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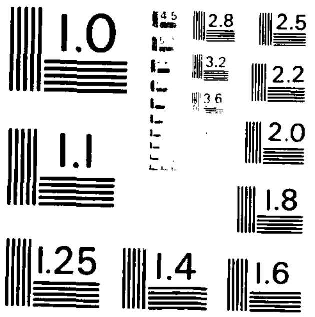

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ENGINEERING REPORT ER-TC-SER 82-6

DEFINITION OF REAL-TIME DISPLAY CAPABILITIES FOR RANGE SAFETY TEST MONITORING

30 April 1982

Prepared for the
Armament Division (AD)

Directorate of Range Safety (SER)

Contract No. F08635-79-C-0140
Study Task Order No. SER 82-6

Prepared by
TYBRIN Corporation
2018-D Lewis Turner Blvd.
Fort Walton Beach, Florida 32548

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

FOREWORD

The work in this report was sponsored by the Directorate of Range Safety(SER) at the Armament Division under Contract No. F08635-79-C-0140 and is a deliverable item under Study Task Order SER 82-6. The work was performed under the technical direction of Mr. Lonnie Owen and was monitored by Mr. R. H. Thompson.

ABSTRACT

The requirements for screen displays that will be necessary for Range Safety real-time visual monitoring of weapon test missions is discussed. Utilization of the control devices, color capabilities, and current real-time program software enhancements for presenting the desired displays is outlined.

1.0 INTRODUCTION

The updating of the Gulf Test Range, as projected by the Southeastern Test and Training Area (SETTA) Range Improvement Committee on Plan for Gulf Range Update (Reference 3), will affect a large number of the display components involved in Range Safety real-time monitoring of weapon tests. Specifically, Range Safety personnel will be required to monitor missions involving up to six drone targets and four shooters (in air-to-air scenarios), and up to ten moving ground targets, as well as simultaneous missions. Range Safety cannot support these missions with the display units, related devices, and the real-time program currently used at the Eglin Centralized Control Facility (CCF).

In January 1982, an investigation into the incorporation of color display units and related graphic input and control devices into the CCF computer configuration was undertaken. (Study Task Order SER 82-2, Reference 1). The investigation revealed that the most cost effective means of adequately providing Range Safety support for the SETTA requirements is to upgrade the existing (CCF) Vector General display system. Recommendations of the report included the installation of color cathode ray tube (CRT) vector display units, special figures (bombs, ships, planes, tanks) installed in a read-only memory (ROM), and the addition of joysticks (for moving the screen display), and data tablets for interactive input of information.

Concurrent with the preparation of Study Task SER 82-2, Study Task SER 82-1 (Reference 2) investigated the software display presentation capabilities of the current Range Safety real-time program, P2457. Recommendations of this study for software enhancements to provide additional graphic presentation capability include the following:

- A single background map, which may be windowed to any portion of the whole, enlarged or reduced (zoomed), moved by user command, and centered on a moving test participant.
- Generation of coordinates needed for drawing debris triangles for multiple test vehicles carrying flight termination systems.
- Generation of maximum energy footprints and ellipses oriented with the flight path.

The implementation of color CRT's,special characters, joysticks, and data tablets will provide the capability for a new dimension in Armament Division real-time weapon test monitoring. While installation of the hardware is a comparatively simple matter, modification of the software to utilize the added capability, and to comply with the recommendations outlined in Task SER 82-1 will require a significant effort. The impact of this effort can be lightened considerably by providing a clear definition of the manner in which the added capabilities and enhancements are to be utilized.

Frequently, persons who monitor missions for range safety purposes are unfamiliar with the mechanics of the operation of the real-time program and, likewise, programmers who maintain the code are unfamiliar with test monitoring display requirements. The unfamiliarity by both parties often leads to misunderstandings, resulting in delays and excessive costs.

The purpose of this report is to delineate the CRT presentations which, by utilizing the hardware and software enhancements recommended by Study Tasks SER 82-1 and SER 82-2, will ensure the effective monitoring of test missions by Range Safety personnel after the planned SETTA Gulf Test Range upgrade.

2.0 RECOMMENDATIONS

The CRT presentations described in this report will require a considerable amount of programming effort. Some of the presentations contain items which may be coded and debugged with existing hardware and the Universal G aphics Language Executive (UGLE) subroutines; others may ot.

Because of the magnitude of the effort at will be required to implement the CRT presentations, i s recommended that, where possible, the appropriate coding be added to the current version of the range safety real-time program, and, if necessary, branched around or commented out. It is further recommended that the modification effort begin as soon as possible.

3.0 DISPLAY REQUIREMENTS

The addition of joysticks and data tablets will provide the capability for considerably more flexibility and efficiency in manipulating screen presentations and data input than is currently possible. Joysticks (omni-directional control handles) are generally used to move the entire data base (e.g., map geodetic coordinates) so that various areas of the whole may be presented on the screen.

The primary function of a data tablet is to provide cursor control for line drawing and "picking" (item selection) capability. The data tablet consists of a digitizer board and a tracing instrument such as a stylus or puck (sometimes called a mouse), which is wired to the board. Depression of a button on the instrument, when the cursor appears at the proper spot on the CRT, completes a circuit; sending a signal to the real-time program, which enters the information in the proper (variable or array) storage location in the computer.

A control feature closely associated with use of the joystick is utilization of function keys to perform steady increase or decrease (zooming) of the field of view (FOV) of the screen presentation. In this report, the term enlargement will refer to an increase in the field of view (a reduction in size of the graphic elements seen on the screen), while reduction will refer to a decrease in the FOV (an increase in size of the graphic elements). In this report, the term "Function keys" may refer to keyboard alphanumeric keys, function buttons, or control dials located on the console.

The display requirements for real-time range safety monitoring of a test mission may be categorized as: a) those presentations necessary for pre-mission setup, and b) those presentations which may occur during the test mission. The following subsections define the display requirements for each category, with the assumption that the recommended hardware and software enhancements have been, or will be incorporated, and that the joysticks and data tablets are used in the manner described previously.

3.1 Pre-Mission Presentations

Program P2457 currently uses an initialization system in which some control variables are input by card decks (or card image disk files), and some are input interactively from the keyboard. A list of the variables, as specified by the P2457 documentation is shown in Figure 3.1, pages 3-37——3-56.

3.1.1 Background Map

The implementation of the hardware and software enhancements outlined in Section 1.0 will remove the necessity for some of the variables, add others, and change the method of input or control of others. The use of the single background map, joystick, zoom function, and the line drawing capability provided by the data tablet, in particular, can significantly revise the pre-mission setup methodology. The revisions will affect not only the programmer and program user, but also the Range Safety Analyst who determines the positions of test-unique map additions such as flight termination lines or maximum energy footprints. The following paragraphs will discuss some of the ramifications caused by implementation of the single background map and the control devices.

[redacted] Currently, program P2457 allows the user to select four background maps from a multiple map file, and to display any one of the four maps on the screen by depressing the appropriate function key defined in the pre-mission setup. Because the scenarios for certain types of missions have remained constant for a period of years, the mission profiles and flight termination lines for those particular missions have been incorporated into some of the current background map files. These files, and the steps necessary to implement the four selected maps, would no longer be needed when the single background map is used; however, a similar concept (many files containing mission-unique flight profiles and termination lines, debris patterns, etc.) would considerably reduce pre-mission initialization effort.

[redacted] The entry of flight termination lines for "first-time" mission scenarios currently requires several time-consuming steps. Typically, in an air-to-air mission, the planned weapon or target vehicle flight path is given to the Safety Analyst on a large (approximately 3 feet per side) map which contains latitude and longitude reference marks, and the Gulf Test Area coastline. The Range Safety analyst adds flight termination lines, based upon the flight pattern and other mission components, and determines the geodetic coordinates of each straight-line endpoint. The coordinates are then punched on cards for input to P2457 (Type 9A) or entered from the keyboard during initilization (parameters SL, CL, EL on Page 13 of Figure 3.1). A similar procedure is used to present hazard figures (boxes, triangles, etc.).

Since some mission test plans provide geodetic coordinate information, the card input and keyboard entry capabilities should be retained, and supplemented by a graphic input device. The use of a large digitizer board* can greatly simplify the procedures currently required for entry of the lines and figures by allowing the Safety Analyst to simply trace the elements on the large map with the stylus or puck. The only requirements for entering data in this manner are: a) that the latitudinal and longitudinal axes of the map be aligned with fiducial marks on the board; and b) that the map limits be established prior to data entry. The limits may be easily determined by the following procedures:

- The user places the stylus (or puck) at a point on the lower right hand corner of the map at which the latitude and longitude are known, and activates the signal switch or button on the stylus (puck).
- The software code records the X,Y raster counts associated with the point.

*Large Digitizer boards (42" by 60") and 11" by 11" data tablets are often sold together as a package.

- The user enters the latitude and longitude values of the point from the keyboard.
- The procedure is repeated for a known point located in the upper left hand corner of the map.
- The software code develops scale factors for converting the raster counts received from the digitizer board to units compatible with units of the background map.
- As the user traces the presentation elements, the software converts the raster counts and stores the information in the appropriate array for screen presentation with the background map.

The data entered in this manner could also be written to an external file, and either retained for future use, or discarded at mission completion.

[redacted] The use of a joystick for control of the background map, as well as presentation elements (e.g., a maximum energy footprint) on the map will require two means of control by the user to distinguish whether he wishes to move the background map so that a different area is viewed, or whether he wishes to move a figure on the area being viewed. The selection may be implemented by using two different function keys to indicate the type of movement desired, and the joystick to position the map or figure.

[redacted] Zooming is generally used in conjunction with movement of the screen presentations to "home-in" on certain elements of the display. Several considerations must be given to the manner in which zooming is used in order to optimize the capability of the function.

- The use of two different function keys - one for enlarge, one for reduce - is essential.
- Enlargement or reduction of a map area or figure should always be done by zooming, rather than by a single step, since the user may easily lose reference marks, and therefore, not comprehend the relationship between the area appearing on the screen, and the entire background map.
- Zooming should have multi-step enlargement/reduction capability for rapid zooming (e.g., a two to one ratio) or for slowly enlarging or reducing a screen presentation to the desired size (e.g., a one and one-tenth to one ratio). The step size should be user-selectable.
- Zooming should emanate from the cursor, with the cursor moving toward the screen center during zooming.
- The zoom function should continue only during the time the enlarge or reduce function key is depressed, so that the user has instantaneous control of zoom termination.

- During zooming, the horizontal and vertical distances (in meters) and the latitudes and longitudes of the map area in view should be displayed. In order to avoid screen clutter, the geodetic coordinates should be presented in single numbers only, as shown in Figure 3.2. At other times during the mission or pre-mission setup, display of the coordinates and distances should be controlled by the user via a function key.

