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Users Guide for EASI Graphics

Dallas W. Sasser

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USERS GUIDE FOR EASI GRAPHICS

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ABSTRACT

EASI (Estimate of Adversary Sequence Interruption) is an analytical technique for measuring the effectiveness of physical protection systems. EASI Graphics is a computer graphics extension of EASI which provides a capability for performing sensitivity and trade-off analyses of the parameters of a physical protection system. This document reports on the implementation of EASI Graphics and illustrates its application with some examples.

CONTENTS

		Page
I	INTRODUCTION	7
II	DISCUSSION	9
	General Discussion of EASI Method	9
	Implementation and Computer Requirements for EASI Graphics	10
	EASI Graphics Evaluation Procedure	11
	Graphical Output Options	15
III	EXAMPLE OF EASI GRAPHICS APPLICATION	23
	Input Requirements for EASI Graphics	23
	Interpretation of EASI Graphics Output	25
	Modifying EASI Graphics Input	28
IV	SUMMARY AND CONCLUSIONS	33
V	REFERENCES	33
APPENDIX A -- THE EASI MATHEMATICAL METHODOLOGY		35
APPENDIX B -- EASI GRAPHICS PROGRAM LISTING		41
APPENDIX C -- PLOT OPTIONS ILLUSTRATED FOR EXAMPLE PROBLEM		83

ILLUSTRATIONS

Figure		Page
1	Flow Chart for EASI Graphics Instruction/Analyst Interface	12
2	Adversary Action Sequence for EASI Graphics Example	13
3	Adversary Time-Sequence Path for Sabotage (Outsider)	14
4	Probability of Interruption vs. Time for Task 5	17
5	Probability of Interruption as a Function of P_d for Sensor 3 and Time for Task 5	18
6	Example of Plot with Oversize Scale	20
7	Reduced-Scale Plot of Example Shown in Figure 6	21
8	Probability of Interruption vs. Response Force Time	25
9	Probability of Interruption vs. Time to Complete Task 5	26
10	Probability of Interruption vs. P_d for Sensor 3	27
11	Probability of Interruption vs. P_d for Sensor 3 and Time to Complete Task 5	28
12	Probability of Interruption vs. Time for Task 5 for Increased Value of P_d Sensor 3	30
13	Probability of Interruption vs. Response Time and Time for Task 5 for Increased Value of P_d for Sensor 3	31

TABLES

Table		Page
I	Numerical Input for Example	15
II	Available Plot Options	16
III	Instructions on Use of EASI Graphics	23
IV	EASI Graphics Input for Example Problem	24
V	Sample of Changes to Input Data	29

I. INTRODUCTION

A relatively simple, easy to use method of evaluating physical protection system performance at a fixed-site nuclear facility has been developed.[1] This method, called Estimate of Adversary Sequence Interruption (EASI), calculates the probability of interrupting an adversary along a physical path described by (1) probability of detection, (2) adversary delay time, (3) probability of communications, and (4) security force response time. The EASI evaluation can be performed on hand-held programmable calculators.[2,3]

A versatile computer graphics version of EASI has also been developed. This EASI Graphics program allows the user to input facility and adversary path attributes at computer graphics terminal. The output consists of a value for the probability of adversary sequence interruption and a variety of user selected plots. These plots provide information related to the sensitivity of the probability of interruption to changes in facility safeguards components. This information provides a basis for evaluating and designing fixed-site security systems.

The purpose of this report is to provide a guide for evaluating physical protection systems using the EASI Graphics program. Instructions are provided for implementing the EASI program on a graphics terminal and for describing an adversary path for evaluation. A specific example which illustrates the plotting capability of EASI Graphics is also presented.

II. DISCUSSION

General Discussion of EASI Method

The Estimate of Adversary Sequence Interruption computer code is an analytical technique for evaluating the effectiveness of physical protection systems. The EASI method consists of a probabilistic analysis of the interactions of basic security functions and is used to calculate the probability of interruption of specific adversary action sequences. Adversary action sequences can include an outsider entering a facility for the purpose of sabotage or theft or an insider either gaining access to a vital area for the purpose of sabotage or gaining access to Special Nuclear Materials (SNM) and egressing.

The EASI code has been adapted for use on hand-held calculators to provide a tool for quick, "first cut," evaluations of physical security systems. EASI is also available as an interactive graphics program for use on computers equipped with an interactive graphics terminal.

The basis of the EASI method is that, for a resolute theft or sabotage attempt to be averted, the response force must be notified of the attempt while there is still sufficient time remaining in the adversary's action sequence for the force to respond and interrupt the sequence. The response force is assumed to be adequate enough to at least delay adversary progress until additional forces arrive to neutralize the adversary.

Input data required for EASI Graphics include (1) the average guard force response time, (2) the standard deviation of security force response time, (3) the probability of communication with the security force, and (4) an adversary action sequence. Each adversary action sequence takes place along a path which includes a starting point, a sequence of detection methods and barriers, and a terminal point. An adversary attempting to use such a path to accomplish a goal of theft or sabotage must defeat each barrier and traverse each open area along the path. Each of these adversary activities is called a task.

Tasks are ordered in time, beginning at the outermost barrier (e.g., a perimeter fence in the case of an outsider or an internal secure area in the case of an insider) and proceeding to the target or terminal point. Associated with each task is an average time to complete the task and a standard deviation.

Also associated with each task is a sensor for detecting adversary activities (e.g., a door alarm, a closed-circuit television (CCTV) camera, etc.). The probability that this sensor will be activated is the probability of detection (P_d) for the particular type of sensor assumed. If there is no sensor associated with a task, the probability of detection is set equal to zero.

The probability of interruption [P(I)] is calculated for each adversary action sequence based on the input parameters. A number of plotting options are available to the user of EASI Graphics. These plots provide the user with information on the sensitivity of the parameters of the system.

A mathematical development of the EASI method is included in Appendix A.

Implementation and Computer Requirements for EASI Graphics

EASI Graphics provides an interactive interface between the analyst and the computer. This interface allows the user to interrogate the computer, input appropriate physical protection system data, modify the input data or facility design, and select the desired output. Program control is provided by the EASI Graphics code, which prompts the user by requesting information and directing the detailed analysis.

The Sandia Laboratories EASI Graphics program uses a Tektronix 4014 graphics terminal to interface with the CDC 6600 time-sharing computer. Sandia users can access the EASI Graphics code at any appropriate graphics terminal by using the following input:

```
GET,UEASI/UN=DWSASSE      (RETURN)
/-UEASI                   (RETURN)
```

The EASI Graphics code is also available to other users as an ANSI standard FORTRAN program which should be easily adapted to any computer with adequate memory and a compatible graphics terminal. Two additional software packages are required: DISSPLA, which is a proprietary product marketed by Integrated Software Systems Corporation, and PLOT-10, which is the Tektronix terminal control and plotting software package. A complete program listing for EASI Graphics is contained in Appendix B.

Instructions for implementing each segment of the program are displayed on the terminal screen by the computer upon completion of the preceding step. A flow chart which illustrates the EASI Graphics instruction/analyst interface is

shown in Figure 1. At each decision point within the program, the computer queries the user for a decision or further information. An evaluation of an adversary action sequence using EASI can be accomplished through the use of questions and requests for information by the computer and responses by the analyst.

EASI Graphics Evaluation Procedure

A hypothetical fixed-site facility and one possible adversary action sequence associated with that facility are shown in Figure 2. This facility will be used to illustrate the EASI evaluation procedure and to define a set of input parameters for the EASI Graphics example described in Section III. Details of the facility evaluation procedures using EASI have been reported previously.[2] The following discussion is included in this report to clarify the example and for completeness. The reader is referred to Reference 2 for additional information on the use of EASI.

Potential adversary targets in Figure 2 are the SNM and the vital component. For this example, only the physical path shown in Figure 2 will be considered. This problem involves examining the vulnerability of the facility to a sabotage attempt by an unauthorized adversary (outsider). Further study of this facility would require that other possible adversary action sequences related to sabotage or theft be evaluated.

Since this problem involves unauthorized entry, the adversary sequence must begin somewhere on the facility boundary, in this case at the perimeter fence. The entire adversary sequence consists of penetrating the perimeter fence, crossing the open area between the fence and the facility's main building, penetrating the locked exterior door, traversing the hallway, and finally penetrating the locked interior door to the target (vital component).

While outside the building, the adversary is subject to surveillance by the CCTV (Sensor 3).* In addition, sensors on both the locked exterior door (Sensor 5) and the locked interior door (Sensor 7) provide adversary detection functions.

The adversary action sequence consists of seven tasks: (1) penetrate fence, (2) cross open area to position of the CCTV, (3) cross open area between

*The sensors are numbered to correspond to the task with which they are associated.

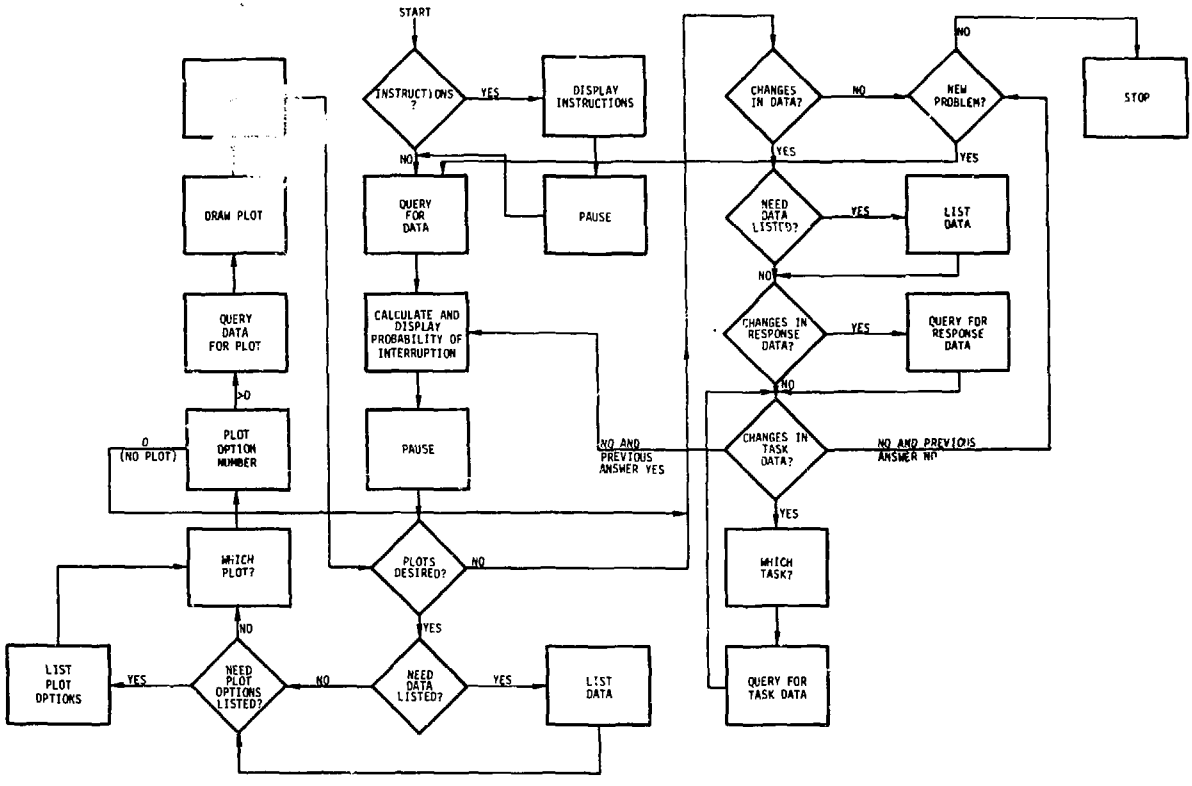


Figure 1. Flow Chart for EASI Graphics Instruction/Analyst Interf[illegible].

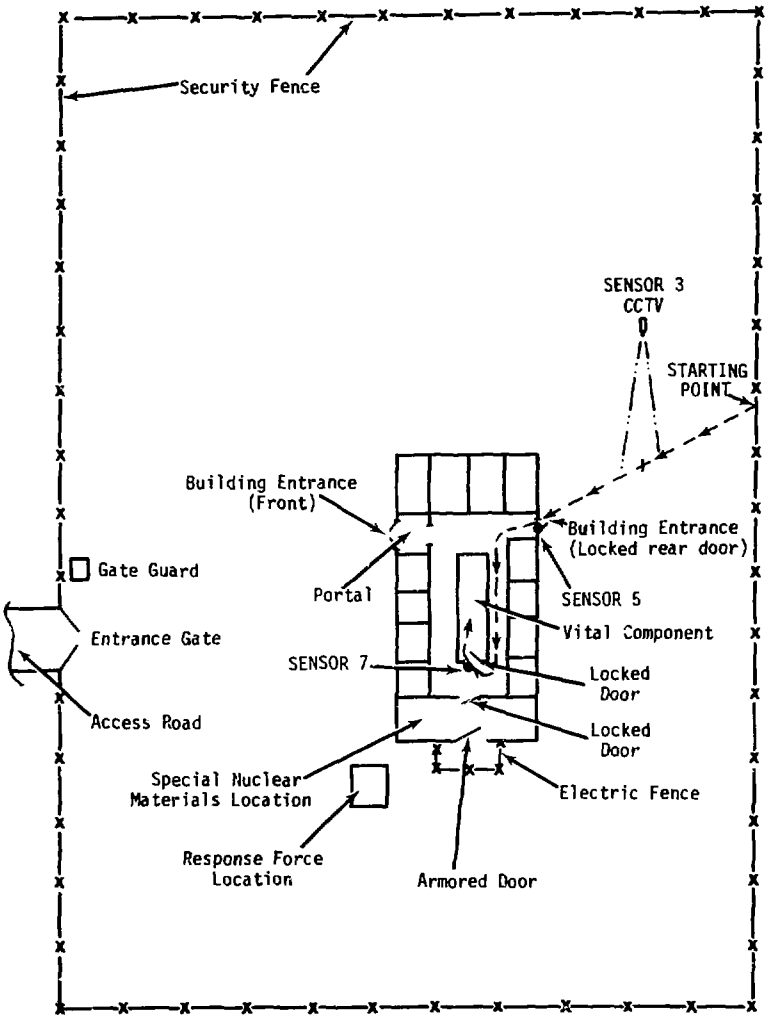
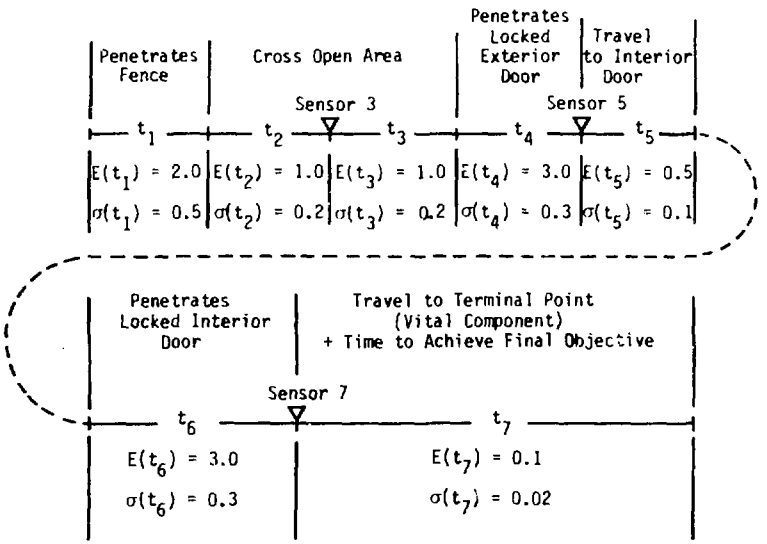


Figure 2. Adversary Action Sequence for EASI Graphics Example.

the CCTV and the main building, (4) penetrate locked exterior door, (5) travel to locked interior door, (6) penetrate locked interior door, and (7) travel to vital component and achieve objective. The adversary time-sequence path (in minutes) for this adversary action sequence is shown in Figure 3.



where: $E(t_i)$ = Expected value (mean) of time to accomplish Task i

$\sigma(t_i)$ = Standard deviation of the mean for Task i

Figure 3. Adversary Time-Sequence Path for Sabotage (Outsider).

Each task is specified by the mean time required to accomplish that task and a standard deviation. Sensors which may provide adversary detection are located at the beginning of their associated task. In this example, Sensor 3 is associated with Task 3, Sensor 5 with Task 5, and Sensor 7 with Task 7.

The input data derived from the time-sequence path in Figure 3 are summarized in Table I. (The procedures by which these data are input to the computer are outlined in Section III, which follows.) Given these data, EASI Graphics calculates the probability of interruption for the particular adversary action sequence described in Figure 3. If the value of P(I) is not sufficiently

high, the input data can be modified and a new value of P(I) calculated. This iterative procedure allows the user to change the performance characteristics of selected physical protection system components until P(I) is satisfactory. This analytical procedure should be performed for other adversary action sequences.

TABLE I

Numerical Input for Example

Response Force Specifications

Mean Response Time	4.0 minutes
Standard Deviation	0.16 minutes
Probability of Communication	0.9

Adversary Time-Sequence Path

Task	Task Time (min) Mean	Task Time (min) Standard Deviation	Probability of Detection (P_d)
1	2.0	0.5	0
2	1.0	0.2	0
3	1.0	0.2	0.3
4	3.0	0.3	0
5	0.5	0.1	0.97
6	3.0	0.3	0
7	0.1	0.02	0.97

Graphical Output Options

The results of the EASI analysis are expressed in terms of the probability that the physical protection system can respond in time to interrupt specific adversary action sequences. EASI calculates and displays P(I) for each defined adversary action sequence. To supplement the EASI calculations, EASI Graphics provides the analyst with a selection of six two-dimensional and eight three-dimensional plots. These plots allow the user to examine the sensitivities of various components along the adversary's path and to study the effect on the probability of interruption of varying the performance of these components. The available plotting options are summarized in Table II.

With the exception of Plot No. 1, the dependent variable for each EASI Graphics plot is the probability of interruption. The dependent variable may

be plotted as a function of one or two independent variables related to the input data, i.e., response time, probability of communication, task time, or probability of detection. The three-dimensional surfaces and two-dimensional curves generated by EASI Graphics may be used to estimate the value of P(I) for different values of the independent variables.

TABLE II

Available Plot Options

Option Number	Description
0	No Plot
	Two-Dimensional Plots
1	Probability of Alarm vs. Time to Terminal Point
2	Probability of Interruption vs. Time to Terminal Point
3	Probability of Interruption vs. Response Time
4	Probability of Interruption vs. Probability of Communication
5	Probability of Interruption vs. Task Time
6	Probability of Interruption vs. Probability of Detection
	Three-Dimensional Plots
	Probability of Interruption as a function of:
7	Response Time and Probability of Communication
8	Task Time and Probability of Detection
9	Response Time and Task Time
10	Response Time and Probability of Detection
11	Probability of Communication and Probability of Detection
12	Task Time and Probability of Communication
13	Task Time and Task Time
14	Probability of Detection and Probability of Detection

For those plots which include task time or probability of detection, the user must specify which task number(s) or sensor(s) is to be used. For example, Figure 4 shows the EASI Graphics plot of the probability of interruption versus task time for Task 5. Prior to executing this plot, the computer would request that the user specify the task number to be plotted. Similarly, Figure 5

illustrates a three-dimensional plot using both task time and the probability of detection. The interaction between the computer and analyst necessary to generate this plot is shown on the following page.*

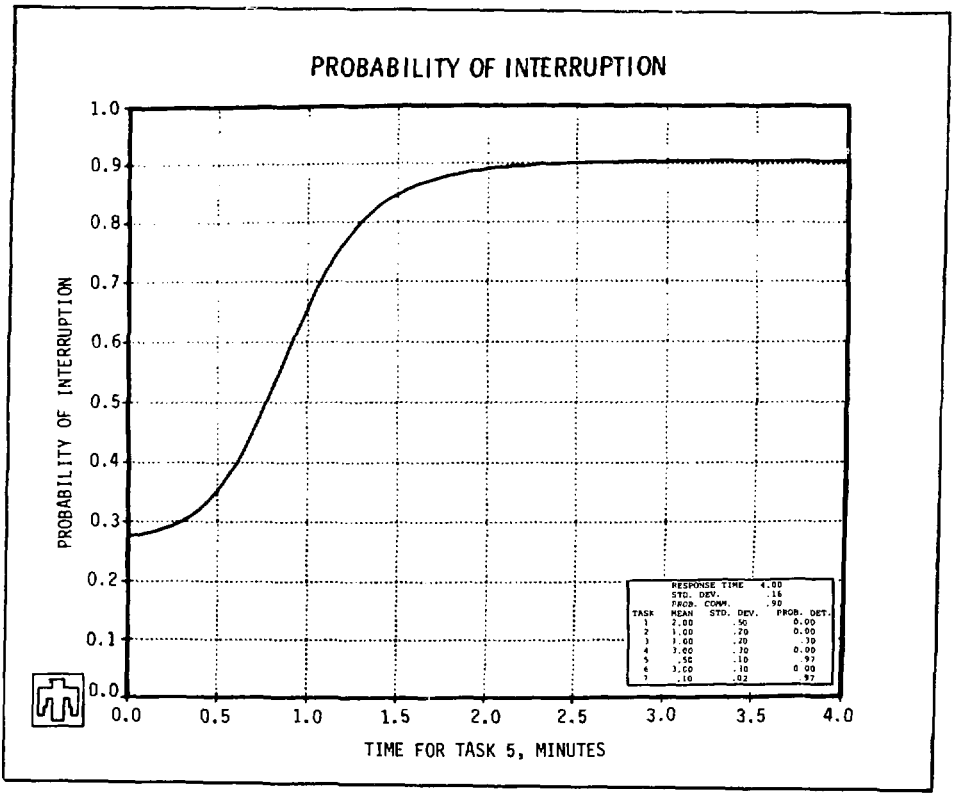


Figure 4. Probability of Interruption vs. Time for Task 5.

*Computer input prompts are indicated by a question mark. Analyst input is followed by a "RETURN" entered at the terminal.

```
WHICH TASK TIME IS THE VARIABLE
ENTER TASK NUMBER    RETURN
? 5

ENTER RATIO OF MEAN TASK TIME TO STANDARD DEVIATION    RETURN
? 5
DO YOU WANT TO SET YOUR OWN SCALE ?1=YES,0=NO    RETURN
? 0

WHICH SENSOR IS THE VARIABLE
ENTER SENSOR NUMBER    RETURN
? 3
```

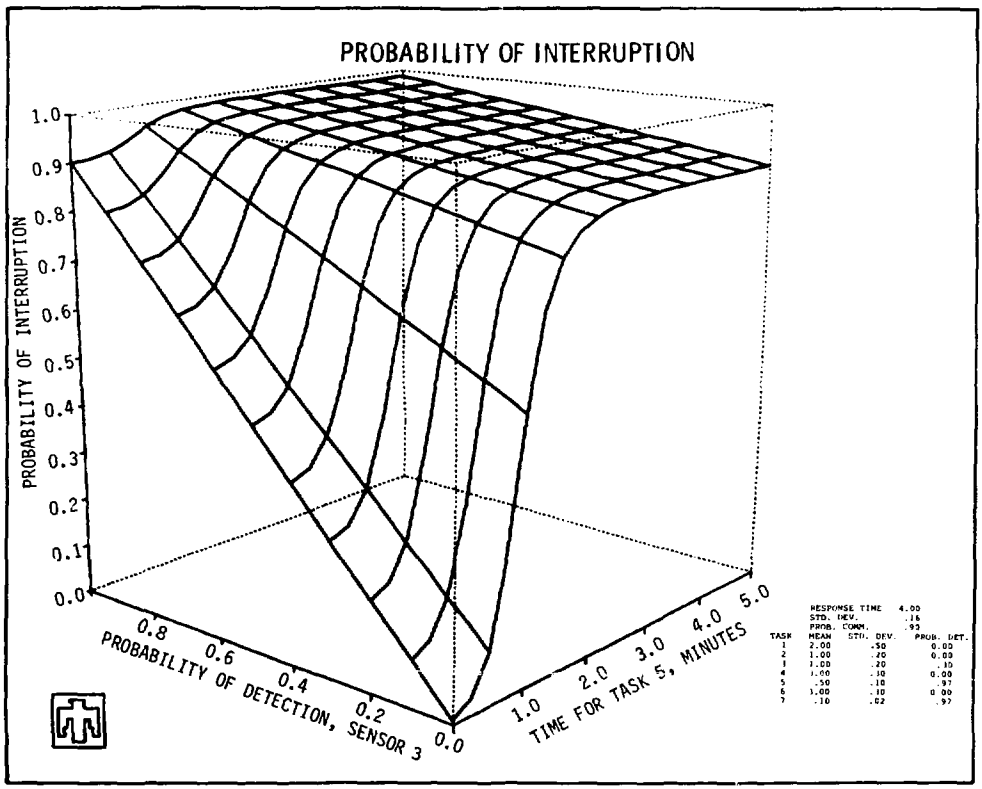


Figure 5. Probability of Interruption as a Function of P_d for Sensor 3 and Time for Task 5.

In addition to requesting appropriate task and sensor numbers, the computer must determine the maximum scale for the task time or response time. As shown in the preceding exchange, the computer requests the ratio of the mean task (or response) time to the standard deviation when these variables are necessary for a plot. This ratio is used to determine the appropriate scale for the axes.

The user also has the option of setting the scale for any independent variables except probabilities. This option is useful for examining smaller sections of a plot or for expanding the plot if the original scale is too large. Figure 6 shows an example of an original plot where the generated curve does not extend the full length of the graph. This plot can be expanded by interaction with the computer as follows:*

```
DO YOU WANT TO SET YOUR OWN SCALE ?1=YES,0=NO   RETURN
? 1
NEED XMAX, MAXIMUM VALUE OF RESPONSE TIME,
AND XSTP, SPACING FOR TICK MARKS, XMAX SHOULD BE
A MULTIPLE OF XSTP.
ENTER MAXIMUM VALUE OF RESPONSE TIME
? 10
ENTER TICK MARK SPACING
? 1
```

The resulting plot is shown in Figure 7. The maximum value of the abscissa (XMAX) has been reduced from 16 to 10; the tick mark spacing (XSTP) remains fixed at 1. Except in unusual situations, the user should adhere to the computer warning on changing the scale and assure that XMAX is a multiple of the tick mark spacing (XSTP). If this is not done, the plot will still be accurate but will appear nonstandard and may be confusing to the user.

*Computer input prompts are indicated by a question mark. Analyst input is followed by a "RETURN" entered at the terminal.

