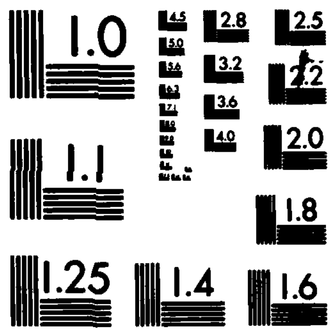
AD-A159 395 STRESS LEVEL TESTING OF ELECTRONICS AVIONICS COMMUNICATIONS AND C3I EQUIPMENTS(U) ARMY TEST AND EVALUATION COMMAND ABERDEEN PROVING GROUND MD 1/1

UNCLASSIFIED 30 AUG 85 TOP-6-1-002 F/G 17/2 NL

END

FILMED

DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: TOP 6-1-002

2. GOVT ACCESSION NO.:

3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): U.S. Army Test and Evaluation Command Test Operations Procedure Stress Level Testing of Electronics, Avionics Communications and C3I Equipments

5. TYPE OF REPORT & PERIOD COVERED: Final Report

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s):

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS: U.S. Army Electronic Proving Ground, ATTN: STEEP-TM, Fort Huachuca, AZ 85613-7110

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: AMC Reg 310-6

11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Army Test and Evaluation Command, ATTN: AMSTE-AD, Aberdeen Proving Ground, MD 21005-5055

12. REPORT DATE: 30 August 1985

13. NUMBER OF PAGES: 26

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report): Approved for public release; distribution unlimited

DTIC ELECTE SEP 1 9 1985 S D A

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report):

18. SUPPLEMENTARY NOTES:

19. KEY WORDS (Continue on reverse side if necessary and identify by block number):

Stress Loading; Simulating and Modeling Functions; Complex Electromagnetic Environment; Repeatable RF Stimuli; Real Time Operation; Direct Coupled RF; Close Coupled RF; Digital Techniques; Low Powered Techniques; Scenario Driven; Stress Tests; Avionics; Communication; Electronics; C3I

20. ABSTRACT (Continue on reverse side if necessary and identify by block number):

This Test Operations Procedure (TOP) describes test methods and techniques for measureing and evaluating the technical performance of a System Under Test (SUT) when the SUT is operated to and beyond specifications in order to determine its response to high levels of stimuli.

The extremely short period allowed for the writing of this TOP along with the great diversity of potential systems to be tested has precluded the writing of a document which conclusively covers the topic of stress level testing. This document should be considered as a TOP which outlines the basic requirements and

DD FORM 1473, 1 JAN 73 — EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

AD-A159 395

DTIC FILE COPY

85 9 19 051

the basic test methodology for conducting stress level testing.
This TOP includes only the electronics aspect of stress level testing. It does not consider the classical environmental and mechanical stress testing of materials; these types of stress testing are covered in MIL-STD-810D.

Keywords include;

19

US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

AMSTE-RP-702-102 30 August 1985
Test Operations Procedure 6-1-002*
AD No.

STRESS LEVEL TESTING OF ELECTRONICS, AVIONICS, COMMUNICATIONS AND C3I EQUIPMENTS

1. SCOPE

1.1 Objective.

This Test Operations Procedure (TOP) describes test methods and techniques for measuring and evaluating the technical performance of a System Under Test (SUT) when the SUT is operated to and beyond specifications in order to determine its response to high levels of stimuli.

1.2 Limitations.

1.2.1 The extremely short period allowed for the writing of this TOP along with the great diversity of potential systems to be tested has precluded the writing of a document which conclusively covers the topic of stress level testing. This document should be considered as a TOP which outlines the basic requirements and the basic test methodology for conducting stress level testing.

1.2.2 This TOP includes only the electronics aspects of stress level testing. It does not consider the classical environmental and mechanical stress testing of materials; these types of stress testing are covered in MIL-STD-810D.

2.0 FACILITIES AND INSTRUMENTATION

Listed below are the general types of instrumentation/facilities required for stress testing of C3I systems.

2.1 Facilities.

Applicable facility requirements include:

2.1.1 A computer facility capable of simulating and modeling functions of the item being tested both stand alone and within a complex electromagnetic environment (both communications and electronic warfare).

2.1.2 A facility capable of providing repeatable message stimuli directly (either by direct connection or by using item under test communications) to the system being tested. This facility should be scenario driven, should offer real time operation and should provide data collection, reduction and analysis capabilities. A facility of this type is described in Appendix C.

2.1.3 A facility capable of providing repeatable Radio Frequency (RF) stimuli to the item under test. This stimuli should represent realistic RF signal effects to be found in selected military situations (or as stated in requirements) and should be provided to the system being tested using digital, direct coupled RF, close coupled RF or low powered RF techniques. This facility should be scenario driven, should offer real time operation and should provide data collection capabilities. A facility of this type is described in Appendix D.

2.1.4 A range facility providing the following.

2.1.4.1 Adequate range space to deploy segments of selected military communications structure.

2.1.4.2 Controlled air space or traffic free air space.

2.1.4.3 Test control station.

2.1.4.4 Space position tracking and plotting capability.

2.1.4.5 Range timing.

2.1.4.6 Meteorological support.

2.1.4.7 Secure Range communications.

2.1.5 If the SUT is an avionics system which is not part of an integrated airframe system, the appropriate J-series aircraft platform(s) may be required.