Screen Definition:

Top:	30°24' Lat.
Bottom:	30°00' Lat.
Left Side:	86°30' Long
Right Side:	86°00' Long.

Screen Presentation

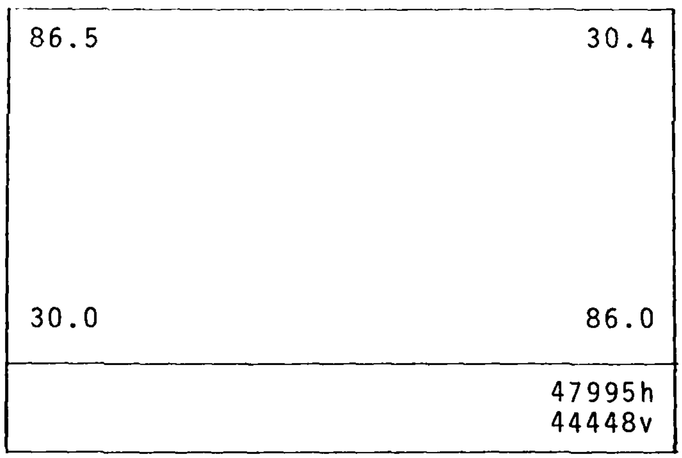


Figure 3.2

■ Rotation of figures on the background maps is currently performed by keyboard entry of the clockwise angle of desired rotation. The rotation feature could be enhanced by the addition of coding which allows the user to rotate the figure clockwise or counterclockwise by turning a control dial in the desired direction. A screen display of the angle of clockwise rotation from true north should be included in the coding.

■ The use of a freely moveable cursor provides the capability for two screen display measurements of the background map which cannot currently be calculated: a) the geodetic and cartesian (referenced to the input origin) positions of the cursor on the screen; b) the X, Y and straight line distances from cursor point A to cursor point B.

Each of the items will require a function key. Presentation of the geodetic and cartesian coordinates of a point would require positioning the cursor on the point and activating a function key. Distance calculations would require an activation of different function key to "zero" the X, Y measurements of point A, and a second activation of the same key at point B.

3.1.2 Automated Data Entry

The entry of radar azimuth, elevation, and range corrections currently requires that the program P2457 user type in up to four numeric values for each radar scheduled for operation on the mission. The keyboard entries will become more time-consuming and subject to error when additional radars, and possibly other calibrated measuring instrumentation become involved in the missions outlined in the SETTA Range Upgrade plan.

Currently, the corrections are obtained by execution of the radar slew/boreshot program (on the IBM 360/65), which receives radar calibration target track data through the Standard Data System network. Differencing of the actual angular and range measurements with the surveyed calibration target measurements, averaging of the normal and plunged modes of track, and calculations of the final corrections are performed by the program.

Radar identification, the order in which the scheduled radars perform their calibration maneuvers, and interactive control of the program are directed by the radar coordinator technician. Immediately prior to termination of the program, the technician initiates a printout of the corrections for all scheduled radars, which he gives to the P2457 user.

The current method of calculating corrections on the IBM/360/65 for entry into a program operating on the CDC 6600 precludes any feasible means of automation of the procedure at present. The installation of an all-VAX 11/780 computer system, however, will easily permit the radar tracking parameter corrections generated by one program to be stored for subsequent use by another program. Since the radar slew/boreshot program will be converted to VAX 11/780 code when the IBM 360/65 is removed, the converted code should contain provisions for writing the radar corrections to a storage area (or file).

3.1.3 Mission Components Definition

The SETTA requirements for up to six drone targets in air-to-air scenarios, and up to ten tank targets in air-to-ground scenarios will entail several considerations not previously addressed in AD real-time Range Safety mission monitoring:

- More than one RDO/RSO team, each monitoring different mission components from different consoles*, will be required.
- Each console will need more than one destruct key.
- Each destruct key must be associated with a displayed icon of a specified color.
- Certain types of mini-missiles will require, in effect, a flight termination ceiling, and therefore, monitoring must be performed from a side view of the scenaric as well as from a top view.
- Low-flying (50 ft. altitude) remotely piloted vehicles (RPV's) may encounter ships or oil rigs during flight, therefore, a side view of the scenario will be necessary.

* A console is assumed to provide two CRT's

- Multiple sets of mach and drag tables will be required for targets and weapons operating in the same mission. Since each mission may use different combinations of weapons and targets, the current method of mach and drag table entry for a single vehicle (only) will need to be revised.

Currently three symbols (* + .) are used to display positions of ships, planes, oil rigs, and airborne targets. The implementation of ROM cards containing icons will permit these mission components, as well as items used in air-to-ground mission scenarios, to be presented on the screen in a more representative manner. The icons should include the following outlines:

ship (top and side views)
oil rig (top and side views)
shooter aircraft (top and side views)
A/A and A/G missiles (one profile only)
Cruise-type missile (top and side views)
mini-missile weapon (single profile only)
glide bomb (top and side views)
tank (top and side views)
truck (top and side views
parachute (top and side views)

The ROM cards will, in all probability, be developed by the display manufacturer. In defining the icon requirements to the manufacturer, particular emphasis should be placed on the necessity for clearly distinguishing between those items which closely resemble one another.

In order to provide visual information of mission components to the RSO, the aerodynamic data, an icon, and the color of the icon must be associated with the vehicle position data received from a particular tracking system. The screen display of the vehicle must also be associated with a destruct key, located on a designated console, to provide flight termination capability.

A suggested method for forming these associations follows:

1. The user first specifies (from the keyboard) the number of mission scenarios he wishes to define.
2. A menu containing specific mission components is presented on the screen (see Figure 3.3).
3. The user selects all of the items that will be involved in the first mission scenario by moving the cursor opposite the selection and activating the signal button (see Figure 3.3.A).
4. The selections will cause the proper mach and drag tables to be loaded in arrays in the real-time program, and will define the icons and screen displays necessary for forming the display element/console number/destruct key association (see Figure 3.4).
5. Because the list of tracking instrumentation anticipated for future missions is voluminous, it will be more feasible for the user to position the cursor at the appropriate location (in Figure 3.4, the asterisk) and to enter the tracker

identification from the keyboard. The remaining elements may be designated by activation of the signal switch on the stylus or puck.

6. The tracker identification should correspond to the identification scheme developed for automated calibration data entry as outlined in Section 3.1.2. Coding in the program should correlate the tracking instrumentation with the vehicle being tracked by association of the cursor position (in raster counts) and the vehicle icon (also in raster counts).

7. In order to avoid the assignment of the same destruct key or shooter number to more than one tracked vehicle, the numeric indicators in the same row for the remaining colors should be (totally) blacked or colored out (see Figure 3.4.A).

8. Where more than one tracked object is specified for any one vehicle type, the order of the objects entered should be associated with the left-to-right color indication as in Figure 3.4.A, column 1, last element row.

9. The color indicative letters, as well as the destruct keys associated with a particular color, should be presented on the screen in the color which is represented (e.g., R, and the numerals 1,2,3,4 underneath it, should be displayed in red. All lines,

icons, and definitive words should be displayed in the same color, but the keyboard entered tracker ID's should be displayed in a different color.

10. By function key option, the selected items from the matrix menu should blink.

11. For those missions in which parachutes are utilized as a destruct or recovery system, the user would specify "parachute" in the mission component selection menu, and enter identical tracker ID's and color selections for the vehicle type and the parachute. During the mission, the displayed vehicle icon would change to the parachute icon when a marked reduction in velocity was discerned, or when a telemetered indication of parachute deployment was received.

12. In air-to-air scenarios, it will be necessary for the RSO to know, during the mission, information about the position of the weapon relative to the target, velocity of the two vehicles, and the closing rate between the two items. Since certain shooters (carrying weapons which will be tracked) are committed to fire at a specified target, the pre-mission setup must form the weapon/target association so that the RSO at a particular console

can monitor the position, velocity and rate data. The presentation in Figure 3.4.A reflects the shooter/weapon/target association.

13. Based upon the recommendation in Study Task SER 82-1 that during the mission, the background map should automatically move to maintain screen centering on a certain vehicle, it will be necessary to designate that vehicle in the pre-mission initialization. The designation can be easily indicated by following the tracker ID with a flag constant, such as -1. (See Figure 3.4.A.

Ships and oil rigs positions are (currently) displayed as * and + symbols. Alteration of the coding will be necessary to implement the ROM-defined ship and oil rig icons. (See Section 3.2).

