Research and Test Department

TEM/RECAP DATA PLOTTER

PIX version 2.0

User's Manual

Report No. R-770

Alvaro R. Auzmendi

Washington Systems Center

ASSOCIATION
OF AMERICAN
RAILROADS

Association of American Railroads
Research and Test Department

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December 1990

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Washington, D.C.

ASSOCIATION OF AMERICAN RAILROADS | RESEARCH AND TEST DEPARTMENT

REPORT BRIEF

TEM/RECAP DATA PLOTTER
PIX Version 2.0
User's Manual

R-770

The TEM/RECAP Data Plotter PIX Version 2.0 is the computer graphics program for the Train Energy Model (TEM)/Rail Energy Cost Analysis Program (RECAP) models. It graphically displays the physical performance of TEM simulated trains in order to evaluate the train handling decisions made by the simulator. Simulated train operating variables like speed, acceleration, braking, locomotive throttle notch positions, drawbar forces, and others can be displayed graphically in different combinations to better understand the performance of the train being analyzed.

This version of the program improves upon previous versions in that many new requested features have been added. Up to nine different train performance variables can be graphically displayed on the same screen. These variables can come from several different train simulations, in order to make comparisons or sensitivity analysis on one or more train performance variables, or from a single TEM simulation.

For clarity purposes, the individual variable-plots of a graph can be distributed within the drawing area. Templates, (combination of variables and general features of a graph) can be saved to a file for later use with any TEM output file. Files and print copies of graphs are also possible.

Besides these features, other general options like titles, labels, legends, colors, enlargements of certain areas of the graph, and the sizes of the graphs are also available. These and other features of the PIX v2.0 computer program make it a state-of-the-art tool for railroads, and unparalleled in its ability to graphically analyze train performance data.

The software can run on an IBM compatible computer equipped with a hard disk and at least 640K of memory.

Copies of the AAR Report: "TEM/RECAP Data Plotter PIX Version 2.0 - User's Manual," are available from the Document Distribution Center, Chicago Technical Center, 3140 South Federal Street, Chicago, Illinois 60616. The AAR report number is R-770; the price is $10.00 for member railroads and $100.00 for nonmembers. The cost includes surface mail postage if mailed within North America. There will be a surcharge for any overseas mail. Checks should be made payable to the Association of American Railroads. This report was issued in December, 1990. A report list is available upon request.

C. E. Taylor
Assistant Vice President
Washington Systems Center

ASSOCIATION
OF AMERICAN
RAILROADS

January 11, 1991

Energy & Locomotive Research Steering Committee

Enclosed is a copy of AAR Report No. R-770, "TEM/RECAP Data Plotter PIX Version 2.0 - User's Manual."

The TEM/RECAP Data Plotter PIX Version 2.0 is the computer graphics program for the Train Energy (TEM)/Rail Energy Cost Analysis Program (RECAP) models. It graphically displays the physical performance of TEM simulated train operations in order to evaluate the train handling decisions made by the simulator. This version of the computer graphics program improves upon previous versions in that many new requested features have been added.

If you have any questions or comments about the new graphics output program or this users manual, please contact Al Auzmendi (202-639 2256).

Sincerely,

C E Taylor

Enclosure

cc: G.H. Way
S.B. Harvey
TEM/RECAP Users' Group
Research Committee
Vehicle/Track Systems Steering Committee
Vehicle/Track Systems Implementation Officers
Train Resistance Subcommittee
Train Operations Simulation Subcommittee

ASSOCIATION
OF AMERICAN
RAILROADS

November 7, 1990

TEM/RECAP User's Group

User's Group Meeting - November 28, 1990

A meeting of the Train Energy Model (TEM)/ Rail Energy Cost Analysis Package (RECAP) User's Group will be held at the Chicago Technical Center (CTC), 3140 South Federal Street, Chicago, Room 100, on November 28, 1990, starting at 9:30AM. The agenda for this meeting is enclosed. It is intended to accommodate the three objectives of the User's Group;

- To provide a forum for TEM/RECAP users on member roads to exhange information on potential applications of TEM/RECAP.
- To allow AAR staff to demonstrate new capabilities and versions of TEM/RECAP as they are developed and to review our planned activities with our user community.
- To provide a forum for user input concerning future improvements and maintenance requirements for TEM/RECAP.

On November 27, 1990, there will also be a comprehensive TEM workshop in Chicago, in the same place starting at 9:00 a.m. We strongly urge you to attend if possible. If attending, please contact Mr. Som P. Singh (312) 567-3620 at the Chicago Technical Center so that proper arrangements can be made.

Enclosed is a list of all railroad personnel receiving this meeting notice and a copy of the subjects to be discussed in the November 27th meeting. If there are other people on your road who should be included in this User's Group and receive this and future mailings, please let me know so that they can be invited to attend and put on the mailing list. Feel free to invite others from your road to attend the meeting, but please let me know they are attending so that we can provide adequate facilities.

If I can be of any assistance, please call (202)-639-2264.

Sincerely,

M. B. Hargrove

M. B. Hargrove, Director
Engineering Economics

Enclosures (3)

Research and Test Department
50 F Street, N.W., Washington, D.C. 20001 (202) 639-2240

TEM/RECAP User's Group
Meeting Agenda
November 28, 1990

Time	Topic	Presenter
9:30AM	Introduction and Organizational Issues	M. B. Hargrove
9:45AM	Current Railroad Applications of TEM/RECAP Successes - Problems	Greg Stephens CSX/Sealand Intermodal Roger Baugher, NS
	Discussion of New Applications including Barriers to Use	User's Group
11:15AM	Current Status and Future developments of TEM	Som Singh W. F. Drish
Noon	Lunch	
12:45PM	Hands-on tutorial on the TEM/RECAP Control Program version 1.0 (TRCP) and the graphics program PIX2	Al R. Auzmendi
2:15PM	Discussion of User's Needs Training and Support Program Improvements	User's Group
3:30PM	Adjourn	

User Manuals for TRCP v.1.0 and PIX2 (Draft) will be available.
Diskettes for TRCP and PIX2 will also be distributed at the meeting.

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October 26, 1990

Train Energy Model Users
Train Simulation Advisory Committee

Gentlemen:

The Vehicle/Track Resistance research and the other activities related to train resistance have now reached their final stage. All the research results are now available for reporting purposes and for inclusion in the Train Energy Model (TEM).

Frequently, representatives of our member railroads call us with questions relating to the train resistance. Therefore, we have planned a short (one day) Vehicle Track Resistance/Train Energy Model workshop from 9:00 a.m. to 4:00 p.m. on Tuesday November 27, 1990.

This workshop is designed to provide a forum for the discussion of the train resistance information developed under the Energy program. The workshop session will include the following:

- Vehicle/Track Resistance - A Summary Report (This will be published as an AAR Report under the Energy Program),
- TEM - Update and the unit train revenue service validation results,
- AERO Subroutine and its incorporation into TEM, and
- Train Controllers developed by the CIGGT for TEM.

I urge you to ask your staff members involved in TEM/ TOES applications or any other train performance simulation activities to attend the workshop.

Those of you who serve on the Train Resistance Review Committee have been mailed a separate letter from Mr. A. J. Peters regarding the Train Resistance Review Committee meeting on November 26, 1990 (2:00 - 5:00 pm).

Research and Test Department -Technical Center
3140 South Federal Street, Chicago, Illinois 60616 TELEX: 270167 FAX: (312) 567-5286

I will soon be mailing an agenda to you. Meanwhile, should you have any questions, please contact me. I look forward to see you all on November 27.

Sincerely,

David R. Anderson
for Som P. Singh

S. P. Singh

cc: C. E. Taylor
K. L. Hawthorne
R. A. Allen
D. H. Stone
A. J. Peters
G. R. Cataldi
G. B. Anderson
W. F. Drish
R. A. Gielow (Airflow Sciences)
G. E. English (CIGGT)

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Alvaro R. Auzmendi, Engineering Economist, AAR

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Engineering Economics Division

13. ABSTRACT

This is the documentation manual for the TEM/RECAP Data Plotter PIX version 2.0. PIX 2.0 like its previous version (i.e. v1.5), displays the physical performance of a set of TEM simulated trains in a graphical format. Although it performs basically the same functions as the previous version, PIX v2.0 has several new features requested by its users.

In order to support a more thorough study of the way the simulated train performed, more variables (9) can be simultaneously plotted in one graph. For clarity purposes, the individual variable-plots can be distributed within the drawing area. Templates of "favorite" graphs can be created and saved for later reuse. Hard copies of graphs are also possible. These and other features of the PIX v2.0 program make it a state-of-the-art tool and unparalleled in its ability to graphically display train performance data.

14. SUBJECT TERMS	15. AVAILABILITY STATEMENT
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EXECUTIVE SUMMARY

The TEM/RECAP Data Plotter (PIX) Version 2.0 is the graphics program for the TEM/RECAP model. This version of the program improves upon previous versions in that many new features have been added to enhance the user's productivity when analyzing graphically the physical performance of one or more simulated trains in the Train Energy Model, (TEM). The following are some of the more important features.