2.2 Instrumentation.

In addition to the instrumentation embedded in the facilities mentioned above the following items are required on an as needed basis.

2.2.1 RF Communications Simulator(s).

2.2.2 RF Noncommunications Simulator(s).

2.2.3 RF Jammer(s).

2.2.4 Range RF Monitoring Equipment(s).

2.3 Characteristics/Requirements.

The characteristics of the instrumentation/facilities are determined by the specific requirements of the equipment(s) and system(s) being tested. Instrumentation/facilities shall have the capability, both qualitatively and quantitatively, to produce stimuli which drive the system being tested into failure. Where applicable, instrumentation (to include that embedded in facilities) shall be calibrated by approved methods and instrumentation traceable to the National Bureau of Standards. The facilities and instrumentation indicated above can provide the necessary characteristics and setups required to perform subtests indicated in this TOP.

3.0 REQUIRED TEST CONDITIONS

The test officer should, during the test process:

3.1 Review TECOM Pamphlet 70-3, Research, Development, and Acquisition and Project Engineer's Handbook for guidance on test planning, execution, reporting and post-test activities.

3.2 Establish and/or continually maintain a readily accessible project log and project file.

3.3 Review local installation project officer's handbook, standard operating procedures (SOPs) and implementing directives which govern the administrative processes for preparing test plans, conducting tests, preparing reports, reporting to the Test Resources Management System (TRMS) and budgeting.

3.4 Acquire and review all descriptive, instructional and specification materiel (to include software documentation) on the test items issued by the government and contractor(s) for checking the test plan subtest objectives, criteria, facility and instrumentation requirements.

3.5 Acquire the necessary information to complete the required simulation/modeling before the arrival of the system under test.

3.6 Ensure availability of appropriate facilities and coordinate the test support requirements including qualified personnel, equipment, maintenance, spare parts and instrumentation.

3.7 Review the detailed test plan and coordinate any changes to the detailed test plan resulting from the simulation/modeling effort.

3.8 Record as a minimum, the following data.

3.8.1 Nomenclature, serial number(s), manufacturer's name, and function of the item(s) under test. Completely describe version of test item software being used or simulated.

3.8.2 Nomenclature, serial number, accuracy tolerance, calibration requirements and latest calibration date of test equipment selected for the tests.

3.8.3 Damage to test item(s) incurred during transit and/or manufacturing defects. Record missing/incomplete software as well as software being modified at the time of testing.

3.8.4 Test item photograph.

3.8.5 Establish test system measures of performance (MOP); identify those MOP that are potentially stress limited. For the purpose of this document the term MOP is taken to mean those technical and operational characteristics which must be evaluated to determine/calibrate a system's effectiveness and utility.

3.8.6 Identify the specification limitations of each MOP. Determine inputs that will stress each MOP beyond specified point.

3.8.7 Identify and document instrumentation or measurement error acceptable for recording data relative to each MOP condition. Determine required sample size for each MOP measurement.

3.8.8 Check with the responsible frequency management agency to ensure authorization for radiation in the required frequency bands during the anticipated test period if a field test is to be performed.

3.8.9 Orient all test personnel on the test objectives, test requirements, schedule of events, and safety precautions.

3.8.10 Have on hand the survey of non-ionizing radiation hazards by the U.S. Army Environmental Hygiene Agency and adhere to all precautions contained therein.

3.8.11 If required, assure that the Airworthiness Release for the SUT has been received from AVSCOM.

3.8.12 Organize test team and establish responsibilities for test conduct, reporting and data control.

3.8.13 Check to ensure that test equipment and accessories are available, operational and meet certified calibration requirements.

3.8.14 Perform an operational check of the test item(s) to ensure normal, correct functioning.

3.8.15 Prepare adequate safety precautions to provide safety for personnel and equipment and ensure that all safety SOPs are observed throughout the test.

3.8.16 Prepare and monitor a data acquisition plan sufficient to ensure that enough samples of all measurements are taken to provide statistical confidence of final data in accordance with TOP 3-1-002.

3.8.17 Identify specific interfaces required between the instrumentation and the system under test.

3.8.18 Identify requirement(s) for interactive capabilities.

4.0 PERFORMANCE TEST PROCEDURES

The generic procedures to be followed for stress testing are given in this section. More specific requirements/procedures for Intercept and C2 systems are given in Appendixes A and B respectively.

4.1 General.

4.1.1 Stress testing is defined as the exercising of a system to and beyond its design specifications in order to determine its response to high levels of stimuli; it is testing to the point at which a system saturates as well as the determination of the effects of such saturation on system operation. In the context of electronic systems it is especially important to know where and how (i.e. graceful or catastrophic) a system fails since this information will enable the eventual system user to design for gradual degredation or to plan missions around the failure point; this information will allow the user to avoid "red line conditions" during equipment usage.

4.1.2 Stress Level Testing is no more than an extension of typical development testing. Instead of testing only to the specified limits of each MOP, testing is extended by adding additional stimuli until the test item fails, either gracefully or catastrophically, to perform the function being considered. The point and type of failure is noted for future use and the test is rerun some predetermined number of times to verify its accuracy/statistical significance. The details of the level of stress developed shall be documented for future tests of similar items on a product improvement version of the test item.

