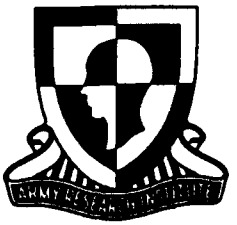
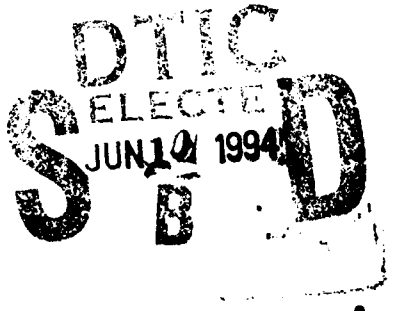


Research Product 94-08

Evaluation of the AirLand Battle Management Advanced Technology Demonstration Prototype Version 1.2: Review of the Trend Analysis and Projection Tool



April 1994

Field Unit at Fort Leavenworth, Kansas
Manpower and Personnel Research Division

U.S. Army Research Institute for the Behavioral and Social Sciences

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13. ABSTRACT *(Maximum 200 words)*

This report documents observations of acceptability of the procedures and algorithms of the Unit Statis Projection and Trend Analysis Tool (USP/TA), a module of the AirLand Battle Management (ALBM) Advanced Technology Demonstration (ATD) decision aid prototype, version 1.2. This is one of a series of assessments of the ALBM ATD prototype conducted during its development. Because little documentation was made available, the assessment was limited to observations made by an analyst working with the Tool. The USP/TA tool provides Army division planners with current and projected unit status information and Force Ratios. Review of the Tool suggests that algorithms supporting resource projections are not adequate for the projection task. Army Field Manual (101-10-1/2) tables used to project status do not, in many cases, have the type of data necessary to support the calculations. The authors recommend that improved algorithms and procedures be developed and validated before proceeding with development.

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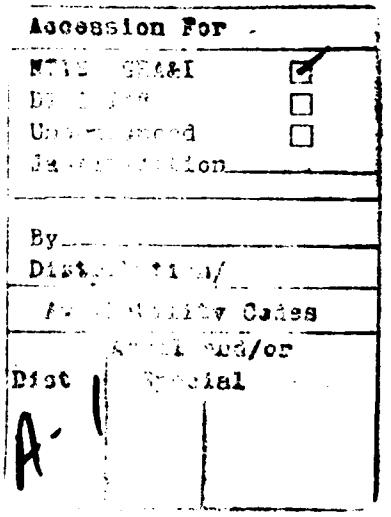

Research Product 94-08

Evaluation of the AirLand Battle Management Advanced Technology Demonstration Prototype Version 1.2: Review of Trend Analysis and Projection Tool

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Human Factors in Training
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FOREWORD

This document contains the results of an early review of the Trend Analysis and Projection Tool, a module of the AirLand Battle Management (ALBM) Advanced Technology Demonstration (ATD) prototype, version 1.2. ALBM ATD is a program to develop decision aid prototypes to support Army division-level tactical planning. This assessment is one of a series of life cycle assessments of ALBM ATD being conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) during the development of the system. The results will be used by the developer and government sponsors of ALBM ATD to guide further development of the system.

The research was conducted under the ARI research task entitled "Support for Command and Control Research." The assessment was in support of the Combined Arms Command (CAC), the program's user representative. A Memorandum of Agreement was in effect with the Combined Arms Combat Developments Activity, "Development and Implementation of the Future Battle Laboratory," dated 30 June 1989. The results of this review were briefed to personnel from the Battle Command Battle Laboratory, Combined Arms Command; Communications and Electronics Command; Lockheed; and MITRE on 7 January 1993. Brigadier General Anderson, Deputy Commanding General for Combat Developments, Combined Arms Center, was briefed on the findings presented in this report on 25 January 1993.

EDGAR M. JOHNSON
Director

EVALUATION OF AIRLAND BATTLE MANAGEMENT ADVANCED TECHNOLOGY DEMONSTRATION PROTOTYPE VERSION 1.2: REVIEW OF THE TREND ANALYSIS AND PROJECTION TOOL

CONTENTS

EVALUATION OF AIRLAND BATTLE MANAGEMENT ADVANCED TECHNOLOGY DEMONSTRATION PROTOTYPE VERSION 1.2: REVIEW OF THE TREND ANALYSIS AND PROJECTION TOOL

Summary

The purpose of this report is to document observations made of the procedures and algorithms used in the Trend Analysis and Projection Tool, a module of the AirLand Battle Management (ALBM) Advanced Technology Demonstration (ATD) prototype. Complete documentation of the algorithms was not available and a systematic review of the procedures and algorithms was not conducted. The comments contained in this report are the product of one analyst's review of available documentation and experience working with the Tool.

The Trend Analysis and Projection Tool is designed to provide Army division planners with current unit status information and projections of this information to points in the future. In addition, it provides current and projected Force Ratios.

Review of the Tool suggests that the four basic calculations made to support projections of resources, i.e., fuel, ammunition, personnel and equipment losses and consumption, are not adequate for the task projecting unit status. For example, the fuel and ammunition algorithms are not sensitive to missions or actual equipment on-hand; the personnel algorithm is designed for division-level attrition and does not lend itself to battalion attrition; the equipment algorithm treats all equipment the same and uses number of items lost rather than a percent, which unrealistically decrements low count equipment items; resupply is limited to once a day.

The basic tables used to project status are taken from FM 101-10-1/2 (1987). These tables in many instances do not have the necessary type of data to support the trend analysis calculations. To compensate for this, the software developer has used available tables to make all projections. For example, tank loss rate tables are used to project helicopter losses. Alternative or supplemental data sources to the FM tables are suggested but may be difficult to implement.

The Trend Analysis and Projection Tool calculates an overall projected combat effectiveness score that appears to be inaccurate. This score cannot be modified by the user for intangible factors before it is ported to another tool for further calculations.

The system contains a module that translates scenario data into information that is used to enter the projection tables. For example, intended mission must be known in order to access personnel attrition data. The module, the COEM (Current Operations Execution Matrix), currently contains static scenario data that was entered by a computer programmer. This means the system as it exists currently can be used with only the present scenario. At a minimum, a modifiable display showing scenario data should be available to users.

It is recommended that the requirement for this tool be reexamined in the light of the feasibility and cost to make operational. Before proceeding with further development, documentation should be developed that describes the methodology, logic and algorithms. These should be validated and improved procedures and algorithms developed where necessary.

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overall management of the program. The Combined Arms Command, Combat Developments at Fort Leavenworth is the Users' representative responsible for functional requirements, knowledge elicitation with subject matter experts, and the operational evaluations. The Program Executive Office for Command and Control Systems (PEO-CCS) is responsible for integration with ATCCS.

Two Force Level Control (FLC) Advisors are currently under development (ALBM ATD Functional Description Requirements Specification; March, 1992) as part of the ALBM ATD system - MET4 and FITE. MET4 is designed to aid commanders and their staffs from brigade through corps to analyze the area of operations and to assess the enemy and friendly capabilities. The second FLC Advisor, the Force Interactive Tactical Evaluator (FITE), interacts with MET4 to aid commanders and their staffs from brigade through corps to develop, wargame, and compare COAs. Together, the FLC Advisors are intended to function as intelligent assistants which can, when requested, (1) automatically complete straightforward, detailed sections of plans, (2) automatically detect certain inconsistencies and unattainable goals in user-specified plans, and (3) automatically determine suggestions for plan alternatives and provide plan detail expansion and check sheets for user-specified partial plans during the course of action generation process. When embedded in the Army Tactical Command and Control System (ATCCS), the system is intended for use at echelons of command from brigade through corps with initial focus at the division level. The FLC Advisors are intended to be installed in the Maneuver Control System (MCS) Version 11.xx using Common Hardware Software (CHS) as a target system, with ATCCS CHS Block 2 as the objective system environment.

Description of the Unit Status Projection and Trend Analysis Tool

The Tool is one of several tools that comprise the Mission, Enemy, Terrain, Troops, and Time Available Tools (MET4) decision aid prototype. The Tool is designed to provide the planner with unit status information for both the current situation and for a projected situation at a user specified future time. This information is used to assist the user in performing an analysis of a new mission and developing assumptions for course of action development. As with other MET4 tools under development, the Tool is dynamic and interactive. Products from the Tool are ported to others as needed. For example, the Tool receives information from the Task Organization Tool (see Appendix A, Figure A-1) and in turn provides information to the Combat Power Calculator Tool (see Figure A-2).

