TATR: A Prototype Expert System for Tactical Air Targeting

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PREFACE

With the support of the Information Processing Techniques Office of the Defense Advanced Research Projects Agency, Rand has studied the issue of adapting new technology in the field of artificial intelligence to the problem of Air Force tactical planning. The study focused on the possibility of using the tools and techniques of knowledge engineering to construct an intelligent assistant "expert system" for tactical air targeting. This report describes a prototype version of such an expert system: the tactical air target recommender (TATR), developed by Rand with input from professional Air Force targeting personnel. Although only a step in an evolutionary development, this version of TATR should be of interest to tactical planners and practitioners and to researchers developing either expert systems or aids for tactical planning.

Earlier versions of TATR were reported in two Rand Notes: N-1645-ARPA, *Toward an Expert Aid for Tactical Air Targeting* (Callero et al., 1981), and N-1796-ARPA, *TATR: An Expert Aid for Tactical Air Targeting* (Callero et al., 1982). The present report, the final documentation for the project, draws on these Notes for background and describes the current version of TATR.

SUMMARY

Rand has developed a prototype "expert system" to help tactical air targeteers select and prioritize airfields and target elements on those airfields. The system, the tactical air target recommender (TATR), applies a knowledge-engineering problem-solving approach in which human domain knowledge is essential, and judgment, experience, and intuition play a larger role than mathematical algorithms and stochastic formalisms (although these are also used as appropriate to aid the targeteer). Based on information provided by experienced Air Force tactical air targeteers, TATR performs the following tasks under the interactive direction of a user: preferential ordering of enemy airfields; determination of the targets to attack on those airfields; and identification of weapon systems that are effective against those targets.

TATR is programmed in the ROSIE[1] programming language (Fain et al., 1981), which was specifically designed by Rand to support knowledge-based programming tasks. ROSIE readily accommodates heuristic logic and has an English-like syntax that facilitates nonprogrammer comprehension and verification of the program. Its readability also enables the user to determine program modifications as the knowledge base evolves. Hence, TATR can provide a vehicle for the development and evolution of targeting concepts and approaches.

TATR is an interactive program that performs its functions and produces outputs only at the direction of a user. Its primary functions are to provide a plan for attacking enemy airfields and to project the effects of implementing the plan. The attack plan results from a joint user/program interchange. The program applies predetermined planning heuristics to generate an initial plan, which can then be modified by user guidance or specific instructions. TATR then replans to incorporate the user's directions. By projecting the results of a series of plans over a number of days, TATR can assist the user in deciding on the best plan or sequence of plans to implement.

In addition to the basic planning function, TATR also interactively maintains its databases by processing updates provided by the user and, in response to user requests, provides detailed information on plans, friendly force capability, and enemy force posture and status.

The prototype version of TATR described in this report is one step in an evolutionary process which typifies the development of

[1]ROSIE is the trademark and service mark of The Rand Corporation for its Rule-Oriented System for Implementing Expertise.

knowledge-engineering systems. At each iteration, TATR provided the stimulus for new perceptions and articulations of the targeting task, which then became the basis for the next iteration. If the prototype is developed further, this process will continue in the same way, even after an operational capability is achieved.

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I. INTRODUCTION

During wartime, tactical air planners determine the intended operational use of tactical air resources in a future operational time period (usually the next day) and prepare the necessary orders and instructions for operational units, such as fighter wings, to execute the planned missions. The selection of enemy target elements to be attacked is a core task in the planning process. Target selection depends primarily on human judgment to integrate information about friendly and enemy force posture, capability, operations, and objectives and thereby determine effective, efficient courses of action. Human decisionmaking is inherently unstructured, and its predominance in target selection has inhibited the development of automated tools to support this process.

Because we believe that automated aids specifically designed to reflect the observable human decision process can contribute to better judgments, we have developed a prototype "expert system" to help tactical air targeteers select and prioritize target elements. This program, the tactical air target recommender (TATR),[1] applies a *knowledge-engineering* problem-solving approach in which human domain knowledge is essential, and judgment, experience, and intuition play a larger role than mathematical algorithms and stochastic formalisms.

Based on decisionmaking techniques provided by experienced Air Force tactical air targeteers, TATR performs the following tasks under the interactive direction of a user:

- Preferential ordering of enemy airfields.
- Determination of the target elements to attack on those airfields.
- Identification of the weapon systems that can be most effective against those target elements.

It also updates the status of database elements both through user inputs and through projections of the effects of friendly air operations.

[1]The version of TATR reported here is a step in an iterative process. Previous prototype development efforts that contributed to the development of TATR are reported in Callero et al. (1981, 1982).

TACTICAL AIR PLANNING

Figure 1 shows the tactical air planning process cycle. The cycle contains four major steps: target file generation, targeting, force application, and Air Tasking Order (ATO) preparation. (The current version of TATR addresses only the targeting step.)

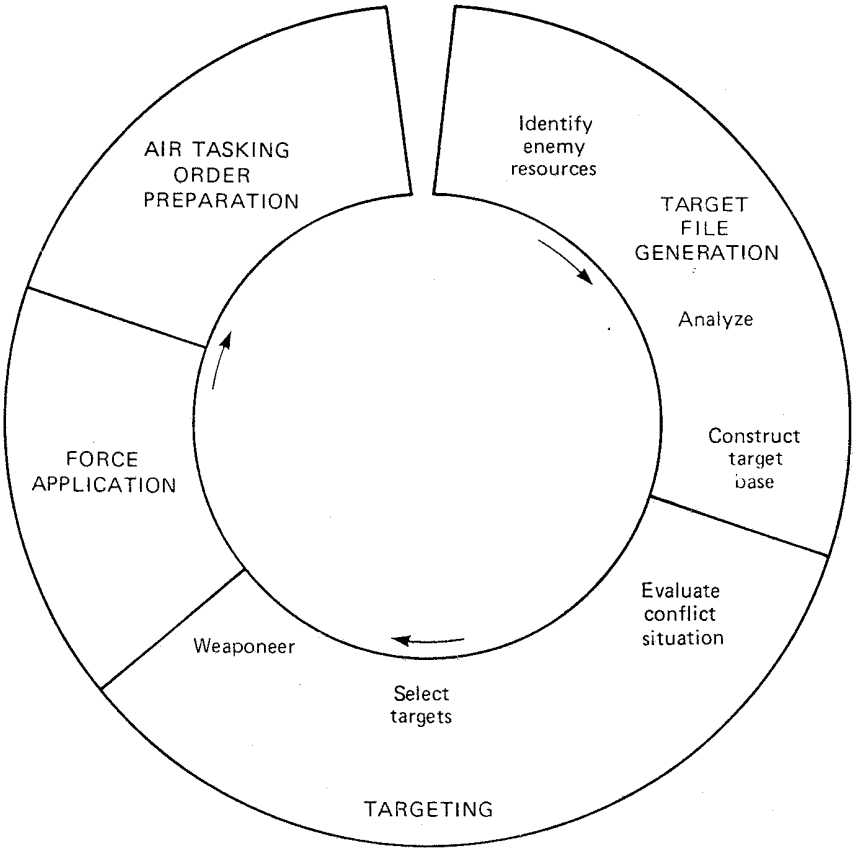

Fig. 1—Tactical air planning cycle

Target File Generation

Intelligence data (information about the enemy) are collected continuously, in peacetime as well as wartime. The process, however, increases in pace and focus after hostilities commence. Raw data are gathered from many sources, through a wide variety of techniques, ranging from strictly human efforts to applications of highly advanced technology. Intelligence analysts reduce the raw data to identify and classify enemy resources and force elements; they then construct a target base composed of large data files on potential target elements. During the course of conflict, the status of the potential target elements can change rapidly as a result of actions against them or of the enemy's own operations; hence, the target base must be modified frequently as new intelligence is reported and analyzed.

This target base provides the main source of information about the enemy for the tactical planning process. For each potential target, the information may include target type, location, organizational linkages, supporting elements, recent movements, and estimates of capabilities. For installations, such as airfields, similar data are provided for force elements (e.g., aircraft), support elements (e.g., maintenance), and facilities (e.g., petroleum storage) located at the installation.

In the USAF Tactical Air Control Center (TACC), where the tactical air planning process takes place, the target base is partially automated by the Data Communication, Storage and Retrieval System (DC/SR). The remainder of the target base resides in hardcopy text, maps, and photographs.

Targeting

The targeting function consists of selecting from the target base specific target elements for attack and identifying weapon systems that can achieve desired damage expectancies. (The latter task is called "weaponeering.") Targeting involves three overlapping and iterative activities: evaluation of target elements in the target base to assess their military value and relevance; selection of a candidate subset of target elements and determination of the effects desired against them; and weaponeering to determine both ability to achieve the desired effects and expected resource costs.

Selection of a subset of target elements from the many candidates in the target base is determined by the significance, accessibility, and vulnerability of target elements; objectives and strategies set forth in apportionment instructions and other guidance documents; rules of engagement; principles of air warfare; and tactics. Effects expected to

be achieved against selected target elements are determined from target analysis information such as vulnerability, perishability, utility value, relationship to other target elements, location and mobility, and target information validation status. Weaponeering calculations array both damage criteria and weapons effects against forces, weapons, fuzing, and delivery tactics. They provide numbers of aircraft required to attain the desired expected damage levels on each target, and they specify the munitions the aircraft should carry. Information on enemy defenses is analyzed as well, and a defense-suppression target list is prepared for each target.

The targeting process results in a prioritized list of target elements for attack during the following day, based on all of the considerations and information accumulated from the above activities. The list is passed to the next step in the planning process, along with weaponeering data and defense-suppression target elements.

Force Application

Force application consists of producing a plan matching friendly air resources and enemy target elements. Inputs to the process include the prioritized target list, the defense-suppression target list, and weaponeering data prepared in the targeting process; threat estimates; availability and capability of friendly forces; weather; and combat objectives, strategies, and tactics. The goal is to generate an assignment of available force to the target set in such a way as to achieve the best possible tradeoff between results and cost (attrition, resource consumption, etc.). For example, forces are generally assigned in strike packages which may include defense-suppression aircraft, fighter escorts, electronic-countermeasure aircraft, and reconnaissance aircraft, in addition to the aircraft actually attacking the target. Overflight coordination with friendly ground fire-support elements may also be required.

The plan specifies the units that are to fly the missions, the types of aircraft, the munitions to be carried, the controlling agencies (e.g., ground radar sites) to be utilized going to and from the target, and the timing of the critical points in the mission, such as rendezvous with tanker and escort aircraft and time over the target.

Air Tasking Order Preparation

The final step in the planning process is to format the agreed-upon plan as an ATO that is promulgated to all appropriate organizations. It directs them to perform the attacks as specified.

RATIONALE FOR AN EXPERT AID

The tactical planning process is characterized by time-constrained application of human judgment to complex problems at every step. Decisions are made by Air Force officers with a variety of experience and backgrounds. At the outbreak of hostilities, they cannot be expected to have broad experience in tactical planning. Because of this, and because of the inherent complexity of tactical planning, there is clearly a need for sophisticated, automated aids to help regularize the process and assist the targeteer in making the best possible selections. Such aids would be particularly important in large-scale, modern conflict, where the most targeting help would be needed and the greatest returns would be expected.

The scattered distribution of expert targeteers in peacetime and the general lack of expertise in dealing with modern forces in large-scale war have important implications for the utility and structure of the targeting aid. From the utility standpoint, the targeting aid would provide a focal point and could serve as the repository for the development and accumulation of (prewar) targeting concepts by the Air Force targeting community. If the distributed knowledge can be centered in a functional tool permitting experimentation, evaluation, and modification, the Air Force might have a good, dependable targeting capability at the outbreak of war. In fact, alternative plans could be developed and made available as a basis for fighting the first day of war. On the other hand, the targeting aid must be adaptable to changing ideas about warfighting that evolve in peacetime as well as during an actual war, since to a large degree it will be necessary to learn to fight the war as it unfolds. Hence, the structure of the targeting aid must permit rapid adaptation within the operational environment.

An aid that can accumulate knowledge, consider heuristics, adapt to the user as well as the situation, and communicate easily with the user would significantly improve the force employment process. Continuing advances in the tools and techniques of artificial intelligence (AI) have brought knowledge engineering to a point where it can serve as the basis for such an aid. A prototype expert system can serve as a vehicle for investigating the current utility of knowledge engineering and may also have the potential to evolve into a useful operational capability.

We have chosen to focus on the targeting step of the tactical planning cycle because it is separable both notionally and in practice. It contains sufficient elements to fully challenge current knowledge-engineering capabilities, and a successful automated aid would fulfill a real need for the targeteer. The focus of targeting interest in this study is on the selection and attacking of enemy airfields.

KNOWLEDGE ENGINEERING

Knowledge engineering requires many iterations of system implementation. The knowledge that human experts possess is often difficult to articulate because it may be incomplete, nondefinitive, or inconsistent. Translating such knowledge into computer programs produces precise and rigorous interpretations which lead to deeper understanding and new perceptions about the problem domain. These, in turn, stimulate changes in the knowledge base that translate into new, precise, and rigorous interpretations in the program. Hence, system development requires an evolutionary approach.

For the tactical targeting aid, two categories of knowledge must be acquired:

1. Knowledge held by humans and used by them to process information about the conflict situation in order to make decisions about the use of tactical air resources.
2. Information about the conflict environment that is known (or at least reported) and is available to the decisionmakers (such information is generally stored in data files or databases).

The unclassified conflict environment developed for our prototype system is based on airfield information developed by the Air Force and used extensively by the Air/Ground Operations School and others. To support the weaponeering function (the relating of expected target damage and specific attacks by various aircraft/munitions combinations) without using classified information and procedures, we developed a representative weaponeering procedure and generated an unclassified weaponeering database which is sufficiently realistic for research purposes.[2]

The human knowledge to be used in a knowledge-engineering system must be acquired directly from persons who are expert (or at least very knowledgeable) in performing the targeting tasks. Targeting-knowledge acquisition must be an ongoing process, even in an operational wartime environment. The knowledge must evolve over time through iterations of trial and evaluation, and the targeting aid must contribute to that process.