Sample Menu- Mission Components

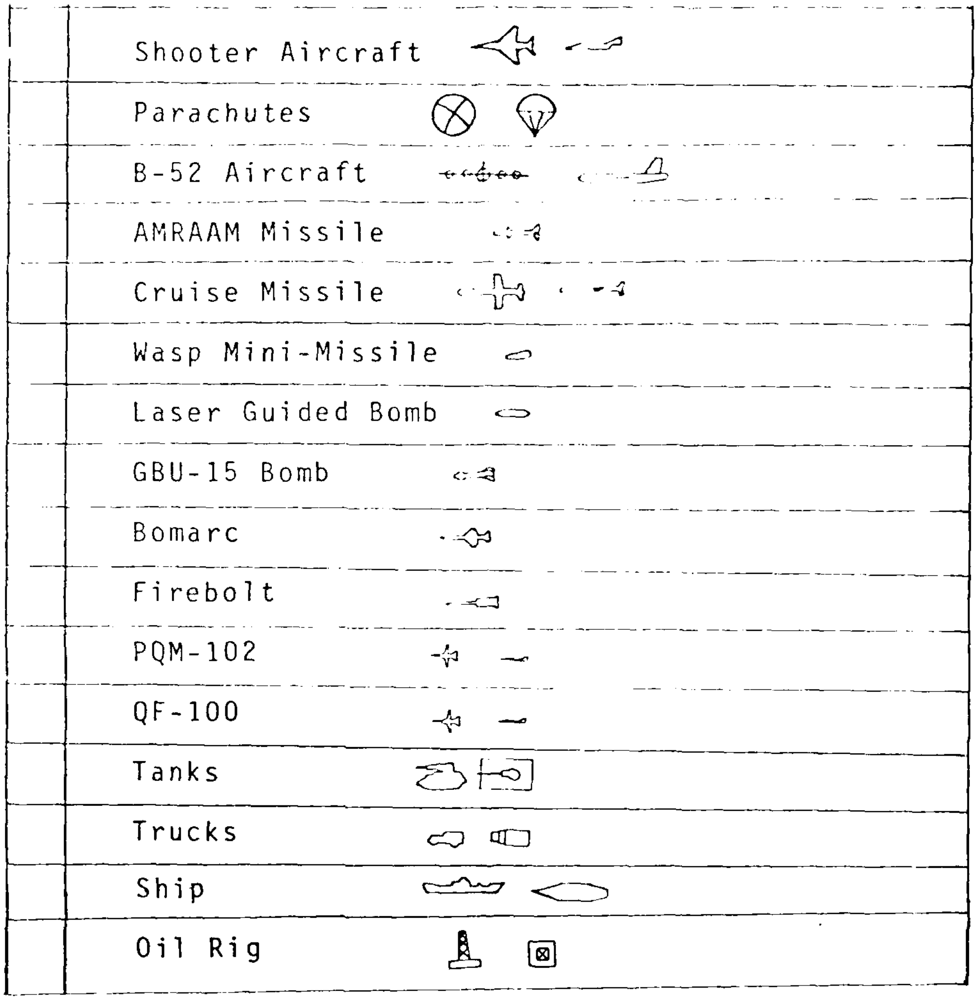


Figure 3.3

Sample Menu- Mission Components

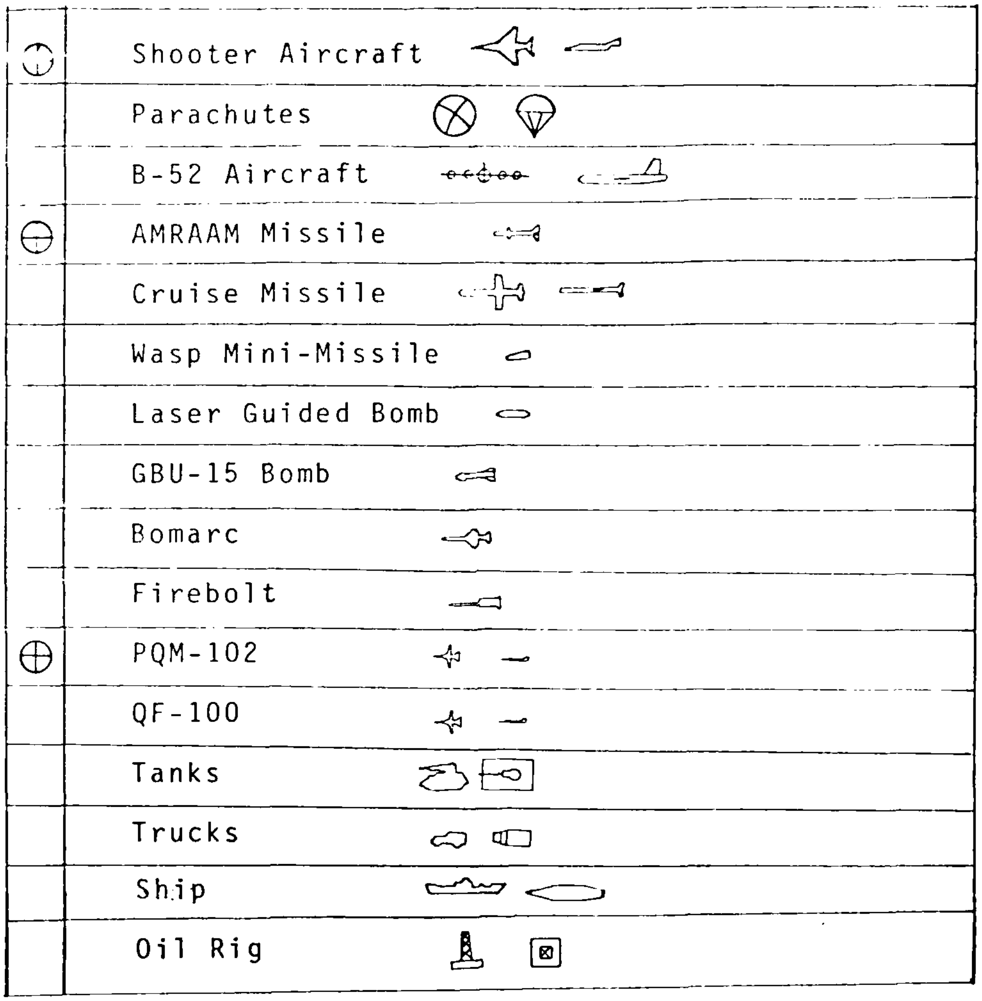


Figure 3.3.A

SAMPLE DISPLAY-AIR-TO-AIR MISSION SCENARIO

Console	1	2	3	4	5	6
Shooter Tracker ID						
Color	R G B Y	R G B Y	R G B Y	R G B Y	R G B Y	R G B Y
Shooter Number	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2
	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3
	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4
PQM-102 Tracker ID						
Color	R G B Y	R G B Y	R G B Y	R G B Y	R G B Y	R G B Y
Destruct Key	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2
	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3
	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4
AMRAAM Tracker ID						
Color	R G B Y	R G B Y	R G B Y	R G B Y	R G B Y	R G B Y
Destruct Key	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2
	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3
	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4

Figure 3.4

Console	1				2				3				4				5				6			
Shooter Tracker ID	25				35				45				55											
Color	R	G	B	Y	R	G	B	Y	R	G	B	Y	R	G	B	Y	R	G	B	Y	R	G	B	Y
Shooter Number			1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3			3		3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4			4		4	4	4	4	4	4	4	4
PQM-102 Tracker ID	110,-1				108,-1				107,-1				109,-1											
Color	R	G	B	Y	R	G	B	Y	R	G	B	Y	R	G	B	Y	R	G	B	Y	R	G	B	Y
Destruct Key	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	1	1	1	1
	2				2	2	2	2	2	2	2	2	2				2	2	2	2	2	2	2	2
	3	3	3	3	3				3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
AMRAAM Tracker ID	27,26				36,37				46,47				56,57											
Color	R	G	B	Y	R	G	B	Y	R	G	B	Y	R	G	B	Y	R	G	B	Y	R	G	B	Y
Destruct Key		1				1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2				2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
				3	3	3	3	3		3				3			3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4				4				4	4	4	4	4	4	4	4	4

Figure 3.4.A

3.2 Real-Time Mission Presentations

Currently, the Range Safety Analyst must choose up to four background maps for use during the entire mission. If he does not choose judiciously, and certain critical mission components exit all the maps chosen, the real-time program must revert to the initialization subroutines for entry of another maps' coordinates; losing valuable time during mission operation.

The use of a single background map will alleviate the problem of delay but will cause the Range Safety Officer to play a more interactive part in maintaining the desired screen presentation. Because the RSO is monitoring voice communications as well as data from the screen, it is imperative that control of the display presentations be as simple as possible and that, wherever possible, the screen presentation be automated.

The following subsections outline the criteria for maintaining simplicity of operation and automation of the screen display.

3.2.1 User Control Options

The control devices utilized for presenting the desired display on the screen are the function keys, the joystick, and the stylus or puck-controlled cursor, which is used in conjunction with the function keys or joystick. Since the joystick is limited to movement of the background map, or of elements on the background map, the burden of screen display control falls on use of the function keys, with or without cursor assistance. (A summary of the function key operations that will be necessary is presented in Section 3.3).

Since the RSO must concentrate his attention on the components of the mission, it is highly important that the use of the function keys require as little conscious thought as possible. There are several steps that can be taken to achieve this goal:

- An overlay (or other means of labeling) of the keys should be made. If it becomes necessary to utilize certain keys for a particular presentation in one scenario, and the same keys for different presentations in another type of scenario, an overlay for each should be provided.
- Intensive training and practice in the use of the function keys should be performed on a regular basis. The training procedure should consist of pre-mission set-up, as well as the use of simulated or replayed data.
- Screen displays which are controlled by the keys should be logically coordinated with the position of the keys on the board. For example: Enlargement or reduction of the background map on the screen will be performed by two keys. Because control of the display may require "fine-tuning", these keys should be located so that the user may operate them with two fingers on one hand.

- Certain often-used keys should be enhanced by the use of colored covers. In addition, certain keys should light up when activated to indicate an "on" or "enable" mode.
- The function buttons should be spring-loaded, "push on/push off" type keys: i.e, a push of the key enables a function if the previous position was off, or disables a function if the previous position was on.

3.2.1.1 Real-Time Usage of Control Devices

Study Task SER 82-1 recommended that during the mission the background map should automatically adjust so that a specified vehicle (or object) remained in the center of the screen. Since the joystick is used for moving the background map, or elements that have been added to the map, and since the elements on the map are expected to remain constant throughout the mission, little, if any, use of the joystick is anticipated after the initialization procedure.

The function keys (either assisted or unassisted by the cursor), on the other hand, may be used considerably for display control in a variety of applications. The applications include:

- Brightening (intensifying the color) of a particular display item.
- Presentation of items that have been added to the background map, but whose display is suppressed until requested by the user.

- Presentation of measured quantities whose display is normally suppressed. The quantities might include such items as the distance from one indicated vehicle to a flight termination line, the distance from an indicated debris pattern to a destruct line, or the geodetic position of a cursor-indicated item.
- Presentation of the name or number (or other indicator) of a displayed icon. Tank icons, for example, will be numerous in certain scenarios, and a cluttered display will result if identification for every icon is continually presented.
- Map enlargement or reduction.
- Re-assignment of tracking indicators during the mission. The possibility exists that a target will fail to fly, or will be destroyed before a weapon can be fired at it. In order to optimize the mission as a whole, the shooter that had been specified to fire at the inoperative target should be reassigned to another target. Since the shooter/weapon/target components were assigned pre-mission to a specific console, the problem now exists of associating a new target display with a previously designated shooter/weapon/console combination and presenting the icon in the originally defined color.

Pre-mission assignment of alternative targets is not feasible, since: a) it is not known which target may fail, and the set up time for alternates for all targets is prohibitive; and b) it is not known which shooter may deplete his weapon supply first, and therefore permit his target to be used as an alternate target. One remedy is to activate a function key, and enter alphanumeric information (e.g., the tracker ID, and, if applicable, the map centering flag) from the keyboard. The real-time program would then channel target TSPI to both of the consoles assigned to monitor that target.

- Split-screen request (see Section 3.2.3).
- Presentation of figures such as debris patterns or maximum energy footprints whose display is suppressed; or suppression of the figures if their display is unnecessary and causes screen clutter. This capability will also require some means of identifying the figure to be displayed or suppressed, such as:

  a. Cursor positioning on the displayed figure, and activation of a "display" function key.

  b. Activation of a dedicated function key to either display or suppress the figure.

c. Activation of a function key to indicate "display" or "suppress" and a sequence of keyboard keys to define the figure (color and figure type, tracker ID and figure type, or other).

- Display of suppressed horizontal and vertical scales, and geodetic coordinates of the area of the map that is presented on the screen.