Description of Documentation Examined

A partial description of the was obtained from design review slides, Detailed Design Review packages, READ.ME files, Help files and explanation capability, and the evaluator's

experience with the Tool. There was not enough information to determine the logic employed to modify and implement the algorithms in the Tool. For example, much of the available documentation does not reflect the current system and significant processes are not documented at all. In some instances (e.g., calculating overall combat effectiveness), it appears that software glitches produce obviously incorrect products and prevent even a cursory analysis. Therefore, the descriptions of the documentation are based on a best attempt to use this documentation, and on the analyst's experience with the Tool in a laboratory.

Observations

Applicability of FM 101-10-1/2

In the Tool, four basic calculations are made to support projections of resources. Fuel, ammunition, personnel and equipment losses and consumption are calculated and presented to the user. The basis for these calculations, according to the software developer, is FM 101-10-1/2, The Staff Officers' Field Manual Organizational, Technical, and Logistical Data Planning Factors, Volume 2 (1987). Four tables in FM 101-10-1/2 are identified as the basis for the algorithms used in the Tool:

- Personnel Loss Projection: (Table 4-18, FM 101-10-1/2, 1987, p. 4-9)
- Petroleum, Oil, Lubrication (POL) Consumption - Diesel: (Table 2-15, FM 101-10-1/2, 1987, p. 2-54)
- Ammunition Consumption (Table 2-19, FM 101-10-1/2, Oct 1987, p. 2-142)
- Equipment Loss Projection - Main Battle Tanks: (Table 2-25, FM 101-10-1/2, Oct 1987, p. 2-176; Modified significantly).

FM 101-10-1/2 is regarded as the authoritative source for planning factors by most military officers. There is no accepted alternative to this document in current publication. As a general rule, this document is considered the starting point for planning future operations. The data in this document may be modified by user experience as necessary. However, there are several problems with the use of FM 101-10-1/2. First, many users consider this document outdated and not reflective of current U.S. Army doctrine. Frequently, users comment that this FM reflects World War II and Korean War results and is inaccurate for use in the environment we face today. As a result, many users have low confidence in this manual and say that they would not use it.

Another major drawback associated with using FM 101-10-1/2 is the mismatch between system requirements and available data in the Manual. It presents planning data in a format suitable for long range logistics and administration planning, but is not supportive of operational planning where specific units and specific missions are known. In addition, the information is presented in standard battalion, brigade and division format, whereas in an actual plan the forces are organized into Task Forces. Consequently, the process of looking up data and obtaining correct information is complicated.

Finally, the Manual does not contain the required information to perform aided tasks with the Tool. For example, the only loss equipment table in the Manual is for Main Battle

Tanks in either a defend or delay mission with an enemy to friendly force ratio of 3 or 4 to 1. No data is available for other equipment, other force ratios or non-European environments. In the ALBM ATD system, the software developer used delay attrition for attack tables and used tank loss rates for all other kinds of equipment. The result is that tank, howitzer, armored personnel carrier and helicopter losses are all the same.

There are few alternatives to this document. However, several possibilities have been suggested to remedy the inadequacy of the tables of FM 101-10-1/2 for use in the Tool:

- Updating the document. Obviously, this is a long term task that will not provide immediate assistance to this effort, but could assist future efforts.

- Convene a group of subject matter experts from Ft. Leavenworth to review these four tables and provide an "expert update" to the software developer.

- Seek assistance from the technical community (TRADOC Analysis Command - TRAC) to determine updated data for the tables.

- Consider an analysis of the training simulations, such as the Corps Battle Simulation (CBS) for possible integration. A frequent question asked by many users was how our projections compared with CBS. Many users have CBS as a mental yardstick of how to assess and compare consumption and attrition because of its use in the Battle Command Training Program (BCTP).

Implementation of the Algorithms

As discussed previously, four calculations are used to make projections about fuel, ammunition, personnel and equipment. All projections are made at the battalion level. In the current scenario, all battalions are organized into task forces, but the calculations are made on the basis of pure battalion organization. Ignoring task organizations simplifies the calculations, but also presents inaccurate information to the user. It is unclear exactly how a user can modify projection tables for actual task forces. It would appear that multiple tables would require modification to project more accurate data. After the four major calculations are performed, the system (by use of a weighting technique) aggregates the calculations into a single number labeled as Combat Effectiveness. This product is then ported to another tool for determining combat power ratios.

Fuel. The first basic algorithm aggregated into the calculation of combat effectiveness is fuel. Fuel consumption (see Figure A-3) is directly taken from Table 2-15, FM 101-10-1/2 (1987). Fuel consumption is limited to diesel only and computed by determining the total gallons per day per unit. By default, a European Usage Profile is loaded in the system for different

types of units. The profile provides information for a specified unit on consumption rates for miscellaneous equipment, tracked vehicles, and wheeled vehicles on a twenty four hour basis. Essentially, it provides a number of hours per day for each of the three categories of equipment and also provides a rate of consumption for either the hours used or the kilometers travelled. The user may modify either the number of hours or kilometers travelled or may modify the rate of consumption. The algorithm allows the user to resupply a unit once a day up to 100% of basic load.

There are several limitations imposed by this application. They include:

- The tables reflect a battalion rate, not the actual Task Force organization. The result will be inaccurate information presented to the user.

- The tables are not sensitive to the actual equipment on hand. A unit with 25% of its equipment will consume as much fuel as a unit with 100% of its equipment.

- The losses projected by the equipment loss projection table are not considered in making fuel projection estimates.

- The actual unit activity is not considered in projecting fuel consumption. A unit in reserve will consume as much fuel as a unit in an attack mission.

- The limiting of resupply to once a day virtually guarantees the unit will run out of fuel. More frequent resupply should be made possible.

Ammunition. The second basic algorithm aggregated into the calculation of combat effectiveness is ammunition. Ammunition consumption is taken from Table 2-19, FM 101-10-1/2 (1987, see Figure A-4). The user may modify the expenditure rates in the system by selecting a specific type of ammunition and a level of intensity appropriate to the mission from a menu. The user then modifies the default value as needed (see Figure A-5). Resupply is limited to once a day at a fixed time.

The limitations imposed by this application include:

- The tables are not sensitive to the actual equipment on hand. A unit with 25% of its weapons will expend as much ammunition as a unit with 100% of its weapons.

- The losses projected by the equipment loss projection table are not considered in making ammunition projection estimates.

- The type of division is not considered in determining ammunition expenditures.

- The once a day resupply is too limiting.

Personnel. The third basic algorithm is personnel. Personnel attrition is taken from Table 4-18, FM 101-10-1/2 (1987). Personnel losses are projected as losses per day per unit as a percentage of strength. The user may modify the tables by selecting an appropriate operation from the table and then selecting the appropriate activity (i.e., Main, Rear or Reserve). At this time the user may modify the default value as required (see Figures A-6, A-7, and A-8). Replenishment is accomplished once a day by entering a value in the replacements window and also entering a value in the return to duty window. Replenishment is limited to once a day.

The limitations imposed by this application are that Table 4-18 is a personnel loss table for divisions. The values expressed in this table depict on a percentage basis what the force as a whole will lose. It is not intended for use with specific battalions whose losses will vary depending on mission. For example, the table has a value of 6.6% losses for a division attacking a fortified zone for the "Main". This value is then applied to all units. However, the lead battalions can be expected to suffer substantially higher losses than follow-on units or artillery units or support units. While the value for the division as a whole may be accurate, the numbers for each of the battalions will be very inaccurate. This inaccurate number is presented to the user for planning purposes and defeats its use as a meaningful planning aid.

Equipment. The final algorithm is equipment. Equipment attrition is based on Table 2-25, FM 101-10-1/2 (1987, see Figure A-9). According to the software developer, it has been modified significantly to provide consistency with other projection models (see Figure A-10). The table itself provides information concerning main battle tank losses. No other table on equipment losses exists and this table was used as an interim solution for all other equipment attrition.

This table also lacks data concerning losses for an attack mission. As an interim solution, the software developer chose to replicate the delay losses for attacking forces. The original table projects losses in percent of tanks lost for a division. The table also provides information on the repair of tanks and their return to duty.

Major modifications to the table have been made without documentation by the software developer. It is possible to see the modifications, but the logic which explains the changes is missing. The software developer initially reduced the percentages of losses by fifty percent. The reduced numbers were then slightly modified for implementation. The actual implementation (see Figure A-11) differs from the documentation in that the numbers are not in agreement. More significantly, the concept of percentage losses is abandoned in favor of losses in numbers per day. No explanation for this final modification

is given. Replenishment provides for the user to specify a number of replacement items and repaired items to be returned to the unit once a day at a prescribed time.

The limitations imposed by this application include:

- All equipment is treated the same and losses are applied uniformly to all tracked items. The result is that the numbers of helicopters and howitzers lost are the same as for tanks.

- Eliminating percentages as a means for calculating losses in favor of numbers of items results in the total loss of low density items within units. In some cases the low density items are critical to mission accomplishment, but are immediately lost because of the technique used for calculation.

- The technique used is visible to the user and undermines credibility in the entire projection process employed.