4.1.3 A generalized method of Stress Level Testing for electronic systems has been developed at the Electronic Proving Ground. This method consists of testing in a simulation/modeling environment, testing in a bench/closed loop environment and testing in a controlled field test environment. These three different phases of the test process and their relationships to each other are shown in figure 1. These relationships allow for the synergistic interaction of the test phases and lead to a logical, economical coupling of field, bench and simulation testing.

4.1.4 The specific details of stress load testing are completely dependent on the type and in many cases the specific system being tested. The test details listed following are, hence, very general in nature and are meant to show general concepts rather than specific cookbook ideas. To lend some detail to the discussion two system types are briefly discussed with regards to the test process. These types, an intercept system and a command and analysis system are discussed respectively in appendixes A and B.

4.2 Pre-Test Preparation.

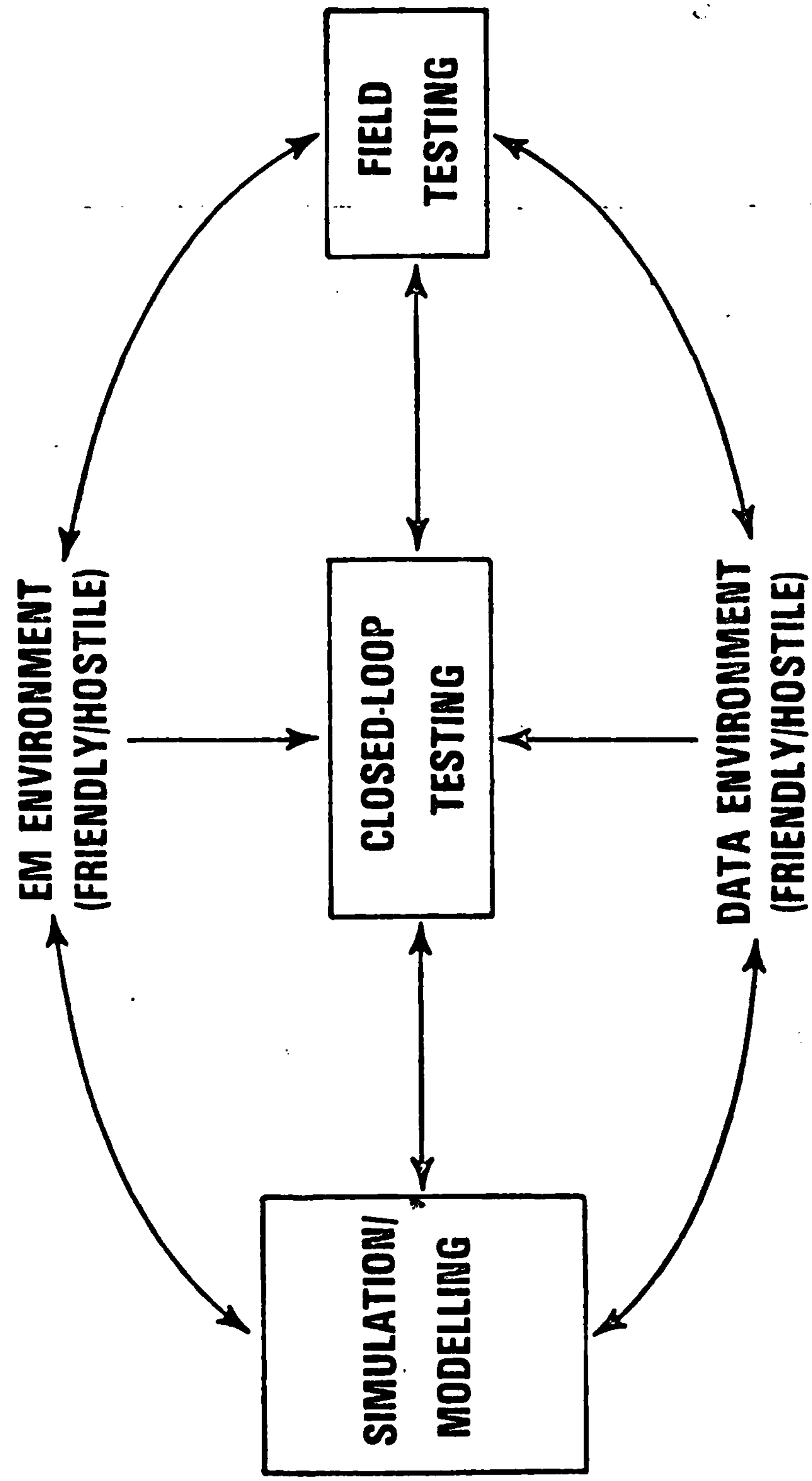


Figure 1. Generalized Test Methodology

4.2.1 After acquiring and reviewing all available/necessary documentation, the MOPs relating to the item being tested will be determined. The specification requirements/limits of each MOP will be described and those MOPs which appear stress dependent will be identified. An example of a stress dependent MOP would be an MOP which says that a receiver can handle up to 20 signals at one time without any degradation in quality. In that case it would be important to determine what would happen to that receiver when faced with 21, 22, ... n signals.