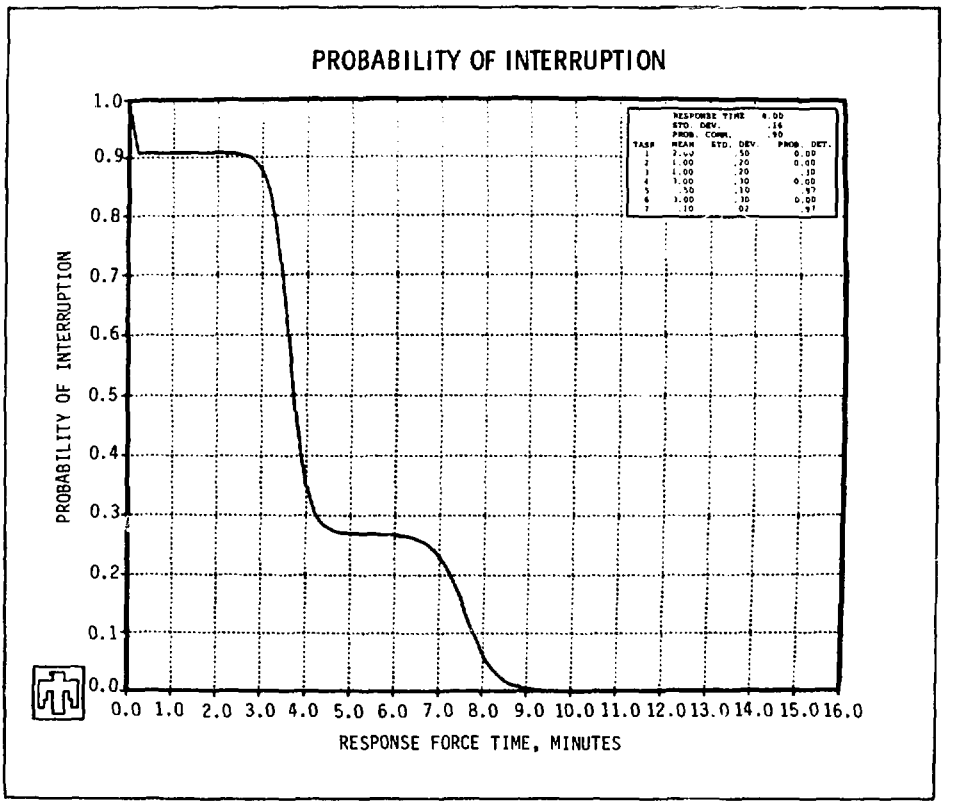


Figure 6. Example of Plot with Oversize Scale.

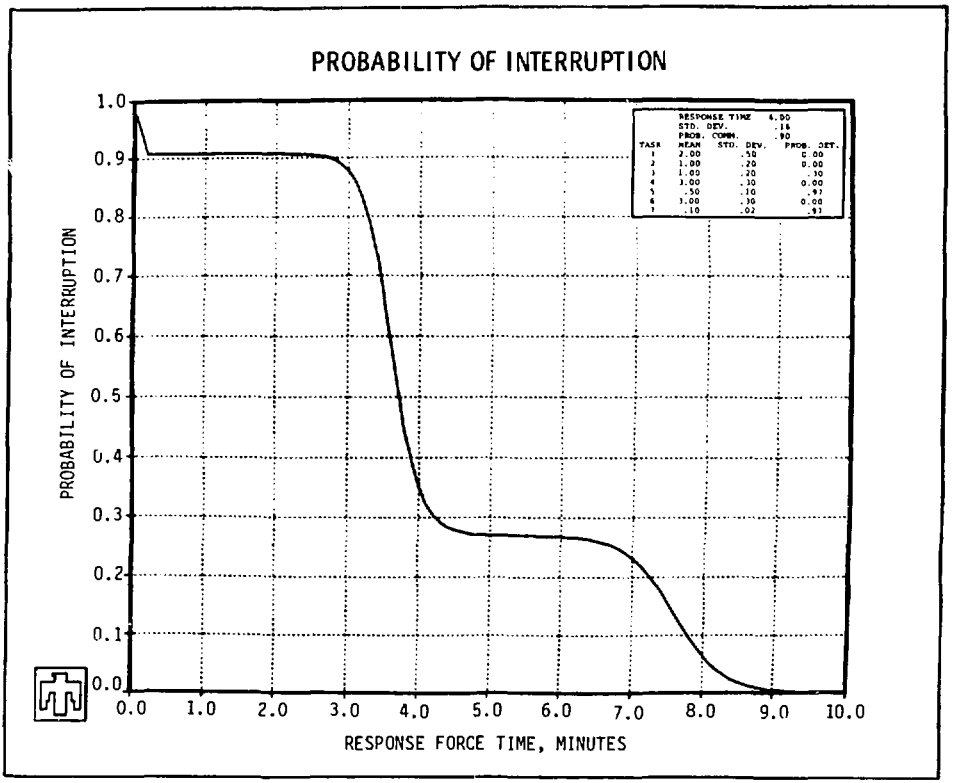


Figure 7. Reduced-Scale Plot of Example Shown in Figure 6.

III. EXAMPLE OF EASI GRAPHICS APPLICATION

The adversary action sequence diagrammed in Figure 2 was used as an example problem for EASI Graphics. This section presents details of the user/computer interactions which provide the input, output, and facility modifications required for a complete evaluation of the specific example adversary action sequence. The sensitivity of P(I) to changes in selected physical protection system components is also examined, and facility modifications which appear to improve the value of P(I) are discussed.

Input Requirements for EASI Graphics

Program initialization and instructional comments are available to the EASI Graphics user (see Table III). These instructions may be listed at the discretion of the user. In addition, once the input data have been entered into the computer, these data may be recalled prior to requesting graphical output.

TABLE III

Instructions on Use of EASI Graphics

```
FOR INSTRUCTIONS ON USE OF THIS PROGRAM, ENTER 1,
OTHERWISE 0        THEN RETURN
? 1
   PAUSE
THIS PROGRAM PROVIDES GRAPHIC OUTPUT FOR EASI (ESTIMATE OF ADVERSARY SEQUENCE
INTERRUPTION).  EASI IS AN ANALYTICAL TECHNIQUE FOR EVALUATING THE EFFECTIVENESS
OF PHYSICAL SECUPITY SYSTEMS.  SCENARIOS CAN INCLUDE AN OUTSIDER ENTERING A
FACILITY FOR THE PURPOSE OF SABOTAGE OR THEFT OR AN INSIDER EITHER GAINING
ACCESS TO A VITAL AREA FOR THE PURPOSE OF SABOTAGE OR GAINING ACCESS TO
MATERIAL AND EGRESSING.  DATA INPUT REQUIRED FOR THE PROGRAM ARE AVERAGE GUARD
FORCE RESPONSE TIME AND STANDARD DEVIATION, PROBABILITY OF COMMUNICATION (WHICH
IS THE PROBABILITY THAT THE GUARDS ARE NOTIFIED WHEN A SENSOR IS ACTIVATED),
AND THE ADVERSARY ACTION SEQUENCE (AAS).  THE AAS IS DESCRIBED IN TERMS OF A
NUMBER OF TASKS, ORDERED IN TIME, WHICH THE ADVERSARY HAS TO PERFORM.
ASSOCIATED WITH EACH TASK IS AN AVERAGE TIME TO PERFORM AND A STANDARD DEVIATION.
IN ADDITION, ASSOCIATED WITH EACH TASK IS A SENSOR WHICH CAN BE ACTIVATED AT THE
BEGINNING OF THE TASK.  THE PROBABILITY THAT IT WILL BE ACTIVATED IS THE
PROBABILITY OF DETECTION WHICH CAN BE SET TO ZERO TO REPRESENT NO SENSOR.
AFTER THE DATA ARE INPUT, THE PROBABILITY OF INTERRUPTION IS CALCULATED AND
DISPLAYED.  THIS IS THE PROBABILITY THAT THE ADVERSARY IS INTERRUPTED BY THE
GUARD FORCE BEFORE THE ADVERSARY'S MISSION IS COMPLETED.  THE USER IS THEN
PRESENTED WITH A NUMBER OF OPTIONS FOR PLOTTING WHICH PROVIDE THE USER WITH
INFORMATION ON THE SENSITIVITY OF THE PARAMETERS OF THE SYSTEM.

PRESS RETURN TO CONTINUE.
?
```

The data shown in Table I were used as input for this example. The sequence of analyst/computer interactions required to input these data is given in Table IV. The input consists of (1) response force characteristics, (2) number of tasks, and (3) task description. Each task description includes the mean time to perform the task, standard deviation, and the probability of detection of the sensor associated with that task. Since there are sensors only for Tasks 3, 5, and 7, all other probabilities of detection were set to zero for this example.

TABLE IV

EASI Graphics Input for Example Problem*

```
    ENTER RESPONSE FORCE CHARACTERISTICS
MEAN RESPONSE TIME    RETURN
? 4
STANDARD DEVIATION    RETURN
? .16
PROBABILITY OF COMMUNICATION    RETURN
? .9
    ENTER TASK DATA
ENTER NUMBER OF TASKS    RETURN
? 7
DATA FOR TASK 1
MEAN TIME TO PERFORM TASK    RETURN
? 2
STANDARD DEVIATION    RETURN
? .5
PROBABILITY OF DETECTION(IF NO SENSOR ENTER 0)    RETURN
? 0
DATA FOR TASK 2
MEAN TIME TO PERFORM TASK    RETURN
? 1
STANDARD DEVIATION    RETURN
? .2
PROBABILITY OF DETECTION(IF NO SENSOR ENTER 0)    RETURN
? 0
DATA FOR TASK 3
MEAN TIME TO PERFORM TASK    RETURN
? 1
STANDARD DEVIATION    RETURN
? .2
PROBABILITY OF DETECTION(IF NO SENSOR ENTER 0)    RETURN
? .3
DATA FOR TASK 4
MEAN TIME TO PERFORM TASK    RETURN
? 3
STANDARD DEVIATION    RETURN
? .3
PROBABILITY OF DETECTION(IF NO SENSOR ENTER 0)    RETURN
? 0
DATA FOR TASK 5
MEAN TIME TO PERFORM TASK    RETURN
? .5
STANDARD DEVIATION    RETURN
? .1
PROBABILITY OF DETECTION(IF NO SENSOR ENTER 0)    RETURN
? .97
DATA FOR TASK 6
MEAN TIME TO PERFORM TASK    RETURN
? 3
STANDARD DEVIATION    RETURN
? .3
PROBABILITY OF DETECTION(IF NO SENSOR ENTER 0)    RETURN
? 0
DATA FOR TASK 7
MEAN TIME TO PERFORM TASK    RETURN
? .1
STANDARD DEVIATION    RETURN
.02
PROBABILITY OF DETECTION(IF NO SENSOR ENTER 0)    RETURN
? .97
PAUSE
    PROBABILITY OF ADVERSARY INTERRUPTION = .352
PRESS RETURN TO CONTINUE
?
```

*Computer input prompts are indicated by a question mark. Analyst inputs are followed by a "RETURN" entered at the terminal.

Following input, the computer automatically calculates and displays the probability of adversary interruption for that particular adversary action sequence; P(I) is 0.352 for this example. At this point in the program the user may either select a number of plots of the computer generated data or modify the input data to examine the effect of these changes on the probability of adversary interruption.

Interpretation of EASI Graphics Output

The low probability of interruption for the example indicates that, for this specific adversary action sequence, the facility safeguards systems are not adequate against a forcible adversary attack with an intent of sabotage. In order to investigate possible safeguards system upgrades to improve the probability of interruption, the user would probably request a complete set of EASI Graphics plots. Such a set of plots for the example are given in Appendix C. Selected plots which emphasize the sensitivity of critical system components are shown in Figures 8 through 11.

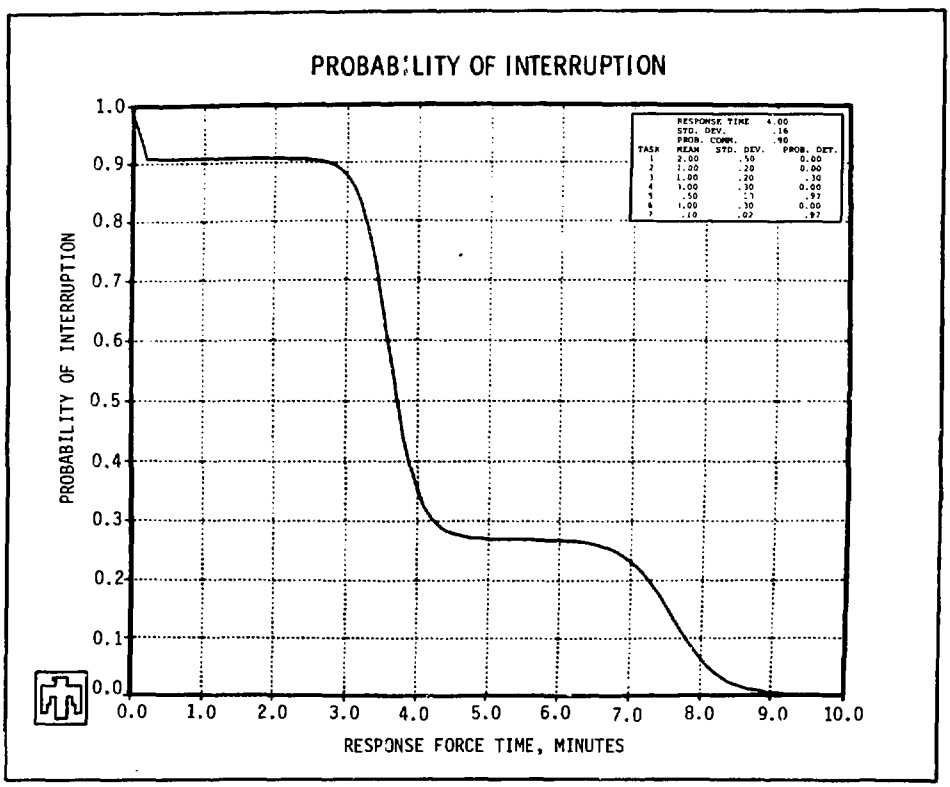


Figure 8. Probability of Interruption vs. Response Force Time.

Figure 8 shows the change in P(I) associated with changes in the guard force response time. For the example adversary action sequence, a rather small decrease in response time can significantly increase the probability of interruption. As shown in Figure 8, the original response force time of 4.0 minutes yields a P(I) of 0.352; however, decreasing the response time to 3.0 minutes increases P(I) to approximately 0.88.

Task 5 involves the adversary traversing an ordinary hallway between the exterior door and the door leading to the target. In this example, Task 5 required a mean time of 0.5 minute to accomplish. As shown in Figure 9, if the time required for the adversary to travel down the hallway can be increased to

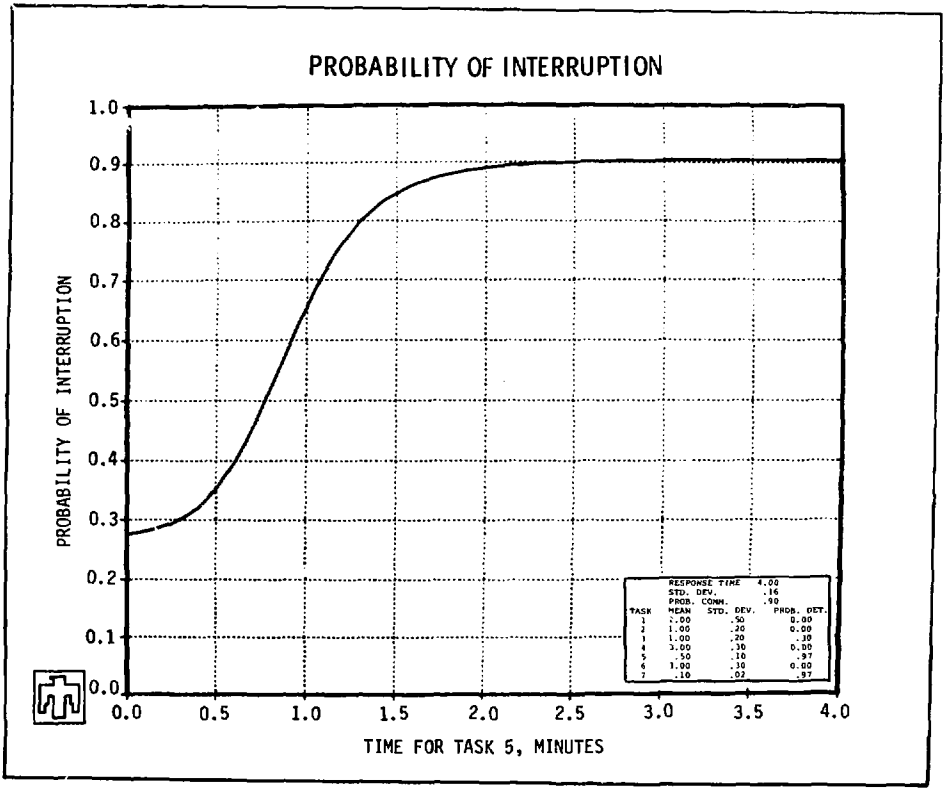


Figure 9. Probability of Interruption vs. Time to Complete Task 5.

Interpretation of EASI Graphics Output

The low probability of interruption for the example indicates that, for this specific adversary action sequence, the facility safeguards systems are not adequate against a forcible adversary attack with an intent of sabotage. In order to investigate possible safeguards system upgrades to improve the probability of interruption, the user would probably request a complete set of EASI Graphics plots. Such a set of plots for the example are given in Appendix C. Selected plots which emphasize the sensitivity of critical system components are shown in Figures 8 through 11.

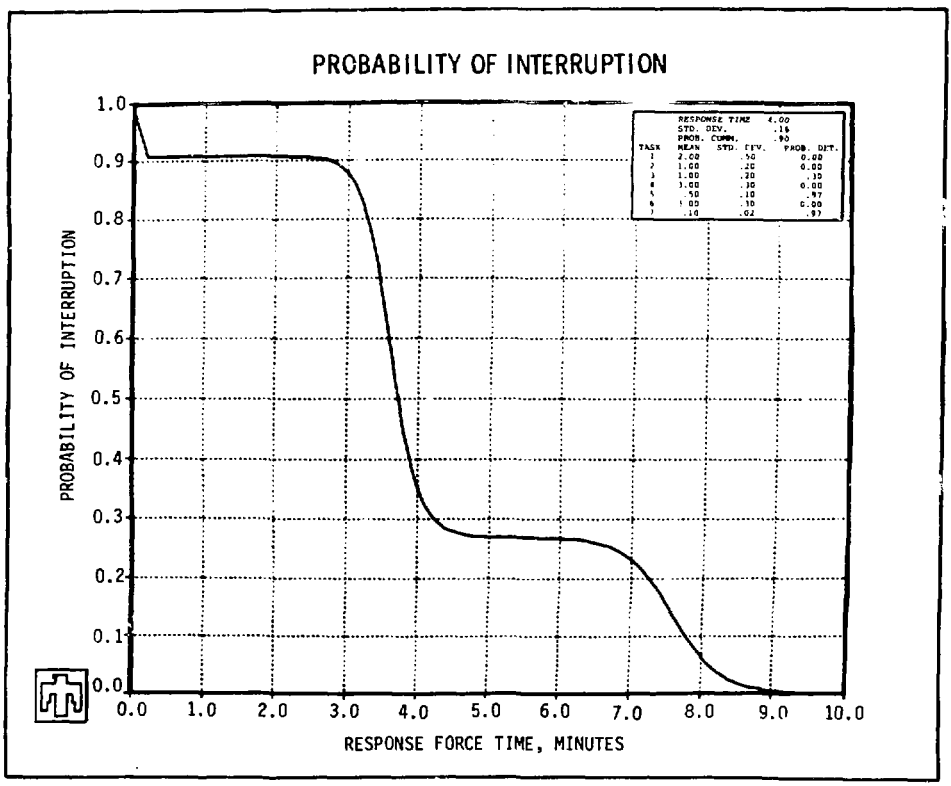


Figure 8. Probability of Interruption vs. Response Force Time.

Figure 8 shows the change in P(I) associated with changes in the guard force response time. For the example adversary action sequence, a rather small decrease in response time can significantly increase the probability of interruption. As shown in Figure 8, the original response force time of 4.0 minutes yields a P(I) of 0.352; however, decreasing the response time to 1.0 minutes increases P(I) to approximately 0.88.

Task 5 involves the adversary traversing an ordinary hallway between the exterior door and the door leading to the target. In this example, Task 5 required a mean time of 0.5 minute to accomplish. As shown in Figure 9, if the time required for the adversary to travel down the hallway can be increased to

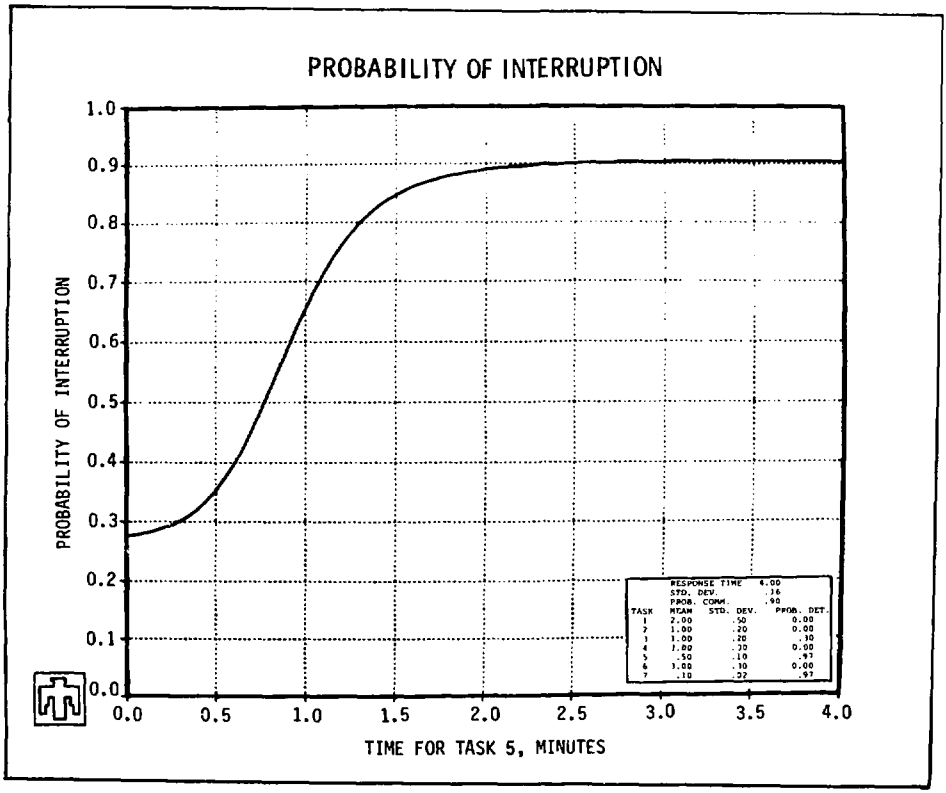


Figure 9. Probability of Interruption vs. Time to Complete Task 5.

between 2.0 and 2.5 minutes, the value of P(I) approaches 0.9. Such a delay could be obtained, for example, by the installation of a hallway barrier which is deployed based on the sensor (alarm) at the exterior door (Sensor 5).

An increase in P(I) could also be attained by increasing the probability of detection for one or more of the sensors in the facility. Since P_d for the sensors located at the exterior and interior doors is already 0.97, only the value of P_d for the CCTV sensor was changed. Figure 10 illustrates the effects on P(I) of varying P_d for Sensor 3. The sensitivity of the probability of interruption is not as great in this case as it is for changes in the response time or mean task time for Task 5. For example, P_d for Sensor 3 would have to be increased to over 0.85 in order to achieve a P(I) exceeding 0.8.

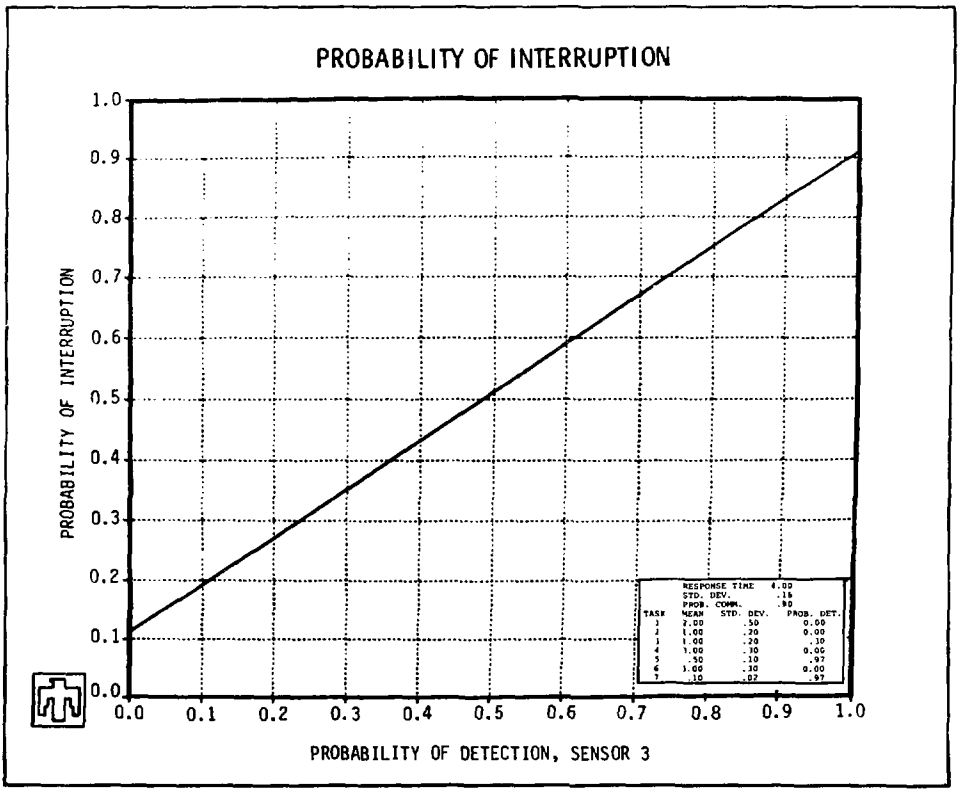


Figure 10. Probability of Interruption vs. P_d for Sensor 3.

Figure 11 illustrates the combined sensitivities for P_d of Sensor 3 and the mean task time for Task 5. Using plots similar to Figure 11, the analyst can investigate the effect of simultaneously varying two parameters. For example, doubling the Task 5 mean time to 1.0 minute and P_d of Sensor 3 to 0.6 produces a P(I) of approximately 0.75 to 0.8.

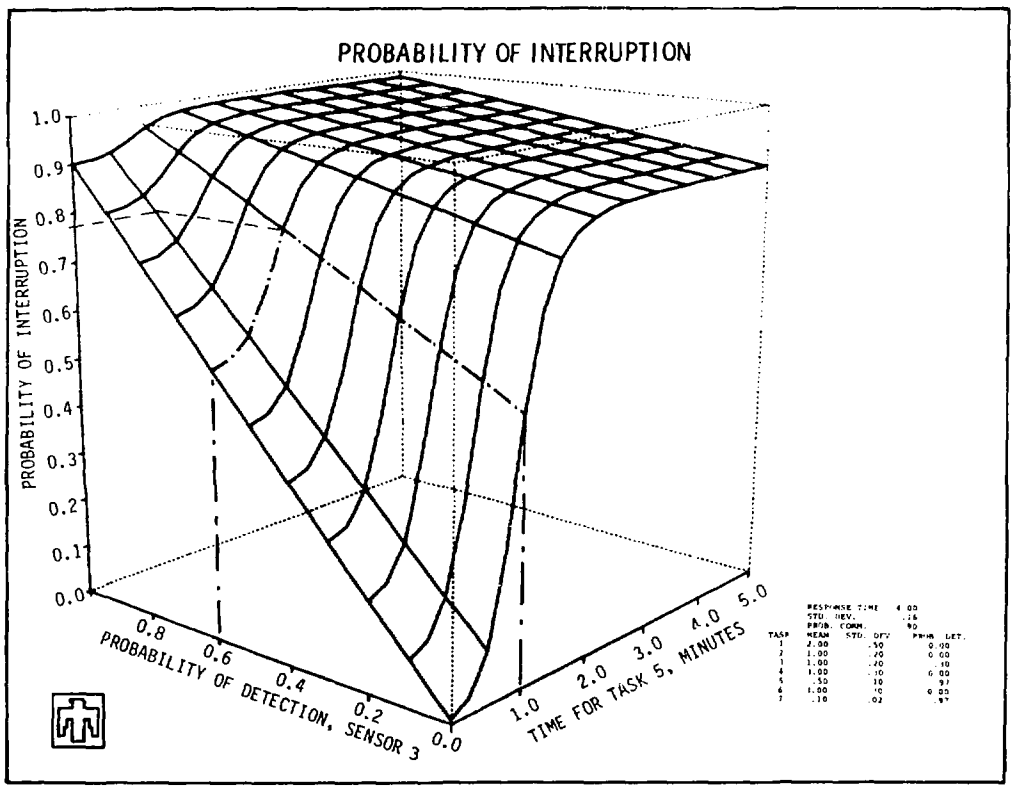


Figure 11. Probability of Interruption vs. P_d for Sensor 3 and Time to Complete Task 5.