Projected Combat Effectiveness

Another calculation performed by the system is an overall combat effectiveness score based on averaging the four basic algorithms that support projections of resources (see Figure A-12). The intent of this overall calculation is to aggregate other algorithm results into a single value that expresses a unit's combat effectiveness.

Realizing that users might feel that some items are more important than others, the software allows the user to weight individual items in terms of their significance to mission accomplishment (Figure A-13). The weighting values range from 1 to 4. Unfortunately, the weighting algorithm appears to have a software glitch and produces inaccurate results (see Figure A-12). No documentation exists to explain the logic for this algorithm and the initial design specifications appear to be outdated. Finally, the value produced by this algorithm cannot be edited by the user.

The limitations imposed by this application are:

- Currently, the value calculated for this application is incorrect and lacks face validity.

- Weighting the items to come up with an overall effectiveness score appears to be mission dependent. Preparing a meaningful default value set appears difficult due to the scenario specific nature of mission analysis.

- The weighting technique seems to add to the confusion of calculating combat effectiveness rather than reducing it.

- Combat effectiveness is composed of more than just the amount of tracked items on hand or projected to be on hand. Intangible factors such as morale, leadership, training, and other combat multipliers will impact combat effectiveness. The current system does not allow the user to modify the combat effectiveness factor for these intangibles. To compound the problem, this value is ported to another tool for use in subsequent calculations.

Current Operations Execution Matrix (COEM)

In order for the system to make projections about specific units, the software must know the intended missions for all units. In addition, the system must know the times missions will change. This information is stored in the COEM (see Figure A-14). It represents a synchronization matrix for units, storing missions, starting times, and information necessary to enter the appropriate tables in FM 101-10-1/2.

The COEM functions as a translator for scenario data (i.e., plans and orders) and assures that the correct table and table entry is used. The COEM is an interim product not intended for users and is not accessible to users. It should be pointed out that the function it performs (i.e., a translator) is a critical task - essential for this aid or others that will follow it. However this task is performed, the user must be able to view the results and modify the matrix as required. Without this information, the user will not be able to knowingly modify the tables used in the algorithms. It would seem logical to display this information in a standard matrix format.

Displays

The displays associated with this tool allow the user to look at a projection at a specific point in time (see Figure A-1) or to look at a unit over time in a graphic format (see Figure A-15). The snapshot look seen in Figure A-1 presents a listing of units and tracked items in a multi-colored gumball display. Each gumball may be queried for additional information. Additionally, each unit may be queried for status information. The name of the unit is backlighted in a color representing overall unit status, however the logic for this backlighting was not available. It was noted during use of this tool that different colors were used for the backlighting, even though the strategy for the use of the colors was not apparent.

As an alternative, a graph of consumption and attrition over time could be displayed with this tool. However, this display was hard to read and understand due to the poor choice of colors and font sizes. In addition, the user should be able to obtain a

unit status report from this window. This would allow the user to understand the data displayed in the graph. Also, the user should be able to zoom the graph to make it easier to read. A final feature that would enhance this display would be the ability to query the graph and obtain explanations for its display.

User Opinions

This report documents only an analyst's impressions of the underlying algorithms. The ALBM ATD prototype was also assessed by users and SMEs who viewed a demonstration of the system and then filled out questionnaires and participated in structured interviews. The results of this assessment are contained in Riedel et al (1993) and the reader is referred to that document for users' opinions. The demonstration nature of the user evaluation and limited time available for the demonstration precluded a detailed examination of the algorithms by the users and SMEs, and those results do not assess the validity of the algorithms and procedures. However, users and SMEs did think that the capability to display current unit status and to project that status to specified times in the future would be very useful in assisting mission analysis.

Conclusions and Recommendations

In summary, it was determined that there was inadequate information to determine the logic employed to modify and implement the algorithms in the Tool. Therefore, a detailed assessment using SMEs was not performed.

It appears that the basic calculations to support projections of resources (e.g., fuel, ammunition, personnel, and equipment losses and consumption) based on FM 101-10-1/2 are inadequate for supporting the Tool. Specifically, the fuel and ammunition algorithms are not sensitive to missions or actual equipment on-hand and the personnel algorithm is designed for division level attrition and does not lend itself to battalion attrition. The equipment algorithm is also unacceptable. Treating all equipment the same is unrealistic and creates basic face validity problems. Using a "number of items lost" technique rather than a percentage system has compounded the validity problem. Furthermore, resupply is inadequately portrayed in these algorithms.

In addition, the calculation of both current and projected overall combat unit effectiveness is unacceptable, and the use of weighting factors to calculate combat unit effectiveness is of questionable utility. The user should be able to modify the combat unit effectiveness value to reflect intangible factors and combat multipliers.

The COEM should have a user display that shows the current and projected schedule of units and their missions over time. It should also show the entry arguments used to enter FM 101-10-1/2 so that the appropriate data in the correct table can be modified by the user.

Finally, the Tool should allow for the roll-up of both brigade and division status reports.

Based on these conclusions, the following recommendations are given. First, the requirements for this tool should be reviewed. Currently, users make an estimate about the future status of subordinate units to support Mission Analysis. With the current design and existing limitations, this tool does not enhance the planning process.

Second, documentation should be developed that describes the current methodology, logic, and algorithms. In addition, all algorithms should have an explanation or analysis function for the user. Third, an alternative to FM 101-10-1/2 should be found that satisfies the requirements of the Tool and users. A new approach should also be developed for equipment attrition, and resupply should be reanalyzed to allow for more frequent replenishment.

It is also recommended that the user be allowed to edit the combat effectiveness value for intangible factors and combat

multipliers. In addition, the COEM needs a user interface to display unit information and serve as a guide for modifying the algorithms.

Finally, it is recommended that a Subject Matter Expert Knowledge Base validation be conducted after the system is adequately documented.

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APPENDIX A

TREND ANALYSIS AND PROJECTION TOOL FIGURES

Figure A-1. Trend Analysis and Projection Table.

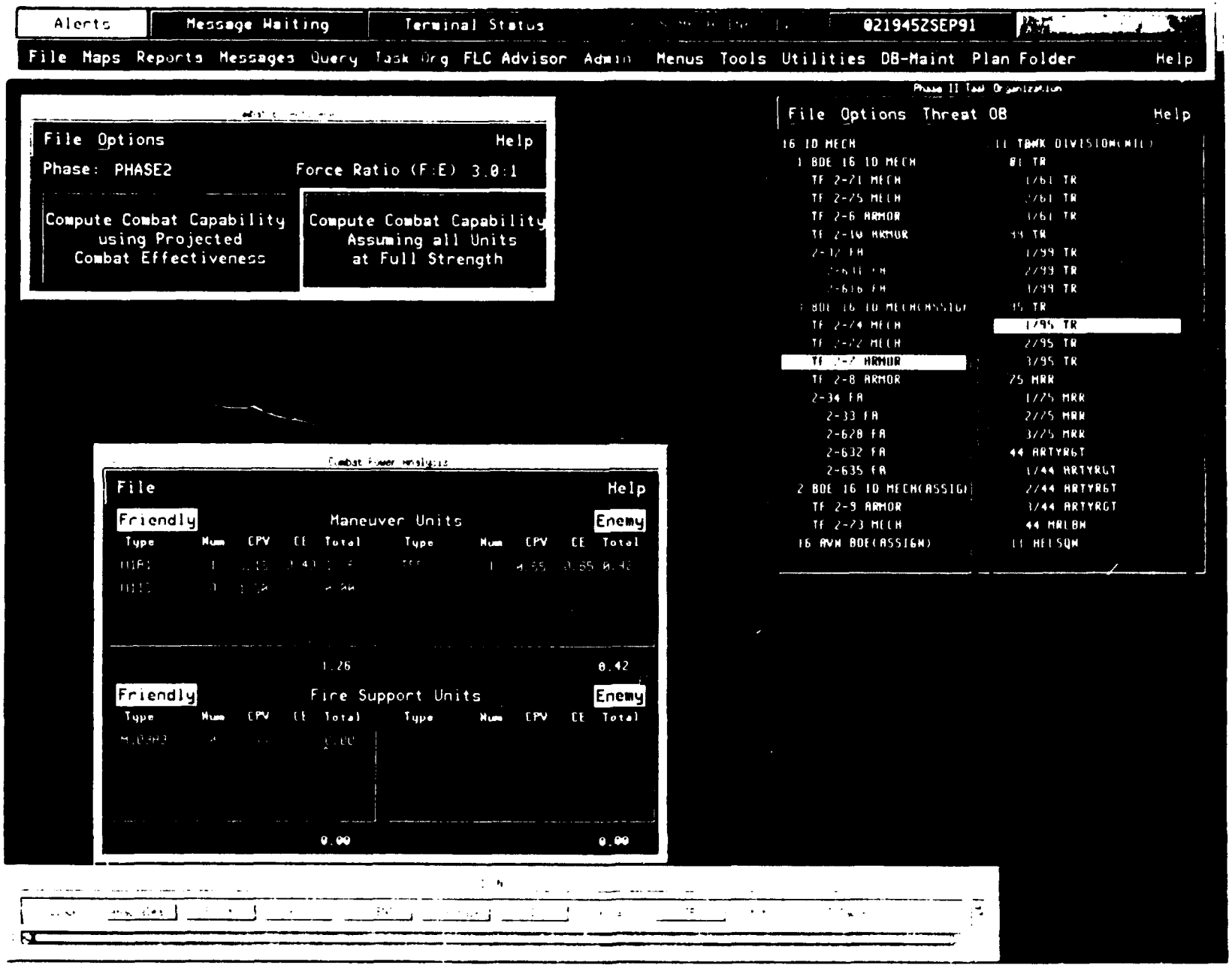

Figure A-2. Combat Power Calculator Tool.