PIX v2.0 lets the user plot up to nine different variables on one screen at the same time. Previous versions of PIX could plot a maximum of three variables at one time. Usually the x-axis is assigned to either track distance or elapsed time from the TEM output file. This means that in previous versions only two more variables could be selected out of a list of over fifteen different variables from the TEM output file. Many times two variables were not enough to get a clear picture of how the train was performing. The solution, although cumbersome, was to create many different plots, print them on a sheet of paper, and analyze them simultaneously. With PIX v2.0 this process is speeded up by being able to graph up to nine different variables on the same screen.

The nine different variables do not have to come from the same TEM output file. In fact, the user may select up to nine TEM output files, allowing the graphical comparison of performance of different train make ups. Better yet, if the user wants to plot variables from TEM output files and TEM/RECAP track files simultaneously on one graph, PIX v2.0 will enable this also.

Due to the capability of drawing so many plots on the same graph, the graph may be a bit crowded with many lines, and hard to interpret.

Realizing this "problem", PIX v2.0 allows the user to partition the working graph screen into as many parts as the user desires. For example, if the full graphic screen is assigned a 100% working area (i.e. y-axis from 0-100%), then the user has the ability to select any subset within the entire working area for each plot. For example, the user can plot the variables "speed/speed limit" on the bottom half of the screen and "elevation/throttle notch" on the top half, against "track distance" on the x-axis. By distributing the plots on the screen in this manner, a clearer picture of the performance of the train can be obtained.

The user will develop a set of "favorite" combinations of variables within a graph that he or she normally wants to analyze. For example, the user may select a graph containing the variables "Speed/Speed Limit/Elevation/Throttle notch" against "Track position". PIX v2.0 provides this capability with plot templates. A template is a combination of variables, colors, legends, titles, etc. specific for a graph that the user can save to a file for later use with different output files. Once the templates have been constructed, the user can use the same template for many different analyses. This way the user avoids having to select each variable individually every time he wants to graph a file.

Another feature of PIX v2.0 is the ability to create plot files. The plots that the user creates can be saved to a file for later use in presentations, reports, or documents. They can be imported into a word processor package and inserted within the text for later printing, or sent straight to the printer from the DOS command line.

For more detail on a specific graph, a feature allows the analyst to "zoom in" on any horizontal position of the plot. For example, if the user is looking at a 200-mile plot, and wants to analyze closely a stretch from

mile 140 to mile 160, he or she can do so by using the "zooming" function.

All these features have been incorporated in the PIX data plotter without any increase in hardware requirements. In fact, PIX v2.0 can be used with the most common video devices available (i.e. CGA, EGA, VGA, EGAMono, HERCULES card, etc.).

By integrating PIX v2.0 to your TEM/RECAP environment, you will find that displaying graphically the physical performance of your train simulations will yield new insights in your analyses and improve your productivity.

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LIST OF EXHIBITS

1.0 INTRODUCTION

This manual is designed to familiarize the user of the Train Energy Model (TEM) and Rail Energy Cost Analysis Program (RECAP) with the workings of the TEM/RECAP Data Plotter program PIX v2.0. PIX v2.0, like its previous versions, displays the physical performance of a TEM simulated train in a graphical format. Although it performs basically the same functions as its previous versions, many new features have been added to improve the productivity in graphically analyzing TEM simulations.

Some of the most wanted features that previous users of the TEM/RECAP package have requested have been incorporated. These include:

1 - Templates for "favorite" plots.

2 - Ability to plot more than 3 variables at the same time.

3 - Ability to use several files at the same time.

4 - Ability to distribute the plots within the working area.

5 - Hard copies and plot files of the plots.

6 - Better presentation of the graphs. (i.e. colors, legends, titles, size, etc.)

Before demonstrating, the specific commands required to control PIX v.20, let us demonstrate the new capabilities.

1.1 Templates for "favorite" plots

Many times, a user of the TEM/RECAP package will have several "favorite" plots. You might want to look at the combination of:

Speed/Speed Limit/Elevation/Throttle notch
vs.
Track Position

OR

Fuel Consumption/Elev./Gradient/Accel./Braking
vs.
Elapsed Time

A template can be created for each of these cases so that the only variable item is the file from which to read the data. Once the templates are created, they can be used with any TEM output or track geometry file to display the combination of variables specified in the template. Other information also selected in the templates include: labels, titles, colors,

legends, size, etc. The advantage of using templates is that once they are created, they can be reused with new output file(s). There is no need to select the combination of variables to be graphed each time a new output file(s) are analyzed. Just select the template you want to use, the output file(s), and then graph the results.

1.2 Ability to plot more than 3 variables at the same time

PIX v2.0 can plot up to nine different variables at the same time. This feature becomes very handy when analyzing a TEM simulation run. Many times when running TEM on automatic mode and the priority is to follow the speed limits on the track, a plot of Speed Limit/Speed/Elevation/Throttle notch vs. Track Position, will give a good indication of how the train was handled by the simulator.

Drops in speed while the speed limit stays constant, may be explained by lack of motive power which may be revealed by plotting the elevation. By adding the throttle notch plot to the graph, an indication of the train handling decisions is gained. For example, suppose the train was going up a hill and the speed was declining. If the throttle notch of the tractive units was not at a maximum (position 8), then the reason for not keeping up with the speed limit might have been an erroneous decision on the part of the train handling algorithm in TEM and not lack of power of the train.

Exhibit 1.4b on page 9 shows this phenomenon graphically. Here we see that between mile posts 2 and 5 the train starts loosing speed (lower third of the graph, (i.e. speed/speed limit). If we look at the elevation plot (top third of the graph), we see that at that point the train has to deal

with a large grade. At this point, if we look at the throttle notch plot (middle third of the graph), we see that the Automatic Train Handling algorithm in TEM was correct. The throttle notch of the motive power units was at its maximum position (i.e. position 8). In this case, it is obvious that the train is lacking motive power. To make the train reach the speed limit at this spot in the track, we would have to add more power to the train.

For this and other reasons, having the capability to display several variables at the same time is very useful. A word of caution: although the ability to display such a large number of variables at the same time is a nice feature, it can become confusing. It is recommended that you display the plots in combinations of no more than 5 variables at the same time.

1.3 Ability to use several files at the same time

The nine different variables may be selected from one TEM output file or from several output files. Not only you have the option of selecting from several TEM output files but you can also choose variables from TEM/RECAP track files and mix them up simultaneously with variables from TEM output files.

Remember, whatever combination of plots you ask to graph will be plotted, no matter how irrelevant or "interesting" they might be.

This feature becomes very useful when performing sensitivity analysis on different train performance indicators. For example, if one is comparing train makeup strategies versus accuracy in following the speed limits, one might run several TEM simulations altering the composition of the train. That is, changing the number of tractive units and their position in the train, the distribution of the lading, the number of cars in the train, etc., and observing their effect on the performance of the train. Then by using a template of Speed/Speed Limit vs Track Position for each of the output files on the same graph, the user can simultaneously view the resulting effect of different train makeups on the Speed/Speed Limit performance of the train.

For example, **Exhibit 1.3** displays a graph of Speed/Speed Limit/Elevation vs. Track Position for three different TEM output files. The three output files use the same route. Three different train makeups are used for each output file. These are:

PIX00 = 4 leading locomotives
100 cars of 263,000 lbs gross weight
(lower third of screen)

PIX25 = 4 leading locomotives
100 cars of 315,000 lbs gross weight
(middle third of screen)

PIX252= 5 leading locomotives
100 cars of 315,000 lbs gross weight
(top third of screen)

