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Unit Performance Assessment System Testbed: Technical Report

University of Central Florida Institute for Simulation and Training

INSTITUTE FOR SIMULATION AND TRAINING

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Unit Performance Assessment System Testbed

Technical Report

IST

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INTRODUCTION

This document is a draft of the technical report required as a deliverable under DARPA contract N61339-90-C-0084, entitled **"UNIT PERFORMANCE ASSESSMENT SYSTEM (UPAS) TESTBED"**. First, it enumerates the project objectives as specified in the contract. Then, it describes the implemented capabilities of the testbed to meet the stated project objectives. The detailed functional description for the enhanced or newly implemented UPAS modules are then described in the appropriate sections in this document.

ORIGINAL PROJECT OBJECTIVES

The original objectives of this project are:

1. Upgrade and assure compatibility of UPAS to SIMNET Version 6.0 Protocol

2. Perform UPAS software refinements and enhancements to improve support for After Action Reviews (AARs)

3. Improve UPAS's data collection methodology

4. Investigate techniques for integrating SIMNET Terrain Database information into UPAS

5. Provide the capability for linking UPAS data with the CSS Statistical Software Package or the Statistical Package for the Social Sciences (SPSS)

PROJECT ACCOMPLISHMENTS

This section addresses the objectives as mentioned above and describes what have been accomplished with respect to those objectives. The description is broken down into tasks as detailed below:

Upgrade UPAS to SIMNET Version 6.0 Protocol

The task for upgrading UPAS to SIMNET Version 6.0 was subcontracted to and performed entirely by Perceptronics. Under this task, an evaluation of four ethernet controller boards was made and the 3COM board was selected as the network interface board used by UPAS. A detailed report for the network interface board evaluation is shown in Appendix C. The UPAS software was successfully upgraded to SIMNET version 6.0. However, due to the switching over of the SIMNET T-site at Ft. Knox to SIMNET version 6.6, the upgraded 6.0 software cannot be thoroughly tested in a real exercise

environment, though it has been tested in a more limited environment in IST's laboratory. With IST's coordination and review effort, Perceptronics has also completed in-line documentation to the UPAS source code to enhance its maintainability. An updated UPAS User's Manual for SIMNET version 6.0 has also been produced by Perceptronics.

Enhance UPAS for After Action Reviews

Four new After Action Review Aids have been implemented and integrated into UPAS. They are: Battle Scorecards, Battle Flow Display, Exercise Timeline and Battle Snapshot Display. These AAR aids can operate at platoon level exercises. Another module (Control Measures Module) has also been implemented and integrated into UPAS to allow the user to input control measures into the UPAS database. The entered control measures can be used by the AAR aids for display and computation purposes.

The detailed functional description for these modules is described in the appropriate sections in this report.

Improve UPAS's data collection methodology

IST has implemented data filtering and integrated that into UPAS data collection. It allows the user to specify a list of vehicle IDs that can be used as a data filter to filter data packets from the network. IST has also identified and recommended the use of a data compression utility to further compress the data files to improve data storage efficiency. For more detailed description on the use of vehicle IDs for data filtering and data compression, refer to the appropriate sections in this report.

Integrate SIMNET Terrain Database into UPAS

The Plan View Display module has been enhanced to integrate Ft. Knox Terrain Database into UPAS. Terrain features, such as tree lines, roads, rivers, buildings, etc. are extracted from the terrain database and displayed in the viewport before vehicle movements and activities are replayed on top of the terrain map. More detailed information is presented in the appropriate section in this report.

Link UPAS data with Statistical Software Packages

IST has investigated and verified the feasibility of exporting UPAS data in a format that is accessible to standard statistical software packages, such as CSS and SPSS. More detailed information

can be found in the appropriate section in this report.

ADDITIONAL PROJECT GOALS FOR FIRST CONTRACT MODIFICATION

The UPAS contract was modified in March 1991 to include additional project goals as listed below:

1. Upgrade UPAS to SIMNET version 6.6

2. Support performance measurement for higher echelon exercises

3. Support performance measurement for aviation combined arms environment

4. Support performance measurement for training research purposes

To fulfil the project goals as stated above, IST has proposed the following research tasks:

1. Integrate terrain display into Battle Flow and Battle Snapshot

2. Upgrade UPAS to work under SIMNET 6.6.

3. Enhance the control measure module to support new control measure types that exist in the aviation combined arms environment with added functionalities to edit and delete existing control measures in the database

4. Information presentation for higher echelon AAR aids

5. Line of sight display

6. Data filtering techniques for higher echelon exercises

PROJECT ACCOMPLISHMENTS FOR FIRST CONTRACT MODIFICATION

This section addresses the research tasks as mentioned above to fulfil the additional project goals arising from first contract modification and describes what have been accomplished with respect to those research tasks. The description is broken down into sections as described below:

Terrain Display in Battle Flow and Snapshot

The terrain display capability has been successfully incorporated into Battle Flow and Battle Snapshot modules. The Ft. Knox terrain database is used in such displays. Please refer to the functional description for these two modules on how to invoke the

terrain display capability.

Upgrade UPAS to SIMNET Version 6.6 Protocol

This task is very crucial for demonstrating the usefulness and functionalities of UPAS to operate in a real exercise environment as the prior version of UPAS for SIMNET 6.0 has never been tested in a such an environment. Initially neither IST nor the government can get SIMNET 6.6 header files and the associated software that are required for the upgrade. This had caused considerable delay in upgrading UPAS to SIMNET 6.6. When the SIMNET 6.6 header files and software finally arrived, IST was able to proceed with the UPAS upgrade. The upgrade effort was finally completed and the upgraded UPAS software was installed successfully at the SIMNET T-site at Ft. Knox to undergo thorough testing in the real exercise environment.

Control Measure Module Enhancement

To support new control measure types pertaining to the aviation combined arms environment, the Control Measure module has been enhanced to support the following control measure types: Air Coordination Area, Combat Service Support Area, Obstacle and Minefield. The Planview Display module has also been enhanced to display control measures. The ability to edit and delete existing control measures in the database has also been added to the Control Measure module. Please refer to the functional description for these modules in this document for more detailed information.

Information Presentation for Higher Echelon AAR Aids

The Platoon Organization module has been enhanced to allow an attached platoon and a company HQ in addition to the previously defined platoon 1, 2, 3. Each platoon can have a maximum of six member vehicles as opposed to four previously allowed. The enhancement also allows the user to identify the member designations in a platoon and the company HQ; Specifically, they are the platoon leader and platoon sergeant in each platoon and the company commander and company executive in the company HQ.

All the AAR modules have been enhanced to support company level exercises. At the company level, the Battle Flow module displays the vehicle traces and the Battle Snapshot module displays the snapshots for the platoon leaders, platoon sergeants, company commander and company executive for all the platoons and company HQ for a given company. Similarly, at the company level, the Exercise Timeline module displays the timelines for all the

platoons and the company HQ for a given company with paging capability to page through all the display pages.

The vehicle id legend area has been made scrollable in order to accommodate the display of the increased number of vehicles at the company level. The terrain display can be turned on or off by the user at will.

The Alps printer has been added to the list of printers supported in UPAS.

The functional description for the affected UPAS modules have also been updated in this document to reflect these added functionalities.

Line of Sight Display

The Line of Sight display capability has been implemented in Battle Snapshot. It allows the user to determine whether line of sight is blocked by the terrain between an observer and a target. Refer to the Line of Sight section in this document for more details.

Data Filtering and Collection for Higher Level Exercises

An improved data collection and filtering technique has been implemented in UPAS enabling it to handle higher data rates and minimize the loss of critical data packets. Refer to the section on Improved Data Collection and Filtering in this report for more details.

ADDITIONAL PROJECT GOALS FOR SECOND CONTRACT MODIFICATION

The UPAS contract was modified in June 1992 to include additional project goals as listed below:

1. To support training situations in which both the BLUFOR and REDFOR units are composed of trainees and also in situations where the REDFOR units are SAFOR units for which training feedback is desired.

2. To display in the Exercise Timeline the tactical radio communications data that have been loaded into the UPAS database.

PROJECT ACCOMPLISHMENTS FOR SECOND CONTRACT MODIFICATION

This section addresses the research tasks as mentioned above to fulfil the additional project goals arising from second contract modification and describes what have been accomplished with respect to those research tasks. The description is broken down into sections as described below:

AAR Aids for REDFOR Units

In order for UPAS to support training feedback for both the BLUFOR and REDFOR units as well as SAFOR units that might be part of the REDFOR units, IST has made changes to the Battle Snapshot, Battle Flow, and Exercise Timeline modules to allow the user to enter the Force (Blue or Red) for which the AAR display will be used. If Red Force is selected, information for the REDFOR units will be displayed in the AAR displays. The type and format of the information displayed are similar to those when Blue Force is selected. Changes have also been made to the Platoon Organization module to allow the user to define platoon organization for the REDFOR units in the same manner as is defined for the BLUFOR units. The functional description for the affected UPAS modules have also been updated in this document to reflect these changes.

Display Communications Data in Timeline

The Exercise Timeline module has been enhanced to display tactical radio communications data that have been loaded and made available in the UPAS database - "COMMO" Table. The exercise timeline can retrieve and display this information on the communication event line for each appropriate company/platoon. Two different symbols are used for the display representing the two different types of communications (Report and Order). These two symbols also appear in the legend area at the bottom of the timeline display. The functional description for the Exercise Timeline module has also been updated in this document to reflect these changes.

ADDITIONAL PROJECT GOALS FOR THIRD CONTRACT MODIFICATION

The UPAS contract was modified in September 1992 to include additional project goals as listed below:

1. To implement Firefight Display for direct and indirect firing

events for a SIMNET exercise

2. To add contour line display to the terrain map employed by each of the UPAS map displays

3. To enable UPAS to run on different SIMNET terrain databases

PROJECT ACCOMPLISHMENTS FOR THIRD CONTRACT MODIFICATION

This section addresses the research tasks to fulfil the additional project goals arising from third contract modification and describes what have been accomplished with respect to those research tasks. The description is broken down into sections as described below:

Implement Firefight Display

To implement Firefight Display for direct and indirect firing events, a new AAR module for Firegight Display has been created and incorporated into UPAS. The detailed functional description for the Firefight Display module is described in the appropriate section in this report.

Add Contour Line Display

The contour line display capability has been integrated into the following AAR modules: Planview Display, Battle Flow, Battle Snapshot and Firefight Display. The contour Line and the contour elevation display can be turned on or off by the user. The contour line spacing is adjustable by the user through appropriate menu entry. For more information on the menu entry and selection, please refer to the appropriate section for the corresponding AAR module.

Enhance UPAS for SIMNET Terrain Databases

All UPAS modules have been modified to operate on all SIMNET-compatible terrain databases as opposed to just Ft. Knox terrain. Users can now set the terrain data path to the desired terrain database through the Set Terrain Data Path option in the UPAS menu. Terrain specific information such as the coordinates of the terrain origin, the boundaries of the terrain are read from the database and used by all UPAS modules for vehicle location mapping and terrain display purposes.

ADDITIONAL PROJECT GOALS FOR FOURTH CONTRACT MODIFICATION

The UPAS contract was modified in March 1993 to include additional project goals as listed below:

1. To implement zooming and panning capabilities using the mouse in the four AAR aids - Battle Snapshot, Battle Flow, Planview Display and Fire Fight Display

2. To implement mouse-driven menu selections in the five AAR aids - Battle Snapshot, Battle Flow, Planview Display, Fire Fight Display and Exercise Timeline

3. To identify vehicle icons in Planview Display

4. To improve source and target vehicle selection in line of sight display

5. To save and display AAR screen images

6. To use the mouse as an input device to enter control measures

PROJECT ACCOMPLISHMENTS FOR FOURTH CONTRACT MODIFICATION

This section addresses the research tasks to fulfil the additional project goals arising from the fourth contract modification and describes what have been accomplished with respect to those research tasks. The description is broken down into sections as described below:

Panning and Zooming

IST has made the necessary software enhancements to the four AAR aids - Battle Snapshot, Battle Flow, Planview Display and Fire Fight Display to allow the user to use the mouse to zoom and pan the display to the desired size and location. The new zooming and panning capabilities replace the old "Change Origin" and "Change Scale" functionalities in the four AAR aids. For details on how to use zooming and panning in these four AAR aids, refer to the appropriate sections in this report.

Mouse-driven Menu Selection in AAR Aids

IST has made the necessary software modifications to implement mouse-driven menu selections in the five AAR aids - Battle Snapshot, Battle Flow, Planview Display, Fire Fight Display and Exercise Timeline. The mouse-driven menu selections include the selection of units, printer configuration setup, terrain option selections and other parameter selections used in the above-mentioned AAR aids. For details on using the mouse-driven menus in these five AAR aids, refer to the appropriate sections in this report.

Identify Vehicle Icons in Planview Display

IST has made the necessary software enhancement to enable the user to identify vehicle icons in the Planview Display. The vehicle icons to be identified include both the friendly and OPFOR vehicles. The mouse is used to select the desired vehicle icon(s) for identification. After selection, a pop-up information box is displayed containing information about the selected vehicles. For details on using the mouse to select the vehicle icons for identification, refer to the appropriate section for Planview Display module in this report.

Improve Vehicle Selection in Line of Sight Display

IST has made the necessary software enhancement to enable the user to select the source and target vehicle icons using the mouse prior to displaying lines of sight in the Battle Snapshot module. The details for using the mouse to select the vehicle icons for Line of Sight display is described in the appropriate section for the Battle Snapshot module in this report.

Saving and Displaying AAR Screen Images

IST has made the necessary software enhancement to allow the user to capture and save the AAR screen images for the five AAR aids - Battle Snapshot, Battle Flow, Planview Display, Fire Fight Display and Exercise Timeline. A new UPAS module, "Screen Image File Display" module, has also been implemented to allow the user to select the desired captured screen images for display. For details on capturing and displaying the captured screen images, refer to the appropriate sections in this report.

Mouse-driven Control Measure Entry

The Control Measure module has been revised to allow the user to use the mouse as an input device to enter control measure information into UPAS. The revised software allows the user to draw control measures as points, multi-segment lines and circles on a terrain map depending on the control measure types. Zooming and panning capabilities with the mouse is also provided. The functional description for the new Control Measure module has been updated in the appropriate section in this report.

ADDITIONAL PROJECT GOALS FOR FIFTH CONTRACT MODIFICATION

The UPAS contract was modified in September 1993 to include additional project goals as listed below:

1. To convert NTC terrain database to PC-compatible format
2. To enhance Plan View Display for use in CAS environment
3. To enhance Exercise Timeline
4. To improve data collection performance to reduce data loss

PROJECT ACCOMPLISHMENTS FOR FIFTH CONTRACT MODIFICATION

This section addresses the research tasks to fulfil the additional project goals arising from the fifth contract modification and describes what have been accomplished with respect to those research tasks. The description is broken down into sections as described below:

NTC Terrain Database Conversion

IST has successfully converted the NTC terrain database to PC-compatible format. Necessary changes were also made to UPAS to make sure that all the AAR modules ran successfully on the converted terrain database.

Planview Display for CAS

IST has modified the Plan View Display module to better address the

needs of the CAS environment. Two Icon Display options were added to the Plan View Display - Individual Icon Display and Aggregate Icon Display. The user can switch to either display option at will when running the module. The Individual Icon Display option displays individual vehicle icons for entity types including rotary-wing aircraft, fixed-wing aircraft, dismounted infantry, tank-class vehicle and others. The Aggregate Icon Display option displays aggregate platoon unit icons for unit types including armored platoon, mechanized platoon and others. For details on using these two display options, refer to the appropriate section in this report on Planview Display module.

Enhance Exercise Timeline

IST has made the necessary software enhancement to the Exercise Timeline module to allow the user to specify the starting and ending times for displaying the timeline graphs. The timeline graph can then be plotted within the specified time limits. For details on how to specify the starting and ending times for the timeline graph and running the Exercise Timeline module in general, refer to the appropriate section in this report.

Improve Data Collection Performance

IST has made the necessary software enhancement to the data collection module to use variable length records in the raw data file as opposed to fixed length records. This reduces the number of bytes required to write to the disk and hence improves the data collection performance. IST has also modified the other UPAS modules to use the variable length records in the raw data file and tested for the proper operation of these modules using the variable length records. The modified modules include the Viewpdu module, NTC conversion module, Index module and all the AAR modules.

Participation in MDT2 Testing

MDT2 stands for Multi-service Distributed Training Testbed. The MDT2 testing was conducted from May 9 to May 27, 1994 at Ft. Knox which is a key MDT2 test location. There were many participants from diverse geographical locations taking part in MDT2 testing, including F16 simulators from Arizona, A10 simulators from Maryland, DFO-MULE laser designators, armored and mechanized vehicle simulators from Ft. Knox D-site. All these simulators communicate with each other using the DSI network. Two UPAS workstations were set up at the Ft. Knox test site to collect data during MDT2 testing and then the data were converted and stored in

the relational database. Various UPAS modules including the AAR modules, Display Graph and Display Table modules were used to analyze the exercise data collected. It demonstrated the capabilities of UPAS as a useful training tool.

BATTLE SCORECARD

Overview and Design Philosophy

Battle scorecards display, in tabular format, the results of direct and indirect fire engagements for SIMNET exercises.

During the design, it is recognized that there are two categories of users that might be using the battle scorecards:

(1) Users with no SQL experience
(2) Users with SQL experience but has no formal programming experience

For the first category of users, ease of use and friendly user interface is the most important consideration. The best approach is to make the scorecard a selectable UPAS menu item, so that All they need to do is to select the appropriate scorecard from the UPAS menu and the scorecard will be displayed on the screen. This type of users are not expected to learn SQL language to be able to produce any of these pre-defined or "canned" scorecards. Obviously, these scorecards need to be pre-defined and integrated into the UPAS menus by other programmers or SQL experts.

For the second category of users (non-programmer SQL experts), they are able to use the SQL commands to retrieve information from the database and display them in whatever format they desire. With their SQL expertise, they have the flexibility to define and customize any scorecards they want. After the scorecards have been defined and integrated into the UPAS menu, they can be used by other users, such as those users under the first category. This can be accomplished through the 'Table Editor' module in UPAS. Typically, each simple scorecard defined through "Table Editor" is associated with an SQL command which retrieves information from the database and display them in a tabular format.

However, each simple scorecard that can be customized and produced through the "Table Editor" can only be associated with one SQL command. The amount of information that can be put into the scorecard is thus restricted to what can be retrieved with one SQL command. For more complicated scorecards that require the use of more than one SQL command to retrieve information from the database, the 'Table Editor' module would not be able to produce the scorecard desired.

Recognizing that the more complicated type of scorecards can only be produced with more than one SQL command, and the results of retrieval by each of the SQL commands need to be stored somewhere in the database before they can be massaged into the final format as called for in the scorecard, a certain degree of programming expertise is required. It would either require a progammer to write a formal program in a language such as C or C++, or alternatively, use a fourth generation language, such as the xdb procedural language to achieve the same purpose. In comparison, the xdb procedural language is easier to learn and master than a formal programming language such as "C" or "C++". So, we have designed and implemented two scorecards using the xdb procedural language. The two scorecards are the "Direct Fire Weapon System Summary" scorecard and the "Fire Support Summmary" scorecard.

Functional Description

Direct Fire Weapon System Summary Scorecard

The "Direct Fire Weapon System Summary" Scorecard will display the following information for direct fire weapons used in the exercise. The information is displayed for each type of firing weapon and ammo used by each side in the exercise.

Number of rounds fired
Number of main battle tanks hit
Number of main battle tanks killed
Number of infantry fighting vehicles hit
Number of infantry fighting vehicles killed
Number of other vehicles hit
Number of other vehicles killed
Total number of vehicles hit
Total number of vehicles killed

The above information is further grouped and totaled based on the firing side, firing weapon and ammo type. An example "Direct Fire Weapon System Summary" scorecard is shown on page 22.

Fire Support Summary Scorecard

The "Fire Support Summary" Scorecard will display the following information for fire support weapons used in the exercise. The information is displayed for each type of firing weapon and ammo used by each side in the exercise.

Number of rounds fired
Number of main battle tanks hit
Number of main battle tanks killed
Number of infantry fighting vehicles hit
Number of infantry fighting vehicles killed

Number of other vehicles hit
Number of other vehicles killed
Total number of vehicles hit
Total number of vehicles killed

The above information is further grouped and totaled based on the firing side, firing weapon and ammo type. An example "Fire Support Summary" scorecard is shown on page 23.

03/22/1991

DIRECT FIRE WEAPON SYSTEM SUMMARY

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
B	US M1	US M392A2 - 105mm/KP	95	4	4	0	1	0	0	4	5
		US M456A1 - 105mm/SCP	87	0	0	6	5	0	0	6	5
Total			182	4	4	6	6	0	0	10	10

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
B	US M2	US M791 - 25mm	197	2	0	1	3	0	0	3	3
Total			197	2	0	1	3	0	0	3	3

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
R	USSR T72M	US M392A2 - 105mm/KP	1	0	1	0	0	0	0	0	1
		US M456A1 - 105mm/SCP	1	0	0	0	0	0	0	0	0
Total			2	0	1	0	0	0	0	0	1

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
R	USSR_BMP2	US M791 - 25mm	155	3	0	0	0	0	0	3	0
Total			155	3	0	0	0	0	0	3	0
Overall total			536	9	5	7	9	0	0	16	14

03/22/1991

FIRE SUPPORT SUMMARY

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
B	US M106A1	US M329 - 107mm/HE	95	4	4	0	1	0	0	4	5
		US M107 - 155mm/HE	87	0	0	6	5	0	0	6	5
Total			182	4	4	6	6	0	0	10	10

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
B	US M109	US M107 -155mm/HE	197	2	0	1	3	0	0	3	3
Total			197	2	0	1	3	0	0	3	3

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
R	USSR M1943	US M329 - 107mm/HE	1	0	1	0	0	0	0	0	1
		US M107 - 155mm/HE	1	0	0	0	0	0	0	0	0
Total			2	0	1	0	0	0	0	0	1

SIDE	FIRING WEAPON	FIRING AMMO	SHOTS	MBT_H	MBT_K	IFV_H	IFV_K	OTH_H	OTH_K	TOT_H	TOT_K
R	USSR_2S1-122H	US M107 -155mm/HE	155	3	0	0	0	0	0	3	0
Total			155	3	0	0	0	0	0	3	0
Overall total			536	9	5	7	9	0	0	16	14

Access to Battle Scorecard Module

The battle scorecard module can be selected and invoked through the UPAS menu selection as follows:

a. Select "Data Summary" from the UPAS main menu as shown in Figure1 on page 25. A new ("Data Summary") menu will appear as depicted in Figure 2 on page 26.

b. Select "Battle Scorecard" from the "Data Summary" menu. A new ("Battle Scorecard") menu will appear as depicted in Figure 3 on page 27.

c. From the "Battle Scorecard" menu, the user selects the desired scorecard. If the scorecard has never been generated before, the scorecard will be generated and displayed. If the scorecard has been generated before, the user will be presented with the message, "Type any key to re-generate battle scorecard. Type <Esc> to display existing battle scorecard". The user will have the option of displaying the existing scorecard or re-generating the scorecard.

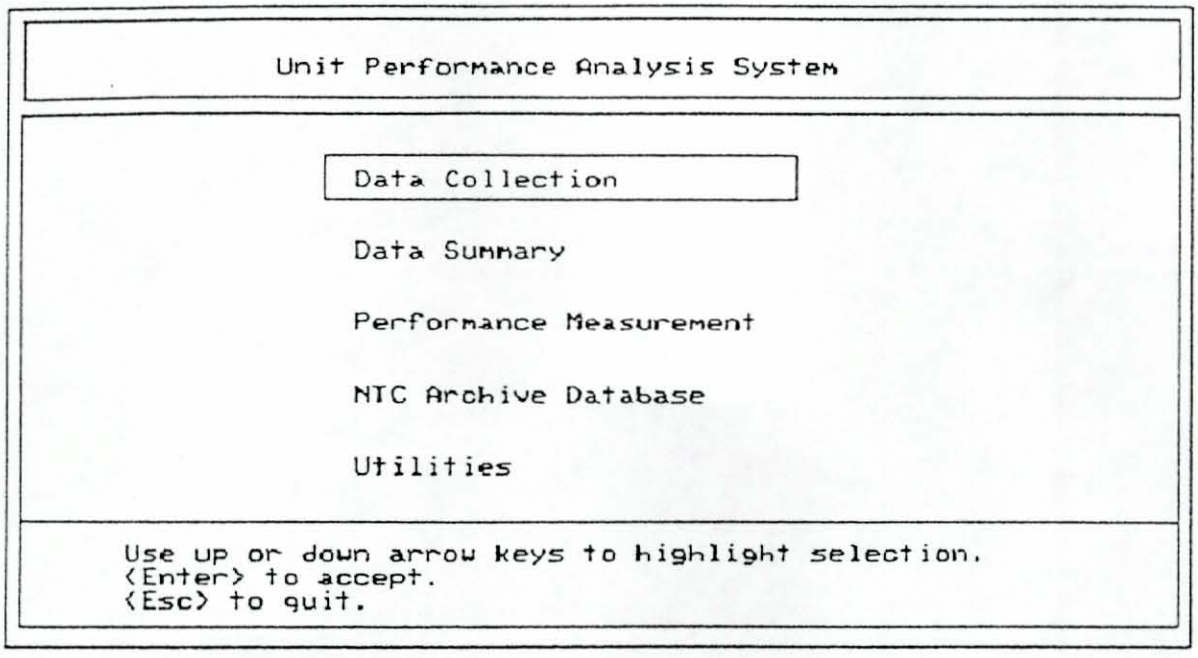


Figure 1 UPAS Main Menu

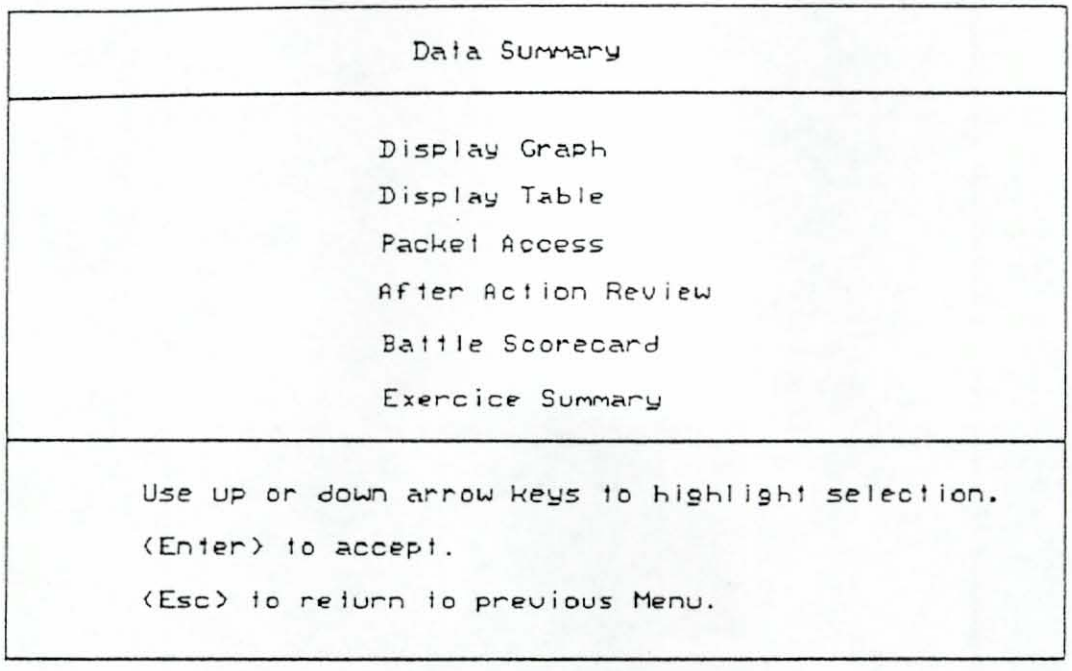


Figure 2 Data Summary Menu

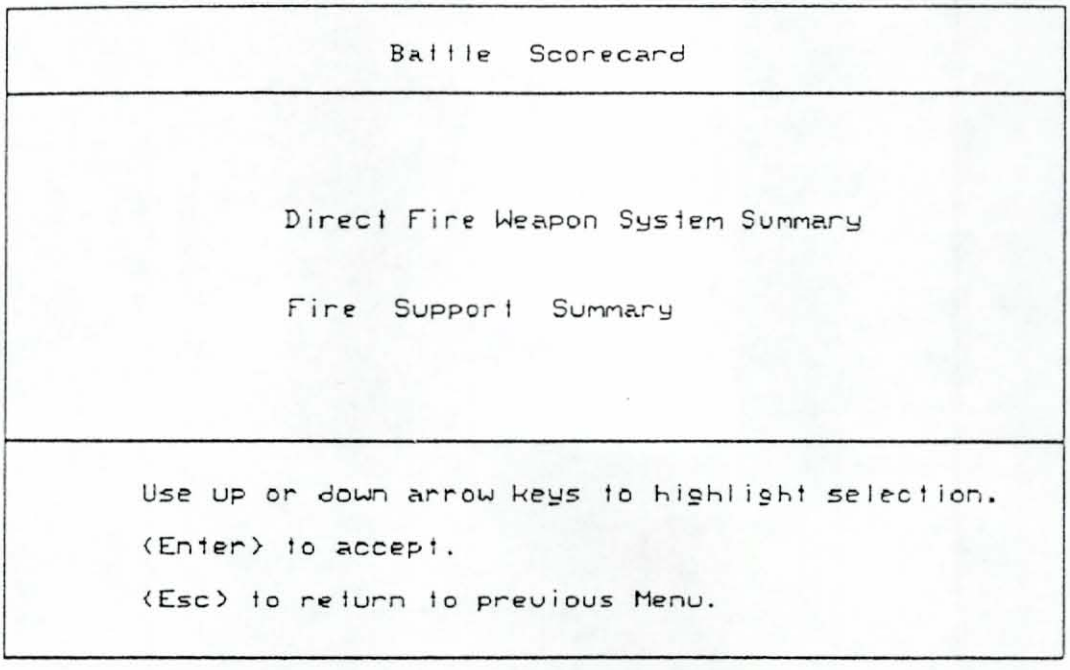


Figure 3 Battle Scorecard Menu

Design and Implementation Details

In this section, a detailed explanation will be given to explain the design and implementation of the "Direct Fire Weapon System Summary" scorecard. This serves as a good example for producing a complicated scorecard using the xdb procedural language. It is hoped that, after reading the explanation, the reader can apply the same technique to design and implement other complicated scorecards of their choice.