4.2.2 Once applicable MOPs have been decided the environment in which the item/system is designed to work will be identified. This environment will serve as input to future testing.

4.3 Simulation/Modeling Testing.

Early in the test process the system under test will be described in a model and inserted in a tactical model of its planned deployment environment. This simulation will be used to provide increasingly heavy stress loads to the system under test and will identify those MOPs that require empirical testing. For RF dependent SUTs the entire RF environment is initially considered and, through the elimination of signals that do not affect the system under test, is ultimately scaled down to a manageable level for closed loop testing.

4.4 Bench/Closed Loop Testing.

4.4.1 Subsequent to receipt of answers from the simulation/-modeling phase of testing the Bench/Closed loop portion of the test plan is written/updated and the system under test hardware is received. In this series of tests the system is immersed in a realistic (data or RF) environment through either direct connection or close coupling with devices producing environmental stimuli. This close connection between the environment and the system being tested allows the SUT to be operated in a simulated, realistic, controlled environment and enables the SUT to be stressed way beyond any capability that could exist and be duplicated in a controlled field test environment.

4.4.2 Closed loop testing for message (data) systems requires a device to transfer messages to/from the system under test. An item of this type has been developed at EPG. This item, the Test Item Stimulator, generates and records a data environment which exercises and stresses systems under test. The TIS provides controlled and repeatable technical/operational digital messages representative of multiple C3I/IEW systems to the SUT and monitors and records the SUT responses in real time. Appendix C contains a detailed description of the TIS.

4.4.3 Closed loop testing for RF systems requires a device to simulate at RF frequencies the signals, both friendly and unfriendly, found in a battlefield environment. An item of this type is currently being developed by EPG. This item, the Stress Loading Facility (SLF), has the capability to test large systems in a controlled environment. It will mitigate the risk of security disclosures, will provide signal loading to and beyond system design points and will enable testing to be done free of contaminating signals. The SLF will provide controlled and repeatable technical and operational simulated signals to items being tested and will monitor and record the SUT response to signals in real time. Appendix D contains a detailed description of the SLF.

4.5 Field Testing.

Subsequent to the completion of closed loop testing the field test phase of the test plan is written/updated and a minimum sized field test is designed. In this series of tests the SUT is immersed in a realistic field environment relative to the MOP being considered. The SUT is operated either by troops or technical personnel to answer specific system related questions as derived from previous closed loop and simulation/-modeling testing. This testing besides resolving open questions will verify the accuracy of previous testing, will verify the adequacy of the system to work in a field environment and will provide feedback to the closed loop and simulation efforts.

5.0 DATA PRESENTATION

5.1 General.

Data will be reduced from its raw state into some predetermined form and analyzed as defined by the test plan. Data from each of the three test phases will be processed to preserve commonality and to be used for correlation. Data reduction and analysis techniques used will include but not be limited to the following.

5.1.1 Data will be identified and time tagged for correlation.

5.1.2 Data will be organized into tabular or graphic form.

5.1.3 Data presented will be sufficient to support the conclusion(s) drawn.

5.1.4 Data collected will be retained in machine readable form until all test issues have been resolved.

5.2 Simulation/Modeling Tests.

Data will be acquired, reduced and analyzed as described in the test plan. There is no standard data format that covers the different types of systems being stressed.

5.3 Bench/Closed Loop Testing.

Data will be acquired, reduced and analyzed as described in the test plan. There is no standard data format that covers the different types of systems being stressed.

5.4 Field Testing.

Data will be acquired, reduced and analyzed as described in the test plan. There is no standard data format that covers the different types of systems being stressed.

APPENDIX A
STRESS LEVEL TESTING OF INTERCEPT SYSTEMS

A.1 General.

A.1.1 This category of testing (except for the vulnerability testing of intelligence equipments) deals primarily with systems which intercept and analyze foreign (red) signals. It is assumed that any message traffic passed between the SUT and any other friendly automated system will be tested as a command and control systems test and that vulnerability testing of any communications links will be tested as in a vulnerability test using the DVAL methodology.

A.1.2 Testing of intercept systems requires a large (in terms of numbers of signals) representative environment. Since the acquisition of actual or replica target emitters in the kinds and numbers required by the SUT is impractical, the environment will be provided by a set of RF threat simulator devices.

A.1.3 During a typical test the SUT will be operated in both closed loop and controlled field test environments. During closed loop testing special technical scenarios will be used to provide RF signals (typically into the receiver input ports) of the SUT. It is expected that closed loop testing will answer many test questions and will allow the environment required for controlled field testing to be downsized. Controlled field testing, as shown in figure A-1, will deploy simulators (either red or blue) at representative distances from the SUT. These simulators will produce many simultaneous/near simultaneous signals. They will be synchronized through a command link to a central processor using a master scenario. Data reduction will be accomplished on both a quick look and post-test basis. For the testing of an airborne system, these methods will be augmented by the ability to track multiple (typically three) aircraft and a means for instrumenting the SUT aboard the aircraft.

A.2 MOP Development.

A list of selected MOPs for an intercept system are given below. Those items deemed to relate to stress testing are marked by an asterisk prior to the listing.