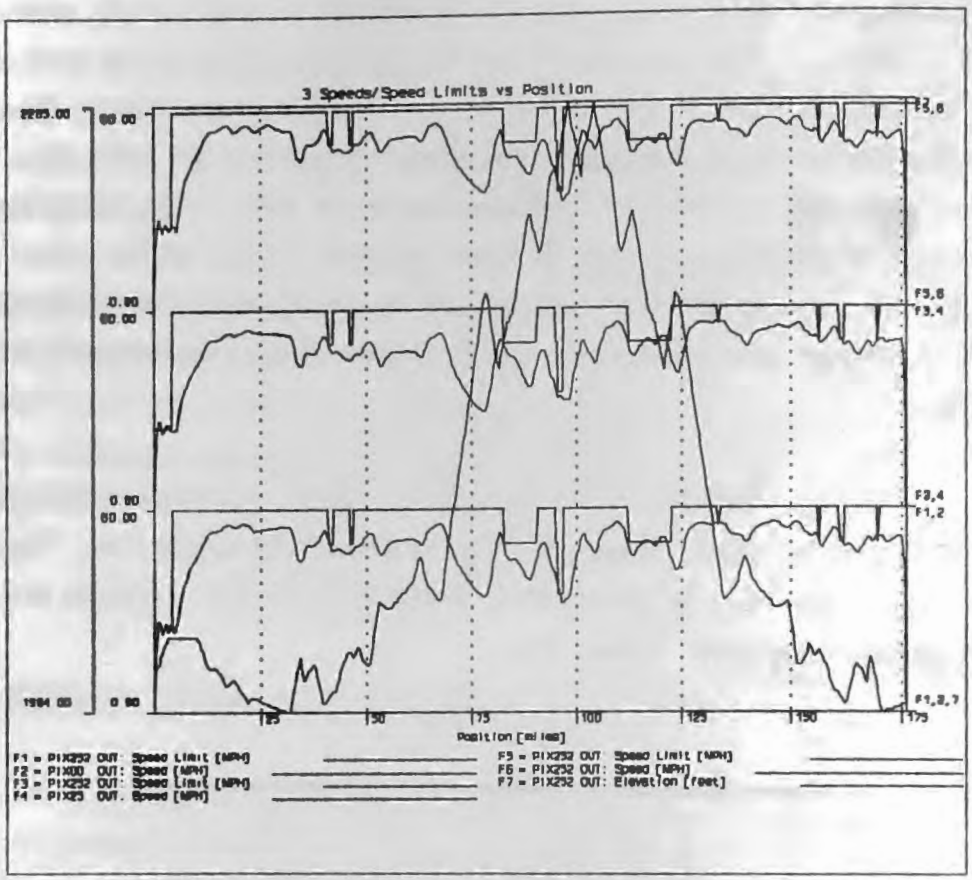


Exhibit 1.3: Speed performance from three output files

The Speed/Speed Limit variables for each output file are each displayed on one-third of the screen. The Elevation variable is displayed using the

whole 100% of the screen since it is the same for all three output files. Obviously, we see that the train with 4 locomotives and 100 cars of 315,000 lbs of gross weight each is the one that has more trouble following the speed limits. The other two perform similarly since the total Hp/ton for each train is essentially the same.

1.4 Ability to distribute the plots within the working area

Due to the number of variables that can be plotted at the same time in a graph, the picture may be a bit crowded at times. Realizing this inconvenience, PIX v2.0 was created with a feature to distribute the individual plots within the screen. That is, if you are plotting a graph of, say, 5 different variables at the same time corresponding to different units on the y-axis, the graph might be hard to read, due to the various lines on the screen. In order to solve this, PIX v2.0 assigns to the y-axis a value of from 0 - 100% work space. Then, when building a template, the user can define subsets of the screen (i.e. 0-50%, 50-100%, 33-66%, etc.) and distribute the variables within these areas.

For example, say you are plotting the graph of Speed/Speed Limit/Elevation/Throttle notch vs. Track Position. If you were to draw all the variables in a 100% scale (i.e. **Exhibit 1.4a**), the graph would look very crowded and hard to read.

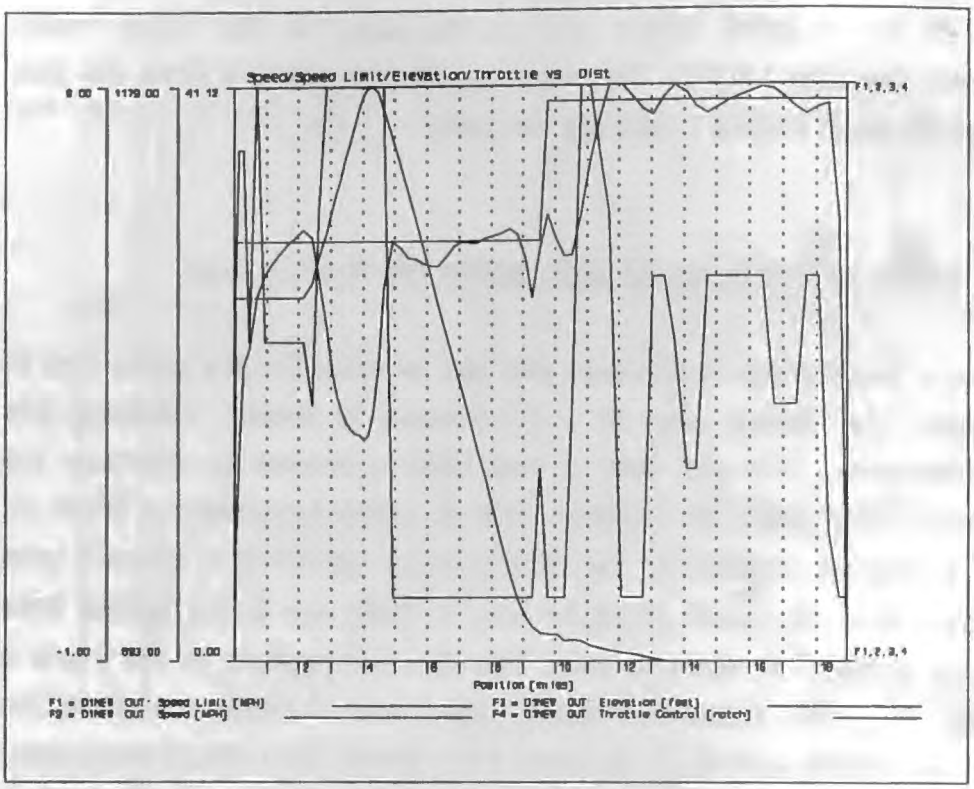


Exhibit 1.4a: Full Screen Representation

However, the graph would look clearer if you divide the screen into three equal parts (i.e. 33% of y-axis each). Then you can plot Speed/Speed Limit on the bottom third, "throttle notch" for the leading locomotives on

the middle third, and "elevation" on the top third. This is shown on **Exhibit 1.4b.** As you can see, the graph is clearer and easier to read than the full-screen representation. You can partition the graph in as many parts as you feel you need.

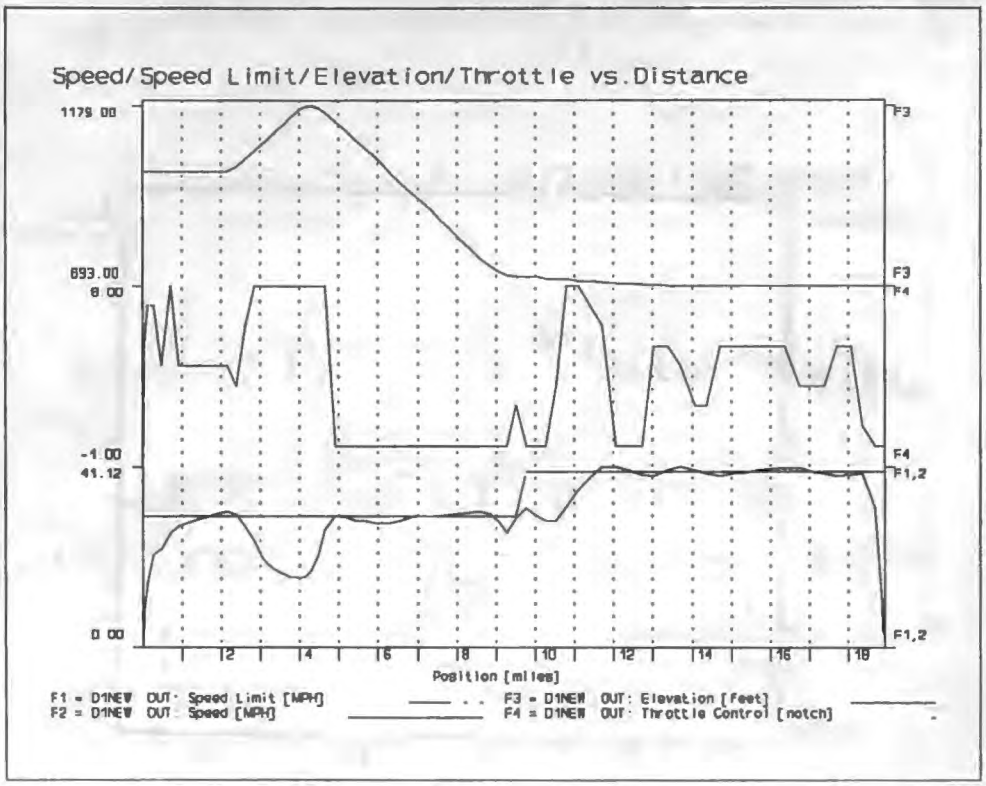


Exhibit 1.4b: 3-screen representation

1.5 Hard copies and plot files of the plots

PIX v2.0 offers the ability to create hard copies of the graphs on paper and on diskettes. For quick review of the graphs on paper, PIX v2.0 has the "screen dump". A screen dump will yield a quick draft of the graph currently displayed on your screen. **Exhibit 1.5a** displays a screen dump of a graph using the template Speed/Speed Limit/Elevation/Drawbar force vs. Track Position, partitioning the y-axis into three 33% areas.