However, it is not the intent of this report to teach the xdb procedural language. For a detailed description of the xdb procedural language, the reader is advised to refer to the appropriate chapter in the XDB User's Manual.[1]

There are two major steps involved in creating the scorecard:

1. Retrieve data from the appropriate database table(s) and insert them into an intermediate scorecard table. This is driven by commands in a xdb procedure command file.

2. Format the data in the intermediate scorecard table and produce the scorecard in the desired format. This is achieved by commands contained in a xdb report command file.

XDB Procedure Command File

To produce the "Direct Fire Weapon System Summary" scorecard, a procedure command file, called sc1_4.cmd, is needed. This plain ascii file can be created using any word processor or text editor. The content of the procedural command file, sc1_4.cmd, is attached to this report as shown in the Appendix A. We will now run through each command in the command file to explain what they are doing.

As shown in the command file, sc1_4.cmd, the first step is to define an intermediate scorecard table, called TSC1_1, to represent the scorecard that is to be produced. The scorecard table contains the following column (or field) names:

fside = firing side
fwpnam = firing weapon name
famonam = firing ammo name
nrounds = number of rounds fired
mbt_h = number of main battle tanks hit
mbt_k = number of main battle tanks killed
ifv_h = number of infantry fighting vehicles hit
ifv_k = number of infantry fighting vehicles killed
oth_h = number of other vehicles hit
oth_k = number of other vehicles killed
tot_h = total number of vehicles hit

tot_k = total number of vehicles killed

Once the table is created, it is initially empty with no data. The next step is to retrieve data from the database and insert them into the table, one column at a time.

For instance, to retrieve information regarding the number of rounds fired by each weapon and ammo type from each side, the following SQL is used:

```
select side,wpnam, amonam,sum(integer(nrounds)) from V_SC1_5
where wpn in ('2882080C', '28821002', '2884082C', '28841002',
'28841043', '28842002')
group by side,wpnam,amonam
```

Note that the weapon codes ('2882080C','28821002','2884082C', '28841002','28841043', '28842002') represent direct fire weapons

Note that V_SC1_5 is a view that has been predefined to include columns from three other tables: FET, PSIT, and PVWT. View can be treated as a virtual table with its constituent columns coming from other tables. The purpose of using a view is that once a view is defined, SQL commands can be issued to retrieve information from just one view as opposed to from a couple of different tables, thereby simplifying the SQL command. The columns in V_SC1_5 are defined as:

side = side
wpn = weapon code
wpnam = weapon name
ammo = ammo code
amonam = ammo name
lpn = logical player number of vehicle
nrounds = number of rounds fired

In the procedural command file, similar views for V_SC1_3, V_SC1_4, V_SC1_6 are also defined.

Once the number of rounds has been retrieved from V_SC1_5, for each possible combination of (side, firing weapon and ammo name), the next step is to insert the data from each of retrieved records into the intermediate scorecard table. The insertion of data can either be an insert operation if the corresponding (side, firing weapon and ammo name) from the retrieved data record does not already exist in the scorecard table; or else, an update operation is performed.

The insert operation is achieved with the SQL command:

```
insert into tsc1_1 values (:fside, :fwpnam, :famonam, 0,
  :mbt_h, 0, 0, 0, 0, 0, 0, 0)
```

while the update operation is achieved with the SQL command:

```
update tsc1_1 set mbt_h =:mbt_h where fside=:fside and
fwpnam=:fwpnam and famonam=:famonam
```

We have just explained how the number of rounds (nrounds) column in the scorecard table is updated with data retrieved from the database through view V_SC1_5.

The other columns in the intermediate scorecard table are also updated in a similar way.

In short, the mbt_h column in the scorecard table is updated through the SQL command:

```
select fside,fwpnam,famonam,count(result) from v_sc1_3
where result='H'
and twpn in ('2882080C','2884082C')
and fwpn in ('2882080C', '28821022', '28821047', '2884082C',
'28841022', '28841022', '28841043', '28842002')
group by fside,fwpnam,famonam
```

The mbt_k column in the scorecard table is updated through the SQL command:

```
select fside,fwpnam,famonam,count(result) from v_sc1_3
where result='K'
and twpn in ('2882080C','2884082C')
and fwpn in ('2882080C', '28821022', '28821047' ,'2884082C',
'28841022', '28841022', '28841043', '28842002')
group by fside,fwpnam,famonam
```

Note that the weapon codes ('2882080C','2884082C') represent main battle tanks

The ifv_h column in the scorecard table is updated through the SQL command:

```
select fside,fwpnam,famonam,count(result) from v_sc1_3
where result='H'
and twpn in ('28821022','28841022','28842002')
and fwpn in ('2882080C', '28821022', '28821047' ,'2884082C',
'28841022', '28841022', '28841043', '28842002')
group by fside,fwpnam,famonam
```

The ifv_k column in the scorecard table is updated through the SQL command:

```
select fside,fwpnam,famonam,count(result) from v_sc1_3
where result='K'
and twpn in ('28821022','28841022','28842002')
and fwpn in ('2882080C', '28821022', '28821047' ,'2884082C',
```

```
'28841022', '28841022', '28841043', '28842002')
group by fside,fwpnam,famonam
```

The oth_h column in the scorecard table is updated through the SQL command:

```
select fside,fwpnam,famonam,count(result) from v_sc1_3
where result='H'
and twpn not in ('2882080C', '2884082C', '28821022', '28841022',
'28842002')
and fwpn in ('2882080C', '28821022', '28821047' ,'2884082C',
'28841022', '28841022', '28841043', '28842002')
group by fside,fwpnam,famonam
```

The oth_k column in the scorecard table is updated through the SQL command:

```
select fside,fwpnam,famonam,count(result) from v_sc1_3
where result='K'
and twpn not in ('2882080C','2884082C',
'28821022','28841022','28842002')
and fwpn in ('2882080C', '28821022', '28821047' ,'2884082C',
'28841022', '28841022', '28841043', '28842002')
group by fside,fwpnam,famonam
```

The tot_h column in the scorecard table is updated through the SQL command:

```
select fside,fwpnam,famonam,count(result) from v_sc1_3
where result='H'
and fwpn in ('2882080C', '28821022', '28821047',  '2884082C',
'28841022', '28841022', '28841043', '28842002')
group by fside,fwpnam,famonam
```

The tot_k column in the scorecard table is updated through the SQL command:

```
select fside,fwpnam,famonam,count(result) from v_sc1_3
where result='K'
and fwpn in ('2882080C', '28821022', '28821047',  ,'2884082C',
'28841022', '28841022', '28841043', '28842002')
group by fside,fwpnam,famonam
```

XDB Report Command File

Once the data has been inserted into the intermediate scorecard table, TSC1_1, it is necessary to use the xdb report facility to format the data in the table to produce the scorecard in the desired format. For the "Direct Fire Weapon System Summary", the corresponding report command file (SC1_4.rpt) is shown in Appendix

B.

The xdb report command file can be created using any convenient text editor, or the xdb interactive report writer can be used to exercise the commands and observe the output report interactively, and then, when the report has reached the desired format, have the commands saved in a report command file for future use.

However, it is not the intent of this technical report to teach the xdb report facility. For a detailed description of the xdb report facility, the reader is advised to refer to the appropriate chapter in the XDB User's Manual.

In summary, the commands in this xdb report command file are used to sort and group the data in the scorecard table using 3 columns ("fside", "fwpnam", "famonam"), compute the totals for the columns ("mbt_h", "mbt_k", "ifv_h", "ifv_k", "oth_h", "oth_k", "tot_h", "tot_k"), compute Overall Total for the number of rounds fired, format the column to the desired widths when appear in the report, rename the column headings, define the margins and title heading.

Indexing for Speeding Up Database Query

The above scorecards require information to be retrieved from the following tables:

Player vehicle weapon table (PVWT)
Player State Initialization table (PSIT)
Pairing Event Table (PET)

As shown in the xdb procedure command file, many of the views used are actually including (joining) columns from PVWT, PSIT and PET.

It has been discovered that the database queries will take an exceedingly long time to complete if no indexing is used. With the use of indexing, the query time can be cut down considerably. In one typical test case, the time for producing the "Direct Fire Weapon System Summary" was cut down from 30 minutes (without indexing) to four minutes (with indexing). So, it is imperative to create the appropriate indexing to speed up the database queries.

For the two scorecards, indexing can be created in PVWT for the following two columns:

Weapon code (PTYPE)
Ammo code (PAMMO)

In the PSIT table, the following index can be created:

logical player number (LPN)

The general rule is that those columns in a table that are used to join with the corresponding columns in another table are good candidates for creating indexes for. As in the above example, the "weapon code" and "ammo code" columns in PVWT need to join with the corresponding columns in PET and the "logical player number" column needs to join with the corresponding column in PET, so indexes can be created for these columns to speed up the database queries.

The XDB's "Create/Alter Index" module can be used to create the indexes desired. For detailed explanation on the xdb's "Create/Alter Index" module, the reader is advised to refer to the corresponding section in the XDB's User Manual.

CONTROL MEASURES

Overview

Control measures are exercise planning data from the unit's operations order normally not transmitted over the network. So, control measures data need to be entered into UPAS by the user. The purpose of the Control Measures Module is to allow the user to enter control measures into the database (Control Measure Table, CMT). It also allows the user to delete existing control measures previously entered. These control measures can be retrieved from the database and displayed in the other AAR aids, such as Battle Flow and Battle Snapshot. They are also used by the Exercise Timeline module to compute the times when the units cross each of the control measures. The following control measures may be entered by the user:

Assembly Areas
Check Points
Release Points
Starting Points
Objectives
Phase Lines
Lines of Departure
Boundary Lines
Air Coordination Areas
Combat Support Service Areas
Obstacles
Minefields

Each control measure is identified by a unique name up to eight characters in length and consists of up to 12 points, except for starting point, release point and check point, which consist of only one point.

Functional Description

The Control Measure module allows the user to draw control measures on the screen by using the mouse. For drawing and modeling purposes, the control measures are divided into three shape categories (points, line segments and circles) as follows:

Point - starting point, release point, check point
Line segments - phase line, boundary line, line of departure
Circle - objective, assembly area, air coordination area, combat support service area, obstacles and minefield

The normal way to add a control measure is to turn on the terrain

display on the screen. Pan the display to the appropriate scale and location. Select the appropriate force and control measure type. Then use the mouse to draw the control measure on the screen. The database table (CMT) will be updated accordingly.

To delete an existing control measure, select the "Delete" function key and proceed as described in the following section.

Access to Control Measures Module

The Control Measures module can be selected and invoked through the UPAS menu selection as follows:

a. Select "Data Collection" from the UPAS main menu as shown in Figure 1 on page 25. A new ("Data Collection") menu will appear as depicted in Figure 4 on page 39.

b. Select "Control Measures" from the "Data Collection" menu. A pop-up menu will appear as depicted in Figure 13 on page 58 to let the user select the force for which the control measures will be displayed.

c. After entering the force, if there are existing control measures for the selected force in the database, they will be shown on the screen initially. Otherwise, a blank grip map will be displayed. The user can then add or delete control measures, turn on/off terrain drawing, change the viewport scale and location by selecting the appropriate function keys as described in the following sections.

Function Key Activation

The Control Measure Module provides the following function keys for activation. Select the appropriate function key to initiate the function.

a. Pan <F1>

The Control Measures Module allows a user to change the location of the display viewport to another area of the battle field. It also allows the user to change the scale of the viewport. Changing the scale to a lower value allows the user to view the battle field in finer detail while a higher value for the scale presents a view of the battle field in coarser granularity but will cover a bigger area of the battle field.

When the function key <F1> is selected, a "Cross-shaped" cursor

appears. The user can position the cursor anywhere in the boundary of the current viewport and click the left mouse button. This position will become the new center of the viewport. If the user clicks the cursor outside the boundary of the viewport, a pop-up menu will appear as shown in Figure 20 on page 63 with the current location of the viewport center displayed. Then the user can enter the new location (x and y coordinates) for the center of the viewport. Note that the coordinates are in meters.

After the new center has been selected or entered, a pop-up menu will appear as shown in Figure 21 on page 64. The user can select the desired scale from the available selections in the menu. One of the selections is "X x Y". If the user selects this selection, another pop-up menu will be displayed as shown in Figure22 on page 64 with the current scale displayed. Then the user can enter the new scale for the viewport. The scale consists of the dimension of the viewport in meters in the x and y direction. The smallest scale the user can enter is 200 meters by 200 meters.

For whatever viewport scale and center selected, they are checked against the terrain database and adjusted to make sure that the new scale and center to be used will never fall out the terrain boundaries defined in the terrain database.

b. Force <F2>

When this function key is selected, a pop-up menu will appear as shown in Figure 13 on page 58. The user can select either the Blue force or Red force. The control measures for the selected force will be read from the database and displayed on the screen. The scale and location of the viewport will be adjusted automatically to render the control measures visible within the viewport.

c. Type <F3>

This function key allows the user to select the type of control measure to be added. Once the control measure type is selected, all subsequent control measures to be added are of this type until explicitly changed. When this function key is selected, a list of all the control measure types is shown on a pop-up selection box as shown in Figure Figure 5 on page 40. Once a new control measure type is selected, the new type name is shown on the screen above the terrain grid.

d. Add <F4>

This function key allows the user to add a control measure by drawing it on the screen with the mouse for the currently selected force and control measure type. When the function key <F4> is selected, a pop-up window will appear as shown in Figure 6 on page 41. The user enters the name for the new control measure. The name should be unique in the CMT database table. The maximum number of control measures allowed for each force is 24 control measures. Ater the name has been entered, the user enters the drawing mode. The user can then draw the appropriate control measure as described in the following section. The user can click the mouse right button within the grid area to end the drawing mode at any time.

The way to draw the control measure depends on the shape categories of the selected control measure type. There are three drawing types: Point, Line segment and Circle.

To draw a contol measure belonging to the "Point" shape category, the user moves the mouse cursor to a desired location on the viewport and clicks the mouse's left button. The control measure and the corresponding name will be displayed at the selected spot.

To draw a control measure belonging to the "Line segments" category, the user moves the mouse to the point on the screen corresponding to the first end point of the first segment and drags the mouse to the other end point of that segment and release the left button. The first segment of the line will be shown on the screen. The user can continue to perform the click-drag-release action of the left mouse botton for each subsequent segment of the line until all the segments of the line have been drawn on the screen. At this point, press the right mouse button to end the drawing. A maximum of 11 line segments is allowed.

To draw a control measure belonging to the "circle" category, the user presses the left mouse button within the grid area and drags the mouse to the second location within the grid area. Once the user releases the left button, the circle is drawn with the control measure name labeled.

e. Delete <F5>

This function key allows the user to delete a control measure for the currently selected force. When the function key is selected, a list of all the current control measure names for the selected force is displayed in a selection box as shown in Figure 7 on page 42. The user can then select the name of the control measure to be deleted. The control measure will then be removed from the database and also from the display within the grid map area.

f. Reserved <F6>

This function key is reserved for later use.

g. Terrain On/Off <F7>

This function key allows the user to enable or disable the terrain display. If terrain has been enabled, selecting the key will disable the terrain display. If terrain has been disabled, selecting the key will enable the terrain display.

h. Refresh <F8>

This function key allows the user to refresh the screen display within the grid area.

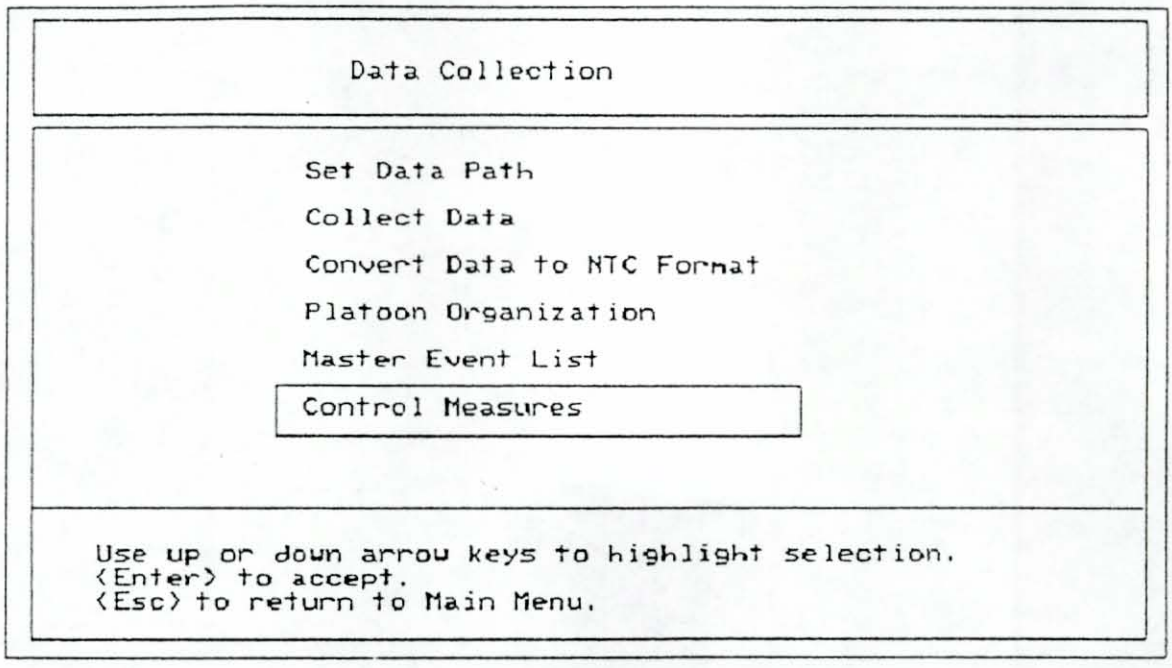


Figure 4 Data Collection Menu

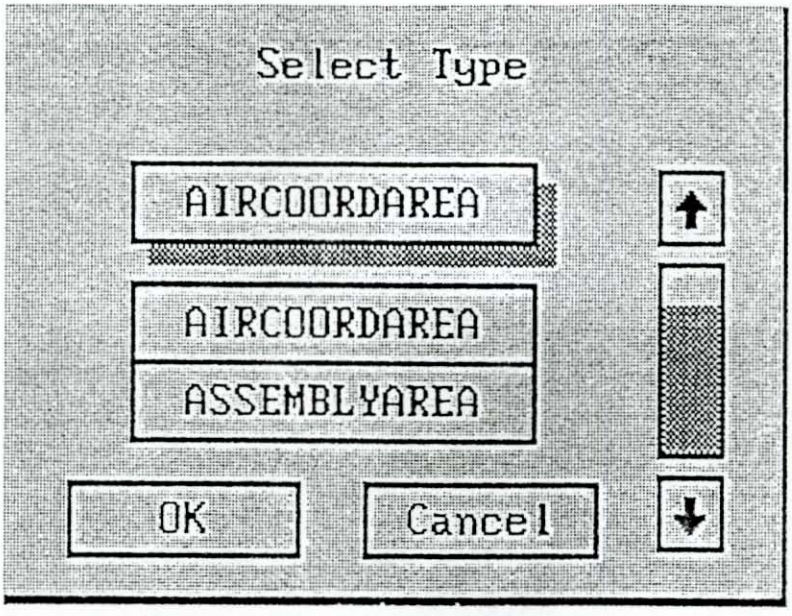


Figure 5 Control Measure Type Selection Menu

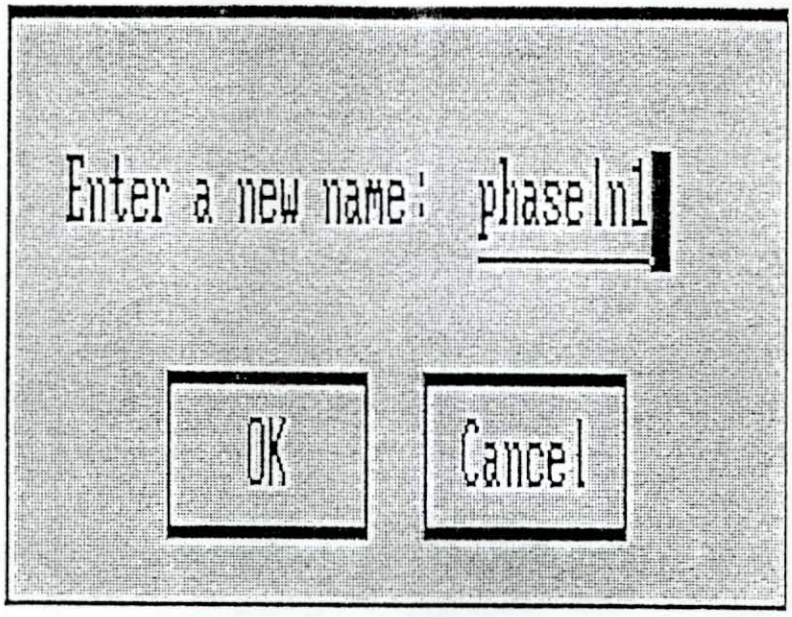


Figure 6 Control Measure Name Entry Menu

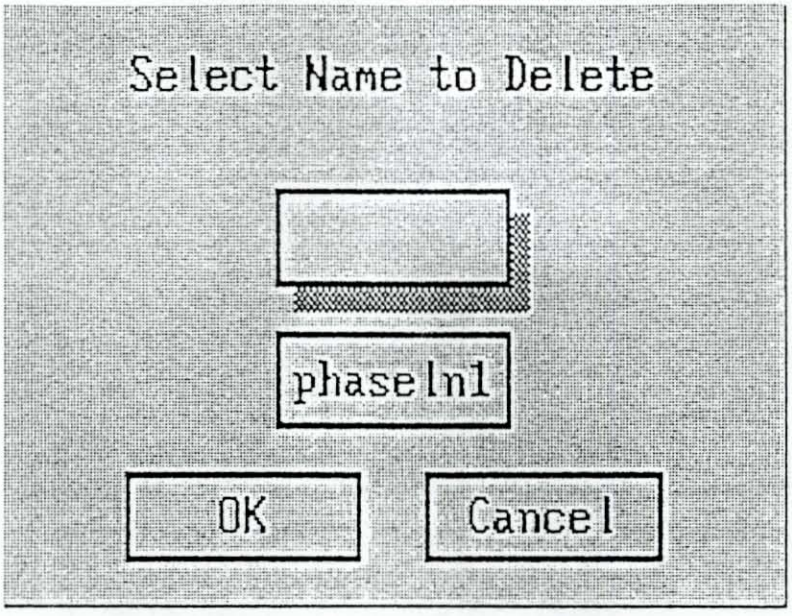


Figure 7 Control Measure Name Selection Menu

PLATOON ORGANIZATION

Functional Description

The platoon organization module allows the user to define all the vehicle id's and the corresponding vehicle designations in a platoon for either the Blue or Red Force. A platoon name is composed of a company id and the corresponding platoon designation within the company. The company id can be one of the following: Company A, B, C, D. The platoon designation can be one of the following: Platoon 1, 2, 3, Attached Platoon and Company HQ.

With the platoon organization module, the user identifies the vehicles for the platoon leader, platoon sergeant for Platoon 1, 2, 3 and the Attached Platoon as well as the company commander and company executive for the company HQ.

The information as entered by the user is stored in the PLTORG table in the database.

Access to Platoon Organization Module

The Platoon Organization module can be selected and invoked through the UPAS menu selection as follows:

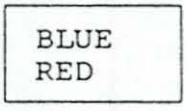
a. Select "Data Collection" from the UPAS main menu as shown in Figure 1 on page 25. A new ("Data Collection") menu will appear as depicted in Figure 4 on page 39.

b. Select "Platoon Organization" from the "Data Collection" menu. The Select Force menu is presented to allow the user to select the "BLUE" or "RED" Force as shown in Figure 8 on page 45. After selecting the force, the user is required to select the company/platoon number by making the appropriate selection as shown in Figure 9 and Figure 10 on page 46.

c. After selecting the desired company and platoon number, a new menu will be displayed as shown in Figure 11 on page 47. For Platoon 1, 2, 3, and Attached Platoon, the user can enter the vehicle id's for the following vehicle designations: platoon leader, platoon sergeant and other vehicle designations. The vehicle id consists of three numbers separated by "." For the company HQ, the user can enter the vehicle id's for the Company Commander, Company Executive and other vehicle designations.

d. The user can press <F2> key to move the cursor to the Commander field or <F3> key to move to the Vehicle Field. After all the vehicle id's have been entered, press <F1> to save the information in the database.

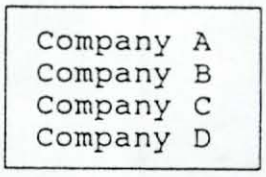
Select the Force



<ESC> to previous menu

Figure 8 Select Force Menu

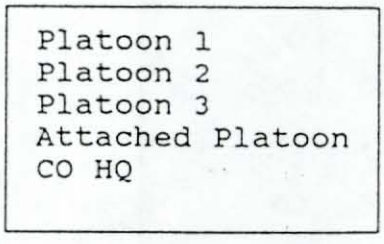
Selecting the company/Platoon Number



Current Company A /Platoon 1

Figure 9 Select Company Menu

Selecting the company/Platoon Number



Current Company A /Platoon 1

Figure 10 Select Platoon Menu

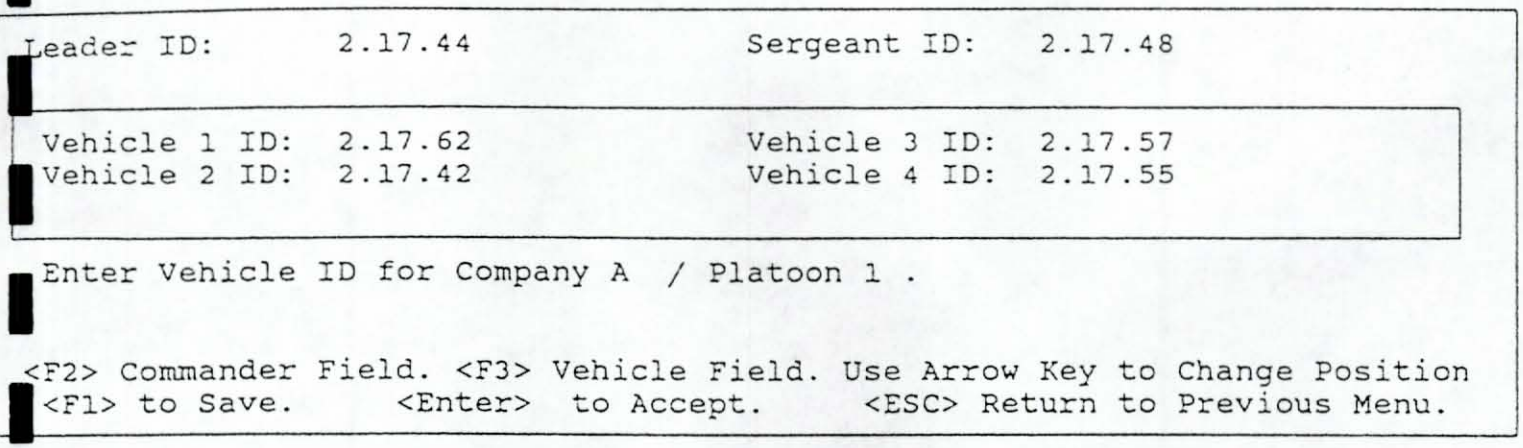


Figure 11 Platoon Organization Input

LINE OF SIGHT

Introduction

During after action review, it is often necessary to know why two hostile units did not fire at each other even when they were relatively close to each other. It might be that the two units cannot see each other because their line of sight was blocked by the intervening terrain. Therefore, it is necessary to have a tool to help the trainers or reviewers determine if the line of sight is blocked between two hostile units.

The algorithm used in LOS determination in UPAS only considers the intervening terrain and some terrain features including treelines and tree canopies. It does not consider other factors such as weather (foggy or clear sky) and time of day (under bright sun light or in a dark night) that might also influence the visibility of the observer.

The Line of Sight Display capability has been incorporated into the Battle Snapshot module in UPAS. For description on invok ingthe Line of Sight Display capability in the Battle Snapshot module, please refer to the corresponding functional description in this document.

Description of LOS Algorithm

The algorithm used in LOS calculation was developed by another IST project which uses the Borland C development environment. The algorithm was adapted to be used in UPAS which uses the Microsoft development environment. For detailed description of the algorithm used in LOS calculation, please refer to [2]. Only a brief description of the algorithm is presented here. Since the LOS calculation requires intimate knowledge of the terrain database, the terrain representation is first described. The algorithm used in LOS calculation is then presented.

Terrain Representation

UPAS uses a terrain database compatible with SIMNET. In the database, the land of the terrain is represented by a large set of polygons. Any two polygons might be next to each other in that they share some edges and vertices. The polygons are not necessarily on the same plane because of the 3-dimensional nature

of the terrain (The terrain rises and falls in height as it goes across hills and valleys).

Besides land polygons, there are treelines and tree canopies. Treelines are rows of trees; each represented by a line segment with a constant height. Tree canopies are groups of trees represented by treelines outlining the borders of the canopies and sets of polygons forming the covers for the canopies. The land, treelines and tree canopies are the terrain features that are used in LOS calculations. Other features like rivers, roads, building structures are not considered in the calculation.