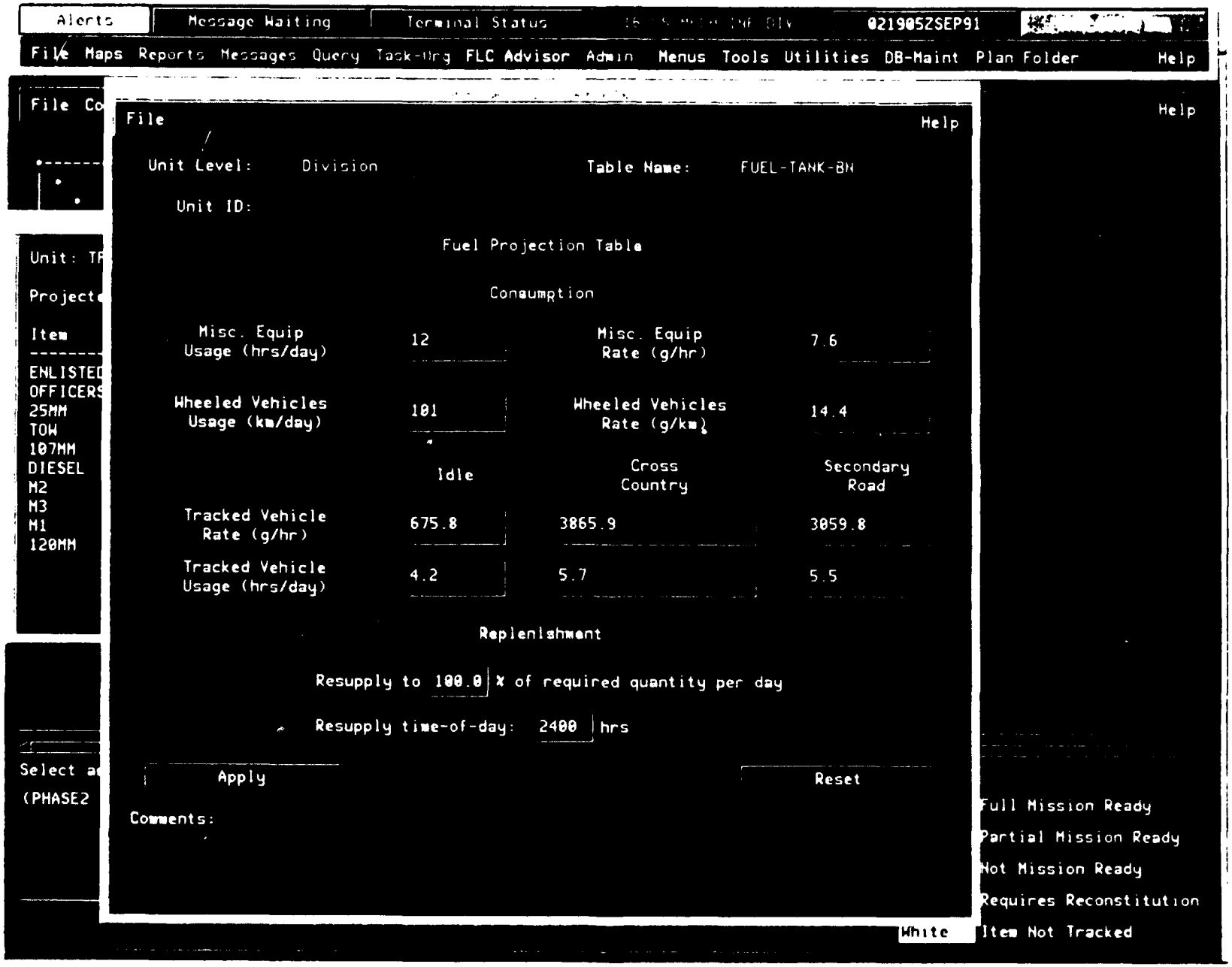

Figure A-3. Fuel Projection Table.

USP: AMMO CONSUMPTION

EXAMPLE FOR HOWITZER SP 8" M110

ROUNDS/WEAPON/DAY:	All Types of Divisions		
Level of Operation:	**Lt.**	**Mod.**	**Hvy.**
Attack, Day 1	56	92	130
Attack, Day 2-4	55	90	127
Attack, Day 5	53	87	123
Attack, Day 5-15	51	84	118
Defense, Day 1	76	126	177
Defense, Day 2-4	71	116	164
Defense, Day 5	61	100	141
Defense, Day 6-15	51	84	118

Figure A-4. Ammunition Consumption Table (Lockheed, 1992).

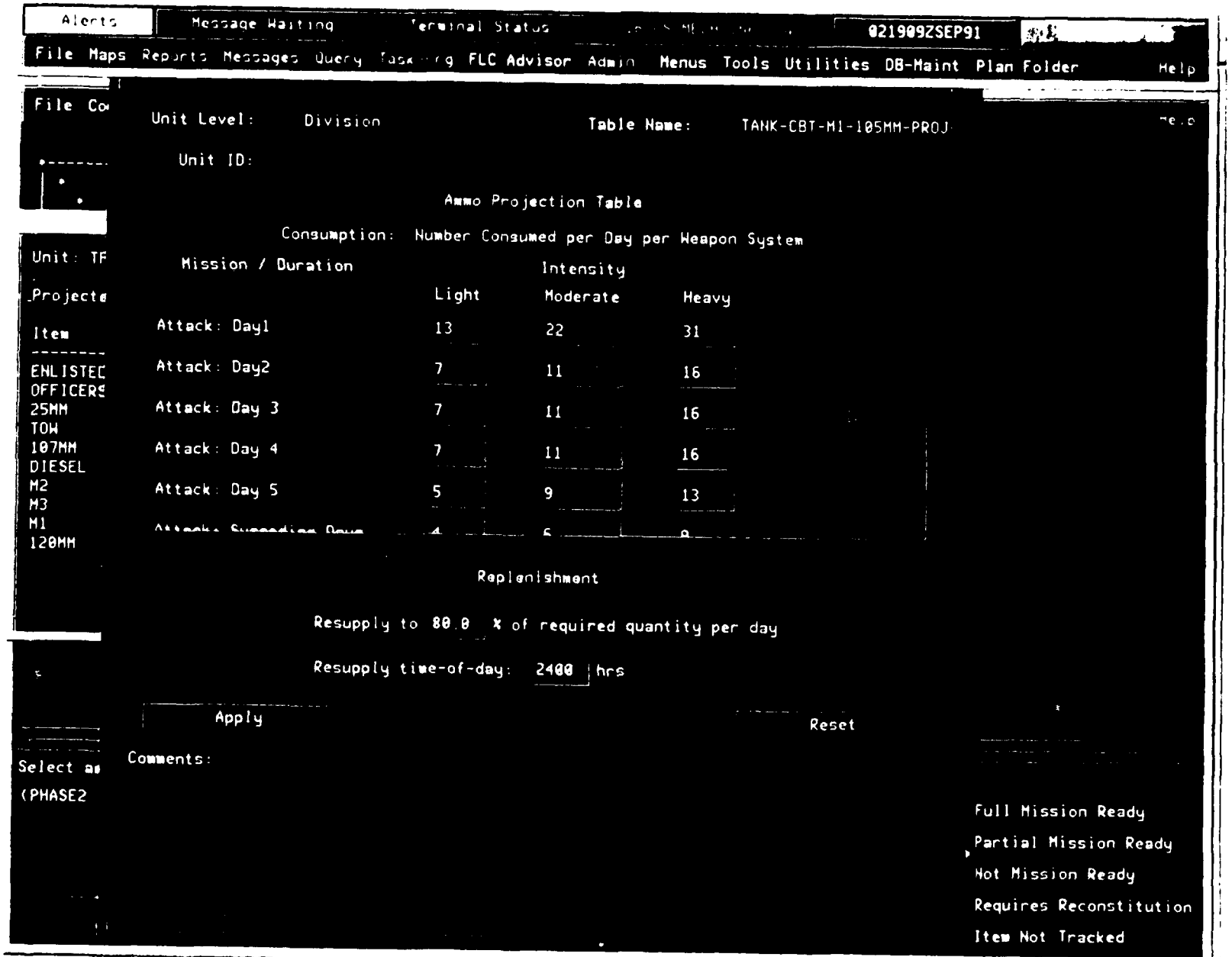

Figure A-5. Ammunition Projection Table.