Modifying EASI Graphics Input

A calculation of the value of P(I) which would result from changing the performance values of selected facility safeguards components can be obtained

by modifying the EASI Graphics input data. Table V illustrates the analyst, computer interaction used to modify the example input data. Before making any changes in the data, EASI Graphics can be instructed to list the original set of input data for reference.

TABLE V

Sample of Changes to Input Data*

```
ANY CHANGES IN DATA? 1-YES, 0=NO    RETURN
? 1
NEED CURRENT DATA LISTED? 1-YES, 0=NO    RETURN
? 1

                                    RESPONSE TIME    4.00
                                    STD.DEV.          .16
                                    PROB.COMM.        .90
                              TASK    MEAN    STD.DEV.    PROB.DET.
                                 1    2.00       .50         0.00
                                 2    1.00       .20         0.00
                                 3    1.00       .20          .30
                                 4    3.00       .30         0.00
                                 5     .50       .10          .97
                                 6    3.00       .30         0.00
                                 7     .10       .02          .97
ANY CHANGES IN RESPONSE FORCE DATA?1=YES,0=NO    RETURN
? 0
ANY CHANGES IN TASK DATA?1=YES,0=NO    RETURN
? 1
ENTER TASK NUMBER    RETURN
? 3
 DATA FOR TASK 3
 MEAN TIME TO PERFORM TASK    RETURN
? 1
 STANDARD DEVIATION    RETURN
? .2
 PROBABILITY OF DETECTION(IF NO SENSOR ENTER 0)    RETURN
? .8
ANY CHANGES IN TASK DATA?1=YES,0=NO    RETURN
? 0
   PAUSE


     PROBABILITY OF ADVERSARY INTERRUPTION = .751
PRESS RETURN TO CONTINUE
?
```

*Computer prompts for input are indicated by a question mark. Analyst input is followed by a "RETURN" entered at the terminal.

As indicated in Table V, no changes were made to the response force characteristics, and only the probability of detection for Task 3 was modified.

Following the input of this change, the computer recalculates P(I) based on the new data. Table V indicates that the change of P_d for Task 3 from 0.30 to 0.80 resulted in an increase of P(I) to 0.751.

The effect of changing P_d is illustrated in Figures 12 and 13. These figures indicate how changes in P_d can affect the influence of other parameters on the value of P(I), in this case, the dependence on the time to perform Task 5. A comparison between Figure 9 and Figure 12 clearly shows the substantial change in the two-dimensional curve relating P(I) and Time for Task 5 that results from increasing P_d for Sensor 3. Additional changes may be made to the input data until the probability of interruption is sufficiently high for the adversary action sequence being studied.

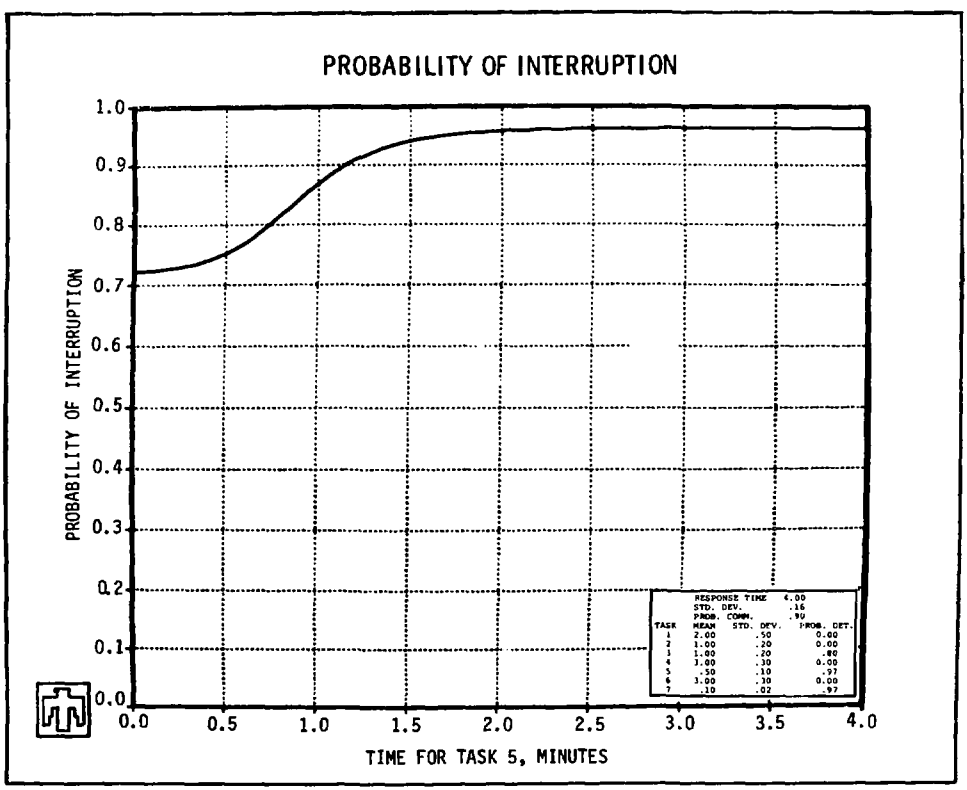


Figure 12. Probability of Interruption vs. Time for Task 5 for Increased Value of P_d Sensor 3.

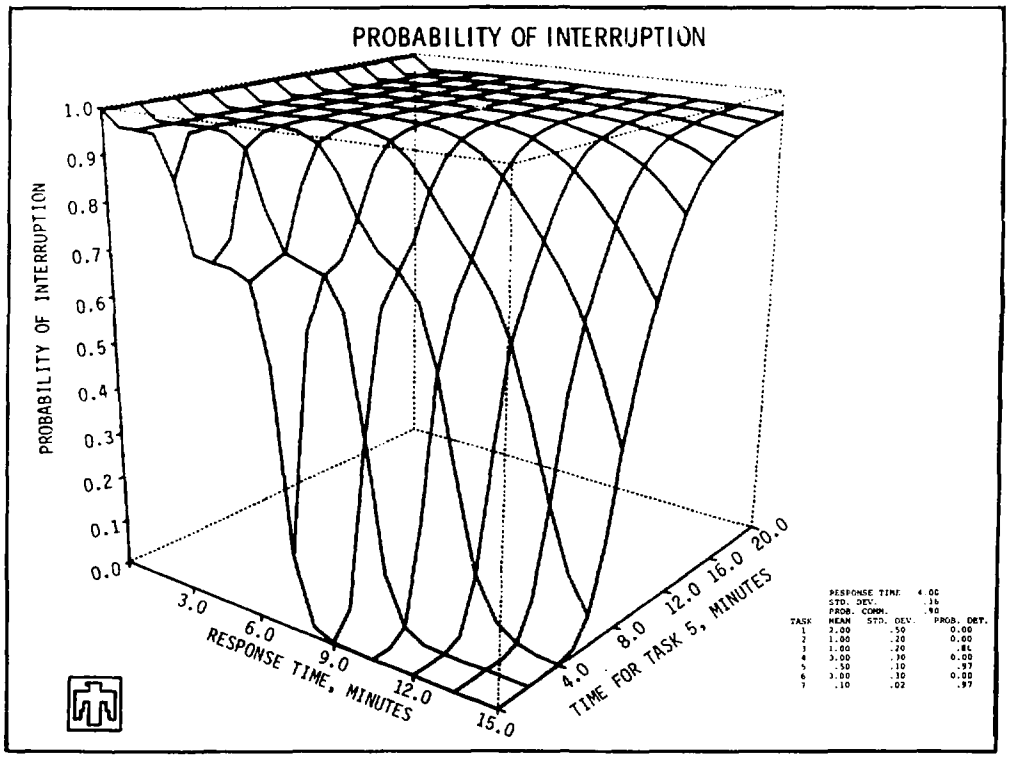


Figure 13. Probability of Interruption vs. Response Time and Time for Task 5 for Increased Value of P_d for Sensor 3.

IV. SUMMARY AND CONCLUSIONS

EASI Graphics is an extension of the EASI method,[1,2] which can provide the analyst with a better understanding of the relative importance of the parameters of a physical security system. The method should be useful both in the evaluation of existing systems and the design of new systems. The method is useful in analyzing a given adversary action sequence but does not answer the question as to which of a group of adversary action sequences should be analyzed. This question would have to be answered by other types of analyses.

V. REFERENCES

1. H. A. Bennett, The EASI Approach to Physical Security Evaluation, SAND76-0050, Sandia Laboratories, Albuquerque, New Mexico, 1976.
2. H. A. Bennett, User's Guide for Evaluating Physical Security Capabilities of Nuclear Facilities by the EASI Method, SAND77-0082, Sandia Laboratories, Albuquerque, New Mexico, June 1977.
3. D. W. Sasser, EASI on the HP-25, HP-65, and HP-67, SAND76-0597, Sandia Laboratories, Albuquerque, New Mexico, May 1977.

APPENDIX A

THE EASI MATHEMATICAL METHODOLOGY

APPENDIX A

THE EAST MATHEMATICAL METHODOLOGY

The EAST method calculates the probability of interruption of an adversary action sequence aimed at theft or sabotage. This is the probability that the response force will be notified when there is sufficient time remaining in the sequence for the force to respond. The notification of the response force is called an alarm and the probability of alarm is

$$P(A) = P(D)P(C) \tag{1}$$

where $P(D)$ = probability of detection

$P(C)$ = probability of communication to the response force.

In the case of only one detection device, the probability of an adversary action sequence interruption is given by

$$P(I) = P(R|A)P(A) \tag{2}$$

where $P(R|A)$ = probability of response force arrival prior to the adversary's action sequence, given an alarm.

An adversary action sequence is defined in terms of a starting point (which can be taken as the location of the first detection device along the adversary's path since adversary activities prior to this point have no effect on the probability of interruption), a sequence of detection devices, transit delays, barrier delays, and a terminal point. The transits and barriers can be thought of as tasks the adversary must perform. It is assumed that detection devices are located only at the beginnings of tasks.

If t_a is the time remaining for the adversary to reach the terminal point when an alarm occurs, and t_r is the response time of the security force, then for adversary interruption it is necessary that

$$t_a - t_r \geq 0. \tag{3}$$

The random variables t_a and t_r are assumed to be independent and normally distributed and thus the random variable

$$x = t_a - t_r$$

is normally distributed with mean

$$\mu_x = E(t_a - t_r) = E(t_a) - E(t_r),$$

variance

$$\sigma_x^2 = \mathrm{var}(t_a - t_r) = \mathrm{var}(t_a) + \mathrm{var}(t_r)$$

and

$$P(R|A) = P(x \geq 0) = \int_0^{\infty} \frac{1}{\sqrt{2\pi\sigma_x^2}} \exp\left[-\frac{(x - \mu_x)^2}{2\sigma_x^2}\right] dx. \tag{4}$$

In EASI $P(R|A)$ is approximated by

$$P(R|A) \cong \frac{\exp(1.7\mu_x/\sigma_x)}{1 + \exp(1.7\mu_x/\sigma_x)}. \tag{5}$$

In the case of several detection devices, the barrier delays and transit times are assumed to be mutually independent random variables. The expected time from a point p to the terminal point n is

$$E(t_p + t_{p+1} + \ldots + t_n) = \sum_{i=p}^{n} E(t_i)$$

where $E(t_i)$ = expected time to perform Task i, and the variance is

$$\mathrm{var}(t_p + \ldots + t_n) = \sum_{i=p}^{n} \mathrm{var}(t_i).$$

The probability $P(R|A)$ is calculated at each detection device and the

probability of sequence interruption is

$$P(I) = P(R|A_1)P(A_1) + \sum_{i=2}^{n} P(R|A_i)P(A_i) \prod_{j=1}^{i-1} (1 - P(A_j)). \qquad (6)$$

P(I) is the probability calculated by EASI.