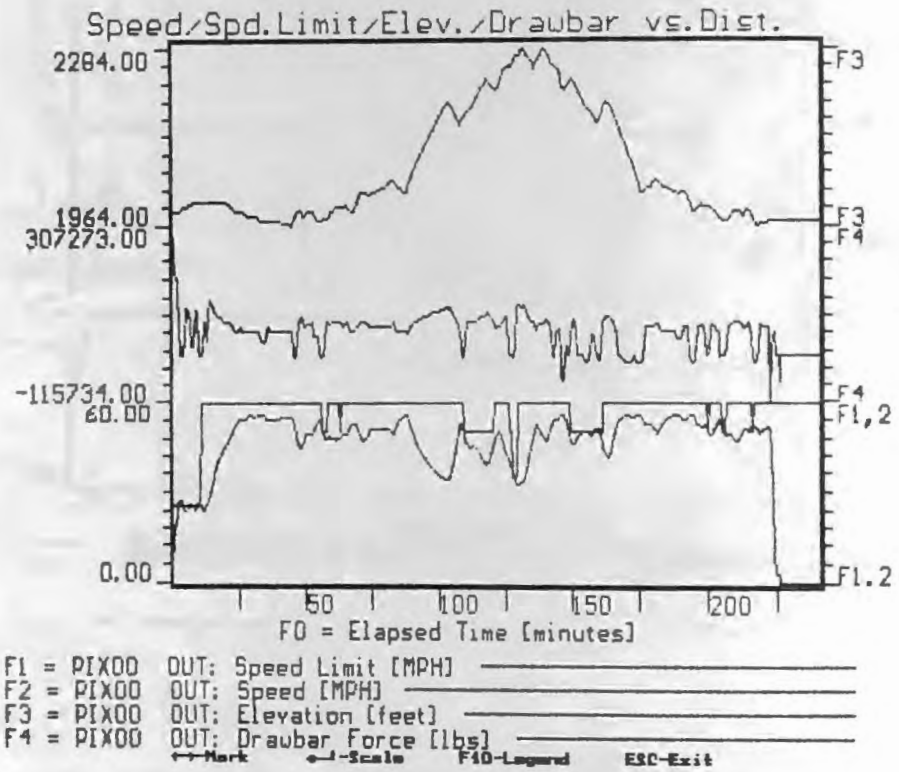


Exhibit 1.5a: Screen dump representation

For a more "polished" representation of the graph, the user can save the graph to a file and then import it to a word processor and use the print capabilities of the word processor. **Exhibit 1.5b** shows the same graph "screen dumped" before, now printed within a word processor.

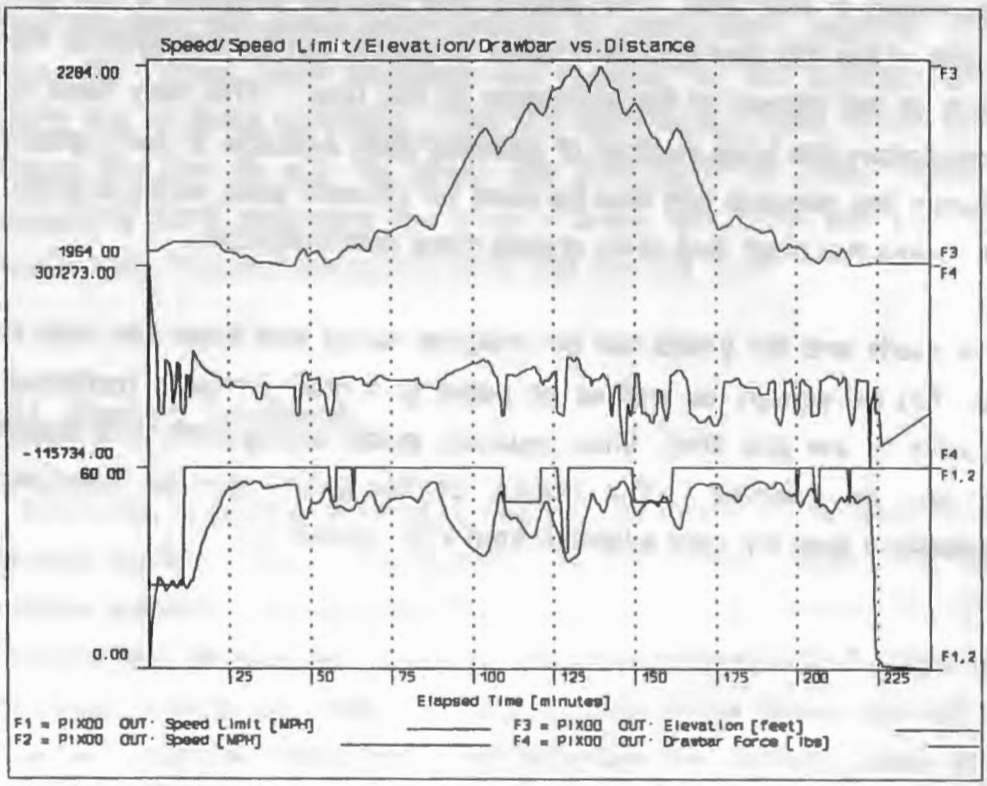


Exhibit 1.5b: Printed from a word processor

If you have a color printer or a data plotter, you can also print the graphs in a color format.

1.6 Better presentation of the graphs

To give the graphs a more "professional look" several features were implemented in PIX v2.0. The graphs now can be assigned a title and the size of the title can also be varied. Legends can be displayed at the bottom of the screen at the discretion of the user. This was done to accommodate the large number of potential plots available in each graph. Different line patterns can also be used for different plots within a graph. This makes the black and white graphs more distinguishable.

The x-axis and the y-axis can be assigned labels and these can vary in size. On the screen, as well as on paper (if a color plotter is available), the color of the plot lines, titles, legends, graph background, and labels can also be selected. The display of the graph can be improved substantially over the best available from PIX, version 1.0.

2.0 EXPLORING PIX v2.0

In Chapter 1 we saw an overview of the new capabilities of PIX v2.0. This section is designed to accompany the execution of PIX v2.0 on your computer. We will demonstrate the detailed capabilities and commands needed to exploit program PIX v2.0. This section will discuss extensively the task of creating templates using different combinations of variables and selecting the global graph settings of colors, titles, legends, screen size, etc. Then, once templates are created, we will generate graphs using one of these templates. We will demonstrate some of the special things you can do with the graph like zooming in on certain positions, displaying more accurately the x or y scale, etc. The first task is to create your "favorite" templates which you use the most.

2.1 Creating Templates

When you enter PIX, the first screen you will see is the template display screen (**Exhibit 2.1a**). The last line on the screen displays the menu options specific to this screen. This menu options line appears on all the screens and displays the choice of commands available to the user at a particular time in the model. On the top part of the screen you will see the name and the description of the templates that currently reside in the PIX system. The name can be any alphanumeric string of up to eight characters long, and the description is a message indicating what the template contains. If more than nine templates exist, you can scroll the screen up and down with the arrow keys to see all of them.

On the bottom half of the screen, the variables corresponding to each template will be displayed. As you move the bar from template to

template (using the arrow keys in the note pad), you will see the variables assigned or programmed to each template.

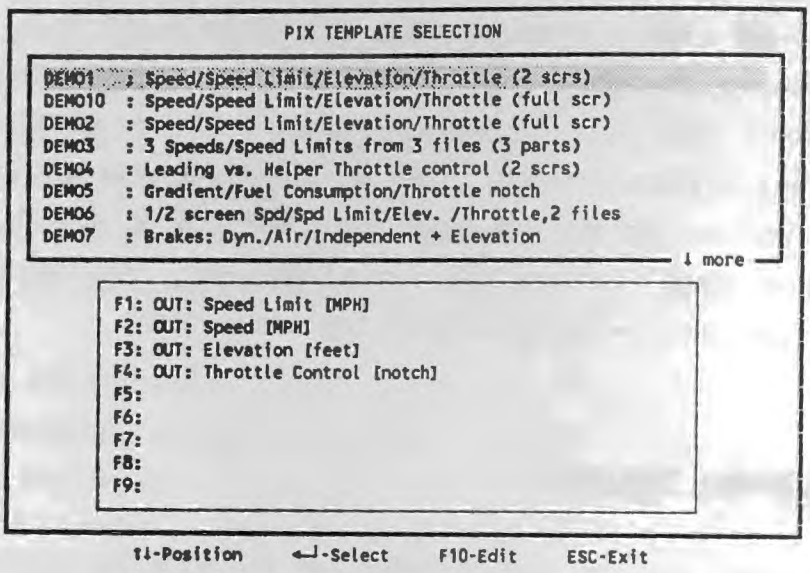


Exhibit 2.1a: PIX Template Selection

To create a new template, put the template selection bar over any template and press the **"F10"** key. The default settings of the template

you will have on the screen will be the ones of the template you had the bar over when you pressed the "F10" key.