3.2.2 Automatic Screen Presentations

The specific goal of real-time mission display presentation design should be to present adequate pictorial and numeric information with a minimum amount of interaction or direction by the RSO. In order to approach this goal, the real-time program will have to routinely present calculated figures and quantities, as well as instrumentation-tracked vehicle position data, on the background map presentation.

Some of the desired features and considerations of automatically presented data include:

- Rotation of the icon so that its longitudinal axis (front to back) is aligned with the course of the tracked vehicle - in the case of a top view- or with the flight path angle (deflection from the horizontal) in the case of a side view.
- Blinking of an icon whose debris pattern or maximum energy footprint intersects a critical object

such as an oil rig or ship, or a flight termination line. Blinking should occur regardless of whether the figures are displayed or suppressed.

- The display of figures such as debris patterns, maximum energy footprints or firing fans should be rotated to the flight path axis of the vehicle for which the calculations are performed.
- Automatic zooming or map movement should occur if a debris pattern or maximum energy footprint (whether displayed or suppressed) exceeds the screen presentation area of the background map.
- A user-selectable area of the screen should be dedicated to constantly displayed alphanumeric information. The information required may differ for air-to-air and air-to-ground scenarios, but should include such parameters as:
  - Vehicle identification
  - Vehicle altitude
  - Vehicle X,Y,Z,VX,VY,VZ
  - Vehicle velocity (feet/second and mach)
  - Vehicle heading
  - Mission time in T+ seconds
  - Closing (weapon to target) distance, rate
  - Miss distance

  The display for air-to-air missions may be expected to include the vehicle information listed above for the target and two weapons, as well as mission time, and closing distance and rate for each weapon. The display for air-to-ground missions may not require certain parameters, such as target velocity, altitude or heading, but may require vehicle information for many more than two weapons.

Although the printed quantities provide precise data, a tradeoff between the area allocated to graphic presentation and the amount of alphanumeric information presented may be necessary. Another consideration for the size of the allocated area is its position on the screen. If the user desires to move the alphanumeric data to a non-essential portion of the display, the allocated area must be small enough so that the alphanumeric characters do not impinge upon critical test components. One solution to presenting essential, but excessive, alphanumeric data may be to reposition, on a line-by-line or column-by-column basis, certain parts of the display. Reduction in the side of the characters may gain space; however, the characters must remain large enough to be easily readable.

3.2.3 Split Screen Displays

Split screen displays simultaneously present any two of the following views of the mission scenario: a) top (vertical) view; b) side (horizontal) view; and c) head-on or rear (also horizontal) view. The division of the screen may occur horizontally of vertically.

The mission scenarios in which split screen displays are anticipated to be necessary are: a) multiple mini-missiles, fired in gatlin-gun fashion from a pod located on an aircraft, at tank or truck targets; b) low-flying RPV targets; c) low flying, self-guiding vehicles such as the cruise missiles; and d) fire control (tail-warning set) missions. Each type of scenario presents a number of considerations which are unique to the split screen display for that scenario type.

3.2.3.1 Mini-Missile Scenarios

Typically, in a mini-missile scenario, the launch aircraft pod fires all of the mini-missiles it contains, and the aircraft rolls out or zooms up to leave the area. Each mini-missile contains a seeker, which scans the earth surface and attempts to discern a background clutter. If no clutter is seen, the mini-missile assumes it is above 2000 meters, and flies downward until it reaches that altitude, at which time the seeker attempts to lock on a target and guide the mini-missile to it. If, however, a clutter is seen when the seeker first points downward, the mini-missile climbs to the 2000 meter altitude, and proceeds as previously described.

There are at least three situations in which the RDO may be required to destroy a mini-missile: a) failure of the system so that the mini-missile does not level off at the 2000 meter altitude, but continues to climb until its energy is expended, and the resulting impact trajectory presents a hazard to life or property; b) seeker lock-on of an object that is not a target; and c) failure of the seeker to lock on to anything.

The background map will be virtually useless in mini-missile scenarios, since only a very small portion of it will be used. Rotation of the top view of the land range containing the targets will be necessary so that the length of the scenario area may be optimally projected on the reduced screen area. Since the target area, or the aircraft flight path may vary for each mission, definition of the area and angle of rotation for split-screen presentation will probably become a function of the pre-mission initialization.

Rotation of a portion of the current background map, and enlargement of that segment may cause a loss of perspective of the surrounding area. In order to retain a north-south, east-west orientation, or else obviate the need for the orientation, indicators on the rotated top view map could be added. These are:

- Tick marks and alphabet characters to indicate the north-south, east-west axes.
- Locations of points of concern, towns, highways, or other reference marks, might be indicated by a

literal character abbreviation (e.g., a building might be represented by the letter B).

The side view presentation will require a display of the altitude at various levels, some indication of the 2000 meter altitude, and a flight termination line ceiling indication. Markers and ground range should also be presented to show the range boundaries and side view scale, since the top view and side view of the range probably will not be identically scaled.

Malfunctioning of a weapon may require real-time zooming of one or both of the split screen displays. Since the selection of additional keys to define which view is to be zoomed, while also utilizing keys to enlarge or reduce, will present a definite problem to the RSO, automation of the display should be incorporated.

Automation will present several problems, since the manner in which a weapon fails will dictate the screen presentation. Failure of a weapon to level off at the 2000 meter mark, for example, will require enlargement of the FOV of the top view display (and a hazard footprint display), while no action may be necessary for the side view. Failure of the weapon to lock on to anything, on the other hand, may require FOV enlargement of the side view as well as the top view, while lock-on of a non-designated target may require reduction of the FOV of both views.

Two or more different types of failures occurring within the same time period may cause contradictory requirements for the screen display. One solution to this problem may be to perform an instantaneous handoff of one vehicle to an RSO at another console.

3.2.3.2 Low-Flying RPV Targets

Unlike the requirement for a split-screen display (only) of a mini-missile mission, the top and side view presentations of low-flying RPV's will be necessary only when the RPV's enter a predefined radius about an object such as a ship or oil rig, flying lower than a pre-defined altitude. A split-screen display requirement based upon this criterion is easily automated, as is definition of the longitudinal axis, in length as well as rotation, of the top view display.

The side view altitude scales may also be easily automated, and the side view presentation should be programmed so that the ship and oil rig icons heights are properly scaled. In order to do this, a correlation, internal to the real-time program, between the height (in rasters) of the original icon on the ROM card and the same height (in rasters) on the side view display must be made. The Range Safety Analyst will be required (during the programming task) to provide the actual height (in feet) above the water of the topmost portions of an oil rig, and the largest ship anticipated to be subject to hazard.

3.2.3.3 Low-Flying Self-Guiding Missiles

The split screen display for low-flying self-guiding missiles, like low-flying RPV displays, will be required only when the missile arrives at a pre-defined distance from and altitude above an object or the shoreline. Definition of ship or oil rig heights may be established as outlined in the preceeding section. Variable coastline altitudes, however, will probably require a disk file or internal storage (data statement in the real-time program) of a set of altitudes vs range coordinates which will require correlation with geodetic positions.

Activation of the flight termination system on the Cruise missile will require that the parachute icons for top and side views replace the Cruise icon. When this occurs, a FOV reduction of the displays may be desirable for a clearer definition of actual position. Another desirable feature may be the printing of abbreviated town names or other identifiers whose display had previously been suppressed.

3.2.3.4 Fire Control Scenarios

Fire control scenarios include missions designed to test the effectiveness of aircraft tail warning sets (TWS). The basic TWS test scenario involves a shooter aircraft closing on,or maintaining a fixed stand-off distance from, a manned B-52 equipped with a tail warning set. When CRT displays indicate that safe test conditions have been attained, a clearance to fire an unguided rocket at the B-52 is given by the RSO.

Currently there are four screen presentation options available to the RSO:

- Time history plots of three selected parameters.
- The current weapon containment fan on a background map in which surface craft positions in the Gulf are indicated.

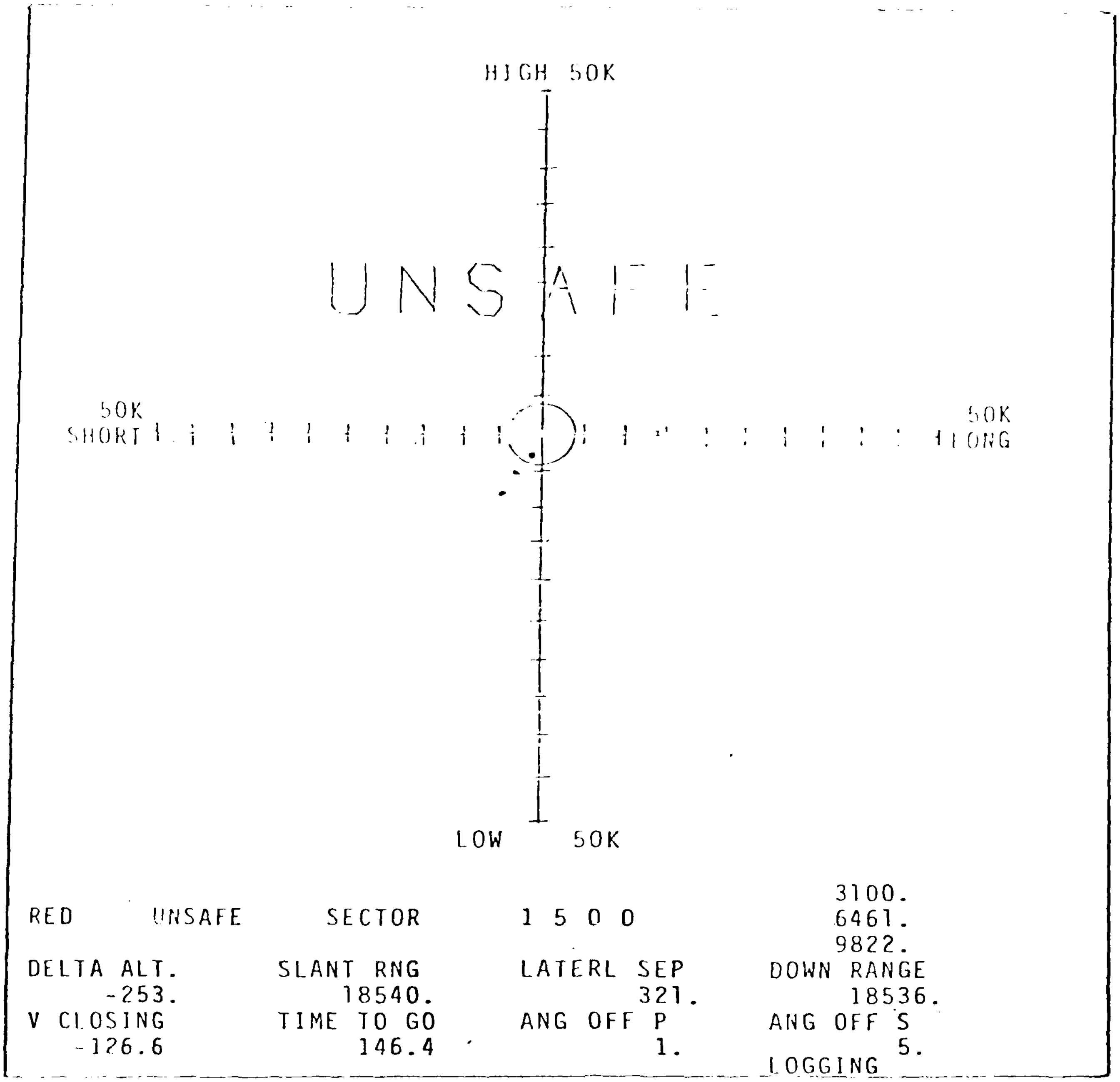
- A projection on the downrange -vertical plane, of a hazard circle about the B-52 and point of closest approach (PCA) of three trajectories: the nominal; the three-sigma high; and the three-sigma low. (See Figure 3.5)
- A projection on the crossrange-vertical plane of the hazard circle and three PCA's.