APPENDIX B

EASI GRAPHICS PROGRAM LISTING

NOTICE

This computer program was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor the United States Nuclear Regulatory Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

```
C     OVERLAY (OVER,0,0)
      PROGRAM EASI(INPUT=65,OUTPUT=65,TAPE77,TAPE66=INPUT,TAPE[illegible],TAPE55,
     1TAPE45)
C
C     THIS PROGRAM PROVIDES GRAPHIC OUTPUT FOR EASI (ESTIMATE OF
C     ADVERSARY SEQUENCE INTERRUPTION). EASI IS AN ANALYTICAL
C     TECHNIQUE FOR EVALUATING THE EFFECTIVENESS OF PHYSICAL
C     SECURITY SYSTEMS. SCENARIOS CAN INCLUDE AN OUTSIDER ENTERING
C     A FACILITY FOR THE PURPOSE OF SABOTAGE OR THEFT OR AN INSIDER
C     EITHER GAINING ACCESS TO A VITAL AREA FOR THE PURPOSE OF
C     SABOTAGE OR GAINING ACCESS TO MATERIAL AND EGRESSING.
C
C     DATA INPUT REQUIRED FOR THE PROGRAM ARE AVERAGE GUARD FORCE
C     RESPONSE TIME AND STANDARD DEVIATION,PROBABILITY OF
C     COMMUNICATION(WHICH IS THE PROBABILITY THAT THE GUARDS ARE
C     NOTIFIED WHEN A SENSOR IS ACTIVATED), AND THE ADVERSARY ACTION
C     SEQUENCE(AAS). THE AAS IS DESCRIBED IN TERMS OF A NUMBER OF TASKS
C     OPERED CHRONOLOGICALLY,WHICH THE ADVERSARY HAS TO PERFORM.
C     ASSOCIATED WITH EACH TASK IS AN AVERAGE TIME TO PERFORM AND A
C     STANDARD DEVIATION. IN ADDITION,ASSOCIATED WITH EACH TASK IS A
C     SENSOR WHICH CAN BE ACTIVATED AT THE BEGINNING OF THE TASK.
C     THE PROBABILITY THAT IT WILL BE ACTIVATED IS THE PROBABILITY
C     OF DETECTION WHICH CAN BE SET TO ZERO TO REPRESENT NO SENSOR.
C
C     AFTER THE DATA ARE INPUT,THE PROBABILITY OF INTERRUPTION IS
C     CALCULATED AND DISPLAYED. THIS IS THE PROBABILITY THAT THE
C     ADVERSARY IS INTERRUPTED BY THE GUARD FORCE BEFORE
C     THE ADVERSARY'S MISSION IS COMPLETED. THE USER IS THEN
C     PRESENTED WITH A NUMBER OF OPTIONS FOR PLOTTING WHICH PROVIDE
C     THE USER WITH INFORMATION ON THE SENSITIVITY OF THE
C     PARAMETERS OF THE SYSTEM.
C
C
C     THIS PROGRAM WAS DEVELOPED BY D. W. SASSER AT SANDIA LABORATORIES
C     IN ALBUQUERQUE,NEW MEXICO.
C
      COMMON /2/ TASKT(25),SDTT(25),POD(25),N,PC,TP,SDTR,PI(25),CPA(25)
      COMMON /BLK/ T(25),IOPT,LL,ASDP,ASDRT,IT,TM,IS,IT1,IT2,ASDRT1,ASDR
     1T2,IS1,IS2,TM1,ISCALF
C
C     INITIALIZE TEKTRONIX PLOT-10 WITH 1200 BAUD RATE,IDENTIFY
C     TEKTRONIX 4014-1 CRT WITH ENHANCED GRAPHICS,AND SET
C     CHARACTER SIZE TO SMALLEST SIZE.
C
      CALL INITT (120)
      CALL TERM (3,4096)
      CALL CHRSIZ (4)
      CALL TSEND
      WRITE (55,130)
      CALL FFFINP (1,TUT,NOUT,66)
C
C     PRINT INSTRUCTIONS IF TUT=1.
C
      IF (TUT.NE.1.) GO TO 10
      CALL NEWPAG
```

```
      CALL CHRSIZ (3)                                                   EASI
      CALL TSEND                                                        EASI
      WRITE (55,190)                                                    EASI
      WRITE (55,200)                                                    EASI
      CALL TSEND                                                        EASI
      PAUSE                                                             EASI
   10 CALL NEWPAG                                                       EASI
      CALL CHRSIZ (4)                                                   EASI
      CALL TSEND                                                        EASI
C                                                                       EASI
C     ACCEPT USER INPUT FOR RESPONSE FORCE TIME,PROBABILITY OF          EASI
C     COMMUNICATION, TASK TIMES, AND SENSOR DETECTION                   EASI
C     PROBABILITIES.                                                    EASI
C                                                                       EASI
      WRITE (55,210)                                                    EASI
      WRITE (55,220)                                                    EASI
      CALL FFFINP (1,TP,NOUT,66)                                        EASI
      WRITE (55,230)                                                    EASI
      CALL FFFINP (1,SOTF,NOUT,66)                                      EASI
      WRITE (55,240)                                                    EASI
      CALL FFFINP (1,PC,NOUT,66)                                        EASI
      WRITE (55,250)                                                    EASI
      CALL FFFINP (1,XN,NOUT,66)                                        EASI
      N=XN                                                              EASI
      WRITE (55,300)                                                    EASI
      DO 40 I=1,N                                                       EASI
      WRITE (55,260) I                                                  EASI
      WRITE (55,270)                                                    EASI
      CALL FFFINP (1,TASKT(I),NOUT,66)                                  EASI
      WRITE (55,280)                                                    EASI
      CALL FFFINP (1,SOTT(I),NOUT,66)                                   EASI
      WRITE (55,290)                                                    EASI
      CALL FFFINP (1,POD(I),NOUT,66)                                    EASI
      WRITE (55,300)                                                    EASI
      J=FLOAT(I)-FLOAT(I/10)*10.                                        EASI
      IF (J.NE.0) GO TO 40                                              EASI
      WRITE (55,310)                                                    EASI
      PAUSE                                                             EASI
      CALL NEWPAG                                                       EASI
      CALL TSEND                                                        EASI
   40 CONTINUE                                                          EASI
   50 CONTINUE                                                          EASI
C                                                                       EASI
C     CALCULATE CUMULATIVE TASK TIME,TOTAL TASK TIME,AND                EASI
C     SUM OF 2 SIGMA FOR EACH TASK TIME.                                EASI
C                                                                       EASI
   60 T(1)=0.                                                           EASI
      TM=0.                                                             EASI
      TM1=0.                                                            EASI
      M=N+1                                                             EASI
      DO 70 I=2,M                                                       EASI
      J=N+2-I                                                           EASI
      TM=TM+TASKT(J)                                                    EASI
      T(I)=TM                                                           EASI
      TM1=TM1+2.*SOTT(J)                                                EASI
```

```
   70 CONTINUE                                                          EASI   112
      LL=N                                                              EASI   113
C                                                                       EASI   114
C                                                                       EASI   115
C     IF LL=1, SUBROUTINE CALC CALCULATES THE PROBABILITY               EASI   116
C     OF INTERRUPTION. IF LL=N, CALC ALSO CALCULATES CUMULATIVE         EASI   117
C     PROBABILITY OF INTERRUPTION AND DETECTION.                        EASI   118
C                                                                       EASI   119
      CALL CALC                                                         EASI   120
      WRITE (55,320) PI(1)                                              EASI   121
      PAUSE                                                             EASI   122
   80 CALL NEWPAG                                                       EASI   123
      CALL TSEND                                                        EASI   124
      IDLST1=0                                                          EASI   125
C                                                                       EASI   126
C     QUERY USER AS TO WHAT PLOT OPTIONS ARE DESIRED.                   EASI   127
C                                                                       EASI   128
      WRITE (55,330)                                                    EASI   129
      CALL FFFINP (-1,IPLOT,NOUT,66)                                    EASI   130
C                                                                       EASI   131
C     IF NO PLOTS DESIRED, TRANSFER TO ASK FOR DATA CHANGES.            EASI   132
C                                                                       EASI   133
      IF (IPLOT.EQ.0) GO TO 110                                         EASI   134
      WRITE (55,340)                                                    EASI   135
      CALL FFFINP (-1,IDLST1,NOUT,66)                                   EASI   136
      IF (IDLST1.EQ.1) GO TO 120                                        EASI   137
   90 WRITE (55,350)                                                    EASI   138
      CALL FFFINP (-1,IPLIST,NOUT,66)                                   EASI   139
      IF (IPLIST.EQ.0) GO TO 100                                        EASI   140
      WRITE (55,360)                                                    EASI   141
C                                                                       EASI   142
C     PRINTOUT OF PLOT OPTIONS.                                         EASI   143
C                                                                       EASI   144
  100 WRITE (55,370)                                                    EASI   145
      CALL FFFINP (1,XIOPT,NOUT,66)                                     EASI   146
      IOPT=XIOPT                                                        EASI   147
      IF (IOPT.EQ.0) GO TO 110                                          EASI   148
      J=MIN((IOPT-1)/6+1,2)                                             EASI   149
C                                                                       EASI   150
C     J=1 FOR TWODIMENSIONAL PLOTS,J=2 FOR THREE                        EASI   151
C     DIMENSIONAL PLOTS.                                                EASI   152
C                                                                       EASI   153
C     CALL OVERLAY (4HOVER,J,0,0)                                       EASI   154
C     IF OVERLAY IS USED DELETE NEXT TWO STATEMENTS.                    EASI   155
      IF(J.EQ.1) CALL TWOD                                              EASI   156
      IF(J.EQ.2) CALL THRED                                             EASI   157
C                                                                       EASI   158
C     THUNDERBIRD LOGO                                                  EASI   159
C                                                                       EASI   160
      CALL BIRD                                                         EASI   161
C                                                                       EASI   162
C     PLOT FINISHED                                                     EASI   163
C                                                                       EASI   164
      CALL ENDPL (0)                                                    EASI   165
      CALL DONEPL                                                       EASI   166
```

```
      REWIND 55                                                         EASI      167
      REWIND 66                                                         EASI      168
      REWIND 77                                                         EASI      169
C                                                                       EASI      170
C     RETURN TO ASK IF ANOTHER PLOT IS DESIRED.                         EASI      171
C                                                                       EASI      172
      GO TO 80                                                          EASI      173
  110 CALL NEWPAG                                                       EASI      174
      CALL TSEND                                                        EASI      175
C                                                                       EASI      176
C     QUERY USER AS TO POSSIBLE CHANGES IN DATA.                        EASI      177
C                                                                       EASI      178
      WRITE (55,380)                                                    EASI      179
      CALL FFFINP (-1,IMOD,NOUT,66)                                     EASI      180
C                                                                       EASI      181
C     IF NO DATA CHANGES,TRANSFER TO ASK FOR NEW PROBLEM                EASI      182
C     OR SIGNOFF.                                                       EASI      183
C                                                                       EASI      184
      IF (IMOD.EQ.0) GO TO 170                                          EASI      185
      WRITE (55,340)                                                    EASI      186
      CALL FFFINP (-1,IDLST2,NOUT,66)                                   EASI      187
      IF (IDLST2.EQ.0) GO TO 140                                        EASI      188
  120 WRITE (55,390) TR                                                 EASI      189
      WRITE (55,400) SDTR                                               EASI      190
      WRITE (55,410) PC                                                 EASI      191
      WRITE (55,420)                                                    EASI      192
      DO 130 I=1,N                                                      EASI      193
      WRITE (55,430) I,TASKT(I),SDTT(I),PDD(I)                          EASI      194
  130 CONTINUE                                                          EASI      195
      IF (IDLST1.EQ.1) GO TO 90                                         EASI      196
  140 Y=0.                                                              EASI      197
      WRITE (55,440)                                                    EASI      198
      CALL FFFINP (-1,I,NOUT,66)                                        EASI      199
      IF (I.EQ.0) GO TO 150                                             EASI      200
      Y=1.                                                              EASI      201
      WRITE (55,210)                                                    EASI      202
      WRITE (55,220)                                                    EASI      203
      CALL FFFINP (1,TR,NOUT,66)                                        EASI      204
      WRITE (55,230)                                                    EASI      205
      CALL FFFINP (1,SDTR,NOUT,66)                                      EASI      206
      WRITE (55,240)                                                    EASI      207
      CALL FFFINP (1,PC,NOUT,66)                                        EASI      208
  150 WRITE (55,450)                                                    EASI      209
      CALL FFFINP (-1,I,NOUT,66)                                        EASI      210
      IF (I.EQ.0) GO TO 160                                             EASI      211
      Y=1.                                                              EASI      212
      WRITE (55,460)                                                    EASI      213
      CALL FFFINP (1,XN,NOUT,66)                                        EASI      214
      J=XN                                                              EASI      215
      WRITE (55,260) J                                                  EASI      216
      WRITE (55,270)                                                    EASI      217
      CALL FFFINP (1,TASKT(J),NOUT,66)                                  EASI      218
      WRITE (55,280)                                                    EASI      219
      CALL FFFINP (1,SDTT(J),NOUT,66)                                   EASI      220
      WRITE (55,290)                                                    EASI      221
```

```
      CALL FFFINP (1,POD(J),NOUT,66)                                    EASI     222
      GO TO 150                                                         EASI     223
  160 IF (Y.EQ.0.) GO TO 170                                            EASI     224
      LL=1                                                              EASI     225
      GO TO 60                                                          EASI     226
  170 CONTINUE                                                          EASI     227
C                                                                       EASI     228
C     QUERY USER AS TO WHETHER NEW PROBLEM IS TO BE RUN.                EASI     229
C                                                                       EASI     230
      WRITE (55,470)                                                    EASI     231
      CALL FFFINP (1,XNEWP,NOUT,66)                                     EASI     232
      NEWP=XNEWP                                                        EASI     233
      IF (NEWP.GT.0) GO TO 10                                           EASI     234
C                                                                       EASI     235
C     END OF SESSION                                                    EASI     236
C                                                                       EASI     237
C                                                                       EASI     238
  180 FORMAT (49HFOR INSTRUCTIONS ON USE OF THIS PROGRAM, ENTER 1,/30HOT EASI     239
     1HERWISE 0        THEN RETURN.)                                    EASI     240
  190 FORMAT (54HTHIS PROGRAM PROVIDES GRAPHIC OUTPUT FOR EASI(ESTIMATE/ EASI     241
     1/58HOF ADVERSARY SEQUENCE INTERRUPTION). EASI IS AN ANALYTICAL//54 EASI     242
     2HTECHNIQUE FOR EVALUATING THE EFFECTIVENESS OF PHYSICAL//60HSECURI EASI     243
     3TY SYSTEMS. SCENARIOS CAN INCLUDE AN OUTSIDER ENTERING//61HA FACIL EASI     244
     4ITY FOR THE PURPOSE OF SABOTAGE OR THEFT OR AN INSIDER//56HEITHER  EASI     245
     5GAINING ACCESS TO A VITAL AREA FOR THE PURPOSE OF//53HSABOTAGE OR  EASI     246
     6GAINING ACCESS TO MATERIAL AND EGRESSING.//59HDATA INPUT REQUIRED  EASI     247
     7FOR THE PROGRAM ARE AVERAGE GUARD FORCE)                          EASI     248
  200 FORMAT (7X,31HRESPONSE TIME AND STANDARD DEVIATION,FR [illegible]  EASI     249
     15HCOMMUNICATION(WHICH IS THE PROBABILITY THAT THE GUARDS ARE//61H EASI     250
     2NOTIFIED WHEN A SENSOR IS ACTIVATED),AND THE ADVERSARY ACTION//59H EASI     251
     3SEQUENCE(AAS). THE AAS IS DESCRIBED IN TERMS OF A NUMBER OF//58HTA EASI     252
     4SKS, ORDERED IN TIME,WHICH THE ADVERSARY HAS TO PERFORM.//61HASSOC EASI     253
     5IATED WITH EACH TASK IS AN AVERAGE TIME TO PERFORM AND A//61HSTANO EASI     254
     6ARD DEVIATION.IN ADDITION,ASSOCIATED WITH EACH TASK IS A//59HSENSO EASI     255
     7R WHICH CAN BE ACTIVATED AT THE BEGINNING OF THE TASK.//60HTHE PRO EASI     256
     8BABILITY THAT IT WILL BE ACTIVATED IS THE PROBABILITY//61HOF DETEC EASI     257
     9TION WHICH CAN BE SET TO ZERO TO REPRESENT NO SENSOR.//59HAFTER TH EASI     258
     $E DATA ARE INPUT,THE PROBABILITY OF INTERRUPTION IS//58HCALCULATED EASI     259
     $ AND DISPLAYED. THIS IS THE PROBABILITY THAT THE//50HADVERSARY IS  EASI     260
     $INTERRUPTED BY THE GUARD FORCE BEFORE//54HTHE ADVERSARY'S MISSION  EASI     261
     $IS COMPLETED. THE USER IS THEN//61HPRESENTED WITH A NUMBER OF OPTI EASI     262
     $IONS FOR PLOTTING WHICH PROVIDE//51HTHE USER WITH INFORMATION ON TH EASI     263
     $E SENSITIVITY OF THE//25HPARAMETERS OF THE SYSTEM.///25HPRESS RETU EASI     264
     $RN TO CONTINUE.)                                                  EASI     265
  210 FORMAT (10X,36HENTER RESPONSE FORCE CHARACTERISTICS,//)           EASI     266
  220 FORMAT (1X,27HMEAN RESPONSE TIME   RETURN)                        EASI     267
  230 FORMAT (1X,27HSTANDARD DEVIATION   RETURN)                        EASI     268
  240 FORMAT (1X,37HPROBABILITY OF COMMUNICATION   RETURN)              EASI     269
  250 FORMAT (10X,15HENTER TASK DATA,//,1X,15HENTER NUMBER OF,15H TASKS EASI     270
     1  RETURN)                                                         EASI     271
  260 FORMAT (1X,13HDATA FOR TASK,I3)                                   EASI     272
  270 FORMAT (1X,34HMEAN TIME TO PERFORM TASK   RETURN)                 EASI     273
  280 FORMAT (1X,27HSTANDARD DEVIATION   RETURN)                        EASI     274
  290 FORMAT (1X,38HPROBABILITY OF DETECTION(IF NO SENSOR ,17HENTER 0)  EASI     275
     1 RETURN)                                                          EASI     276
```

```
      300 FORMAT (1X,//)                                                    EASI
      310 FORMAT (35HA NEW PAGE IS NEEDED. IF A HARDCOPY/33HIS NEEDED DO IT  EASI
         1NOW, THEN RETURN.)                                                EASI
      320 FORMAT (//,5X,40HPROBABILITY OF ADVERSARY INTERRUPTION = ,F5.3/24H EASI
         1PRESS RETURN TO CONTINUE)                                         EASI
      330 FORMAT (35HPLOTS DESIRED+ 1=YES, 0=NO   RETURN)                   EASI
      340 FORMAT (45HNEED CURRENT DATA LISTED+ 1=YES,0=NO   RETURN)         EASI
      350 FORMAT (45HNEED PLOT OPTIONS LISTED+ 1=YES,0=NO   RETURN)         EASI
      360 FORMAT (1X,12HPLOT OPTIONS/20X,11H0   NO PLOT/20X,51H1   PROBABILI EASI
         1TY OF ALARM VS. TIME TO TERMINAL POINT/20X,15H2   PROBABILITY,43H EASI
         2OF INTERRUPTION VS. TIME TO TERMINAL POINT/20X,49H3   PROBABILITY EASI
         3OF INTERRUPTION VS. RESPONSE TIME,/20X,35H4   PROBABILITY OF INTER EASI
         4RUPTION VS.,24HPROBABILITY OF COMMUNICATION/20X,45H5   PROBABILITY EASI
         5 OF INTERRUPTION VS. TASK TIME/20X,60H6   PROBABILITY OF INTERRUPT EASI
         6ION VS. PROBABILITY OF DETECTION//10X,48H    PROBABILITY OF INTERR EASI
         7UPTION AS A FUNCTION OF/20X,50H7   RESPONSE TIME AND PROBABILITY O EASI
         8F COMMUNICATION/20X,42H8   TASK TIME AND PROBABILITY OF DETECTION/ EASI
         920X,31H9   RESPONSE TIME AND TASK TIME/19X,47H10   RESPONSE TIME A EASI
         $ND PROBABILITY OF DETECTION/19X,38H11   PROBABILITY OF COMMUNICATI EASI
         $ON AND ,24HPROBABILITY OF DETECTION/19X,47H12   TASK TIME AND PROB EASI
         $ABILITY OF COMMUNICATION/19X,28H13   TASK TIME AND TASK TIME/19X,3 EASI
         53H14   PROBABILITY OF DETECTION AND,25H PROBABILITY OF DETECTION// EASI
         $)                                                                 EASI
      370 FORMAT (1X,33HENTER PLOT OPTION NUMBER   RETURN)                  EASI
      380 FORMAT (41HANY CHANGES IN DATA+ 1=YES, 0=NO   RETURN)             EASI
      390 FORMAT (T30,20H       RESPONSE TIME ,F6.2)                        EASI
      400 FORMAT (T30,20H       STD.DEV.      ,F6.2)                        EASI
      410 FORMAT (T30,20H       PROB.COMM.    ,F6.2)                        EASI
      420 FORMAT (T30,34HTASK   MEAN   STD.DEV.   PROB.DET.)                EASI
      430 FORMAT (T30,2X,I2,1X,F6.2,3X,F6.2,6X,F6.2)                        EASI
      440 FORMAT (45HANY CHANGES IN RESPONSE FORCE DATA+1=YES,0=NO,9H   RETU EASI
         1RN)                                                               EASI
      450 FORMAT (35HANY CHANGES IN TASK DATA+1=YES,0=NO,9H   RETURN)       EASI
      460 FORMAT (26HENTER TASK NUMBER   RETURN)                            EASI
      470 FORMAT (25HNEW PROBLEM OR SIGNOFF+, 34H1=NEW PROBLEM,0=SIGNOFF    EASI
         1 RETURN)                                                          EASI
          END                                                               EASI
```

```
      SUBROUTINE CALC                                                   EASI   314
C                                                                       EASI   315
C     IN THIS SUBROUTINE THE CUMULATIVE PROBABILITY OF DETECTION,       EASI   316
C     CPA(1),CPA(2),.... AND THE CUMULATIVE PROBABILITY OF              EASI   317
C     INTERRUPTION, PI(1),PI(2),.... ARE CALCULATED. IF LL=1 ONLY THE   EASI   318
C     PROBABILITY OF INTERRUPTION( = PI(1) ) IS CALCULATED.             EASI   319
C                                                                       EASI   320
      COMMON /2/ TASKT(25),SDTT(25),PDD(25),N,PC,TR,SDTR,PI(25),CPA(25) EASI   321
      COMMON /3LK/ T(25),IOPT,LL,ASDR,ASDRT,IT,TM,IS,IT1,IT2,ASDRT1,ASDR EASI   322
     1T2,IS1,IS2,TM1,ISCALE                                             EASI   323
      DIMENSION PRA(25), PD(25)                                         EASI   324
      DO 10 I=1,N                                                       EASI   325
      PD(I)=PDD(I)                                                      EASI   326
   10 CONTINUE                                                          EASI   327
      M=N-1                                                             EASI   328
      DO 30 K=1,LL                                                      EASI   329
      KK=N+1-K                                                          EASI   330
      XMUX=-TR                                                          EASI   331
      VARX=SDTR**2+1.E-10                                               EASI   332
      PI(K)=0.                                                          EASI   333
      CPA(K)=0.                                                         EASI   334
      DO 20 I=1,N                                                       EASI   335
      J=N+1-I                                                           EASI   336
      XMUX=XMUX+TASKT(J)                                                EASI   337
      VARX=VARX+SDTT(J)**2                                              EASI   338
      PA=PD(J)*PC                                                       EASI   339
      PRA(J)=1.                                                         EASI   340
      Z=1.7*XMUX/VARX**.5                                               EASI   341
      IF (Z.LT.100.) PRA(J)=EXP(Z)/(1.+EXP(Z))                          EASI   342
      PI(K)=PI(K)*(1.-PA)+PA*PRA(J)                                     EASI   343
      CPA(K)=CPA(K)*(1.-PA)+PA                                          EASI   344
   20 CONTINUE                                                          EASI   345
      PD(KK)=0.                                                         EASI   346
   30 CONTINUE                                                          EASI   347
      PI(N+1)=0.                                                        EASI   348
      PI(N+2)=0.                                                        EASI   349
      CPA(N+1)=0.                                                       EASI   350
      CPA(N+2)=0.                                                       EASI   351
      DO 40 I=1,N                                                       EASI   352
      PD(I)=PDD(I)                                                      EASI   353
   40 CONTINUE                                                          EASI   354
      RETURN                                                            EASI   355
      END                                                               EASI   356
```

```
      SUBROUTINE DOC (ICCR)                                             EASI     357
      COMMON /2/ TASKT(25),SDTT(25),PDO(25),N,PC,TK,SDTR,PI(25),CPA(25) EASI     358
      COMMON /BLK/ T(25),IOPT,LL,ASOR,ASCRT,IT,TH,IS,IT1,IT2,ASORT1,ASOR EASI     359
     1T2,IS1,IS2,TM1,ISCALE                                             EASI     360
      DIMENSION TABLE(200), CORN(8)                                     EASI     361
      CALL HEIGHT (.1)                                                  EASI     362
      XM=2.514                                                          EASI     363
      XN=N+4                                                            EASI     364
      XN=.15*XN+.05                                                     EASI     365
      CORN(1)=0.                                                        EASI     366
      CORN(2)=0.                                                        EASI     367
      CORN(3)=0.                                                        EASI     368
      CORN(8)=0.                                                        EASI     369
      CORN(4)=8.8-XN                                                    EASI     370
      CORN(6)=8.8-XN                                                    EASI     371
      CORN(5)=10.75-XM                                                  EASI     372
      CORN(7)=10.75-XM                                                  EASI     373
      K=2*ICCR-1                                                        EASI     374
      L=K+1                                                             EASI     375
      WRITE (45,30) TR                                                  EASI     376
      REWIND 45                                                         EASI     377
      READ (45,20) (TABLE(I),I=1,10)                                    EASI     378
      REWIND 45                                                         EASI     379
      CALL MESSAG (TABLE,100,.14+CORN(K),XN-.35+CORN(L))                EASI     380
      WRITE (45,40) SDTR                                                EASI     381
      REWIND 45                                                         EASI     382
      READ (45,20) TABLE(1),TABLE(2),TABLE(3),TABLE(4),TABLE(5),TABLE(6) EASI     383
     1,TABLE(7),TABLE(8),TABLE(9),TABLE(10)                             EASI     384
      REWIND 45                                                         EASI     385
      CALL MESSAG (TABLE,100,.14+CORN(K),XN-.2+CORN(L))                 EASI     386
      WRITE (45,50) PC                                                  EASI     387
      REWIND 45                                                         EASI     388
      READ (45,20) TABLE(1),TABLE(2),TABLE(3),TABLE(4),TABLE(5),TABLE(6) EASI     389
     1,TABLE(7),TABLE(8),TABLE(9),TABLE(10)                             EASI     390
      REWIND 45                                                         EASI     391
      CALL MESSAG (TABLE,100,.14+CORN(K),XN-.35+CORN(L))                EASI     392
      WRITE (45,60)                                                     EASI     393
      REWIND 45                                                         EASI     394
      READ (45,20) TABLE(1),TABLE(2),TABLE(3),TABLE(4),TABLE(5),TABLE(6) EASI     395
     1,TABLE(7),TABLE(8),TABLE(9),TABLE(10)                             EASI     396
      REWIND 45                                                         EASI     397
      CALL MESSAG (TABLE,100,.14+CORN(K),XN-.5+CORN(L))                 EASI     398
      W=XN-.65+CORN(L)                                                  EASI     399
      DO 10 I=1,N                                                       EASI     400
      WRITE (45,70) I,TASKT(I),SDTT(I),PDO(I)                           EASI     401
      REWIND 45                                                         EASI     402
      READ (45,20) TABLE(1),TABLE(2),TABLE(3),TABLE(4),TABLE(5),TABLE(6) EASI     403
     1,TABLE(7),TABLE(8),TABLE(9),TABLE(10)                             EASI     404
      REWIND 45                                                         EASI     405
      CALL MESSAG (TABLE,100,.14+CORN(K),W)                             EASI     406
      W=W-.15                                                           EASI     407
   10 CONTINUE                                                          EASI     408
      IF (IOPT.LE.6) CALL BLNK1 (.1+CORN(K),XN+.15+CORN(K),.1+CORN(L),XN EASI     409
     1+.1+CORN(L),2)                                                    EASI     410
      CALL RESET (6HHEIGHT)                                             EASI     411
```

```
      RETURN                                                            EASI    412
C                                                                       EASI    413
   20 FORMAT (10A10)                                                    EASI    414
   30 FORMAT (20H       RESPONSE TIME ,F6.2,1H3)                        EASI    415
   40 FORMAT (20H       STD.DEV.      ,F6.2,1H3)                        EASI    416
   50 FORMAT (20H       PROB.COMM.    ,F6.2,1H3)                        EASI    417
   60 FORMAT (35HTASK   MEAN   STD.DEV.   PROB.DET.$)                   EASI    418
   70 FORMAT (2H  ,I2,1H ,F6.2,3H   ,F6.2,6H       ,F6.2,1H3)           EASI    419
      END                                                               EASI    420
```

```
      SUBROUTINE BIRD                                                   EASI      421
      DIMENSION IX(27), IY(27)                                          EASI      422
      DATA IX(1),IX(2),IX(3),IX(4),IX(5),IX(6),IX(7),IX(8),IX(9),IX(10), EASI      423
     1IX(11),IX(12),IX(13),IX(14),IX(15),IX(16),IX(17),IX(18),IX(19),IX( EASI      424
     2IX(21),IX(22),IX(23),IX(24),IX(25),IX(26),IX(27)/80,65,55,50,5 EASI      425
     39,53,53,39,39,44,44,47,47,53,53,65,65,71,71,74,74,80,80,86,86,32,32,8 EASI      426
     46/                                                                EASI      427
      DATA IY(1),IY(2),IY(3),IY(4),IY(5),IY(6),IY(7),IY(8),IY(9),IY(10), EASI      428
     1IY(11),IY(12),IY(13),IY(14),IY(15),IY(16),IY(17),IY(18),IY(19),IY( EASI      429
     2IY(21),IY(22),IY(23),IY(24),IY(25),IY(26),IY(27)/48,48,57,57,5 EASI      430
     34,54,48,48,18,18,27,27,36,36,12,12,36,36,27,27,18,18,6,63,63,6,6/ EASI      431
      CALL MOVABS (80,18)                                               EASI      432
      DO 10 I=1,22                                                      EASI      433
      CALL DRWABS (IX(I),IY(I))                                         EASI      434
   10 CONTINUE                                                          EASI      435
      CALL MOVABS (IX(23),IY(23))                                       EASI      436
      DO 20 I=24,27                                                     EASI      437
      CALL DRWABS (IX(I),IY(I))                                         EASI      438
   20 CONTINUE                                                          EASI      439
      CALL TCEND                                                        EASI      440
      RETURN                                                            EASI      441
      END                                                               EASI      442
```

```
      SUBROUTINE DEV (X)                                                EASI    443
C                                                                       EASI    444
C     THIS SUBROUTINE REQUESTS THAT THE USER KEEP RATIOS OF MEANS       EASI    445
C     TO STANDARD DEVIATIONS AT LEAST 4 TO MINIMIZE PROBLEMS            EASI    446
C     WITH NEGATIVE VALUES FROM NORMAL DISTRIBUTION.                    EASI    447
C                                                                       EASI    448
   10 IF (X.GE.4.) RETURN                                               EASI    449
      WRITE (55,20)                                                     EASI    450
      CALL FFFINP (1,X,NOUT,66)                                         EASI    451
      GO TO 10                                                          EASI    452
C                                                                       EASI    453
   20 FORMAT (32HFOR TECHNICAL REASONS THIS RATIO,31H SHOULD BE AT LEAST EASI    454
     1 4.  REENTER)                                                     EASI    455
      END                                                               EASI    456
```

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      SUBROUTINE FFFINP (QUAN,NUMBER,NNUM,NIN)                          EASI     457
C                                                                       EASI     458
C                                                                       EASI     459
C               F F F I N P                                             EASI     460
C                                                                       EASI     461
C     FORMAT FREE FORTRAN INPUT CONVERSION                              EASI     462
C                                                                       EASI     463
C     MODIFICATION OF THE FFINC CODE BY GARY KINEMOND, SANDIA LABS      EASI     464
C                                                                       EASI     465
C     ORIGINAL FFINC CODE FROM JAMES D. DUIGG, LLL, FROM HIS            EASI     466
C                                                                       EASI     467
C     VERSION DATED JULY 29 1976                                        EASI     468
C                                                                       EASI     469
C                                                                       EASI     470
C     SUBROUTINE FFFINP ACCEPTS  FREE  FORM NUMBERS FROM A DATA FILE,   EASI     471
C     INTERPRETS THEM, AND PLACES THE RESULTS INTO AN OUTPUT ARGUMENT   EASI     472
C     ARRAY CALLED NUMBER.                                              EASI     473
C                                                                       EASI     474
C     ARGUMENTS:                                                        EASI     475
C                                                                       EASI     476
C        QUAN   = THE QUANTITY OF NUMBERS TO BE INPUT.                  EASI     477
C        NUMBER = THE OUTPUT ARRAY.                                     EASI     478
C        NNUM   = THE QUANTITY  OF  NUMBERS  RECIEVED FROM THE FILE.    EASI     479
C                                                                       EASI     480
C     EXPLANATION OF ARGUMENTS:                                         EASI     481
C                                                                       EASI     482
C        QUAN   -INPUT ARGUMENT-  THE  MAXIMUM NUMBER OF NUMBERS TO BE  EASI     483
C                ACCEPTED FROM  THE  TERMINAL,    THE   ACTUAL   NUMBER EASI     484
C                RECIEVED MAY BE LESS THAN >QUAN>.                      EASI     485
C                                                                       EASI     486
C        NUMBER -OUTPUT ARGUMENT- THE FIRST WORD ADDRESS OF THE OUTPUT  EASI     487
C                ARRAY.  IF  >QUAN>  IS  A  NEGATIVE NUMBER, THE OUTPUT EASI     488
C                (>NUMBER>) WILL  BE  FIXED  POINT  (INTEGER)  NUMBERS. EASI     489
C                OTHERWISE IT  WILL  BE  FLOATING POINT (REAL).  IF THE EASI     490
C                QUANTITY OF NUMBERS  RECEIVED  FROM THE FILE IS LESS   EASI     491
C                THAN >QUAN>.  THE  REMAINING WORDS IN THE OUTPUT ARRAY EASI     492
C                WILL BE DEFAULTED (I.E.  LEFT UNCHANGED).              EASI     493
C                                                                       EASI     494
C        NNUM   -OUTPUT ARGUMENT- THE NUMBER  OF  WORDS  WRITTEN  INTO  EASI     495
C                ARRAY >NUMBER.   >NNUM>  WILL  BE SET TO THE NUMBER OF EASI     496
C                NUMBERS SUPPLIED FROM THE FILE , OR >QUAN>, WHICHEVER  EASI     497
C                IS LESS.                                               EASI     498
C                                                                       EASI     499
C                                                                       EASI     500
      INTEGER COL,DIGIT,EXP,EXSIGN,ERRCOL,FINISH,FIRST,PROMPT           EASI     501
      INTEGER QUAN,QUANT,SYM(9),SYMBOL,STOP,TYPE                        EASI     502
      INTEGER PERIOD,CHAR(81)                                           EASI     503
      DIMENSION MESS(4), NUM(10), NUMBER(1)                             EASI     504
      EQUIVALENCE (IEQ,REQ)                                             EASI     505
      DATA SYM(1),SYM(2),SYM(3),SYM(4),SYM(5),SYM(6),SYM(7),SYM(8),SYM(9 EASI     506
     1)/1H-,1H+,1H.,3HNUM,1H ,1H,,1H*,1HE,1H^/                          EASI     507
      DATA NUM(1),NUM(2),NUM(3),NUM(4),NUM(5),NUM(6),NUM(7),NUM(8),NUM(9 EASI     508
     1),NUM(10)/1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9/                EASI     509
C                                                                       EASI     510
      DATA MESS(1)/10H -- INSUFF/,MESS(2)/10HICIENT DAT/,MESS(3)/1CHA ON EASI     511
```

```
      1 THIS /,MESS(4)/8HLINE -- /
C
      DATA NIL/3HNIL/,NUMB/3HNUM/,PERIOD
C
      DATA QUANO/-99999999999./
C
C     .... MAXIMUM NO. OF COLUMNS ON TERMINAL IS 80.
      NCOL=80
      COL=81
C     .... LOGICAL TAPE NO. OF INPUT FILE IS NIN FOR INPUT, 55 FOR OUTPU
      NOUT=55
      NNUM=0
      NTOT=0
      STOP=1
      LOOP=1
C     .... LOOP=1  INDICATES INPUT LINE IS OK.
C     .... LOOP=0  INDICATES ERROR IN LAST INPUT LINE.
C     .... LOOP=-1 INDICATES INPUT LINE BEING CHECKED [illegible]
      LSTERR=0
      NONLNF=(-1)
      QUANT=QUAN
      LINE1=0
C     .... TYPE +0 INDICATES FIXED POINT (INTEGER) NUMBER.
C     .... TYPE +0 INDICATES FLOATING POINT (REAL) NUMBER.
      TYPE=QUANT
      IF (QUANT.LT.0) QUANT=QUANT*(-1)
      PROMPT=0
      .... DEFAULT THE ARRAY UPON ENTRY.
C     .... FILL MISSING DATA WITH LARGE NEGATIVE NUMBERS FOR USE
      FLPT=QUANO
      DO 10 I=1,QUANT
      IF (TYPE.GT.0) REQ=FLPT
      IF (TYPE.LT.0) IEQ=INT(FLPT)
   10 NUMBER(I)=IEQ
      GO TO 15
C
C
C     .... TEST FOR BEGINNING OF NUMBER INDICATED BY + - , OR
C     .... 0 THRU 9.  IGNORE SUPERFLUOUS SPACE.
   20 IF (SYMBOL.EQ.SYM(5)) GO TO 150
C     .... TEST FOR DEFAULT.
      IF (SYMBOL.EQ.SYM(6)) GO TO 290
      MULT=1
      ASSIGN 320 TO FINISH
      ASSIGN 110 TO NEXT
      FIRST=2
      LAST=4
      SYM(3)=NIL
C     .... TEST FOR DEFAULT MULTIPLIER.
      IF (SYMBOL.EQ.SYM(7)) GO TO 150
      ASSIGN 330 TO FINISH
      C1=10
      C2=1.
      C3=0.
      SYM(3)=PERIOD
```

```
      INTSGN=1                                                          EASI   567
      RESIGN=1.                                                         EASI   568
      EXSIGN=1                                                          EASI   569
      EXP=0                                                             EASI   570
      FLPT=ROIGIT                                                       EASI   571
      ASSIGN 60 TO NEXT                                                 EASI   572
      FIRST=1                                                           EASI   573
      LAST=8                                                            EASI   574
C     .... TEST FOR 0 THRU 9.                                           EASI   575
      IF (SYMBOL.EQ.NUMB) GO TO 150                                     EASI   576
      ASSIGN 40 TO NEXT                                                 EASI   577
      FIRST=3                                                           EASI   578
      LAST=6                                                            EASI   579
C     .... TEST FOR . (DECIMAL).                                        EASI   580
      IF (SYMBOL.EQ.SYM(3)) GO TO 30                                    EASI   581
      LAST=4                                                            EASI   582
C     .... TEST FOR + (PLUS).                                           EASI   583
      IF (SYMBOL.EQ.SYM(2)) GO TO 150                                   EASI   584
C     .... SYMBOL IS - (MINUS).                                         EASI   585
      INTSGN=(-1)                                                       EASI   586
      RESIGN=(-1.)                                                      EASI   587
      GO TO 150                                                         EASI   588
C                                                                       EASI   589
C     .... SYMBOL IS . (DECIMAL).                                       EASI   590
   30 SYM(3)=NIL                                                        EASI   591
      C1=1.                                                             EASI   592
      C2=0.                                                             EASI   593
      C3=.1                                                             EASI   594
      GO TO 150                                                         EASI   595
C                                                                       EASI   596
C                                                                       EASI   597
C     .... PREVIOUS SYMBOL WAS + OR -.  TEST FOR . (DECIMAL).           EASI   598
   40 IF (SYMBOL.EQ.SYM(3)) GO TO 30                                    EASI   599
C     .... TEST FOR SPACE FOLLOWING PERIOD.                             EASI   600
      IF (SYMBOL.EQ.SYM(5)) GO TO 310                                   EASI   601
C     .... SYMBOL IS 0 THRU 9.                                          EASI   602
      ASSIGN 60 TO NEXT                                                 EASI   603
      FIRST=1                                                           EASI   604
      LAST=8                                                            EASI   605
C     .... INCORPORATE DIGIT INTO NUMBER.                               EASI   606
   50 FLPT=FLPT*C1+ROIGIT*(C2+C3)                                       EASI   607
      C3=C3*.1                                                          EASI   608
      GO TO 150                                                         EASI   609
C                                                                       EASI   610
C                                                                       EASI   611
C     .... NUMBER IS UNDER CONSTRUCTION.                                EASI   612
   60 IF (SYMBOL.EQ.NUMB) GO TO 50                                      EASI   613
C     .... TEST FOR . (DECIMAL POINT).                                  EASI   614
      IF (SYMBOL.EQ.SYM(3)) GO TO 30                                    EASI   615
      ASSIGN 20 TO NEXT                                                 EASI   616
      LAST=6                                                            EASI   617
C     .... TEST FOR COMPLETION OF NUMBER.                               EASI   618
      IF (SYMBOL.EQ.SYM(5).OR.SYMBOL.EQ.SYM(6)) GO TO 330               EASI   619
      ASSIGN 110 TO NEXT                                                EASI   620
      FIRST=2                                                           EASI   621
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      LAST=4                                                            EASI  622
C     .... TEST FOR * (MULTIPLIER).                                     EASI  623
      IF (SYMBOL.EQ.SYM(7)) GO TO 150                                   EASI  624
      ASSIGN 70 TO NEXT                                                 EASI  625
      FIRST=1                                                           EASI  626
C     .... TEST FOR E (EXPONENT).                                       EASI  627
      IF (SYMBOL.EQ.SYM(8)) GO TO 150                                   EASI  628
      ASSIGN 80 TO NEXT                                                 EASI  629
      FIRST=4                                                           EASI  630
C     .... TEST FOR + (POSITIVE EXPONENT).                              EASI  631
      IF (SYMBOL.EQ.SYM(2)) GO TO 150                                   EASI  632
C     .... SYMBOL IS - (NEGATIVE EXPONENT).                             EASI  633
      EXSIGN=(-1)                                                       EASI  634
      GO TO 150                                                         EASI  635
C                                                                       EASI  636
C                                                                       EASI  637
C     .... PREVIOUS SYMBOL WAS E (EXPONENT).                            EASI  638
   70 ASSIGN 100 TO NEXT                                                EASI  639
      FIRST=4                                                           EASI  640
      LAST=7                                                            EASI  641
C     .... TEST FOR 0 THRU 9.                                           EASI  642
      IF (SYMBOL.EQ.NUMB) GO TO 90                                      EASI  643
      ASSIGN 80 TO NEXT                                                 EASI  644
      LAST=4                                                            EASI  645
C     .... TEST FOR + (POSITIVE EXPONENT).                              EASI  646
      IF (SYMBOL.EQ.SYM(2)) GO TO 150                                   EASI  647
C     .... SYMBOL IS - (NEGATIVE EXPONENT).                             EASI  648
      EXSIGN=(-1)                                                       EASI  649
      GO TO 150                                                         EASI  650
C                                                                       EASI  651
C                                                                       EASI  652
C     .... EXPONENT IS UNDER CONSTRUCTION.                              EASI  653
   80 ASSIGN 100 TO NEXT                                                EASI  654
      LAST=7                                                            EASI  655
C     .... INCORPORATE DIGIT INTO EXPONENT.                             EASI  656
   90 EXP=EXP*10+DIGIT                                                  EASI  657
      GO TO 150                                                         EASI  658
C                                                                       EASI  659
C                                                                       EASI  660
C     .... EXPONENT IS UNDER CONSTRUCTION.  TEST FOR 0 THRU 9.          EASI  661
  100 IF (SYMBOL.EQ.NUMB) GO TO 90                                      EASI  662
      ASSIGN 20 TO NEXT                                                 EASI  663
      FIRST=1                                                           EASI  664
      LAST=6                                                            EASI  665
C     .... TEST FOR END OF EXPONENT.                                    EASI  666
      IF (SYMBOL.EQ.SYM(5).OR.SYMBOL.EQ.SYM(6)) GO TO 330               EASI  667
C     .... EXPONENT IS COMPLETE AND FOLLOWED BY MULTIPLIER (*).         EASI  668
      ASSIGN 110 TO NEXT                                                EASI  669
      FIRST=2                                                           EASI  670
      LAST=4                                                            EASI  671
      GO TO 150                                                         EASI  672
C                                                                       EASI  673
C                                                                       EASI  674
C     .... BEGIN CONSTRUCTION OF MULTIPLIER.                            EASI  675
  110 FIRST=4                                                           EASI  676
```