- * .Rate of Processing the Field of View
- * .Out of Field of View Processing, Rejection or Rejection/Processing of Out of Field of View signals.
- .Emitter Characteristic (Time Frequency) Measurement Accuracy with Attention to Multipath/Field Effects
- * .Saturation/Graceful Degradation
- * .Saturation/Amount of Data Lost
- * .False/Erroneous Data Handling Capability
- .Repairability
- * .File Modulation Capability Update

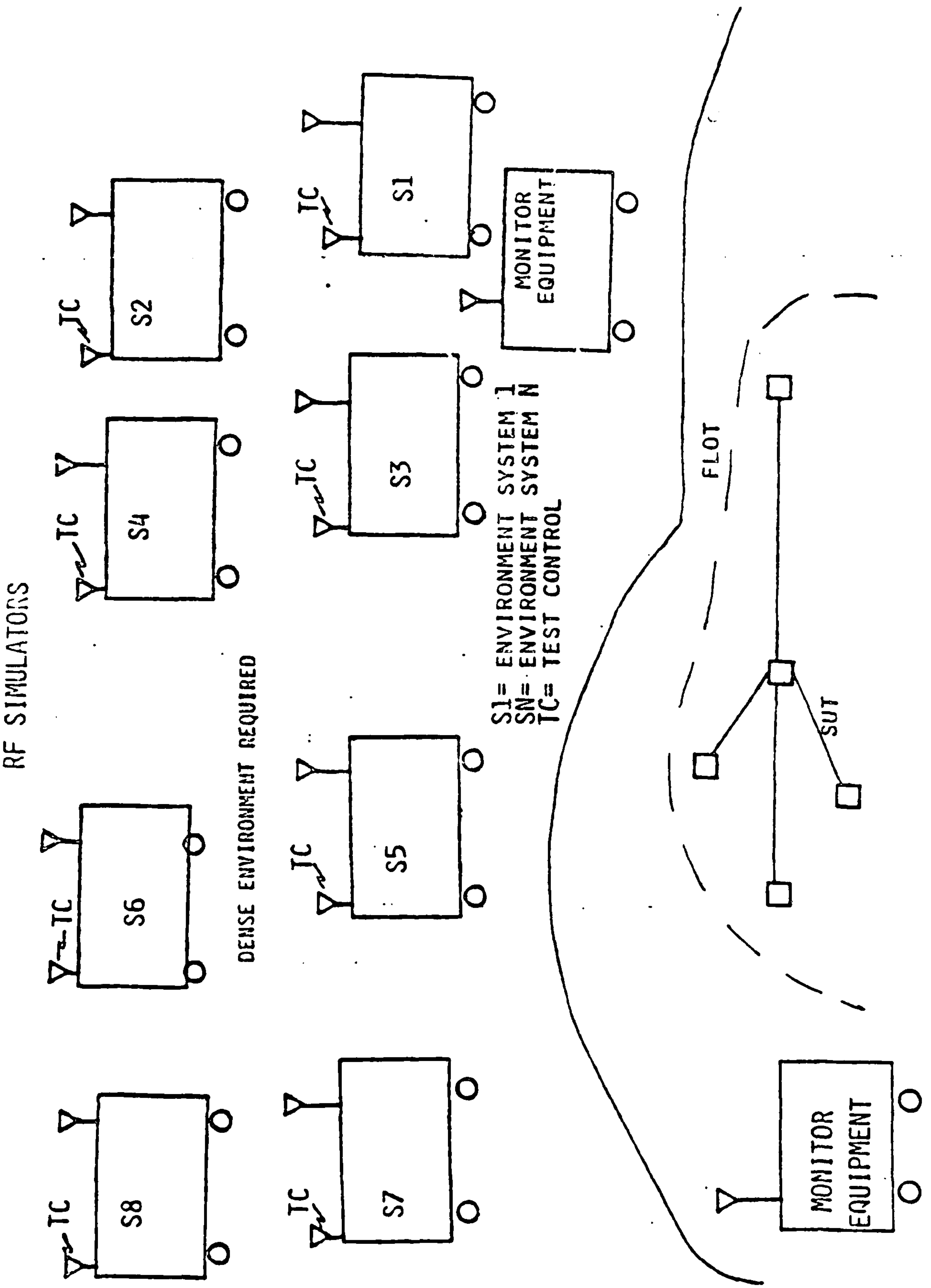


Figure A-1. Intercept system under test.

Enter Data
Record Data

* .Command and Control Links Reliability, Error Rate, Susceptibility, Vulnerability
.Pre-Test Inventory and Inspection
.Environmental Testing
.System Reliability
.System Availability
.System Maintainability
.System Compatibility
* .Interoperability
* .Vulnerability to ECM
* .Vulnerability to ESM
* .Human Factors Engineering
* .MANPRINT
.Safety
.Bite Testing
.Logistics Support
* .Software Evaluation
.Documentation and Training Evaluation
* .Probability of Intercept
* .Probability of False Alarm
* .Processing Time of Intercept (How long from intercept to information output)
* .Digital Modulation Capability (FSK, PPM)
* .Encryptic/Nonencryptic Voice and Data Capability
* .Digital Encryptic Recovery Capability
* .Spread Spectrum Capability
* .Time and Frequency Multiplexing Capability
* .AM, FM, SSB, CW Capability
* .Voice/Digital Recording Capability
* .Recording Time/Signal with Attention to Multipath and Field Effects
* .Co-channel Interference
.System Setup and Initialization Time
.Tear Down Time
.Site Preparation
.Mobility/Transportability
.Mast Stability
* .ECCM

A.3 <u>Specific Test Requirements.</u>

A.3.1 The applicable MOPs will be considered in the test design process for each of the three phases of testing. For the purposes of brevity this document will discuss only the MOP "Processing time of Intercept."