We acquired our initial set of targeting knowledge through extensive discussions of targeting techniques with highly qualified Air Force tactical targeteers. After eliciting an initial set of targeting heuristics, we formalized and structured those heuristics and iteratively, with the

[2]In an actual operational environment, automated weaponeering calculations and database updates could be accomplished by interfacing with existing programs on the DC/SR.

targeteers, improved our interpretation and the conciseness and precision of their rules. After sufficient agreement, we implemented the heuristics in the TATR program, which became the primary vehicle for evolving further heuristics. From that point, TATR evolved through hands-on use by selected targeteers.

ROSIE

A key feature of TATR is that it is programmed in the ROSIE (Rule-Oriented System for Implementing Expertise) programming language (Fain et al., 1981). ROSIE was developed at Rand to support knowledge-based programming tasks. It readily accommodates heuristic logic and has an English-like syntax that facilitates comprehension and verification of the program by non-programmers. Its readability also enables the user to determine appropriate program modifications as the knowledge base evolves. Hence, TATR can provide a vehicle for the development and evolution of targeting concepts and approaches.

II. TATR FUNCTIONS AND INTERFACE

OVERVIEW

TATR is an interactive program that performs its functions and produces outputs only at the direction of a user. *Its primary functions are to provide the user with a plan for attacking enemy airfields and to project the effects of implementing the plan.* The plan results from a joint user/program interchange. TATR applies predetermined planning heuristics to generate an initial plan that can then be modified by user guidance or specific instructions. The program then replans to incorporate the user's directions. By projecting the results of a series of plans over a number of days, TATR can aid the user in deciding on the best plan or sequence of plans to implement.

In addition to the basic planning function, TATR also interactively maintains its databases by processing updates from the user, and, in response to user requests, it provides detailed information about plans, friendly force capabilities, and enemy force posture and status.

To facilitate understanding of TATR functions, outputs, and interfaces, and to introduce key definitions and terminology, we will sketch the automatic plan-generation function, briefly discuss database information, and describe how the user can interface with TATR to modify the TATR-generated plan. A more extensive discussion of the program logic, heuristics, and calculations follows in Sec. III. An example of a planning session is given in Appendix C.

Plan-Generation Function

TATR uses a database of information describing the airfields, the target elements on the airfields (e.g., aircraft, runways, maintenance facilities), and the types of friendly forces available for the attack. When a user calls upon TATR to execute the plan-generation function, the program applies a qualitative rating process to each target on each airfield. The first step in the process is to examine each target's vulnerability to attack. Next, target elements having capacity characteristics (e.g., petroleum storage) are assessed according to their ability to support nominal sortie-generation requirements. Based on these assessments, the target's operational status, factors pertaining to the airfield (e.g., sortie activity), and the tactical objectives of friendly

counterair activities, TATR then rates each target as excellent, very good, good, or unrecommended.

Once the target elements are rated, the program "weaponeers"[1] each target rated as excellent, very good, or good, and determines the effects that attacks on those targets would have on the sortie-generation capability of each airfield. TATR displays target ratings and the results of each step in the sortie generation calculation as they are determined.

The program then orders the airfields by the reduction the attacks are expected to produce in the numbers of sorties each airfield can generate in a day and forms a target development list (TDL). The TDL contains the ordered list of airfields with the target elements on each airfield that have been determined best to attack and the types and numbers of aircraft that could be assigned to the attacks. The TDL comprises the product of the plan-generation function and forms the basis for interactive plan development with the user.

The Database

The TATR program requires a database of general information about enemy airfields and specific information regarding the composition of each airfield. The general information includes the types of target elements that might be found on each airfield, the types of enemy aircraft that might be present, the types of friendly aircraft and weapons available to attack the enemy airfields, and parameters of weapon system capability and friendly-aircraft effectiveness. The specific information includes a detailed description of each enemy airfield, usually containing 80 or more assertions. An abbreviated example of the airfield information is shown in Fig. 2.

The initial TATR database is generated in advance and updated dynamically as the program is being executed. This dynamic updating capability is an absolute necessity, since the status of the enemy airfields changes during the battle. Changes result from enemy operations that either diminish or increase resources and from actions against them by friendly forces.

Changes in the enemy's status are recognized and processed in two different ways: First, friendly aircrews and intelligence systems observe and report changes; the information is extracted from the intelligence reports and entered by the user prior to or during

[1]The weaponeering process can either (1) identify weapon systems that are effective against a target and determine the number of those systems necessary to achieve a specified damage expectancy, or (2) calculate damage expectancy against a target, given a specified type and number of weapon systems. Both approaches are used in TATR, but the present discussion assumes use of the former.

```
Let the name of Afld #1 be ......
Assert Afld #1 does have a nuclear capability.
Let the ceiling at Afld #1 be 4500 feet.
Let the visibility at Afld #1 be 5 miles.
Let the primary mission of Afld #1 be OCA.
Let the number of double bay shelters at Afld #1 be 75.
Assert Afld #1 does not have underground facilities for aircraft.
Assert each of floggers and farmers is a type of aircraft
   at Afld #1.
Assert maintenance hard is accessible at Afld #1.
Let the number of maintenance hard areas at Afld #1 be 2.
Let the average_size of maintenance hard areas at Afld #1
   be 5000 ft**2.
Let the percentage_expectation for finding aircraft in
   maintenance hard at Afld #1 be 0.75.
Assert munitions assembly area is accessible at Afld #1.
Let the number of munitions assembly areas at Afld #1 be 1.
Let the munitions_assembly_area at Afld #1 be 9000 ft**2.
Let the operating_efficiency of munitions assembly at Afld #1
   be 0.85.
Assert pol hard is accessible at Afld #1.
Let the number of pol hard areas at Afld #1 be 2.
Let the average_number of pol hard tanks per area at Afld #1 be 50.
Let the average_capacity of pol hard tanks at Afld #1 be 8000 gals.
Assert pol soft is accessible at Afld #1.
Let the number of pol soft storage areas at Afld #1 be 2.
Let the average_number of pol soft tanks per area at Afld #1 be 5.
Let the average_capacity of pol soft tanks at Afld #1 be 5000 gals.
    etc.
    etc.
```

Fig. 2—Illustrative data entries for an enemy airfield

interactive plan development. Second, TATR recognizes that friendly actions were previously planned to have been carried out against an enemy airfield, hence changes are expected to have occurred that have not yet been reported. In this case, the user can enter the actual (if known) number and type of weapon systems and target elements attacked, and the program will calculate the effects and reflect them as status estimates in the database. If no actual information about a previously planned attack is available, the effects of the planned attack are projected and reflected as estimates in the database. Reported information takes precedence over projected effects.

INTERFACE

A user interfaces with TATR primarily through "menu-driven" communications. TATR presents a menu of things the user can choose to do at any given time, and the user selects the thing he desires to do next by identifying it on the menu. Following selection of a menu

item, the user is presented with either (1) the final result of his action, (2) another menu, (3) a question requiring a direct answer, or (4) access to modify the TATR rule sets or database. The top-level menu is shown in Fig. 3. (A complete set of menus and questions is given in Appendix D, along with examples of what results from their selection.)

The *Display* portion of the menu allows the user to look at information he or she might need to develop a final target list. For instance, item [A] gives the user a display of the TDL, an example of which is shown in Fig. 4. The sortie reduction (SR) at each airfield is shown

```
Display:
   [A] Target Development List (TDL)
   [B] Designated Weapon Packages
   [C] Target Recovery Tables
   [D] Target Status Tables
   [E]  (not implemented)
   [F] Additional Target Information

Modify:
   [G] Target Development List
   [H] Weapon Packages
   [I] Attack Projections
   [J] Data & Rulesets

Tasking Commands:
   [K] Attack Targets Specified by TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session
```

Fig. 3—Top-level menu

Current TDL (Target Development List): Day 1 v3 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
	AFLD #1			SC: 640 -> 238		
402	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
	Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	Mun Load Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	POL Hard	EX	1.0 -> 0.26	3 F-111X/2	0.74	0.18
	AFLD #3			SC: 288 -> 270		
18	Munitions Soft	G	1.0 -> 0.26	8 F-111X/1	0.74	0.48
	Mun Load Area	G	1.0 -> 0.28	11 F-16X/2	0.72	0.66
	POL Hard	G	1.0 -> 0.23	5 F-111X/1	0.77	0.3

Fig. 4—Illustrative target development list (TDL)

in the first column, and the sortie capability (SC) before and after the attack is also indicated. The third column shows the target ratings (EX for excellent and G for good). The fourth column indicates the change in status of each target element—in this case, all change from 1.0 (perfect) to 1 minus their damage expectancy (DE) from an attack carried out by the number, type, and munitions load of the weapon packages shown in the fifth column. The last column indicates the expected aircraft attrition.

Item [B], designated weapon packages, displays additional information about the damage expectancy and the weapon packages that could be used against each of the target elements on each base. Items [C] and [D] display the expected rate of reconstitution and the current status of each target attacked, respectively. Item [F], additional target information, gives the user access to the entire target data file.

The modify and tasking items are described below.

[G] *Modify target development list.* Allows the user to add airfields to or delete airfields from the TDL.

[H] *Modify weapon packages.* Allows the user to investigate the effect of using different weapon packages against target elements on the TDL. Any combination of aircraft and munitions load may be investigated. The number of weapon systems may be either specified or program-determined to meet TATR's desired damage expectancy. Once a preferred weapon package has been identified, this item also allows the user to designate it for use on the TDL.

[I] *Modify attack projections.* Allows the user to investigate the effect of changing the target elements to be attacked on an airfield. Once a preferred set of target elements has been identified, this item allows the user to designate it for use on the TDL.

[J] *Modify data & rulesets.* Allows the user to reflect changes to the database resulting from intelligence reports, changes in general planning guidance, and/or changes in weaponeering approaches. This item also allows the user to change TATR's targeting rules or any other ruleset in the program.

[K] *Attack targets specified by TDL.* Causes TATR to calculate the results of implementing a TDL. A copy of the modified database containing resultant target status is saved and tagged for future reference and/or return during a planning session. In this manner, item [K] allows the user to *look ahead* into future time periods to investigate the longer-term effects of an attack or series of attacks.

[L] *Advance to the next time period.* Simulates moving ahead in time to the next day. This item is used in conjunction with [K] for investigating the longer-term effects of attacks.

[M] *Initiate Target Rating & Weaponeering Program.* Initiates the plan-generation function described earlier.

[N] *Move to a previously seen day.* Recalls the database and TDL previously generated using [K]. This item is used in conjunction with [K] and [L] to look ahead.

[O] *Exit from this TATR session.* Terminates the TATR session.

The information that would appear on the user's terminal during an illustrative plan-generation interface is shown in Appendix C.

III. THE TATR PROGRAM

OVERVIEW

The main components of the TATR program are listed in Table 1 and described below.

Table 1

TATR PROGRAM COMPONENTS

Component	Contents
Target database	Airfields; airfield target elements; enemy aircraft capability; weather
Operational status	Target element status; battle damage; target element reconstitution
Rules	Tactical file; policy file; users file
Weaponeering	Probability-of-arrival tables; probability-of-damage tables; computation functions
Displays	Target development list; weapon systems packages; strike results; target operational status

Target Database

The target database currently stored in TATR contains a selected set of enemy airfields extracted from an unclassified exercise database used by the Air Force in the Air/Ground Operations School. In addition to general airfield data, each entry contains detailed information about the important targets located at the airfield, including the current number and type of enemy aircraft and their characteristics (e.g., range, munitions, POL[1] requirements). The following target elements are considered by TATR:[2]

[1]Petroleum, oil, and lubricants.

[2]A target element is considered "hard" if it has been hardened against attack (e.g., a concrete bunker). The designation as "hard" or "soft" appears as part of the name of the element.

- Aircraft
- Access taxiways
- Maintenance soft
- Maintenance hard
- Munitions loading area
- Munitions assembly area
- Munitions storage hard
- Munitions storage soft
- Refueling soft
- Rapid turn area
- POL storage hard
- POL storage soft

Weather forecasts are also included, because TATR can limit the weapon systems it considers to those whose delivery parameters are below the ceiling and visibility forecast for a target. Some illustrative airfield database entries were shown in Fig. 2. Based on user inputs, the program dynamically updates the target database to reflect rapidly changing conditions that would be expected in a combat environment.

Operational Status

The operational status (opstat) component of the program includes the current status of the airfield targets and the target reconstitution at each airfield. *The opstat is displayed as the percentage of the target element that is still operational.* For example, if the target element is undamaged, its status is 1; if it is completely destroyed, its status is 0. Battle damage resulting from each strike may be entered by the user as an input from an intelligence battle damage report. If such an input is not made, the program assumes that all planned strikes occur and achieve the damage estimated. Opstat incorporates provisions for the reconstitution of targets, based on estimates of the expected improvement in a target's capability in each time period after a strike. This increment of improvement is applied to a target's opstat for each time period unless it is overridden by an input of confirmed target status.

Rules

As stated earlier, TATR is programmed in the ROSIE language. The program consists of English-like rules organized in logical, procedural rulesets. The organization and form of the rules facilitate the user's comprehension of the program flow and logic. The main body of rules, the tactical file, performs the primary tasks of developing the

attack plan, interacting with the user, dynamically updating data files, and controlling the sequence of program events. These rules fall into three major categories: target-element capability, target-element rating, and airfield selection.

Target-Element Capability Rules. These rules define various capabilities, such as the rate at which targets are reconstituted (repaired or resupplied), the current activity level at the airfield, and the capacity of various critical resources at the airfield, such as munitions storage, munitions assembly, and maintenance. A portion of the ROSIE ruleset defining the munitions soft capability in TATR is shown in Fig. 5.

Since these rules define the terms used by the program (e.g., munitions soft capacity, daily consumption of POL by an aircraft type), they are fixed and would not normally be modified by the user.

Target-Element Rating Rules. These rules evaluate each target element at an airfield and rate it as either excellent, very good, good, or unrecommended. The rating considers the criticality of the target element relative to maintaining the airfield's primary mission, the vulnerability of the target element to attack, and the current status and effectiveness of the target element. A portion of the ROSIE ruleset for rating aircraft as targets is shown in Fig. 6.

Once all the targets are rated, the program uses those elements rated excellent, very good, or good to project the effect of an attack against them.