All of the polygons, edges and vertices that form the polygons are organized in the database in a manner that facilitates their retrieval by means of (patch, grid) pairs. The terrain as projected on the x-y plane can be divided into 500m x 500m square patches and each patch is further subdivided into sixteen 125m x 125m square grids. Each patch is identified by a patch index and each grid is identified by a grid index. Each polygon, edge and vertex can be associated with one or more (patch, grid) pair. The database is organized such that given a (patch, grid) pair, all the edges of polygons (for land and tree canopies) and of treelines reside within the patch and grid can be easily calculated and retrieved.

LOS Calculation

The LOS calculation involves the following steps:

(1) Given an observer and a target, the line connecting the two points (LOS) is projected to the x-y plane. The Bresenham's algorithm is then used to locate all the (patch, grid) pairs that can be traversed by LOS.

(2) For each (patch, grid) pair found in step 1, determine all the edges that are covered by the (patch, grid) pair. Only these edges will be used for LOS calculations.

(3) For each edge located by step 2, determine if the LOS is blocked by the edge. This is determined as follows. First, the point of intersection of the edge and LOS on the x-y plane is calculated. Then the height of the edge and LOS at the point of intersection is compared. If the edge is higher than LOS at the point of intersection, the LOS is blocked.

Note that more than one edge might block the LOS. In UPAS, the edge nearest to the observer and blocking the LOS is identified and a green line is drawn from the observer to the blocking edge and a red line drawn from the blocking edge to the target. If no blocking occurs, the entire line from the observer to the target is

colored green.

Because of the amount of computations involved in LOS calculations, it is highly recommended that a high-powered computer, such as a 386 or a 486 PC, be used to speed up the calculations.

BATTLE FLOW

Functional Description

The Battle Flow Display illustrates the units' movement during an exercise by plotting the paths of the units from the specified start time (which defaults to the exercise start time) to the specified end time (which defaults to the end of the exercise). It is a very useful AAR aid in that the display shows the battle formation of the units at different points in time, how the units move relative to each other and toward the objective, how the units follow preestablished control measures, and whether the units apply various movement techniques efficiently.

The Battle Flow Display can be used for either the Blue or Red Force as selected by the user. At the platoon level, it shows the paths of all the vehicles in the platoon. At the company level, it shows the paths of the platoon leaders, platoon sergeants, company commander and company executive for all the platoons and company HQ for the company.

An example Battle Flow Display is shown in Figure 17 on page 60. If terrain display is enabled, the display will show the background terrain as in Figure 18 on page 61. Figure 19 on page 62 shows the terrain with contour lines and contour elevations.

The information to be displayed in the Battle Flow diagram includes:

a. A terrain map displayed in the background if terrain display is enabled

b. Control measures for the selected Blue or Red Force are displayed on top of the terrain map. Control measures to be included in the display are: Phase lines, boundary lines, lines of departure, objectives, assembly areas, starting points, release points, check points, air coordination areas, combat support service areas, obstacles and minefields.

c. The paths of some or all the vehicles in the unit, depending on the echelon selected. The paths of the vehicles are labeled with letters (A, B, . . .). In the vehicle ID legend area (on top of the main graphic display area), the labels are displayed with the corresponding vehicle bumper numbers and unit's designation (such as platoon leader designation). To add the time dimension to the Battle Flow Display, position update markers ('+'s) and numerical markers are placed at suitable intervals along the path. The user can select the interval between position update markers and the frequency of numerical marker interval (expressed as a multiple number of position update markers; E.g., if you want to place a

numerical marker for every five position markers, then the frequency of numerical marker interval is five).

d. The initial enemy positions are represented in the display as circles. The circles are colored blue for blue enemy units or red for red enemy units.

During the AAR, when the user comes across a display screen that he wants to save for future reference, he can activate the appropriate Screen Capture function to save the desired screen display to a file. For the Battle Flow display screen, the file to be saved has a default file name beginning with "BFLW" followed by one or more numeric digits. The numeric digits will be incremented by one for each additional screen captured. For example, if the first Battle Flow screen was saved in the file, "BFLW0001", the next Battle Flow screen will be saved in the file, "BFLW0002".

Access to Battle Flow Module

The Battle Flow module can be selected and invoked through the UPAS menu selection as follows:

a. Select "Data Summary" from the UPAS main menu as shown in Figure1 on page 25. A new ("Data Summary") menu will appear as depicted in Figure 2 on page 26.

b. Select "After Action Review" from the "Data Summary" menu. A new ("After Action Review") menu will appear as depicted in Figure12 on page 57.

c. Select "Battle Flow" from the "After Action Review" menu. The user will be presented with the Select Force menu to select "BLUE" or "RED" Force as shown in Figure 13 on page 58. After selecting the force, the user is required to select the desired echelon level for the display as shown in Figure 14 on page 58. Two choices (company or platoon level) are available.

d. If platoon level has been selected, the user is required to select the company/platoon number by making the appropriate selection as shown in Figure 15 and Figure 16 on page 59. Alternatively, if company level has been selected, the user is required to select the company id by making the appropriate selection as shown in Figure 15 on page 59.

e. After selecting the desired company and/or platoon number, the battle flow will be displayed as shown in Figure 17 on page 60.

Function Key Activation

The Battle Flow Module provides the following function keys for activation. Select the appropriate function key to initiate the function.

a. Pan <F1>

The Battle Flow Module allows a user to change the location of the display viewport to another area of the battle field. It also allows the user to change the scale of the viewport. Changing the scale to a lower value allows the user to view the battle field in finer detail while a higher value for the scale presents a view of the battle field in coarser granularity but will cover a bigger area of the battle field.

When the function key <F1> is selected, a "Cross-shaped" cursor appears. The user can position the cursor anywhere in the boundary of the current viewport and click the left mouse button. This position will become the new center of the viewport. If the user clicks the cursor outside the boundary of the viewport, a pop-up menu will appear as shown in Figure 20 on page 63 with the current location of the viewport center displayed. Then the user can enter the new location (x and y coordinates) for the center of the viewport. Note that the coordinates are in meters.

After the new center has been selected or entered, a pop-up menu will appear as shown in Figure 21 on page 64. The user can select the desired scale from the available selections in the menu. One of the selections is "X x Y". If the user selects this selection, another pop-up menu will be displayed as shown in Figure22 on page 64 with the current scale displayed. Then the user can enter the new scale for the viewport. The scale consists of the dimension of the viewport in meters in the x and y direction. The smallest scale the user can enter is 200 meters by 200 meters.

b. Capture Screen <F2>

When this function key is selected, a pop-up menu will appear as shown in Figure 23 on page 65. The user can enter up to two lines of text to describe the screen display that he is capturing. These two lines of text will be appended to the bottom of the display screen overlaying the function key area and will be saved to a screen image file with the appropriate file name.

c. Change Time Parameter <F3>

When this function key is selected, a pop-up menu will appear as shown in Figure 24 on page 66. The user can select one of the

three options in the menu: Change Starting/Ending Time, Change Position Marker Interval, Change Frequency of Numerical Marker Interval.

With the Change Starting/Ending Time option, the user is allowed to enter the new starting and ending times to plot the battle flow. When the option is chosen, a pop-up menu will appear as shown in Figure 25 on page 66. Then, the user can enter the desired starting and ending times in hhmmss format. When the program is first started, the start time defaults to the start time of the exercise and the ending time defaults to the ending time of the exercise.

With the Change Position Marker Interval option, the user is allowed to enter the interval between position update markers in seconds. The pop-up menu for this prompt is shown in Figure 27 on page 67. The current value for the position marker interval is also displayed in the menu.

With the Change Frequency of Numerical Marker Interval option, the user is allowed to enter the frequency of numerical marker interval, which is expressed as a multiple number of position update markers. The pop-up menu for this prompt is shown in Figure26 on page 67. The current value for the Frequency of Numerical Marker Interval is also displayed in the menu.

d. Setup printer <F4>

This function key allows the user to set up the printer. When the function key <F4> is selected, a pop-up window will appear as shown in Figure 28 on page 68. The user highlights the appropriate selection with the mouse or the up and down arrow keys and then press <Enter> to accept the choice. Depending on the printer type selected, the user might also be prompted to select the printer mode (Portrait or Landscape mode), printer resolution and printer port as shown in Figure 29, Figure 30 and Figure 31 on page 68 and page 69.

e. Print <F5>

The Battle Flow Display as shown on the screen can be printed on the printer by selecting the function key <F5>.

f. Change Units <F6>

This function key allows the user to enter a new unit for which the battle flow will be displayed. The new unit can be entered by specifying the force, echelon level, company and platoon number for the desired unit by responding to the series of menu prompts as presented earlier.

g. Terrain On/Off <F7>

This function key allows the user to enable or disable the terrain display. If terrain has been enabled, selecting the key will disable the terrain display. If terrain has been disabled, selecting the key will enable the terrain display.

After the function key has been selected to enable the terrain display, the user is allowed to show or hide the contour lines, turn on or off the contour elevations and change the contour line spacing by making the appropriate selections in the menus as shown in Figure 32 on page 70, Figure 33 on page 70 and Figure 34 on page 71.

h. When in the main graphic display screen, left, right, up, and down arrow keys can be used to move the display viewport in the appropriate direction to cover a different area of the battle field. The vehicle id legend area (on top of the main graphic display area) is scrollable. The user can scroll the information in the legend area by selecting the <PgUp> and <PgDn> keys. The program can be interrupted by pressing <Esc> key any time.

Index File and Position Marker Update

The Battle Flow Display module displays the paths of the vehicles by displaying the position update markers (including the numerical position markers) on the screen and connect them by lines. The smaller the interval between the position update markers, the more points will be plotted on the battle flow giving higher granularity. However, it will take a longer time to generate the display. The user has to make a tradeoff between higher granularity and faster display. The user has complete control to specify the value for the interval between the position markers. As a general guideline, the longer the exercise is, the longer is the interval to be selected in order to minimize the number of the points to be plotted and hence the time required to do the plotting.

To expedite the plotting process, it is necessary to retrieve the location of the vehicles quickly so that position markers can be plotted at the appropriate intervals. The location information for the vehicles is contained in vehicle appearance packets in the raw data file. It is not necessary to read all the vehicle appearance packets in the file as it will take too long to read the whole data file. It is only sufficient to retrieve the vehicle appearance packets at the times as indicated by the position update interval. Therefore, the speed of plotting depends very much on how fast the program can get at the desired packets in the file at the desired

intervals. To expedite the search, the program uses an index file that was created immediately after data collection. For more information on the contents of the index file and how it works, please refer to the appropriate description on page 93.