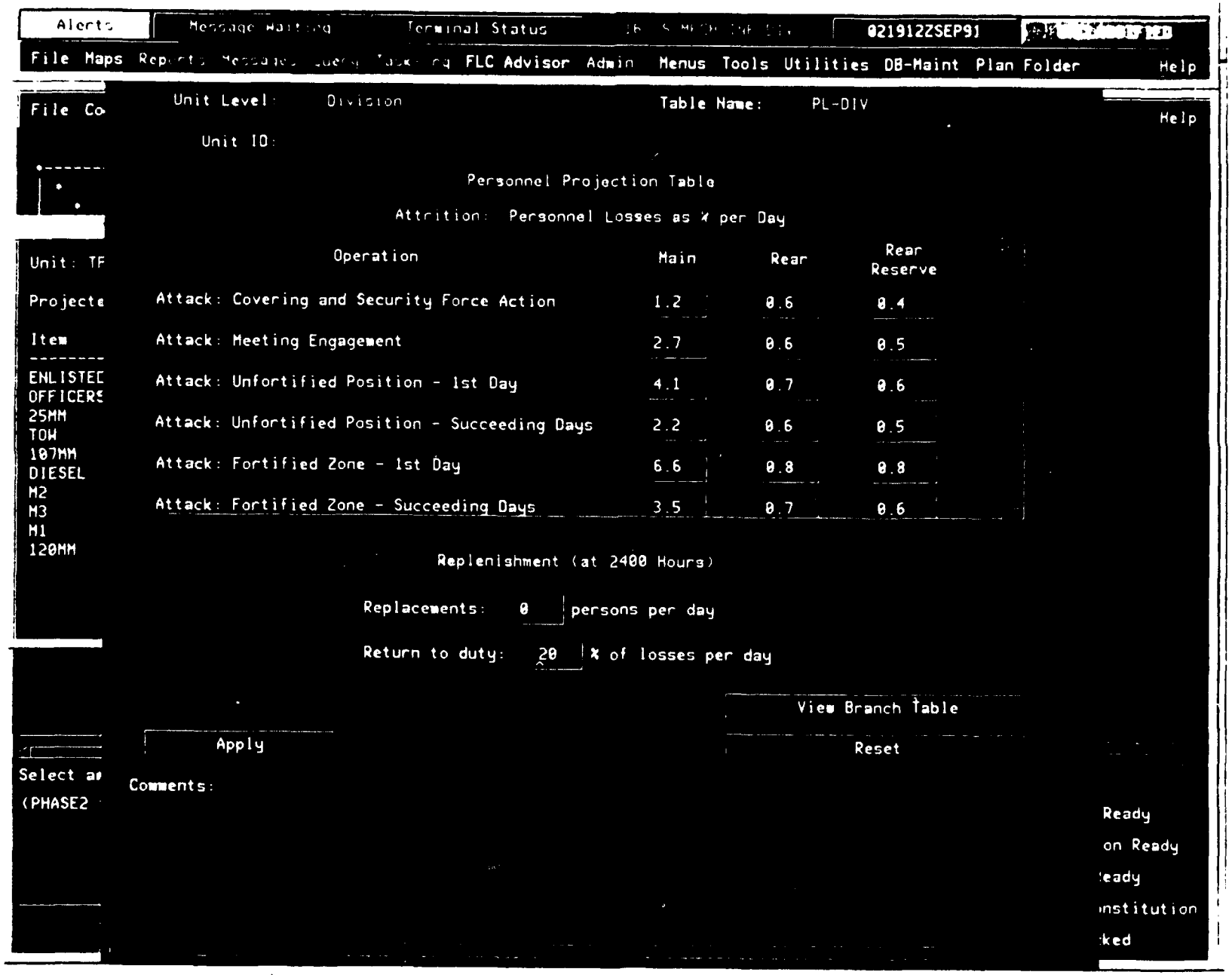

Figure A-6. Personnel Projection Table, Part 1.

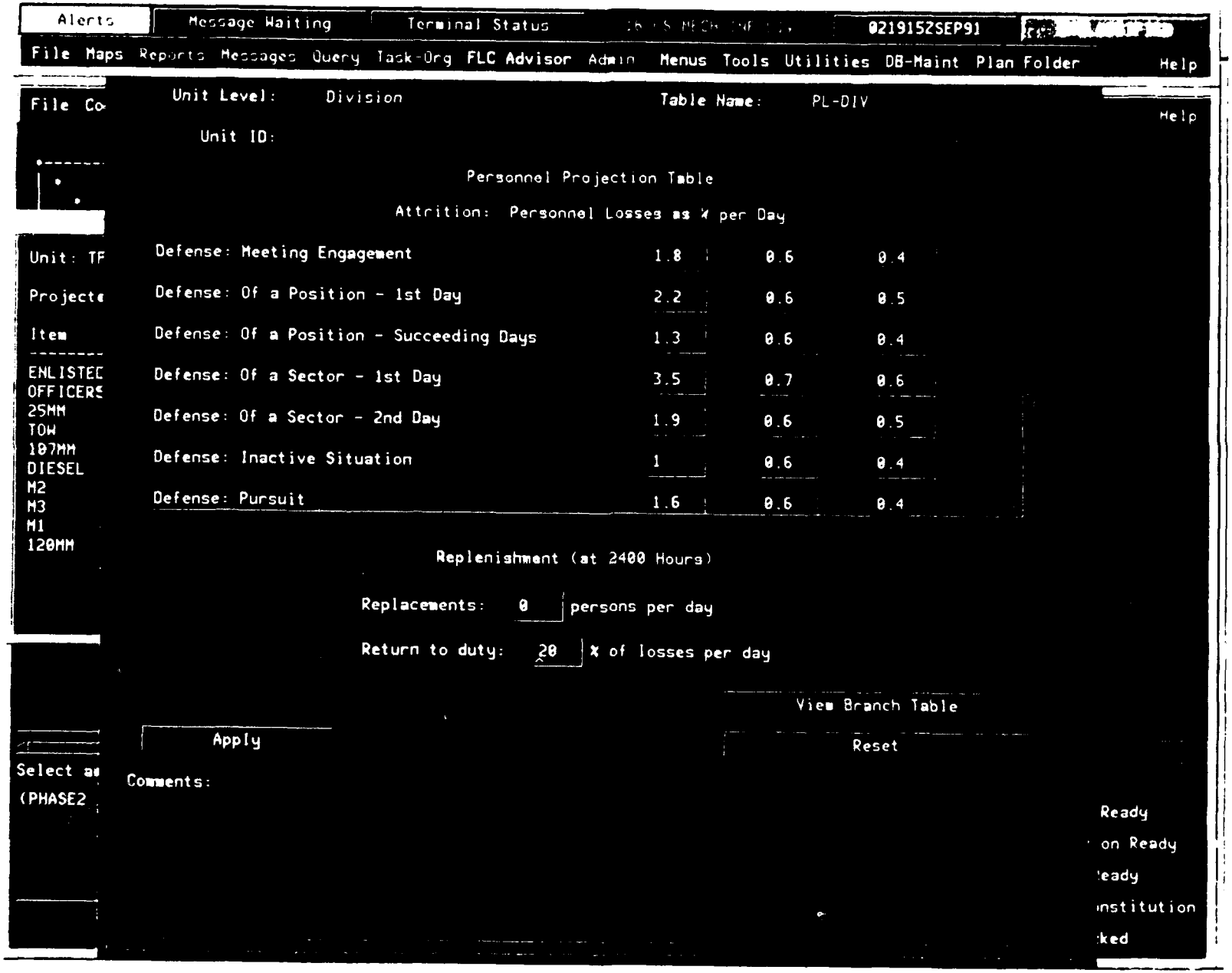

Figure A-7. Personnel Projection Table, Part 2.