A.3.2 Upon definition of MOP requirements a simulation of the SUT/SUT environment will be developed. This simulation (if technically feasible) will be tailored to, in this case, answer the processing time MOP. Signals will be provided to the SUT incrementally up to and beyond the specified requirements level and the intercept time monitored to determine when, where and how the system fails.

A.3.3 Subsequent to the simulation effort the SUT will be run in a closed loop situation using the Stress Loading Facility. The exact SLF connections/type and numbers of signals provided relate to the SUT and its corresponding environment. It is envisioned that the environment of figure A-1 will be created using the SLF as simulator/monitor equivalents. Again signals will be provided incrementally to the SUT up to and beyond its specified requirements level and the results of the test used to verify simulation results (if a simulation test was feasible) and determine empirically where and how the system fails.

A.3.4 Subsequent to simulation/closed loop testing a limited field test will be run. Testing will use the environment type shown in figure A-1 and will be configured to both validate simulation/closed loop test results as well as to specifically answer the MOP being considered.

APPENDIX B
STRESS LEVEL TESTING OF COMMAND AND CONTROL SYSTEMS

B.1 Command and Control Systems Testing.

B.1.1 This category (except for vulnerability testing of C2 equipments) deals primarily with the transfer of data between two or more friendly (blue) equipments or systems. This data transfer is done either via tactical or strategic circuits or by communications equipment indigenous to the SUT.

B.1.2 Since future systems of this type will be primarily digital, computer-based systems, it is probable that data passed to/from the SUT will be in the form of digital messages. In order to test the ability of the SUT to process this traffic, the SUT must be connected to the system(s) with which it is designed to interface or to a message driver or stimulator which can emulate such systems. The number of interfacing systems is quite large for some SUTs. These interfacing systems most often are not economically available for a test, and they are not amenable to the strict control and repeatability necessary for development testing. Therefore a programmable device which can represent an interfacing system and provide controlled, repeatable stimuli is the preferred approach.

B.1.3 During a typical test, the stimulator(s) will be connected as shown in figure B-1 at one or more points to the SUT. The stimulators, connected to a common control network, will pass scenario-driven, realistic, time-correlated data to the SUT. Data received from the SUT (to include messages received, time of messages received, etc.) will be recorded in the stimulator for reduction (both in real-time and batch) for analysis and reporting.

B.2 MOP Development.

A list of selected MOPs for a command and analysis system are given below. Those items deemed to relate to stress testing are marked by an asterisk prior to the listing.

* .Time of Response (Time from Request/Command from an Operator to Time of Acknowledgement/Display/Response)

- Minimum Response Time (Data re Acknowledgement of Receipt) to any Request.
- Time for Display of Command Menus, Report Formats, Worksheet Formats and Similar Fixed Data Blocks
- Time for Display of Directives to Messages/Reports Stores in the system to Include Work Queues of Feeder Inputs to be Processed
- Time for Display/Listing of Historical or Long-term Messages/Reports Stored in the System
- Time for Displays of Selective Correlation/Sorts of Stored Data