Airfield-Selection Rules. These rules provide a basis for choosing a particular airfield to attack from a set of possible candidates. The rules assess the sortie capability of each airfield and the reduction in sortie capability that could be achieved by attacking the recommended targets. The program applies the rules and uses the results to compile

```
To generate a capacity of an area at an airfield:

[1] Select the area:

      <MUNITIONS SOFT>

      Produce (the number of munitions soft areas at the airfield)
            * (the average_size of munitions soft bunkers at that airfield)
            * (the average_number of munitions soft bunkers per area
                  at that airfield)
            * (the status of munitions soft at that airfield)
            / (the average_space_requirement for munitions storage).
```

Fig. 5—Portion of ROSIE ruleset defining munitions soft capability

```
To rate_aircraft at an airfield:

[1] If the airfield does have exposed aircraft,
       choose situation:

    If the number of aircraft in "the open" at the airfield
          is greater than .25 * the total_number (TOTAL)
          of aircraft at that airfield,
       let EXCELLENT be the rating for aircraft at that airfield;

    If that number [of exposed aircraft] is greater than .20 * TOTAL,
       let VERY GOOD be the rating for aircraft at that airfield;

    If that number [of exposed aircraft] is greater than .15 * TOTAL,
       let GOOD be the rating for aircraft at that airfield;

    Default: let UNRECOMMENDED be the rating for aircraft
          at that airfield.

End.
```

Fig. 6—Portion of ROSIE ruleset for rating aircraft

a TDL, which contains each airfield under consideration, ordered by the sortie reduction achievable from attacking the preferred targets. Also included are the weapon packages needed to effect the desired damage on each target element.

The airfield selection rules calculate the sortie reduction that would result from attacking each recommended target element separately and then combine these reductions to determine the effect of attacking groups of elements. A portion of a ROSIE airfield selection ruleset is shown in Fig. 7. This ruleset determines the percentage reduction in aircraft after an attack by F-16X/1 or F-4X/4 aircraft on aircraft, maintenance hard, or the munitions loading area at an airfield.[3]

Although the tactical file can be modified, like any TATR rule or database item, we consider its rules to be firm in the sense that a user would not normally change them for any particular operational run. Needed operational flexibility is provided by two sets of rules and parameters called the policy file and the user file.

Policy and User Files. The policy and user file sets are those rules and parameters that would normally be changed by a user to account for situational variation, command guidance and direction, and individual targeteer approaches. The policy file contains things that targeteers have no independent authority to establish or change and would be procedurally bound not to change. Policies and directions

[3]The use of these rules to determine aircraft reduction is illustrated in Appendix C.

```
To generate percentage_reduction to aircraft
   after an attack on a target at an airfield:

[1] If the current_DE (for the target) at the airfield ~= 0,
    select the target:

    <AIRCRAFT>
          Produce ((that current_DE)
                * (the number of exposed aircraft)
                / (the total_number of aircraft at that airfield));

    <MAINTENANCE HARD>
          Choose situation:

          If the weapon_system for use against maintenance hard
                 at that airfield = F-16X/1,
             produce ((that current_DE)
                    * ((the number of aircraft sent against maintenance hard
                           at that airfield)
                     / 1 [aircraft required to destroy each shelter])
                    * .75 [probability of finding aircraft in a shelter]
                    * 2 [aircraft per shelter]
                    / (the total_number of aircraft at that airfield));

          If that weapon_system = F-4X/4,
             produce ((that current_DE)
                    * ((the number of aircraft sent against maintenance hard
                           at that airfield)
                     / 2 [aircraft required to destroy each shelter])
                    * .75 [probability of finding aircraft in a shelter]
                    * 2 [aircraft per shelter]
                    / (the total_number of aircraft at that airfield));

    <MUNITIONS LOADING AREA>
      If the total_number (TOTAL) of aircraft at the airfield > 20
         and that current_DE > .25,
                produce ((that current_DE)
                * ((the capacity of central MLA [munitions loading area]
                          at that airfield)
                    / (1 - that current_DE))
                / (TOTAL));

End.
```

NOTE: The asterisk(*) and slash(/) are standard programming symbols for "multiplied by" and "divided by." The term "current-DE" refers to the damage expectancy for the target element, based on previous attacks.

Fig. 7—Portion of ROSIE ruleset for determining percentage reduction in aircraft after an attack

from higher authorities (e.g., command, theater, national) fall in this category. They might include rules of engagement, political and geographical limitations, and weapon system employment constraints. The user file contains items that targeteers have complete control over in interacting with TATR to develop an attack plan. These items include attack objectives, desired damage expectancy, and rules, data, and parameters for TDL generation which allow for exploring variations in TDLs under different conditions.

A portion of the policy rules is shown in Fig. 8. These ROSIE rules determine whether or not a given weapon system satisfies current policy for use against a particular target element. For example, they prohibit the use of F-16/X aircraft against airfields more than 400 nautical miles from the battle area and the use of F-4X/4 aircraft to attack specified target elements during poor weather.

Weaponeering

The weaponeering component determines which combinations of aircraft type, munitions load, and delivery tactics are effective against a given target element and calculates how many aircraft are required to achieve a desired damage expectancy against that element. Effective combinations are determined by applying rules such as those shown in Fig. 8 and using a table of preferred weapon systems for each target element type. Note that the choice of attack aircraft and target is influenced by the weather.

During the weaponeering process, the weaponeering component considers the probability of the aircraft arriving at the target and the probability of those that arrive damaging the target with the munitions being carried and the delivery tactic used. These probabilities are provided to the program in tabular form. The computational procedure is far simpler than the damage computation routines normally used by the Air Force. However, it provides sufficient weaponeering capability for our immediate needs. In an operational implementation of TATR, the TATR system would be interfaced with an official Air Force weaponeering program.

The weaponeering subroutine that calculates weapons effects is programmed in the C programming language (Kernighan and Ritchie, 1978). Aircraft types, munitions loads, and delivery tactics are determined by ROSIE rules in the main body of the TATR program. All data reflecting aircraft capability are constructive and unclassified.

```
To decide a weapon_system does satisfy policy_rule
   for use against a target at an airfield:

[1] Select the type of attack aircraft used by the weapon_system:

    <F-111X>
       If the distance from home base to the airfield > 1000 miles,
          conclude false [weapon system does not satisfy policy];

    <F-4X, F-16X>
       If the distance from home base to the airfield > 400 miles,
          conclude false [weapon system does not satisfy policy].

[2] If the ceiling at the airfield is less than 3500 feet or
       the visibility at that airfield is less than 3 miles,
       let the weather be poor,
    otherwise,
       let the weather be good.

[3] Select the target:

    <AIRCRAFT>
       If the weapon_system = either F-16X/2 or F-4X/3,
          conclude true [weapon system does satisfy policy];

    <MAINTENANCE HARD>
       If (the weather = good and
           the weapon_system = either F-4X/4 or F-16X/1) or
          (the weather = poor and
           the weapon_system = either F-111X/1 or F-4X/1),
          conclude true [weapon system does satisfy policy];

    <MUNITIONS HARD>
       If the weapon_system = F-111X/1 or
          (the weather = good and that weapon_system = F-4X/4),
          conclude true [weapon system does satisfy policy];

    <POL HARD>
       If (the weather = good and
           the weapon_system = either F-4X/4 or F-111X/2) or
          (the weather = poor and the weapon_system = F-111X/1),
          conclude true [weapon system does satisfy policy];

    Default:  Conclude false [weapon system does not satisfy policy].

End.
```

NOTE: The term "weapon system" refers to the attack aircraft plus its delivery aids and the munitions it carries.

Fig. 8—Portion of ROSIE ruleset defining TATR policy

Displays

Since TATR is an interactive program, all outputs are provided to the user on-line at a terminal. On-line displays from video terminals can be saved and printed in hardcopy form. Illustrative displays are shown in Appendixes B, C, and D.

TATR LOGIC FLOW

The TATR program generates an airfield attack plan, following six major steps:

- Rate target elements at each airfield to determine acceptable targets.
- Weaponeer target elements at airfields containing acceptable targets.
- Form strike packages of airfield attack aircraft.
- Determine the sortie reduction achievable by each attack.
- Display an initial TDL containing recommended airfields, target elements to attack, and weapon packages needed for the attack; order the airfields according to the sortie reduction achievable by the attacks.
- Interact with the user to develop a final TDL.

Each of these steps is discussed below.

Rate Target Elements

The first step in the plan-generation process is to determine the acceptability of the target elements at each airfield. The TATR program automatically evaluates every target element at every airfield, assigning each a rating of excellent (EX), very good (VG), good (G) or unrecommended (U). Generally, to be rated EX, VG, or G, target elements must be considered both critical to the operation of the airfield and vulnerable to attack. The rating rules also take into account other factors, including:

- The objective of the attack (sortie reduction, sortie suppression, or capability neutralization).
- The capability of the target element to support the maximum sortie rate (e.g., munitions, POL, and maintenance would be rated as having either an extensive, adequate, or limited capability).

- Recovery time (the time required for the target element to recover from an attack).
- The current status of the target element (the percentage of the element that is still operational).
- The number and quantity of the target elements.
- The activity level at the airfield (high or low).

These ratings provide an indication of how acceptable each target element is as a target and a preliminary estimate of the relative payoff from a successful attack.

Weaponeer Target Elements

The second step in the plan-generation process is to determine the best combination of aircraft, munitions load, and delivery tactic for attacking the recommended target elements on each of the TDL airfields. A target element is recommended if it is evaluated as EX, VG, or G by the rating rules.

The user has three strike objectives from which to choose: sortie reduction, sortie suppression, and capability neutralization. The objectives are defined in Table 2. The emphasis in the current TATR implementation has been on refining and extending the rules for sortie reduction; thus the rating rules addressing this objective are the most sophisticated.

Table 2

DEFINITION OF TATR OBJECTIVES

Objective	Definition
Sortie reduction	Reduce overall airfield sortie rate for a period of days
Sortie suppression	Reduce overall airfield sortie rate for a period of hours
Capability neutralization	Destroy the airfield's ability to perform a special function

For each recommended target element, the program identifies feasible combinations of aircraft, munitions load, and delivery tactic by using data that represent weapons effects calculations from operational tests. The feasible combinations are then screened by rules (such as those shown in Fig. 8) that reflect policy, user, or operational (e.g.,

range) constraints. Combinations that survive the screening are submitted to a weaponeering component. At present, the best combination is considered to be the one that requires the least attrition to achieve the desired damage expectancy.

Table 3 shows the inputs and the outputs of the weaponeering component. This component determines how many of each type of aircraft are needed to attack each target element at each airfield on the TDL. The aircraft type and number, called the attack force, forms the strike package. At present, the best strike package is considered to be the one that requires the least attrition to achieve the desired damage expectancy. Of course, the targeteer has the option of changing the recommended strike package or selecting another one to take into account the difference in cost and availability of the different types of aircraft in the strike packages.

In the current implementation of TATR, defense suppression and air-defense escort aircraft are not included in the strike package. These factors would have to be incorporated before the program could be used in an operational tactical air planning environment.

The user may set the desired damage expectancy (the default is 0.70). The actual damage expectancy usually will exceed the desired damage expectancy because the weaponeering component always satisfies the desired DE and applies only integer numbers of aircraft.

Table 3

WEAPONEERING COMPONENT OF TATR

Source of Information	Input to Weaponeering Subroutine	Output from Weaponeering Subroutine
TDL	Airfield	Airfield
TATR rules	Target element	Target element
TATR rules	Aircraft/munitions/ tactic	Aircraft/munitions/ tactic
User	Strike objective	Quantity of aircraft
User	Desired damage expectancy	Expected attrition
Opstat	Previous strike results	Desired damage expectancy; actual damage expectancy

Calculate Sortie Reduction

TATR assists the targeteer in deciding which airfield to attack by rating each airfield in terms of the sortie reduction an attack would cause. After TATR forms the strike package, it determines the sortie reduction achievable by attacking each recommended target element at each airfield. Sortie reduction is obtained by subtracting an airfield's postattack sortie capability from its preattack capability. The sortie capability of each airfield is determined for the time period of interest (some number of days). For example, the sortie capability over a two-day period would be the sum of the capabilities for each of the two days, taking into account target reconstitution and resupply. The program assumes that each target element is reconstituted and resupplied on a daily basis, the rate depending on the target element type.

TATR determines an airfield's sortie capability by examining the current description (quantity, area, operational status, etc.) of certain key target elements at the airfield and calculating the maximum number of sorties each element can support. *The smallest of these maximum numbers is the limiting factor and thus the maximum sortie capability of the airfield.*[4] For example, suppose there are only enough aircraft to support a sortie rate of 110, enough munitions to support a sortie rate of 120, enough POL to support a sortie rate of 100, and enough maintenance capability to support a sortie rate of 150. Also suppose that all other target elements can support a sortie rate of 140 or more. TATR would decide that the airfield's sortie capability is 100, since this is the best the airfield can do with its limited POL supply.

The key target elements used to estimate airfield sortie capability are shown in Table 4, which also lists some (but not all) of the factors used in calculating the sortie capability each target element can support. Complete documentation of the factors considered is provided in the database displays of Appendix B.

TATR assumes that maintenance takes place in shelters and hangars; thus an attack on maintenance will destroy a certain percentage of the aircraft at the airfield. It will therefore reduce sorties both by reducing aircraft and by reducing the airfield's maintenance capability. Similarly, TATR assumes that an attack on the munitions loading area will destroy some aircraft. The program estimates the loss of aircraft when maintenance or munitions loading is attacked and incorporates it into the sortie reduction caused by the attack (see Fig. 7).

---

[4]Note that the targeteer can choose not to attack any of the "less effective" target elements on the airfield, and the sortie reduction (as estimated by the program) will remain the same, unless aircraft would be destroyed by an attack on any of these other elements (see Appendix C).

Table 4

TARGET ELEMENTS USED TO ESTIMATE AIRFIELD SORTIE CAPABILITY AND FACTORS CONSIDERED

Target Element	Factors Considered
Aircraft	Number; type; maximum sortie rate; munitions/mission; POL/mission
Munitions storage (soft, hard)	Status; number of areas; bunkers per area; bunker size; munitions/aircraft type
POL storage (soft, hard)	Status; number of areas; tanks per area; tank capacity; POL/aircraft type
Maintenance (soft, hard)	Status; number of areas; size of areas; space requirements/aircraft
Munitions loading	Status; number of areas; central area loading time for each aircraft type; dispersed area loading time for each aircraft type
Munitions assembly	Status; number of areas; size of areas; space requirement/aircraft; permanent area assembly capacity; dispersed area assembly capacity; operating efficiency of munitions assembly at the airfield

Order and Display TDL

The fifth step in the plan-generation process adjusts the TDL order to reflect the sortie reduction achievable by attacking each airfield and displays the TDL to the user. Airfields for which a high sortie reduction can be attained are listed ahead of those with a lower achievable sortie reduction. A sample TDL is shown in Fig. 9. The TDL is ordered by number of sorties reduced, regardless of the type of aircraft making up those sorties. Thus the targeteer may choose to reorder the TDL, because, for example, 98 sorties from airfield #4 may be more of a threat than 138 sorties from airfield #2.