For example, if you put the selection bar over "DEMO1: Half Screen Speed/Speed limit/Elevation/Throttle" and press the "F10" key to edit, the screen you will see will be the **"Template Edit Screen"** (**Exhibit 2.1b**).

Exhibit 2.1b: Template Edit Screen

2.1.1 Global graph settings

The first task is to name the template to any name you like in field **"SHORT NAME"** of the **"global graph settings"** section. In this section you specify the colors, sizes, x-axis, title and other general information for the graph.

Some of these input fields have a pop-up options menu available to them. These are:

Title Color, Label Color, Background,
Primary x-axis, Minor x-axis and axis color

The pop-up menu can be accessed by placing the entry bar on one of the fields and hitting the "Enter" key. Once in the options menu for a field, you can select any of the options (using the arrow keys) by placing the marker on the option you want and pressing the "Enter" key.

A few fields deserve explanation. The field **"Legend State"** is an ON/OFF field which you can change with the "SPACE BAR" key. When ON, the legend will appear when you first see the graph on your screen

and consequently will reduce the working area for the displayed graph (i.e. by placing the legends on the bottom of the graph, it will make the y-axis smaller). The legend can also be toggled ON/OFF while looking at the graph output screen. That is, if you saved the template with the legends OFF option, while looking at the graph, you can bring the legends back to the screen by pressing the "F10" key.

The fields where a "size" is requested also need some clarification. PIX considers the entire screen as 100% scale. The size of the title and labels is input in a percent (%) format. You will notice that these two fields have a "**/10**" beside them. The value you enter here will also be divided by 10 to account for decimals of a percent. This means that if you input "**20**" in this field, then PIX will assume that you would like the title size to represent 2% of the entire plot screen. (Note, 20 and 15 are good numbers to input for "**title size**" and "**label size**" respectively)

The fields "**Primary x-axis**" and "**Minor x-axis**" relate to the units on the x-axis. The reason for having a primary and a minor x-axis is to account for the fact that the user can plot variables from TEM output files and track (TRK) files simultaneously. For example, if you are graphing "elevation" from the TEM output file and "gradient" from the track file against track position, you will need to select an x-axis from both files (i.e. track position from the OUT file and from the TRK file).

2.1.2 Assigning variables to function keys

After you finish customizing the global graph parameters to your taste, you can start specifying the variables you would like to include in this template. This is done by assigning or programming a function key (i.e.

F1..F9) to a TEM/RECAP variable. This is done so that when the graph appears on the screen, you can toggle ON/OFF each of the plot lines (variables) by pressing its corresponding function key. This becomes very useful when plotting many screen at the same time on the same screen. To avoid "overcrowding" of the variables, once you are finished looking at some of the variables, you can toggle them OFF by pressing its function key and therefore reclaim the screen space taken by the variable.

Exhibit 2.1.2a shows an example of a variable function definition.

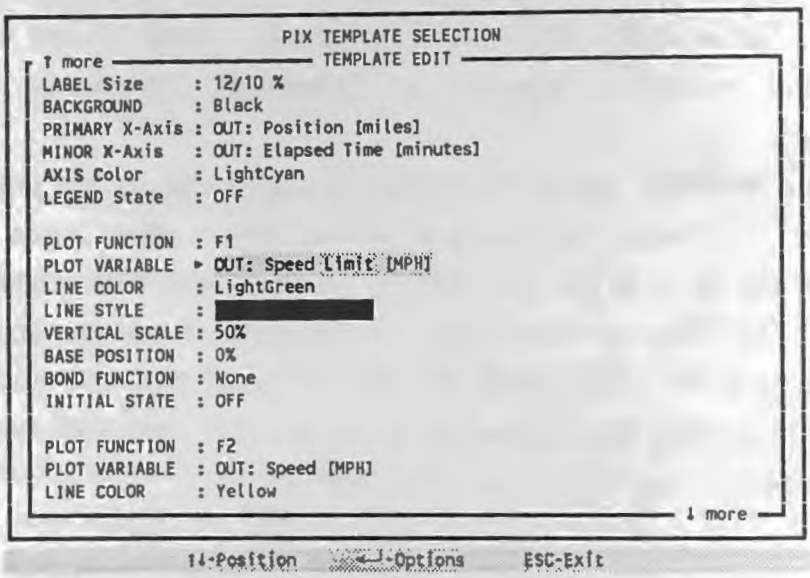


Exhibit 2.1.2a: Fields to program a function key

In this exhibit, the "F1" key is shown. The first field is trivial and it just

says which function key we are editing. This field is non-accessible.

The "**plot variable**" field defines the variable to assign to the "F1" key. It can be modified by pressing the "Enter" key and selecting from the available options menu (**Exhibit 2.1.2b**). To select one of the variables out of the list, place the bar over the desired variable and hit the "Enter" key.

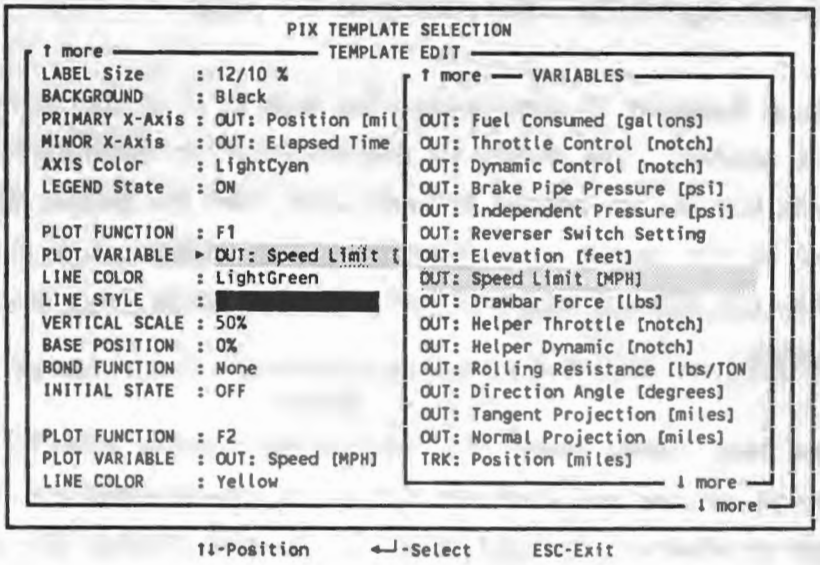


Exhibit 2.1.2b: Options menu for "Plot Variable" field

The "**line color**" and the "**line style**" fields define the color of the plot line and style, respectively. They also have an options menu showing the different colors and line styles available. Note that some line styles will not be captured by some videos and printers.

The "**vertical scale**" and "**base position**" fields are related to the partitioning of the graph screen into subsets and drawing within these subsets (see section 1.4). The "vertical scale" defines the height (i.e. within the y-axis) of the plot within the 100% scale of the entire y-axis. The "base position" defines the starting point on the y-axis for this plot. For example, if you wanted to plot the variable "Elevation" reduced to a 50% scale (half the screen) and start at a base of 0% (i.e. x-axis) then the plot would look like **Exhibit 2.1.2c**. This graph shows Speed/Speed Limit on the top half of the screen and Elevation on the bottom half of the screen plotted against the Track position on the x-axis.

The "**bond function**" is used to bond the units of a variable to the units of another variable. The reason for this is that if two variables have the same units but are not bonded to each other, then the picture displayed might not be the correct one. Remember that variables may have the same units but different maximum and minimum values (e.g., Speed and Speed Limit).

The last field, "**initial state**", can take on two values: ON/OFF. This entry selects whether you want the plot line to appear when you first see the graph or whether you want to switch the plot variable ON with the function key representing this variable. You will understand the reason for this feature if you select a template that has many variables and you turn them on all at once. The picture you see will be difficult to analyze and probably make a wonderful "**collage**".