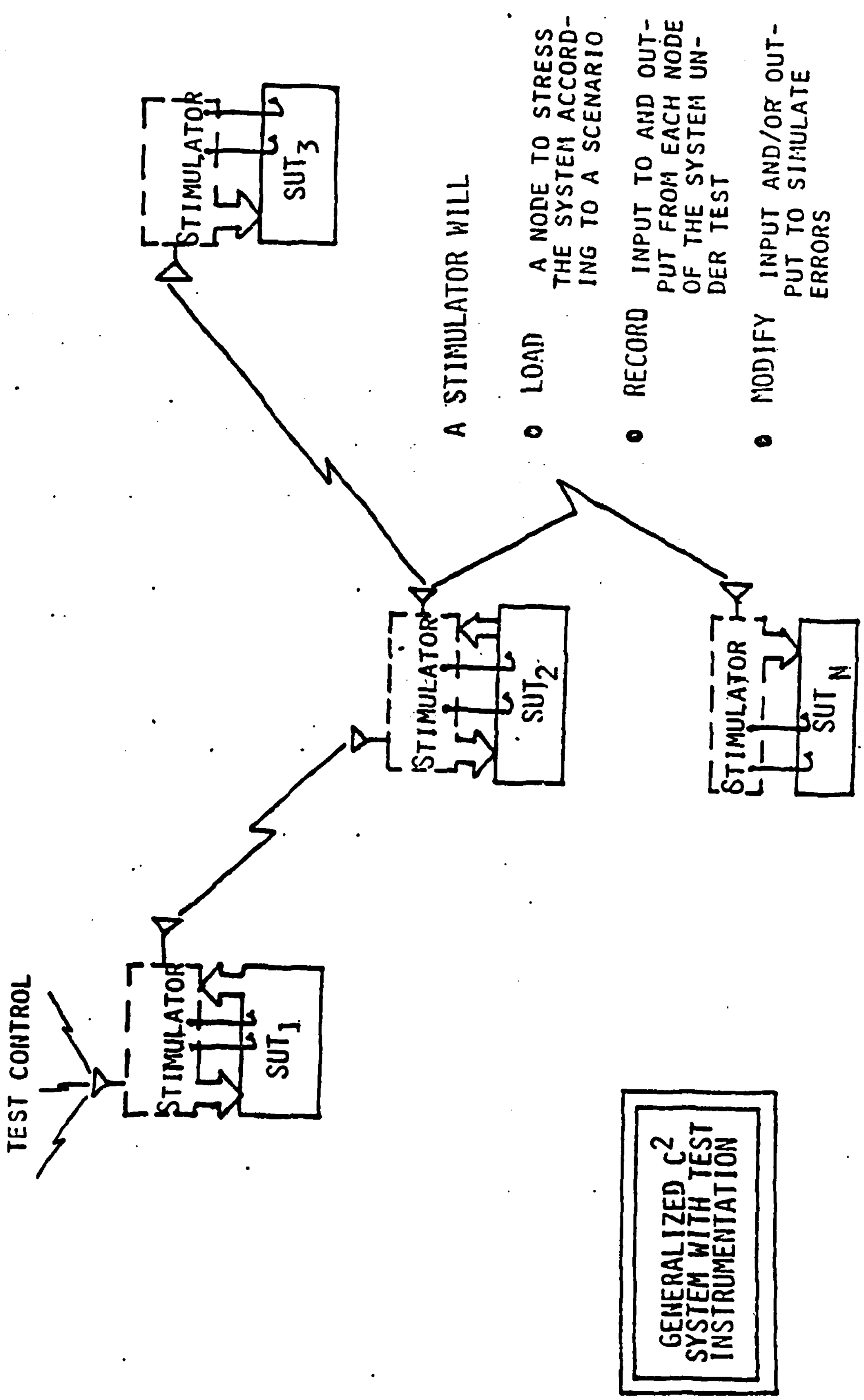


Figure B-1. Command and Control System Test Concept

.Capability to Process Compartmented/Noncompartmented Material

* .Automatic Message Routing Capability

- Priority Routing
- Originator Routing
- Message Type Routing

* .Text Editing Capability

- Paging and Scrolling
- Display Content Transfer
- Graphics Capability
- Protected and Open Area Capability and Modification
- Mass Storage Capability
- Short-term Storage Capability
- Storage Transfer Capability
- Mass Storage Emergency Destruction Capability

* .Communication Links

- Message Assembly Capability
- Error Correction Capability
- Message Acknowledgements/Retransmission Capability
- Code Transliteration Capability
- Communication Line Terminations Characteristics
- Secure Communication Capability
- Variable Link Capability (HF, VHF, UHF, VOICE/TTY/DATA)

* .Interrupts of System Utilization by Diagnostic Routines

* .Number of Reports/Day Capability

* .Number of Characters/Day Capability

* .Number of Interfaces Capability

* .Calculation Capability

* .System Overload/Graceful Degradation

.Pre-Test Inspection and Inventory

.Environmental Testing (Operation in Extreme Heat, Cold, Salt, Fog, Etc.)

.Reliability

.Availability

.Maintainability

.Compatibility

* .Interoperability

  .Susceptibility

* .Vulnerability

* .Vulnerability to ESM

* .Human Factors Engineering

* .MANPRINT

  .Safety

  .BITE Testing (System Diagnostic to Lowest Field Replaceable Units)

  .Logistic Support Package

  .Software Evaluation, Maintainability

  .Documentation and Training

  .Setup/Tear down time

  .Site Preparation

  .Transportability of System

  .Mobility of System

  .Mast Stability

  .Hearability as a Function of Antenna Height

B.3 Specific Test Requirements.

B.3.1 The applicable MOPs will be considered in the test design process for each of the three phases of testing. For the purposes of brevity this document will discuss only the MOP "Time of Response."

B.3.2 Upon definition of MOP requirements a simulation of the Data environment will be developed. This simulation will be tailored, in this case, to answer the time of response MOP. Messages will be provided to the SUT incrementally up to and beyond the specified requirements level and the response time monitored to determine when, where and how the system fails.

B.3.3 Subsequent to the simulation effort the SUT will be run in a closed loop situation using the Test Item Stimulator. The exact TIS connections/types and numbers of messages provided relate to the SUT and its corresponding data environment. It is envisioned that the data environment of figure B-1 will be created using the TIS to provide external messages to the SUT. Again a message will be provided incrementally to the SUT up to and beyond its specified requirements level and the results of the test used to verify simulation results (if a simulation was feasible) and determine empirically where and how the system fails.