The TDL includes the airfields, recommended target elements, estimated change in target-element status, weapon package needed to effect that change, damage expectancy, attrition, and overall change in the sortie capability of the airfield. Thus, in Fig. 9, attacking maintenance hard, munitions soft, and POL soft at airfield #4 would change the sortie capability of that airfield from 190 to 92, a reduction of 98; and the preferred weapon package for attacking maintenance hard at airfield #4 is 3 F-16X/1s, which would produce a damage expectancy of 0.77 and attrition of 0.24.

Target Development List: Day 1 Version 1 -- Time Frame = MEDIUM

SR	Targets	Rating	Status	Weapack	DE	Attrition
	AFLD #1			SC: 640 -> 211		
429	Main Hard	VG	1.0 -> 0.27	8 F-16X/1	0.73	0.64
	Mun Assem Area	VG	1.0 -> 0.26	4 F-16X/2	0.74	0.32
	Munitions Hard	VG	1.0 -> 0.25	5 F-111X/1	0.75	0.5
	Mun Load Area	VG	1.0 -> 0.26	4 F-16X/2	0.74	0.32
	POL Hard	VG	1.0 -> 0.28	3 F-111X/2	0.72	0.3
	AFLD #2			SC: 292 -> 154		
138	Main Hard	VG	1.0 -> 0.28	18 F-111X/1	0.72	1.8
	Munitions Hard	VG	1.0 -> 0.25	5 F-111X/1	0.75	0.5
	POL Hard	G	1.0 -> 0.25	5 F-111X/1	0.75	0.5
	AFLD #4			SC: 190 -> 92		
98	Main Hard	VG	1.0 -> 0.23	3 F-16X/1	0.77	0.24
	Munitions Soft	VG	1.0 -> 0.27	8 F-16X/2	0.73	0.64
	POL Soft	G	1.0 -> 0.17	2 F-16X/1	0.83	0.16
	AFLD #3			SC: 288 -> 272		
16	POL Hard	VG	1.0 -> 0.25	5 F-111X/1	0.75	0.5
	Munitions Hard	G	1.0 -> 0.25	5 F-111X/1	0.75	0.5
	Munitions Soft	G	1.0 -> 0.27	8 F-111X/1	0.73	0.8

Fig. 9—Illustrative TDL Produced by TATR

User Interaction

The final step in the plan-generation process permits direct interaction with and involvement by the user. The user can directly modify the plan or investigate the effect of changes to operational conditions and/or parameters assigned to the user file. This interaction will cause TATR to reaccomplish one or more of the previous steps in the plan-generation process. As explained in Sec. II, the user may modify the TDL, the weapon packages, the attack projections, and even the data and rulesets. He decides when to calculate the results of attacking targets on the TDL, when to move ahead (or back) in time to a different day, and when to generate a new TDL. Appendix C contains a detailed trace of a user-TATR interactive planning session, illustrating the many ways the user may interact with the system.

IV. POTENTIAL BENEFITS FROM A FULLY OPERATIONAL TATR

This report has described TATR in its current stage of development. To be made operational, TATR would have to be linked to the operational weaponeering programs and database systems in the combat planning center. It would also need to be further iterated to improve its targeting performance and to more accurately reflect the targeting concepts and procedures in use. The potential benefits of making TATR operational (in addition to providing a direct aid to the targeteer in making real-time decisions) would include the following:

- *A Repository of Targeting Knowledge.* The English-like linguistic structures of the ROSIE programming language allow the heuristic model used in TATR to be readily understandable by targeting professionals. As a result, TATR could evolve into the main document for recording targeting concepts, doctrine, procedures, and skills. It would incorporate the knowledge of all who worked with it and contributed to its evolution.
- *A Learning Tool.* Newly assigned targeteers could use TATR to orient themselves quickly on all the airfield targeting factors in a given theater. Both experienced and new targeteers could use TATR to regularly exercise and enhance their planning acuity.
- *A Research Tool.* An advanced version of TATR could remain dedicated to targeting research to develop greater insight into the targeting problem.
- *A Preplanning Tool in an Operational Context.* In any theater where U.S. air forces may have to be employed, there will be a high premium attached to having attack plans on the shelf and ready to be implemented. TATR will allow air planners to keep such a plan updated and optimized daily.
- *A Force Structuring Tool.* In an era of limited resources, the Air Force may be able to deploy only a limited number of forces to a theater or theaters. Determining the optimum minimum force mix to achieve desired conflict objectives will remain a continuing problem. TATR could help decisionmakers to identify this optimum force mix and to quantify the capability of many possible force combinations.
- *A Tool for Identifying Intelligence Requirements.* TATR has a capability to identify required information for the intelligence

community. The intelligence information gathered today is so voluminous that air planners must continually work toward determining exactly what is required, as opposed to desired, information. By exercising and evolving TATR, the intelligence requirements can be readily recognized, because they must be specified in detail. Also, the effect of having or not having an item of information is immediately apparent from the quality of the TATR output.

Appendix A

PRIMARY AND SECONDARY TATR MENUS

Figure A.1 shows all of TATR's primary menus, which provide for the selection of major alternative actions. Figure A.2 shows TATR's secondary menus, which are used to select the target and target elements of interest after the major alternative is chosen.

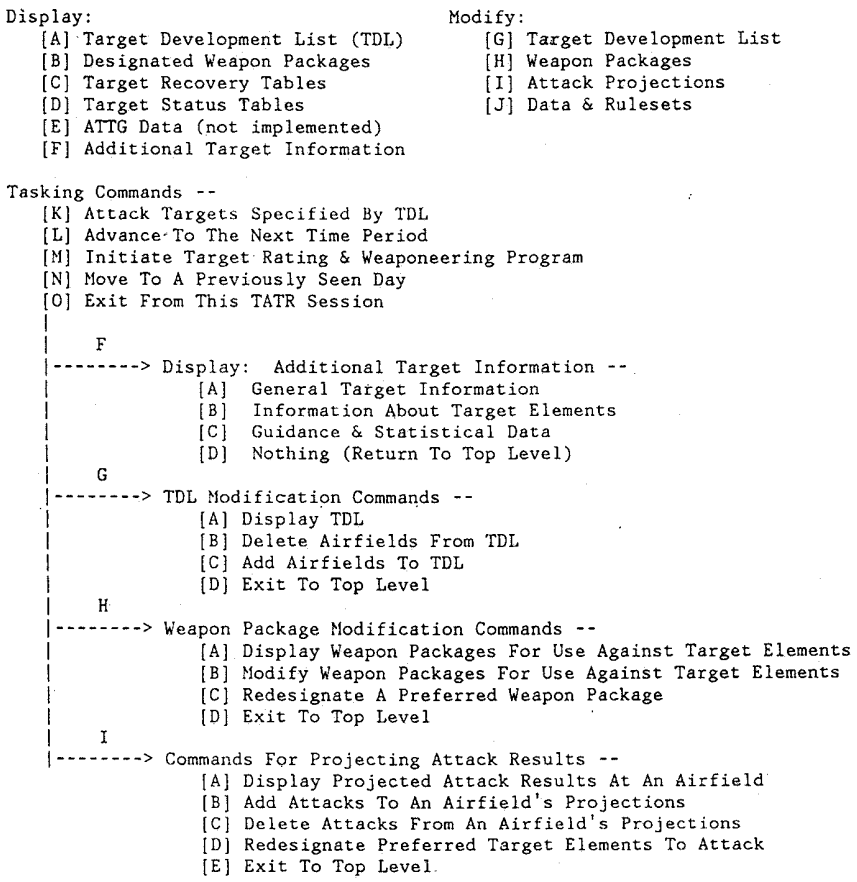

Fig. A.1—Primary menus in TATR

```
Which targets would you like to use?
   [A]  AFLD #1
   [B]  AFLD #2
   [C]  AFLD #3
   [D]  AFLD #4

Which target elements would you like to use?
   [A]  Access Taxiways              [H]  Munitions Soft
   [B]  Aircraft                     [I]  Munitions Loading Area
   [C]  Landing Surfaces             [J]  POL Hard
   [D]  Maintenance Hard             [K]  POL Soft
   [E]  Maintenance Soft             [L]  Rapid Turn Area
   [F]  Munitions Assembly Area      [M]  Refueling Soft
   [G]  Munitions Hard
```

Fig. A.2—Secondary menus in TATR

Appendix B

TATR PROTOTYPE DATABASE

The following tables were generated by the TATR system. They represent the initial TATR database. All items marked with an asterisk (*) vary dynamically as enemy airfields are attacked. These items were calculated by TATR from rules that take this variation into account. In this prototype database, a *vulnerable* target element is one that can be seriously damaged by a reasonable expenditure of current weapon systems. An *accessible* target element is one that can be easily located, identified, and seriously damaged without heavy attrition. The term "percent in undamaged <target element> area" can best be explained by example: If the entry for munitions hard at an airfield is 0.4, this means that 40 percent of the munitions still available for use there are munitions hard (thus, 60 percent must be munitions soft). The "time frame" refers to the length of time the objective (e.g., sortie reduction) should be maintained. "Short" stands for less than 1 day; "medium," for 1 to 3 days: and "long," for more than 3 days.

GENERAL TARGET INFORMATION	AFLD #1	AFLD #2	AFLD #3	AFLD #4
Engaged in Attacks	Yes	Yes	Yes	Yes
Primary Mission	OCA	OCA	OCA	OCA
Activity Level:				
* Short Time Frame	HIGH	HIGH	HIGH	HIGH
* Medium Time Frame	HIGH	HIGH	HIGH	HIGH
* Long Time Frame	HIGH	HIGH	HIGH	HIGH
Capabilities:				
Nuclear	Yes	Yes	Yes	Yes
Chemical	No	No	No	No
Elite Corps	Yes	Yes	Yes	Yes
Neutralize	NUCLEAR	NUCLEAR	NUCLEAR	NUCLEAR
Distance (nm)	200	250	300	250
Combat Radius (nm)	400	300	400	300
Double Bay Shelters	75	35	50	20
Maintenance Area:				
* Main Hard (sq ft)	10000.0	16000.0	15000.0	9000.0
* Main Soft (sq ft)	10000.0	4000.0	18000.0	3000.0
Per Aircraft:				
* Main Area (sq ft)	133.33	285.71	471.43	266.67
* Mun Assembly (sq ft)	60	142.86	171.43	200
Storage Capabilities:				
* POL Area	LIMITED	LIMITED	LIMITED	LIMITED
* Mun Assembly Area	LIMITED	EXTENSIVE	EXTENSIVE	EXTENSIVE
* Munitions Storage	LIMITED	LIMITED	LIMITED	LIMITED
* Maintenance Area	ADEQUATE	ADEQUATE	EXTENSIVE	ADEQUATE
Quantities:				
* POL Hard (gals)	800000.0	480000.0	600000.0	160000.0
* POL Soft (gals)	50000.0	140000.0	400000.0	240000.0
* Mun Hard (ton)	1538.46	1538.46	820.51	205.13
* Mun Soft (ton)	153.85	123.08	1230.77	1641.03
Total Quantities:				
* POL (gals)	850000.0	620000.0	1E+06	400000.0
* Munitions (ton)	1692.31	1661.54	2051.28	1846.15
Consumption:				
* POL (gals/day)	140000.0	112000.0	140000.0	56000.0
* Mun (ton/day)	300.0	240.0	300.0	120.0
Supplies:				
* POL (days)	5.64	6.92	6.84	15.38
* Munitions (days)	6.07	5.54	7.14	7.14
*Maximum Sorties/Day	320	146	144	95

ACCESS TAXIWAYS	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	No	No	No	No
Accessible	Yes	Yes	Yes	Yes
Number	3	6	3	2
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
No. of Cuts to Close	3	6	3	2
Runway Connections	3	6	3	4
Connect at 1 End Only	Yes	No	Yes	No

AIRCRAFT	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	No	No	No
Accessible	Yes	Yes	Yes	Yes
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
No. of FLOGGERS	50	40	50	20
No. of FARMERS	100	30	20	25
*Total	150	70	70	45
Exposed Aircraft	Yes	Yes	Yes	Yes
No. Exposed	6	10	25	5
Sustained Sortie Rate	2	2	2	2
*Observed Sortie Rate	0.67	2.29	2.86	2.22
Waves/12 hrs	5	3	4	3
Aircraft/12 hrs	50	80	100	50
*Avg Size of Waves	10	26.67	25	16.67
*Days to Reconstitute	0	0	0	0

LANDING SURFACES	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	No	No	No	No
Accessible	Yes	Yes	Yes	Yes
Number	3	1	3	2
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
No. of Cuts to Close	3	2	6	2

MAINTENANCE HARD	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	Yes	No	Yes
Accessible	Yes	Yes	Yes	Yes
No. of areas	2	2	5	1
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
Avg Area Size (sq ft)	5000	8000	3000	9000
*Percent in Undamaged				
Maintenance Area	0.99	0.99	0.95	1

MAINTENANCE SOFT	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	Yes	Yes	Yes
Accessible	Yes	Yes	Yes	Yes
No. of Areas	2	2	2	2
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
Avg Area Size (sq ft)	5000	2000	9000	1500
*Percent in Undamaged				
Maintenance Area	0.01	0.01	0.05	0

MUNITIONS ASSEMBLY AREA	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	No	No	No
Accessible	Yes	Yes	Yes	Yes
No. of Areas	1	4	6	3
Current DE				
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
Size of Area (sq ft)	9000	10000	12000	9000

MUNITIONS HARD	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	Yes	Yes	Yes
Accessible	Yes	Yes	Yes	Yes
No. of Areas	2	2	2	2
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
Avg Bunkers / Area	5	5	4	2
Avg Size (cb ft)	3000	3000	2000	1000
*Percent in Undamaged Munitions Quantity	0.91	0.93	0.4	0.11