The weapon containment fan presentation can be used to position the test in a safe operational area, while the downrange and crossrange presentations are used to determine safe clear-to-fire conditions. (The methodology for clear-to-fire determination is outlined in Reference 2, ER-TC-SER 82-1, p. 6-33.) Since there is nothing to be gained by a split screen display of the time history plots or the containment fan presentation with any of the remaining displays, the incorporation of these options is not considered.

The presentation of the current downrange and crossrange displays (in a reduced size) on a vertically split screen, however, will provide, in effect, a three-dimensional concept of the relative positions of the B-52 and the three PCA predictions. The 3D concept may be further enhanced by superimposing the B-52 side view and head-on view icons on the crosshairs of the downrange and crossrange displays.

The use of color can also enhance the display. Some considerations for judicious choice of coloration include:

- The words "red" and "unsafe" should appear in red;



Dots represent nominal, 3-σ high, and 3-σ low PCA's

Current Downrange Fire Control Display

Figure 3.5

the words "green" and "safe" should be displayed in green. Use of these colors should be avoided elsewhere in the display, with the possible exception of the hazard circle or the icons.

- The PCA indications (dots) should appear in a different color than the hazard radius circle or the crosshairs. Blinking of these indicators is suggested.
- In order to prevent eye fatigue, the alphanumeric characters (except those words previously mentioned), the display division line, and the crosshairs should appear in as dark a color as possible. Since green has been previously designated, blue is suggested.
- Consistency in coloration of the left and right displays (of the split screen) should be maintained; i.e., if the hazard circle is red on the downrange presentation, the crossrange hazard circle presentation should also be colored red.

Currently, program P2457 recognizes a signal from function key 7 to present the downrange display on the CRT, and function key 8 to present the crossrange display. Conceivably, the split screen display could be automatically activated once the area of safe operation was determined, and thereby obviate the use of the two function keys.

3.3 Function Key Usage Summary

There are currently sixteen function buttons located on the console, separate from the alphanumeric keyboard.Referring to Figure 3.1, Page 3-56; four of these keys are used to determine the background map display, two are used to select the downrange or crossrange fire control system presentation, and five are not used.

The implementation of a s'ngle background map will free four of the keys for other usage, while automation of a split-screen downrange-crossrange presentation for the fire control system will allow use of two others. Keys 1 and 2 are mission-unique keys (i.e., key 1 is used on fire control system missions only; key 2 is used for Bomarc launches) and therefore, by branches in the program, could serve dual purposes. If this is necessary an overlay of the keys should be provided to flag the RSO of their purpose in the particular mission being monitored. Keys 9, 10 and 16 are common to all missions and should not be changed.

The following table summarizes the function keys usage discussed in this report. It is assumed that no keys operate in tandem; i.e., the activation of one key does disengage another key from operation.

Function Key Usage Table

Notes	Function
	Enlarge field of view
	Reduce field of view
4	Rotate clockwise
4	Rotate counterclockwise
	Select horizontal split screen display
	Select vertical split screen display
1	Operate on top or left portion of split screen
1	Operate on lower or right portion of split screen
1	Move the background map
1	Move a figure on the background map
4,2	Display suppressed figure, icon, or calculated value
4,2	Suppress display of indicated figure, icon, or value
2	Blink figure, icon, or value
4,2	Brighten figure, icon, or value
1	Signal point-to-point distance measurement and display distance
3	Select file containing mission-unique display parameters (flight termination lines, flight profile, etc.)
3	Select zoom ratio
3	Signal numeric entry of tracker ID from keyboard

Notes:
1. Activation required prior to activation of another function key, implementation of the joystick, or utilization of the cursor as a control function.
2. Activation required after cursor is positioned at the desired figure, icon, value, menu item, etc.
3. Keyboard function keys suggested
4. Control dial suggested

Table 3.1

INPUT - OUTPUT
REQUIREMENTS

UNIT	TYPE	RESIDENCY	REQUIREMENT
INPUT=TAPE5	INPUT	INTERNAL DISK	ALWAYS
OUTPUT=TAPE6	OUTPUT	INTERNAL DISK	ALWAYS
*TAPE1	INPUT	EXTERNAL DISK	ALWAYS - MAP DATA BASE
LOG=TAPE8	OUTPUT	EXTERNAL MAG TAPE	OPTIONAL - LOG TAPE
REPLAY=TAPE9	INPUT	EXTERNAL MAG TAPE	OPTIONAL - REPLAY TAPE
TAPE10	INPUT	EXTERNAL DISK	ALWAYS - WEATHER
TAPE11	INPUT	INTERNAL DISK	OPTIONAL - FCS TABLE
TAPE12	INPUT	INTERNAL DISK	OPTIONAL - FCS TABLE
TAPE13	INPUT	INTERNAL DISK	OPTIONAL - FCS TABLE
TAPE14	INPUT	INTERNAL DISK	OPTIONAL - FCS TABLE
TAPE15	INPUT	INTERNAL DISK	OPTIONAL - FCS TABLE
RADAR	INPUT	STANDARD DATA SYS	ALWAYS

* THE DEFAULT MAP FILE IS PF=MULTIMAPS,ID=RTMAPS,PW=CCF.

HARDWARE REQUIREMENTS

SYSTEM	PERCENT CM	PERCENT IO
CDC6600		
IBM360/65		
STANDARD DATA SYSTEM INTERFACE		

Figure 3.1

TYPICAL JOB SETUP

```
E000,T0,RT,NT2,STEG1.
ROUTE,OUTPUT,DC=PR,FC=U1,DEF.
PAUSE.  USE UNCL. TAPE FOR LFN=LOG.
VSN,LOG=RTA1/RTA2/RTA3/RTA4/RTA5/RTA6/RTA7/RTA8/RTA9/RTA10.
REQUEST,LOG,S,NR.   UNCL  SAVE FOR (MATHEMATICIAN)  9993V946
*ATTACH,TAPE11,TWCOSPEED,ID=RTMAPS,PW=CCF,MR=1.
*ATTACH,TAPE12,
*ATTACH,TAPE13,
*ATTACH,TAPE14,
*ATTACH,TAPE15,
SELECT,P2457.
LGO.
END-OF-RECORD
TYPE 1      NUMBER OF CONSOLES CARD                ALWAYS
TYPE 2      CONSOLE SELECTION CARD                 ALWAYS
TYPE 3      KEYBOARD CARD                          ALWAYS
TYPE 4      RANGE CALIBRATION SELECT CARD          ALWAYS
TYPE 5      BDIIP VARIABLE CARD                    ALWAYS
TYPE 6      MACH VS DRAG CARDS                     OPTIONAL (MAX 13)
*TYPE 7     FIRE CONTROL TABLE                     OPTIONAL
TYPE 8      MAP SELECTION CARDS                    ALWAYS 4 CARDS
TYPE  9     NUMBER OF ADDITIONAL LINES CARDS       ALWAYS   (PROF 1)
TYPE  9A    ADDITIONAL LINES SPECIFICATIONS CARDS  OPTIONAL (MAX 30)
TYPE  9     NUMBER OF ADDITIONAL LINES CARDS       OPTIONAL (PROF 2)
TYPE  9A    ADDITIONAL LINES SPECIFICATIONS CARDS  OPTIONAL (MAX 30)
TYPE 10     NUMBER OF DOWNRANGE LINES CARD         ALWAYS
TYPE 10A    DOWNRANGE LINES SPECIFICATIONS CARDS   OPTIONAL (MAX 20)
TYPE 11     NUMBER OF CROSSRANGE LINES CARD        ALWAYS
TYPE 11A    CROSSRANGE LINES SPECIFICATIONS CARDS  OPTIONAL (MAX 20)
END-OF-FILE
```

*IF FCS OPTION IS NOT REQUIRED, DELETE TAPES 11,12,13,14,15 AND CARD TYPE 7
*IF CARD TYPE 7 CONTAINS ALL FCS TABLE REQUIRED, DELETE TAPES 11 THRU 15
*MUST ANSWER "YES" TO FCS PRIOR TO ANSWERING "YES" TO VERIFY IN INIT.
OTHERWISE, P2457 WILL BOMB.

