QUESTIONNAIRE AND RESULTS

EXIT INTERVIEW RESULTS OF TESTING
IITRI PROJECT P6055
(CONTRACT NO. DTFR53-82-C-00254)

The following is a summary and analysis of the exit interview results obtained from the test of a Proposed Alerter/Emergency Brake System, Contract Number DTFR53-82-C-00254. The interviews contained seven questions and these are restated and discussed in appropriate groupings along with minority viewpoints.

The exit interviews can be divided into two parts: questions one through four, and five through seven. Questions one through four tested the environment of the train simulator as compared to the real environment. The results indicate that the simulator represented a close approximation of the real environment with which the train engineers were familiar. These results serve to validate the second part of the test.

The second part of the interview contained the critical questions, five through seven, that dealt with the devices under examination. Both the alerter light and the foot pedal tests acquired positive feedback from the vast majority of train engineers. A bar graph, Figure 1, has been included to graphically summarize the test results.

Note that of the sixteen train engineers questioned, some were asked the same questions or group of questions after a second run, and others did not respond to some questions. For these reasons, the gross number of responses to each question varies between 22 and 13. Figure 1 circumvents this discrepancy by indicating responses in percent form.

Overall, there were twenty-two responses to the first two questions, nineteen agreeing the simulation was accurate with varying levels of enthusiasm and three disagreeing.

The first two questions in the exit interview probed the subject for his overall reaction to the simulator. They were, "Did you feel you drove this train the same way you would an actual train over this district?" and, "If not, what was different about what you did?" These questions are important to ascertain the validity of the test results to real train handling. The

Figure 1.

QUESTIONS

1 & 2	Simulator drive like real thing? (22 responses)
3	Simulator more stressful? (21 responses)
4	Harder to stay alert in simulator? (21 responses)
5 & 6	Like alerter? (14 responses)
7	Like pedal? (13 responses)

responses were almost entirely positive, agreeing that the simulation was accurate. Some of those who answered positively had minor complaints. In some areas the train ran slightly faster or slower than one train engineer believed was appropriate. A couple of train engineers commented on the film. One said it looked different from the actual thing; another found the simulator's different signal indications to diminish the realism.

Three of the train engineers believed the simulator did not accurately represent the actual train and track run. One commented that the braking did not have the proper feel, and thus he had to adjust his control to where he felt he would have been over- or underbraking if he were in a real train. This same train engineer also felt that the speed of the simulated train was not entirely consistent with an actual train's performance on some areas of the real track being represented. Additionally, according to this train engineer some aspects of the motion, such as pitch and yaw, were exaggerated. A different train engineer became most unhappy with the train's performance during the final three miles. The third unhappy train engineer felt more strongly than the others that the poor signal indications detracted from the simulation.

The third questions dealt with stress: "Was this more or less stressful than driving a real train?" In rough terms, approximately half of the respondents thought the simulator was more stressful, one-quarter thought it was less stressful, and the remaining one-quarter thought the stress levels were comparable to real train driving. Of those who thought the simulator was more stressful than a real train, several felt anxiety over their unfamiliarity with the simulator (perhaps similar to driving a new car), and became more comfortable during the second run. A couple of train engineers were bothered by the resolution of the film, complaining that it was blurry. One train engineer commented that his awareness of being watched added stress; this anxiety probably also affected many of the other train engineers who thought the simulator to be more stressful.

The unanimous viewpoint of those who thought the simulator represented a less stressful environment concerned the lack of danger to themselves and especially to others. The simulator removed these responsibilities and thus reduced the stress level. The remaining train engineers felt the simulated environment provided about the same amount of stress as the real environment. Ideally this is the desired response, indicating that the train engineers accepted the simulation sufficiently to prevent abnormal stress from affecting the test results.

There were twenty-one responses to the third question, twelve indicating the simulator to be more stressful, five indicating it to be less stressful, and four indicating it to be equally as stressful as the real environment.

The fourth question, "Did you have any more trouble than usual in staying awake or attentive in the simulator than you do in driving a real train?" obviously functions as a preparatory lead-in to questions concerning the alerter system, but the responses were varied and detailed enough to warrant a separate discussion.

Not surprisingly, roughly half of the train engineers were noncommittal, feeling that their alertness in the simulator was equivalent to that in a real train. This response agrees with the fact that most of the train engineers reported that the simulation was very much like the real thing in the first two questions. The remaining half of the train engineers was divided into approximately three-quarters believing it harder to stay awake, and one-quarter believing it easier to stay awake in the simulator. Those who thought it was harder to stay alert in the simulator cited monotonous conditions, an overly comfortable environment due to air conditioning or lack of a stimulant like fresh air, and a fairly common response dealt with a lack of companionship (e.g., a brakeman) to alleviate the boredom.

The few who thought they were more alert in the simulator all had different reactions. One commented that the speed of a real train, if it were unchanging, put him to sleep. He did not encounter that problem in the simulator. Another train engineer observed that the duration of the simulator run was short enough to accommodate him and still another train engineer remained alert by noticing slight differences in the simulation as compared to the real thing.