MUNITIONS SOFT	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	Yes	Yes	Yes
Accessible	Yes	Yes	Yes	Yes
No. of Areas	1	1	2	2
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
Avg Bunkers / Area	3	3	3	4
Avg size (cb ft)	1000	800	4000	4000
*Percent in Undamaged Munitions Quantity	0.09	0.07	0.6	0.89

MUNITIONS LOADING AREA	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	Yes	Yes	No
Accessible	Yes	Yes	Yes	Yes
No. of Areas	1	1	2	4
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0

POL HARD	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	Yes	Yes	No
Accessible	Yes	Yes	Yes	Yes
No. of Areas	2	2	2	4
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
Avg Tanks / Area	50	20	15	20
Avg Size (gals)	8000	12000	20000	2000
*Percent in Undamaged Pol Quantity	0.94	0.77	0.6	0.4

POL SOFT	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	No	No	Yes
Accessible	Yes	Yes	Yes	Yes
No. of Areas	2	2	2	2
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
Avg Tanks / Area	5	10	20	4
Avg Size (gals)	5000	7000	10000	30000
*Percent in Undamaged Pol Quantity	0.06	0.23	0.4	0.6

RAPID TURN AREA	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	Yes	Yes	Yes
Accessible	Yes	Yes	Yes	Yes
No. of Areas	1	1	1	1
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
Contains Mun Soft	Yes	Yes	Yes	Yes

REFUELING SOFT				
	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	Yes	Yes	No
Accessible	Yes	Yes	Yes	Yes
No. of Areas	1	1	2	3
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
Size of Areas	SIZE-A	SIZE-A	SIZE-A	SIZE-A

GUIDANCE & STATISTICAL DATA		
Enemy Airfields:	Time Period:	2 DAYS
AFLD #1	*Time Frame:	MEDIUM
AFLD #2	Objective:	SORTIE REDUCTION
AFLD #3	Desired Effect	
AFLD #4	on Aircraft:	KKILL
	Factor:	ENEMY MAXIMUM COMBAT RADIUS
		ONGOING ENEMY ATTACKS

Aircraft Statistics:		
	FLOGGERS	FARMERS
Relative Value	1.8	1.0
Sortie Rate	2.0	2.2
Pol / Mission (gals)	1400	1200
Mun / Mission (ton)	3	0.5

Appendix C

ILLUSTRATIVE USER-TATR INTERACTIVE PLANNING SESSION

This appendix provides a listing of the information appearing on the user's terminal during an illustrative user-TATR plan-generation interaction. Some editing has been done for brevity—once a lengthy TATR output has been shown, repeated showing provides no new insight into the interaction process.

This illustrative interaction begins after the database has been updated in preparation for a plan-generation session. The updates reflect data from operational reports on the previous days' missions against the airfields, including the actual number of weapons systems that arrived over the targets, as well as adjustments for intelligence reports of observed target status.

TATR's outputs are shown in roman type; the user's inputs are shown in boldface; and the authors' annotations are shown in brackets.

```
      TATR -- Tactical Air Target Recommender

The attack objective is SORTIE REDUCTION.
The time period is 2 DAYS and the time frame is MEDIUM.
The desired effect on aircraft is KKILL.

                    --- TOP LEVEL MONITOR ---

Display:                                Modify:
   [A] Target Development List             [G] Target Development List
   [B] Designated Weapon Packages          [H] Weapon Packages
   [C] Target Recovery Tables              [I] Attack Projections
   [D] Target Status Tables                [J] Data & Rulesets
   [E]   (not implemented)
   [F] Additional Target Information

Tasking Commands --

   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Day
   [M] Generate a TDL
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session
```

```
What would you like to do? m

Recomputing TDL (Target Development List)...

Rating target elements at AFLD #1          ...(please wait)

[There follows a stream of comments designed to show the user what
 steps are being computed and to keep him informed of interim data.
 We omit it here for brevity.]

What would you like to do? a  [Display the TDL]

Current TDL  (Target Development List): Day 1 -- Time Frame = MEDIUM
```

	SR	Elements	Rating	Status	Weapack	DE	Attrit'n
		AFLD #1			SC: 640 -> 238		
	402	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
		Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
		Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
		Mun Load Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
		POL Hard	EX	1.0 -> 0.26	3 F-111X/2	0.74	0.18
		AFLD #3			SC: 288 -> 270		
	18	Munitions Soft	G	1.0 -> 0.26	8 F-111X/1	0.74	0.48
		Mun Load Area	G	1.0 -> 0.28	11 F-16X/2	0.72	0.66
		POL Hard	G	1.0 -> 0.23	5 F-111X/1	0.77	0.3

```
What would you like to do? g  [Modify the TDL]

[In this sequence we show how to add an airfield that the user wants
 to attack but that TATR did not include on the TDL.]

TDL Modification Commands --

   [A] Display TDL
   [B] Delete Airfields From TDL
   [C] Add Airfields To TDL
   [D] Exit To Top Level

What would you like to do? c

Not included in the target development list
```

	SR	Elements	Rating	Status	Weapack	DE	Attrit'n
[A]		AFLD #2			SC: 292 -> 278		
	14	Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
		POL Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
		Mun Load Area	G	1.0 -> 0.25	4 F-16X/2	0.75	0.24

```
[B]     AFLD #4                                                  SC:  190 -> 176
     14   Main Hard          EX    1.0  -> 0.23     3 F-16X/1   0.77     0.18
          Munitions Soft     EX    1.0  -> 0.26     8 F-16X/2   0.74     0.48
          POL Soft            G    1.0  -> 0.15     2 F-16X/1   0.85     0.12

Specified entries will be added to the target development list. . .

Select entries (hit * for all): a

Current TDL  (Target Development List): Day 1 -- Time Frame = MEDIUM

     SR     Elements        Rating     Status          Weapack      DE    Attrit'n
+=============================================================================+
        AFLD #1                                                 SC:  640 -> 238
    402   Main Hard          EX    1.0  -> 0.26     8 F-16X/1   0.74     0.48
          Mun Assem Area     EX    1.0  -> 0.25     4 F-16X/2   0.75     0.24
          Munitions Hard     EX    1.0  -> 0.23     5 F-111X/1  0.77     0.3
          Mun Load Area      EX    1.0  -> 0.25     4 F-16X/2   0.75     0.24
          POL Hard           EX    1.0  -> 0.26     3 F-111X/2  0.74     0.18

        AFLD #3                                                 SC:  288 -> 270
     18   Munitions Soft      G    1.0  -> 0.26     8 F-111X/1  0.74     0.48
          Mun Load Area       G    1.0  -> 0.28    11 F-16X/2   0.72     0.66
          POL Hard            G    1.0  -> 0.23     5 F-111X/1  0.77     0.3

        AFLD #2                                                 SC:  292 -> 278
     14   Munitions Hard     EX    1.0  -> 0.23     5 F-111X/1  0.77     0.3
          POL Hard           EX    1.0  -> 0.23     5 F-111X/1  0.77     0.3
          Mun Load Area       G    1.0  -> 0.25     4 F-16X/2   0.75     0.24

What would you like to do? d  [Exit to Top Level]

Returning To The Top Level Monitor. . .

What would you like to do? i  [Modify Attack Projections]

[In this sequence we show how a user can investigate the effects of
 attacking a target element combination on an airfield other than
 the one TATR included in the TDL]

Commands For Projecting Attack Results --

   [A] Display Projected Attack Results At An Airfield
   [B] Add Attacks To An Airfield's Projections
   [C] Delete Attacks From An Airfield's Projections
   [D] Redesignate Preferred Target Elements To Attack
   [E] Exit To Top Level

What would you like to do? b
```

```
Which airfield would you like to use? b    Afld #2

Attack projections for AFLD #2              Day 1 -- Time Frame = MEDIUM

     SR      Elements       Rating      Status          Weapack      DE    Attrit'n
+=============================================================================+
     14   Munitions Hard     EX     1.0  -> 0.23      5 F-111X/1   0.77     0.3
          POL Hard           EX     1.0  -> 0.23      5 F-111X/1   0.77     0.3
          Mun Load Area       G     1.0  -> 0.25      4 F-16X/2    0.75     0.24
+=============================================================================+

   [A]  Access Taxiways                [H]  Munitions Soft
   [B]  Aircraft                       [I]  Munitions Loading Area
   [C]  Landing Surfaces               [J]  POL Hard
   [D]  Maintenance Hard               [K]  POL Soft
   [E]  Maintenance Soft               [L]  Rapid Turn Area
   [F]  Munitions Assembly Area        [M]  Refueling Soft
   [G]  Munitions Hard

Which target elements would you like to use? i

Simulating an attack on target elements at AFLD #2          . . .

The sortie capability of AFLD #2 before the attack = 292

Results of attack:

    Target Elements                Status

 Munitions Loading Area        1.0  -> 0.25

Calculating reductions in aircraft at AFLD #2:

                                  FLOGGERS     FARMERS

 Munitions Loading Area          40 -> 38     30 -> 28

Calculating the sortie capability of AFLD #2:

Sortie throughput for DAY 1:

 Aircraft Type  Number  Sortie Rate  Sorties    Excess Capacity

   FLOGGERS       38        2.0         76
   FARMERS        28        2.2         61
 ============================================
 Total aircraft sorties:                137

 Munitions Storage (Hard & Soft)        137          1402 TONS
 Munitions Assembly Area                137           687 TONS
```

Munitions Loading Area	144	21 MINUTES
POL Storage (Hard & Soft)	137	439680 GALS

Cumulative sorties through DAY 1 = 137

Reconstituting target elements at AFLD #2. . .(please wait)

[Note that the excess capacity refers to the capacity of the target element to support more than the required sorties. Thus we see above that besides the munitions needed to support 137 sorties, there were an additional 1402 tons of munitions at airfield #2.]

Sortie throughput for DAY 2:

Aircraft Type	Number	Sortie Rate	Sorties	Excess Capacity
FLOGGERS	39	2.0	78	
FARMERS	29	2.2	63	
Total aircraft sorties:			141	
Munitions Storage (Hard & Soft)			141	1967 TONS
Munitions Assembly Area			141	680 TONS
Munitions Loading Area			141	1157 MINUTES
POL Storage (Hard & Soft)			141	563920 GALS

Cumulative sorties through DAY 2 = 278

The projected sortie capability after the attack = 278

The projected sortie capability reduction = 14

Attack projections for AFLD #2 Day 1 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
14	Mun Load Area	G	1.0 -> 0.25	4 F-16X/2	0.75	0.24
14	Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	POL Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	Mun Load Area	G	1.0 -> 0.25	4 F-16X/2	0.75	0.24

[We note here that even though munitions and POL storage were determined to be excellent targets by the TATR planning rules, they did not impact directly on sortie generation capability within the medium time frame. The planning rules consider more than just sortie generation, but the user need not, as exemplified here.]

Would you like to add another entry? **no**

Would you like to try another target? **no**

What would you like to do? ***** [The user calls for the menu again.]

Commands For Projecting Attack Results --

[A] Display Projected Attack Results At An Airfield
[B] Add Attacks To An Airfield's Projections
[C] Delete Attacks From An Airfield's Projections
[D] Redesignate Preferred Target Elements To Attack
[E] Exit To Top Level

What would you like to do? **b**

Which airfield would you like to use? **a** Afld #1

Attack projections for AFLD #1 Day 1 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
402	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
	Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	Mun Load Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	POL Hard	EX	1.0 -> 0.26	3 F-111X/2	0.74	0.18

Which target elements would you like to use? **d i f**
[Maintenance hard, munitions assembly area, and munitions loading area.

Simulating an attack on target elements at AFLD #1 . . .

The sortie capability of AFLD #1 before the attack = 640

The projected sortie capability after the attack = 253

[The same series of information items shown in the similar run above are omitted here for brevity.]

The projected sortie capability reduction = 387

Attack projections for AFLD #1 Day 1 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
402	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
	Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	Mun Load Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	POL Hard	EX	1.0 -> 0.26	3 F-111X/2	0.74	0.18

387	Main Hard	EX	1.0	-> 0.26	8 F-16X/1	0.74	0.48
	Mun Load Area	EX	1.0	-> 0.25	4 F-16X/2	0.75	0.24
	Mun Assem Area	EX	1.0	-> 0.25	4 F-16X/2	0.75	0.24

Would you like to add another entry? **no**

Would you like to try another target? **no**

What would you like to do? **e** [Return to top level]

Returning To The Top Level Monitor. . .

What would you like to do? **h** [Modify weapon packages]

[In this sequence we show how a user can change the preferred weapon system for attacking a target element from the one selected by TATR.]

Weapon Package Modification Commands --

[A] Display Weapon Packages For Use Against Target Elements
[B] Modify Weapon Packages For Use Against Target Elements
[C] Redesignate A Preferred Weapon Package
[D] Exit To Top Level

What would you like to do? **b**

Which airfield would you like to use? **a** Afld #1

Your choice of target element? **i** [Munitions loading area]

Weapon packages for use against Munitions Loading Area at AFLD #1

Weapon Packages	Nos.	DE	Delivery Tactic	Attrit'n
F-16X/2	4	0.75	LOW	0.24
F-4X/3	4	0.74	LOW	0.32

Ceiling: 4500 FEET
Visibility: 5 MILES

[A] F-16X/2 (MK82, CBU)
[B] F-4X/3 (CBU)

Which weapon systems would you like to use? **b**

Do you wish to specify the number of F-4X/3 to use? **no**

Do you wish to specify a desired DE? **no**

Recomputing weapon package for Munitions Loading Area. . .

Weapon packages for use against Munitions Loading Area at AFLD #1

Weapon Packages	Nos.	DE	Delivery Tactic	Attrit'n
F-4X/3	4	0.74	LOW	0.32
F-16X/2	4	0.75	LOW	0.24

Ceiling: 4500 FEET
Visibility: 5 MILES

Would you like to add other weapon packages? **no**

What would you like to do? **d** [Return to top level]

Returning To The Top Level Monitor. . .

What would you like to do? **i** [Modify attacks]

[In this sequence we show how a user can change the target elements to attack from the set on the TDL to another set that has been investigated earlier and is preferred by the user.]