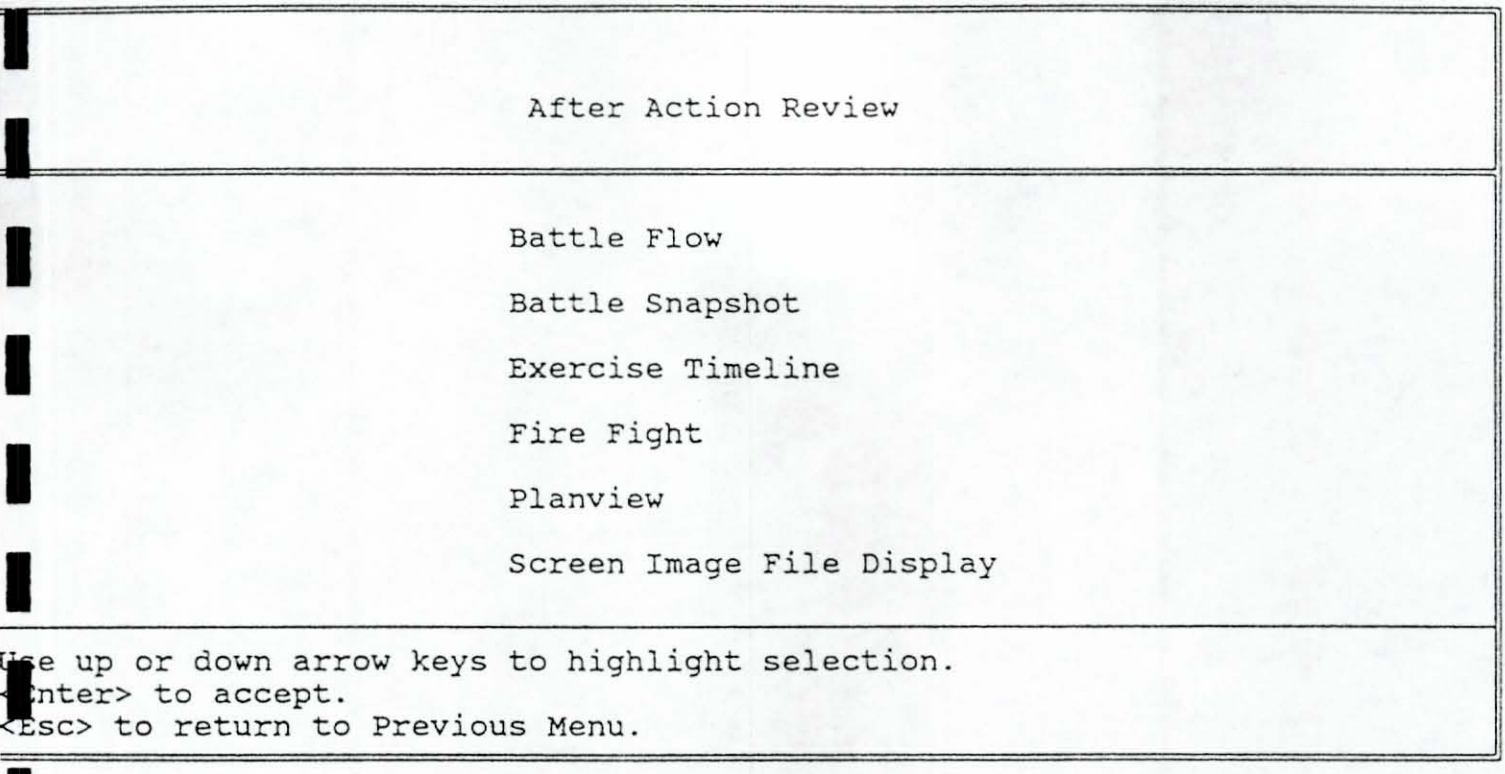


Figure 12 After Action Review Menu

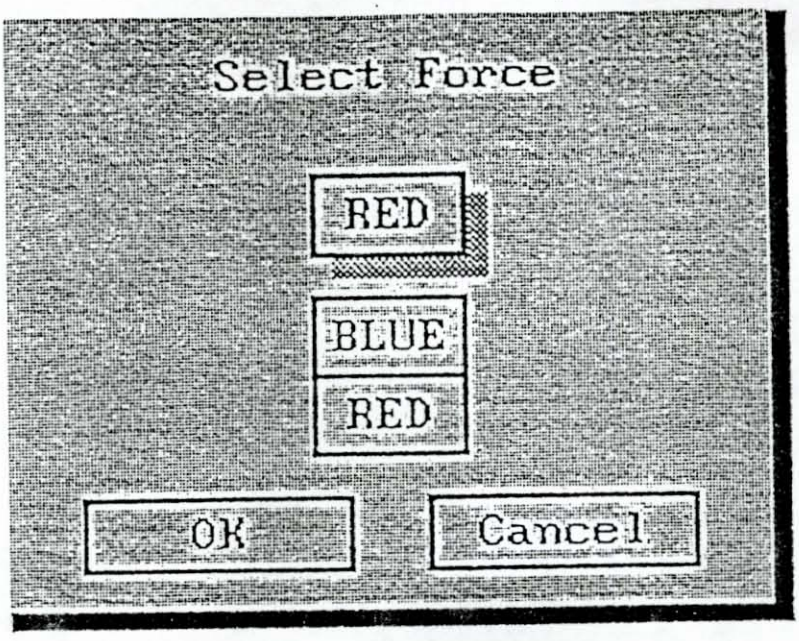


Figure 13 Select Force Menu

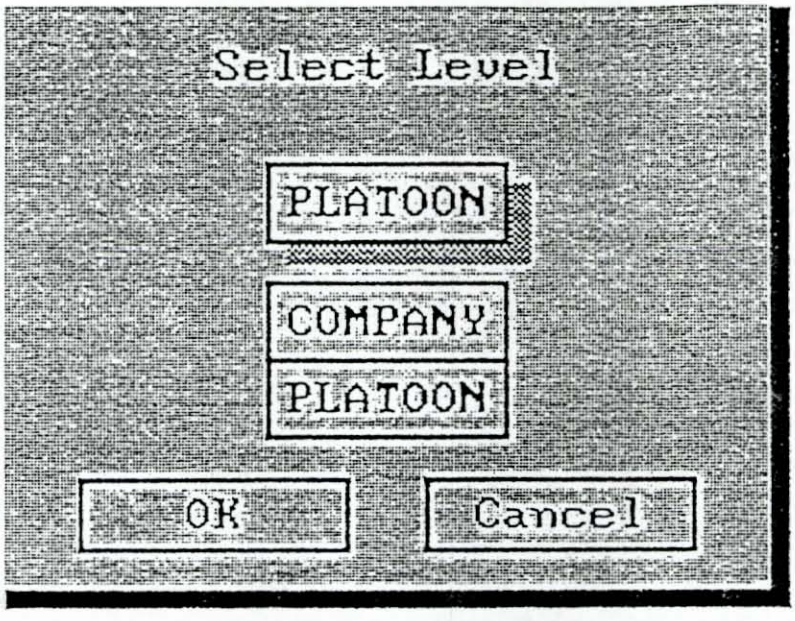


Figure 14 Echelon Level Menu

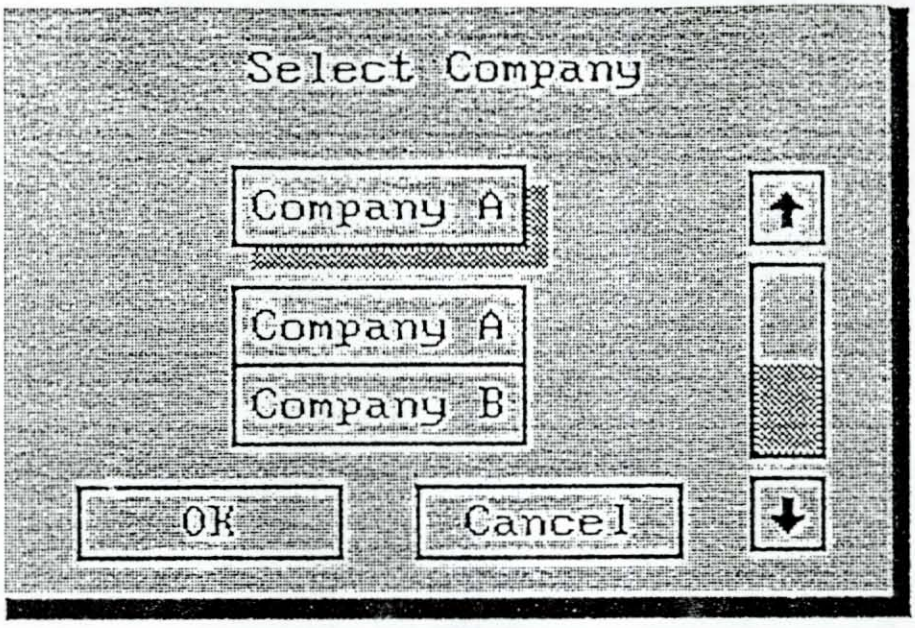


Figure 15 Select Company Menu

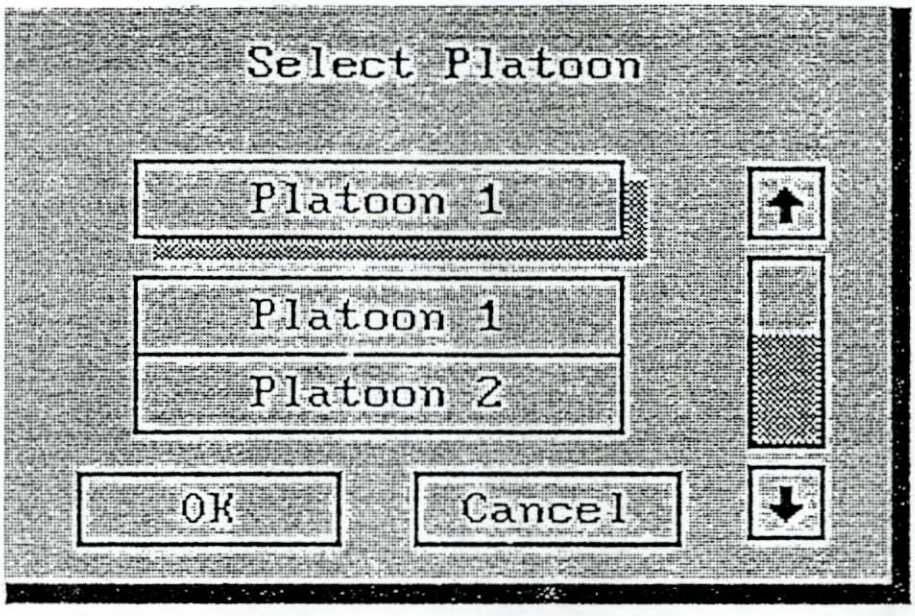


Figure 16 Select Platoon Menu

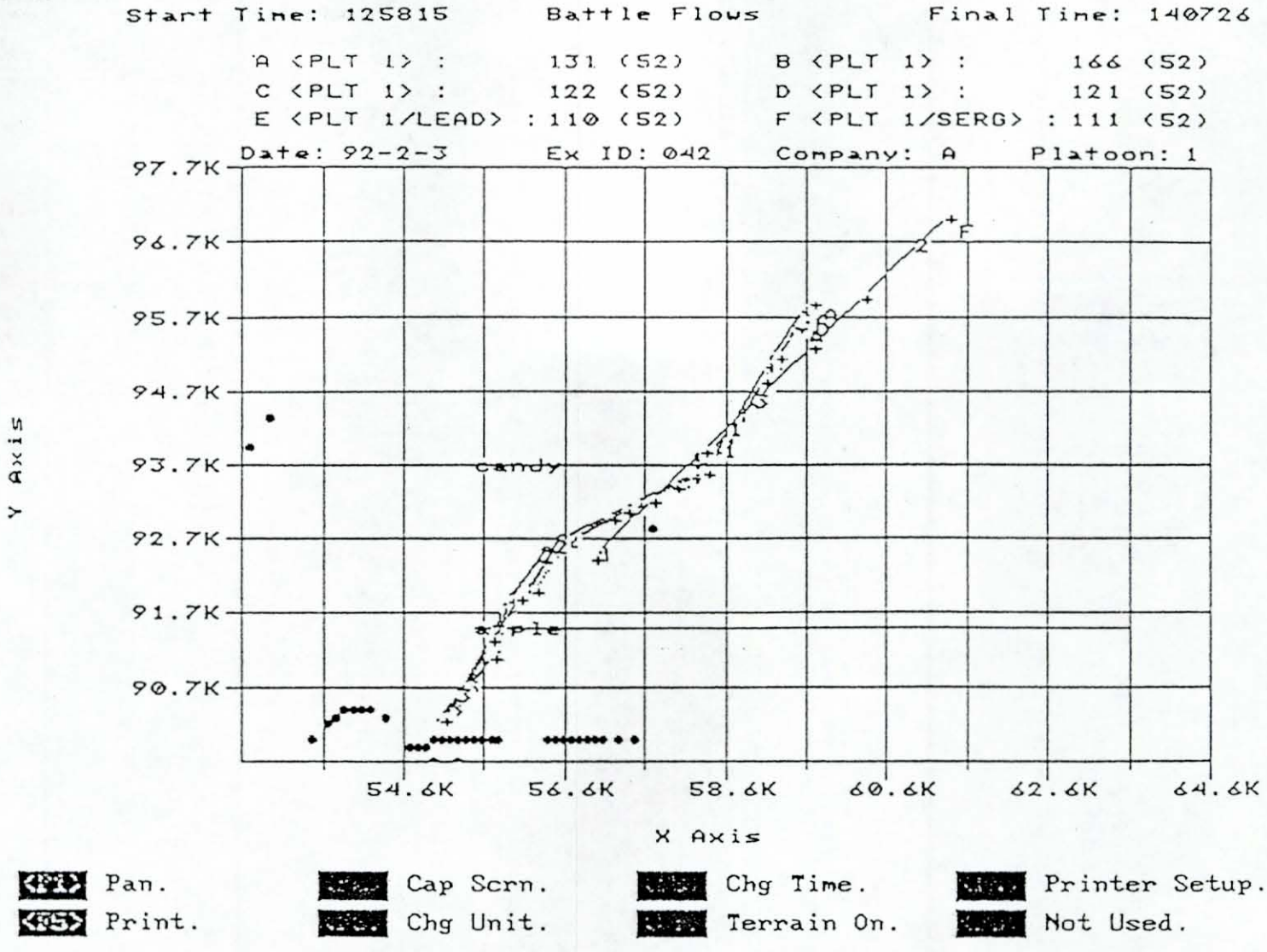


Figure 17 Battle Flow Display

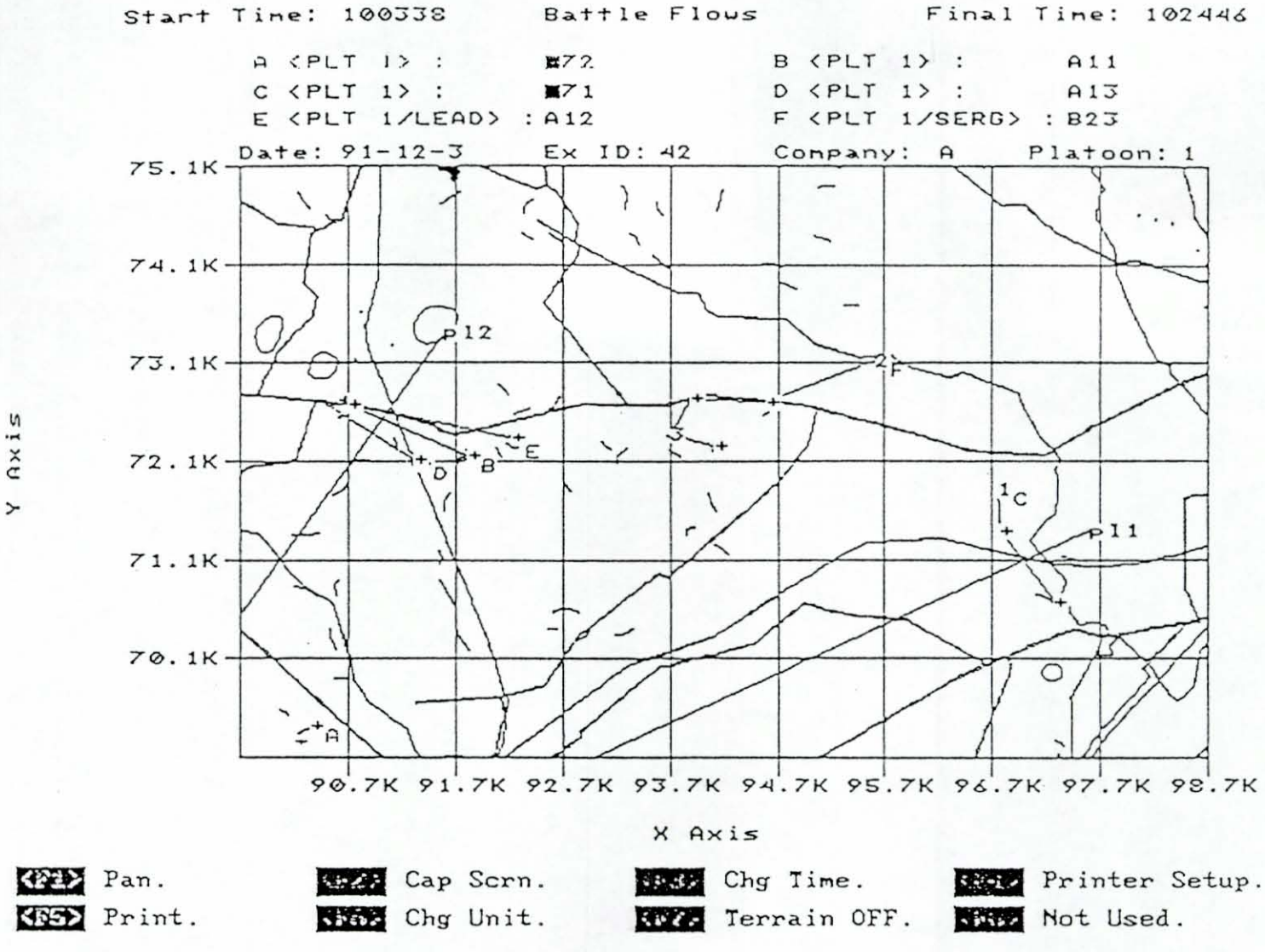


Figure 18 Battle Flow Display With Terrain

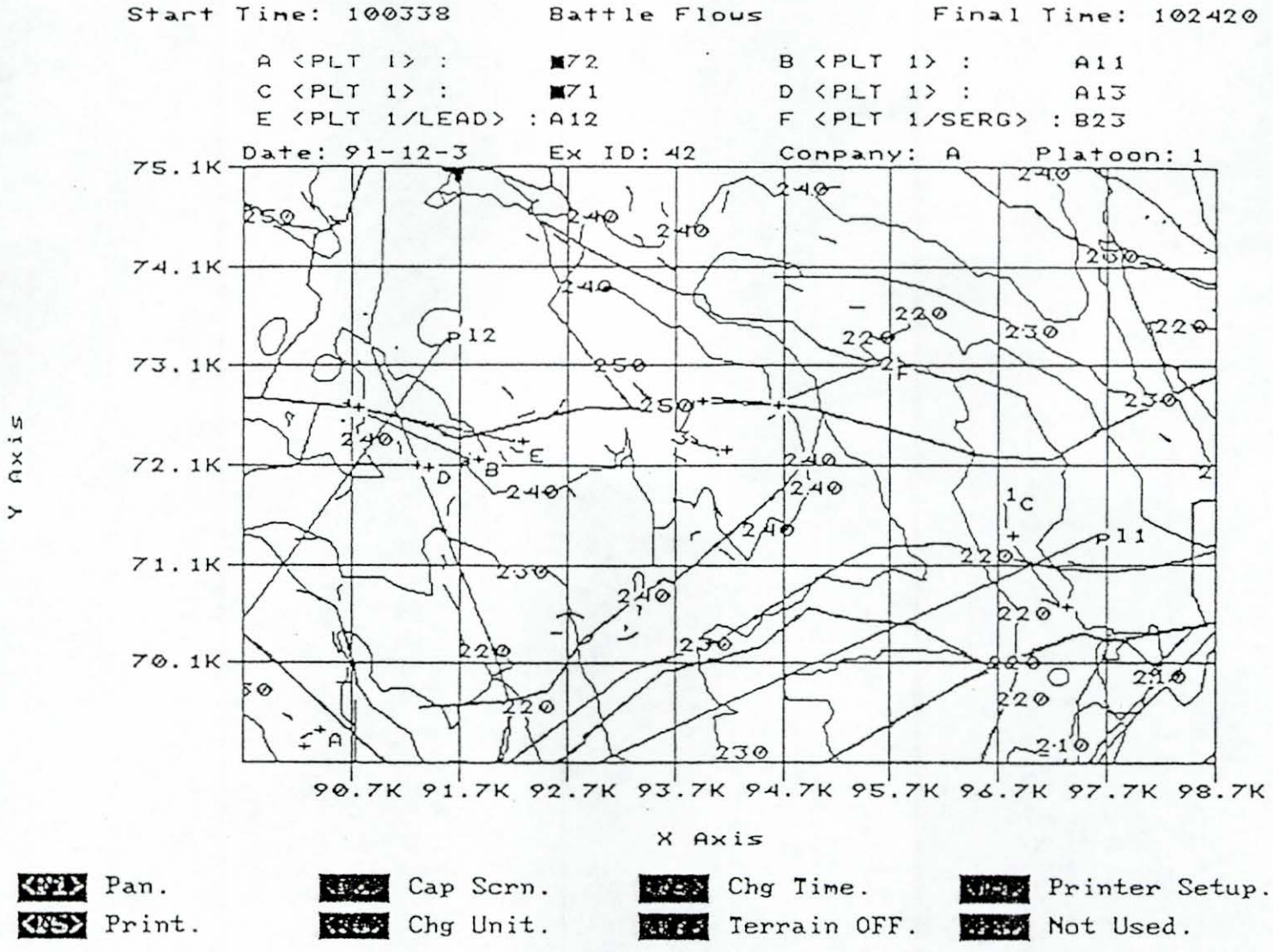


Figure 19 Battle Flow Display With Contour

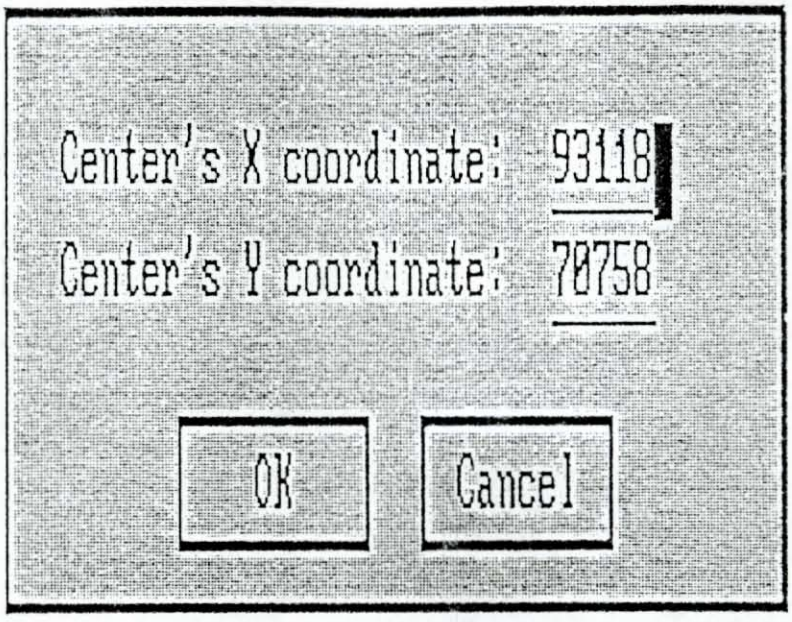


Figure 20 Change Viewpoint Menu

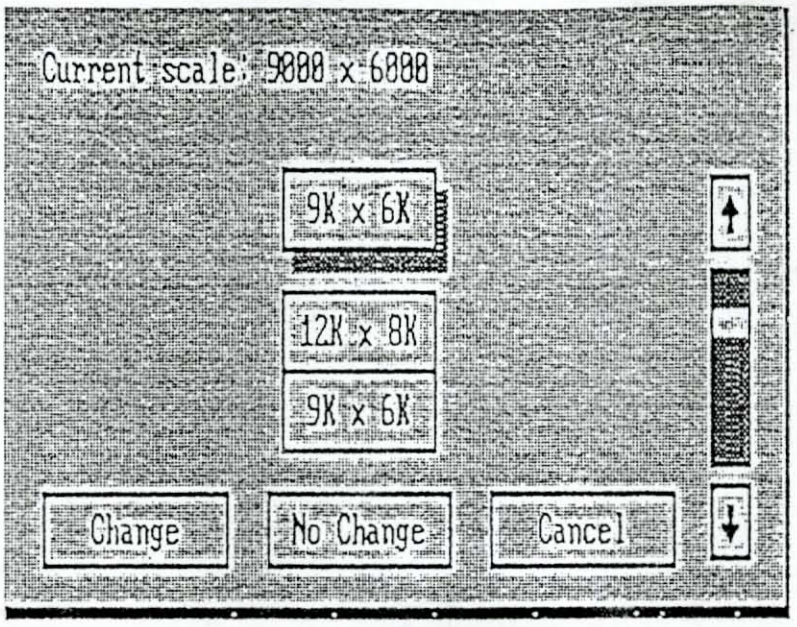


Figure 21 Select Scale Menu

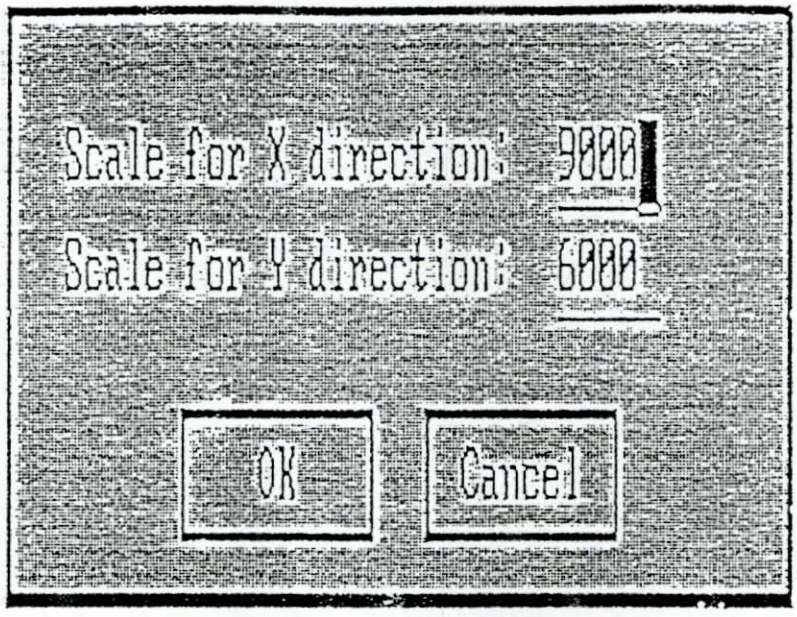


Figure 22 Change Scale Menu

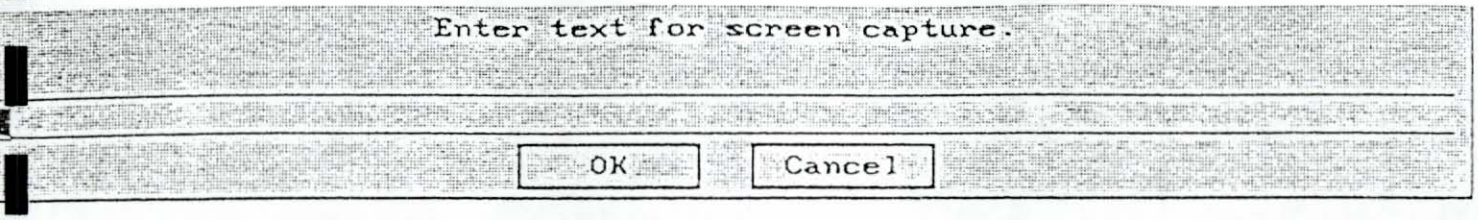


Figure 23 Screen Capture Text Entry Menu

Figure 24 Change Time Parameter Menu

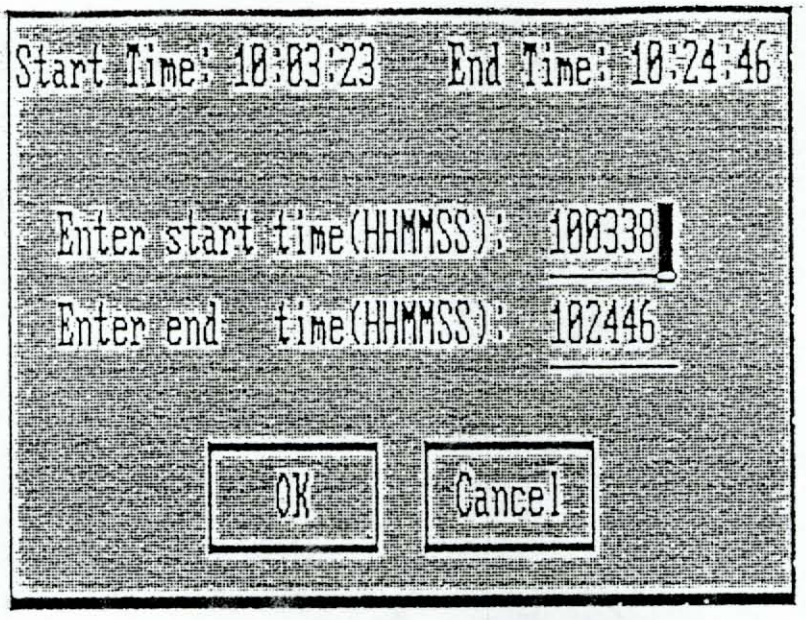


Figure 25 Change Starting/Entry Time Menu

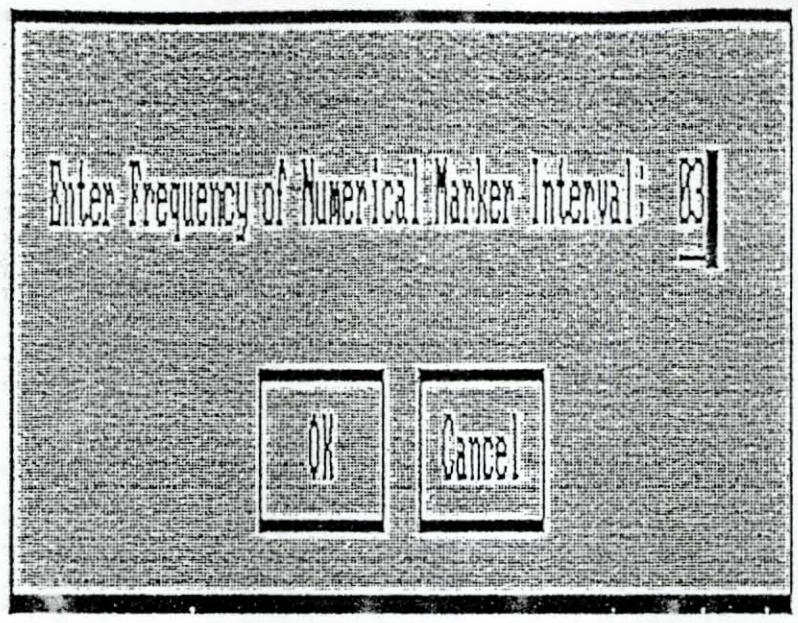


Figure 26 Change Numerical Marker Frequency Menu

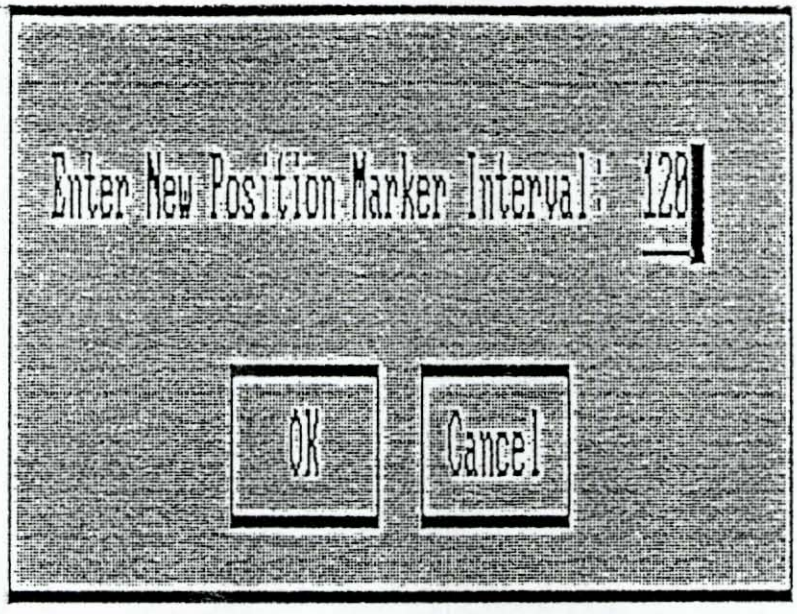


Figure 27 Change Position Marker Internal Menu

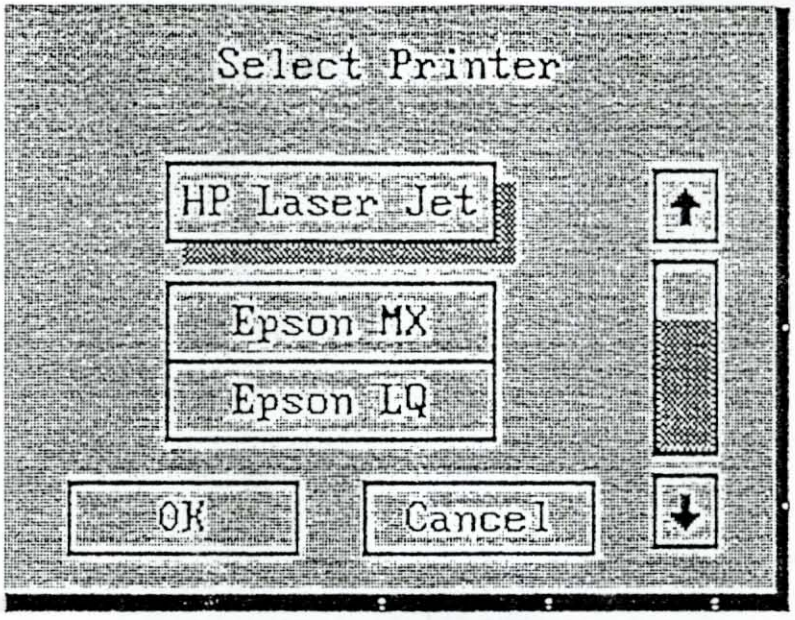


Figure 28 Select Printer Menu

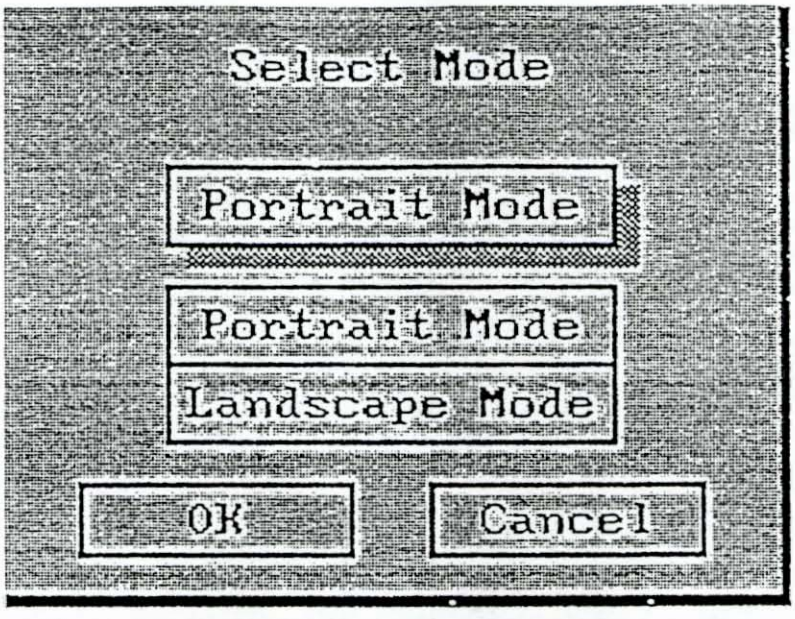


Figure 29 Select Printer Mode Menu

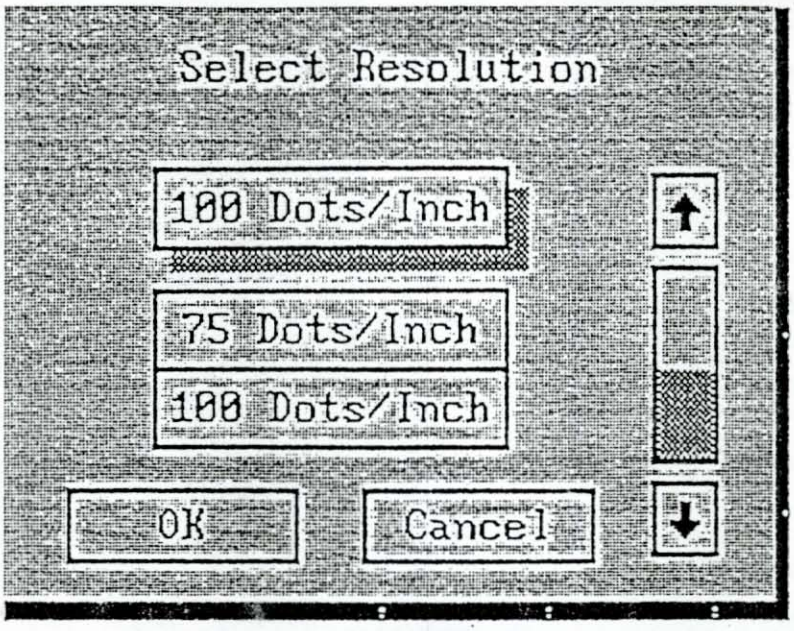


Figure 30 Select Printer Resolution Menu

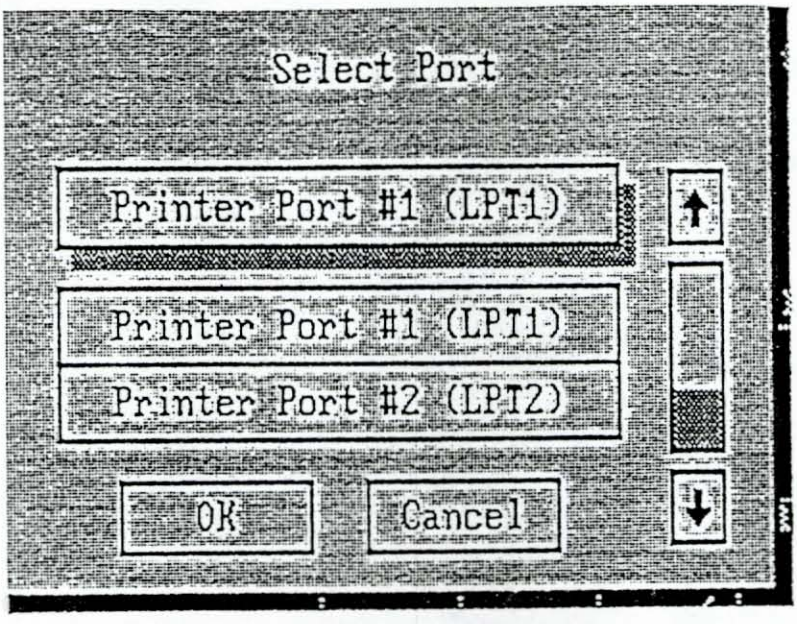


Figure 31 Select Printer Port Menu

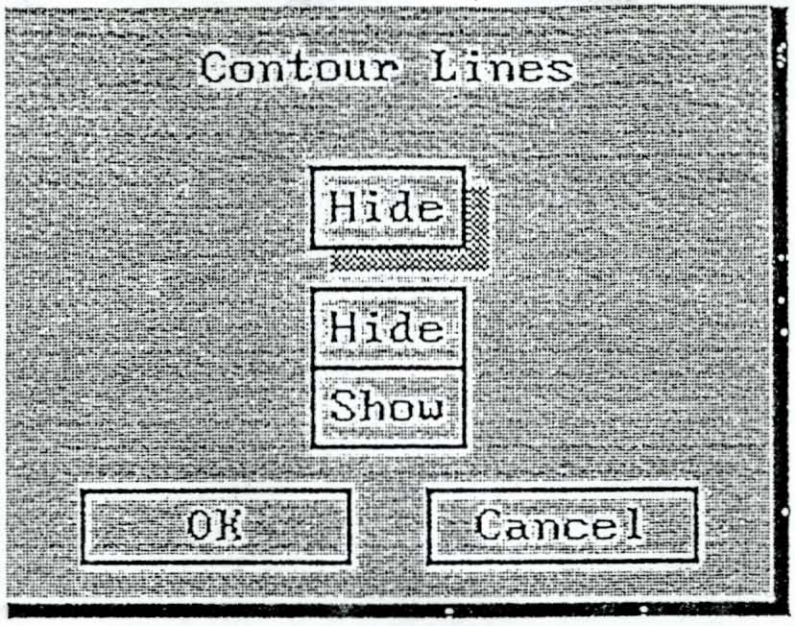


Figure 32 Show Contour Lines Menu

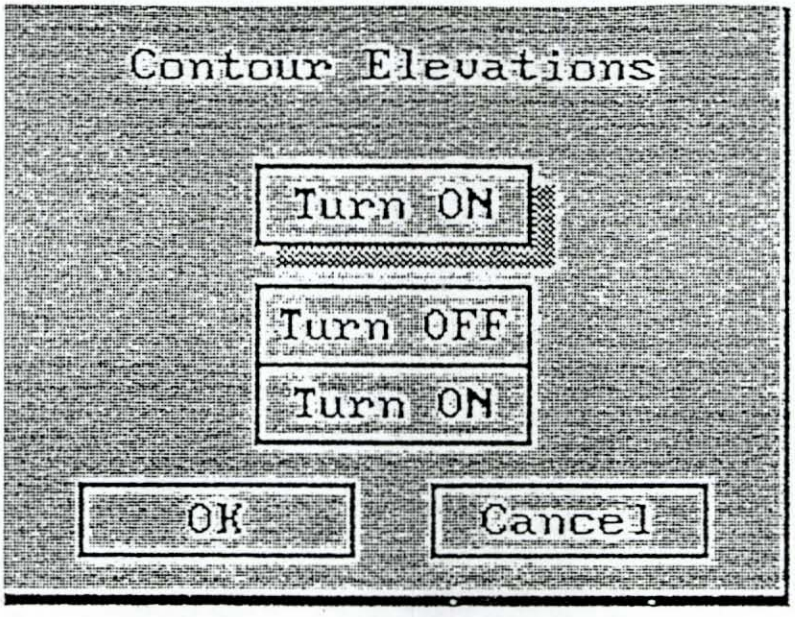


Figure 33 Show Contour Elevation Menu

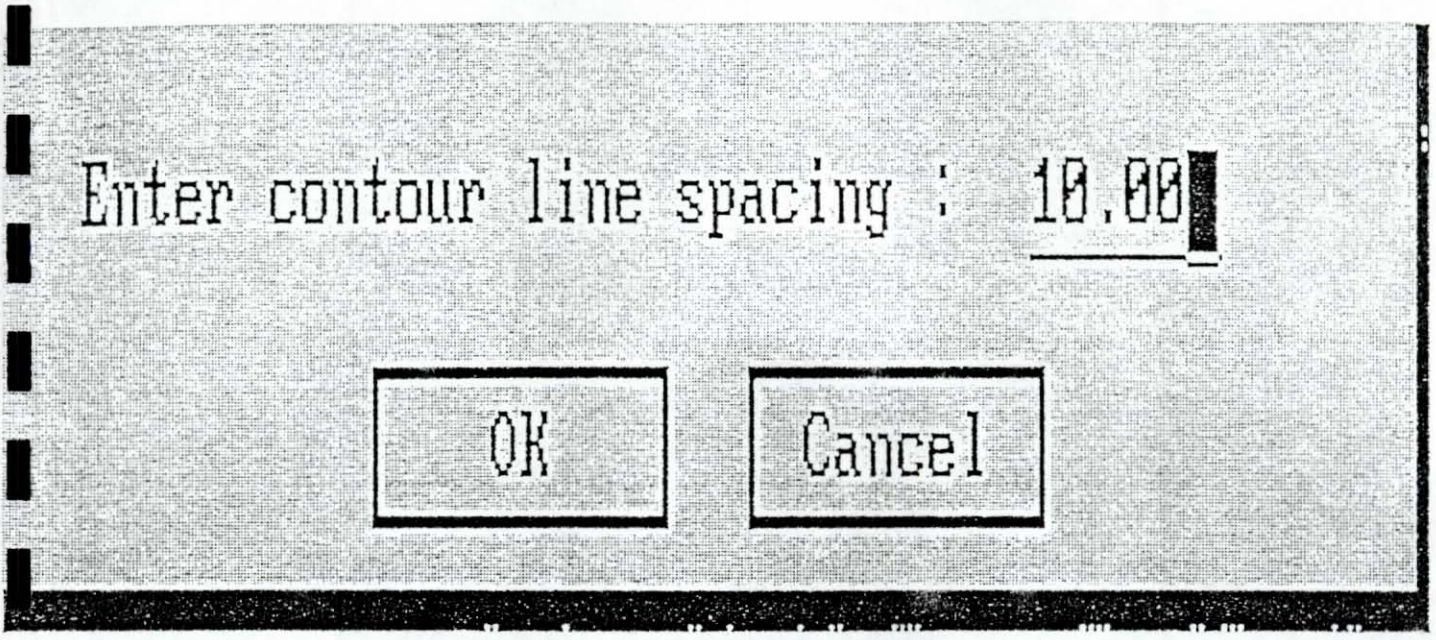


Figure 34 Contour Line Spacing Entry Menu

EXERCISE TIMELINE

Functional Description

Exercise Timeline Display provides a graphic display to illustrate the times at which major events occur during an exercise for the vehicles in a platoon. The display of these major events in an easily comprehensible format will help the exercise participants to recall what happened during the exercise when they conduct the After Action Review. This helps them focus their attention on these critical points in time at which major events occur. Other AAR aids, such as Planview display or Battle Snapshot can then be taken to focus on these critical times.

The Exercise Timeline Display can be used for either the Blue or Red Force as selected by the user.

The major events displayed in the Exercise Timeline can be grouped into three categories:

"Move" events
"Shoot" events
"Communication" events

The "Move" events to be included in the display are:

The time interval (shown as a bar in the display) is between the first and last (non-disabled) vehicles in the selected platoon crossing any one of the control measures: Assembly Areas, Check Points, Objectives, Phase Lines, Lines of Departure, Starting Points, Release Points. Note that disabled vehicles are not included when calculating the time interval. For Starting Points, Check points, Release points, vehicles coming within 50 meters of the said points are considered crossing. For Phase lines, Lines of Departure, vehicles need to actually cross the said lines to be considered crossing. For Assembly Areas, vehicles are considered to have left the areas when they are more than 100 meters from the area. For Objectives, vehicles are considered to have reached the Objectives when they are within 100 meters of the said Objectives.

Time during which no vehicles in the platoon move. Note that disabled vehicles are excluded from the calculation.

The "Shoot" events included in the display are:

Time at which artillery fire occurs near a unit. Any artillery or mortar fire within 500 meters from any of the vehicles in the platoon is considered near.

Time at which the first enemy fire is received by a platoon regardless of if that fire results in a hit, kill or miss, provided that it is within 500 meters from any unit in the platoon

Time at which first friendly fire is delivered by any vehicle in the platoon (one per platoon per exercise) regardless of if that fire results in a hit, kill or miss

Time at which vehicles are destroyed by any vehicle in the platoon.

Time at which any vehicle in the platoon gets destroyed.

The "Communication" events included in the display are:

Times for the following communication events: Report, Call for Fire, Order, Request for Information, Miscellaneous.

An example Exercise Timeline Display is shown in Figure 35 on page 77. This is a higher echelon display in which more than one platoon is involved. Each display page accommodates two platoons. For a company with more than two platoons, it might take more than one page to display the Exercise Timeline for all the platoons in the company. The user can page through all the pages by pressing the appropriate function keys. At the platoon level, only one page is sufficient to accommodate the display for the platoon.

The length of the time scale covers the length of the exercise. The starting time is marked on the time scale in the format of "hhmm" as the first label on the time scale. The other time labels to be marked on the time scale will be in the format of "mm" without the preceding "hh" to avoid a cluttered appearance. The precision of each time label chosen depends on the duration of the exercise. The shorter the exercise, the finer (more precise) will be the time label.