The train engineers who felt that their alertness varied as if the simulator were the real thing observed that they became fatigued in about the same circumstances as those encountered on a real train. Again, this is the preferred result. The majority of train engineers felt this way, but the dichotomy of this result with the results indicating that most of the train engineers felt more stress in the simulator environment seems to indicate some inconsistency in the train engineers' responses.

There were twenty-one responses to the fourth question, seven indicating that it was harder to stay alert, three indicating that it was easier, and eleven indicating that the simulator required about the same amount of effort to stay alert as a real train.

The fifth and sixth questions dealt with the alerter: "How did you feel about the alerter light? Did you feel the alerter light helped you remain alert? Was the alerter sound device activated? If so, was it helpful in keeping you alert? Was the sound too soft, too loud, or objectionable in any way?"

Fourteen train engineers responded to these questions concerning the alerter system. Except for one dissenting train engineer and two indifferent train engineers, all of the train engineers like the idea of an alerter light, feeling that it did and would help them remain alert. In most cases, the alerter did not activate its sound device, but the four train engineers that heard it had varying comments. All thought the sound amplitude was about right, but one remarked that the sound was not helpful and another said that the light was more helpful than the sound. The train engineer who disliked the alerter idea tested the alerter by allowing it to activate, and found the sound to be irritating. He had the unique observation that if a train engineer does not care enough about his work to stay awake, this device would be ineffective. Conversely he observed that for those who do care about their work, it would be merely a nuisance. One train engineer thought all engines should have the system and one remarked that it was "innovative" but did not feel it was essential.

The final series of questions, "Did you use the foot pedal? If yes, was the foot pedal helpful? Would you like to have one on your locomotive? What changes would you recommend in how the pedal operates to make it more useful?" addressed the train engineers' reaction to the foot pedal which activated the bells, then horn, and if enough pressure were applied, it would also engage the emergency brakes.

Thirteen train engineers responded to these questions concerning the pedal. All of the train engineers liked the idea and would like to have it on their locomotives except for one who complained that using his feet in that manner was uncomfortable. One train engineer commented that although he used it a lot, he was worried about applying excessive pressure and initiating an emergency application of the brakes. Another remarked that he could get by without the pedal, but would use it if it became available. Most train engineers agreed that having their hands free from the bell and horn operations resulted in easier handling of the other tasks of train operation. Some improvements and/or changes were suggested. A couple of train engineers noted that the pedal should be mounted in a more permanent fashion. One train engineer requested that the pedal be mounted in a centered position between the legs, while another praised the right-handed location of the pedal. A couple of train engineers suggested that a wider pedal would be convenient and perhaps this approach could further alleviate positional problems. One train engineer commented that on the release, there should be a two-part pedal to slide the foot over. Another requested sanders be attached to the pedal.

APPENDIX O - RECORDED OCCURRENCE OF ALERTER ALARMS

APPENDIX O - RECORDED OCCURRENCE OF ALERTER ALARMS

RALES RUN ID	SEGMENT 1			SEGMENT 2			SEGMENT 3			SEGMENT 4			SEGMENT 5			SEGMENT 6		
	#	M	H	#	M	H	#	M	H	#	M	H	#	M	H	#	M	H
#1				2	3.5	5	1	2	2				8	2.25	3	1	3	3
#2	1	2	2	2	2.5	3				1	3	3	9	2.8	4	3	2.67	3
#3																		
#4																		
#5							1	4	4	2	2	2	8	2.37	3	2	2.5	3
#6				3	1.3	2				1	2	2	11	2	2	2	2	2
#7																		
#8																		
#9																		
#10																		
#11				3	2.66	3	1	2	2	2	2	3	10	2.9	7	2	3.5	4
#12	1	2	2	4	2.5	3	1	2	2	2	2	2	12	2.67	4	3	2	2
#13																		
#14																		
#15	2	3	3										4	2	2	1	3	3
#16	2	1.5	2	1	3	3							5	2.8	3			
#17	1	2	2	2	1.5	2	1	2	2				10	2.1	3	2	2.5	3
#18				4	2.5	3	1	2	2				10	2.9	4	1	2	2
#19																		
#20																		
#21							1	2	2				7	2.43	4	1	3	3
#22	1	2	2				1	3	3				9	2.67	3	2	3.5	4
#23																		
#24																		
#25																		
#26																		
#27				2	2.5	3	1	3	3				11	2.54	3	2	3	3
#28													4	2.25	3	1	3	3
#29																		
#30																		
#31													4	4.75	6			
#32	1	2	2										3	5	9			

Key: # - number of times alerter prompt was given; M - mean in seconds that alerter stage 1 warning was on;
H - longest time, in seconds, that stage 1 alerter was on.