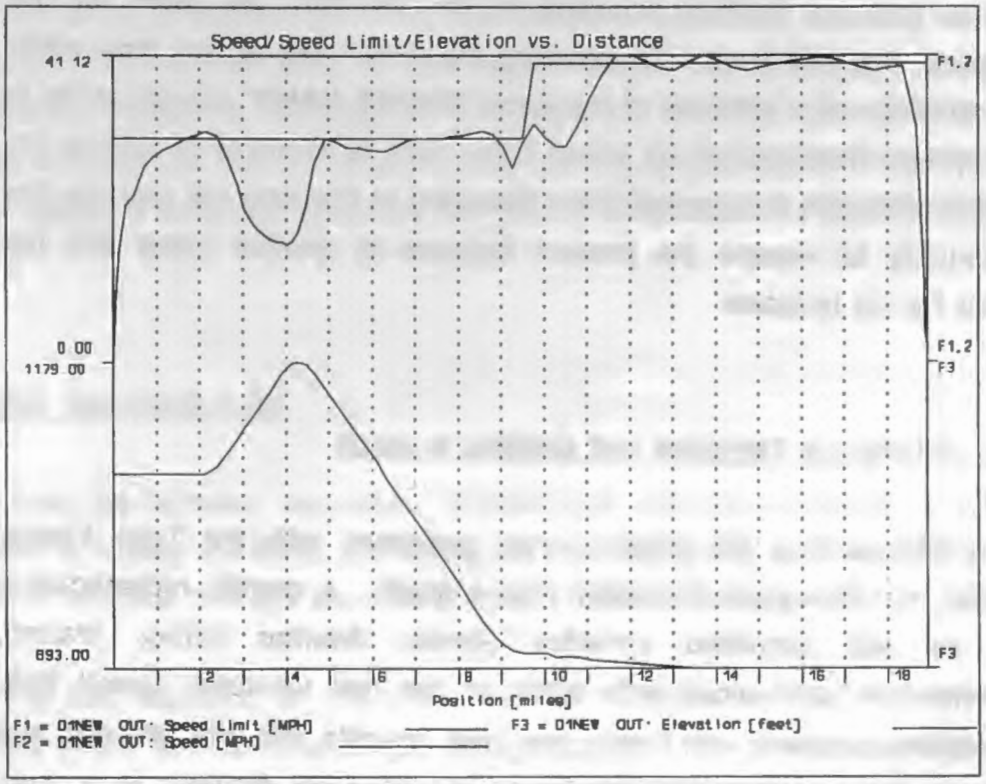


Exhibit 2.1.2c: Distributing the plots on the working screen

To traverse through the function key definitions and program other function keys, you can do so with the arrow keys, PgDn/PgUp keys, "Enter" key, and F1..F9 keys. The same procedure we discussed for the

F1 key applies to all the other function keys.

Once you are finished selecting all the variables you want for the template, you can save it by pressing the "ESC" key at any time within the template. If a template of the same **"SHORT NAME"** already exists in the system, then you will be asked if you want to overwrite or replace the old template with the present one. **Esc**aping at this time will give you the opportunity to rename the present template to another name and not affect the old template.

2.2 Selecting a Template and creating a graph

To analyze how the physical train performed with the Train Energy Model, no display can be better than a graph. A graphic representation of the key simulated variables (speed, drawbar forces, braking, acceleration, etc.) along with some of the real variables (speed limit, elevation, curvature, etc.) can give new insights into the analysis and explain the operating decisions taken by the TEM simulator in a more comprehensive way. After all..."a graph is worth a thousand words".

To generate a graph with PIX v2.0 takes a three step process:

1 - Selecting a template

2 - Selecting a file(s) for each variable

3 - Displaying the graph

2.2.1 Selecting a Template

You select a template from the "**PIX template selection**" screen (Exhibit 2.1a). The options menu on the bottom line of the screen has all the options available at this stage of the program. To select a template, put the selection bar over the one you want to use and press the "Enter" key. To **delete** a template, place the bar on the template and press the "Del" key.

2.2.2 Selecting a file

Once the template has been created, and you have selected it, you need to specify the file(s) containing the variables in the template. This is done from the "**PIX file selection**" screen (**Exhibit 2.2.2a**).

The files displayed on the bottom half of the screen are all the current TEM output files residing in "c:\trcp\pgm\OUT.ZIP", the default specified in section A.1). The OUT.ZIP file contains all the TEM output files in the TRCP environment (for more information see the TRCP manual, AAR R-743). Note that if you had selected a variable from a TEM/RECAP track file, then the files displayed would have been track files in the TRK.ZIP archive.

If you want to select files from other directories in your drive, you can travel through your drive by selecting the "..\" file. Each time this is done, you will "climb up" one sub-directory in your drive. Once you find the file

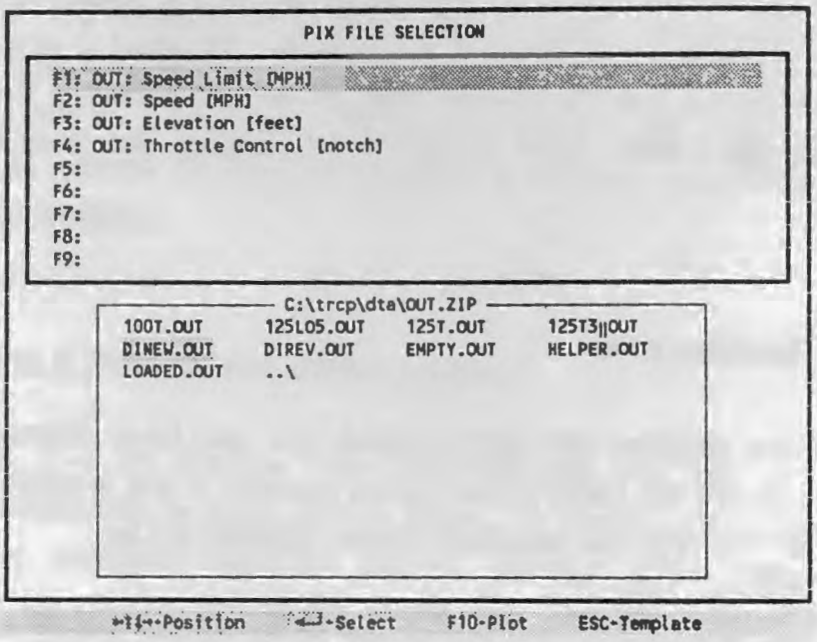


Exhibit 2.2.2a: PIX File Selection Screen

you want, press the "Enter" key and it will be selected. For example, if we select file "D1NEW.OUT" for variable "Speed Limit" from the list, then **Exhibit 2.2.2b** displays the results. The "F1" key for "Speed Limit" is

assigned file "D1NEW.OUT" and the bar moves to the next variable to be assigned a file.

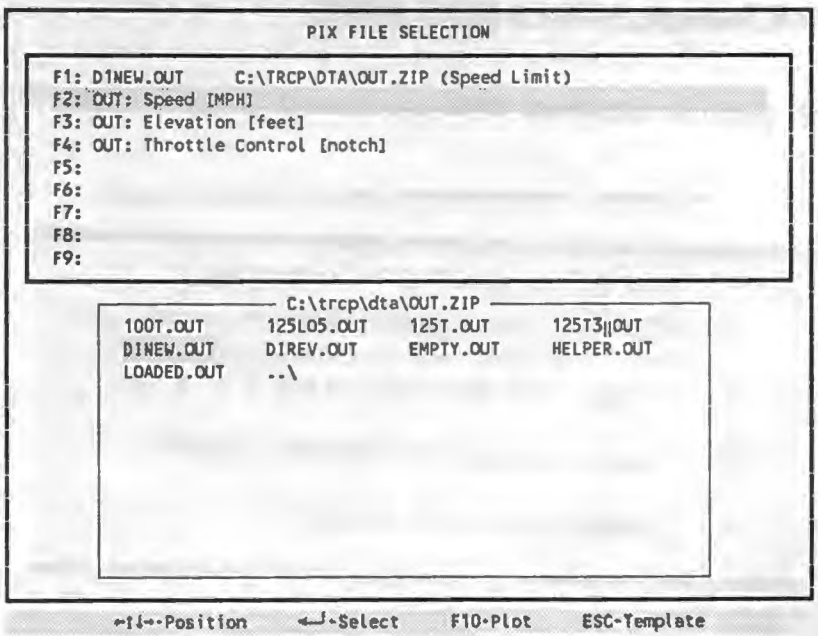


Exhibit 2.2.2b: Selecting a file

2.2.3 Displaying the graph

Once you have assigned all the variables to file(s), to view the graph just press the "F10" key. A "Please Wait" message will appear on the screen while PIX reads the file(s). A few moments later, the graph will be drawn. Once you finish viewing the graph you can exit by pressing the "ESC" key.

2.3 Special features within a graph screen

Once the graph is displayed, there are several things one can do:

1 - "Zoom in" on a specific position on the track

2 - Obtain more accuracy on the Y or X axis

3 - Toggle legends and variables ON/OFF

4 - Create hard copies of graphs

2.3.1 "Zooming in" on a specific position on the graph

Many times a graph may look a bit crowded with too much information, specially when the route you are analyzing is very long. Train variables like throttle notch, curvature, gradient, speed, etc. which vary all the time

will be hard to read when looking at a long stretch of track. To solve this, PIX offers a "zooming" feature which , lets the user look at a particular position on the graph with more detail. To use this feature, while looking at a graph, set the function ON by pressing the "left/right arrow" keys in the note pad. Immediately, you will see a vertical dotted line in the center of your screen. Place the vertical line (using the arrow keys) at the point where you would like to "zoom in". Next, press the "Enter" key and a message will pop-up asking you to specify a delta range (# of miles on each side of the point selected?) for the new graph display.

Delta value in miles: _____

Enter your choice and hit the "Enter" key one more time to see the new display. To return to the original display, use the same procedure but leave the entry blank and hit the "Enter" key. To delete the dotted line, press the "End" key in your note pad.

Bellow, Exhibit 1.4b has been "zoomed in" at 5 miles on the x-axis using a delta range of 3 miles on each side. **Exhibit 2.3.1** is the resulting graph. The x-axis now shows the track from mile 2 to mile 8.