The shoot events in the Exercise Timeline are color-coded as follows:

"First friendly fire delivered", "First enemy fire received", "Artillery fire near unit" are color-coded based on the force of the firing vehicles (blue for Blue Force and red for Red Force).

"Enemy vehicles destroyed", "Friendly vehicles destroyed" are color-coded based on the force of the vehicles destroyed.

During the AAR, when the user comes across a display screen that he wants to save for future reference, he can activate the appropriate Screen Capture function to save the desired screen display to a file. For the Exercise Timeline display screen, the file to be saved has a default file name beginning with "TIML" followed by one or more numeric digits. The numeric digits will be incremented by one for each additional screen captured. For example, if the first Exercise Timeline screen was saved in the file, "TIML0001", the next Exercise Timeline screen will be saved in the file, "TIML0002".

Access to Exercise Timeline Module

The Exercise Timeline module can be selected and invoked through the UPAS menu selection as follows:

a. Select "Data Summary" from the UPAS main menu as shown in Figure 1 on page 25. A new ("Data Summary") menu will appear as depicted in Figure 2 on page 26.

b. Select "After Action Review" from the "Data Summary" menu. A new ("After Action Review") menu will appear as depicted in Figure 12 on page 57.

c. Select "Exercise Timeline" from the "After Action Review" menu. The user will be presented with the Select Force menu to select "BLUE" or "RED" Force as shown in Figure 13 on page 58. After selecting the force, the user is required to select the desired echelon level for the display as shown in Figure 14 on page 58. Two choices (company or platoon level) are available.

d. If platoon level has been selected, the user is required to select the company/platoon number by making the appropriate selection as shown in Figure 15 and Figure 16 on page 59. Alternatively, if company level has been selected, the user is required to select the company id by making the appropriate selection as shown in Figure 15 on page 59.

e. After selecting the desired company and platoon number, the exercise timeline will be displayed as shown in Figure 35 on page 77.

Function Key Activation

The Exercise Timeline Module provides the following function keys for activation. Select the appropriate function key to initiate

the function.

a. Change Units <F1>

This function key allows the user to enter a new unit for which the exercise timeline will be displayed. The new unit is entered by specifying the force, echelon level, company and platoon number for the desired unit by responding to the series of menu prompts as presented earlier.

b. Capture Screen <F2>

When this function key is selected, a pop-up menu will appear as shown in Figure 23 on page 65. The user can enter up to two lines of text to describe the screen display that he is capturing. These two lines of text are appended to the bottom of the display screen overlaying the function key area and saved to a screen image file with the appropriate file name.

c. Setup printer <F3>

This function key allows the user to set up the printer. When the function key is selected, a pop-up window will appear as shown in Figure 28 on page 68. The user highlights the appropriate selection with the mouse or the up and down arrow keys and then press <Enter> to accept the choice. Depending on the printer type selected, the user might also be prompted to select the printer mode (Portrait or Landscape mode), printer resolution and printer port as shown in Figure 29, Figure 30 and Figure 31 on page 68 and page 69.

d. Print <F4>

The Exercise Timeline Display as shown on the screen is printed on the printer by selecting this function key.

e. Next Legend <F5>

This function key allows the user to display the next legend page as there are more than one page for the legend. Selecting this key while at the last legend page displays the first legend

page.

e. Since the higher echelon (company) display takes more than one display page, the user can select Up and Down Arrow keys to page through the timeline display for all the platoons in the company. The program can be interrupted by pressing <Esc> key any time.

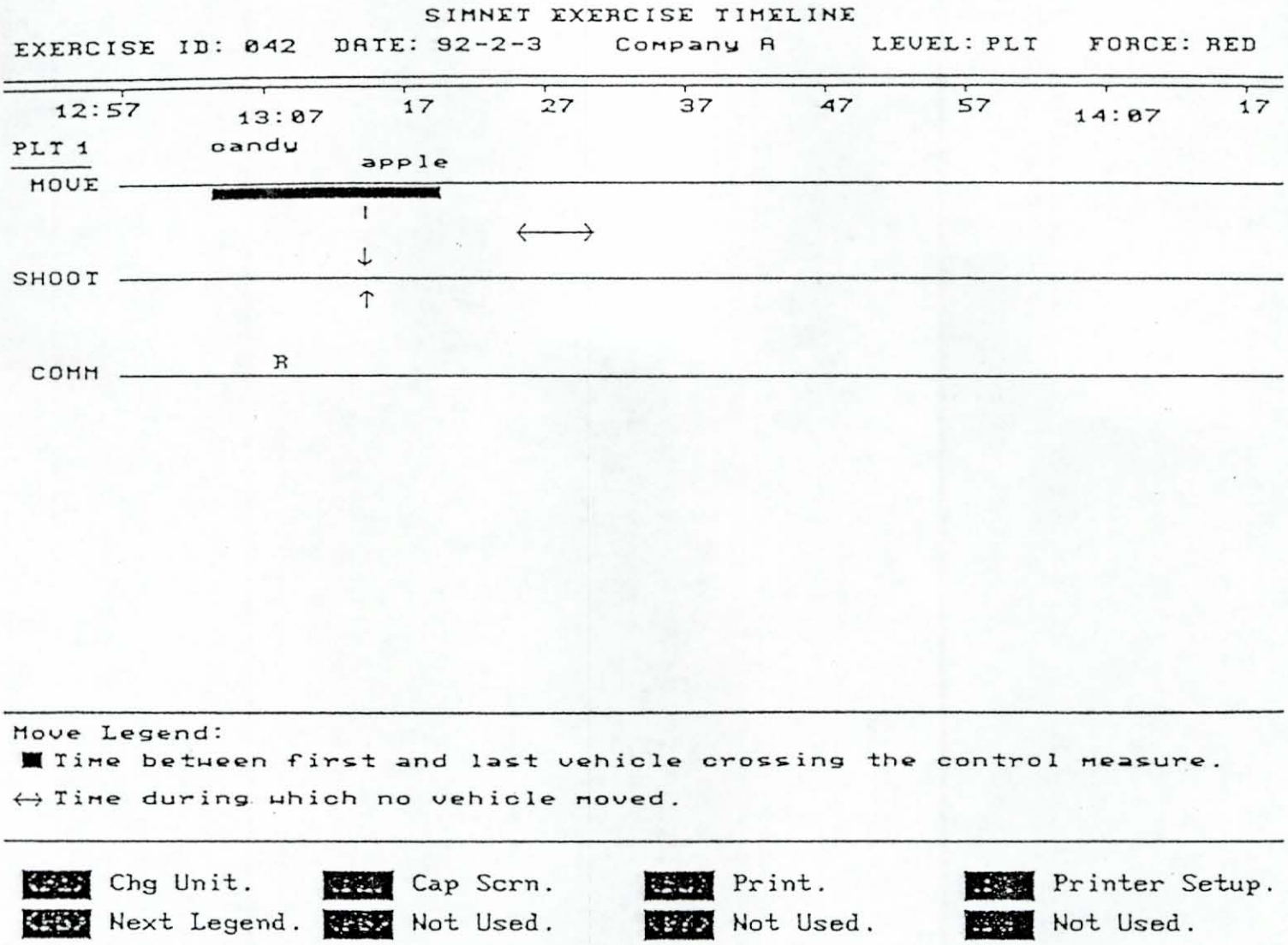


Figure 35 Exercise TimeLine

BATTLE SNAPSHOT

Functional Description

The Battle Snapshot Module takes a snapshot display of the units at a particular point in time as entered by the user. Some of the useful times to take the Battle Snapshot are when the vehicles are crossing the preestablished control measures, and also when they are under enemy fires. These are times when it is most useful to see how the units position themselves and react. These times are obtained from the Exercise Timeline Display.

The Battle Snapshot Display is used for either the Blue or Red Force as selected by the user. At the platoon level, it displays the snapshot of all the vehicles in the platoon. At the company level, it displays the snapshot of the platoon leaders, platoon sergeants, company commander and company executive for all the platoons and company HQ for the company.

The information to be displayed in the Battle Snapshot includes:

a. A terrain map displayed in the background if terrain display is enabled.

b. Control measures for the selected Blue or Red Force are displayed on top of the terrain map. Control measures to be included in the display are: Phase lines, boundary lines, lines of departure, objectives, assembly areas, starting points, release points, check points, air coordination areas, combat support service areas, obstacles and minefields.

c. The orientation and position of some or all the vehicles in the unit, depending on the echelon selected. The orientations of their gun tubes are also displayed. The vehicles are labeled with letters (A, B, . . .). In the vehicle ID legend area (on top of the main graphic display area), the labels are displayed with the corresponding vehicle bumper numbers and unit's designation (such as platoon leader designation).

d. The position of enemy vehicles. The enemy vehicles are represented as circles. They are colored blue for live Blue Force units, cyan for killed Blue Force units, red for live Red Force units and white for killed Red Force units.

An example Battle Snapshot Display is shown in Figure 37 on page 85. If terrain display is enabled, the display will show the background terrain as in Figure 38 on page 86.

During the AAR, when the user comes across a display screen that he wants to save for future reference, he can activate the appropriate

Screen Capture function to save the desired screen display to a file. For the Battle Snapshot display screen, the file to be saved has a default file name beginning with "SSHT" followed by one or more numeric digits. The numeric digits will be incremented by one for each additional screen captured. For example, if the first Battle Snapshot screen was saved in the file, "SSHT0001", the next Battle Snapshot screen will be saved in the file, "SSHT0002".

Access to Battle Snapshot Module

The Battle Snapshot module is selected and invoked through the UPAS menu selection as follows:

a. Select "Data Summary" from the UPAS main menu as shown in Figure1 locate on page 25. A new ("Data Summary") menu will appear as depicted in Figure 2 on page 26.

b. Select "After Action Review" from the "Data Summary" menu. A new ("After Action Review") menu will appear as depicted in Figure12 on page 57.

c. Select "Battle Snapshot" from the "After Action Review" menu. The user will be presented with the Select Force menu to select "BLUE" or "RED" Force as shown in Figure 13 on page 58. After selecting the force, the user is required to select the desired echelon level for the display as shown in Figure 14 on page 58. Two choices (company or platoon level) are available.

d. If platoon level is selected, the user is required to select the company/platoon number by making the appropriate selection as shown in Figure 15 and Figure 16 on page 59. Alternatively, if company level is selected, the user is required to select the company id by making the appropriate selection as shown in Figure 15 on page 59.

e. After selecting the desired company and platoon number, the user is prompted for the time for which the snapshot will be taken as shown in Figure 36 on page 84.

f. After selecting the desired time, the battle snapshot will be displayed as shown in Figure 37 on page 85.

Function Key Activation

The Battle Snapshot Module provides the following function keys for activation. Select the appropriate function key to initiate the function.

a. Pan <F1>

The Battle Flow Module allows a user to change the location of the display viewport to another area of the battle field. It also allows the user to change the scale of the viewport. Changing the scale to a lower value allows the user to view the battle field in finer detail while a higher value for the scale presents a view of the battle field in coarser granularity but will cover a bigger area of the battle field.

When the function key <F1> is selected, a "Cross-shaped" cursor appears. The user positions the cursor anywhere in the boundary of the current viewport and clicks the left mouse button. This position becomes the new center of the viewport. If the user clicks the cursor outside the boundary of the viewport, a pop-up menu appears as shown in Figure 20 on page 63 with the current location of the viewport center displayed. Then the user enters the new location (x and y coordinates) for the center of the viewport. Note that the coordinates are in meters.

After the new center is selected or entered, a pop-up menu appears as shown in Figure 21 on page 64. The user selects the desired scale from the available selections in the menu. One of the selections is "X x Y". If the user selects this selection, another pop-up menu is displayed as shown in Figure22 on page 64 with the current scale displayed. Then the user enters the new scale for the viewport. The scale consists of the dimension of the viewport in meters in the x and y direction. The smallest scale the user can enter is 200 meters by 200 meters.

b. Capture Screen <F2>

When this function key is selected, a pop-up menu appears as shown in Figure 23 on page 65. The user can enter up to two lines of text to describe the screen display that he is capturing. These two lines of text are appended to the bottom of the display screen overlaying the function key area and are saved to a screen image file with the appropriate file name.

c. Change Time <F3>

This function key allows the user to enter the time when the Battle Snapshot will be taken. When selected, a pop-up menu appears as shown in Figure 36 on page 84. Then, the user can enter the desired time in hhmmss format.

d. Setup printer <F4>

This function key allows the user to set up the printer. When the function key <F4> is selected, a pop-up window appears as shown in Figure 28 on page 68. The user highlights the appropriate selection with the mouse or the up and down arrow keys and then presses <Enter> to accept the choice. Depending on the printer type selected, the user might also be prompted to select the printer mode (Portrait or Landscape mode), printer resolution and printer port as shown in Figure 29, Figure 30 and Figure 31 on page 68 and page 69.

e. Print <F5>

The Battle Snapshot Display as shown on the screen can be printed on the printer by selecting the function key <F5>.

f. Change Units <F6>

This function key allows the user to enter a new unit for which the battle flow will be displayed. The new unit is entered by specifying the force, echelon level, company and platoon number for the desired unit by responding to the series of menu prompts as presented earlier.

g. Terrain On/Off <F7>

This function key allows the user to enable or disable the terrain display. If terrain is enabled, selecting the key disables the terrain display. If terrain is disabled, selecting the key enables the terrain display.

After the function key is selected to enable the terrain display, the user is allowed to show or hide the contour lines, turn on or off the contour elevations and change the contour line spacing by making the appropriate selections in the menus as shown in Figure 32 on page 70, Figure 33 on page 70 and Figure 34 on page 71.

h. LOS <F8>

This function key allows the user to make selection for source and target vehicles between which lines of sight will be displayed. Lines of sight are displayed in blue if the lines of sight between the source and target vehicles are not blocked by intervening terrain features or in red if they are blocked. For details on how to make the selection, refer to the appropriate section below.

i. When in the main graphic display screen, left, right, up, and down arrow keys can be used to move the display viewport in the appropriate direction to cover a different area of the battle field. The vehicle id legend area (on top of the main graphic display area) is scrollable. The user can scroll the information in the legend area by selecting the <PgUp> and <PgDn> keys. The program can be interrupted by pressing <Esc> key any time.

Making Selection for Line of Sight Display

After selecting <LOS> key, the function key in the footer area changes to that as shown in Figure 39 on page 87. There are four new function keys for selection as described below.

a. Source <F1>

This function key allows the user to select a source vehicle to be used in LOS display. After selecting this function key, the user uses the mouse to select any vehicle from the currently selected unit that appears in the viewport as the source vehicle by clicking on the appropriate vehicle icon.

b. Selected Targets <F2>

This function key allows the user to select target vehicle(s) to be used in LOS display. After selecting this function key, the user uses the mouse to select any vehicle(s) that are visible in the viewport as the target vehicle(s) by clicking on the appropriate vehicle icon(s). Note that since some vehicle icons might overlap, more than one target vehicle may be selected by the mouse click. The line(s) of sight will then be displayed between the selected source and target vehicles.

c. All Targets <F3>

This function key allows the user to select all vehicles in the viewport as target vehicles. Lines of sight will be displayed from the selected source vehicle to all the selected target vehicles.

d. Erase <F4>

This function key allows the user to erase the lines of sight currently being displayed.

e. Exit <Esc>

Pressing this key takes the user to the previous level of function key selection.

Index File for Faster Search

To display the location of the vehicles and the orientation of the gun tubes for the vehicles at a specified time, the program needs to locate the appropriate vehicle appearance packets in the raw data file quickly. To expedite the search, the program uses an index file that was created immediately after data collection. For more information on the contents of the index file and how it works, please refer to the appropriate description on page 93.

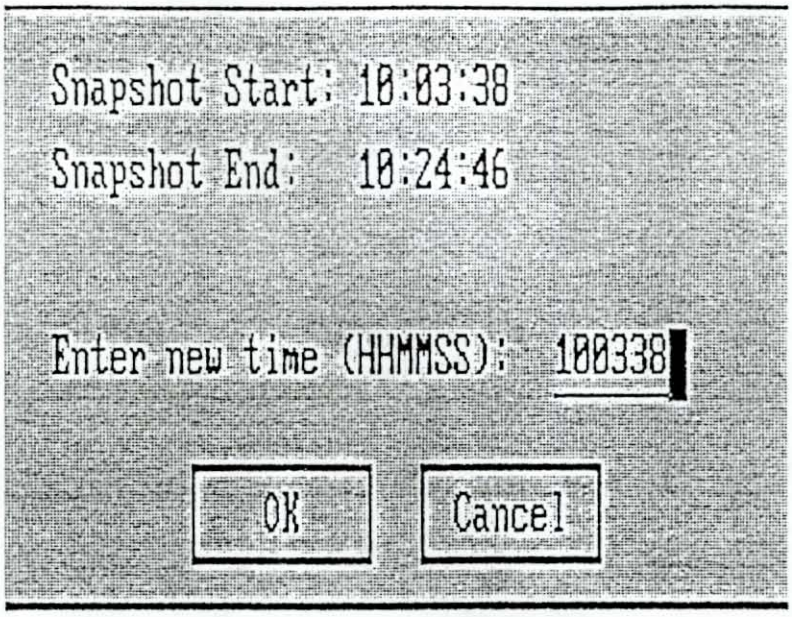


Figure 36 Time Prompt Menu

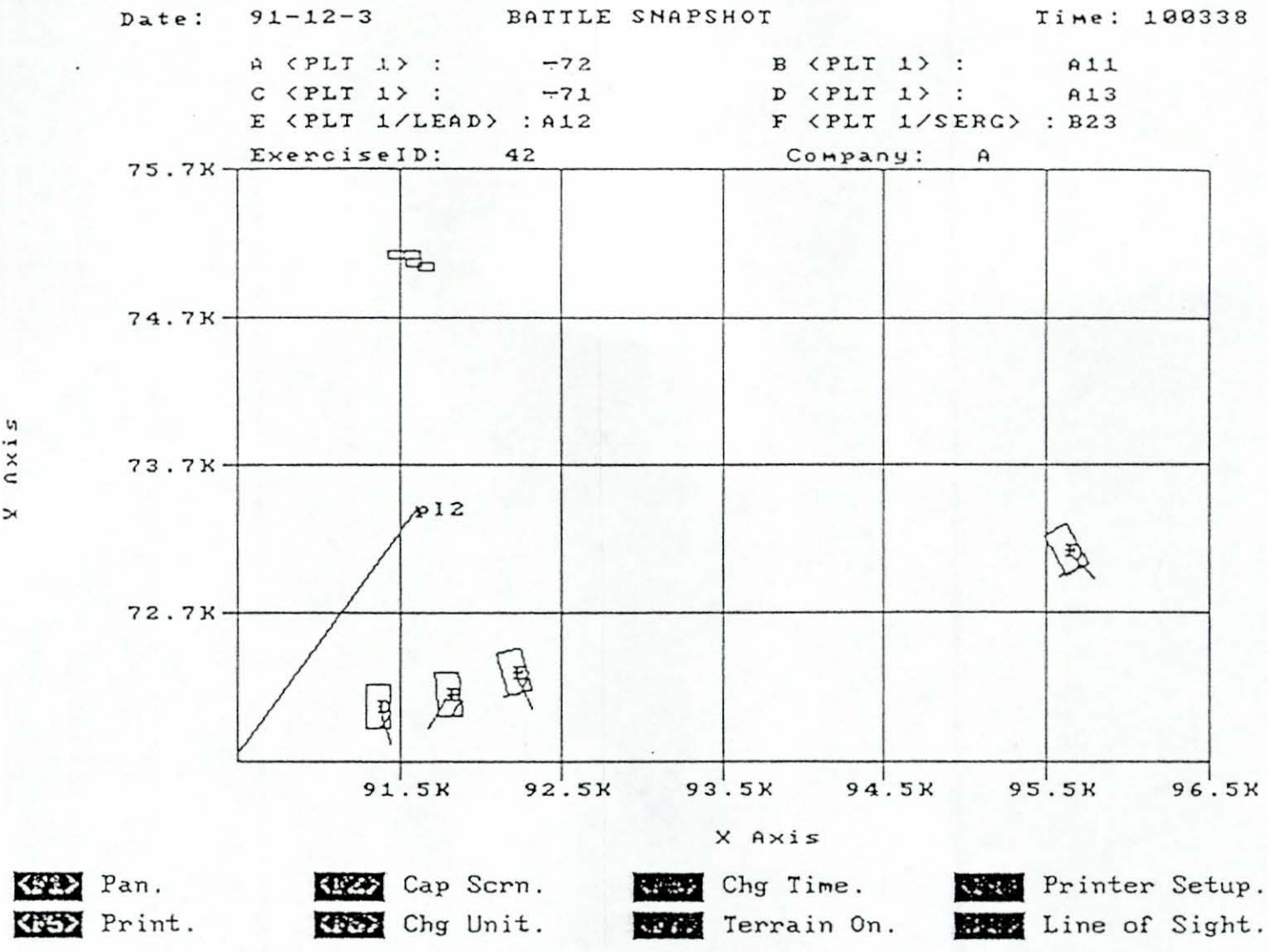


Figure 37 Battle Snapshot Display

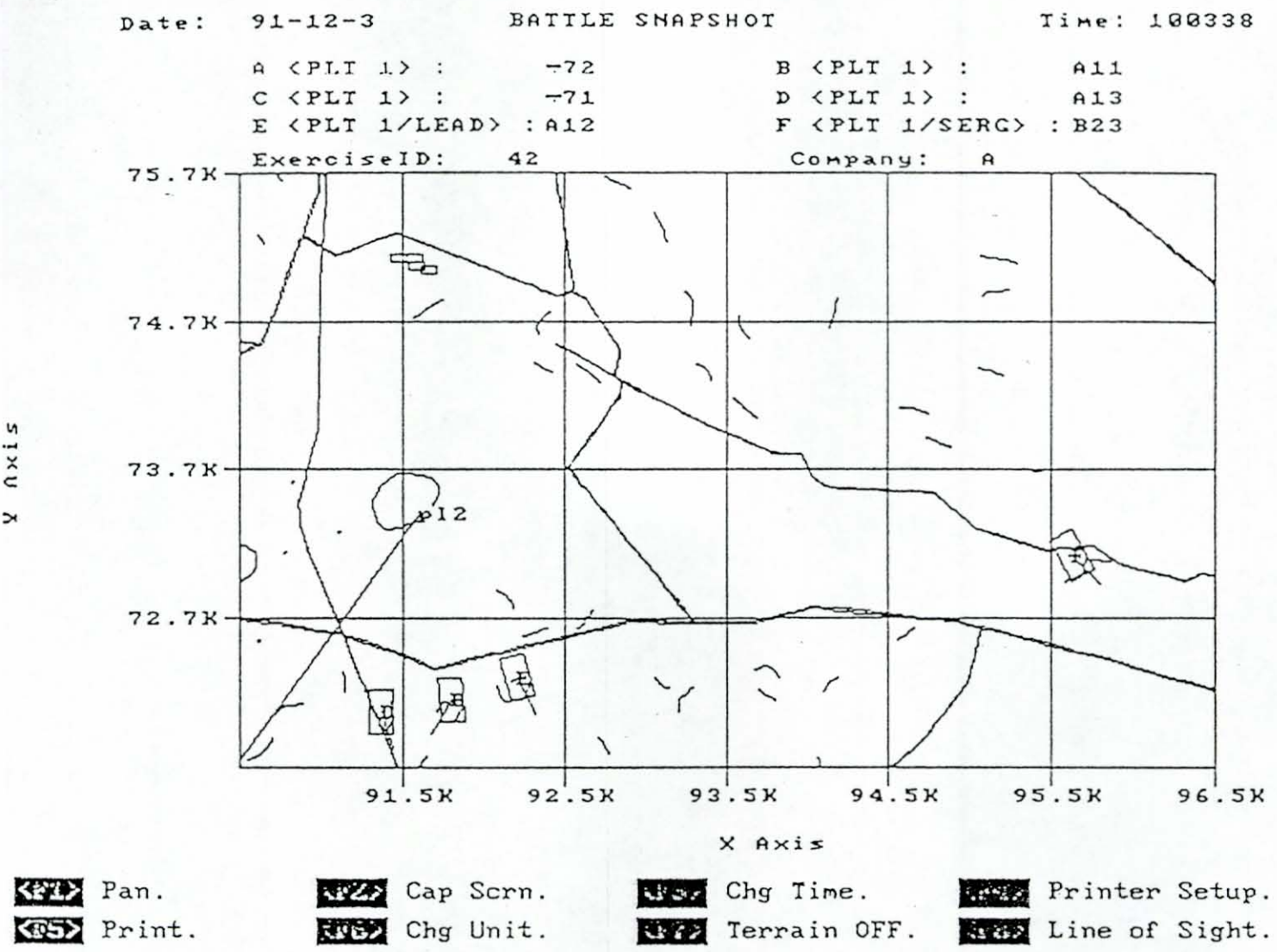


Figure 38 Battle Snapshot Display With Terrain

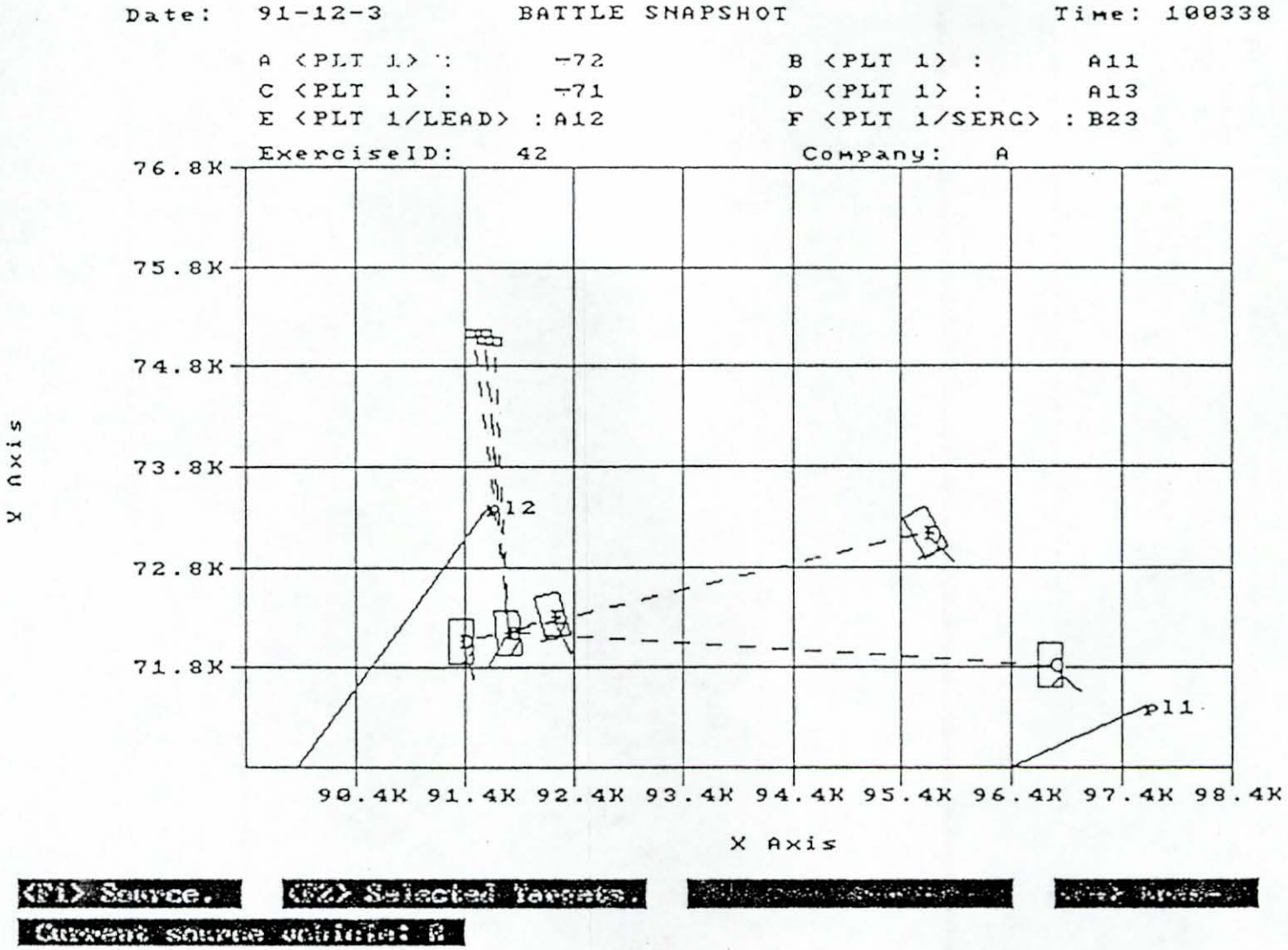


Figure 39 LOS Function Key Selection

PLAYBACK PLAN VIEW DISPLAY

Overview

The Playback Plan View Display Module has been enhanced to include the following capabilities:

Terrain information is retrieved from the terrain database and displayed with the plan view display

Control measures included in the display are: Phase lines, boundary lines, lines of departure, objectives, assembly areas, starting points, release points, check points, air coordination areas, combat support service areas, obstacles and minefields.

Re-starting the Plan View Display at a different time or the next event has been speeded up by using an index file created during data collection

The new functional description, access to the Playback Plan View Display Module and the corresponding function key description are presented in the following sections.

Functional Description

The Playback Plan View Display Module plays back the units' movements and activities during an exercise from the start time (which defaults to the exercise start time) to the end of the exercise. The playback is done at the "Simulated" speed as opposed to the real time speed. "Simulated" speed is the speed at which playback information is read from the recorded media and displayed to the screen as fast as the computer can do.

A terrain map is first displayed in the background. Control measures are retrieved from the database and displayed on the map. Next, data packets are read from the raw data file to obtain the location of the vehicles in chronological order. Depending on the display type selected, icons representing the individual vehicles or the aggregate platoon units are displayed on the screen during playback. Their movements are animated by continuously erasing the icons from their old positions and redisplaying them at their new positions.