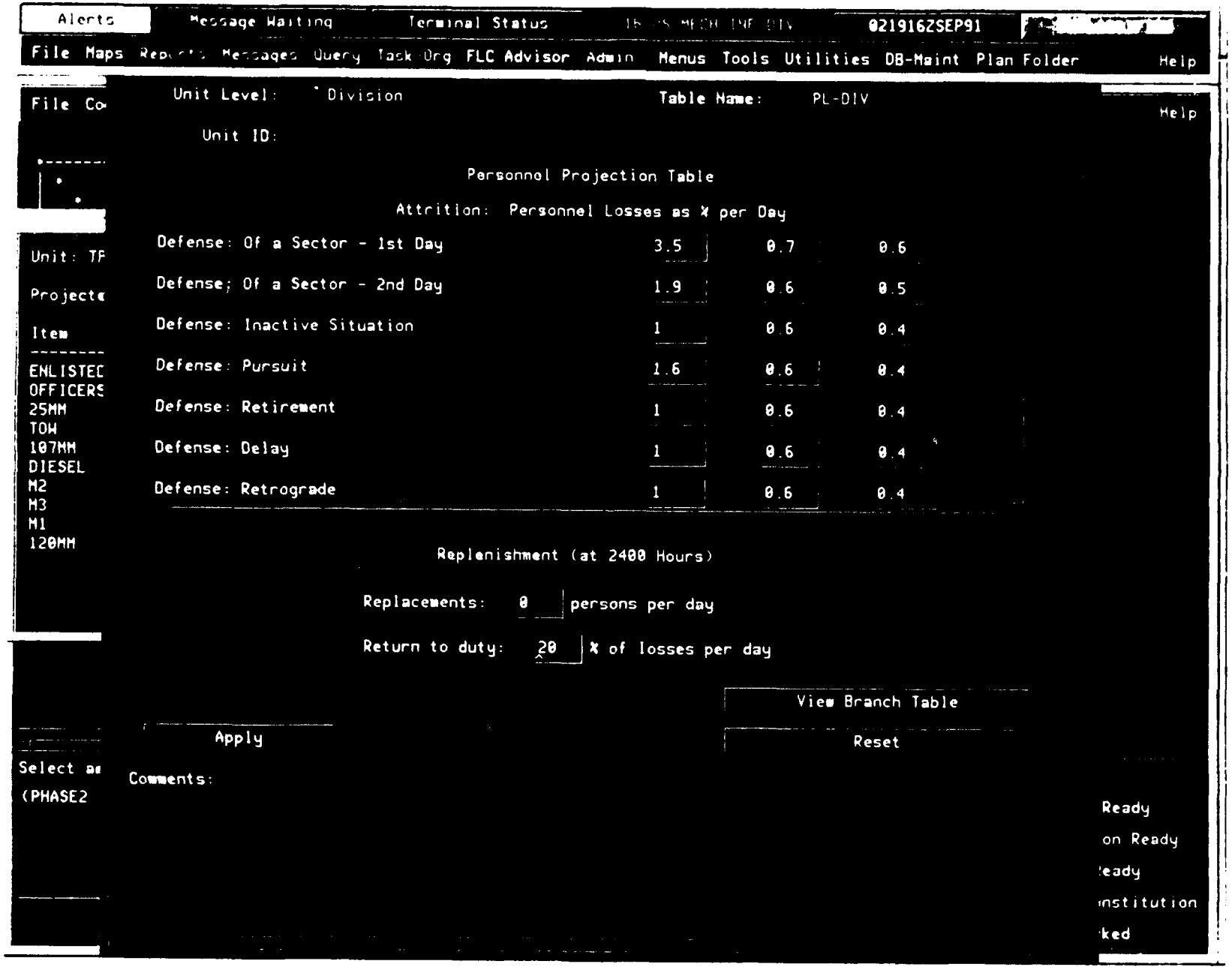

Figure A-8. Personnel Projection Table, Part 3.

USP: Main Battle Tank Losses

Assumptions: Main Battle Tank Losses
(Table 2-25, FM 101-10-1/2, Oct 1987, p. 2-176)

The original source for Main Battle Tank losses is shown below. The notes accompanying the chart present a consistencyproblem for both the user and the USP model in that all other resource models:

- **avoid mixing resupply/repair/reinforcement data with the loss data**
- **avoid large ambiguities ("up to...") by selecting assumptions**
- **calculate losses incrementally rather than repeatedly referring to day 1 data**
- **provide attack data**

Armored or Mechanized Division

Level of Commitment:	DELAY (CFA)			DEFEND (MBA)			ATTACK		
	Lt.	Mod.	Hvy.	Lt.	Mod.	Hvy.	Lt.	Mod.	Hvy.
Day 1	12%	30	73	na	22	54	-	-	-
Day 2	13%	18	8	na	12	14	-	-	-
Day 3	6%	11	6	na	8	10	-	-	-

"Footnote: Up to 80% of the losses are reparable by unit or intermediate maintenance personnel.... average repair time is 10 man-hours."
""Second and third day percentage losses must be applied to the number of operational tanks on hand the first day of commitment."

Figure A-9. FM 101-10-1/2 Main Battle Tank Loss Table (Lockheed, 1992).

USP: Main Battle Tank Losses

Interim data BEFORE modification for incremental projection:

Armored or Mechanized Division

Level of Commitment:	DELAY (CFA)			DEFEND (MBA)			ATTACK		
	Lt.	Mod.	Hvy.	Lt.	Mod.	Hvy.	Lt.	Mod.	Hvy.
Day 1	6%	15	36.5	na	11	27	6	15	36.5
Day 2	6.5%	9	4	na	6	7	6.5	9	4
Day 3	3%	5.5	3	na	3	5	3	5.5	3

Losses shown are assumed permanent. ""Second and third day percentage losses must be applied to the number of operational tanks on hand the first day of commitment."

Armored or Mechanized Division

Level of Commitment:	DELAY (CFA)			DEFEND (MBA)			ATTACK		
	Lt.	Mod.	Hvy.	Lt.	Mod.	Hvy.	Lt.	Mod.	Hvy.
Day 1	6%	15	36.5	na	11	27	6	15	36.5
Day 2	6.5%	9	4	na	6	7	6.5	9	4
Day 3	3%	5.5	3	na	3	5	3	5.5	3

Losses shown are assumed permanent. ""Second and third day percentage losses must be applied to the number of operational tanks on hand the first day of commitment."

Figure A-10. Equipment Loss Table as Modified by the Software (Lockheed, 1992).

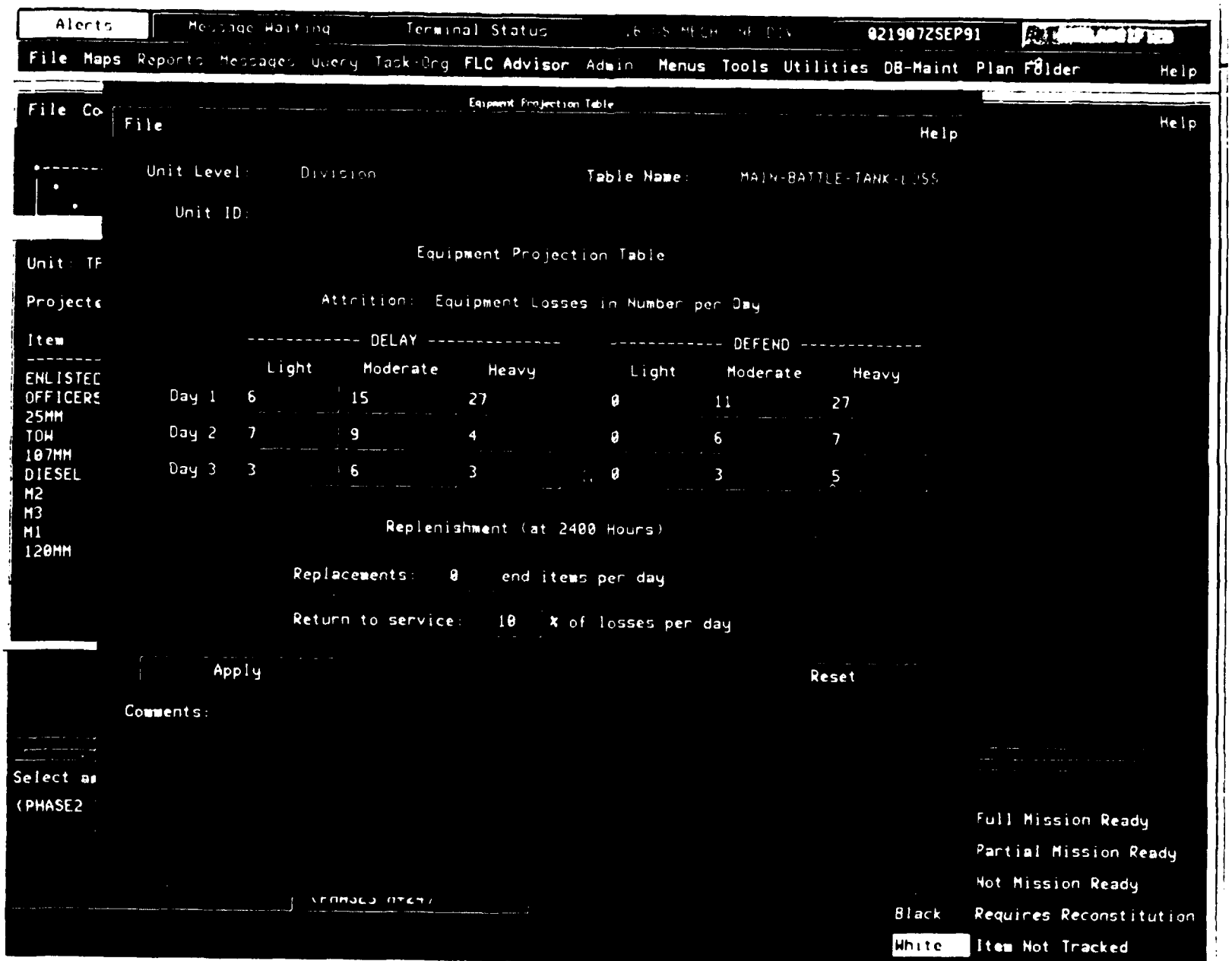

Figure A-11. Equipment Projection Table as implemented by the developer.