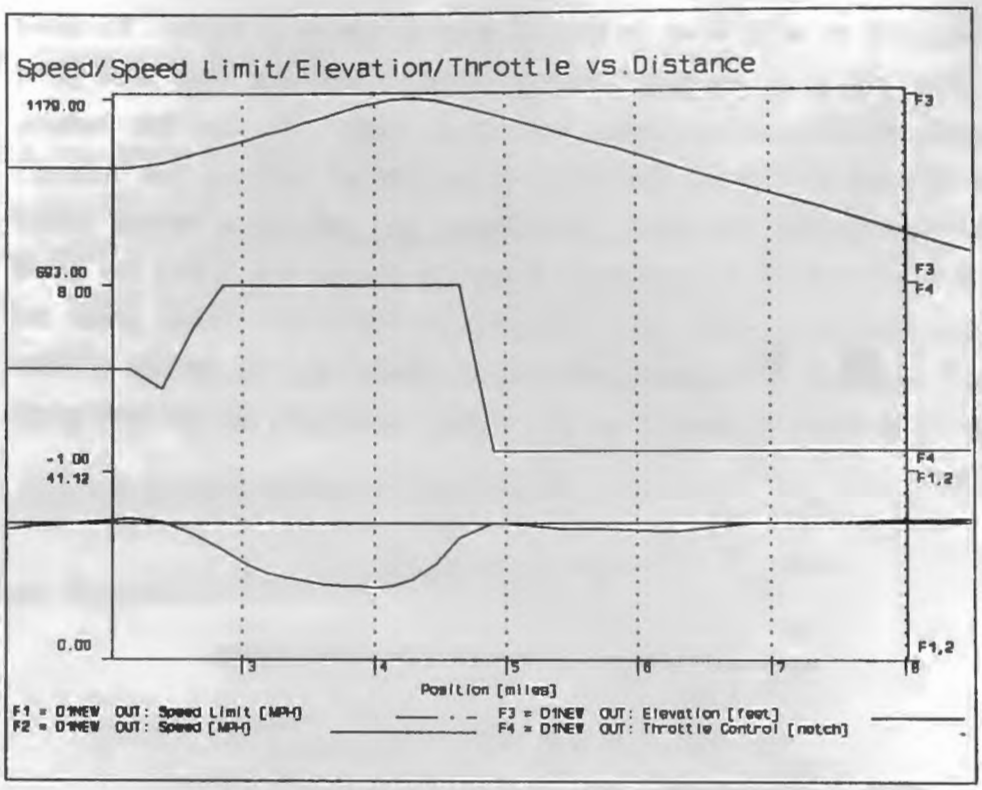


Exhibit 2.3.1: Exhibit 1.4b "zoomed" at 5 miles a 3 mile delta range

2.3.2 More accuracy on the y-axis and x-axis

On any given route, the range of some variables, like drawbar forces, can vary greatly. The units on the y-scale or x-scale may not be sufficient to define the exact number within an acceptable range. To

tackle this situation, PIX also includes a feature to display, in more detail, both the units of the y-axis and the x-axis on any of the plots.

For the x-axis scale, the function that turns this feature ON is the "left/right arrow" keys in your note pad. Similarly as in the "zoom" function, as you press either of these two keys, the vertical dotted line will appear and on the bottom-right corner of the screen you will see a more accurate representation of the position of the dotted line in the route. As you move the dotted line through the route, the position in the track will automatically change.

For the y-axis scale, the function that turns this feature ON is the "up/down arrow" keys. Once ON, you will see on the screen a horizontal dotted line (**note** that sometimes the dotted line will appear over one of the axes, making it hard to see. The solution is to move the "up" or "down" arrow keys a few times). Also, displayed on the lower left corner of the graph, the measure for the "F1" variable will be shown. The "F1" key is the default, but if you want to see the units of another variable, hold down the "Alt" key and press the function of your choice. To delete the dotted line, press the "End" key in your note pad.

Exhibit 2.3.2 shows a "screen dump" representation of Exhibit 1.3 now showing the units of the "elevation" and "track position" variables with more accuracy.

2.3.3 Toggle legends and variables ON/OFF

The graphics screen grows smaller as more features are added to the screen, due to the fixed size of the

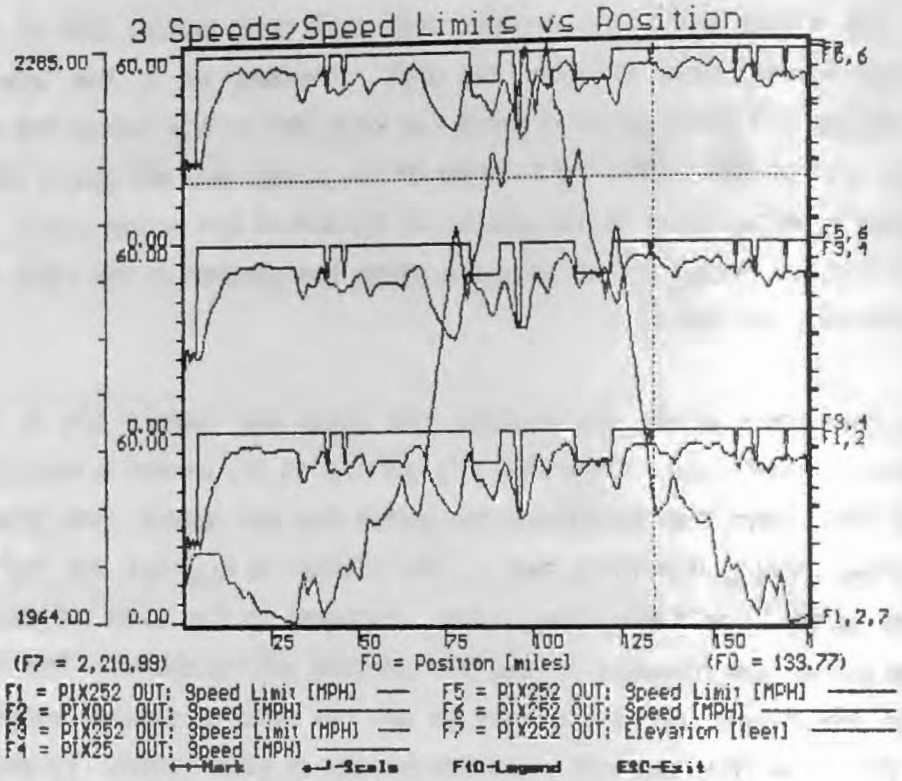


Exhibit 2.3.2: More accuracy on the units of the axis

monitor, if the graph legends are turned ON, then the space used by the legends has to come from the space used by the graph itself. This will yield the same graph but in a smaller scale. Although the graph will be

in a smaller scale, it is recommended that you **do** display the legends, specially when plotting many variables at the same time. To turn them ON/OFF on the screen, press the "F10" key. **Exhibit 2.3.3** displays a "screen dump" representation of Exhibit 1.3 with the legends OFF. As

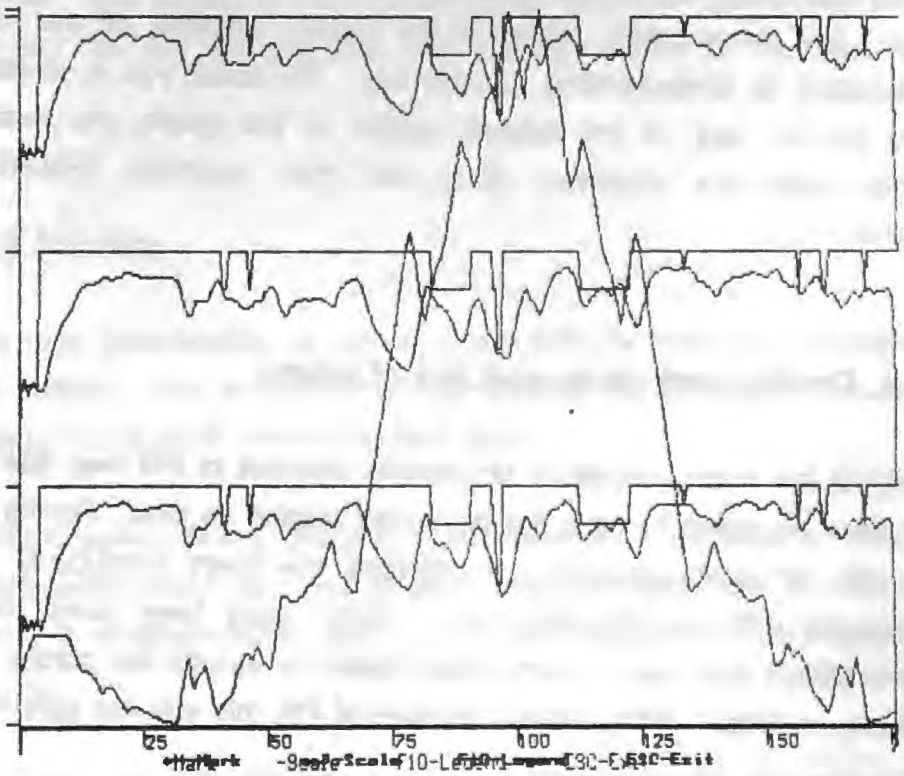


Exhibit 2.3.3: "Screen dump" of Exhibit 1.3 with legends OFF

you can see, the clarity of the graph deteriorates when the legends are OFF.