Figure 3.1 (Cont'd)

```
TYPE 1   NUMBER OF CONSOLES CARD                                  MANDATORY
COLUMN  PARAMETER  DESCRIPTION                                              SCALING
  1       NCONSL      NUMBER OF CONSOLES                                      I1
                      = 1  ONE CCF CONSOLE REQUIRED
                      = 2  TWO CCF CONSOLE REQUIRED
RESTRICTIONS: 1 LE NCONSL LE 2


TYPE 2   CONSOLE SELECTION CARD                                   MANDATORY
COLUMN  PARAMETER  DESCRIPTION                                              SCALING
  1       IWHCH       CONSOLE REQUIRED                                        I1
                      = 1 CONSOLE ONE REQUIRED
                      = 2 CONSOLE TWO REQUIRED
RESTRICTIONS: 1 LE IWHCH LE 2


TYPE 3   KEYBOARD OPTION CARD                                     MANDATORY
COLUMN  PARAMETER  DESCRIPTION                                              SCALING
  1       KBD         KEYBOARD 9 SELECT OPTION                                I1
                      = 0 KEYBOARD 9 NOT USED (NORMAL PROCEDURE)
                      = 1 KEYBOARD 9 SELECTED
RESTRICTIONS: 0 LE KBD LE 1
NOTEB:

NOTES: KBD=0 IS NORMAL OPERATING SELECTION
         KEYBOARD 9 IS THE TEKTRONIX KEYBOARD AND WILL BE REQUIRED ONLY
         WHEN THE FOUR ALPHANUMERIC KEYBOARDS ARE NOT OPERATIONAL


TYPE 4   RANGE CALIBRATION POINTS SELECT CARD                     MANDATORY
COLUMN  PARAMETER  DESCRIPTION                                              SCALING
  1       IRNG        RANGE SELECTION OPTIONS                                 I1
                      = 1 USE WATER RANGE CAL POINTS
                      = 2 USE TA B70 RANGE CAL POINTS
                      = 3 USE TA C52 RANGE CAL POINTS
                      = 4 USE TA C72 RANGE CAL POINTS
RESTRICTIONS: 1 LE IRNG LE 4
NOTES: NOT USED IF PLOTBOARD SCALING IS NOT REQUIRED
```

Figure 3.1 (Cont'd)

TYPE 5 BDIIP VARIABLE CARD MANDATORY

COLUMN	PARAMETER DESCRIPTION		SCALING
1-10	REFERENCE DIAMETER	FEET	F10.5
11-20	VEHICLE WEIGHT	LBS	F10.5
21-22	NUMBER OF DRAG ENTRIES (MAX 50)		I2
25	STEP CHANGE FLAG = 1 COL(26 - 46) REQUIRED = 2 COL(26 - 46) MAY BE BLANK		I1
26-35	LOWER ERROR TOLERANCE		F10.0
36-45	UPPER ERROR TOLERANCE		F10.0
46-50	STEP SIZE	SECONDS	F5.3

NOTES: THESE CARDS ARE MEANINGFUL ONLY IF "BDIIP" IS SELECTED IN THE MENU FOR "IIP TYPE".

TYPE 6 MACH VS DRAG CARDS OPTIONAL

COLUMN	PARAMETER DESCRIPTION		SCALING
1-10	MACH ENTRY (1)	MACH	F10.10
11-20	DRAG ENTRY (1)	KD	F10.10
61-70	MACH ENTRY (4)	MACH	F10.10
71-80	DRAG ENTRY (4)	KD	F10.10

RESTRICTIONS: MAXIMUM OF 13 CARDS = 13
MAXIMUM NUMBER OF TABLE ENTRIES = 50

NOTES: NOT REQUIRED WHEN COL(21-22) = 00 ON LEAD CARD TYPE 5

Figure 3.1 (Cont'd)

```
  TYPE 7   FIRE CONTROL TABLES                              OPTIONAL
COLUMN  PARAMETER  DESCRIPTION                                        SCALING
NOTES: MANDATORY IF "FCS" IS SELECTED IN INIT
          OTHERWISE, MAY BE OMITTED
  CONSOLE OPTION: FCS TABLES MAY BE SELECTED FROM THE CONSOLE VIA
                  MODE          COMMAND         PROGRAM ACTION
                  IDLE          FCSTAB11        SELECT FCS TABLE FROM TAPE 11
                                FCSTAB12        SELECT FCS TABLE FROM TAPE 12
                                FCSTAB13        SELECT FCS TABLE FROM TAPE 13
                                FCSTAB14        SELECT FCS TABLE FROM TAPE 14
                                FCSTAB15        SELECT FCS TABLE FROM TAPE 15
```

Figure 3.1 (Cont'd)

TYPE 8 MAP SELECTION CARDS (4 CARDS) MANDATORY

COLUMN	PARAMETER DESCRIPTION	SCALING
FIRST MAP CARD		
1- 2	ENTITY NUMBER (PUNCH 08)	I2
20-29	PICTURE NAME 1	A10
SECOND MAP CARD		
1- 2	ENTITY NUMBER (PUNCH 09)	I2
20-29	PICTURE NAME 2	A10
THIRD MAP CARD		
1- 2	ENTITY NUMBER (PUNCH 16)	I2
20-29	PICTURE NAME 3	A10
FOURTH MAP CARD		
1- 2	ENTITY NUMBER (PUNCH 17)	I2
20-29	PICTURE NAME 4	A10

NOTES:

1ST MAP CARD ASSOCIATES FUNCTION KEY 3, ENTITY 08 WITH PICTURE NAME 1
2ND MAP CARD ASSOCIATES FUNCTION KEY 4, ENTITY 09 WITH PICTURE NAME 2
3RD MAP CARD ASSOCIATES FUNCTION KEY 5, ENTITY 16 WITH PICTURE NAME 3
4TH MAP CARD ASSOCIATES FUNCTION KEY 6, ENTITY 17 WITH PICTURE NAME 4

CONSOLE OPTION: PICTURES MAY BE SELECTED FROM THE CONSOLE VIA

MODE	COMMAND	PROGRAM ACTION
IDLE	NEWF SETNAME	ATTACH NEW MAP FILE. FILE NAME IS "SETNAME"
IDLE	KEY# PICT	PLACE PICTURE NAMED "PICT" INTO FUNCTION KEY # FROM FILE "SETNAME"

Figure 3.1(Cont'd)

```
  TYPE  9  NUMBER OF ADDITIONAL LINES CARD              MANDATORY
COLUMN  PARAMETER  DESCRIPTION                                             SCALING
 1- 2           NUMBER OF ADDITIONAL LINES (SEE CASES 1 TO 3 BELOW)  I2
                    = 0  OMIT TYPE  9A CARDS
                    GT 0 READ TYPE  9A CARDS
  4             TWO PROFILES OPTION.                                  I1
                 .NE.2 OR BLANK INDICATES THAT ONLY ONE SET
                  OF TYPE 9 CARDS WILL BE USED (I.E. ONE PROFILE).

                 =2 INDICATES THAT A SECOND SET OF TYPE 9 CARDS
                 WILL FOLLOW THE LAST TYPE 9A CARD OF SET 1.
                 CC 4 OF THE SECOND TYPE 9 CARD IS NOT USED.
NOTES: LINES WILL BE DISPLAYED ON PRESENTATIONS AT FUNCTIONAL KEY POSN 3-6
  CONSOLE OPTION:  LINES MAY BE DRAWN FROM THE CONSOLE VIA
                  MODE          COMMAND
                  SURVEIL        REF X Y Z XX YY ZZ
                                 LN RB1 NM1 RB2 NM2
```

```
  TYPE  9A HORIZONTAL LINE SPECIFICATION CARDS                 OPTIONAL
COLUMN  PARAMETER  DESCRIPTION                                          SCALING
```

COLUMN	DESCRIPTION		SCALING
1- 2	STARTING LATITUDE	DEG	F2.0
4- 5	STARTING LATITUDE	MIN	F2.0
7-11	STARTING LATITUDE	SEC	F6.3
15-16	STARTING LONGITUDE	DEG	F2.0
18-19	STARTING LONGITUDE	MIN	F2.0
21-25	STARTING LONGITUDE	SEC	F6.3
30-31	ENDING LATITUDE	DEG	F2.0
33-34	ENDING LATITUDE	MIN	F2.0
36-40	ENDING LATITUDE	SEC	F6.3
45-46	ENDING LONGITUDE	DEG	F2.0
48-49	ENDING LONGITUDE	MIN	F2.0
51-55	ENDING LONGITUDE	SEC	F6.3

```
RESTRICTIONS:  MAXIMUM OF 30 CARDS ALLOWED FOR EACH PROFILE.
NOTES: NOT REQUIRED IF COL(1-2) = 00 ON LEAD CARD TYPE  9

   DESCRIPTION OF THREE TYPE 9 CONFIGURATIONS:
    CASE1: NO ADDITIONAL LINES. ONLY ONE TYPE 9 CARD REQUIRED
           WITH CC2 =0, CC4 =0 OR BLANK
    CASE2: ONE SET OF ADDITIONAL LINES (ONE PROFILE). ONLY ONE
           TYPE 9 CARD WITH CC4 =0 OR BLANK FOLLOWED BY THE
           APPROPRIATE NUMBER OF TYPE 9A CARDS.
    CASE3: TWO SETS OF ADDITIONAL LINES (TWO PROFILES). SET 1
           IS IDENTICAL TO CASE2 EXCEPT A "2" IS IN CC4 OF
           THE TYPE 9 CARD TO INDICATE ANOTHER TYPE 9 WILL
           FOLLOW THE LAST TYPE 9A CARD OF SET 1. THE
           TYPE 9 AND TYPE 9A CARDS OF SET 2 ARE FORMATTED
           THE SAME AS SET 1 EXCEPT THAT CC4 OF THE TYPE 9
           CARD IS IGNORED.
```

Figure 3.1 (Cont'd)

TYPE 10 NUMBER OF DOWNRANGE LINES CARD MANDATORY

COLUMN	PARAMETER DESCRIPTION	SCALING
1- 2	NUMBER OF DOWNRANGE LINES	I2
	= 0 OMIT TYPE 10A CARDS	
	GT 0 READ TYPE 10A CARDS	

RESTRICTIONS: MAXIMUM OF 20 CARD TYPE 10A ALLOWED

NOTES: LINES ARE DRAWN ON PRESENTATION ASSOCIATED WITH FUNCTION KEY 2

CONSOLE OPTION: DOWNRANGE LINES MAY BE DRAWN FROM THE CONSOLE VIA

MODE	COMMAND
IDLE	LNX ALT1 DR1 ALT2 DR2

TYPE 10A DOWNRANGE LINE SPECIFICATION CARDS OPTIONAL

COLUMN	PARAMETER DESCRIPTION		SCALING
1-10	ALTITUDE 1 START	FT	F10.3
11-20	DOWNRANGE 1 START	FT	F10.3
21-30	ALTITUDE 2 STOP	FT	F10.3
31-40	DOWNRANGE 2 STOP	FT	F10.3

RESTRICTIONS: MAXIMUM OF 20 CARDS ALLOWED

Figure 3.1(Cont'd)

TYPE 11 NUMBER OF CROSSRANGE CARD MANDATORY

COLUMN	PARAMETER DESCRIPTION	SCALING
1- 2	NUMBER OF CROSSRANGE LINES =0 OMIT TYPE 11A CARDS GT 0 READ TYPE 11A CARDS	I2

RESTRICTIONS: MAXIMUM OF 20 CARDS ALLOWED

NOTES: LINES ARE DRAWN ON PRESENTATION ASSOCIATED WITH FUNCTION KEY 2

CONSOLE OPTION: CROSSRANGE LINES MAY BE DRAWN FROM THE CONSOLE VIA

MODE	COMMAND
IDLE	LNZ ALT1 CR1 ALT2 CR2

TYPE 11A CROSSRANGE LINE SPECIFICATIONS CARDS OPTIONAL

COLUMN	PARAMETER DESCRIPTION		SCALING
1-10	ALTITUDE 1 START	FT	F10.3
11-20	CROSSRANGE 1 START	FT	F10.3
21-30	ALTITUDE 2 STOP	FT	F10.3
31-40	CROSSRANGE 2 STOP	FT	F10.3