APPENDIX O - RECORDED OCCURRENCE OF ALERTER ALARMS (CONTINUED)

RALES RUN ID	SEGMENT 7			SEGMENT 8			SEGMENT 9			SEGMENT 10			SEGMENT 11			COND.
	#	M	H	#	M	H	#	M	H	#	M	H	#	M	H	
#1				1	4	4	2	2	2	2	3.5	4				R
#2					2	2	2	3	3	2	4.5	6	2	2	2	R
#3																
#4							2	3	3	2	2	2				R
#5							2	2	2	2	2	2	3	3	4	R
#6																R
#7																
#8																
#9																
#10																
#11				2	3	3	2	2.5	3	2	3	3	3	2.67	3	R
#12				2	3.5	4	2	3	3	2	5	7	1	4	4	R
#13																
#14																
#15							2	2	2							R
#16							1	2	2	1	1	1				R
#17				3	2.33	3	2	2.5	3	3	2	3				U
#18				3	3	3	4	3.25	6	3	2.33	3				U
#19																
#20																
#21				1	2	2	1	6	6	2	2.5	3	2	2.5	3	U
#22				3	2.67	3	1	3	3	2	3	3	1	2	2	U
#23																
#24																
#25																
#26																
#27							2	3	3				2	3.5	4	U
#28							1	3	3	1	3	3				U
#29																
#30																
#31				2	3	3	1	4	4	1	3	3	2	4	4	U
#32							2	4	4				1	3	3	U

Key: # - number of times alerter prompt was given; M - mean in seconds that alerter stage 1 warning was on; H - longest time, in seconds, that stage 1 alerter was on; R - rested; U - unrested.

APPENDIX O – RECORDED OCCURRENCE OF ALERTER ALARMS (CONTINUED)

RALES RUN ID	SEGMENT 1			SEGMENT 2			SEGMENT 3			SEGMENT 4			SEGMENT 5			SEGMENT 6		
	#	M	H	#	M	H	#	M	H	#	M	H	#	M	H	#	M	H
#33				1	4	4	2	2.5	3				3	2.67	3	1	5	5
#34	1	3	3	3	2	3	2	2.5	3	1	3	3	4	2.25	3			
#35	2	2	2	2	1.5	2				2	2	3	3	2.67	4	1	2	2
#36	1	3	3	1	2	2										1	2	2
#37	1	2	2	3	1.67	2				1	2	2	11	2.54	4	2	2	2
#38	1	2	2	4	1.75	2							6	2.33	3	1	2	2
#39				3	2.67	3				2	2.5	3	14	2.5	5	2	2	2
#40				3	2	2	1	2	2	2	3	3	13	2.38	4	2	2.5	3
#41				2	2.5	3	2	2.5	3	1	3	3	10	3.9	5	2	3.5	4
#42				2	8	10	2	3.5	4	3	3.3	4	7	3.43	5	2	5	5
#43				4	2	2	1	2	2				8	2.38	3	1	2	2
#44				3	2	2	1	2	2				8	2.25	3	2	2	2
#45	1	1	1	3	2	3	1	2	2				7	2.14	3	1	3	3
#46	1	3	3				2	1.5	2				7	2.14	3	1	3	3
#47	1	2	2	1	2	2												
#48				2	1	1												
#49																		
#50																		
#51																		
#52																		
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#64																		

Key: # – number of times alerter prompt was given; M – mean in seconds that alerter stage 1 warning was on; H – longest time, in seconds, that stage 1 alerter was on.

APPENDIX O – RECORDED OCCURRENCE OF ALERTER ALARMS (CONTINUED)

RALES RUN ID	SEGMENT 7			SEGMENT 8			SEGMENT 9			SEGMENT 10			SEGMENT 11			COND.
	#	M	H	#	M	H	#	M	H	#	M	H	#	M	H	
#33										1	3	3				R
#34				1	2	2										R
#35				1	3	3	1	4	4							U
#36				1	2	2										U
#37				1	2	2	2	2	2	2	2.5	3	1	3	3	R
#38							1	4	4	2	1.5	2	1	5	5	R
#39				1	2	2	2	2.5	3	2	2.5	3				U
#40				1	4	4	1	2	2	1	2	2	1	2	2	U
#41				1	3	3	2	3	3	2	5.5	7	1	2	2	U
#42				2	2.5	3	2	4	4	1	6	6				U
#43				1	3	3	2	2.5	3	2	2.5	3				U
#44				2	2	2	2	2	2	3	2	2				U
#45				1	4	4	2	2	2	1	2	2				U
#46				2	2	2	1	2	2	1	2	2	2	2	2	U
#47																R
#48																R
#49																
#50																
#51																
#52																
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#64																

Average Number Rested 14.73

Average Number Unrested 17.44

Average Highest Time Rested 2.89

Average Highest Time Unrested 3.0

Key: # - number of times alerter prompt was given; M - mean in seconds that alerter stage 1 warning was on; H - longest time, in seconds, that stage 1 alerter was on; R - rested; U - unrested.