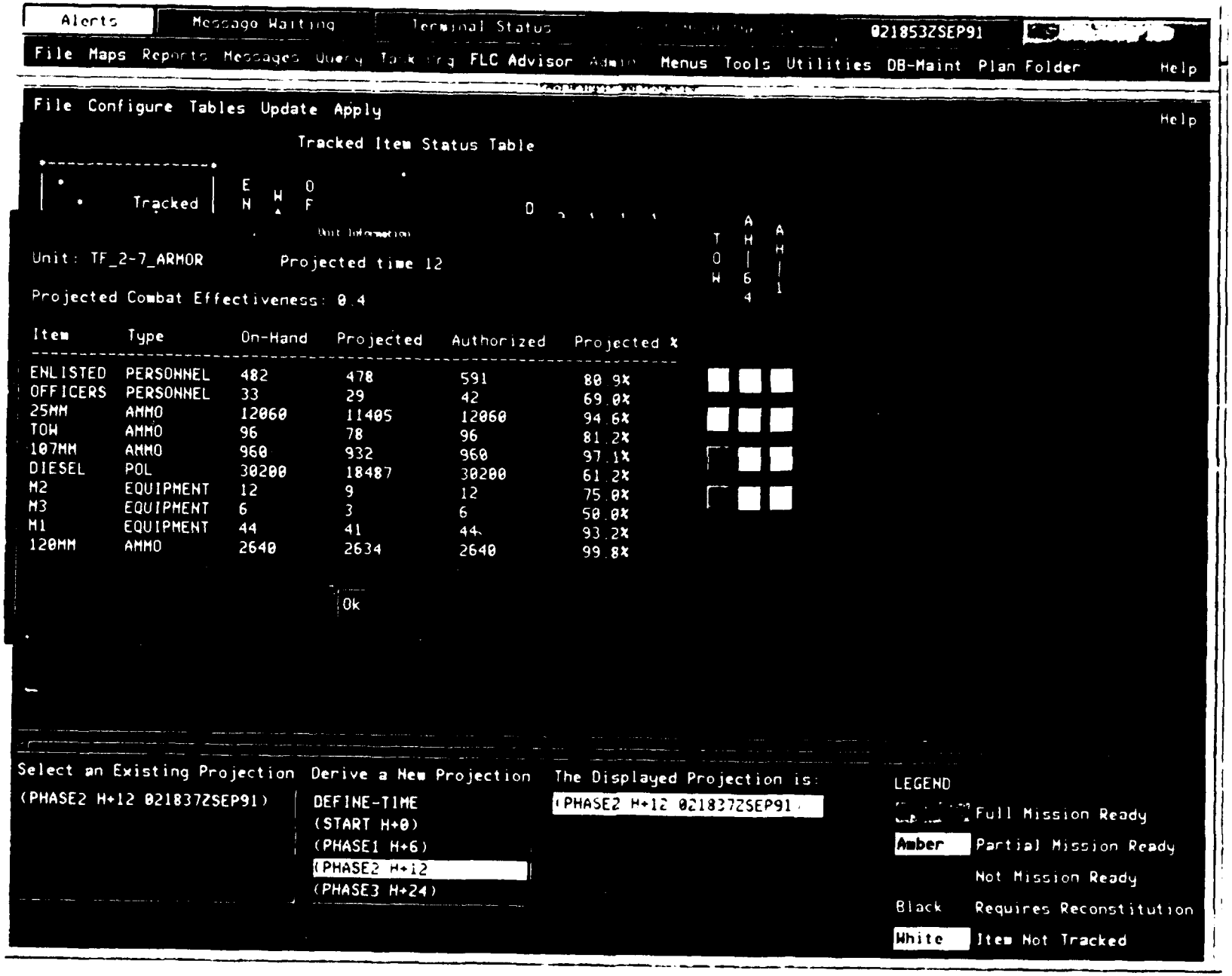

Figure A-12. Unit Status Table.