RESTRICTIONS: MAXIMUM OF 20 CARDS ALLOWED

Figure 3.1(Cont'd)

```
INPUT FILES OR MAG TAPE FORMATS
TAPE1        STANDARD MAP DATA BASE FILE FORMAT
TAPE9        STANDARD CCF LOG TAPE FORMAT
TAPE10       STANDARD EAFB WEATHER DECK FORMAT
TAPE11       STANDARD FIRE CONTROL TABLE FORMAT
TAPE12       STANDARD FIRE CONTROL TABLE FORMAT
TAPE13       STANDARD FIRE CONTROL TABLE FORMAT
TAPE14       STANDARD FIRE CONTROL TABLE FORMAT
TAPE15       STANDARD FIRE CONTROL TABLE FORMAT


OUTPUT FILES OR MAGNETIC TAPES
LOG=TAPE8    STANDARD CCF LOG TAPE FORMAT
```

Figure 3.1(Cont'd)

INITIALIZATION MODE

P2457 M E N U

PARAMETER	DEFAULT	VALID COMMANDS
PAD NO 1	21	21,22,23,24,25,32,33,34,55
AZBS	0.0 MILS	ANY INTEGER OR REAL
ELBS	0.0 MILS	ANY INTEGER OR REAL
SKNBS	0.0 YARDS	ANY INTEGER OR REAL
BCNBS	0.0 YARDS	ANY INTEGER OR REAL
PAD NO 2	33	21,22,23,24,25,32,33,34,55
AZBS	0.0 MILS	ANY INTEGER OR REAL
ELBS	0.0 MILS	ANY INTEGER OR REAL
SKNBS	0.0 YARDS	ANY INTEGER OR REAL
BCNBS	0.0 YARDS	ANY INTEGER OR REAL
MODE	LIVE	LIVE REPLAY SIMU
ORIG LAT	30.42141	25.0 LE X LE 31.0
ORIG LON	86.79821	81.0 LE X LE 90.0
ORIG HT	93.177 FT MSL	ANY POSITIVE NUMBER
FLT LINE	0.0 DEG	0.0 LE X LE 360.0
XO	02374B	NA
YO	16602B	NA
XE	03707B	NA
YS	14357B	NA
PDP-11	NO	NA (NO ONLY!)
IIP TYPE	VTIIP	VTIIP BDIIP NOIIP
NO PTS SMOOTHING	51	31 LE X LE 99
SHOOTER CHANNELS	S10S10S10	0 OR S09 - S20
TARGET CHANNELS	S12S12S14	F OR S09 - S20
IIP VEHICLE	T	T S NO
FCS	NO	NO YES
VERIFY	NO	NO YES

NOTES: ENTERING AN "R" AT ANY POSITION WILL RETURN TO TOP OF MENU.

EACH TIME A NEW PAD NUMBER IS ENTERED, THE SUBSEQUENT BORESHOT DATA WILL BE APPLIED TO THAT PAD ENTRY

Figure 3.1(Cont'd)

IDLE MODE COMMANDS

I. SWITCHES

COMMAND		FNCTN KEY	ACTION
EX			BEGIN EXECUTION - LEAVE IDLE MODE
END			END EXECUTION - RETURN TO IDLE MODE
END JOB			PROGRAM TERMINATION COMMAND
KILL	(BE CAREFUL!)		IDENTICAL TO "END JOB" EXCEPT NO OUTPUT OR DAYFILE
L	ON/OFF		LOG TAPE ON-OFF SWITCH
WARN	ON/OFF		TAIL WARNING SPECIAL O/P TAPE SWITCH
INT	ON/OFF		INTERMEDIATE SYSTEM DATA LOG RECORD
DISON		3 4 5 6	DISPLAY SHIP NUMBERS ON MAPS
DISOFF		3 4 5 6	REMOVE SHIP NUMBERS FROM MAPS
DLOG			DUMP SHIP LOCATIONS TO A PRINT FILE
DIS1		9	DISPLAY SHIP POSITION PAGE 1
DIS2		9	DISPLAY SHIP POSITION PAGE 2

II. SPECIAL OPTIONS OR OVERLAYS

COMMAND		FNCTN KEY	ACTION
*SURVEIL			ENTER SURVEY MODE FOR GRAPHICS
*INIT OR MENU			RETURN TO INITIALIZATION MODE
*SIML OR SIMU			ENTER SIMULATION MODE
*LOCATE SX			ENTER LOCATE MODE FROM SDS CH X
FCSTABXX			READ FCS TABLES FROM TAPE XX MUST HAVE SAID "YES" TO FCS IN INIT
FIRING R1 R2			ENTER FIRING RANGES (FT) FOR TIMETOFR
FF WW LL			DRAW FIRING FAN WW MILES WIDE AND LL MILES LONG
ROTATE XXX	25 DEGREES DEFAULT		CHANGE ROTATION ANGLE FOR FCS TO XXX DEG
MAP			DUMP UGLE BUFFER ON IBM 360/65
WEATHER			ATTACH,TAPE10,LATESTWEATHER, ID=C2,PW=UNC. (REF. RADREF)
AUTOT			AUTOMATIC BESTSELECT TARGET
AUTOS			AUTOMATIC BESTSELECT SHOOTER
OT SX			OVERIDE BESTSELECT TARGET ON SDS CH X
OS SX			OVERIDE BESTSELECT SHOOTER ON SDS CH X
TG CX CY CZ			CHANGE TARGET SDS ASSIGNMENT
SH CX CY CZ			CHANGE SHOOTER SDS ASSIGNMENT
NEWF SETNAME			ATTACH NEW MAP FILE NAMED "SETNAME"
KEY# PICT			ASSOCIATE MAP NAMED "PICT" WITH KEY # FROM MAP FILE "SETNAME"

*THESE MODES HAVE SEPARATE COMMANDS SECTION

Figure 3.1(Cont'd)

IV. GRAPHICS

COMMAND	FNCTN KEY	ACTION
PROF N	3 4 5 6	DISPLAY PROFILE "N" (N=1 OR 2)
OIL X Y Z XX YY ZZ	3 4 5 6	MARK AN OIL WELL
SHP X Y Z XX YY ZZ	3 4 5 6	MARK A SHIP POSITION
DLSHP NN	3 4 5 6 9	DELETE SHIP NUMBERED NN
UPDATE	3 4 5 6 9	REMOVE SHIP MARKINGS
ERASE	3 4 5 6	ERASE ALL ADDITIONAL LINES EXCEPT THOSE FROM LEAD CARD
SUBX		
SL X Y Z XX YY ZZ	3 4 5 6	START LINE LATITUDE AND LONGITUDE
CL X Y Z XX YY ZZ	3 4 5 6	CONTINUE LINE LATITUDE AND LONGITUDE
EL X Y Z XX YY ZZ	3 4 5 6	END LINE LATITUDE AND LONGITUDE
BOX X Y Z XX YY ZZ	3 4 5 6	REFERENCE LAT AND LON FOR BOX POSITION
BOX S L	3 4 5 6	DRAW BOX S FEET BY L FEET
TRI X Y Z XX YY ZZ	3 4 5 6	REFERENCE LAT AND LON FOR TRI POSITION
TRI B H	3 4 5 6	DRAW TRI: B MILE BASE, H MILE ALT
RTFIGN X	3 4 5 6	ROTATE FIGURE N, X DEG CLOCKWISE
MVFN# D	3 4 5 6	MOVE FIGURE NUMBER # D MILES NORTH
MVFS# D	3 4 5 6	MOVE FIGURE NUMBER # D MILES SOUTH
MVFE# D	3 4 5 6	MOVE FIGURE NUMBER # D MILES EAST
MVFW# D	3 4 5 6	MOVE FIGURE NUMBER # D MILES WEST
LNX ALT1 DR1 ALT2 DR2	2	ADDITIONAL DOWNRANGE LINE COMMAND
LNZ ALT1 CR1 ALT2 CR2	2	ADDITIONAL CROSSRANGE LINE COMMAND
DROP X	2	DROP DOWNRANGE LINES
DROP Z	2	DROP CROSSRANGE LINES
REF K X1 X2 X3 Y1 Y2 Y3	3 4 5 6 10	DEFINE HAZARD FOOTPRINT NUMBER "K" (K=1 OR 2) BY LATITUDE AND LONGITUDE
FPT K BRN RNG	3 4 5 6 10	DEFINE A POINT ON HAZARD FOOTPRINT "K" (K=1 TO 7) BY BEARING AND RANGE "NM"
FCL P1 P2	3 4 5 6 10	DEFINE CENTERLINE OF FIGURE BY TWO POINTS P1 P2 OF THE FIGURE
MV K BRN RNG	3 4 5 6 10	MOVE FIGURE "K" (K=1 OR 2) BY BEARING "DEG" AND RANGE "NM"
RT K DEG	3 4 5 6 10	ROTATE FIGURE "K" (K=1 OR 2) "DEG" DEGREES
CLEAR K	3 4 5 6 10	DELETE FIGURE "K" (K=1 OR 2)
FMODE	3 4 5 6	TURN ON FIGURES
EFMODE	3 4 5 6	TURN OFF FIGURES

Figure 3.1(Cont'd)

IV. GRAPHICS (CONTINUED)

COMMAND	FNCTN KEY	ACTION
CF K WW		DEFINE CLEAR TO FIRE LINE AT 90 DEG
HF K WW		FROM FIG "K" (K=1 OR 2) , WW NAUTICAL
	3 4 5 6 10	MILES WIDE
DEL K	3 4 5 6 10	DELETE FIRING LINE "K" (K=1 TO 4)
DELAL	3 4 5 6 10	DELETE ALL FIRING LINES
REFP "SITENAME"	10	FIND RNG AND BRNG FROM "SITE" TO CENTER OF HAZARD FOOTPRINT. ETACAN TTACAN A20 A3 D3 C10
REFP X1 X2 X3 Y1 Y2 Y3	10	FIND RANGE AND BEARING FROM LAT: X1 X2 X3 LON: Y1 Y2 Y3 OF CENTER OF HAZARD FOOTPRINT

Figure 3.1(Cont'd)