```
      IF (SYMBOL.EQ.SYM(2)) GO TO 150                                   EASI    677
      MULT=DIGIT                                                        EASI    678
      ASSIGN 120 TO NEXT                                                EASI    679
      LAST=E                                                            EASI    680
      GO TO 150                                                         EASI    681
C                                                                       EASI    682
C                                                                       EASI    683
C     .... COMPLETE CONSTRUCTION OF MULTIPLIER.                         EASI    684
  120 ASSIGN 230 TO NEXT                                                EASI    685
      FIRST=1                                                           EASI    686
      IF (SYMBOL.EQ.SYM(5).OR.SYMBOL.EQ.SYM(6)) GO TO 130               EASI    687
      GO TO 140                                                         EASI    688
  130 GO TO FINISH, (320,330,360)                                       EASI    689
  140 MULT=MULT*10+DIGIT                                                EASI    690
      ASSIGN 120 TO NEXT                                                EASI    691
      FIRST=4                                                           EASI    692
      GO TO 150                                                         EASI    693
C                                                                       EASI    694
C                                                                       EASI    695
C     .... READ THE NEXT CHARACTER ON THE CURRENT LINE.                 EASI    696
  150 IF (COL.LE.NCOL) GO TO 200                                        EASI    697
C     .... THE LINE HAS BEEN COMPLETELY READ.                           EASI    698
      ASSIGN 20 TO NEXT                                                 EASI    699
      FIRST=1                                                           EASI    700
      LAST=E                                                            EASI    701
      SYM(5)=PERIOD                                                     EASI    702
      EXPON=0                                                           EASI    703
      MULT=1                                                            EASI    704
      COL=2                                                             EASI    705
      LOOP=LOOP*(-1)                                                    EASI    706
      IF (LOOP) 160,260,280                                             EASI    707
C                                                                       EASI    708
C                                                                       EASI    709
C     .... READ NEW LINE AND CHECK FOR ERRORS.                          EASI    710
  160 LASNUM=NNUM                                                       EASI    711
      LASTOT=NTOT                                                       EASI    712
      LASTOP=STOP                                                       EASI    713
C     .... TEST TO SEE IF SUBROUTINE E[illegible] IS COMPLETE.          EASI    714
      IF (STOP.NE.1.OR.NONLNE.EQ.3) GO TO [illegible]                   EASI    715
      NONLNE=0                                                          EASI    716
C     .... CHECK FOR FIRST LINE READ                                    EASI    717
      IF (LINE1.EQ.0) GO TO 170                                         EASI    718
C     .... PRINT ERROR MESSAGE TO OUTPUT FILE.                          EASI    719
      WRITE (NOUT,390) (MESS(I),I=1,4)                                  EASI    720
C     .... ECHO THE DATA LINE.                                          EASI    721
      WRITE (NOUT,400) (CHAR(M),M=1,NCOL)                               EASI    722
      NNUM=-1                                                           EASI    723
C     .... EXIT THE SUBROUTINE                                          EASI    724
      RETURN                                                            EASI    725
C     .... READ ONE LINE FROM THE INPUT FILE.                           EASI    726
  170 READ (NIN,380) (CHAR(M),M=1,NCOL)                                 EASI    727
      IF (EOF(NIN)) 180,190                                             EASI    728
  180 WRITE (NIN,410)                                                   EASI    729
      GO TO 170                                                         EASI    730
  190 CONTINUE                                                          EASI    731
```

```
      CHAR(NCOL+1)=SYM(5)                                               EASI      732
      LINE1=1                                                           EASI      733
C     .... INTERPRET CHARACTERS.                                        EASI      734
C     .... FIRST TEST FOR 0 THRU 9.                                     EASI      735
  200 SYMBOL=NUMB                                                       EASI      736
      COL=CCL+1                                                         EASI      737
      DO 220 M=1,10                                                     EASI      738
      DIGIT=M-1                                                         EASI      739
      RDIGIT=DIGIT                                                      EASI      740
      IF (CHAR(COL).EQ.NUM(M)) GO TO 210                                EASI      741
      GO TO 220                                                         EASI      742
  210 GO TO NEXT, (20,40,60,70,80,100,110,120)                          EASI      743
  220 CONTINUE                                                          EASI      744
C     .... TEST FOR + - . * OR E.                                       EASI      745
      DIGIT=0                                                           EASI      746
      RDIGIT=0.                                                         EASI      747
      DO 240 M=FIRST,LAST                                               EASI      748
      SYMBOL=SYM(M)                                                     EASI      749
      IF (CHAR(COL).EQ.SYM(M)) GO TO 230                                EASI      750
      GO TO 240                                                         EASI      751
  230 GO TO NEXT, (20,40,60,70,80,100,110,120)                          EASI      752
  240 CONTINUE                                                          EASI      753
      NONLNE=1                                                          EASI      754
C     .... TEST FOR -* PAIR.                                            EASI      755
      IF (CHAR(COL).EQ.SYM(7)) GO TO 350                                EASI      756
C     .... CHARACTER IS ERRORONEOUS SYMBOL.                             EASI      757
  250 LOCP=0                                                            EASI      758
      IF (LSTERR.NE.0) GO TO 150                                        EASI      759
C     .... RECORD LOCATION OF FIRST ERRONEOUS SYMBOL.                   EASI      760
      LSTERR=NTOT+1                                                     EASI      761
      ERRCOL=COL                                                        EASI      762
      GO TO 150                                                         EASI      763
C                                                                       EASI      764
C                                                                       EASI      765
C     .... ERROR IN LAST LINE.                                          EASI      766
  260 LOCP=1                                                            EASI      767
      LSTERR=0                                                          EASI      768
      NNUM=LASNUM                                                       EASI      769
      NTOT=LASTOT                                                       EASI      770
      STOP=LASTOP                                                       EASI      771
C     .... BEGIN WRITING ERROR MESSAGE.                                 EASI      772
      WRITE (NOUT,420)                                                  EASI      773
C     .... ECHO LAST LINE.                                              EASI      774
      WRITE (NOUT,400) (CHAR(M),M=1,NCOL)                               EASI      775
      ERRCOL=ERRCOL+2                                                   EASI      776
      DO 270 M=1,NCOL                                                   EASI      777
  270 CHAR(M)=SYM(5)                                                    EASI      778
      CHAR(ERRCOL)=SYM(9)                                               EASI      779
C     .... PLACE AN UP ARROW (^) UNDER ERRONEOUS CHARACTER.             EASI      780
      WRITE (NOUT,400) (CHAR(M),M=1,ERRCOL)                             EASI      781
      NNUM=-1                                                           EASI      782
C     .... EXIT THE SUBROUTINE                                          EASI      783
      RETURN                                                            EASI      784
C                                                                       EASI      785
C                                                                       EASI      786
```

```
SUBROUTINE  FFFINP                                  CDC 6600 FTN V3.0-V34A OPT=1  11/17/77  09.10.41.
      C     .... LAST LINE IS OK...INTERPRET.                                    EASI
        280 NNUM=LASNUM                                                          EASI
            NTOT=LASTOT                                                          EASI
            STOP=LASTOP                                                          EASI
            GO TO 200                                                            EASI
      C                                                                          EASI
      C                                                                          EASI
      C     .... DEFAULT ONE NUMBER.                                             EASI
        290 LAST=7                                                               EASI
            NNUM=NNUM+STOP                                                       EASI
            NTOT=NTOT+1                                                          EASI
        300 IF (NNUM.GE.QUANT) STOP=0                                            EASI
            MULT=1                                                               EASI
            SYM(3)=PERIOD                                                        EASI
            NONLNE=NONLNE+1                                                      EASI
            GO TO 150                                                            EASI
      C                                                                          EASI
      C                                                                          EASI
      C     .... DEFAULT FURTHER INPUT.                                          EASI
        310 STOP=0                                                               EASI
            ASSIGN 20 TO NEXT                                                    EASI
            FIRST=1                                                              EASI
            LAST=6                                                               EASI
            GO TO 300                                                            EASI
      C                                                                          EASI
      C                                                                          EASI
      C     .... DEFAULT N NUMBERS.                                              EASI
        320 ASSIGN 20 TO NEXT                                                    EASI
            FIRST=1                                                              EASI
            LAST=6                                                               EASI
            NNUM=NNUM+(MULT-1)*STOP                                              EASI
            NTOT=NTOT+MULT-1                                                     EASI
            GO TO 300                                                            EASI
      C                                                                          EASI
      C                                                                          EASI
      C     .... COMPLETE THE CONSTRUCTION OF A NUMBER.                          EASI
        330 EXP=EXP*EXSIGN                                                       EASI
            FLPT=FLPT*RESIGN*10.**EXP                                            EASI
      C     .... THE NAME OF THE OUTPUT ARRAY (ARGUMENT  3) IS                   EASI
      C     .... >NUMBER>, AN INTEGER NAME.  IF QUAN (ARGUMENT  1)               EASI
      C     .... CALLS FOR FLOATING POINT OUTPUT, USE AN EQUIVALENCE             EASI
      C     .... STATEMENT TO SUPRESS REAL-TO-INTEGER CONVERSION.                EASI
            REQ=FLPT                                                             EASI
            IF (TYPE.LT.0) IEQ=FLPT                                              EASI
            ASSIGN 20 TO NEXT                                                    EASI
            FIRST=1                                                              EASI
            LAST=6                                                               EASI
            NTOT=NTOT+MULT                                                       EASI
      C     .... IF QUANTITY REQUIREMENTS ARE MET, OR IF CHECKING                EASI
      C     .... LINE FOR ERRORS, DO NOT WRITE INTO OUTPUT ARRAY.                EASI
            IF (STOP.NE.1.OR.LOOP.LE.0) GO TO 300                                EASI
            NNUM=NNUM+1                                                          EASI
            MULT=NNUM+MULT-1                                                     EASI
            IF (MULT.GE.QUANT) MULT=QUANT                                        EASI
      C     .... WRITE NUMBER(S) INTO OUTPUT ARRAY.                              EASI
```

```
      DO 340 M=NNUM,MULT                                        EASI    842
  340 NUMBER(M)=IEQ                                             EASI    843
      NNUM=MULT                                                 EASI    844
      GO TO 300                                                 EASI    845
C                                                               EASI    846
C     .... SET UP DELETE MECHANISM.                             EASI    847
  350 IF (INTSGN.EQ.1) GO TO 250                                EASI    848
      ASSIGN 360 TO FINISH                                      EASI    849
      ASSIGN 110 TO NEXT                                        EASI    850
      FIRST=2                                                   EASI    851
      LAST=4                                                    EASI    852
      SYM(3)=NIL                                                EASI    853
      GO TO 150                                                 EASI    854
C     .... DELETE N NUMBERS.                                    EASI    855
  360 NTOT=NTOT-MULT                                            EASI    856
      IF (NTOT.GT.NNUM) GO TO 300                               EASI    857
      IF (NTOT.LT.0) NTOT=0                                     EASI    858
      STOP=1                                                    EASI    859
      NNUM=NTOT                                                 EASI    860
      GO TO 300                                                 EASI    861
C                                                               EASI    862
C                                                               EASI    863
C     .... CORRECT THE VALUE OF NNUM FOR OUTPUT (ARGUMENT  4)   EASI    864
C     .... IF NECESSARY AND RETURN.                             EASI    865
  370 IF (NNUM.GE.QUANT) NNUM=QUANT                             EASI    866
      RETURN                                                    EASI    867
C                                                               EASI    868
  380 FORMAT (81A1)                                             EASI    869
  390 FORMAT (7A10)                                             EASI    870
  400 FORMAT (2X,78A1)                                          EASI    871
  410 FORMAT (38HYOU DID NOT ENTER DATA----- ENTER DATA)        EASI    872
  420 FORMAT (/29HSYNTAX ERROR IN LAST LINE....)                EASI    873
      END                                                       EASI    874
```

```
C     OVERLAY (1,0)                                                     EASI    875
C     PROGRAM TWOD                                                      EASI    876
C     IF OVERLAY IS USED DELETE NEXT STATEMENT.                         EASI    877
      SUBROUTINE TWOD                                                   EASI    878
C                                                                       EASI    879
C     IN THIS SUBROUTINE SIX TWO-DIMENSIONAL PLOT OPTIONS ARE           EASI    880
C     IMPLEMENTED. THESE OPTIONS ARE                                    EASI    881
C                                                                       EASI    882
C     1  PROBABILITY OF ALARM VS. TIME TO TERMINAL POINT                EASI    883
C     2  PROBABILITY OF INTERRUPTION VS. TIME TO TERMINAL POINT         EASI    884
C     3  PROBABILITY OF INTERRUPTION VS. RESPONSE TIME                  EASI    885
C     4  PROBABILITY OF INTERRUPTION VS. PROBABILITY OF                 EASI    886
C        COMMUNICATION                                                  EASI    887
C     5  PROBABILITY OF INTERRUPTION VS. TASK TIME                      EASI    888
C     6  PROBABILITY OF INTERRUPTION VS. PROBABILITY OF                 EASI    889
C        DETECTION                                                      EASI    890
C                                                                       EASI    891
      COMMON /2/ TASKT(25),SOTT(25),PDD(25),N,PC,TR,SOTR,PI(25),CPA(25) EASI    892
      COMMON /BLK/ T(25),IOPT,LL,ASDP,ASDRT,IT,TM,IS,IT1,IT2,ASDRT1,ASDR EASI    893
     1T2,IS1,IS2,TM1,ISCALE                                             EASI    894
      DIMENSION X(2000), W(2000), LABELX(100), LABELY(100)              EASI    895
C                                                                       EASI    896
C                                                                       EASI    897
C     INITIALIZE TEKTRONIX TERMINAL CONTROL SYSTEM, BEGIN               EASI    898
C     PLOT IN DISSPLA AND SET PAGE SIZE.                                EASI    899
C                                                                       EASI    900
      CALL TCS (120)                                                    EASI    901
      CALL BGNPL (-1)                                                   EASI    902
      CALL PAGE (14.3,11.)                                              EASI    903
      CALL TOUTPT (27)                                                  EASI    904
      CALL TOUTPT (104)                                                 EASI    905
C                                                                       EASI    906
C     BRANCH TO REQUESTED PLOT                                          EASI    907
C                                                                       EASI    908
      GO TO (10,50,90,120,140,220), IOPT                                EASI    909
C                                                                       EASI    910
C     PROBABILITY OF ALARM VS. TIME TO TERMINAL POINT                   EASI    911
C                                                                       EASI    912
   10 LL=N                                                              EASI    913
      CALL CALC                                                         EASI    914
      WRITE (55,240)                                                    EASI    915
      CALL FFFINP (-1,ISCALE,NOUT,66)                                   EASI    916
      IF (ISCALE.EQ.0) GO TO 30                                         EASI    917
      WRITE (55,250)                                                    EASI    918
      WRITE (55,260)                                                    EASI    919
   20 CALL FFFINP (1,XMAX,NOUT,66)                                      EASI    920
      WRITE (55,270)                                                    EASI    921
      CALL FFFINP (1,XSTP,NOUT,66)                                      EASI    922
      IF (XMAX.GE.TM) GO TO 30                                          EASI    923
      WRITE (55,280) TM                                                 EASI    924
      GO TO 20                                                          EASI    925
   30 CONTINUE                                                          EASI    926
      CALL TITLE (31HCUMULATIVE PROBABILITY OF ALARM,31,30HTIME TO TERMI EASI    927
     1NAL POINT,MINUTES,30,20HPROBABILITY OF ALARM,20,11.,8.)           EASI    928
      IF (ISCALE.EQ.0) XMAX=FLOAT(IFIX(TM+1.))                          EASI    929
```

```
      X(1)=T(1)                                                         EASI      930
      W(2*N+1)=CPA(N+1)                                                 EASI      931
      DO 40 I=1,N                                                       EASI      932
      X(2*I+1)=T(I+1)                                                   EASI      933
      X(2*I)=T(I+1)                                                     EASI      934
      W(2*I-1)=CPA(I)                                                   EASI      935
      W(2*I)=CPA(I)                                                     EASI      936
   40 CONTINUE                                                          EASI      937
      MM=2*N+1                                                          EASI      938
      GO TO 230                                                         EASI      939
C                                                                       EASI      940
C     PROBABILITY OF INTERRUPTION VS. TIME TO TERMINAL POINT            EASI      941
C                                                                       EASI      942
   50 LL=N                                                              EASI      943
      CALL CALC                                                         EASI      944
      WRITE (55,240)                                                    EASI      945
      CALL FFFINP (-1,ISCALE,NOUT,66)                                   EASI      946
      IF (ISCALE.EQ.0) GO TO 70                                         EASI      947
      WRITE (55,250)                                                    EASI      948
      WRITE (55,260)                                                    EASI      949
   60 CALL FFFINP (1,XMAX,NOUT,66)                                      EASI      950
      WRITE (55,270)                                                    EASI      951
      CALL FFFINP (1,XSTP,NOUT,66)                                      EASI      952
      IF (XMAX.GE.TM) GO TO 70                                          EASI      953
      WRITE (55,280) TM                                                 EASI      954
      GO TO 60                                                          EASI      955
   70 CONTINUE                                                          EASI      956
      CALL TITLE (38-CUMULATIVE PROBABILITY OF INTERRUPTION,38,3HTIME T EASI      957
     10 TERMINAL POINT,MINUTES,33,27HPROBABILITY OF INTERRUPTION,27,11,. EASI      958
     29.)                                                               EASI      959
      IF (ISCALE.EQ.0) XMAX=FLOAT(IFIX(TM+1.))                          EASI      960
      X(1)=T(1)                                                         EASI      961
      W(2*N+1)=PI(N+1)                                                  EASI      962
      DO 80 I=1,N                                                       EASI      963
      X(2*I)=T(I+1)                                                     EASI      964
      X(2*I+1)=T(I+1)                                                   EASI      965
      W(2*I-1)=PI(I)                                                    EASI      966
      W(2*I)=PI(I)                                                      EASI      967
   80 CONTINUE                                                          EASI      968
      MM=2*N+1                                                          EASI      969
      GO TO 230                                                         EASI      970
C                                                                       EASI      971
C     PROBABILITY OF INTERRUPTION VS.RESPONSE TIME                      EASI      972
C                                                                       EASI      973
   90 WRITE (55,290)                                                    EASI      974
      CALL FFFINP (1,ASDP,NOUT,66)                                      EASI      975
      CALL DEV (ASDP)                                                   EASI      976
      WRITE (55,240)                                                    EASI      977
      CALL FFFINP (-1,ISCALE,NOUT,66)                                   EASI      978
      IF (ISCALE.EQ.0) GO TO 100                                        EASI      979
      WRITE (55,250)                                                    EASI      980
      WRITE (55,[illegible])                                            EASI      981
      CALL FFFINP (1,XMAX,NOUT,66)                                      EASI      982
      WRITE (55,[illegible])                                            EASI      983
      CALL FFFINP (1,XSTP,NOUT,66)                                      EASI      984
```

```
  100 CONTINUE
      TMAX=(TM+TM1)/(1.-2./ASDR)
      IF (ISCALE.EQ.0) MM=TMAX/.1
      IF (ISCALE.EQ.1) MM=XMAX/.1
      STR=TR
      TR=.0001
      SSDTR=SDTR
      SDTR=TR/ASDR
      LL=1
      DO 110 I=1,MM
      CALL CALC
      X(I)=TR
      W(I)=FI(1)
      TR=TR+.1
      SDTR=TR/ASDR
  110 CONTINUE
      TR=STR
      SDTR=SSDTR
      CALL TOUTPT (27)
      CALL TOUTPT (104)
      CALL TITLE (27HPROBABILITY OF INTERRUPTION,27,27HRESPONSE FORCE TI
     1ME,MINUTES,27,27HPROBABILITY OF INTERRUPTION,27,11.,9.)
      IF (ISCALE.EQ.0) XMAX=FLOAT(IFIX(TMAX+1.))
      GO TO 230
C
C     PROBABILITY OF INTERRUPTION VS. PROBABILITY OF
C     COMMUNICATION
C
  120 LL=1
      ISCALE=0
      SPC=PC
      PC=0.
      DO 130 I=1,201
      CALL CALC
      X(I)=PC
      W(I)=FI(1)
      PC=PC+.005
  130 CONTINUE
      MM=201
      PC=SPC
      XMAX=1.
      CALL TITLE (28HPROBABILITY OF INTERRUPTION$,100,29HPROBABILITY OF
     1COMMUNICATION$,100,28HPROBABILITY OF INTERRUPTION$,100,11.,9.)
      GO TO 230
C
C     PROBABILITY OF INTERRUPTION VS. TASK TIME
C
  140 WRITE (55,300)
      CALL FFFINP (1,TI,NOUT,66)
      LL=N
      CALL CALC
      IT=TI
      STASKT=TASKT(IT)
      WRITE (55,310)
      CALL FFFINP (1,ASDR,NOUT,66)
```

```
      CALL CEV (ASOR)                                                   EASI    1040
      WRITE (55,240)                                                    EASI    1041
      CALL FFFINP (-1,ISCALE,NOUT,66)                                   EASI    1042
      IF (ISCALE.EQ.0) GO TO 150                                        EASI    1043
      WRITE (55,250)                                                    EASI    1044
      WRITE (55,260)                                                    EASI    1045
      CALL FFFINP (1,XMAX,NOUT,66)                                      EASI    1046
      WRITE (55,270)                                                    EASI    1047
      CALL FFFINP (1,XSTP,NOUT,66)                                      EASI    1048
  150 CONTINUE                                                          EASI    1049
      TASKT(IT)=.000001                                                 EASI    1050
      SSDTT=SDTT(IT)                                                    EASI    1051
      SDTT(IT)=TASKT(IT)/ASOR                                           EASI    1052
      LL=1                                                              EASI    1053
      IF (ISCALE.EQ.1) GO TO 180                                        EASI    1054
      S=0.                                                              EASI    1055
      IF (IT.EQ.N) GO TO 170                                            EASI    1056
      J=IT+1                                                            EASI    1057
      DO 160 I=J,N                                                      EASI    1058
      S=S+TASKT(I)-2.*SDTT(I)                                           EASI    1059
  160 CONTINUE                                                          EASI    1060
  170 TMAX=(TR+2.*SDTR-S)/(1.-2./ASOR)                                  EASI    1061
      IF (TMAX.GT.0.) GO TO 180                                         EASI    1062
      CALL CONEPL                                                       EASI    1063
      TASKT(IT)=STASKT                                                  EASI    1064
      SDTT(IT)=SSDTT                                                    EASI    1065
      WRITE (55,320) IT                                                 EASI    1066
      PAUSE                                                             EASI    1067
      RETURN                                                            EASI    1068
  180 IF (ISCALE.EQ.0) MM=IFIX(20.*TMAX)                                EASI    1069
      IF (ISCALE.EQ.1) MM=IFIX(20.*XMAX+1.5)                            EASI    1070
      IF (MM.LE.2000) GO TO 190                                         EASI    1071
      CALL INITT (120)                                                  EASI    1072
      CALL NEWPAG                                                       EASI    1073
      CALL CHRSIZ (4)                                                   EASI    1074
      CALL TSEND                                                        EASI    1075
      WRITE (55,330)                                                    EASI    1076
      STOP                                                              EASI    1077
  190 DO 200 I=1,MM                                                     EASI    1078
      CALL CALC                                                         EASI    1079
      X(I)=TASKT(IT)                                                    EASI    1080
      W(I)=PI(1)                                                        EASI    1081
      TASKT(IT)=TASKT(IT)+.05                                           EASI    1082
      SDTT(IT)=TASKT(IT)/ASOR                                           EASI    1083
  200 CONTINUE                                                          EASI    1084
      IF (ISCALE.EQ.1) GO TO 210                                        EASI    1085
      XMAX=FLOAT(IFIX(TMAX+1.))                                         EASI    1086
      MM=MM+1                                                           EASI    1087
      X(MM)=XMAX                                                        EASI    1088
      W(MM)=PI(1)                                                       EASI    1089
  210 TASKT(IT)=STASKT                                                  EASI    1090
      SDTT(IT)=SSDTT                                                    EASI    1091
      WRITE (45,350) IT                                                 EASI    1092
      REWIND 45                                                         EASI    1093
      READ (45,340) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA EASI    1094
```

```
      1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)
      REWIND 45
      CALL TITLE (28HPROBABILITY OF INTERRUPTIONS,100,LABELX,100,29HPROB
     1ABILITY OF INTERRUPTIONS,100,11.,9.)
      GO TO 230
C
C     PROBABILITY OF INTERRUPTION VS. PROBABILITY OF
C     DETECTION
C
  220 WRITE (55,360)
      CALL FFFINP (1,SI,NOUT,66)
      LL=1
      ISCALE=0
      IS=SI
      SPDD=FDD(IS)
      PDC(IS)=0.
      CALL CALC
      X(1)=0.
      W(1)=FI(1)
      PDC(IS)=1.
      CALL CALC
      X(2)=1.
      W(2)=FI(1)
      PDC(IS)=SPDD
      MM=2
      XMAX=1.
      WRITE (45,370) IS
      REWIND 45
      READ (45,340) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA
     1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)
      REWIND 45
      CALL TITLE (28HPROBABILITY OF INTERRUPTIONS,100,LABELX,100,29HPROB
     1ABILITY OF INTERRUPTIONS,100,11.,9.)
C
C     CALL SEQUENCE FOR DISSPLA TWO-DIMENSIONAL PLOT
C
  230 CALL CORNER (X,W,XMAX,1.,MM,ICOR)
      IF (ISCALE.EQ.0) CALL GRAF (0.,5HSCALE,XMAX,0.,5HSCALE,1.)
      IF (ISCALE.EQ.1) CALL GRAF (0.,XSTP,XMAX,0.,5HSCALE,1.)
      CALL TOUTPT (27)
      CALL TOUTPT (96)
      CALL DOC (ICOR)
      CALL TOUTPT (27)
      CALL TOUTPT (97)
      CALL GRID (1,1)
      CALL TOUTPT (27)
      CALL TOUTPT (96)
      CALL FRAME
      CALL TOUTPT (27)
      CALL TOUTPT (104)
      CALL CURVE (X,W,MM,0)
      CALL TOUTPT (27)
      CALL TOUTPT (96)
      RETURN
C
```