If the display type selected is for individual vehicles, the vehicles as shown on the map are represented by blue and red icons depending on their sides. Different icon shapes are used to represent different vehicle types. Currently, five icon shapes are used for the following vehicle types: aircraft, helicopter, infantry, tank-class vehicle(with turret) and other vehicle. Their coloration changes to reflect the change of status. A vehicle that

has just fired a weapon will brighten in color (from blue to lite cyan and from dark red to light red). A blue vehicle has its color changed to dark cyan and a red vehicle changed to white when killed. An example Plan View Display is shown in Figure 40 on page 95. If terrain display is enabled, the display will show the background terrain as shown in Figure 41 on page 96.

If the display type selected is for aggregate units, the aggregate platoon units will be displayed instead of the individual vehicles. The aggregate icons as shown on the map are represented by blue and red icons depending on their sides. Different icon shapes are used to represent different aggregate unit types. Currently, three icon shapes are used for the following aggregate unit types: armored platoon, mechanized platoon and other aggregate type. The location of the aggregate icon is computed from the locations of the constituent vehicles by calculating the center of mass. Killed vehicles in the platoon are excluded from the center of mass calculation.

Included in the heading of the display are:

Simulated Time - This is the time for the exercise activities. It is updated continuously as the playback of the exercise continues.

Next Event - This is a description of the next master event that would occur after the currently displayed simulated time.

Next Event Time - Time for the next master event

During the AAR, when the user comes across a display screen that he wants to save for future reference, he can activate the appropriate Screen Capture function to save the desired screen display to a file. For the Plan View display screen, the file to be saved has a default file name beginning with "PVD" followed by one or more numeric digits. The numeric digits will be incremented by one for each additional screen captured. For example, if the first Plan View screen was saved in the file, "PVD0001", the next Plan View screen will be saved in the file, "PVD0002".

Access to Playback Plan View Display Module

The Playback Plan View Display module can be selected and invoked through the UPAS menu selection as follows:

a. Select "Data Summary" from the UPAS main menu as shown in Figure1 on page 25. A new ("Data Summary") menu will appear as depicted in Figure 2 on page 26.

b. Select "After Action Review" from the "Data Summary" menu. A new ("After Action Review") menu will appear as depicted in Figure12 on page 57.

c. Select "Playback" from the "After Action Review" menu. The Plan View Display showing the playback of the exercise activities will be displayed as shown in Figure 40 on page 95.

Function Key Activation

The Playback Plan View Display Module provides the following function keys for activation. Select the appropriate function key to initiate the function. There are two function key sets. The user selects the <More> function key to go one function key set to the next function key set.

The following are the function keys available in the first function key set:

a. Pan <F1>

The Plan View Module allows a user to change the location of the display viewport to another area of the battle field. It also allows the user to change the scale of the viewport. Changing the scale to a lower value allows the user to view the battle field in finer detail while a higher value for the scale presents a view of the battle field in coarser granularity, but covers a bigger area of the battle field.

When the function key <F1> is selected, a "Cross-shaped" cursor appears. The user positions the cursor anywhere in the boundary of the current viewport and clicks the left mouse button. This position becomes the new center of the viewport. If the user clicks the cursor outside the boundary of the viewport, a pop-up menu appears as shown in Figure 20 on page 63 with the current location of the viewport center displayed. Then the user enters the new location (x and y coordinates) for the center of the viewport. Note that the coordinates are in meters.

After the new center is selected or entered, a pop-up menu appears as shown in Figure 21 on page 64. The user selects the desired scale from the available selections in the menu. One of the selections is "X x Y". If the user selects this selection, another pop-up menu is displayed as shown in Figure22 on page 64 with the current scale displayed. Then the user enters the new scale for the viewport. The scale consists of the dimension of the viewport in meters in the x and y direction. The smallest scale the user can enter is 200 meters by 200 meters.

b. Capture Screen <F2>

When this function key is selected, a pop-up menu will appear as shown in Figure 23 on page 65. The user can enter up to two lines of text to describe the screen display that he is capturing. These two lines of text are appended to the bottom of the display screen overlaying the function key area and are saved to a screen image file with the appropriate file name.

c. Change Time <F3>

This function key allows the user to enter the new start time at which the Plan View Display will restart its display. When selected, a pop-up menu will appear as shown in Figure 43 on page 98. Then, the user can enter the desired start time in hhmmss format. When the program is first started, the start time defaults to the start time of the exercise.

d. Setup printer <F4>

This function key allows the user to set up the printer. When the function key <F4> is selected, a pop-up window appears as shown in Figure 28 on page 68. The user highlights the appropriate selection with the mouse or the up and down arrow keys and then presses <Enter> to accept the choice. Depending on the printer type selected, the user might also be prompted to select the printer mode (Portrait or Landscape mode), printer resolution and printer port as shown in Figure 29, Figure 30 and Figure 31 on page 68 and page 69.

e. Print <F5>

The Plan View Display as shown on the screen is printed on the printer by selecting the function key <F5>.

f. Next Event <F6>

This function key allows the user to restart the Plan View Display at the next event time as shown at the header of the display. Master events and the associated event times can be defined using the Master Event List Module in UPAS.

g. Terrain On/Off <F7>

This function key allows the user to enable or disable the terrain display. If terrain has been enabled, selecting the key

disables the terrain display. If terrain has been disabled, selecting the key enables the terrain display.

After the function key is selected to enable the terrain display, the user is allowed to show or hide the contour lines, turn on or off the contour elevations and change the contour line spacing by making the appropriate selections in the menus as shown in Figure 32 on page 70, Figure 33 on page 70 and Figure 34 on page 71.

h. More <F8>

This function key allows the user to display the next fuction key set (as shown in Figure 42 on page 97).

i. When in the main graphic display screen, left, right, up, and down arrow keys are used to move the display viewport in the appropriate direction to cover a different area of the battle field. The program can be interrupted by pressing <Esc> key any time.

The following are the function keys available in the second function key set:

a. Refresh Screen <F1>

The movement of vehicles leaves trails behind. After a while, the terrain background might need to be refreshed to remove the vehicle trails. Selecting this function key allows the screen display to be refreshed.

b. Identify Vehicles <F2>

Upon selecting this function key, an X-shaped cursor appears. Depending on the current display type, the user is instructed to click on any individual or aggregate vehicle icon(s) to view the corresponding vehicle ID(s) or platoon organization(s) for the icon(s). The samples of vehicle ID(s) and aggregate icon display are shown in Figure 44 on page 99 and Figure 45 on page 100 respectively. The user can continue clicking more icons to view the corresponding vehicle ID(s) or platoon organization(s). To stop viewing, the user needs to click elsewhere on the screen where there are no icons(s).

c. Display Type <F3>

The user uses this function key to change display type. When function key F3 is selected, a pop up window will appear, as shown in Figure 46 on page 101. The user highlights the appropriate selection with the mouse or the up and down arrow keys and then press <Enter> to accept the choice. Possible choices are individual and aggregate display. Select individual display to display individual vehicle icons or aggregate display to display aggregate platoon icons. A sample of the aggregate display is shown in Figure 47 on page 102 .

d. More <F4>

This function key brings the user back to the next function key set.

Index File for Faster Search

The Playback Plan View Display Module allows the user to enter a new start time (or the next event time) to start the playback. Without an index file, the system would have to read the raw data file (where all the collected data are stored) sequentially until it finds the packet with the matching time stamp to start the playback. This is very time consuming, especially if the destination packet has many other packets preceding it in the raw data file.

To speed up the search for the desired packet, an index file is created immediately after data collection. This index file contains pointers to packets in the raw data file spaced one second apart. That is, the N^{th} pointer in the index file points to the packet in the raw data file with its time stamp equal to n seconds after the exercise start time. The index file is much smaller than the raw data file because each pointer in the index file takes only four bytes while each packet in the raw data file could take a few hundred bytes depending the packet type.

With the index file, searching a packet at N seconds after the exercise start time would involve reading the N^{th} pointer from the index file and then using the pointer to read the desired packet from the raw data file. This is much faster than the sequential read mechanism when no index file is used.

The index file is used by any UPAS module that needs to search the raw data file for any packet with a given time stamp. Currently, the following UPAS modules make use of this index file to expedite the search:

Playback Plan View Display Module

Battle Snapshot Display Module
Battle Flow Display Module

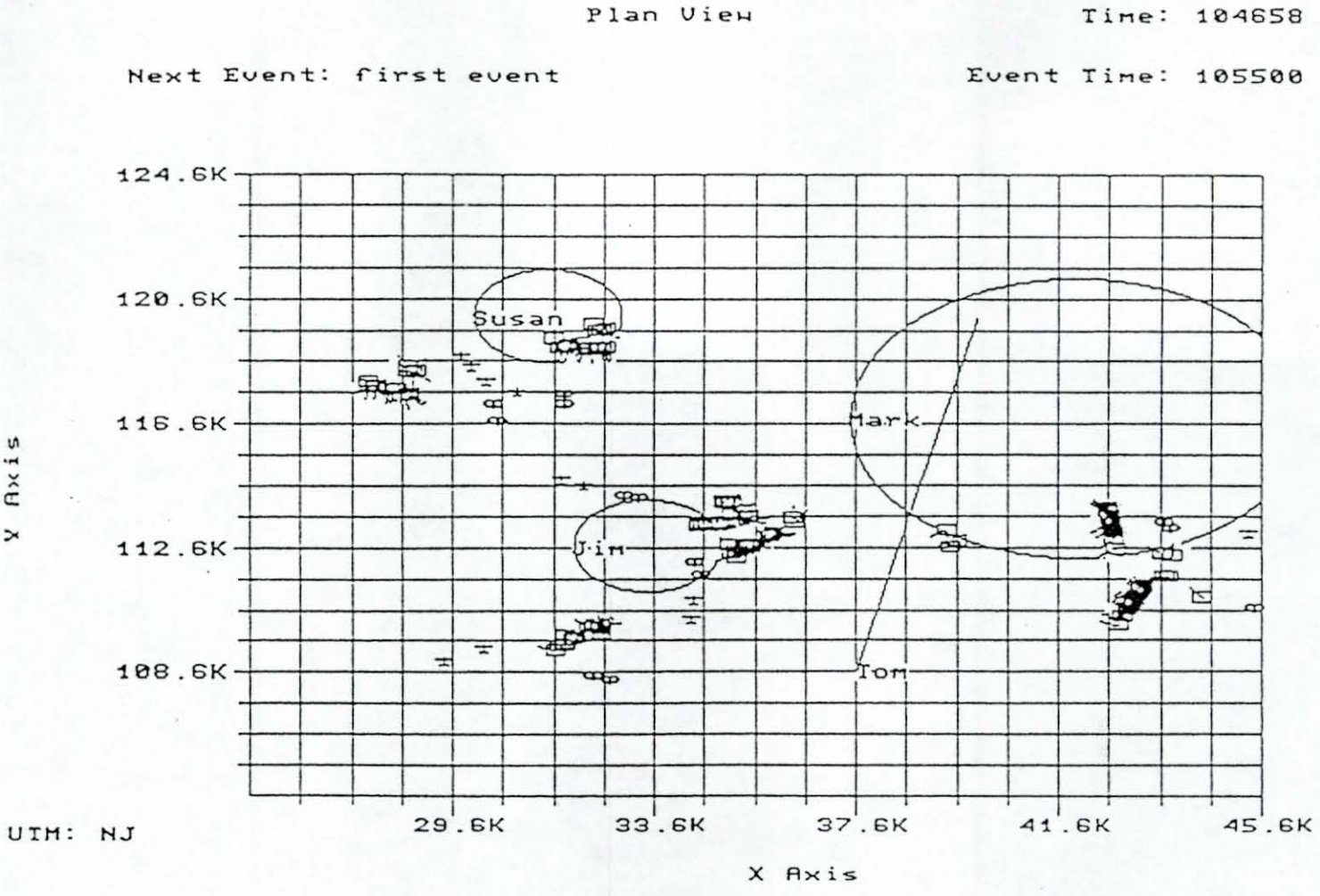


Figure 40 Plan View Display

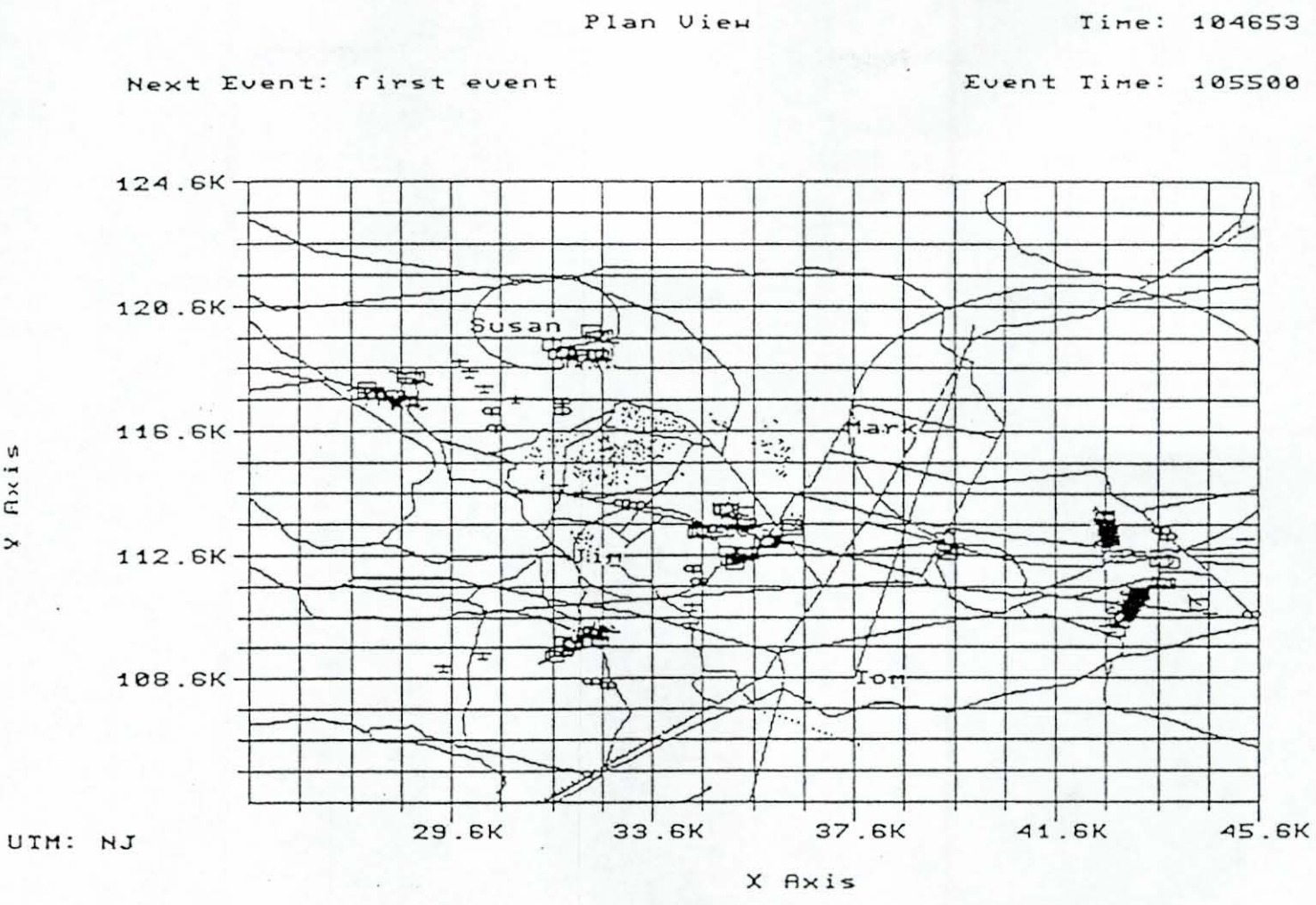


Figure 41 Plan View Display With Terrain

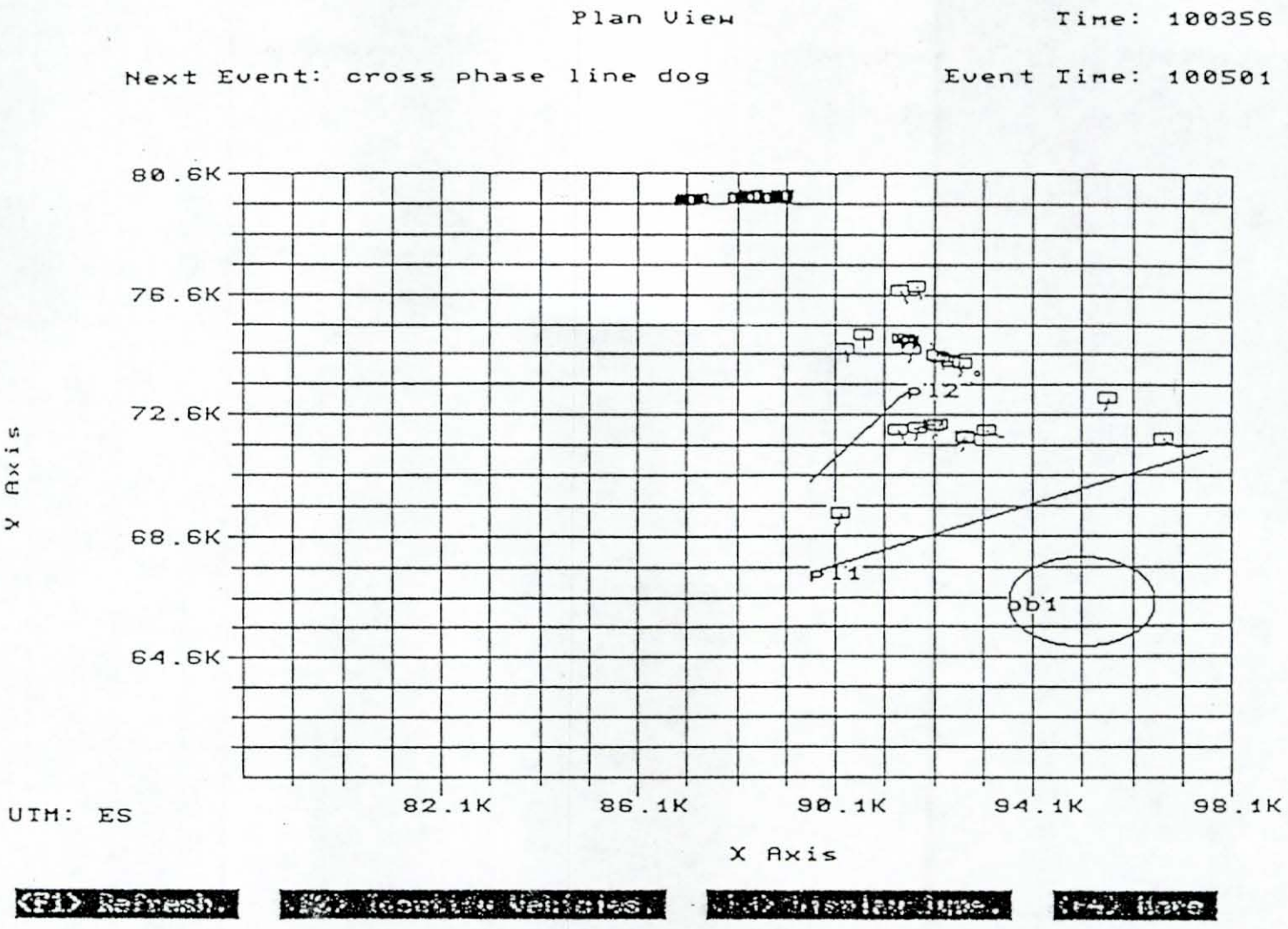


Figure 42 Second Function Key Set

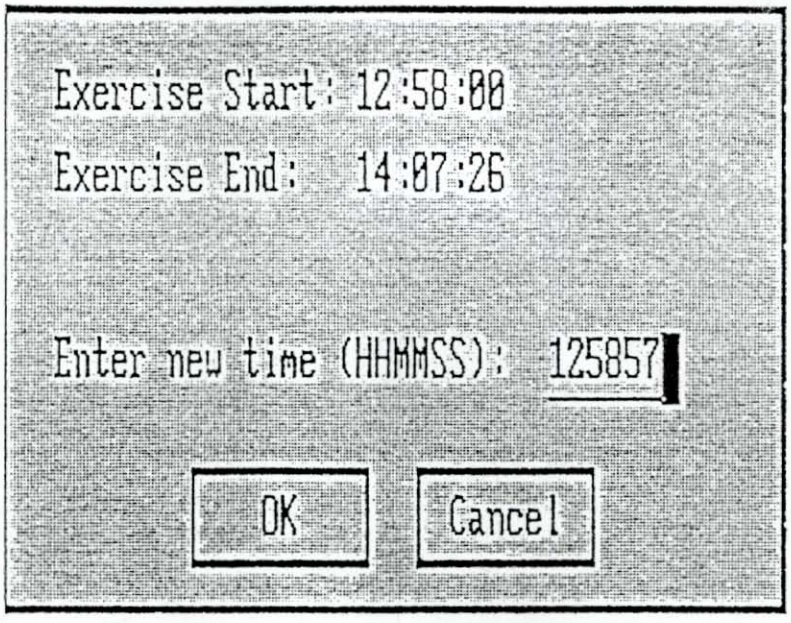


Figure 43 Change Time Menu

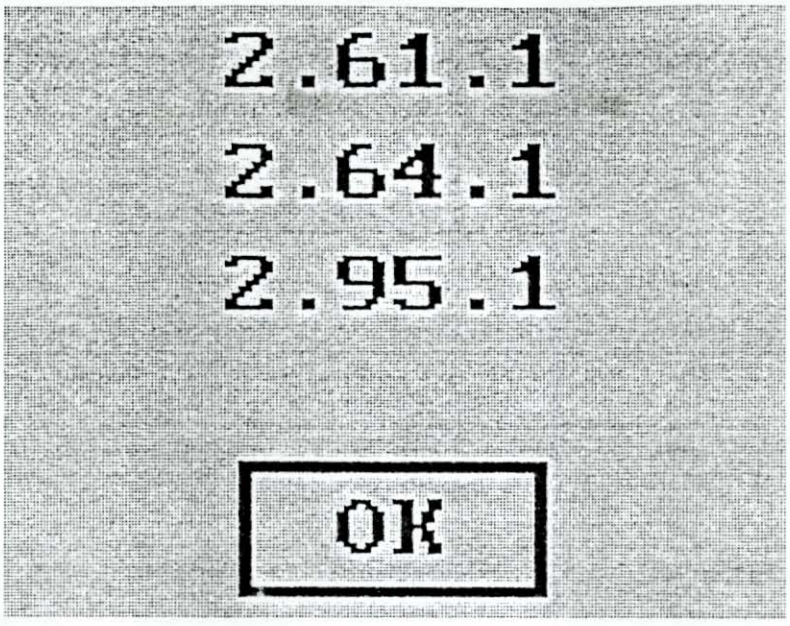


Figure 44 Vehicle ID Display

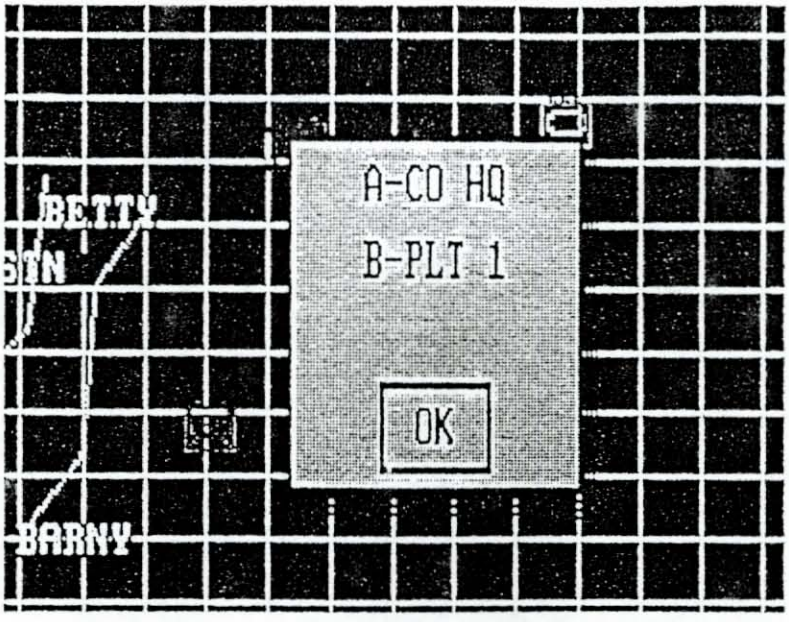


Figure 45 Aggregate Icon Display

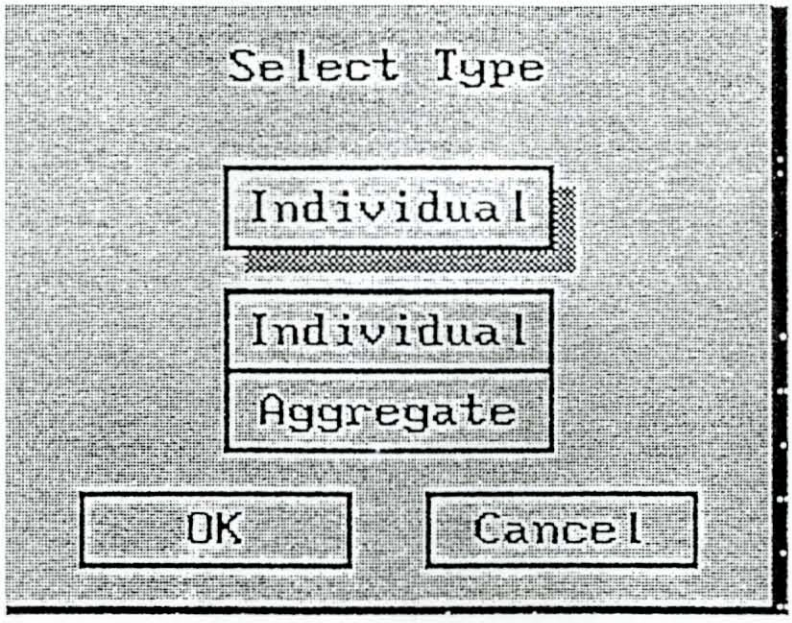


Figure 46 Pop-Up Menu

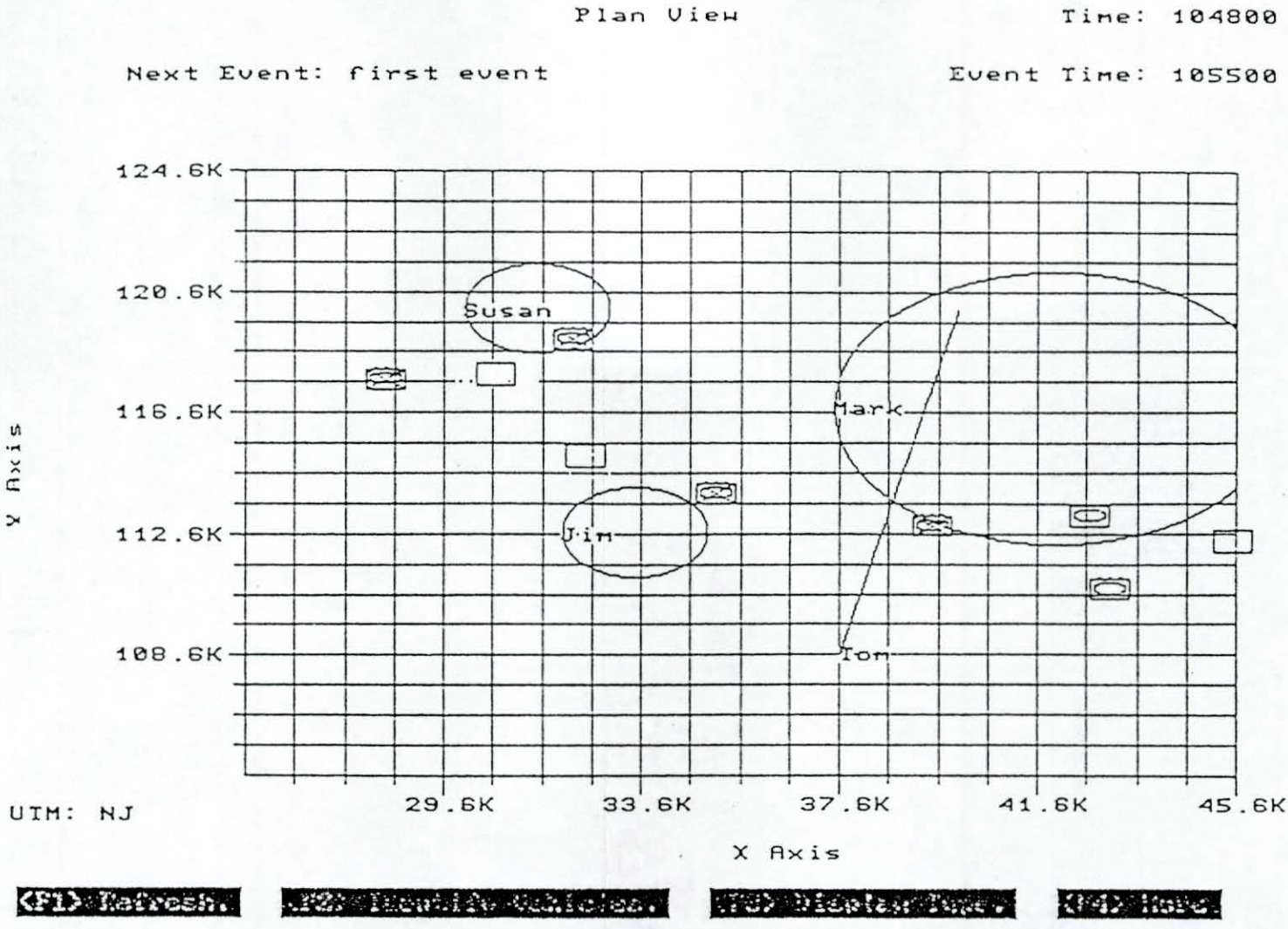


Figure 47 Plan View Display (Aggregate)

FIRE FIGHT

Functional Description

The Fire Fight Display summarizes the direct and indirect fires of all units during an exercise by plotting the firing events from the specified start time (which defaults to the exercise start time) to the specified end time (which defaults to the ending time of the exercise).