What would you like to do? **d** [Redesignate preferred attack]

Which target would you like to use? **a** Afld #1

Attack projections for AFLD #1 Day 1 -- Time Frame = MEDIUM

	SR	Elements	Rating	Status	Weapack	DE	Attrit'n
	402	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
		Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
		Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
		Mun Load Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
		POL Hard	EX	1.0 -> 0.26	3 F-111X/2	0.74	0.18
[A]	387	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
		Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
		Mun Load Area	EX	1.0 -> 0.26	4 F-4X/3	0.74	0.32
[B]	387	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
		Mun Load Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
		Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24

Select 1 entry: **a**

What would you like to do? **e**

Returning To The OCA Top Level Monitor. . .

What would you like to do? **a**

Current TDL (Target Development List): Day 1 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
	AFLD #1			SC: 640 -> 253		
387	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
	Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	Mun Load Area	EX	1.0 -> 0.26	4 F-4X/3	0.74	0.32
	AFLD #3			SC: 288 -> 270		
18	Munitions Soft	G	1.0 -> 0.26	8 F-111X/1	0.74	0.48
	Mun Load Area	G	1.0 -> 0.28	11 F-16X/2	0.72	0.66
	POL Hard	G	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	AFLD #2			SC: 292 -> 278		
14	Mun Load Area	G	1.0 -> 0.25	4 F-16X/2	0.75	0.24

[At this point the user has investigated other ways to attack AFLD #1 and has opted for a lesser sortie reduction level in favor of a smaller weapons package. Also, the user has opted to show both F-4Xs and F-16Xs as viable candidates for this attack.]

[The following sequence is another example of investigating an alternate attack to conserve friendly weapon systems.]

What would you like to do? **i**

Commands For Projecting Attack Results --

[A] Display Projected Attack Results At An Airfield
[B] Add Attacks To An Airfield's Projections
[C] Delete Attacks From An Airfield's Projections
[D] Redesignate Preferred Target Elements To Attack
[E] Exit To Top Level

What would you like to do? **b**

Which target would you like to use? **c**

Attack projections for AFLD #3 Day 1 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
18	Munitions Soft	G	1.0 -> 0.26	8 F-111X/1	0.74	0.48
	Mun Load Area	G	1.0 -> 0.28	11 F-16X/2	0.72	0.66
	POL Hard	G	1.0 -> 0.23	5 F-111X/1	0.77	0.3

Which target elements would you like to use? **i** [Munitions loading area]

Simulating an attack on target elements at AFLD #3 . . .

Attack projections for AFLD #3 Day 1 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
18	Mun Load Area	G	1.0 -> 0.28	11 F-16X/2	0.72	0.66
18	Munitions Soft	G	1.0 -> 0.26	8 F-111X/1	0.74	0.48
	Mun Load Area	G	1.0 -> 0.28	11 F-16X/2	0.72	0.66
	POL Hard	G	1.0 -> 0.23	5 F-111X/1	0.77	0.3

What would you like to do? **e**

Returning To The OCA Top Level Monitor. . .

What would you like to do? **a**

Current TDL (Target Development List): Day 1 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
	AFLD #1			SC: 640 -> 253		
387	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
	Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	Mun Load Area	EX	1.0 -> 0.26	4 F-4X/3	0.74	0.32
	AFLD #3			SC: 288 -> 270		
18	Mun Load Area	G	1.0 -> 0.28	11 F-16X/2	0.72	0.66
	AFLD #2			SC: 292 -> 278		
14	Mun Load Area	G	1.0 -> 0.25	4 F-16X/2	0.75	0.24

What would you like to do? **k** [Attack targets specified by TDL]

Saving this planning session as version 1 of day 1.

Attacking target elements at AFLD #1

What would you like to do? **d** [Display target status tables]

Which targets would you like to use? **a b c** [Airfields 1, 2 and 3]

Which target elements would you like to use? **all**

Status Table: (percentage of target undamaged)

AFLD #1 AFLD #2 AFLD #3

Access Taxiways	100	100	100
Aircraft	98	95	92
Landing Surfaces	100	100	100
Maintenance Hard	26	100	100
Maintenance Soft	100	100	100
Muns Assembly Area	25	100	100
Munitions Hard	100	100	100
Munitions Soft	100	100	100
Muns Loading Area	26	25	27
POL Hard	100	100	100
POL Soft	100	100	100
Rapid Turn Area	100	100	100
Refueling Soft	100	100	100

What would you like to do? o [Exit from this TATR session]

Appendix D

TATR MENUS

This appendix contains all the high-level TATR menus, together with a typical result that might be obtained by selecting the menu entry indicated by the arrow (==>). This is intended for reference and not as a demonstration of TATR's use. See Appendix A for a description of TATR's top-level or primary menus, and Appendix C for a listing of a TATR demonstration.

```
MENU

Display:                                  Modify:
==>[A] Target Development List (TDL)         [G] Target Development List
   [B] Designated Weapon Packages            [H] Weapon Packages
   [C] Target Recovery Tables                [I] Attack Projections
   [D] Target Status Tables                  [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session


RESULT

Current TDL  (Target Development List): Day 1 v3 -- Time Frame = MEDIUM

     SR     Elements       Rating      Status          Weapack      DE    Attrit'n
+=============================================================================+
        AFLD #1                                    SC:  640 -> 238
    402   Main Hard          EX     1.0  -> 0.26     8 F-16X/1   0.74     0.48
          Mun Assem Area     EX     1.0  -> 0.25     4 F-16X/2   0.75     0.24
          Munitions Hard     EX     1.0  -> 0.23     5 F-111X/1  0.77     0.3
          Mun Load Area      EX     1.0  -> 0.25     4 F-16X/2   0.75     0.24
          POL Hard           EX     1.0  -> 0.26     3 F-111X/2  0.74     0.18

        AFLD #3                                    SC:  288 -> 270
     18   Munitions Soft     G      1.0  -> 0.26     8 F-111X/1  0.74     0.48
          Mun Load Area      G      1.0  -> 0.28    11 F-16X/2   0.72     0.66
          POL Hard           G      1.0  -> 0.23     5 F-111X/1  0.77     0.3
```

```
MENU

Display:                                    Modify:
   [A] Target Development List (TDL)           [G] Target Development List
==>[B] Designated Weapon Packages              [H] Weapon Packages
   [C] Target Recovery Tables                  [I] Attack Projections
   [D] Target Status Tables                    [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session


RESULT

Which targets would you like to use? a d

Which target elements would you like to use? b c d f g i j

Table of preferred weapon packages for use at:

                                        Ceiling      Visibility

                AFLD #1                 --    4500 FEET      5 MILES
                AFLD #4                 --    4500 FEET      4 MILES

                                  Weapon                          Delivery
  Target Elements      Targets    Packages   Nos.     DE          Tactic     Attrit'n
+=============================================================================+

  Aircraft             AFLD #1    F-16X/2      2     0.95          LOW        0.16
                       AFLD #4    F-16X/2      0     0.95          LOW        0.04

  Landing Surfaces     AFLD #1    F-111X/1     6     0.72          LOW        0.36
                       AFLD #4    F-111X/1     4     0.8           LOW        0.24

  Maintenance Hard     AFLD #1    F-16X/1      8     0.74          LOW        0.48
                       AFLD #4    F-16X/1      3     0.77          LOW        0.18

  Muns Assembly Area   AFLD #1    F-16X/2      4     0.75          LOW        0.24
                       AFLD #4    F-16X/2     20     0.72          LOW        1.2

  Munitions Hard       AFLD #1    F-111X/1     5     0.77          LOW        0.3
                       AFLD #4    F-111X/1     5     0.77          LOW        0.3

  Muns Loading Area    AFLD #1    F-16X/2      4     0.75          LOW        0.24
                       AFLD #4    F-16X/2     29     0.71          LOW        1.74

  POL Hard             AFLD #1    F-111X/2     3     0.74          LOW        0.18
                       AFLD #4    F-111X/2     8     0.81          LOW        0.48
```

MENU

```
Display:                                  Modify:
   [A] Target Development List (TDL)         [G] Target Development List
   [B] Designated Weapon Packages            [H] Weapon Packages
==>[C] Target Recovery Tables                [I] Attack Projections
   [D] Target Status Tables                  [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session
```

RESULT

```
Which targets would you like to use? a

Which target elements would you like to use? d f g i j
```

		Days to Recover														
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Main Hard	AFLD #1	100														
Mun Assem Area	AFLD #1	35	65	95	100											
Munitions Hard	AFLD #1	23	33	43	73	100										
Mun Load Area	AFLD #1	75	100													
POL Hard	AFLD #1	36	56	76	96	100										

```
MENU

Display:                                    Modify:
   [A] Target Development List (TDL)           [G] Target Development List
   [B] Designated Weapon Packages              [H] Weapon Packages
   [C] Target Recovery Tables                  [I] Attack Projections
==>[D] Target Status Tables                    [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session


RESULT

Which targets would you like to use? all

Which target elements would you like to use? all

Status Table:  (percentage of target undamaged)
```

	AFLD #1	AFLD #2	AFLD #3	AFLD #4
Access Taxiways	100	100	100	100
Aircraft	100	100	100	100
Landing Surfaces	100	100	100	100
Maintenance Hard	100	100	100	100
Maintenance Soft	100	100	100	100
Muns Assembly Area	35	100	100	100
Munitions Hard	23	100	100	100
Munitions Soft	100	100	36	100
Muns Loading Area	75	100	78	100
POL Hard	36	100	33	100
POL Soft	100	100	100	100
Rapid Turn Area	100	100	100	100
Refueling Soft	100	100	100	100

MENU

Display:
- [A] Target Development List (TDL)
- [B] Designated Weapon Packages
- [C] Target Recovery Tables
- [D] Target Status Tables
- ==>[E] (not implemented)
- [F] Additional Target Information

Modify:
- [G] Target Development List
- [H] Weapon Packages
- [I] Attack Projections
- [J] Data & Rulesets

Tasking Commands --
- [K] Attack Targets Specified By TDL
- [L] Advance To The Next Time Period
- [M] Initiate Target Rating & Weaponeering Program
- [N] Move To A Previously Seen Day
- [O] Exit From This TATR Session

RESULT

ATTG Data not implemented

```
MENU

Display:                                    Modify:
   [A] Target Development List (TDL)           [G] Target Development List
   [B] Designated Weapon Packages              [H] Weapon Packages
   [C] Target Recovery Tables                  [I] Attack Projections
   [D] Target Status Tables                    [J] Data & Rulesets
   [E] (not implemented)
==>[F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session


RESULT


              Display:  Additional Target Information --
                 [A]  General Target Information
                 [B]  Information About Target Elements
                 [C]  Guidance & Statistical Data
                 [D]  Nothing (Return To Top Level)
```

MENU

```
Display:                                  Modify:
   [A] Target Development List (TDL)      ==>[G] Target Development List
   [B] Designated Weapon Packages            [H] Weapon Packages
   [C] Target Recovery Tables                [I] Attack Projections
   [D] Target Status Tables                  [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session
```

RESULT

```
              TDL Modification Commands --

                 [A] Display TDL
                 [B] Delete Airfields From TDL
                 [C] Add Airfields To TDL
                 [D] Exit To Top Level
```

```
MENU

Display:                                    Modify:
   [A] Target Development List (TDL)           [G] Target Development List
   [B] Designated Weapon Packages           ==>[H] Weapon Packages
   [C] Target Recovery Tables                  [I] Attack Projections
   [D] Target Status Tables                    [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session


RESULT

              Weapon Package Modification Commands --
                 [A] Display Weapon Packages For Use Against Target Elements
                 [B] Modify Weapon Packages For Use Against Target Elements
                 [C] Redesignate A Preferred Weapon Package
                 [D] Exit To Top Level
```

MENU

```
Display:                                  Modify:
   [A] Target Development List (TDL)         [G] Target Development List
   [B] Designated Weapon Packages            [H] Weapon Packages
   [C] Target Recovery Tables             ===>[I] Attack Projections
   [D] Target Status Tables                  [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session
```

RESULT

```
Commands For Projecting Attack Results --
   [A] Display Projected Attack Results At An Airfield
   [B] Add Attacks To An Airfield's Projections
   [C] Delete Attacks From An Airfield's Projections
   [D] Redesignate Preferred Target Elements To Attack
   [E] Exit To Top Level
```

```
MENU

Display:                                    Modify:
   [A] Target Development List (TDL)           [G] Target Development List
   [B] Designated Weapon Packages              [H] Weapon Packages
   [C] Target Recovery Tables                  [I] Attack Projections
   [D] Target Status Tables                ==>[J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session


RESULT

        [puts you into ROSIE where you can edit the data and rules]
        [type "done." to return to TATR]
        [Warning: you must know how to edit files in ROSIE]
```

```
MENU
Display:                                  Modify:
   [A] Target Development List (TDL)         [G] Target Development List
   [B] Designated Weapon Packages            [H] Weapon Packages
   [C] Target Recovery Tables                [I] Attack Projections
   [D] Target Status Tables                  [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
==>[K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session


RESULT:

Saving this planning session as version 4 of day 1.

Attacking target elements at AFLD #1

Results of attack:

    Target Elements                Status

 Maintenance Hard              1.0  -> 0.92
 Munitions Assembly Area       1.0  -> 0.25
 Munitions Hard                1.0  -> 0.23
 Munitions Loading Area        1.0  -> 0.25
 POL Hard                      1.0  -> 0.26

Calculating reductions in aircraft at AFLD #1:

                               FLOGGERS     FARMERS
 Maintenance Hard              50 -> 47     100 -> 94
 Munitions Assembly Area
 Munitions Hard
 Munitions Loading Area        47 -> 46     94 -> 92
 POL Hard

Attacking target elements at AFLD #3

Results of attack:

    Target Elements                Status

 Munitions Soft                1.0  -> 0.26
 Munitions Loading Area        1.0  -> 0.28
 POL Hard                      1.0  -> 0.23

Calculating reductions in aircraft at AFLD #3:

                               FLOGGERS     FARMERS
 Munitions Soft
 Munitions Loading Area        50 -> 46     20 -> 18
 POL Hard
```

```
MENU

Display:                                    Modify:
   [A] Target Development List (TDL)           [G] Target Development List
   [B] Designated Weapon Packages              [H] Weapon Packages
   [C] Target Recovery Tables                  [I] Attack Projections
   [D] Target Status Tables                    [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
==>[L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session


RESULT

Advancing the period of the attack to day 2

Reconstituting target elements at AFLD #1          . . .

    Aircraft                    0.92 -> 1.0
    Maintenance Hard            0.92 -> 1.0
    Munitions Assembly Area     0.25 -> 0.35
    Munitions Hard              0.23 -> 0.23
    Munitions Loading Area      0.25 -> 0.75
    POL Hard                    0.26 -> 0.36

Reconstituting target elements at AFLD #3          . . .

    Aircraft                    0.92 -> 1.0
    Munitions Soft              0.26 -> 0.36
    Munitions Loading Area      0.28 -> 0.78
    POL Hard                    0.23 -> 0.33

The attack is now in day 2
```

```
MENU

Display:                                    Modify:
   [A] Target Development List (TDL)           [G] Target Development List
   [B] Designated Weapon Packages              [H] Weapon Packages
   [C] Target Recovery Tables                  [I] Attack Projections
   [D] Target Status Tables                    [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
==>[M] Initiate Target Rating & Weaponeering Program
   [N] Move To A Previously Seen Day
   [O] Exit From This TATR Session

RESULT

Recomputing TDL (Target Development List). . .

Rating target elements at AFLD #1          . . .(please wait)

Recommendations:

    Target Elements            Ratings

 Maintenance Hard              EXCELLENT
 Munitions Assembly Area       VERY GOOD
 Munitions Loading Area        VERY GOOD
 POL Hard                      VERY GOOD


Weaponeering target elements at AFLD #1          . . .(please wait)

Attacking recommended target elements at AFLD #1          . . .

Calculating the sortie capability of AFLD #1:

Sortie throughput for DAY 1:
```