```
      240 FORMAT (54HDO YOU WANT TO SET YOUR OWN SCALE+1=YES,0=NO    RETURN) EASI    1150
      250 FORMAT (49HNEED XMAX, MAXIMUM VALUE OF INDEPENDENT VARIABLE,/48HAN EASI    1151
         1D XSTP, SPACING FOR TICK MARKS. XMAX SHOULD BE/19HA MULTIPLE OF XS EASI    1152
         2TP.)                                                              EASI    1153
      260 FORMAT (52HENTER MAXIMUM VALUE OF INDEPENDENT VARIABLE   RETURN)  EASI    1154
      270 FORMAT (32HENTER TICK MARK SPACING   RETURN)                      EASI    1155
      280 FORMAT (32HMAXIMUM VALUE SHOULD BE AT LEAST,F8.2/46HWHICH IS THE S EASI    1156
         1UM OF THE TASK TIMES     REENTER)                                 EASI    1157
      290 FORMAT (55HENTER RATIO OF MEAN RESPONSE TIME TO STANDARD DEVIATION EASI    1158
         1,9H   RETURN)                                                     EASI    1159
      300 FORMAT (//,32HWHICH TASK TIME IS THE VARIABLE+/26HENTER TASK NUMBE EASI    1160
         1R   RETURN)                                                       EASI    1161
      310 FORMAT (/51HENTER RATIO OF MEAN TASK TIME TO STANDARD DEVIATION,9H EASI    1162
         1   RETURN)                                                        EASI    1163
      320 FORMAT (30HPROBABILITY OF INTERRUPTION IS/29HINSENSITIVE TO TIME F EASI    1164
         1OR TASK ,I2,/24HPRESS RETURN TO CONTINUE)                         EASI    1165
      330 FORMAT (49HTOO MANY PLOT POINTS, REDIMENSION ARRAYS)              EASI    1166
      340 FORMAT (10A10)                                                    EASI    1167
      350 FORMAT (13HTIME FOR TASK,I3,10H ,MINUTES$)                        EASI    1168
      360 FORMAT (//,29HWHICH SENSOR IS THE VARIABLE+/28HENTER SENSOR NUMBER EASI    1169
         1   RETURN)                                                        EASI    1170
      370 FORMAT (33HPROBABILITY OF DETECTION, SENSOR ,I2,1H$)              EASI    1171
          END                                                               EASI    1172
```

```
      SUBROUTINE ARESQ (X,Y,XMAX,YMAX,M,XMIN)                           EASI    1173
C                                                                       EASI    1174
C     IN THIS SUBROUTINE                                                EASI    1175
C                                                                       EASI    1176
C     XMIN=MIN((X(I)-XMAX)**2+(Y(I)-YMAX)**2,I=1,M)                     EASI    1177
C                                                                       EASI    1178
C     IS CALCULATED                                                     EASI    1179
C                                                                       EASI    1180
      DIMENSION X(1), Y(1)                                              EASI    1181
      XMIN=1.E52                                                        EASI    1182
      DO 10 I=1,M                                                       EASI    1183
      R=(X(I)-XMAX)**2+(Y(I)-YMAX)**2                                   EASI    1184
      IF (R.LT.XMIN) XMIN=R                                             EASI    1185
   10 CONTINUE                                                          EASI    1186
      RETURN                                                            EASI    1187
      END                                                               EASI    1188
```

```
      SUBROUTINE CORNER (X,Y,XMAX,YMAX,M,ICOR)                          EASI    1189
C                                                                       EASI    1190
C     IN THIS SUBROUTINE A CORNER OF THE PLOT IS DETERMINED             EASI    1191
C     WHICH IS THE FURTHEST AWAY FROM THE CURVE OF THE PLOT.            EASI    1192
C     THIS CORNER IS USED FOR DISPLAYING DATA FOR THE PLOT.             EASI    1193
C                                                                       EASI    1194
      DIMENSION X(1), Y(1)                                              EASI    1195
      ICOR=1                                                            EASI    1196
      CALL ARESQ (X,Y,0.,0.,M,DIS)                                      EASI    1197
      DIST=DIS                                                          EASI    1198
      CALL ARESQ (X,Y,0.,YMAX,M,DIS)                                    EASI    1199
      IF (DIS.LE.DIST) GO TO 10                                         EASI    1200
      ICOR=2                                                            EASI    1201
      DIST=DIS                                                          EASI    1202
   10 CALL ARESQ (X,Y,XMAX,YMAX,M,DIS)                                  EASI    1203
      IF (DIS.LE.DIST) GO TO 20                                         EASI    1204
      ICOR=3                                                            EASI    1205
      DIST=DIS                                                          EASI    1206
   20 CALL ARESQ (X,Y,XMAX,0.,M,DIS)                                    EASI    1207
      IF (DIS.LE.DIST) GO TO 30                                         EASI    1208
      ICOR=4                                                            EASI    1209
   30 CONTINUE                                                          EASI    1210
      RETURN                                                            EASI    1211
      END                                                               EASI    1212
```

```
C     OVERLAY (2,0)                                                     EASI   1213
C     PROGRAM THRED                                                     EASI   1214
C     IF OVERLAY IS USED DELETE NEXT STATEMENT.                         EASI   1215
      SUBROUTINE THRED                                                  EASI   1216
C                                                                       EASI   1217
C     IN THIS SUBROUTINE EIGHT THREE-DIMENSIONAL PLOT                   EASI   1218
C     OPTIONS ARE IMPLEMENTED. THESE PLOT OPTIONS ARE                   EASI   1219
C                                                                       EASI   1220
C     PROBABILITY OF INTERRUPTION AS A FUNCTION OF                      EASI   1221
C          1  RESPONSE TIME AND PROBABILITY OF                          EASI   1222
C             COMMUNICATION                                             EASI   1223
C          2  TIME FOR TASK *IT* AND PROBABILITY OF                     EASI   1224
C             DETECTION FOR SENSOR *IS*                                 EASI   1225
C          3  RESPONSE TIME AND PROBABILITY OF DETECTION                EASI   1226
C             FOR SENSOR *IS*                                           EASI   1227
C          4  RESPONSE TIME AND PROBABILITY OF DETECTION                EASI   1228
C             DETECTION FOR SENSOR *IS*                                 EASI   1229
C          5  PROBABILITY OF COMMUNICATION AND PROBABILITY              EASI   1230
C             DETECTION FOR SENSOR *IS*                                 EASI   1231
C          6  TIME FOR TASK *IT* AND PROBABILITY OF                     EASI   1232
C             COMMUNICATION                                             EASI   1233
C          7  TIME FOR TASK *IT1* AND TIME FOR TASK *IT2*               EASI   1234
C          8  PROBABILITY OF DETECTION FOR SENSOR *IS1* AND             EASI   1235
C             PROBABILITY OF DETECTION FOR SENSOR *IS2*                 EASI   1236
C                                                                       EASI   1237
C     THE USER IS QUERIED ABOUT THE VARIABLES OF THE PLOT               EASI   1238
C     AND INFORMATION NEEDED TO CONSTRUCT THE PLOT IS                   EASI   1239
C     REQUESTED.                                                        EASI   1240
C                                                                       EASI   1241
      COMMON /2/ TASKT(25),SDTT(25),PDD(25),N,PC,TR,SDTR,PI(25),CFA(25) EASI   1242
      COMMON /BLK/ T(25),IOPT,LL,ASDR,ASDRT,IT,TM,IS,IT1,IT2,ASDRT1,ASDR EASI   1243
     1T2,IS1,IS2,TM1,ISCALE                                             EASI   1244
      COMMON /NEW/ XMAX,XDEL,INTX,YMAX,YDEL,INTY,VUX,VUZ,VUY,W(500),LABE EASI   1245
     1LX(100),LABELY(100),X0,Y0,XSTP,YSTP                               EASI   1246
      INTX=2                                                            EASI   1247
      INTY=2                                                            EASI   1248
      X0=0.                                                             EASI   1249
      Y0=0.                                                             EASI   1250
C                                                                       EASI   1251
C     INITIALIZE TEKTRONIX TERMINAL CONTROL SYSTEM. BEGIN               EASI   1252
C     PLOT IN DISSPLA, AND SET PAGE SIZE.                               EASI   1253
C                                                                       EASI   1254
      CALL TCS (120)                                                    EASI   1255
      CALL BGNPL (-1)                                                   EASI   1256
      CALL PAGE (14.4,11.)                                              EASI   1257
      I=IOPT-6                                                          EASI   1258
C                                                                       EASI   1259
C     BRANCH TO REQUESTED PLOT.                                         EASI   1260
C                                                                       EASI   1261
      GO TO (10,40,100,160,190,210,270,370), I                          EASI   1262
C                                                                       EASI   1263
C     PROBABILITY OF INTERRUPTION AS A FUNCTION OF                      EASI   1264
C     RESPONSE TIME AND PROBABILITY OF COMMUNICATION.                   EASI   1265
C                                                                       EASI   1266
   10 WRITE (55,550)                                                    EASI   1267
```

```
      CALL FFFINP (1,ASDP,NOUT,66)                                      FASI    1268
      CALL CEV (ASOR)                                                   FASI    1269
      XMAX=(TM+TM1)/(1.-2./ASOR)                                        FASI    1270
      WRITE (55,410)                                                    FASI    1271
      CALL FFFINP (-1,ISCALE,NOUT,66)                                   FASI    1272
      IF (ISCALE.EQ.0) GO TO 20                                         FASI    1273
      WRITE (55,420)                                                    FASI    1274
      WRITE (55,430)                                                    FASI    1275
      CALL FFFINP (1,XMAX,NOUT,66)                                      FASI    1276
      WRITE (55,440)                                                    FASI    1277
      CALL FFFINP (1,XSTP,NOUT,66)                                      FASI    1278
      XDEL=XSTP/2.                                                      FASI    1279
   20 CONTINUE                                                          FASI    1280
      YMAX=1.                                                           FASI    1281
      YDEL=.1                                                           FASI    1282
      YSTP=.2                                                           FASI    1283
      VUX=2.4                                                           FASI    1284
      VUY=-2.                                                           FASI    1285
      VUZ=1.5                                                           FASI    1286
      WRITE (45,470)                                                    FASI    1287
      REWIND 45                                                         FASI    1288
      READ (45,450) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA FASI    1289
     1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)                  FASI    1290
      REWIND 45                                                         FASI    1291
      WRITE (45,460)                                                    FASI    1292
      REWIND 45                                                         FASI    1293
      READ (45,450) LABELY(1),LABELY(2),LABELY(3),LABELY(4),LABELY(5),LA FASI    1294
     1BELY(6),LABELY(7),LABELY(8),LABELY(9),LABELY(10)                  FASI    1295
      REWIND 45                                                         FASI    1296
      STR=TR                                                            FASI    1297
      SSDTR=SDTR                                                        FASI    1298
      SPC=PC                                                            FASI    1299
      GO TO 390                                                         FASI    1300
   30 TR=STR                                                            FASI    1301
      SDTR=SSDTR                                                        FASI    1302
      PC=SPC                                                            FASI    1303
      GO TO 400                                                         FASI    1304
C                                                                       FASI    1305
C     PROBABILITY OF INTERRUPTION AS A FUNCTION OF                      FASI    1306
C     TIME FOR TASK "IT" AND PROBABILITY OF                             FASI    1307
C     DETECTION FOR SENSOR "IS".                                        FASI    1308
C                                                                       FASI    1309
   40 WRITE (55,510)                                                    FASI    1310
      CALL FFFINP (1,TI,NOUT,66)                                        FASI    1311
      IT=TI                                                             FASI    1312
      WRITE (55,520)                                                    FASI    1313
      CALL FFFINP (1,ASDPT,NOUT,66)                                     FASI    1314
      CALL CEV (ASDPT)                                                  FASI    1315
      WRITE (55,410)                                                    FASI    1316
      CALL FFFINP (-1,ISCALE,NOUT,66)                                   FASI    1317
      IF (ISCALE.EQ.0) GO TO 50                                         FASI    1318
      WRITE (55,420) IT                                                 FASI    1319
      WRITE (55,430) IT                                                 FASI    1320
      CALL FFFINP (1,XMAX,NOUT,66)                                      FASI    1321
      WRITE (55,440)                                                    FASI
```

```
      CALL FFFINP (1,XSTP,NOUT,66)
      XDEL=XSTP/2.
   55 CONTINUE
      WRITE (55,570)
      CALL FFFINP (1,SI,NOUT,66)
      IS=SI
      YMAX=1.
      YDEL=.1
      YSTP=.2
      VUX=-2.4
      VUY=-2.
      VUZ=1.5
      IF (ISCALF.EQ.1) GO TO 80
      S=0.
      IF (IT.EQ.N) GO TO 70
      J=IT+1
      DO 60 I=J,N
      S=S+TASKT(I)-2.*SDTT(I)
   60 CONTINUE
   70 XMAX=(TR+2.*SDTR-S)/(1.-2./ASQRT)
      IF (XMAX.GT.0.) GO TO 80
      CALL CONEPL
      WRITE (55,540) IT
      PAUSE
      RETURN
   80 CONTINUE
      WRITE (45,530) IT
      REWIND 45
      READ (45,450) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA
     1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)
      REWIND 45
      WRITE (45,560) IS
      REWIND 45
      READ (45,450) LABELY(1),LABELY(2),LABELY(3),LABELY(4),LABELY(5),LA
     1BELY(6),LABELY(7),LABELY(8),LABELY(9),LABELY(10)
      REWIND 45
      STASK=TASKT(IT)
      SSDTT=SDTT(IT)
      SPOD=POD(IS)
      GO TO 390
   90 TASKT(IT)=STASK
      SDTT(IT)=SSDTT
      POD(IS)=SPOD
      GO TO 400
C
C     PROBABILITY OF INTERRUPTION AS A FUNCTION OF
C     RESPONSE TIME AND TIME FOR TASK *IT*
C
  100 WRITE (55,550)
      CALL FFFINP (1,ASDR,NOUT,66)
      CALL DEV (ASDR)
      WRITE (55,510)
      CALL FFFINP (1,TI,NOUT,66)
      IT=TI
      WRITE (55,520)
```

```
      CALL FFFINP (1,ASDRT,NOUT,66)                                     EASI    1378
      CALL CEV (ASDRT)                                                  EASI    1379
      WRITE (55,410)                                                    EASI    1380
      CALL FFFINP (-1,ISCALE,NOUT,66)                                   EASI    1381
      IF (ISCALE.EQ.0) GO TO 110                                        EASI    1382
      WRITE (55,420)                                                    EASI    1383
      WRITE (55,430)                                                    EASI    1384
      CALL FFFINP (1,XMAX,NOUT,66)                                      EASI    1385
      WRITE (55,440)                                                    EASI    1386
      CALL FFFINP (1,XSTP,NOUT,66)                                      EASI    1387
      XDEL=XSTP/2.                                                      EASI    1388
      WRITE (55,500) IT                                                 EASI    1389
      WRITE (55,480) IT                                                 EASI    1390
      CALL FFFINP (1,YMAX,NOUT,66)                                      EASI    1391
      WRITE (55,440)                                                    EASI    1392
      CALL FFFINP (1,YSTP,NOUT,66)                                      EASI    1393
      YDEL=YSTP/2.                                                      EASI    1394
  110 CONTINUE                                                          EASI    1395
      VUX=2.4                                                           EASI    1396
      VUY=-2.                                                           EASI    1397
      VUZ=1.5                                                           EASI    1398
      WRITE (45,470)                                                    EASI    1399
      REWIND 45                                                         EASI    1400
      READ (45,450) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA EASI    1401
     1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)                  EASI    1402
      REWIND 45                                                         EASI    1403
      WRITE (45,530) IT                                                 EASI    1404
      REWIND 45                                                         EASI    1405
      READ (45,450) LABELY(1),LABELY(2),LABELY(3),LABELY(4),LABELY(5),LA EASI    1406
     1BELY(6),LABELY(7),LABELY(8),LABELY(9),LABELY(10)                  EASI    1407
      REWIND 45                                                         EASI    1408
      IF (ISCALE.EQ.1) GO TO 140                                        EASI    1409
      XMAX=3.*TR                                                        EASI    1410
      S=0.                                                              EASI    1411
      IF (IT.EQ.N) GO TO 130                                            EASI    1412
      J=IT+1                                                            EASI    1413
      DO 120 I=J,N                                                      EASI    1414
      S=S+TASKT(I)-2.*SDTT(I)                                           EASI    1415
  120 CONTINUE                                                          EASI    1416
  130 YMAX=(XMAX*(1.+2./ASDRT)-S)/(1.-2./ASDRT)                         EASI    1417
      IF (YMAX.GT.0.) GO TO 140                                         EASI    1418
      YMAX=1.                                                           EASI    1419
  140 CONTINUE                                                          EASI    1420
      STR=TR                                                            EASI    1421
      SSDTR=SDTR                                                        EASI    1422
      SSDTT=SDTT(IT)                                                    EASI    1423
      STASK=TASKT(IT)                                                   EASI    1424
      GO TO 590                                                         EASI    1425
  150 TR=STR                                                            EASI    1426
      SDTR=SSDTR                                                        EASI    1427
      TASKT(IT)=STASK                                                   EASI    1428
      SDTT(IT)=SSDTT                                                    EASI    1429
      GO TO 400                                                         EASI    1430
C                                                                       EASI    1431
C     PROBABILITY OF INTERRUPTION AS A FUNCTION OF                      EASI    1432
```

```
      C     RESPONSE TIME AND PROBABILITY OF DETECTION
      C     FOR SENSOR *IS*.
      C
        160 WRITE (55,550)
            CALL FFFINP (1,ASDR,NOUT,66)
            CALL DEV (ASDR)
            WRITE (55,570)
            CALL FFFINP (1,SI,NOUT,66)
            IS=SI
            XMAX=(TM+TM1)/(1.-2./ASDR)
            WRITE (55,410)
            CALL FFFINP (-1,ISCALE,NOUT,66)
            IF (ISCALE.EQ.0) GO TO 170
            WRITE (55,420)
            WRITE (55,430)
            CALL FFFINP (1,XMAX,NOUT,66)
            WRITE (55,440)
            CALL FFFINP (1,XSTP,NOUT,66)
            XDEL=XSTP/2.
        170 CONTINUE
            YMAX=1.
            YSTP=.2
            YDEL=.1
            WRITE (45,470)
            REWIND 45
            READ (45,450) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA
           1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)
            REWIND 45
            WRITE (45,560) IS
            REWIND 45
            READ (45,450) LABELY(1),LABELY(2),LABELY(3),LABELY(4),LABELY(5),LA
           1BELY(6),LABELY(7),LABELY(8),LABELY(9),LABELY(10)
            REWIND 45
            VUX=2.4
            VUY=-2.
            VUZ=1.5
            STR=TR
            SSDTR=SDTR
            SPDD=POD(IS)
            GO TO 390
        180 TR=STR
            SDTR=SSDTR
            POD(IS)=SPDD
            GO TO 400
      C
      C     PROBABILITY OF INTERRUPTION AS A FUNCTION OF
      C     PROBABILITY OF COMMUNICATION AND PROBABILITY OF
      C     DETECTION FOR SENSOR *IS*
      C
        190 WRITE (55,570)
            CALL FFFINP (1,SI,NOUT,66)
            IS=SI
            XMAX=1.
            YMAX=1.
            ISCALE=0
```

```
      VUX=-2.4                                                          EASI    1488
      VUY=-2.                                                           EASI    1489
      VUZ=1.5                                                           EASI    1490
      WRITE (45,460)                                                    EASI    1491
      REWIND 45                                                         EASI    1492
      READ (45,450) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA EASI    1493
     1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)                  EASI    1494
      REWIND 45                                                         EASI    1495
      WRITE (45,560) IS                                                 EASI    1496
      REWIND 45                                                         EASI    1497
      READ (45,450) LABELY(1),LABELY(2),LABELY(3),LABELY(4),LABELY(5),LA EASI    1498
     1BELY(6),LABELY(7),LABELY(8),LABELY(9),LABELY(10)                  EASI    1499
      REWIND 45                                                         EASI    1500
      SPC=PC                                                            EASI    1501
      SPDD=PDD(IS)                                                      EASI    1502
      GO TO 390                                                         EASI    1503
  200 PC=SPC                                                            EASI    1504
      PCC(IS)=SPDD                                                      EASI    1505
      GO TO 400                                                         EASI    1506
C                                                                       EASI    1507
C     PROBABILITY OF INTERRUPTION AS A FUNCTION OF                      EASI    1508
C     TIME FOR TASK *IT* AND PROBABILITY OF COMMUNICATION.              EASI    1509
C                                                                       EASI    1510
  210 WRITE (55,510)                                                    EASI    1511
      CALL FFFINP (1,TI,NOUT,66)                                        EASI    1512
      IT=TI                                                             EASI    1513
      WRITE (55,520)                                                    EASI    1514
      CALL FFFINP (1,ASDRT,NOUT,66)                                     EASI    1515
      CALL DEV (ASDRT)                                                  EASI    1516
      WRITE (55,410)                                                    EASI    1517
      CALL FFFINP (-1,ISCALE,NOUT,66)                                   EASI    1518
      IF (ISCALE.EQ.0) GO TO 220                                        EASI    1519
      WRITE (55,490) IT                                                 EASI    1520
      WRITE (55,480) IT                                                 EASI    1521
      CALL FFFINP (1,XMAX,NOUT,66)                                      EASI    1522
      WRITE (55,440)                                                    EASI    1523
      CALL FFFINP (1,XSTP,NOUT,66)                                      EASI    1524
      XDEL=XSTP/2.                                                      EASI    1525
  220 CONTINUE                                                          EASI    1526
      VUX=-2.4                                                          EASI    1527
      VUY=-2.                                                           EASI    1528
      VUZ=1.5                                                           EASI    1529
      YMAX=1.                                                           EASI    1530
      YSTP=.2                                                           EASI    1531
      YDEL=.1                                                           EASI    1532
      IF (ISCALE.EQ.1) GO TO 250                                        EASI    1533
      S=0.                                                              EASI    1534
      IF (IT.EQ.N) GO TO 240                                            EASI    1535
      J=IT+1                                                            EASI    1536
      DO 230 I=J,N                                                      EASI    1537
      S=S+TASKT(I)-2.*SDTT(I)                                           EASI    1538
  230 CONTINUE                                                          EASI    1539
  240 XMAX=(TR+2.*SDTR-S)/(1.-2./ASDRT)                                 EASI    1540
      IF (XMAX.GT.0.) GO TO 250                                         EASI    1541
      CALL DONEPL                                                       EASI    1542
```

```
      WRITE (55,540) IT                                                 EASI    1543
      PAUSE                                                             EASI    1544
      RETURN                                                            EASI    1545
  260 CONTINUE                                                          EASI    1546
      WRITE (45,530) IT                                                 EASI    1547
      REWIND 45                                                         EASI    1548
      READ (45,450) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA EASI    1549
     1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)                  EASI    1550
      REWIND 45                                                         EASI    1551
      WRITE (45,460)                                                    EASI    1552
      REWIND 45                                                         EASI    1553
      WRITE (45,460)                                                    EASI    1554
      REWIND 45                                                         EASI    1555
      READ (45,450) LABELY(1),LABELY(2),LABELY(3),LABELY(4),LABELY(5),LA EASI    1556
     1BELY(6),LABELY(7),LABELY(8),LABELY(9),LABELY(10)                  EASI    1557
      REWIND 45                                                         EASI    1558
      STASK=TASKT(IT)                                                   EASI    1559
      SSDTT=SDTT(IT)                                                    EASI    1560
      SPC=PC                                                            EASI    1561
      GO TO 390                                                         EASI    1562
  261 TASKT(IT)=STASK                                                   EASI    1563
      SDTT(IT)=SSDTT                                                    EASI    1564
      PC=SPC                                                            EASI    1565
      GO TO 400                                                         EASI    1566
C                                                                       EASI    1567
C     PROBABILITY OF INTERRUPTION AS A FUNCTION OF                      EASI    1568
C     TIME FOR TASK *IT1* AND TIME FOR TASK *IT2*                       EASI    1569
C                                                                       EASI    1570
  271 WRITE (55,510)                                                    EASI    1571
      CALL FFFINP (1,TI1,NOUT,66)                                       EASI    1572
      IT1=TI1                                                           EASI    1573
      WRITE (55,510)                                                    EASI    1574
      CALL FFFINP (1,TI2,NOUT,66)                                       EASI    1575
      IT2=TI2                                                           EASI    1576
      WRITE (55,560) IT1                                                EASI    1577
      CALL FFFINP (1,ASDRT1,NOUT,66)                                    EASI    1578
      CALL DEV (ASDRT1)                                                 EASI    1579
      WRITE (55,560) IT2                                                EASI    1580
      CALL FFFINP (1,ASDRT2,NOUT,66)                                    EASI    1581
      CALL DEV (ASDRT2)                                                 EASI    1582
      WRITE (55,410)                                                    EASI    1583
      CALL FFFINP (-1,ISCALE,NOUT,66)                                   EASI    1584
      IF (ISCALE.EQ.0) GO TO 280                                        EASI    1585
      WRITE (55,490) IT1                                                EASI    1586
      WRITE (55,480) IT1                                                EASI    1587
      CALL FFFINP (1,XMAX,NOUT,66)                                      EASI    1588
      WRITE (55,440)                                                    EASI    1589
      CALL FFFINP (1,XSTP,NOUT,66)                                      EASI    1590
      XDEL=XSTP/2.                                                      EASI    1591
      WRITE (55,500) IT2                                                EASI    1592
      WRITE (55,480) IT2                                                EASI    1593
      CALL FFFINP (1,YMAX,NOUT,66)                                      EASI    1594
      WRITE (55,440)                                                    EASI    1595
      CALL FFFINP (1,YSTP,NOUT,66)                                      EASI    1596
      YDEL=YSTP/2.                                                      EASI    1597
```