To avoid overcrowding all the variables in a graph, a feature was built into PIX v2.0 to "erase" plot variables off the screen and later bring them back with the touch of a key. If you remember from the section on building templates (Section 2.1.2), the function keys F1..F9 are programmed to a specific TEM/RECAP variable. You can display or "erase" any plot variable, defined in the current template, off the screen by pressing its corresponding function key. To assist you in identifying each function key, in the legend section of the graph, the available function keys are displayed along with their matching TEM/RECAP variable.

2.3.4 Creating hard copies and files of graphs

One of the major drawbacks of previous versions of PIX was that it did not have an option to save the generated graphs on disk. Saving a file on disk for later reference can improve the users productivity when comparing different simulation runs. Many users have found that for presentations and report writing, they needed to include the graphs within the text or slides. With previous versions of PIX this was not allowed.

PIX v2.0 offers this feature with the touch of a key. To capture a graph on the screen and save it to a file, the user needs to first display the graph on the screen with all its "bells and whistles". Then, while holding the "Alt" key, press the letter "P". A message will pop-up asking for a file path and name. Write in the name of your choice and press "Enter" to save the file.

If all the user wants is a quick hard copy of the displayed graph, there is also an option for this. This option is called the **"screen dump"** option. To use it, display the graph on the screen and while holding the "Alt" key press the "S" key (make sure your printer is ON and that your printer setup is the appropriate one (section A.1)). Immediately you will see the cursor traveling the screen and at the same time sending the output to the printer. The quality of the "screen dump" graph will not be as good as the plot file, but will give the user a rough display of the graph on paper.

2.3.5 A few hints

Some color combinations do not draw well and the plot may not appear on the screen. The solution is to use another set of colors. Usually, dark backgrounds work better than light ones.

We recommend printing plot files from within word processors. Some word processors have very nice features that can manipulate the graphs (i.e. rotate it, enlarge/reduce, etc.) and produce exceptional hard copies of the figures.

A "hot" key was also implemented to exit PIX temporarily and return to the Disk Operating System (DOS). This key is the combination "Ctrl/F1". This feature is useful when you need to "check" something out in your drives and you are in the middle of an analysis with PIX. Memory allowable, PIX will let you do this. To return to PIX (where you left off), type "EXIT" anywhere at the DOS command line.

REFERENCES

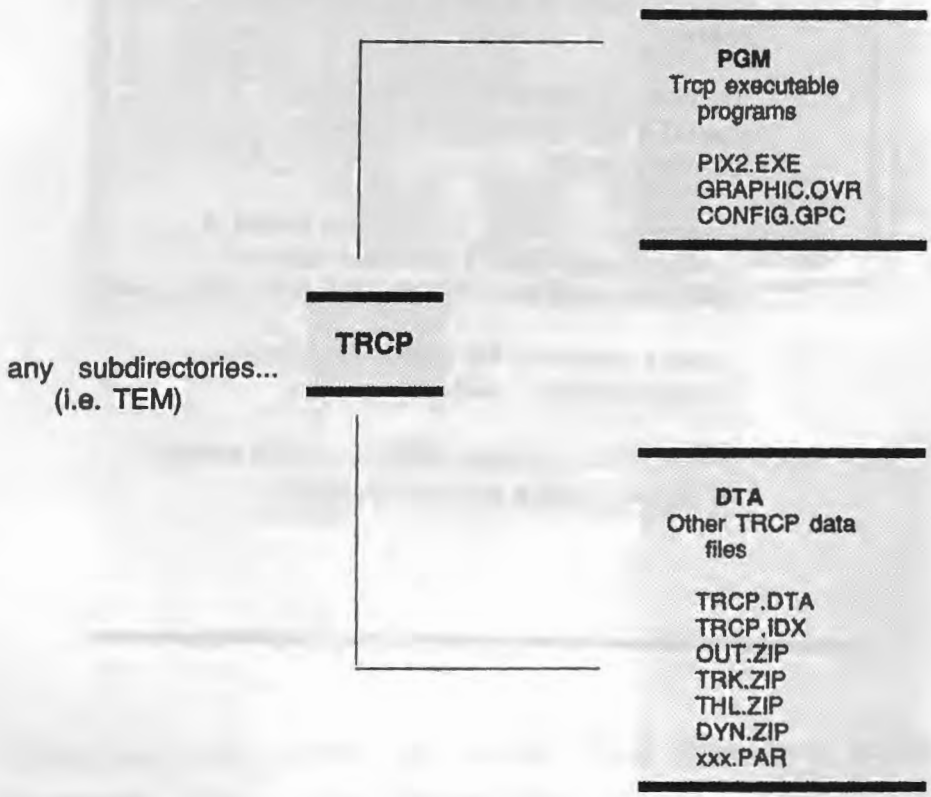
1 - Auzmendi, Alvaro R., TEM/RECAP Control Program (TRCP) Version 1.0 -- User's Manual. AAR Report No. 743; AAR Technical Center, Chicago Illinois; December 1990

APPENDIX A
INSTALLATION OF PIX v.2.0

A: INSTALLING PIX v2.0

The hardware requirements for the PIX v2.0 are very basic. All you need is a PC-XT computer or better, and a CGA or more powerful video device. However, since you will probably be running the TEM/RECAP model as well, the computer will need to have (preferably) a 386 or higher operating system, a math co-processor, and an EGA or VGA video device.

After running the TRCPINST.BAT file distributed with TRCP, your setup will be the following:



A.1 Updating the Internal system defaults

To update the internal system defaults use the following procedure:

1 - Enter TRCP and select from the options menu the function **"PX2"**.

2 - After pressing **"Enter"**, you will be in PIX v2.0. Press **"Shift/F1"** (while holding the Shift key down press the "F1" key) to enter the PIX defaults menu.

3 - Update the paths to the data files (i.e.DTA sub-directory) to reflect your directory setup.

4 - Declare your video device. To make a change, press the "Enter" key and a menu will pop-up.

5 - Do the same for the printer selection and the plotter color selection.

6 - When done, escape (**ESC**) out and select option **3** to save the configuration.

A display of the internal defaults screen is shown in **Exhibit A.1**. The first five entries specify the paths and file names of where your TRCP archive files (.ZIP files) are located in the environment that you are using.

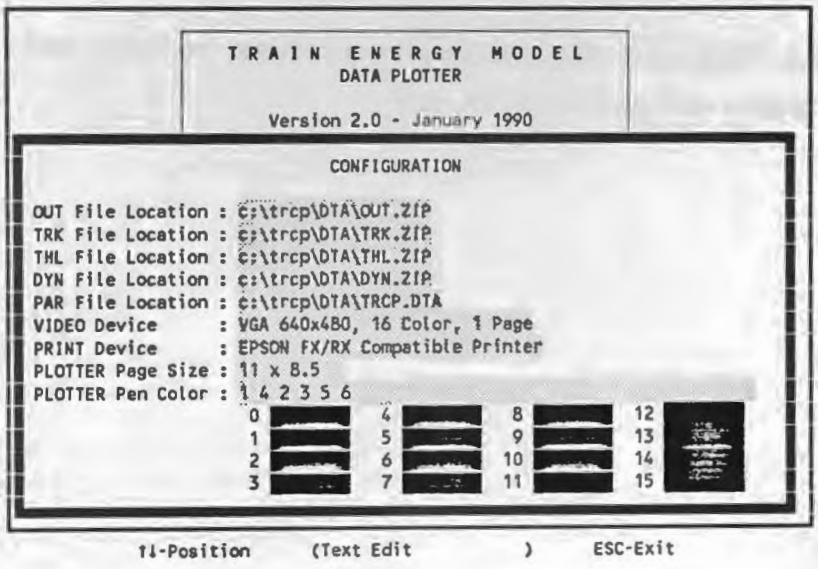


Exhibit A.1: PIX Internal Defaults

In the next two entries you declare your video and printer type respectively. Option menus are available for each. The last two entries are for the plotter. In one you select the paper size and the other the

colors to be assigned to each pen of the plotter.

The way you assign colors to pens is the following. The colors are ordered 0 - 15. To assign a pen to a color, enter the pen numbers (i.e. 16 of them), separated by blanks, in such a way that the fifth pen number you enter will be assigned color 4 (i.e. colors start at 0). For example, Exhibit A.1 shows that pen 6 will be assigned color 5.

After you have gone through the previous setup, you are ready to start plotting graphs with your new PIX v2.0.