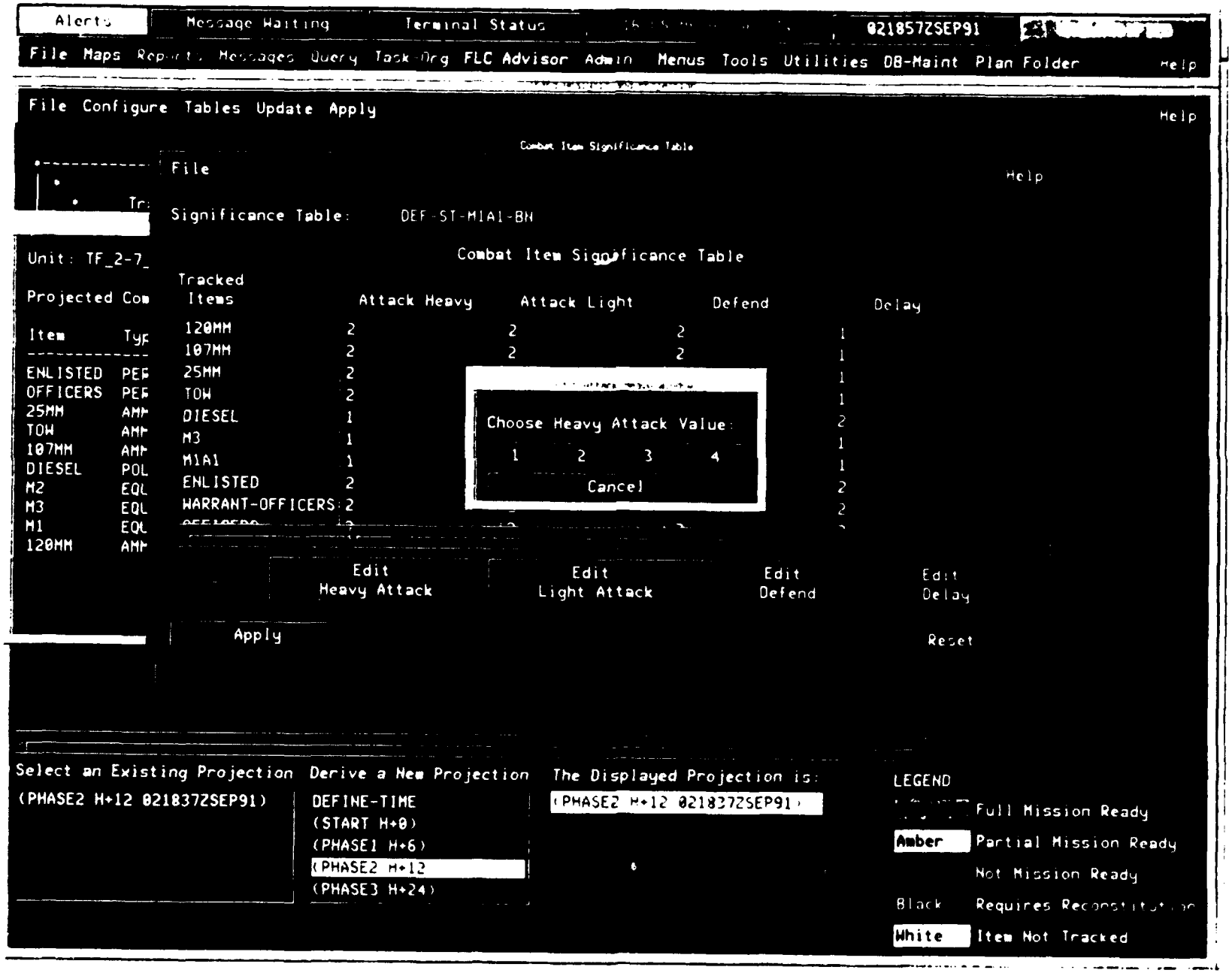

Figure A-13. M1A1 Combat Item Significance Table.

```
(:3_BDE_16_ID_MECH
 (:H+0 :H+6 :H+12 :H+15.5 :H+18)
 ((:DTG-Reason (:change-mission :change-report :change-phase :change-phase
  (:Mission (:Attack :Attack :Attack :Attack :Attack))
  (:Activity (:Position-Fortified :Position-Fortified :Position-Fortified
                                  :Position-Fortified :Position-Unfortified
  (:Intensity (:Light :Light :Light :Light :Moderate))
  (:Role (:Main :Main :Main :Main :Main))
  (:Location (:NC32500550 :NC32500550 :NC41501550 :NC41501550 NC51502450))
  (:TO (:TO-1 :TO-1 :TO-1 :TO-1 :TO-1))
  (:Resupply (:None :None :None :None :None))

(:TF_2-72_MECH
 (:H+0 :H+1.75 :H+4 :H+6 :H+12 :H+14 :H+14.5 :H+15.5 :H+18)
 ((:DTG-Reason (:change-mission :change-location :change-location :change-
                                :change-location :change-location :change-
                                :change-phase :end-operations))
  (:Mission (Attack :Attack :Defend :Defend :Attack :Defend :Attack :Atta
  (:Activity (:Meeting-Engagement :Meeting-Engagement :Pursuit :Pursuit :P
                                  :Position-Fortified :Position-Fortified
  (:Intensity (:Light :Light :Light :Light :Light :Light :Light :Light :He
  (:Role (:Main :Main :Main :Main :Main :Main :Main :Main :Main))
  (:Location (:NC32001400 :NC40501640 :OBJ-PIE :NC40002100 :NC42002200 :OB
                          :NC51003300))
  (:TO (:TO-1 :TO-1 :TO-1 :TO-1 :TO-1 :TO-1 :TO-1 :TO-1 :TO-1))
  (:Resupply (:None :None :None :None :None :None :None :None :None))))

(:TF_2-74_MECH
 (:H+0 :H+1.5 :H+4.15 :H+6 :H+12 :H+14 :H+15 :H+15.5 :H+17 :H+18)
 ((:DTG-Reason (:change-mission :change-location :change-location :change-
                                :change-location :change-location :change-
                                :change-phase :change-location :end-operat
  (:Mission (:Attack :Attack :Defend :Defend :Attacjk :Defend :Attack :Att
  (:Activity (:Meeting-Engagement :Meeting-Engagement :Pursuit :Pursuit
                                  :Position-Fortified :Pursuit :Position-F
                                  :Pursuit :Position-Unfortified))
  (:Intensity (:Light :Light :Light :Light :Light :Light :Light :Light :Li
  (:Role (:Main :Main :Main :Main :Main :Main :Main :Main :Main :Main))
  (:Location (:NC42500900 :WESER :OBJ-PIE :NC44001900 :NC46001950 :OBJ-BAC
                          :PL-SLICE :NC5940-3440))
  (:TO (:TO-1 :TO-1 :TO-1 :TO-1 :TO-1 :TO-1 :TO-1 :TO-1 :TO-1 :TO-1))
  (:Resupply (:None :None :None :None :None :None :None :None :None :None
```

Figure A-14. Portion of the Current Operations Execution Matrix (COEM) taken from Unit Status Projection Tool Software Code.

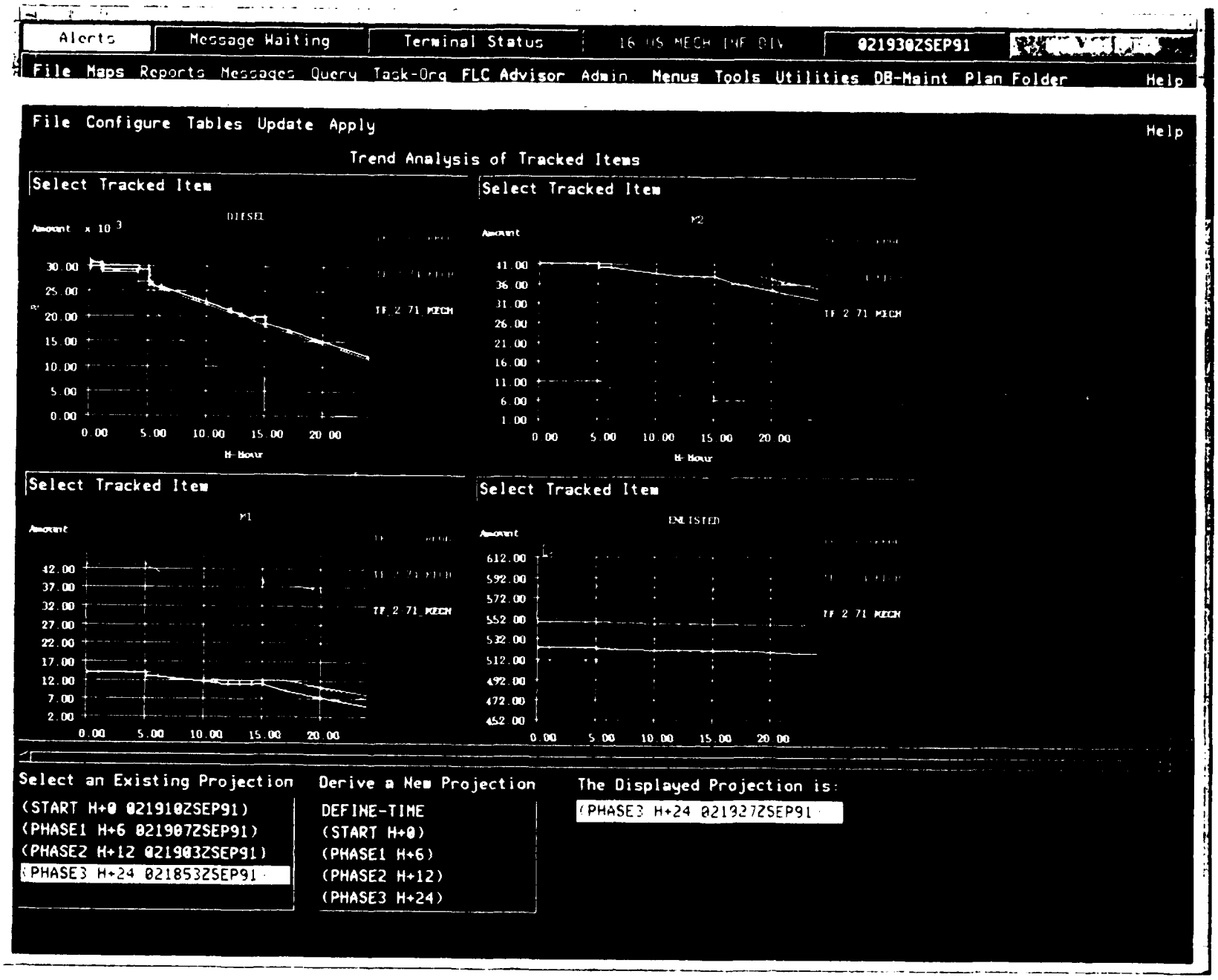

Figure A-15. Trend Analysis and Projection Graph.

APPENDIX B

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

APPENDIX B

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

AA	Avenue of Approach
AACT	Avenue of Approach Comparison Tool
ALBM	AirLand Battle Management
AMC	Army Materiel Command
ARI	Army Research Institute
ATCCS	Army Tactical Command and Control System
ATD	Advanced Technology Demonstration
BA	Battlefield Area
BCBL	Battle Command Battle Laboratory
C&C	Cover and Concealment
CECOM	Communications and Electronics Command
COA	Course of Action
COEM	Current Operations Execution Matrix
DMA	Defense Mapping Agency
EM	Execution Monitor
ESC	Enemy and Situation Capabilities
ETL	Engineering Topographic Laboratory
FITE	Force Interactive Tactical Evaluator
FLC	Force Level Control
FM	Field Manual
FSC	Friendly and Situation Capabilities
ITD	Interim Terrain Data
LAT	Location Analysis Tools
LOS	Line of Sight
MAUA	Multi-Attribute Utility Analysis
MCOO	Modified Combined Obstacle Overlay
MET4	Mission, Enemy, Terrain, Troops and Time Available Tools
OCOKA	Observation and Fire, Cover and Concealment, Obstacles, Key Terrain, Adequacy of Maneuver Space
OPORD	Operations Order
PEO-CCS	Program Executive Office for Command and Control Systems
SD	Standard Deviation
SME	Subject Matter Expert
TDA	Tactical Decision Aid
TRADOC	Training and Doctrine Command
USP/TA	Unit Status Projection and Trend Analysis