Direct fires are shown as shot lines extending from the firing vehicles to the points of impact. The firing vehicles are represented as red or blue vehicle icons depending on the sides of the firers. Note that tank icons can be distinguished from non-tank icons by the presence of their turrets. Shot lines are colored white for misses and green for hits. Killed vehicles are represented as dead vehicle icons which are colored cyan for killed blue vehicles and white for killed red vehicles.

Indirect (artillery) fires are represented as rectangular icons at the points of impact and are colored blue for blue force missions, red for red force missions and white for missions for which the sides cannot be identified.

An example Fire Fight Display is shown in Figure 48 on page 108. If terrain display is enabled, the display will show the background terrain as in Figure 49 on page 109.

The information to be displayed in the Fire Fight diagram includes:

a. A terrain map displayed in the background if terrain display is enabled.

b. Control measures for the selected Blue or Red Force are displayed on top of the terrain map. Control measures to be included in the display are: Phase lines, boundary lines, lines of departure, objectives, assembly areas, starting points, release points, check points, air coordination areas, combat support service areas, obstacles and minefields.

c. All the direct and indirect firing events within the selected time interval.

During the AAR, when the user comes across a display screen that he wants to save for future reference, he activates the appropriate Screen Capture function to save the desired screen display to a file. For the Fire Fight display screen, the file to be saved has a default file name beginning with "FFIG" followed by one or more numeric digits. The numeric digits will be incremented by one for each additional screen captured. For example, if the first Fire

Fight screen was saved in the file, "FFIG0001", the next Fire Fight screen will be saved in the file, "FFIG0002".

Access to Fire Fight Display Module

The Fire Fight Display module is selected and invoked through the UPAS menu selection as follows:

a. Select "Data Summary" from the UPAS main menu as shown in Figure1 on page 25. A new ("Data Summary") menu appears as depicted in Figure 2 on page 26.

b. Select "After Action Review" from the "Data Summary" menu. A new ("After Action Review") menu appears as depicted in Figure12 on page 57.

c. Select "Fire Fight" from the "After Action Review" menu. A fire fight display showing all the direct and indirect firing events is displayed as shown in Figure 48 on page 108..

Function Key Activation

The Fire Fight Module provides the following function keys for activation. Select the appropriate function key to initiate the function.

a. Pan <F1>

The Battle Flow Module allows a user to change the location of the display viewport to another area of the battle field. It also allows the user to change the scale of the viewport. Changing the scale to a lower value allows the user to view the battle field in finer detail while a higher value for the scale presents a view of the battle field in coarser granularity but covering a bigger area of the battle field.

When the function key <F1> is selected, a "Cross-shaped" cursor appears. The user positions the cursor anywhere in the boundary of the current viewport and clicks the left mouse button. This position becomes the new center of the viewport. If the user clicks the cursor outside the boundary of the viewport, a pop-up menu appears as shown in Figure 20 on page 63 with the current location of the viewport center displayed. Then the user can enter the new location (x and y coordinates) for the center of the viewport. Note that the coordinates are in meters.

After the new center has been selected or entered, a pop-up menu

appears as shown in Figure 21 on page 64. The user selects the desired scale from the available selections in the menu. One of the selections is "X x Y". If the user selects this selection, another pop-up menu is displayed as shown in Figure22 on page 64 with the current scale displayed. Then the user enters the new scale for the viewport. The scale consists of the dimension of the viewport in meters in the x and y direction. The smallest scale the user can enter is 200 meters by 200 meters.

b. Capture Screen <F2>

When this function key is selected, a pop-up menu appears as shown in Figure 23 on page 65. The user enters up to two lines of text to describe the screen display that he is capturing. These two lines of text are appended to the bottom of the display screen overlaying the function key area and will be saved to a screen image file with the appropriate file name.

c. Change Time Parameter <F3>

The function allows the user to enter the starting and ending times for displaying the firing events. When this function key is selected, a pop-up menu appears as shown in Figure 50 on page 110. Then, the user enters the desired start time in hhmmss format. When the program is first started, the starting time defaults to the start time of the exercise. After the start time has been entered, the user is prompted to enter the ending time in hhmmss format. When the program is first started, the ending time defaults to the ending time of the exercise.

d. Setup printer <F4>

This function key allows the user to set up the printer. When the function key <F4> is selected, a pop-up window will appear as shown in Figure 28 on page 68. The user highlights the appropriate selection with the mouse or the up and down arrow keys and then press <Enter> to accept the choice. Depending on the printer type selected, the user might also be prompted to select the printer mode (Portrait or Landscape mode), printer resolution and printer port as shown in Figure 29, Figure 30 and Figure 31 on page 68 and page 69.

e. Print <F5>

The Fire Fight Display as shown on the screen can be printed on the printer by selecting the function key <F5>.

f. Change Fire Round Number <F6>

For weapons with rapid firing capabilities, such as 25mm/HEI and 30mm/HEDP, it might be desirable to reduce the number of shot lines to keep the screen from being cluttered. This function allows the user to enter a fire round number which represents the number of shot lines to be bypassed for each shot line displayed on the screen. The initial fire round number is defaulted to one. The corresponding pop-up menu is shown in Figure 51 on page 111.

g. Terrain On/Off <F7>

This function key allows the user to enable or disable the terrain display. If terrain is enabled, selecting the key will disable the terrain display. If terrain is disabled, selecting the key will enable the terrain display.

After the function key is selected to enable the terrain display, the user is allowed to show or hide the contour lines, turn on or off the contour elevations and change the contour line spacing by making the appropriate selections in the menus as shown in Figure 32 on page 70, Figure 33 on page 70 and Figure 34 on page 71.

h. When in the main graphic display screen, left, right, up, and down arrow keys are used to move the display viewport in the appropriate direction to cover a different area of the battle field. The program can be interrupted by pressing <Esc> key any time.

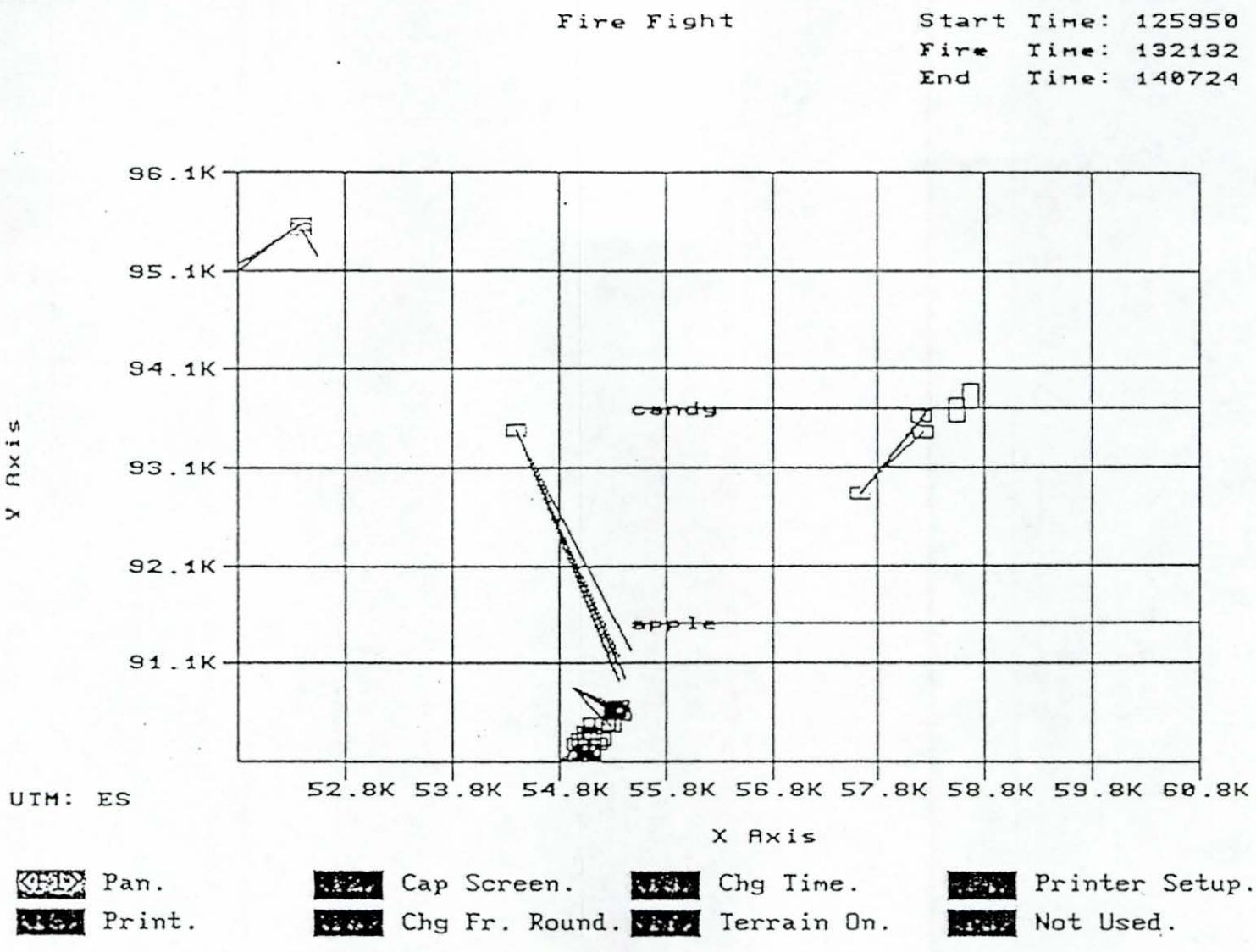


Figure 48 Fire Fight Display

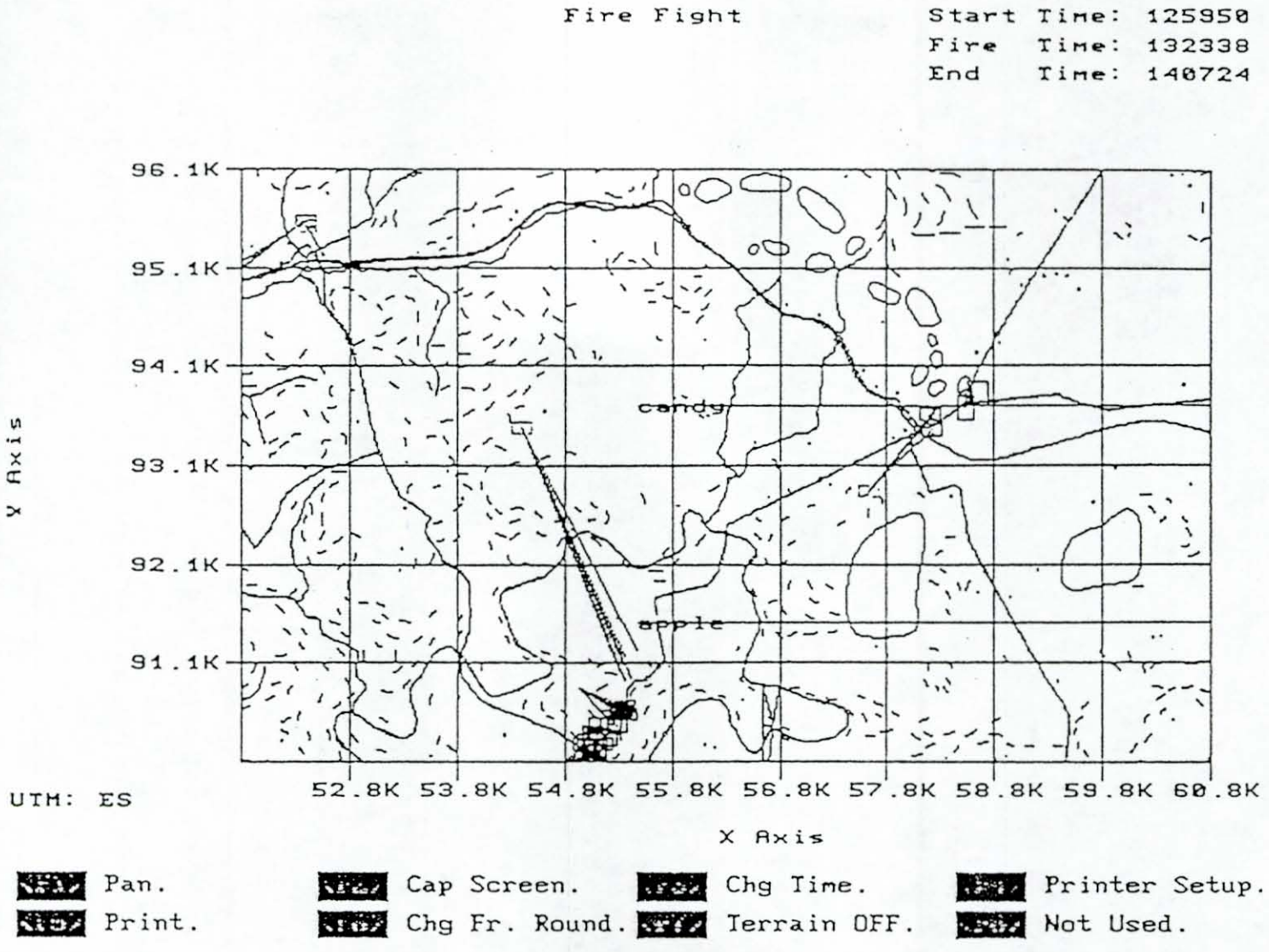


Figure 49 Fire Fight Display With Terrain

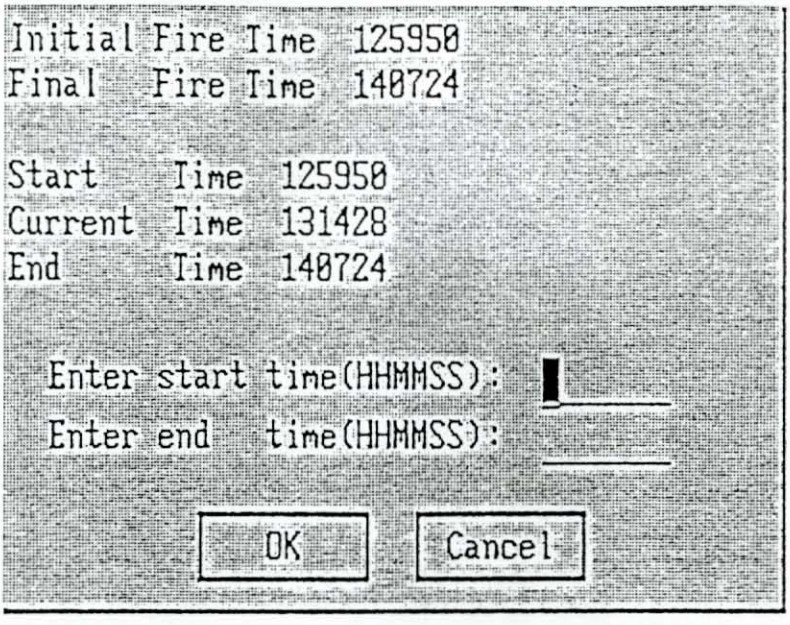


Figure 50 Change Time Menu

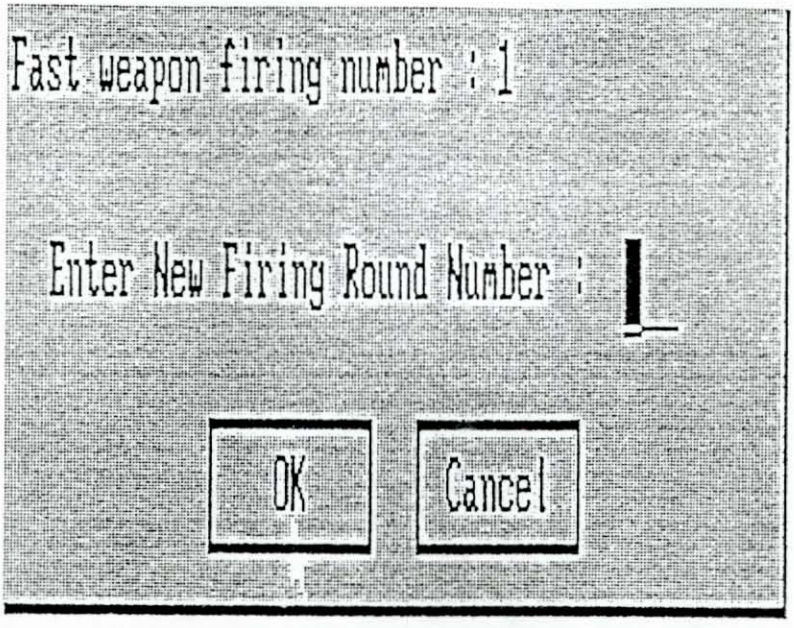


Figure 51 Change Firing Rounds Menu

SCREEN IMAGE FILE DISPLAY

Functional Description

The Screen Image File Display module displays screen image files which have been captured and saved while running UPAS. The **A**fter **A**ction **R**eview modules allow the user to capture and save screen images that are of interest for future reference. Each screen image is saved to a file when the Screen Capture function is activated in the respective module.

Each screen image file has a unique name. The beginning letters of the file name identify the module saving the file and the last four letters are numeric digits, the value of which is incremented by one after each specific file has been saved. The following is a list of the screen image file names used for the AAR modules:

Battle Flow Display	-- BFLW????
Battle SnapShot Display	-- SSHT????
Planview Display	-- PVD????
Exercise TimeLine Display	-- TIML????
Fire Fight Display	-- FFIG????

The '????' denotes a numeric value starting from 0001 to 9999.

Currently, the screen image files are located in \upm\pcx directory.

Access to Screen Image File Display Module

The Screen Image File Display module is selected and invoked through the UPAS menu selection as follows:

a. Select "Data Summary" from the UPAS main menu as shown in Figure1 on page 25. A new ("Data Summary") menu appears as depicted in Figure 2 on page 26.

b. Select "After Action Review" from the "Data Summary" menu. A new ("After Action Review") menu appears as depicted in Figure12 on page 57.

c. Select "Screen Image File Display" from the "After Action Review" menu. The user is presented with a file selection menu containing a list of all the screen image files which have been captured and saved before as shown in Figure 52 on page 114.

d. After a file has been selected from the list, the screen image file is displayed.

e. After reviewing the displayed screen image file, the user may press any key to return to the Screen Image file Selection menu to select another file for display or press escape to exit the module.

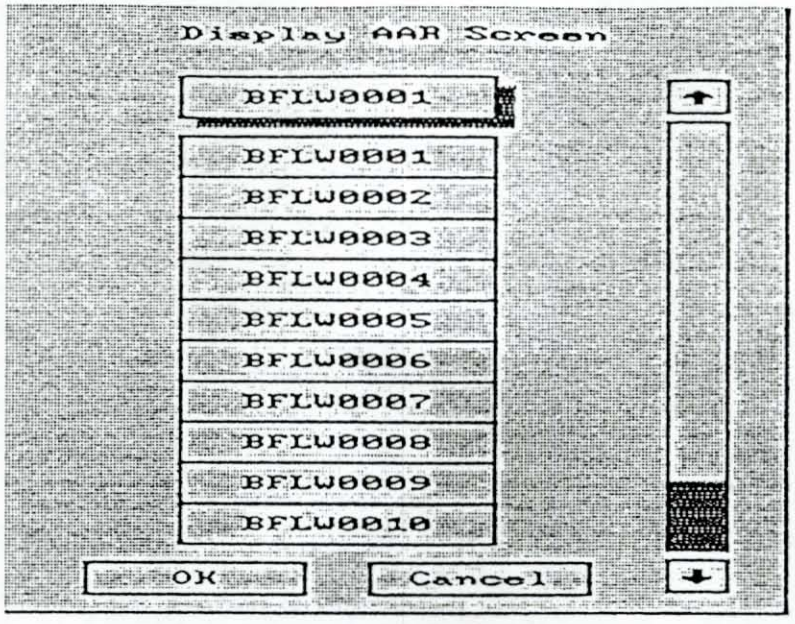


Figure 52 Screen Image File Selection Menu

IMPROVED DATA COLLECTION FILTERING TECHNIQUE

Background

It has been reported from field testing that, at times UPAS loses data packets during data collection. This data loss is more pronounced for higher echelon exercises because of the larger number of data packets involved. Even for platoon level exercises, if many data packets are received in a short burst, data loss might occur during the burst period.

Solution

To correct or minimize the adverse effect of data losses, the following measures have been taken:

(1) Use a large buffer to buffer incoming data while the disk write is in progress

(2) Write more than one data packet to the hard disk for each disk write to increase the throughput

(3) Use Vehicle id's for data filtering

Buffering

It is recognized that data packets are not coming in at a steady rate. There will be brief periods of time when there are plenty of incoming data packets while at other times the data rate is lower. Due to the fluctuating data rate, a large buffer can be used to buffer the packets at times when the hard disk is not able to keep up with the high data rate. When the data rate drops, the hard disk will be able to write the data packets from the buffer.

Writing multiple packets for each disk access

The read-write head of the hard drive is a slow mechanical device. It needs to move itself to the correct position on the hard disk before electronic transfer can take place. The average access time (to move the read-write head) ranges from 15 to 40 milliseconds while the transfer rate is roughly one to 10 Meg bits per second. For discussion purposes, assume 20 milliseconds for the access time and 5 Meg bits per sec for the transfer rate. Assume also that each data packet is 250 bytes in size. The time required to write a 250-byte packet to the hard disk will be:

access time + electronic transfer time

where access time = around 20 milliseconds
and transfer time = 0.5 milliseconds

Apparently, the electronic transfer is much faster than the disk access. It follows that it would be more efficient to transfer multiple packets for each disk write because each disk write involves only one disk access even though it transfers multiple packets. By saving the number of disk accesses, the throughput improves considerably.

Vehicle IDs as data filter

UPAS currently allows the user to specify a list of vehicle id's for data filtering. Only packets with the matching vehicle id's are collected while other packet types are discarded. By selecting the vehicle id filter, the amount of data written to the disk is minimized considerably and data loss is less apt to occur. Note that, to facilitate user input, UPAS has been modified to allow the specification of wildcards (*) for any of the three fields in a vehicle id. It also allows the specification of "0.0.0" for vehicle id. In SIMNET, some indirect fire weapons use "0.0.0" as their vehicle id.

Please refer to the appropriate section in this report for the updated functional description for the Data Collection and Filtering Module that describes in more detail how to specify the vehicle id's for data filtering.

Periodic Closing of Data File

The UPAS data collection module has been modified to periodically close and reopen the file that receives collected data. The frequency for closing and reopening the file is tunable and is currently set to close and reopen the file for every 500 disk writes. The overhead for closing and reopening the data file is relatively small compared to the benefit accrued from such practice. This is necessary to ensure that the data file has its data saved and closed properly at different points during data collection. If the data file is only closed at the end of a long data collection session and the system crashes before the end of the session, the data file would have been empty.

DATA COLLECTION AND FILTERING

Overview

The Data Collection Module has been enhanced to include the following capabilities:

The new Data Collection Module allows the user to specify a list of vehicle IDs to be used for filtering. This is accomplished through three additional menus for adding, modifying and viewing vehicle IDs as described in the following sections.

Functional Description

Before data collection begins, the user can specify the data filter to be used for selecting the desired pdu's. Data filtering enables the UPAS system to collect and store data from the network more selectively, thereby reducing the capacity requirement of the storage media than would otherwise be possible.

The data filter consists of an exercise ID, which is mandatory, and an optional list of vehicle IDs. If no vehicle IDs are specified, then all PDUs pertaining to the selected exercise ID will be collected regardless of what vehicle IDs the PDU's contain. If both exercise ID and a list of vehicle IDs are specified, then only PDUs containing the matching exercise ID and vehicle IDs will be collected.

Access to Data Collection Module

The Data Collection module can be selected and invoked through the UPAS menu selection as follows:

a. Select "Data Collection" from the UPAS main menu as shown in Figure 1 on page 25. A new ("Data Collection") menu will appear as depicted in Figure 4 on page 39.

b. Select "Collect Data" from the "Data Collection" menu. A new ("Data Collection Setup") menu appears as depicted in Figure 53 on page 119.

c. Fill in the required data for the fields: Exercise date, Exercise ID. The Mission Type, Armor/Mech/Combined Arms, Organization fields are not required to be filled in. Four function keys <F1> through <F4> are also active at this time as described in the following sections.

Function Key Activation

The Data Collection Module provides the following function keys for activation. Press the appropriate function key to initiate the function.

a. Start Data Collection <F1>

When this function key is pressed, data collection begins. Normally, this key is pressed after the user has entered the exercise id and the vehicle IDs for data filtering.

b. Adding IDs <F2>

When this function key is pressed, a new pop-up menu (Adding IDs) appears as shown in Figure 54 on page 120. The system supplies the user a blank line to key in the desired vehicle IDs that are used for data filtering. The user has to key in the vehicle ID in the same format as the example in the footer area of the menu. The user can add as many vehicle IDs as can be fit into the line. Once the user hits the <ENTER> key, the system will accept and append the vehicle IDs to the list of selected vehicle IDs. Then, the line is cleared waiting for the user to key in more vehicle IDs.

c. Modifying IDs <F3>

When this function key is pressed, a new pop-up menu (Modifying IDs) appears as shown in Figure 55 on page 121. The IDs' line in the menu is used to display the list of vehicle IDs previously selected. It allows the user to modify or delete any vehicle IDs within the line. The operation is similar to add IDs except that when an <ENTER> key is pressed, the line will display more vehicle IDs from the list of previously selected vehicle IDs for the user to modify.

d. Viewing IDs <F4>

When this function key is pressed, a new pop-up menu (Viewing IDs) will appear as shown in Figure 56 on page 122. This function allows the user to view all selected vehicle IDs without adding or modifying them. The left and right arrow keys allow the user to scroll through all the selected vehicle IDs.

e. Each vehicle ID entered is validated for numeric data type and within the range from one to 65535. If a vehicle ID fails the validation, an error message is displayed in the footer area of the menu.

The program is interrupted by pressing <Esc> key any time.