Aircraft Type	Number	Sortie Rate	Sorties	Excess Capacity
FLOGGERS	49	2.0	98	
FARMERS	99	2.2	217	
Total aircraft sorties:			315	
Munitions Storage (Hard & Soft)			315	104 TONS
Munitions Assembly Area			237	
Munitions Loading Area			313	
POL Storage (Hard & Soft)			265	

Cumulative sorties through DAY 1 = 237

Reconstituting target elements at AFLD #1. . .(please wait)

Sortie throughput for DAY 2:

Aircraft Type	Number	Sortie Rate	Sorties	Excess Capacity
FLOGGERS	49	2.0	98	
FARMERS	99	2.2	217	
Total aircraft sorties:			315	
Munitions Storage (Hard & Soft)			315	32 TONS
Munitions Assembly Area			315	190 TONS
Munitions Loading Area			315	674 MINUTES
POL Storage (Hard & Soft)			191	

Cumulative sorties through DAY 2 = 428

The sortie capability of AFLD #1 before the attack = 428

Results of attack:

Target Elements	Status
Maintenance Hard	1.0 -> 0.92
Munitions Assembly Area	0.35 -> 0.08
Munitions Loading Area	0.75 -> 0.20
POL Hard	0.36 -> 0.05

Calculating reductions in aircraft at AFLD #1:

	FLOGGERS	FARMERS
Maintenance Hard	49 -> 46	99 -> 93
Munitions Assembly Area		
Munitions Loading Area		
POL Hard		

Calculating the sortie capability of AFLD #1:

Sortie throughput for DAY 1:

Aircraft Type	Number	Sortie Rate	Sorties	Excess Capacity
FLOGGERS	46	2.0	92	
FARMERS	93	2.2	204	
Total aircraft sorties:			296	
Munitions Storage (Hard & Soft)			296	129 TONS
Munitions Assembly Area			54	
Munitions Loading Area			128	1413 MINUTES
POL Storage (Hard & Soft)			66	

Cumulative sorties through DAY 1 = 54

Reconstituting target elements at AFLD #1. . .(please wait)

Sortie throughput for DAY 2:

Aircraft Type	Number	Sortie Rate	Sorties	Excess Capacity
FLOGGERS	49	2.0	98	
FARMERS	99	2.2	217	
Total aircraft sorties:			315	
Munitions Storage (Hard & Soft)			315	57 TONS
Munitions Assembly Area			294	
Munitions Loading Area			218	24 MINUTES
POL Storage (Hard & Soft)			90	

Cumulative sorties through DAY 2 = 144

The projected sortie capability after the attack = 144

The projected sortie capability reduction = 284

Rating target elements at AFLD #3 . . .(please wait)

Recommendations:

Target Elements	Ratings

Weaponeering target elements at AFLD #3 . . .(please wait)

Attacking recommended target elements at AFLD #3 . . .

```
MENU

Display:                                    Modify:
   [A] Target Development List (TDL)           [G] Target Development List
   [B] Designated Weapon Packages              [H] Weapon Packages
   [C] Target Recovery Tables                  [I] Attack Projections
   [D] Target Status Tables                    [J] Data & Rulesets
   [E] (not implemented)
   [F] Additional Target Information

Tasking Commands --
   [K] Attack Targets Specified By TDL
   [L] Advance To The Next Time Period
   [M] Initiate Target Rating & Weaponeering Program
==>[N] Move To A Previously Seen Day
   [O] Exit From This TATR Session


RESULT


Map Of Previously Seen Days In The Attack

   Day 1 v1 => Day 2 v1 => Day 3 v1 => Day 4 v1
                           Day 3 v2
                           ==========> Day 4 v3
   Day 1 v2 => Day 2 v3
               Day 2 v4
               Day 2 v5

You are currently in day 1.

Do you wish to move to another day? yes

Which day? 3
Which version? 2

You are now in version 2 of day 3.
```

MENU

Display: Additional Target Information --
==>[A] General Target Information
[B] Information About Target Elements
[C] Guidance & Statistical Data
[D] Nothing (Return To Top Level)

RESULT

Which targets would you like to use? all

GENERAL TARGET INFORMATION				
	AFLD #1	AFLD #2	AFLD #3	AFLD #4
Engaged in Attacks	Yes	Yes	Yes	Yes
Primary Mission	OCA	OCA	OCA	OCA
Activity Level:				
* Short Time Frame	HIGH	HIGH	HIGH	HIGH
* Medium Time Frame	HIGH	HIGH	HIGH	HIGH
* Long Time Frame	HIGH	HIGH	HIGH	HIGH
Capabilities:				
Nuclear	Yes	Yes	Yes	Yes
Chemical	No	No	No	No
Elite Corps	Yes	Yes	Yes	Yes
Neutralize	NUCLEAR	NUCLEAR	NUCLEAR	NUCLEAR
Distance (nm)	200	250	300	250
Combat Radius (nm)	400	300	400	300
Double Bay Shelters	75	35	50	20
Maintenance Area:				
* Main Hard (sq ft)	10000.0	16000.0	15000.0	9000.0
* Main Soft (sq ft)	10000.0	4000.0	18000.0	3000.0
Per Aircraft:				
* Main Area (sq ft)	133.33	285.71	471.43	266.67
* Mun Assembly (sq ft)	60	142.86	171.43	200
Storage Capabilities:				
* POL Area	LIMITED	LIMITED	LIMITED	LIMITED
* Mun Assembly Area	LIMITED	EXTENSIVE	EXTENSIVE	EXTENSIVE
* Munitions Storage	LIMITED	LIMITED	LIMITED	LIMITED
* Maintenance Area	ADEQUATE	ADEQUATE	EXTENSIVE	ADEQUATE
Quantities:				
* POL Hard (gals)	800000.0	480000.0	600000.0	160000.0
* POL Soft (gals)	50000.0	140000.0	400000.0	240000.0
* Mun Hard (ton)	1538.46	1538.46	820.51	205.13
* Mun Soft (ton)	153.85	123.08	1230.77	1641.03
Total Quantities:				
* POL (gals)	850000.0	620000.0	1E+06	400000.0
* Munitions (ton)	1692.31	1661.54	2051.28	1846.15
Consumption:				
* POL (gals/day)	140000.0	112000.0	140000.0	56000.0
* Mun (ton/day)	300.0	240.0	300.0	120.0
Supplies:				
* POL (days)	5.64	6.92	6.84	15.38
* Munitions (days)	6.07	5.54	7.14	7.14
*Maximum Sorties/Day	320	146	144	95

* calculated values

```
MENU

Display:  Additional Target Information --
   [A]  General Target Information
==>[B]  Information About Target Elements
   [C]  Guidance & Statistical Data
   [D]  Nothing (Return To Top Level)

RESULT

Which targets would you like to use? all

Which target elements would you like to use? a b
```

ACCESS TAXIWAYS	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	No	No	No	No
Accessable	Yes	Yes	Yes	Yes
Number	3	6	3	2
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
*Days to Reconstitute	0	0	0	0
No. of Cuts to Close	3	6	3	2
Runway Connections	3	6	3	4
Connect at 1 End Only	Yes	No	Yes	No

AIRCRAFT	AFLD #1	AFLD #2	AFLD #3	AFLD #4
*Vulnerable	Yes	No	No	No
Accessible	Yes	Yes	Yes	Yes
Current DE	0	0	0	0
Status	1.0	1.0	1.0	1.0
No. of FLOGGERS	50	40	50	20
No. of FARMERS	100	30	20	25
*Total	150	70	70	45
Exposed Aircraft	Yes	Yes	Yes	Yes
No. Exposed	6	10	25	5
Sustained Sortie Rate	2	2	2	2
*Observed Sortie Rate	0.67	2.29	2.86	2.22
Waves/12 hrs	5	3	4	3
Aircraft/12 hrs	50	80	100	50
*Avg Size of Waves	10	26.67	25	16.67
*Days to Reconstitute	0	0	0	0

MENU

```
Display:  Additional Target Information --
   [A]  General Target Information
   [B]  Information About Target Elements
==>[C]  Guidance & Statistical Data
   [D]  Nothing (Return To Top Level)
```

RESULT

GUIDANCE & STATISTICAL DATA

Enemy Airfields:	Time Period:	2 DAYS
AFLD #1	*Time Frame:	MEDIUM
AFLD #2	Objective:	SORTIE REDUCTION
AFLD #3	Desired Effect	
AFLD #4	on Aircraft:	KKILL
	Factor:	ENEMY MAXIMUM COMBAT RADIUS
		ONGOING ENEMY ATTACKS

Aircraft Statistics:

	FLOGGERS	FARMERS
Relative Value	1.8	1.0
Sortie Rate	2.0	2.2
Pol / Mission (gals)	1400	1200
Mun / Mission (ton)	3	0.5

* calculated values

```
MENU

TDL Modification Commands --

==>[A] Display TDL
   [B] Delete Airfields From TDL
   [C] Add Airfields To TDL
   [D] Exit To Top Level


RESULT

Current TDL  (Target Development List): Day 1 v3 -- Time Frame = MEDIUM

     SR      Elements       Rating      Status          Weapack      DE    Attrit'n
+=============================================================================+
        AFLD #1                                    SC:  640 -> 238
    402   Main Hard          EX     1.0  -> 0.26     8 F-16X/1   0.74     0.48
          Mun Assem Area     EX     1.0  -> 0.25     4 F-16X/2   0.75     0.24
          Munitions Hard     EX     1.0  -> 0.23     5 F-111X/1  0.77     0.3
          Mun Load Area      EX     1.0  -> 0.25     4 F-16X/2   0.75     0.24
          POL Hard           EX     1.0  -> 0.26     3 F-111X/2  0.74     0.18

        AFLD #3                                    SC:  288 -> 270
     18   Munitions Soft     G      1.0  -> 0.26     8 F-111X/1  0.74     0.48
          Mun Load Area      G      1.0  -> 0.28    11 F-16X/2   0.72     0.66
          POL Hard           G      1.0  -> 0.23     5 F-111X/1  0.77     0.3
```

MENU

TDL Modification Commands --

```
   [A] Display TDL
==>[B] Delete Airfields From TDL
   [C] Add Airfields To TDL
   [D] Exit To Top Level
```

RESULT

Current TDL (Target Development List): Day 1 v3 -- Time Frame = MEDIUM

	SR	Elements	Rating	Status	Weapack	DE	Attrit'n
[A]		AFLD #1			SC: 640 -> 238		
	402	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
		Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
		Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
		Mun Load Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
		POL Hard	EX	1.0 -> 0.26	3 F-111X/2	0.74	0.18
[B]		AFLD #3			SC: 288 -> 270		
	18	Munitions Soft	G	1.0 -> 0.26	8 F-111X/1	0.74	0.48
		Mun Load Area	G	1.0 -> 0.28	11 F-16X/2	0.72	0.66
		POL Hard	G	1.0 -> 0.23	5 F-111X/1	0.77	0.3

Specified entries will be deleted from the developing target list. . .