```
  280 CONTINUE                                                          EASI    1598
      VUX=-2.4                                                          EASI    1599
      VUY=-2.                                                           EASI    1600
      VUZ=1.5                                                           EASI    1601
      IF (ISCALE.EQ.1) GO TO 350                                        EASI    1602
      INC=0                                                             EASI    1603
      S=0.                                                              EASI    1604
      IF (IT1.LT.IT2) S=-TASKT(IT2)+2.*SDTT(IT2)                        EASI    1605
      IF (IT1.EQ.N) GO TO 300                                           EASI    1606
      J=IT1+1                                                           EASI    1607
      DO 290 I=J,N                                                      EASI    1608
      S=S+TASKT(I)-2.*SDTT(I)                                           EASI    1609
  290 CONTINUE                                                          EASI    1610
  300 XMAX=(TR+2.*SDTR-S)/(1.-2./ASDPT1)                                EASI    1611
      IF (XMAX.GT.0.) GO TO 310                                         EASI    1612
      XMAX=1.                                                           EASI    1613
      INC=1                                                             EASI    1614
  310 S=0.                                                              EASI    1615
      IF (IT2.LT.IT1) S=-TASKT(IT1)+2.*SDTT(IT1)                        EASI    1616
      IF (IT2.EQ.N) GO TO 330                                           EASI    1617
      J=IT2+1                                                           EASI    1618
      DO 320 I=J,N                                                      EASI    1619
      S=S+TASKT(I)-2.*SDTT(I)                                           EASI    1620
  320 CONTINUE                                                          EASI    1621
  330 YMAX=(TR+2.*SDTR-S)/(1.-2./ASDPT2)                                EASI    1622
      IF (YMAX.GT.0.) GO TO 350                                         EASI    1623
      IF (INC.EQ.0) GO TO 340                                           EASI    1624
      CALL CONEPL                                                       EASI    1625
      WRITE (55,590) IT1,IT2                                            EASI    1626
      PAUSE                                                             EASI    1627
      RETURN                                                            EASI    1628
  340 YMAX=1.                                                           EASI    1629
  350 CONTINUE                                                          EASI    1630
      WRITE (45,530) IT1                                                EASI    1631
      REWIND 45                                                         EASI    1632
      READ (45,450) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA EASI    1633
     1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)                  EASI    1634
      REWIND 45                                                         EASI    1635
      WRITE (45,530) IT2                                                EASI    1636
      REWIND 45                                                         EASI    1637
      READ (45,450) LABELY(1),LABELY(2),LABELY(3),LABELY(4),LABELY(5),LA EASI    1638
     1BELY(6),LABELY(7),LABELY(8),LABELY(9),LABELY(10)                  EASI    1639
      REWIND 45                                                         EASI    1640
      STASK1=TASKT(IT1)                                                 EASI    1641
      SSDTT1=SDTT(IT1)                                                  EASI    1642
      STASK2=TASKT(IT2)                                                 EASI    1643
      SSDTT2=SDTT(IT2)                                                  EASI    1644
      GO TO 390                                                         EASI    1645
  360 TASKT(IT1)=STASK1                                                 EASI    1646
      SDTT(IT1)=SSDTT1                                                  EASI    1647
      TASKT(IT2)=STASK2                                                 EASI    1648
      SDTT(IT2)=SSDTT2                                                  EASI    1649
      GO TO 400                                                         EASI    1650
C                                                                       EASI    1651
C     PROBABILITY OF INTERRUPTION AS A FUNCTION OF                      EASI    1652
```