V. PARAMETER DISPLAY AND SCALING

COMMAND	FNCTN KEY	ACTION
AN S1		DISPLAY PARAMETER S1 IN POSITION A(N)
A1 S1 S2 S3 S4		DISPLAY PARAMETERS S1 S2 S3 S4 IN POSITIONS A1 A2 A3 A4
A2 S1 S2 S3 S4		DISPLAY PARAMETERS S1,S2 S3 S4 IN POSITIONS A5 A6 A7 A8
FEET		DISPLAY SLANT RANGE (ANS#6) IN FEET
MILES	(DEFAULT)	DISPLAY SLANT RANGE (ANS#6) IN NAUTICAL MILES
BN S1	1	PLOT PARAMETER S1 IN TIME HIST POSN N
B S1 S2 S3	1	PLOT PARAMETERS S1 S2 S3 IN TIME HISTORY POSITIONS 1 2 3
SC N YY	1	SCALE TIME HIST N, + OR - YY VALUE
%SC		
SC N BB TT	1	SCALE TIME HIST N, MIN=BB, MAX=TT
T YY	1	SET TIME HIST TIME FRAME TO YY SEC
ALT MIN MAX	2	SET ALTITUDE LIMITS ON VERTICAL PLOTS
X YY ZZ	2	SET DOWNRANGE SCALE ON VERTICAL PLOTS
Z XX	2	SET CROSSRANGE SCALE ON VERTICAL PLOTS + OR - XX
DR N1 N2 N3 N4	7	SET LONG-SHORT, HIGH-LOW SCALE
CR N1 N2 N3 N4	8	SET LEFT-RIGHT, HIGH-LOW SCALE
HAZARD FFF	7 8	DEFINE HAZARD CIRCLE (FT) FOR PCA COMP

Figure 3.1(Cont'd)

EXECUTION MODE

I. SWITCHES

COMMAND		FNCTN KEY	ACTION
END			END EXECUTION - ENTER IDLE MODE
L	ON/OFF		LOG TAPE ON-OFF SWITCH
INT	ON/OFF		INTERMEDIATE SYSTEM DATA LOG RECORD
DISON		3 4 5 6	DISPLAY SHIP NUMBERS ON MAPS
DISOFF		3 4 5 6	REMOVE SHIP NUMBERS FROM MAPS
DLOG			DUMP SHIP LOCATIONS TO A PRINT FILE
DIS1		9	DISPLAY SHIP POSITION PAGE 1
DIS2		9	DISPLAY SHIP POSITION PAGE 2

II. SPECIAL OPTIONS OR OVERLAYS

COMMAND	FNCTN KEY	ACTION
AUTOT		AUTOMATIC BESTSELECT TARGET
AUTOS		AUTOMATIC BESTSELECT SHOOTER
OT SX		OVERIDE BESTSELECT TARGET ON SDS CH X
OS SX		OVERIDE BESTSELECT SHOOTER ON SDS CH X
TG CX CY CZ		CHANGE TARGET SDS ASSIGNMENT
SH CX CY CZ		CHANGE SHOOTER SDS ASSIGNMENT
FIRING R1 R2		ENTER FIRING RANGES (FT) FOR TIMETOFR
FF WW LL	3 4 5 6	DRAW FIRING FAN WW MILES WIDE AND LL MILES LONG
ROTATE XXX	25 DEGREES DEFAULT	CHANGE ROTATION ANGLE FOR FCS TO XXX DEG
MAP		DUMP UGLE BUFFER ON IBM 360/65

Figure 3.1(Cont'd)

V. PARAMETER DISPLAY AND SCALING

COMMAND	FNCTN KEY	ACTION
AN S1		DISPLAY PARAMETER S1 IN POSITION A(N)
A1 S1 S2 S3 S4		DISPLAY PARAMETERS S1 S2 S3 S4 IN POSITIONS A1 A2 A3 A4
A2 S1 S2 S3 S4		DISPLAY PARAMETERS S1,S2 S3 S4 IN POSITIONS A5 A6 A7 A8
FEET		DISPLAY SLANT RANGE (ANS#6) IN FEET
MILES	(DEFAULT)	DISPLAY SLANT RANGE (ANS#6) IN NAUTICAL MILES
BN S1	1	PLOT PARAMETER S1 IN TIME HIST POSN N
B S1 S2 S3	1	PLOT PARAMETERS S1 S2 S3 IN TIME HISTORY POSITIONS 1 2 3
SC N YY	1	SCALE TIME HIST N, + OR - YY VALUE
SC N BB TT	1	SCALE TIME HIST N, MIN=BB, MAX=TT
T YY	1	SET TIME HIST TIME FRAME TO YY SEC
ALT MIN MAX	2	SET ALTITUDE LIMITS ON VERTICAL PLOTS
X YY ZZ	2	SET DOWNRANGE SCALE ON VERTICAL PLOTS
Z XX	2	SET CROSSRANGE SCALE ON VERTICAL PLOTS + OR - XX
DR N1 N2 N3 N4	7	SET LONG-SHORT, HIGH-LOW SCALE
CR N1 N2 N3 N4	8	SET LEFT-RIGHT, HIGH-LOW SCALE
HAZARD FFF	7 8	DEFINE HAZARD CIRCLE (FT) FOR PCA COMP

Figure 3.1(Cont'd)

LOCATE MODE

COMMAND	FNCTN KEY	ACTION
END		RETURN TO IDLE MODE
MK B NM	3 4 5 6 9	MARK SHIP B DEGREES AND NM MILES FROM SEARCH A/C PRESENT POSITION
MR	(DEFAULT)	LOCATE SHIPS USING BEARING FROM TARGET'S NOSE
MT		LOCATE SHIPS USING TRUE BEARING FROM NORTH OF TARGET
UPDATE	3 4 5 6 9	REMOVE SHIP MARKINGS

SURVEIL MODE

COMMAND	FNCTN KEY	ACTION
END		RETURN TO INIT
REF X Y Z XX YY ZZ	3 4 5 6 9	DEFINE ORIGIN FOR SHIP MARKING OR LINE
LN RB1 NM1 RB2 NM2	3 4 5 6	DRAW LINE FROM (RB1,NM1) TO (RB2,NM2) USING REF X Y Z XX YY ZZ AS AN ORIGIN
MK RB1 NM1		MARK SHIP AT (RB1,NM1) USING REF X Y Z XX YY ZZ AS AN ORIGIN

SIMU MODE

COMMAND	FNCTN KEY	ACTION
END		RETURN TO INIT
TG X Y Z VX VY VZ		DEFINE INITIAL TARGET POSN, VELOCITY X,Y & Z IN KFT; VX,VY & VZ IN KFT/SEC
SH X Y Z VX VY VZ		DEFINE INITIAL SHOOTER POSN, VELOCITY

FIXED TARGET MODE (MENU)

LATITUDE OF TARGET
LONGITUDE OF TARGET
HEIGHT OF TARGET
TARGET/SHOOTER ORIENTATION ANGLE (FLIGHT LINE)
VERIFY YES NO

Figure 3.1(Cont'd)

ANSWER LIST (P2457)

#	NAME	UNITS
1	ALTITUDE OF SHOOTER	FEET
2	ALTITIDE OF TARGET	FEET
3	DELTA ALTITIDE	FEET
4	ALTITIDE RATE OF SHOOTER	FT/SEC
5	ALTITIDE RATE OF TARGET	FT/SEC
6	SLANT RANGE	NM OR FEET
7	LATERAL SEPARATION	FEET
8	GROUND RANGE	FEET
9	VELOCITY OF SHOOTER	KNOTS
10	VELOCITY OF TARGET	KNOTS
11	GROUND VELOCITY OF SHOOTER	FT/SEC
12	GROUND VELOCITY OF TARGET	FT/SEC
13	MACH NUMBER OF SHOOTER	MACH
14	MACH NUMBER OF TARGET	MACH
15	CLOSING VELOCITY	FT/SEC
16	TIME TO GO	SEC
17	BEARING	DEG
18	COURSE OF SHOOTER	DEG
19	COURSE OF TARGET	DEG
20	ANGLE OFF SHOOTER	DEG
21	ANGLE OFF TARGET	DEG
22	FLIGHT PATH OF SHOOTER	DEG
23	FLIGHT PATH OF TARGET	DEG
24	TRACK CROSSING ANGLE	DEG
25	DEPRESSION ANGLE	DEG
26	IMPACT LATITIDE	DEG
27	IMPACT LONGITUDE	DEG
28	DOWNRANGE	FEET
29	TIME-TO-FIRING RANGE 1	FEET
30	TIME-TO-FIRING RANGE 2	FEET

Figure 3.1(Cont'd)

FUNCTION KEY DEFINITIONS

KEY NO	DESCRIPTION
1	RADAR TIME HISTORIES
2	VERTICAL DISPLAY
3	BACKGROUND MAP # 1
4	BACKGROUND MAP # 2
5	BACKGROUND MAP # 3
6	BACKGROUND MAP # 4
7	FCS HIGH-LOW/LONG-SHORT
8	FCS HIGH-LOW/RIGHT-LEFT
9	TABULATION OF SHIP LOCATION AND TIME OF MARKING
10	DISPLAY OF HAZARD FIGURE PARAMETERS
11	NOT USED
12	NOT USED
13	NOT USED
14	NOT USED
15	NOT USED
16	MAKE A HARD COPY

Figure 3.1(Cont'd)

REFERENCES

1. Eglin Range Safety Color Graphics Display Unit Evaluation (Engineering Report ER-TC-SER-82-2, TYBRIN Corporation, 20 April 1982).

2. Real-Time Range Safety Algorithm Requirements (Engineering Report ER-TC-SER 82-1, TYBRIN Corporation, 7 May 1982).

3. Southeastern Test and Training Area Plan for Gulf Range Upgrade (Prepared by SETTA Range Improvement Committee, May 1981).

STATEMENT OF WORK

A result of Task SER 82-2, "Real-Time Range Safety Display Device Requirement Study", will be recommendations for updating the Eglin real-time display device capabilities. In order to make optimal use of the recommended new hardware capabilities, new software must be developed.

The contractor is directed (in close coordination with SER personnel) to develop a comprehensive set of display graphics/numerics requirements for range safety use on the upgraded Eglin real time computer configuration. Preliminary results of Task SER 82-2 indicate that the following capabilities should be considered in the development:

- Color - The software which currently provides graphic displays for real-time monitoring of weapons tests by Range Safety personnel contains no provisions for presenting information in colors, as would be desirable if color-capable display units were utilized.
- The use of symbolic pictorial outlines for elements involved in the test (e.g., various size aircraft outlines, various weapon outlines, ship outlines, tank outlines) to provide instant recognition and comprehension to personnel monitoring the test.
- The capability to enter map coordinates or other data, such as destruct lines, debris patterns, or firing fans, (either on a permanent or temporary

basis) via tracing mechanisms linked to the display units.

- The presentation of two sets of graphic (or graphic/digital) information in a split-screen mode (variable sizing per presentation).
- The capability to re-position displayed information on the screen by means of a display control device (trackball, mouse, joystick).
- The ability to enlarge selected areas of information (e.g., one segment of a map) either by zooming or by step-size functions.

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