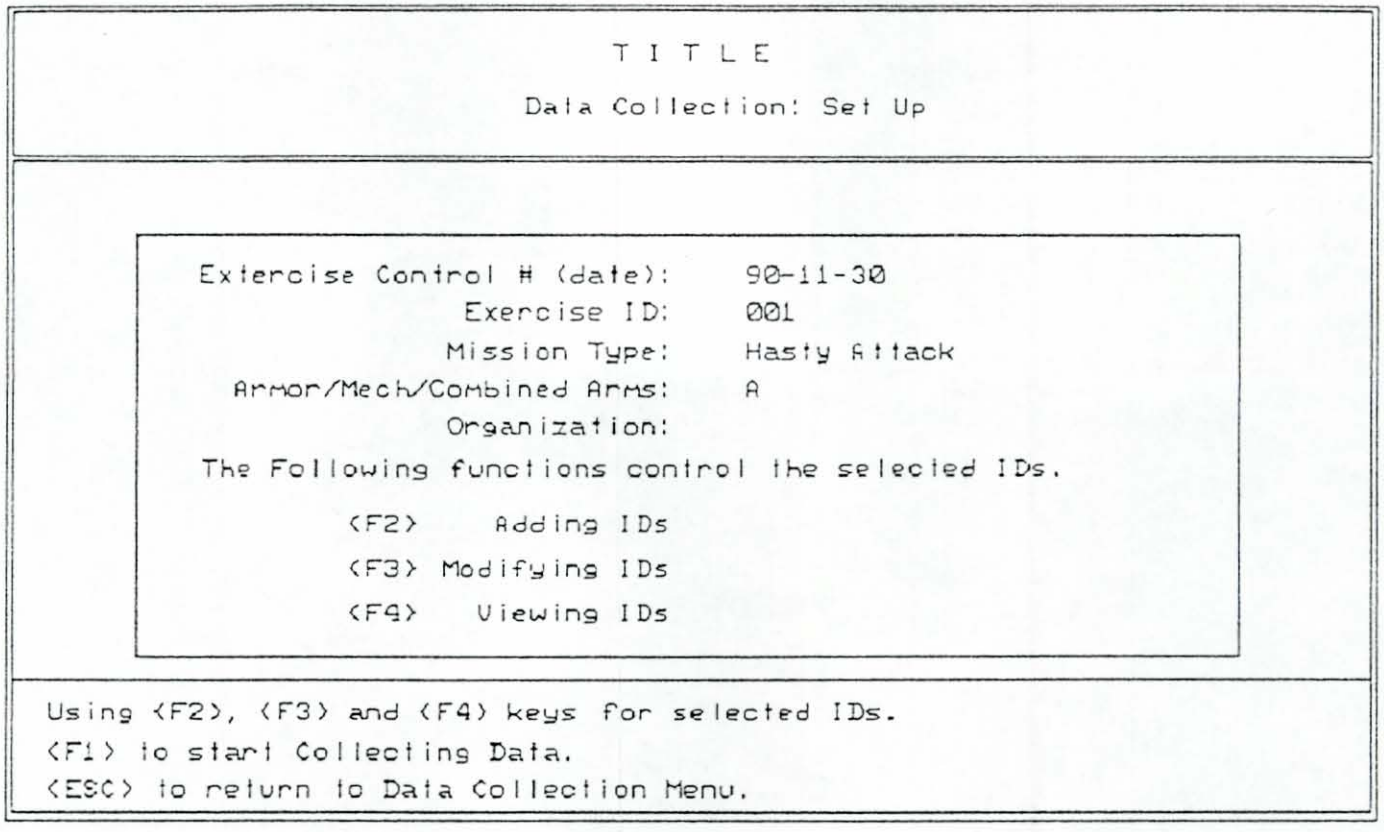


Figure 53 Data Collection Setup Menu

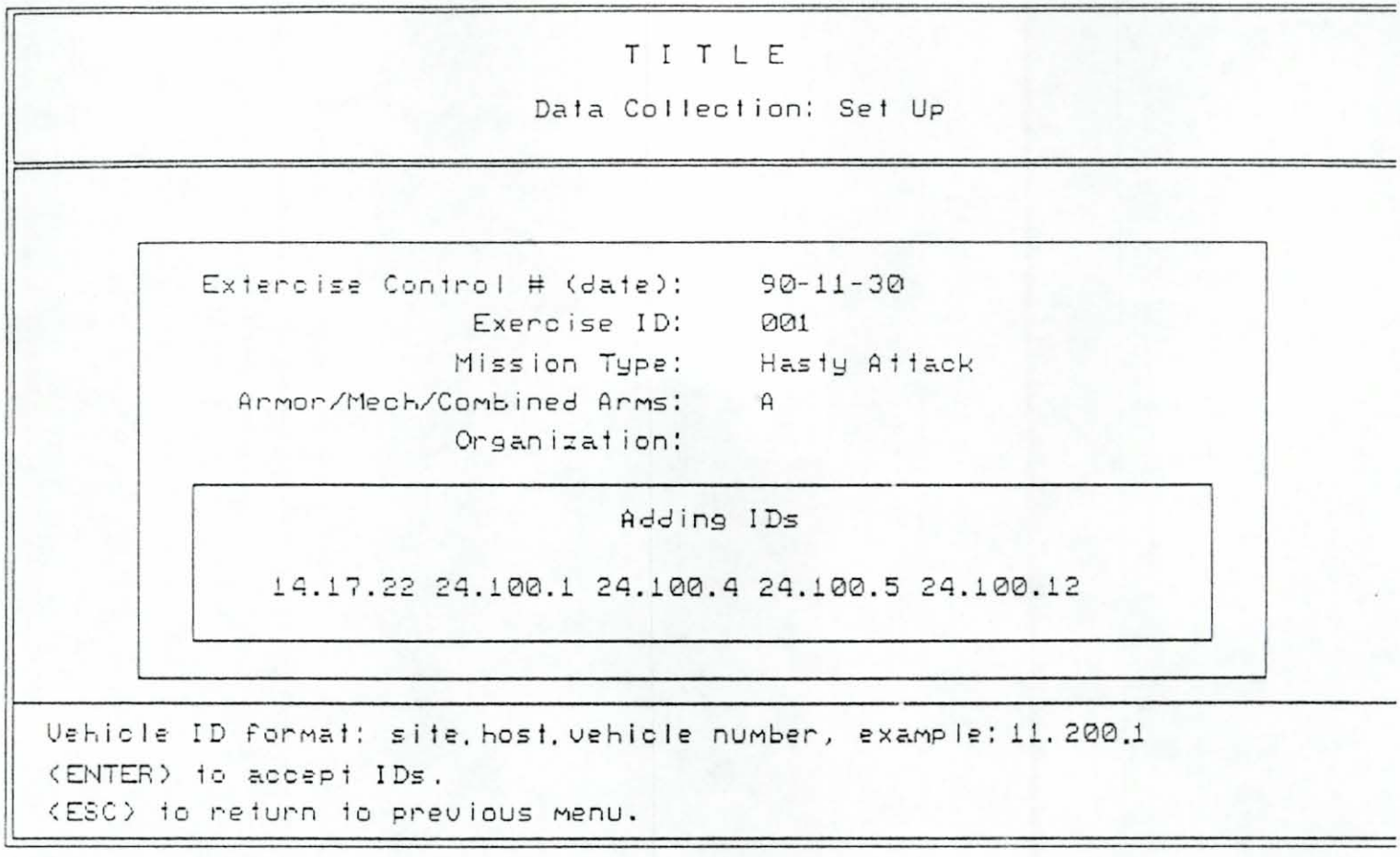


Figure 54 Adding ID Menu

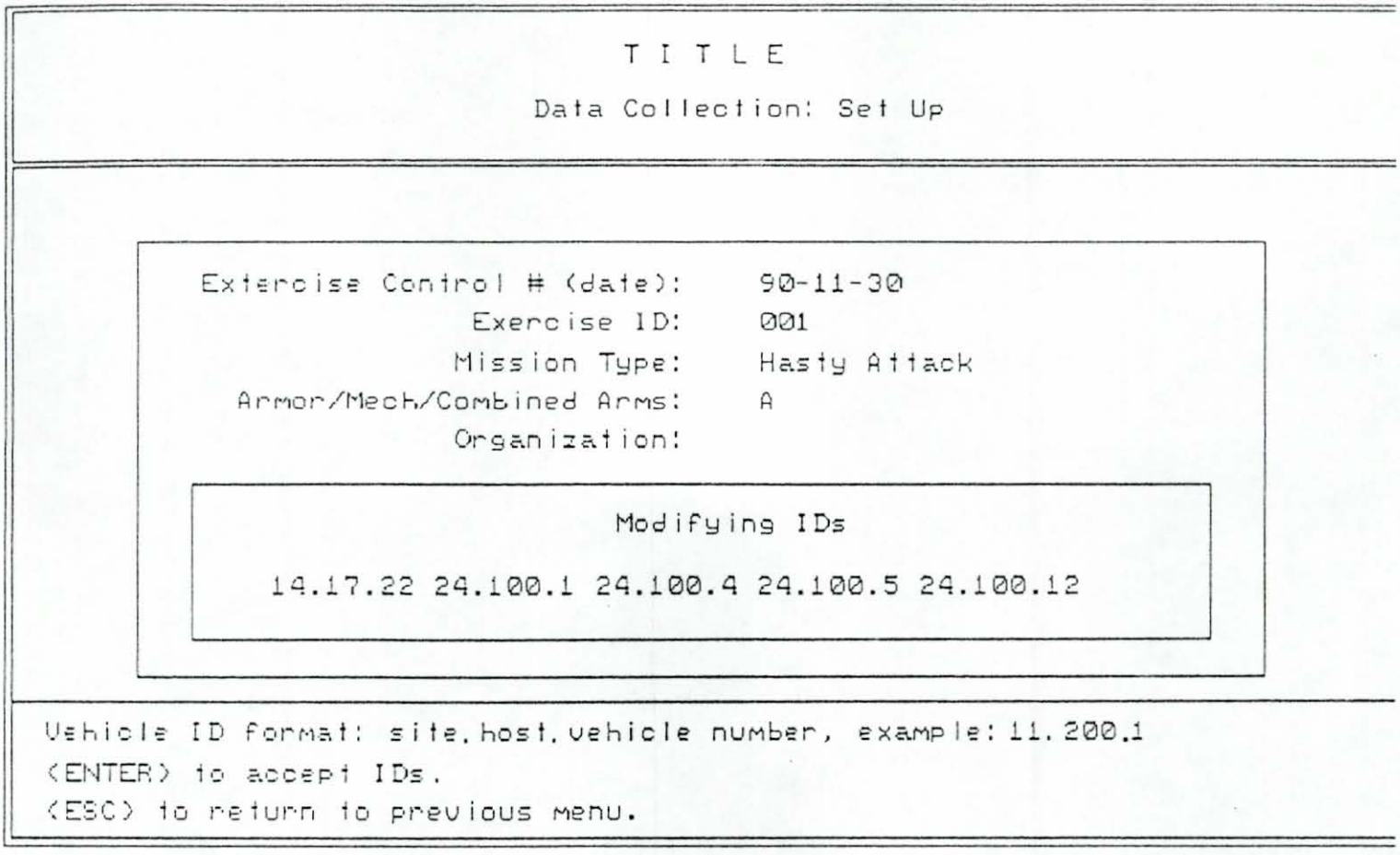


Figure 55 Modifying ID Menu

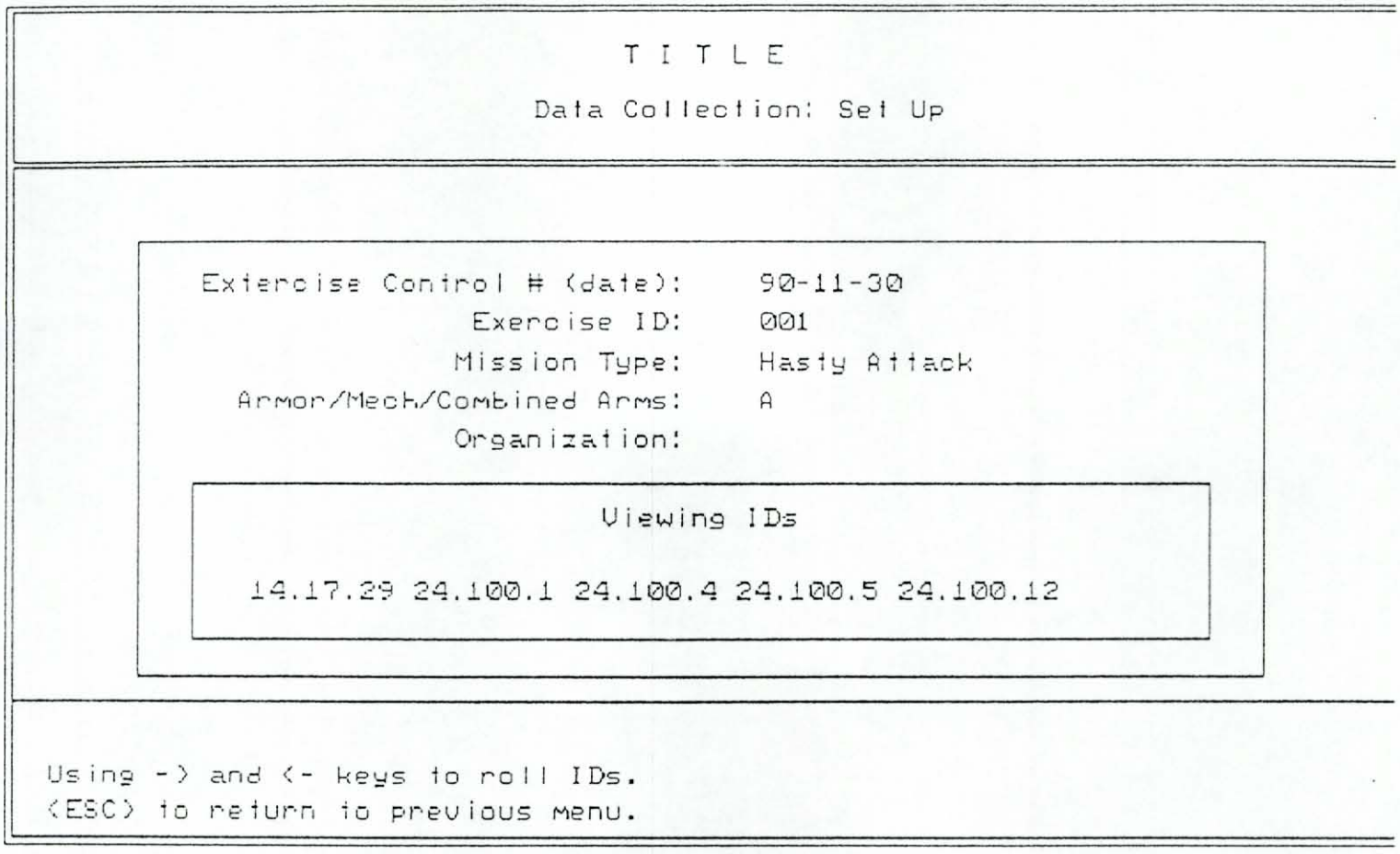


Figure 56 Viewing ID Menu

DATA COMPRESSION AND DECOMPRESSION

Overview

UPAS collects data from SIMNET and saves the data in a raw data file called $UPM.DAT. Depending the length of the exercise and the number of exercise participants, this data file is normally very large. As a typical example, an exercise involving 62 vehicles and lasting 18 minutes has created a raw data file with a size of 5.74 Mbytes. There is a need to compress the file to minimize the use of disk space.

User Instruction

In order to minimize the use of disk space, the File Archiving Utility, called PKARC, can be used to compress the raw data file. The procedure to compress $UPM.DAT is as follows:

a. Set the current directory to where $UPM.DAT is located. For instance, if it is located in \UPM\FNSIM3, then enter:

```
CD \UPM\FNSIM3
```

b. Invoke PKARC to compress $UPM.DAT into a compressed version of the raw data file, called $UPM.ARC as follows:

```
PKARC A $UPM.ARC $UPM.DAT
```

Once the compressed version of the raw data file has been created, the original version ($UPM.DAT) can be deleted to save disk space.

Note that the UPAS system only runs on the decompressed version of the raw data file. If you want to run UPAS and you have only the compressed version, it needs to be decompressed before running UPAS.

The procedure to decompress $UPM.ARC is as follows:

a. Set the current directory to where $UPM.ARC is located. For instance, if it is located in \UPM\FNSIM3, then enter:

```
CD \UPM\FNSIM3
```

b. Invoke PKXARC to decompress $UPM.ARC into the original decompressed version of the raw data file ($UPM.DAT) as follows:

```
PKXARC $UPM.ARC
```

Compression Results

To find out how efficient the compression is, the File Archiving Utility, PKARC, was used to compress $UPM.DAT with an original size of 5.7M bytes. The resulting compressed version of the data file, $UPM.ARC, has a size of 3.0 Mbytes. This represents a reduction of 2.7 Mbytes, or 48%.

LINKING TO STATISTICAL SOFTWARE PACKAGES

Functional Description

The XDB Export Utility allows the user to export any XDB table or view to an ASCII file, which can then be read by the standard statistical software packages such as CSS and SPSS [3] [4]. There are two ASCII file formats: free and fixed. Free format ASCII files allow variable field lengths with the fields separated by field delimiters. Fixed format ASCII files have fixed field lengths without the need for delimiters between fields. Either format can be used to export data to be used by CSS and SPSS.

Since UPAS data tables are using XDB table format, the XDB Export Utility can be used to export UPAS data. If the UPAS data to be exported are in any of the standard, predefined UPAS tables (such as FET for firing event table, PET for pairing event table, etc.), then just run the XDB export utility to export that table into an ASCII file.

If the UPAS data to be exported are contained in more than one UPAS table, a view can be defined to include the appropriate columns from the corresponding UPAS tables. Then, run the XDB export utility to export that view into an ASCII file.

For a detailed description of the XDB Export Utility and on how to define views, please refer to the appropriate sections in the XDB user's manual.

REFERENCES

1. XDB User's Manual, XDB Systems, Inc.

2. Mikel Petty, Charles Campbell, "Efficient Line of Sight Determination in Polygonal Terrain", IST Technical Report IST-TR-92-5.

3. Marija J. Norusis, SPSS/PC+ Advanced Statistics V2.0 for the IBM PC/XT/AT and PS2, SPSS Inc., 444 N. Michigan Ave., Chicago, IL 60611.

4.Marija J. Norusis, SPSS/PC+ V2.0 Base Manual for the IBM PC/XT/AT and PS/2.

APPENDIX

Appendix A. Procedure Command File

```
/* direct fire weapon system summary*/
cls
drawbox @8,20 to 16,60
print @12,32 "Please Wait..."
set error off      /* turn off error message */

exec sql
  drop table tsc1_1
end-exec

exec sql
  create table tsc1_1
    (fside char 1, fwpnam char 24, famonam char 24, nrounds
integer,
     mbt_h integer, mbt_k integer, ifv_h integer, ifv_k integer,
     oth_h integer, oth_k integer, tot_h integer, tot_k integer)
end-exec

exec sql
  drop view v_sc1_3
end-exec

exec sql
  create view v_sc1_3
  (fside,fwpn,fwpnam,fammo,famonam,flpn,result,range,tlpn,twpn)as
  select
  ps1.side,fwpn,pv1.pveh,fammo,pv2.pwpn,flpn,result,range,tlpn,
  ps2.ptype from pet, psit ps1, psit ps2, pvwt pv1, pvwt pv2
  where pet.flpn=ps1.lpn and pet.tlpn=ps2.lpn
  and pet.fwpn=pv1.ptype and pet.fammo=pv2.pammo
end-exec

exec sql
  drop view v_sc1_4
end-exec

exec sql
  create view v_sc1_4
  (fside,fwpn,fwpnam,fammo,famonam,flpn,result,range,tlpn) as
  select
  ps1.side,fwpn,pv1.pveh,fammo,pv2.pwpn,flpn,result,range,tlpn
  from pet, psit ps1, pvwt pv1, pvwt pv2
  where pet.flpn=ps1.lpn
  and pet.fwpn=pv1.ptype and pet.fammo=pv2.pammo
end-exec
```

Procedure Command File
for Direct Fire Weapon System Summary Scorecard

```
exec sql
  drop view v_sc1_5
end-exec

exec sql
  create view v_sc1_5
  (side,wpn,wpnam,ammo,amonam,lpn,nrounds) as
  select psit.side,fet.wpn,pv1.pveh,fet.ammo,pv2.pwpn,fet.lpn,
  fet.nrounds from
  fet, psit, pvwt pv1, pvwt pv2 where fet.lpn=psit.lpn
  and fet.wpn=pv1.ptype and fet.ammo=pv2.pammo
end-exec
/*********
exec sql
  drop view v_sc1_6
end-exec
********/

/********
exec sql
  create view v_sc1_6
  (side,wpn,wpnam,lpn) as
  select psit.side,psit.ptype,pvwt.pveh,psit.lpn
  from psit,pvwt
  where psit.ptype=pvwt.ptype
end-exec
********/

set error on     /* turn on the error message */

/****shots  */

exec sql
q2: select side,wpnam,amonam,sum(integer(nrounds)) from v_sc1_5
    where    wpn    in    ('2882080C','28821002','2884082C',
'28841002','28841043', '28842002')
    group by side,wpnam,amonam
end-exec

first q2
while status[q2] >0
  fside = q2.side
  fwpnam = q2.wpnam
  famonam = q2.amonam
  nrounds = q2.sum(integer(nrounds))
  /* print fside,fwpnam,famonam,nrounds */

  exec sql
  q1:  select * from tsc1_1 where fside=:fside and fwpnam=:fwpnam
```

```
      and famonam=:famonam
  end-exec
  first q1
  if status[q1] >0
  /* display q1 */
  /* print "....updating...." */
  exec sql
    update tsc1_1 set nrounds=:nrounds where fside=:fside and
      fwpnam=:fwpnam
      and famonam=:famonam
  end-exec
  else
  /* print "....inserting....." */
  exec sql
  insert into tsc1_1 values
    (:fside, :fwpnam, :famonam, :nrounds,
     0, 0, 0, 0,
     0, 0, 0, 0)
  end-exec
  endif

  close q1
  next q2
endwhile
close q2

/* pause */
/****mbt_h  */

exec sql
q2: select fside,fwpnam,famonam,count(result) from v_sc1_3
    where result='H' and twpn in ('2882080C', '2884082C')
    and  fwpn in ('2882080C','28821022','28821047',
    '2884082C','28841022','28841022','28841043','28842002')
    group by fside,fwpnam,famonam
end-exec

first q2
while status[q2] >0
  fside = q2.fside
  fwpnam = q2.fwpnam
  famonam = q2.famonam
  mbt_h = q2.count(result)
  /* print fside,fwpnam,famonam,mbt_h */

  exec sql
  q1:  select * from tsc1_1 where fside=:fside and fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
```

```
  first q1
  if status[q1] >0
  /* display q1 */
  /* print "....updating...." */
  exec sql
  update  tsc1_1  set  mbt_h=:mbt_h  where  fside=:fside  and
fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  else
  /* print "....inserting....." */
  exec sql
  insert into tsc1_1 values
    (:fside, :fwpnam, :famonam, 0,
     :mbt_h, 0, 0, 0,
     0, 0, 0, 0)
  end-exec
  endif

  close q1
  next q2
endwhile
close q2

/* pause */
/****mbt_k  */

exec sql
q2: select fside,fwpnam,famonam,count(result) from v_sc1_3
    where result='K' and fwpn in ('2882080C','28821022','28821047',
    '2884082C','28841022','28841022','28841043','28842002')
    and twpn in ('2882080C', '2884082C')
    group by fside,fwpnam,famonam
end-exec

first q2
while status[q2] >0
  fside = q2.fside
  fwpnam = q2.fwpnam
  famonam = q2.famonam
  mbt_k = q2.count(result)
  /* print fside,fwpnam,famonam,mbt_k */

  exec sql
  q1:  select * from tsc1_1 where fside=:fside and fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  first q1
  if status[q1] >0
```

```
  /* display q1 */
  /* print "....updating...." */
  exec sql
  update  tsc1_1  set  mbt_k=:mbt_k  where  fside=:fside  and
fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  else
  /* print "....inserting....." */
  exec sql
  insert into tsc1_1 values
    (:fside, :fwpnam, :famonam, 0,
     0, :mbt_k, 0, 0,
     0, 0, 0, 0)
  end-exec
  endif

  close q1
  next q2
endwhile
close q2

/****ifv_h  */

exec sql
q2: select fside,fwpnam,famonam,count(result) from v_sc1_3
    where result='H' and fwpn in ('2882080C','28821022','28821047',
    '2884082C','28841022','28841022','28841043','28842002')
    and twpn in ('28821022','28841022','28842002')
    group by fside,fwpnam,famonam
end-exec

first q2
while status[q2] >0
  fside = q2.fside
  fwpnam = q2.fwpnam
  famonam = q2.famonam
  ifv_h = q2.count(result)
  /* print fside,fwpnam,famonam,ifv_h */

  exec sql
  q1:  select * from tsc1_1 where fside=:fside and fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  first q1
  if status[q1] >0
  /* display q1 */
  /* print "....updating...." */
  exec sql
```

```
  update  tsc1_1  set  ifv_h=:ifv_h  where  fside=:fside  and
fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  else
  /* print "....inserting....." */
  exec sql
  insert into tsc1_1 values
    (:fside, :fwpnam, :famonam, 0,
     0, 0, :ifv_h, 0,
     0, 0, 0, 0)
  end-exec
  endif

  close q1
  next q2
endwhile
close q2

/* pause */
/****ifv_k  */

exec sql
q2: select fside,fwpnam,famonam,count(result) from v_sc1_3
    where result='K' and fwpn in ('2882080C','28821022','28821047',
    '2884082C','28841022','28841022','28841043','28842002')
    and twpn in ('28821022','28841022','28842002')
    group by fside,fwpnam,famonam
end-exec

first q2
while status[q2] >0
  fside = q2.fside
  fwpnam = q2.fwpnam
  famonam = q2.famonam
  ifv_k = q2.count(result)
  /* print fside,fwpnam,famonam,ifv_k */

  exec sql
  q1:  select * from tsc1_1 where fside=:fside and fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  first q1
  if status[q1] >0
  /* display q1 */
  /* print "....updating...." */
  exec sql
  update  tsc1_1  set  ifv_k=:ifv_k  where  fside=:fside  and
fwpnam=:fwpnam
```

```
        and famonam=:famonam
    end-exec
    else
    /* print "....inserting....." */
    exec sql
    insert into tsc1_1 values
      (:fside, :fwpnam, :famonam, 0,
       0, 0, 0, :ifv_k,
       0, 0, 0, 0)
    end-exec
    endif

    close q1
    next q2
endwhile
close q2

/****oth_h  */

exec sql
q2: select fside,fwpnam,famonam,count(result) from v_sc1_3
     where result='H' and fwpn in ('2882080C','28821022','28821047',
    '2884082C','28841022','28841022','28841043','28842002')
     and twpn not in
    ('2882080C','2884082C','28821002','28841002','28842002')
     group by fside,fwpnam,famonam
end-exec

first q2
while status[q2] >0
  fside = q2.fside
  fwpnam = q2.fwpnam
  famonam = q2.famonam
  oth_h = q2.count(result)
  /* print fside,fwpnam,famonam,oth_h */

  exec sql
  q1:  select * from tsc1_1 where fside=:fside and fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  first q1
  if status[q1] >0
  /* display q1 */
  /* print "....updating...." */
  exec sql
  update  tsc1_1  set  oth_h=:oth_h  where  fside=:fside  and
fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
```

```
  else
  /* print "....inserting....." */
  exec sql
  insert into tsc1_1 values
    (:fside, :fwpnam, :famonam, 0,
     0, 0, 0, 0,
     :oth_h, 0, 0, 0)
  end-exec
  endif

  close q1
  next q2
endwhile
close q2

/****oth_k  */
exec sql
q2: select fside,fwpnam,famonam,count(result) from v_sc1_3
    where result='K' and fwpn in ('2882080C','28821022','28821047',
    '2884082C','28841022','28841022','28841043','28842002')
    group by fside,fwpnam,famonam
end-exec

first q2

while status[q2] >0
  fside = q2.fside
  fwpnam = q2.fwpnam
  famonam = q2.famonam
  oth_k = q2.count(result)
  /* print fside,fwpnam,famonam,oth_k */

  exec sql
  q1:  select * from tsc1_1 where fside=:fside and fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  first q1
  if status[q1] >0
  /* display q1 */
  /* print "....updating...." */
  exec sql
  update  tsc1_1  set  oth_k=:oth_k  where  fside=:fside  and
fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  else
  /* print "....inserting....." */
  exec sql
  insert into tsc1_1 values
```

```
    (:fside, :fwpnam, :famonam, 0,
     0, 0, 0, 0,
     0, :oth_k, 0, 0)
  end-exec
  endif

  close q1
  next q2
endwhile
close q2

/* pause */
/****tot_h  */

exec sql
q2: select fside,fwpnam,famonam,count(result) from v_sc1_3
    where result='H' and fwpn in ('2882080C','28821022','28821047',
    '2884082C','28841022','28841022','28841043','28842002')
    group by fside,fwpnam,famonam
end-exec

first q2
while status[q2] >0
  fside = q2.fside
  fwpnam = q2.fwpnam
  famonam = q2.famonam
  tot_h = q2.count(result)
  /* print fside,fwpnam,famonam,tot_h */

  exec sql
  q1:  select * from tsc1_1 where fside=:fside and fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  first q1
  if status[q1] >0
  /* display q1 */
  /* print "....updating...." */
  exec sql
  update  tsc1_1  set  tot_h=:tot_h  where  fside=:fside  and
fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  else
  /* print "....inserting....." */
  exec sql
  insert into tsc1_1 values
    (:fside, :fwpnam, :famonam, 0,
     0, 0, 0, 0,
     0, 0, :tot_h, 0)
```

```
  end-exec
  endif

  close q1
  next q2
endwhile
close q2

/****tot_k  */

exec sql
q2: select fside,fwpnam,famonam,count(result) from v_sc1_3
    where result='K' and fwpn in ('2882080C','28821022','28821047',
    '2884082C','28841022','28841022','28841043','28842002')
    group by fside,fwpnam,famonam
end-exec

first q2
while status[q2] >0
  fside = q2.fside
  fwpnam = q2.fwpnam
  famonam = q2.famonam
  tot_k = q2.count(result)
  /* print fside,fwpnam,famonam,tot_k */

  exec sql
  q1:  select * from tsc1_1 where fside=:fside and fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  first q1
  if status[q1] >0
  /* display q1 */
  /* print "....updating...." */
  exec sql
  update  tsc1_1  set  tot_k=:tot_k  where  fside=:fside  and
fwpnam=:fwpnam
       and famonam=:famonam
  end-exec
  else
  /* print "....inserting....." */
  exec sql
  insert into tsc1_1 values
    (:fside, :fwpnam, :famonam, 0,
     0, 0, 0, 0,
     0, 0, 0, :tot_k)
  end-exec
  endif

  close q1
```

Procedure Command File
for Direct Fire Weapon System Summary Scorecard

```
  next q2
endwhile
close q2
```

Procedure Command File
for Direct Fire Weapon System Summary Scorecard

Appendix B. Report Command File

```
select * from tsc1_1
report
sort      2 fside,fwpnam,famonam
total     nrounds >> nrounds >> fwpnam y btitle
Total
Overall total
total     mbt_h >> mbt_h >> fwpnam y btitle
Total
Overall total
total     mbt_k >> mbt_k >> fwpnam y btitle
Total
Overall total
total     ifv_h >> ifv_h >> fwpnam y btitle
Total
Overall total
total     ifv_k >> ifv_k >> fwpnam y btitle
Total
Overall total
total     oth_h >> oth_h >> fwpnam y btitle
Total
Overall total
total     oth_k >> oth_k >> fwpnam y btitle
Total
Overall total
total     tot_h >> tot_h >> fwpnam y btitle
Total
Overall total
total     tot_k >> tot_k >> fwpnam y btitle
Total
Overall total
format    nrounds 0/0/5
format    mbt_h 0/0/5
format    mbt_k 0/0/5
format    ifv_h 0/0/5
format    ifv_k 0/0/5
format    oth_h 0/0/5
format    oth_k 0/0/5
format    tot_h 0/0/5
format    tot_k 0/0/5
format    fside 0/0/4
format    fwpnam 0/0/14
rename    fside SIDE
rename    fwpnam FIRING^WEAPON
rename    famonam FIRING^AMMO
rename    nrounds SHOTS
rename    mbt_h MBT_H
rename    mbt_k MBT_K
```

Report Command File for Direct Fire Weapon System Summary Scorecard

```
rename    ifv_h IFV_H
rename    ifv_k IFV_K
rename    oth_h OTH_H
rename    oth_k OTH_K
rename    tot_h TOT_H
rename    tot_k TOT_K
margin    0 0 5
heading   all
date      on
page      on
title     c a 1
DIRECT FIRE WEAPON SYSTEM SUMMARY
```

Report Command File for Direct Fire Weapon System Summary Scorecard