Select entries (hit * for all): b

Current TDL (Target Development List): Day 1 v3 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
	AFLD #1			SC: 640 -> 238		
402	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
	Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	Mun Load Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	POL Hard	EX	1.0 -> 0.26	3 F-111X/2	0.74	0.18

```
MENU

TDL Modification Commands --

   [A] Display TDL
   [B] Delete Airfields From TDL
==>[C] Add Airfields To TDL
   [D] Exit To Top Level


RESULT

Not included in the target development 1

     SR     Elements       Rating      Status          Weapack      DE   Attrit'n
+=============================================================================+
[A]      AFLD #3                                  SC:  288 -> 270
     18    Munitions Soft     G     1.0  -> 0.26     8 F-111X/1  0.74    0.48
           Mun Load Area      G     1.0  -> 0.28    11 F-16X/2   0.72    0.66
           POL Hard           G     1.0  -> 0.23     5 F-111X/1  0.77    0.3

[B]      AFLD #2                                  SC:  292 -> 278
     14    Munitions Hard    EX     1.0  -> 0.23     5 F-111X/1  0.77    0.3
           POL Hard          EX     1.0  -> 0.23     5 F-111X/1  0.77    0.3
           Mun Load Area      G     1.0  -> 0.25     4 F-16X/2   0.75    0.24

[C]      AFLD #4                                  SC:  190 -> 176
     14    Main Hard         EX     1.0  -> 0.23     3 F-16X/1   0.77    0.18
           Munitions Soft    EX     1.0  -> 0.26     8 F-16X/2   0.74    0.48
           POL Soft           G     1.0  -> 0.15     2 F-16X/1   0.85    0.12

Specified entries will be added to the target development list. . .

Select entries (hit * for all): b c

Current TDL  (Target Development List): Day 1 v3 -- Time Frame = MEDIUM

     SR     Elements       Rating      Status          Weapack      DE   Attrit'n
+=============================================================================+
          AFLD #1                                  SC:  640 -> 238
    402    Main Hard         EX     1.0  -> 0.26     8 F-16X/1   0.74    0.48
           Mun Assem Area    EX     1.0  -> 0.25     4 F-16X/2   0.75    0.24
           Munitions Hard    EX     1.0  -> 0.23     5 F-111X/1  0.77    0.3
           Mun Load Area     EX     1.0  -> 0.25     4 F-16X/2   0.75    0.24
           POL Hard          EX     1.0  -> 0.26     3 F-111X/2  0.74    0.18

          AFLD #2                                  SC:  292 -> 278
     14    Munitions Hard    EX     1.0  -> 0.23     5 F-111X/1  0.77    0.3
           POL Hard          EX     1.0  -> 0.23     5 F-111X/1  0.77    0.3
           Mun Load Area      G     1.0  -> 0.25     4 F-16X/2   0.75    0.24

          AFLD #4                                  SC:  190 -> 176
     14    Main Hard         EX     1.0  -> 0.23     3 F-16X/1   0.77    0.18
           Munitions Soft    EX     1.0  -> 0.26     8 F-16X/2   0.74    0.48
           POL Soft           G     1.0  -> 0.15     2 F-16X/1   0.85    0.12
```

MENU

```
Weapon Package Modification Commands --
==>[A] Display Weapon Packages For Use Against Target Elements
   [B] Modify Weapon Packages For Use Against Target Elements
   [C] Redesignate A Preferred Weapon Package
   [D] Exit To Top Level
```

RESULT

```
Which target would you like to use? a

Which target elements would you like to use? b c d
```

Weapon packages for use against Aircraft at AFLD #1

Weapon Packages	Nos.	DE	Delivery Tactic	Attrit'n
F-16X/2	2	0.95	LOW	0.16
F-4X/3	2	0.95	LOW	0.22

Ceiling: 4500 FEET
Visibility: 5 MILES

Weapon packages for use against Landing Surfaces at AFLD #1

Weapon Packages	Nos.	DE	Delivery Tactic	Attrit'n
F-111X/1	6	0.72	LOW	0.36
F-4X/4	5	0.79	HIGH	0.7

Ceiling: 4500 FEET
Visibility: 5 MILES

Weapon packages for use against Maintenance Hard at AFLD #1

Weapon Packages	Nos.	DE	Delivery Tactic	Attrit'n
F-16X/1	8	0.74	LOW	0.48
F-4X/4	5	0.74	HIGH	0.7

Ceiling: 4500 FEET
Visibility: 5 MILES

```
MENU

Weapon Package Modification Commands --
   [A] Display Weapon Packages For Use Against Target Elements
==>[B] Modify Weapon Packages For Use Against Target Elements
   [C] Redesignate A Preferred Weapon Package
   [D] Exit To Top Level


RESULT

Which target would you like to use? a

Which target element would you like to use? c


Weapon packages for use against Landing Surfaces at AFLD #1

     Weapon                        Delivery
     Packages  Nos.    DE          Tactic   Attrit'n     Ceiling:  4500 FEET
+=============================================+          Visibility:  5 MILES
     F-111X/1    6     0.72         LOW       0.36
+=============================================+
     F-4X/4      5     0.79         HIGH      0.7


   [A]  F-4X/4 (LGB)
   [B]  F-111X/1 (MK84)
   [C]  F-4X/1 (MK82, MK84)


Which weapon systems would you like to use? c

Do you wish to specify the number of F-4X/1 to use? yes

How many? 12

Recomputing weapon package for Landing Surfaces. . .

Weapon packages for use against Landing Surfaces at AFLD #1

     Weapon                        Delivery
     Packages  Nos.    DE          Tactic   Attrit'n     Ceiling:  4500 FEET
+=============================================+          Visibility:  5 MILES
     F-4X/1      12    0.94         LOW       0.96
+=============================================+
     F-111X/1    6     0.72         LOW       0.36
     F-4X/4      5     0.79         HIGH      0.7
```

MENU

```
Weapon Package Modification Commands --
   [A] Display Weapon Packages For Use Against Target Elements
   [B] Modify Weapon Packages For Use Against Target Elements
==>[C] Redesignate A Preferred Weapon Package
   [D] Exit To Top Level
```

RESULT

```
Which target would you like to use? a

Which target elements would you like to use? j k

Weapon packages for use against POL Hard at AFLD #1

      Weapon                    Delivery
      Packages  Nos.    DE      Tactic   Attrit'n     Ceiling:  4500 FEET
+=============================================+   Visibility:  5 MILES
      F-111X/1    6     0.86      LOW       0.36
+=============================================+
[A]   F-111X/2    3     0.74      LOW       0.18
[B]   F-4X/4      4     0.87      HIGH      0.56

Specify the preferred weapon package. . .
Select 1 Entry: b

Weapon packages for use against POL Hard at AFLD #1

      Weapon                    Delivery
      Packages  Nos.    DE      Tactic   Attrit'n     Ceiling:  4500 FEET
+=============================================+   Visibility:  5 MILES
      F-4X/4      4     0.87      HIGH      0.56
+=============================================+
      F-111X/1    6     0.86      LOW       0.36
      F-111X/2    3     0.74      LOW       0.18

Weapon packages for use against POL Soft at AFLD #1

      Weapon                    Delivery
      Packages  Nos.    DE      Tactic   Attrit'n     Ceiling:  4500 FEET
+=============================================+   Visibility:  5 MILES
      F-16X/1     2     0.85      LOW       0.12
+=============================================+
[A]   F-4X/2      2     0.83      LOW       0.16

Specify the preferred weapon package. . .
Select 1 Entry: a

Weapon packages for use against POL Soft at AFLD #1

      Weapon                    Delivery
      Packages  Nos.    DE      Tactic   Attrit'n     Ceiling:  4500 FEET
+=============================================+   Visibility:  5 MILES
      F-4X/2      2     0.83      LOW       0.16
+=============================================+
      F-16X/1     2     0.85      LOW       0.12
```

```
MENU

Commands For Projecting Attack Results --
==>[A] Display Projected Attack Results At An Airfield
   [B] Add Attacks To An Airfield's Projections
   [C] Delete Attacks From An Airfield's Projections
   [D] Redesignate Preferred Target Elements To Attack
   [E] Exit To Top Level


RESULT

Which target would you like to use? a

Attack projections for AFLD #1              Day 1 v3 -- Time Frame = MEDIUM
```

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
402	Main Hard	EX	1.0 -> 0.26	8 F-16X/1	0.74	0.48
	Mun Assem Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	Mun Load Area	EX	1.0 -> 0.25	4 F-16X/2	0.75	0.24
	POL Hard	EX	1.0 -> 0.26	3 F-111X/2	0.74	0.18

```
MENU

Commands For Projecting Attack Results --
   [A] Display Projected Attack Results At An Airfield
==>[B] Add Attacks To An Airfield's Projections
   [C] Delete Attacks From An Airfield's Projections
   [D] Redesignate Preferred Target Elements To Attack
   [E] Exit To Top Level


RESULT

Which target would you like to use? b

Attack projections for AFLD #2              Day 1 v3 -- Time Frame = MEDIUM

     SR      Elements       Rating      Status          Weapack      DE    Attrit'n
+=============================================================================+
     14   Munitions Hard     EX     1.0  -> 0.23      5 F-111X/1  0.77     0.3
          POL Hard           EX     1.0  -> 0.23      5 F-111X/1  0.77     0.3
          Mun Load Area       G     1.0  -> 0.25      4 F-16X/2   0.75     0.24
+=============================================================================+


   [A]  Access Taxiways                [H]  Munitions Soft
   [B]  Aircraft                       [I]  Munitions Loading Area
   [C]  Landing Surfaces               [J]  POL Hard
   [D]  Maintenance Hard               [K]  POL Soft
   [E]  Maintenance Soft               [L]  Rapid Turn Area
   [F]  Munitions Assembly Area        [M]  Refueling Soft
   [G]  Munitions Hard

Which target elements would you like to use?   d c h

Simulating an attack on target elements at AFLD #2          . . .

The sortie capability of AFLD #2 before the attack = 292

Results of attack:

    Target Elements              Status

 Maintenance Hard              1.0  -> 0.91
 Landing Surfaces              1.0  -> 1.0    TARGET IS NOT VULNERABLE
 Munitions Soft                1.0  -> 0.23
```

Calculating reductions in aircraft at AFLD #2:

	FLOGGERS	FARMERS
Maintenance Hard	40 -> 37	30 -> 28
Landing Surfaces		
Munitions Soft		

Calculating the sortie capability of AFLD #2:

Sortie throughput for DAY 1:

Aircraft Type	Number	Sortie Rate	Sorties	Excess Capacity
FLOGGERS	37	2.0	74	
FARMERS	28	2.2	61	
Total aircraft sorties:			135	
Munitions Storage (Hard & Soft)			135	1313 TONS
Munitions Assembly Area			135	693 TONS
Munitions Loading Area			135	1425 MINUTES
POL Storage (Hard & Soft)			135	442480 GALS

Cumulative sorties through DAY 1 = 135

Reconstituting target elements at AFLD #2. . .(please wait)

Sortie throughput for DAY 2:

Aircraft Type	Number	Sortie Rate	Sorties	Excess Capacity
FLOGGERS	39	2.0	78	
FARMERS	29	2.2	63	
Total aircraft sorties:			141	
Munitions Storage (Hard & Soft)			141	1837 TONS
Munitions Assembly Area			141	680 TONS
Munitions Loading Area			141	1392 MINUTES
POL Storage (Hard & Soft)			141	566720 GALS

Cumulative sorties through DAY 2 = 276

The projected sortie capability after the attack = 276

The projected sortie capability reduction = 16

Attack projections for AFLD #2 Day 1 v3 -- Time Frame = MEDIUM

SR	Elements	Rating	Status	Weapack	DE	Attrit'n
16	Main Hard		1.0 -> 0.3	17 F-111X/1	0.7	1.02
	Land Surf		1.0 -> 0.1	2 F-111X/1	0.9	0.12
	Munitions Soft		1.0 -> 0.23	3 F-111X/1	0.77	0.18
14	Munitions Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	POL Hard	EX	1.0 -> 0.23	5 F-111X/1	0.77	0.3
	Mun Load Area	G	1.0 -> 0.25	4 F-16X/2	0.75	0.24

```
MENU

Commands For Projecting Attack Results --
   [A] Display Projected Attack Results At An Airfield
   [B] Add Attacks To An Airfield's Projections
==>[C] Delete Attacks From An Airfield's Projections
   [D] Redesignate Preferred Target Elements To Attack
   [E] Exit To Top Level


RESULT

Which target would you like to use? b

Attack projections for AFLD #2              Day 1 v3 -- Time Frame = MEDIUM

     SR     Elements       Rating      Status          Weapack      DE    Attrit'n
+=============================================================================+

[A]  16   Main Hard                  1.0  -> 0.3     17 F-111X/1  0.7      1.02
          Land Surf                  1.0  -> 0.1      2 F-111X/1  0.9      0.12
          Munitions Soft             1.0  -> 0.23     3 F-111X/1  0.77     0.18

[B]  14   Munitions Hard    EX       1.0  -> 0.23     5 F-111X/1  0.77     0.3
          POL Hard          EX       1.0  -> 0.23     5 F-111X/1  0.77     0.3
          Mun Load Area      G       1.0  -> 0.25     4 F-16X/2   0.75     0.24

Specified entries will be deleted from the projections. . .

Select entries (hit * for all): a

Attack projections for AFLD #2              Day 1 v3 -- Time Frame = MEDIUM

     SR     Elements       Rating      Status          Weapack      DE    Attrit'n
+=============================================================================+
     14   Munitions Hard    EX       1.0  -> 0.23     5 F-111X/1  0.77     0.3
          POL Hard          EX       1.0  -> 0.23     5 F-111X/1  0.77     0.3
          Mun Load Area      G       1.0  -> 0.25     4 F-16X/2   0.75     0.24
+=============================================================================+
```

```
MENU

Commands For Projecting Attack Results --
   [A] Display Projected Attack Results At An Airfield
   [B] Add Attacks To An Airfield's Projections
   [C] Delete Attacks From An Airfield's Projections
==>[D] Redesignate Preferred Target Elements To Attack
   [E] Exit To Top Level


RESULT

Which target would you like to use? a

Attack projections for AFLD #1              Day 1 v3 -- Time Frame = MEDIUM

     SR      Elements       Rating      Status          Weapack      DE    Attrit'n
+=============================================================================+
     37    POL Soft                  1.0  -> 0.15     2 F-16X/1    0.85     0.12
           Acft (exposed)            1.0  -> 0.05     2 F-16X/2    0.95     0.16
           Munitions Soft            1.0  -> 0.23     3 F-16X/2    0.77     0.18
+=============================================================================+

[A] 402    Main Hard          EX     1.0  -> 0.26     8 F-16X/1    0.74     0.48
           Mun Assem Area     EX     1.0  -> 0.25     4 F-16X/2    0.75     0.24
           Munitions Hard     EX     1.0  -> 0.23     5 F-111X/1   0.77     0.3
           Mun Load Area      EX     1.0  -> 0.25     4 F-16X/2    0.75     0.24
           POL Hard           EX     1.0  -> 0.26     3 F-111X/2   0.74     0.18

Specified entry will become the preferred target elements to attack. . .

Select 1 entry: a

Attack projections for AFLD #1              Day 1 v3 -- Time Frame = MEDIUM

     SR      Elements       Rating      Status          Weapack      DE    Attrit'n
+=============================================================================+
    402    Main Hard          EX     1.0  -> 0.26     8 F-16X/1    0.74     0.48
           Mun Assem Area     EX     1.0  -> 0.25     4 F-16X/2    0.75     0.24
           Munitions Hard     EX     1.0  -> 0.23     5 F-111X/1   0.77     0.3
           Mun Load Area      EX     1.0  -> 0.25     4 F-16X/2    0.75     0.24
           POL Hard           EX     1.0  -> 0.26     3 F-111X/2   0.74     0.18
+=============================================================================+

     37    POL Soft                  1.0  -> 0.15     2 F-16X/1    0.85     0.12
           Acft (exposed)            1.0  -> 0.05     2 F-16X/2    0.95     0.16
           Munitions Soft            1.0  -> 0.23     3 F-16X/2    0.77     0.18
```

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