```
C     PROBABILITY OF DETECTION FOR SENSOR *IS1* AND                    EASI    1653
C     PROBABILITY OF DETECTION FOR SENSOR *IS2*                        EASI    1654
C                                                                      EASI    1655
  370 WRITE (55,570)                                                   EASI    1656
      CALL FFFINP (1,SI1,NOUT,66)                                      EASI    1657
      IS1=SI1                                                          EASI    1658
      WRITE (55,570)                                                   EASI    1659
      CALL FFFINP (1,SI2,NOUT,66)                                      EASI    1660
      IS2=SI2                                                          EASI    1661
      ISCALE=0                                                         EASI    1662
      VUX=-2.4                                                         EASI    1663
      VUY=-2.                                                          EASI    1664
      VUZ=1.5                                                          EASI    1665
      XMAX=1.                                                          EASI    1666
      YMAX=1.                                                          EASI    1667
      SPDO1=PDO(IS1)                                                   EASI    1668
      SPDO2=PDO(IS2)                                                   EASI    1669
      WRITE (45,560) IS1                                               EASI    1670
      REWIND 45                                                        EASI    1671
      READ (45,450) LABELX(1),LABELX(2),LABELX(3),LABELX(4),LABELX(5),LA EASI    1672
     1BELX(6),LABELX(7),LABELX(8),LABELX(9),LABELX(10)                 EASI    1673
      REWIND 45                                                        EASI    1674
      WRITE (45,560) IS2                                               EASI    1675
      REWIND 45                                                        EASI    1676
      READ (45,450) LABELY(1),LABELY(2),LABELY(3),LABELY(4),LABELY(5),LA EASI    1677
     1BELY(6),LABELY(7),LABELY(8),LABELY(9),LABELY(10)                 EASI    1678
      REWIND 45                                                        EASI    1679
      GO TO 390                                                        EASI    1680
  380 PDO(IS1)=SPDO1                                                   EASI    1681
      PDO(IS2)=SPDO2                                                   EASI    1682
      GO TO 400                                                        EASI    1683
  390 CONTINUE                                                         EASI    1684
      CALL THRED1                                                      EASI    1685
      I=IOPT-6                                                         EASI    1686
      GO TO (30,90,150,180,200,260,360,380), I                         EASI    1687
  400 CALL PHYSOP (2.5,.25)                                            EASI    1688
      CALL RESET (6HBSHIFT)                                            EASI    1689
      CALL BSCALE (1.1,1.1)                                            EASI    1690
      CALL EOC (4)                                                     EASI    1691
      CALL RESET (6HPHYSOR)                                            EASI    1692
      CALL RESET (6HBSCALE)                                            EASI    1693
      RETURN                                                           EASI    1694
C                                                                      EASI    1695
  410 FORMAT (54H00 YOU WANT TO SET YOUR OWN SCALE+1=YES,0=NO    RETURN) EASI    1696
  420 FORMAT (42HNEED XMAX, MAXIMUM VALUE OF RESPONSE TIME,/49HAND XSTP, EASI    1697
     1 SPACING FOR TICK MARKS. XMAX SHOULD BE/19HA MULTIPLE OF XSTP.)  EASI    1698
  430 FORMAT (45HENTER MAXIMUM VALUE OF RESPONSE TIME   RETURN)        EASI    1699
  440 FORMAT (32HENTER TICK MARK SPACING   RETURN)                     EASI    1700
  450 FORMAT (10A10)                                                   EASI    1701
  460 FORMAT (29HPROBABILITY OF COMMUNICATIONS)                        EASI    1702
  470 FORMAT (23HRESPONSE TIME, MINUTES)                               EASI    1703
  480 FORMAT (36HENTER MAXIMUM VALUE OF TIME FOR TASK,I3,9H   RETURN)  EASI    1704
  490 FORMAT (41HNEED XMAX, MAXIMUM VALUE OF TIME FOR TASK,I3,1H,/49HAND EASI    1705
     1 XSTP, SPACING FOR TICK MARKS. XMAX SHOULD BE/19HA MULTIPLE OF XST EASI    1706
     2P.)                                                              EASI    1707
```

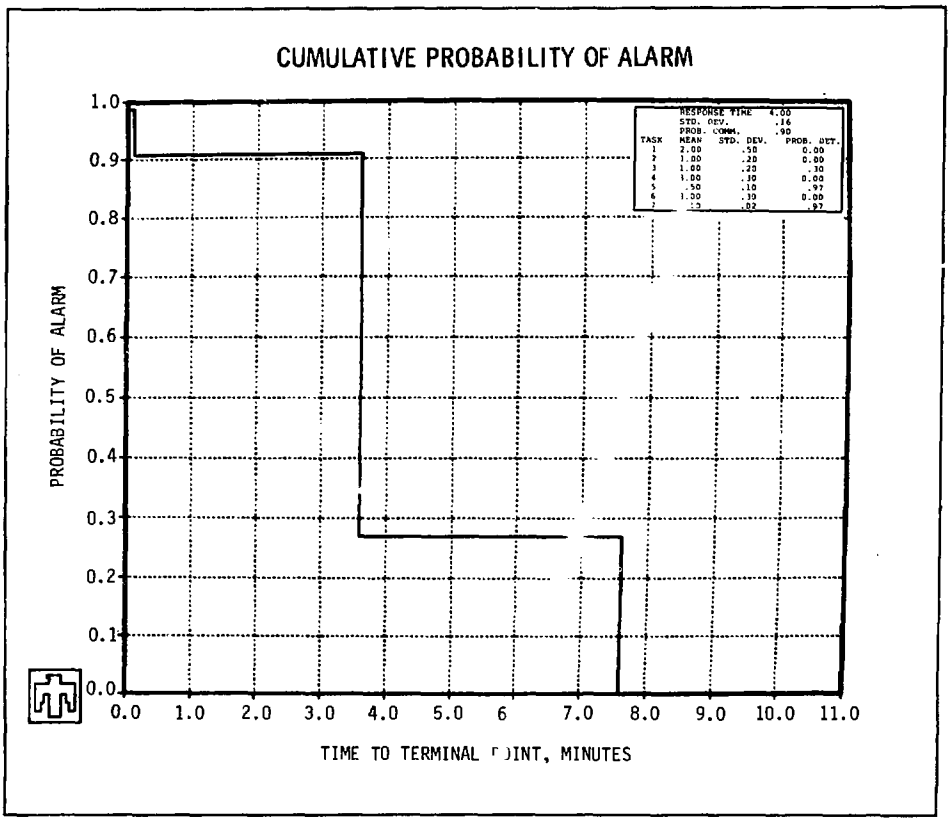
```
      500 FORMAT (41HNEED YMAX, MAXIMUM VALUE OF TIME FOR TASK,I3,1H,/48HAND EASI
         1 YSTP, SPACING FOR TICK MARKS. YMAX SHOULD BE/19HA MULTIPLE OF YST EASI
         2P.)                                                              EASI
      510 FORMAT (//,32HWHICH TASK TIME IS THE VARIABLE+/26HENTER TASK NUMBE EASI
         1R   RETURN)                                                      EASI
      520 FORMAT (/51HENTER RATIO OF MEAN TASK TIME TO STANDARD DEVIATION,9H EASI
         1   RETURN)                                                       EASI
      530 FORMAT (13HTIME FOR TASK,I3,10H ,MINUTES$)                       EASI
      540 FORMAT (30HPROBABILITY OF INTERRUPTION IS/29HINSENSITIVE TO TIME F EASI
         1OR TASK ,I2,/24HPRESS RETURN TO CONTINUE)                        EASI
      550 FORMAT (55HENTER RATIO OF MEAN RESPONSE TIME TO STANDARD DEVIATION EASI
         1,9H   RETURN)                                                    EASI
      560 FORMAT (33HPROBABILITY OF DETECTION, SENSOR ,I2,1H)              EASI
      570 FORMAT (//,29HWHICH SENSOR IS THE VARIABLE+/28HENTER SENSOR NUMBER EASI
         1   RETURN)                                                       EASI
      580 FORMAT (51HENTER RATIO OF MEAN TASK TIME TO STANDARD DEVIATION/8HF EASI
         1OR TASK,I3,9H   RETURN)                                          EASI
      590 FORMAT (30HPROBABILITY OF INTERRUPTION IS/31HINSENSITIVE TO TIME F EASI
         1OR TASKS ,I2,5H AND ,I2)                                         EASI
          END                                                              EASI
```

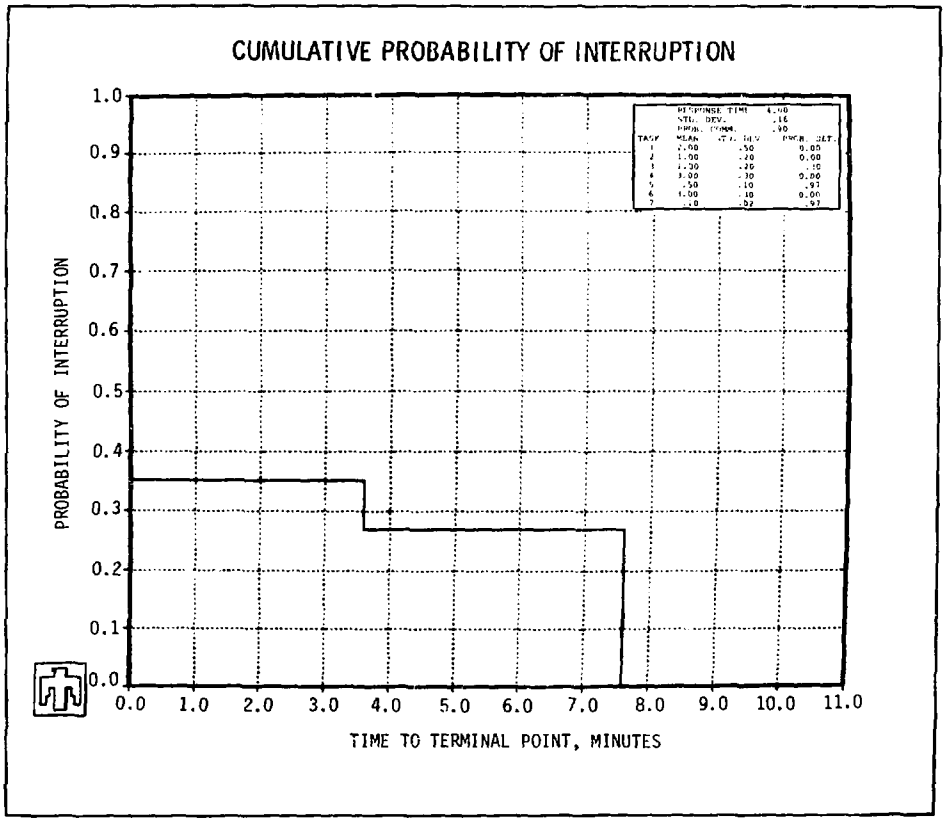
```
      SUBROUTINE THRED1                                                 EASI    1728
C                                                                       EASI    1729
C     THIS SUBROUTINE CONTAINS THE CALL SEQUENCE TO DISSPLA             EASI    1730
C     WHICH GENERATES A THREE-DIMENSIONAL PLOT.                         EASI    1731
C                                                                       EASI    1732
      COMMON /2/ TASKF(25),SDTT(25),POD(25),N,PC,TR,SDTR,PI(25),GPA(25) EASI    1733
      COMMON /BLK/ T(25),IOPT,LL,ASDR,ASDRT,IT,TM,IS,IT1,IT2,ASDRT1,ASDR EASI    1734
     1T2,IS1,IS2,TM1,ISCALE                                             EASI    1735
      COMMON /NEW/ XMAX,XDEL,INTX,YMAX,YDEL,INTY,VUX,VUZ,VUY,W(500),LABE EASI    1736
     1LX(100),LABELY(100),XC,YC,XSTP,YSTP                               EASI    1737
      EXTERNAL ZFUN                                                     EASI    1738
      CALL TOUTPT (27)                                                  EASI    1739
      CALL TOUTPT (104)                                                 EASI    1740
      CALL ESHIFT (0.,.3)                                               EASI    1741
      CALL TITL3D (28HPROBABILITY OF INTERRUPTION$,100,10.,9.)          EASI    1742
      CALL RESET (6HBSHIFT)                                             EASI    1743
      CALL BSCALE (1.2,1.2)                                             EASI    1744
      CALL AXES3D (LABELX,100,LABELY,100,28HPROBABILITY OF INTERRUPTIONS EASI    1745
     1,100,1.,1.,1.)                                                    EASI    1746
      CALL VUABS (VUX,VUY,VUZ)                                          EASI    1747
      CALL 24XANG (90.)                                                 EASI    1748
      CALL ESHIFT (-2.45,-.6)                                           EASI    1749
      IF (ISCALE.EQ.1) GO TO 10                                         EASI    1750
      IF (XMAX.NE.1.) XMAX=FLOAT(IFIX(XMAX/5.+1.))*5.                   EASI    1751
      XDEL=XMAX/10.                                                     EASI    1752
      IF (YMAX.NE.1.) YMAX=FLOAT(IFIX(YMAX/5.+1.))*5.                   EASI    1753
      YDEL=YMAX/10.                                                     EASI    1754
      XSTP=XMAX/5.                                                      EASI    1755
      YSTP=YMAX/5.                                                      EASI    1756
   10 CALL GRAF3D (XC,XSTP,XMAX,YC,YSTP,YMAX,0.,.1,1.)                  EASI    1757
      CALL TOUTPT (27)                                                  EASI    1758
      CALL TOUTPT (97)                                                  EASI    1759
      CALL BOX3D                                                        EASI    1760
      CALL TOUTPT (27)                                                  EASI    1761
      CALL TOUTPT (104)                                                 EASI    1762
      CALL SURFUN (ZFUN,INTX,XDEL,INTY,YDEL,W)                          EASI    1763
      CALL TOUTPT (27)                                                  EASI    1764
      CALL TOUTPT (96)                                                  EASI    1765
      RETURN                                                            EASI    1766
      END                                                               EASI    1767
```

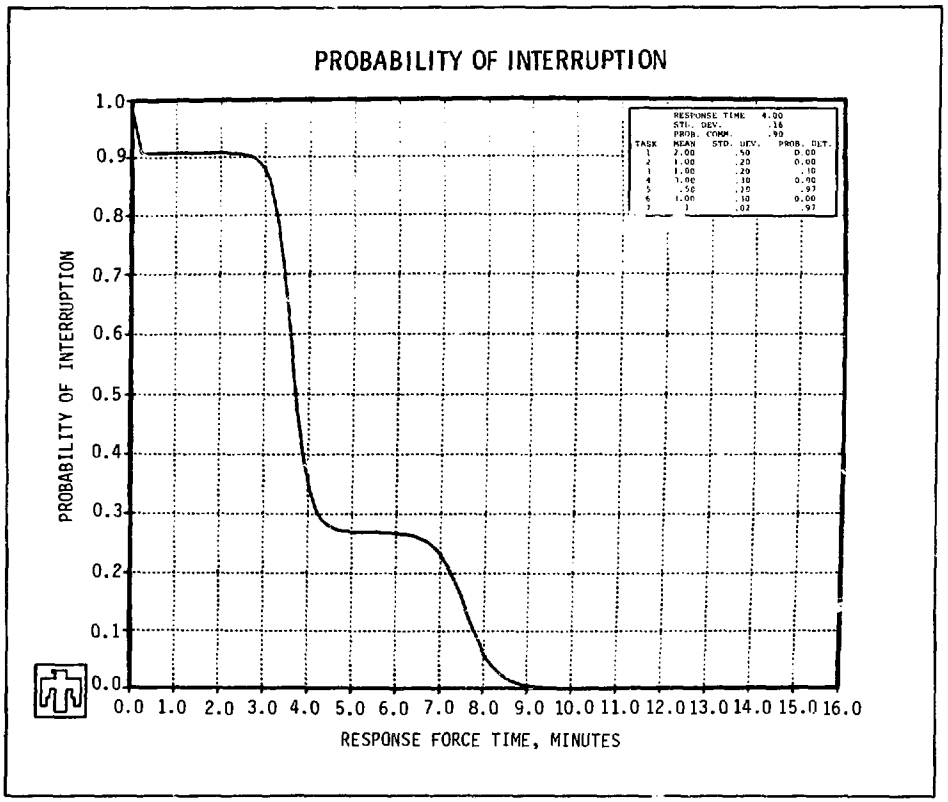
```
      FUNCTION ZFUN (X,Y)                                               EASI    1768
C                                                                       EASI    1769
C     THE VARIABLES  X,Y  ARE THE INDEPENDENT VARIABLES FOR THE         EASI    1770
C     DISSPLA THREE-DIMENSIONAL PLOT AND ZFUN IS THE DEPENDENT          EASI    1771
C     VARIABLE. ZFUN IS THE PROBABILITY OF INTERRUPTION AND             EASI    1772
C     X,Y  ARE DEFINED BELOW DEPENDING ON THE PLOT OPTION               EASI    1773
C     SELECTED BY THE USER.                                             EASI    1774
C                                                                       EASI    1775
      COMMON /2/ TASKT(25),SDTT(25),PDD(25),N,PC,TR,SDTR,PI(25),CPA(25) EASI    1776
      COMMON /BLK/ T(25),IOPT,LL,ASDR,ASDRT,IT,TM,IS,IT1,IT2,ASDRT1,ASDR EASI    1777
     1T2,IS1,IS2,TM1,ISCALE                                             EASI    1778
      I=IOPT-6                                                          EASI    1779
      GO TO (10,20,30,40,50,60,70,80), I                                EASI    1780
   10 TR=X                                                              EASI    1781
      SDTR=X/ASDR                                                       EASI    1782
      PC=Y                                                              EASI    1783
      GO TO 90                                                          EASI    1784
   20 TASKT(IT)=X                                                       EASI    1785
      SDTT(IT)=X/ASDRT                                                  EASI    1786
      PDD(IS)=Y                                                         EASI    1787
      GO TO 90                                                          EASI    1788
   30 TR=X                                                              EASI    1789
      SDTR=X/ASDR                                                       EASI    1790
      TASKT(IT)=Y                                                       EASI    1791
      SDTT(IT)=Y/ASDRT                                                  EASI    1792
      GO TO 90                                                          EASI    1793
   40 TR=Y                                                              EASI    1794
      SDTR=X/ASDR                                                       EASI    1795
      PDD(IS)=Y                                                         EASI    1796
      GO TO 90                                                          EASI    1797
   50 PC=X                                                              EASI    1798
      PDD(IS)=Y                                                         EASI    1799
      GO TO 90                                                          EASI    1800
   60 TASKT(IT)=X                                                       EASI    1801
      SDTT(IT)=X/ASDRT                                                  EASI    1802
      PC=Y                                                              EASI    1803
      GO TO 90                                                          EASI    1804
   70 TASKT(IT1)=X                                                      EASI    1805
      TASKT(IT2)=Y                                                      EASI    1806
      SDTT(IT1)=X/ASDRT1                                                EASI    1807
      SDTT(IT2)=Y/ASDRT2                                                EASI    1808
      GO TO 90                                                          EASI    1809
   80 PDD(IS1)=X                                                        EASI    1810
      PDD(IS2)=Y                                                        EASI    1811
   90 LL=1                                                              EASI    1812
      CALL CALC                                                         EASI    1813
      ZFUN=PI(1)                                                        EASI    1814
      RETURN                                                            EASI    1815
      END                                                               EASI    1816
```

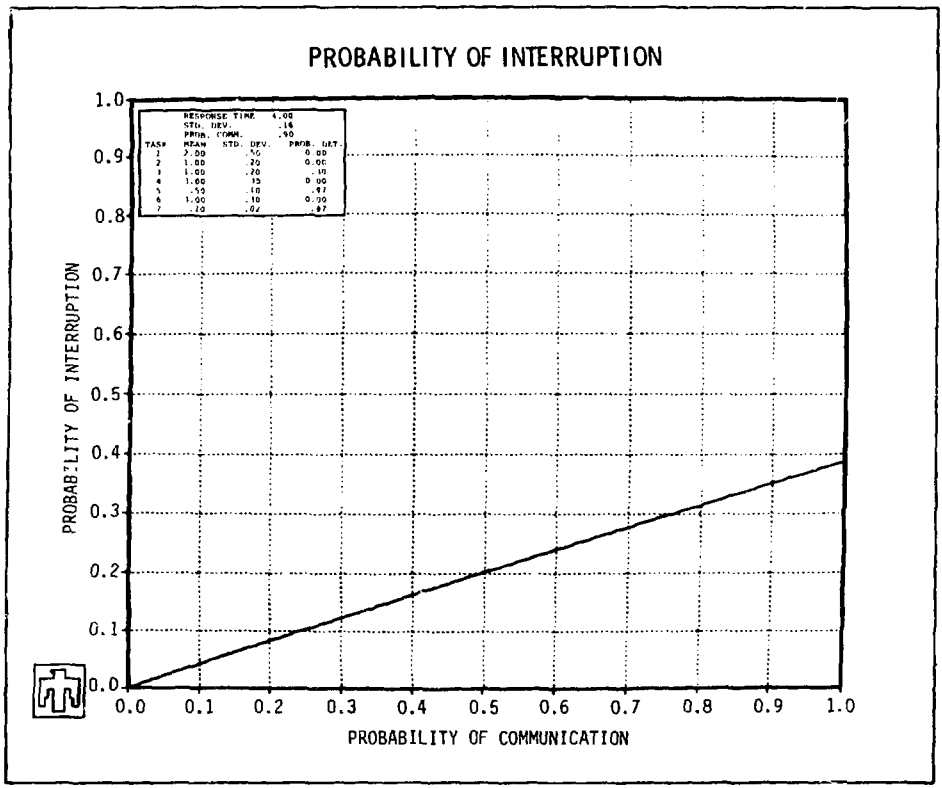
APPENDIX C

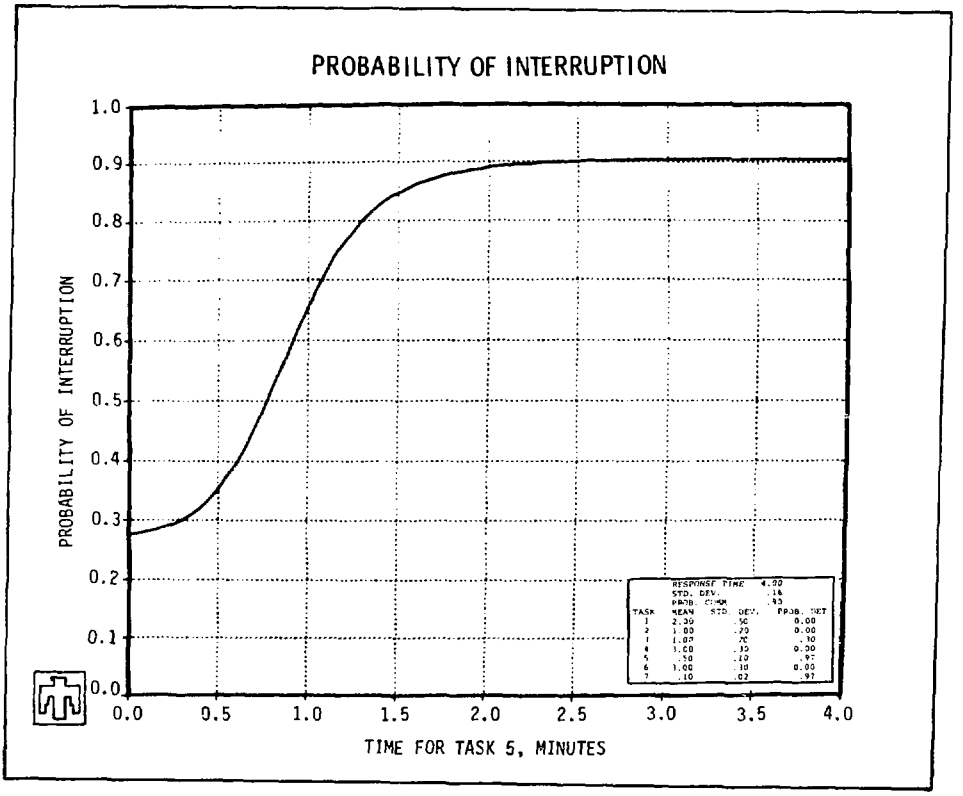
PLOT OPTIONS ILLUSTRATED FOR EXAMPLE PROBLEM

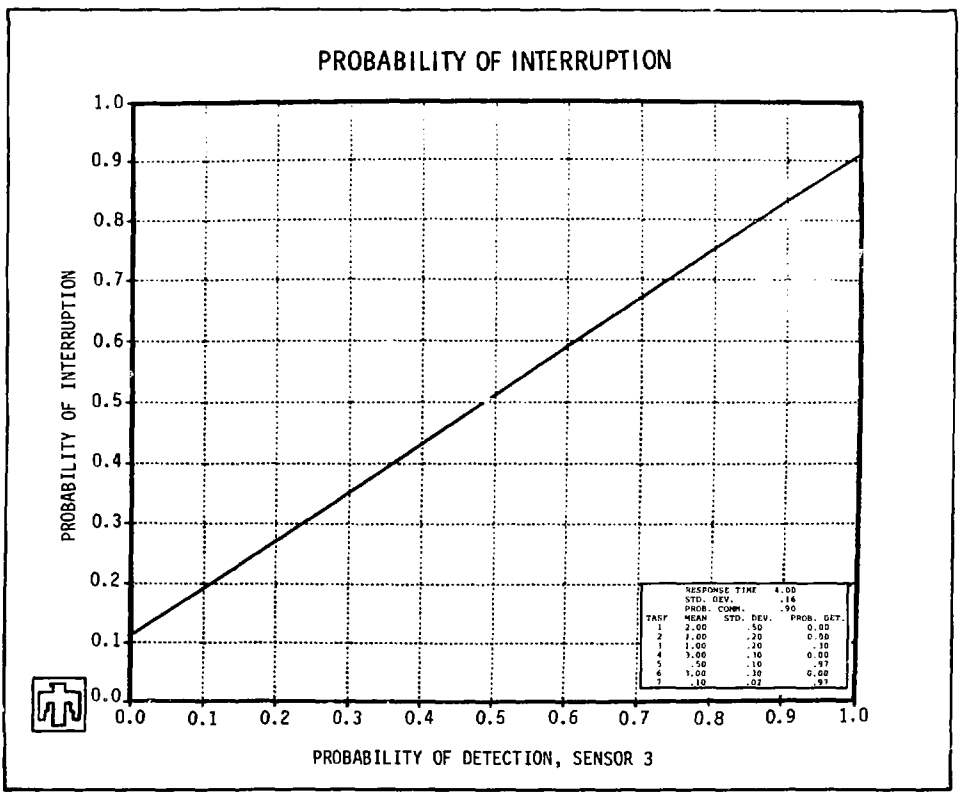

CUMULATIVE PROBABILITY OF ALARM
RESPONSE TIME 4.00
STD. DEV. .16
PROB. COMM. .90
TASK MEAN STD. DEV. PROB. DET.
1 2.00 .50 0.00
2 1.00 .20 0.00
3 1.00 .20 .30
4 1.00 .10 0.00
5 .50 .10 .97
6 1.00 .10 0.00
7 .50 .02 .97
PROBABILITY OF ALARM
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6 7.0 8.0 9.0 10.0 11.0
TIME TO TERMINAL POINT, MINUTES

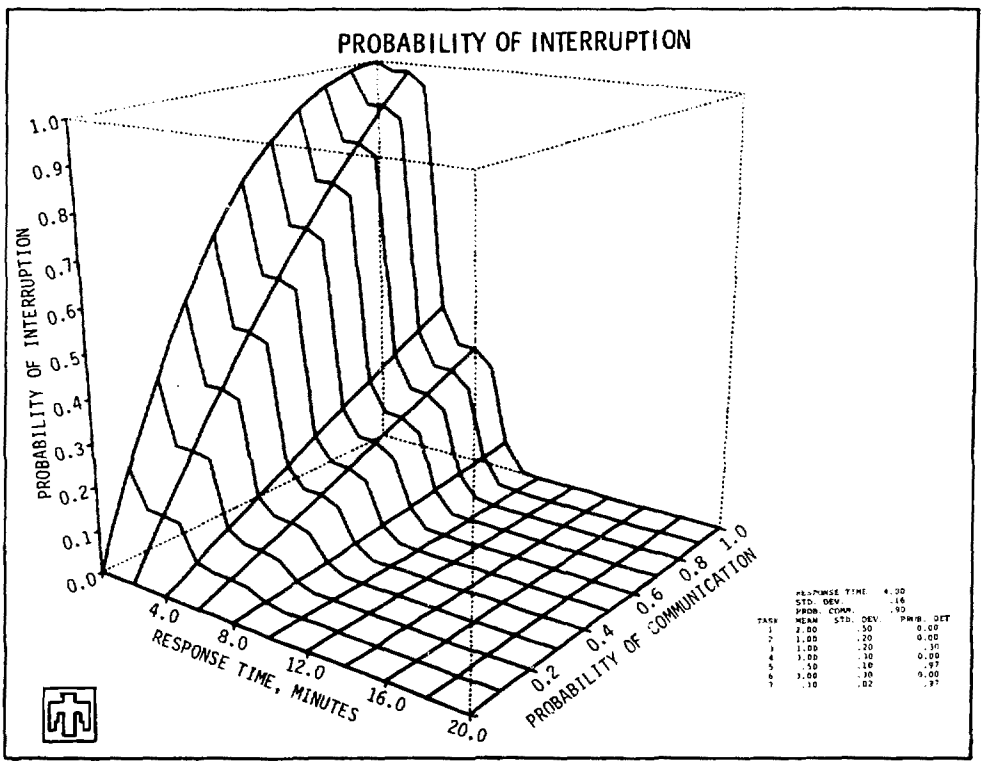

CUMULATIVE PROBABILITY OF INTERRUPTION
PROBABILITY OF INTERRUPTION
TIME TO TERMINAL POINT, MINUTES
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0


PROBABILITY OF INTERRUPTION
RESPONSE TIME 4.00
STD. DEV. .16
PROB. CONFM. .90
TASK MEAN STD. DEV. PROB. DIT.
1 2.00 .50 0.00
2 1.00 .20 0.00
3 1.00 .20 .10
4 1.00 .10 0.00
5 .50 .10 .97
6 1.00 .10 0.00
7 1 .02 .97
PROBABILITY OF INTERRUPTION
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0
RESPONSE FORCE TIME, MINUTES


PROBABILITY OF INTERRUPTION
RESPONSE TIME 4.00
STD. DEV. .16
PROB. COMM. .90
TASK MEAN STD. DEV. PROB. INT.
1 2.00 .50 0.00
2 1.00 .20 0.00
3 1.00 .20 .10
4 1.00 .15 0.00
5 .50 .10 .07
6 1.00 .10 0.90
7 .20 .02 .07
PROBABILITY OF INTERRUPTION
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
PROBABILITY OF COMMUNICATION


PROBABILITY OF INTERRUPTION
PROBABILITY OF INTERRUPTION
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
TIME FOR TASK 5, MINUTES
RESPONSE TIME 4.00
STD. DEV. .16
PROB. CHGM .93
TASK MEAN STD. DEV. PROB. INT
1 2.30 .50 0.00
2 1.00 .70 0.00
3 1.00 .70 .30
4 1.00 .30 0.00
5 .50 .10 .97
6 1.00 .10 0.00
7 .10 .02 .97


PROBABILITY OF INTERRUPTION
PROBABILITY OF INTERRUPTION
PROBABILITY OF DETECTION, SENSOR 3
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
RESPONSE TIME 4.00
STD. DEV. .16
PROB. COMM. .90
TASK MEAN STD. DEV. PROB. DET.
1 2.00 .50 0.00
2 1.00 .20 0.90
3 1.00 .20 .10
4 3.00 .10 0.00
5 .50 .10 .97
6 3.00 .30 0.00
7 .10 .02 .97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PROBABILITY OF INTERRUPTION
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0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
4.0
8.0
12.0
16.0
20.0
RESPONSE TIME, MINUTES
0.2
0.4
0.6
0.8
1.0
PROBABILITY OF COMMUNICATION
RESPONSE TIME 4.00
STD. DEV. .16
PROB. COMP. .90
TASK MEAN STD. DEV PWB DET
1 2.00 .50 0.00
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3 1.00 .20 .90
4 3.00 .30 0.00
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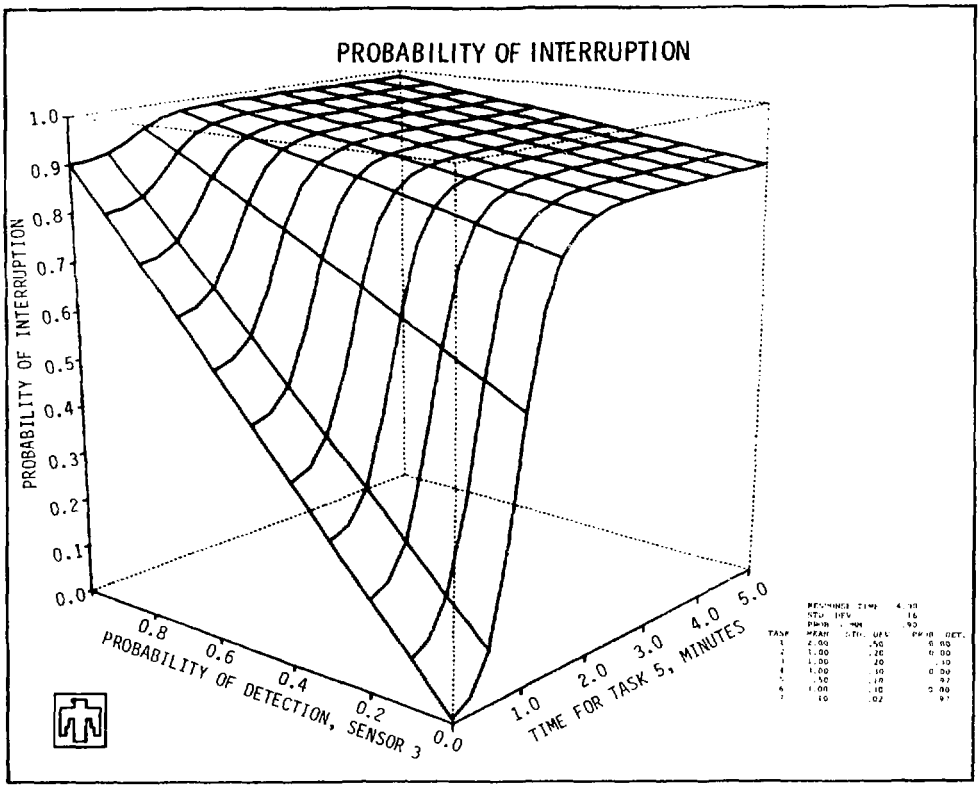
6 3.00 .30 0.00
7 .30 .02 .97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PROBABILITY OF INTERRUPTION
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0.9
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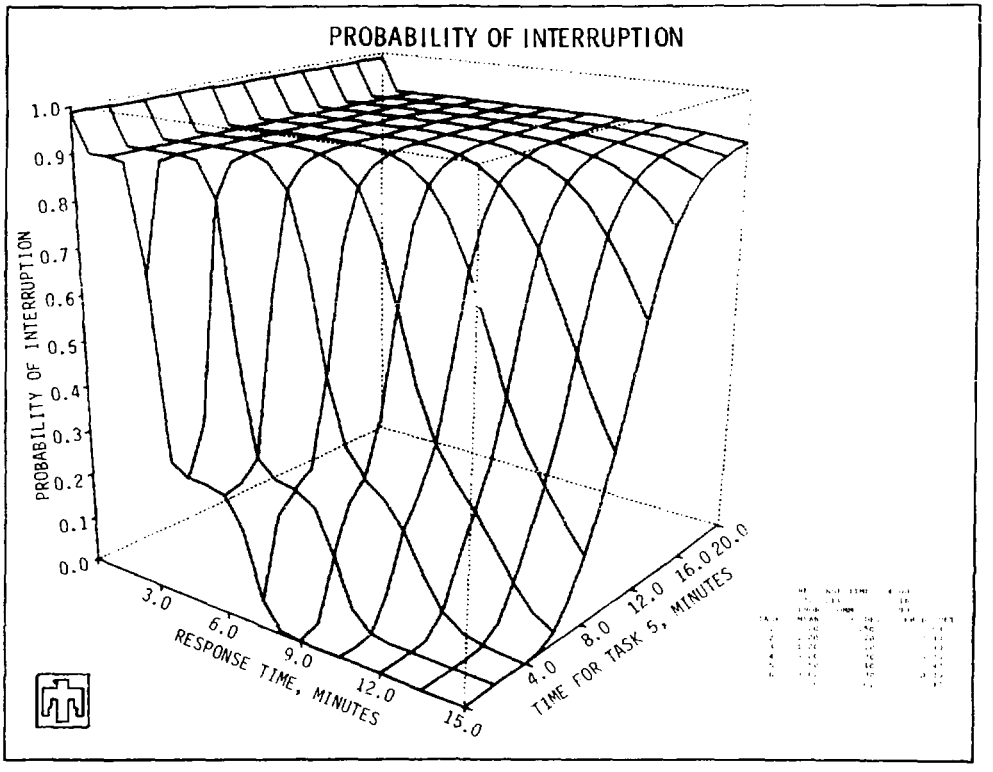
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.8
0.6
0.4
0.2
0.0
PROBABILITY OF DETECTION, SENSOR 3
1.0
2.0
3.0
4.0
5.0
TIME FOR TASK 5, MINUTES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PROBABILITY OF INTERRUPTION
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0.9
0.8
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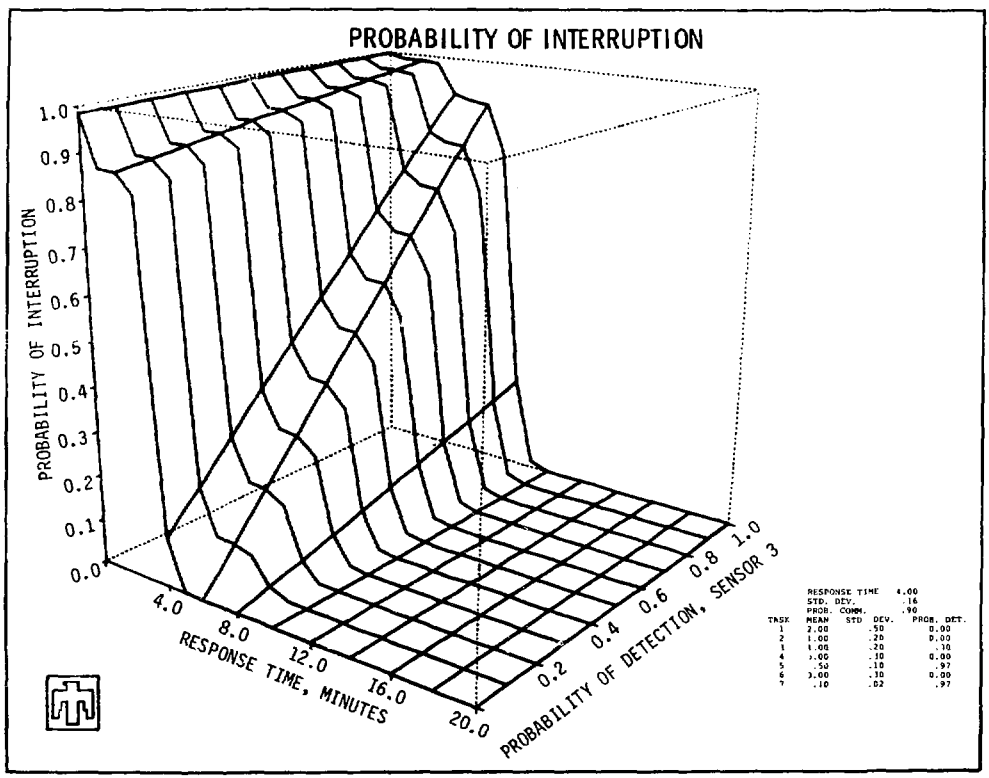
0.6
0.5
0.4
0.3
0.2
0.1
0.0
3.0
6.0
9.0
12.0
15.0
RESPONSE TIME, MINUTES
4.0
8.0
12.0
16.0
20.0
TIME FOR TASK 5, MINUTES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PROBABILITY OF INTERRUPTION
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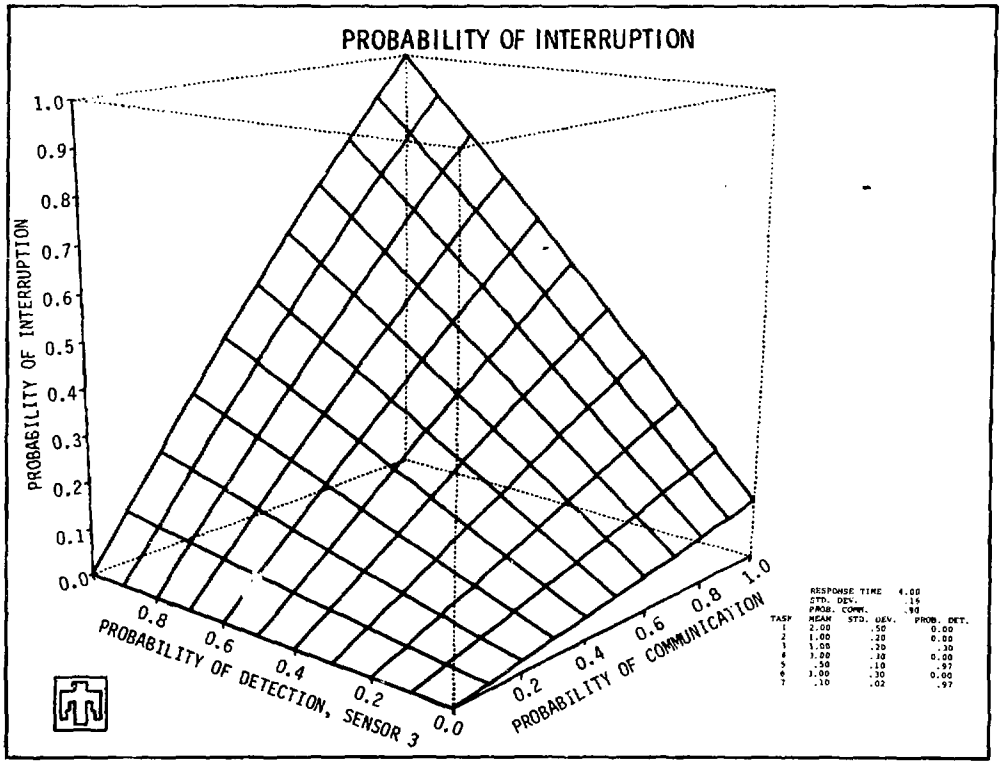
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
4.0
8.0
12.0
16.0
20.0
RESPONSE TIME, MINUTES
0.2
0.4
0.6
0.8
1.0
PROBABILITY OF DETECTION, SENSOR 3
RESPONSE TIME 4.00
STD. DEV. .16
PROB. COMM. .90
TASK MEAN STD DEV. PROB. DET.
1 2.00 .50 0.00
2 1.00 .20 0.00
3 1.00 .20 .10
4 3.00 .10 0.00
5 .50 .10 .97
6 3.00 .10 0.00
7 .10 .02 .97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PROBABILITY OF INTERRUPTION
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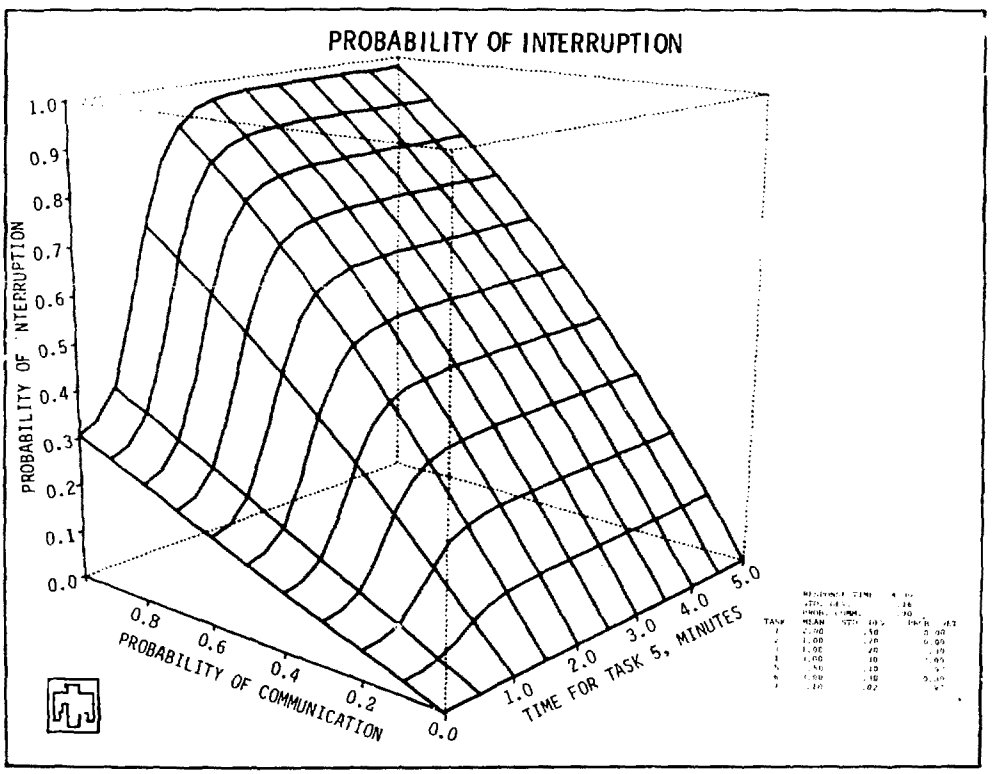
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.8
0.6
0.4
0.2
0.0
PROBABILITY OF DETECTION, SENSOR 3
0.2
0.4
0.6
0.8
1.0
PROBABILITY OF COMMUNICATION
RESPONSE TIME 4.00
STD. DEV. .15
PROB. COMM. .90
TASK MEAN STD. DEV. PROB. DET.
1 2.00 .50 0.00
2 1.00 .20 0.00
3 1.05 .20 .30
4 3.00 .40 0.00
5 .50 .10 .97
6 3.00 .30 0.00
7 .10 .02 .97


PROBABILITY OF INTERRUPTION
PROBABILITY OF INTERRUPTION
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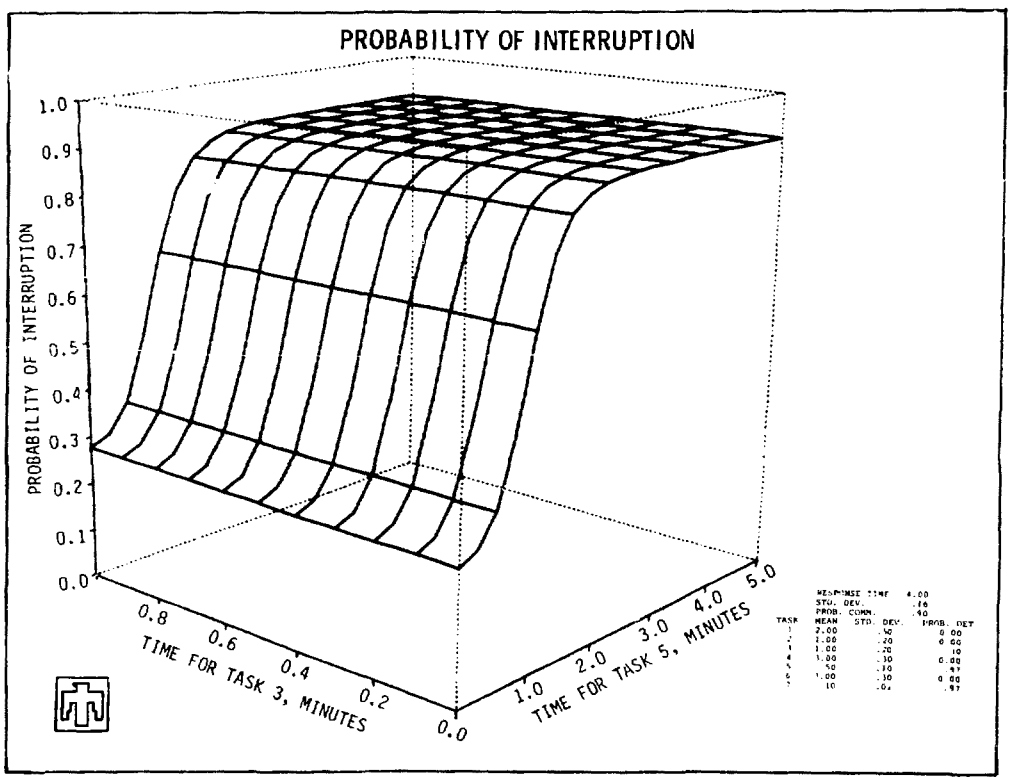
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.8
0.6
0.4
0.2
0.0
PROBABILITY OF COMMUNICATION
1.0
2.0
3.0
4.0
5.0
TIME FOR TASK 5, MINUTES


PROBABILITY OF INTERRUPTION
PROBABILITY OF INTERRUPTION
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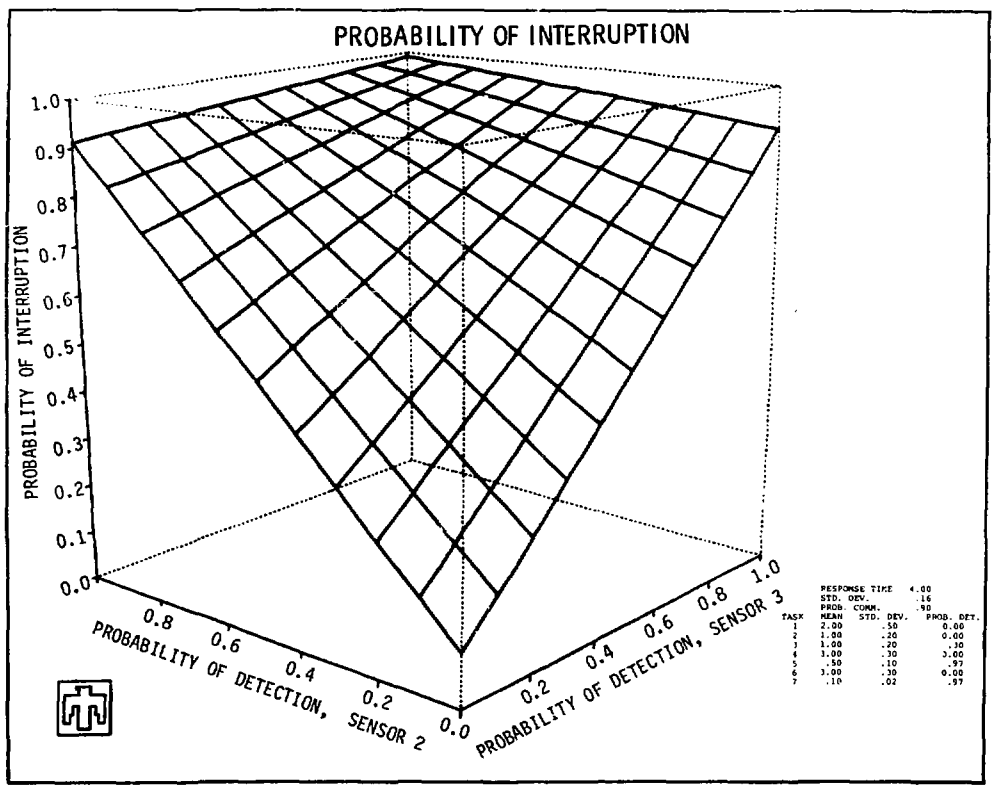
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.8
0.6
0.4
0.2
0.0
TIME FOR TASK 3, MINUTES
1.0
2.0
3.0
4.0
5.0
TIME FOR TASK 5, MINUTES
RESPONSE TIME 4.00
STD. DEV. .16
PROB. COMM. .40
TASK MEAN STD. DEV. PROB. DET
3 2.00 .50 0.00
4 2.00 .20 0.00
5 1.00 .20 .10
6 3.00 .30 0.00
7 .50 .10 .97
8 1.00 .30 0.00
9 .10 .04 .97


PROBABILITY OF INTERRUPTION
PROBABILITY OF INTERRUPTION
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0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.8
0.6
0.4
0.2
0.0
PROBABILITY OF DETECTION, SENSOR 2
0.2
0.4
0.6
0.8
1.0
PROBABILITY OF DETECTION, SENSOR 3
RESPONSE TIME 4.00
STD. DEV. .16
PROB. COMM. .90
TASK MEAN STD. DEV. PROB. DET.
1 2.00 .50 0.00
2 1.00 .20 0.00
3 1.00 .20 .30
4 3.00 .30 3.00
5 .50 .10 .97
6 3.00 .30 0.00
7 .10 .02 .97