B.3.4 Subsequent to simulation/closed loop testing a limited field test will be run. Testing will use the environment type shown in Figure B-1 and will be configured to both validate simulation/closed loop test results as well as to specifically answer the MOP being considered.

APPENDIX C

TEST ITEM STIMULATOR (TIS) DESCRIPTION

1. The TIS is a transportable or fixed site test system for testing C3I systems. The TIS generates the data environment to exercise and stress the systems under test to measure their interoperability, software, and system performance. The TIS provides controlled and repeatable digital messages for stimulation of multiple C3I systems under test and monitors/records their responses in real-time. The data environment generation is performed by a single or multi-processor system under control of both prespecified and real-time interactive scenarios. It utilizes state-of-the-art commercial computers, displays, licensed commercial software, and government owned/controlled applications software. Either military or commercial communications may be used to link the TIS with systems under test.

2. The TIS supplies a data environment which:

* Complies with message standards and specifications.

* May also include carefully selected and controlled errors.

* Does not include spurious or unintentional messages.

* Allows test messages to be automatically associated, singly or in sets, with functional test objectives.

* Allows message timing to be specified and synchronized with other tests or test control events.

* Provides large volumes of validated input messages to stress test large systems with confidence.

* Measures communications and processing throughputs.

* Can be designed to independently stress system functions/resources to avoid intractable test results.

3. Description of how the TIS functions:

a. The TIS initially generates a simulated data environment which it presents to the SUT via military or commercial data links. The TIS then records system responses in real-time to ascertain the validity of interface designs, compliance with design standards, and the performance resulting from achieved interoperability.

b. Each TIS can simultaneously supply message traffic on 28 narrow-band and 4 JTIDS data links or the equivalent data rate in almost any combination. The TIS monitors/records output messages in real-time and records data for subsequent off-line analysis.

c. The TIS is transportable and capable of operating in a wide range of geographic and climatic conditions.

d. The TIS, as a stand-alone test support system, supports test operations during pre-test, real-time, and post-test phases. During pre-test, the software provided assists test planners in scenario creation, message preparation, critical data identification, and in conducting pre-test diagnostics. Following the test, the software aids evaluation by providing utilities for data reduction, collation, and consolidation; identifying significant events; providing a library of analytic support modules; providing "friendly" interactive man-machine interface of graphic and textual data terminals.

e. When operation in the role of a test driver, the TIS:

(1) Stimulates tactical activities in the systems under test/participating systems by simulating tactical sensor or intelligence sources.

(2) Emulates the message streams and communications logic of C3I systems and interfaces with the system under test to support interoperability testing.

(3) Encodes and transmits scenario driven messages in the correct format and content while using the appropriate communications protocols.

(4) Receives, decodes, displays, and records message streams received from the system under test as a result of their processing, operator activity, or battle management in real-time.

4. FUNCTIONAL DESCRIPTION. The following functional capabilities are provided by the TIS:

a. Scenario generation and modification

b. Library of tactical system-specific appliques (SSA) (software packages) including: TADIL-J, MCS, TACFIRE, AN/TSQ-73, HAWK, and ASAS.

c. Time-metered scenario control driven by actual exercise time (IRIG-B).

d. Ability to stop, start, and modify the test in real-time.

e. Time tagged (IRIG-B) data collection of test messages.

f. Quick-look analysis of test data for test control.

g. Library of data reduction and analysis software for post-test evaluation.

h. Interactive graphic display subsystem.

APPENDIX D

STRESS LOADING FACILITY (SLF) DESCRIPTION

1. Stress Loading Facility (SLF) is an integrated testing system to achieve a dense electromagnetic threat test environment while simultaneously monitoring key performance parameters. The SLF will provide for test scenario generation, automated generation of accurate communications/non-communications RF signal signatures in dense scenarios (stress load), automated test data collection with time code correlation, semi-automated test data reduction and analysis, centralized computer coordination of all test events (including message stimulation), test control, and test repeatability in support of C3I systems development testing. This will be accomplished in a closed environment to exclude unwanted signals from contaminating the test results and to prevent the radiation of classified or sensitive signals into the external environment during testing.

2. The potential role of the SLF is to provide a capability between the computer simulation/modeling and open range controlled field testing, in which a controlled and repeatable test environment can be applied to the system under test which could not practically be done in a controlled open range field test.

3. The SLF is comprised of the following subsystems as shown on the attached block diagram (Figure D-1):

* TEST CONTROL STATION (TCS)
* CENTRAL COMPUTER SUBSYSTEM (CCS)
* COMMUNICATIONS THREAT SIMULATOR (CTS)
* NON-COMMUNICATIONS THREAT SIMULATOR (NCTS)
* FUNCTIONAL SYSTEMS SIMULATOR (FSS)
* TEST DATA MONITORING SUBSYSTEM (TDMS)

4. Descriptions of how the SLF functions:

a. The SLF generates a simulated RF environment based on a time event scenario that is developed during the pre-test period. This RF environment also includes the associated modulations and types of information that would be transmitted by this RF environment. The systems/functions/components that are associated with the system under test to allow it to operate realistically, and are not physically available for the test, will be simulated within the SLF.

b. The CTS, NCTS, FSS, and TDMS each have their own dedicated control processor which will allow them to operate in a stand-alone mode without the SLF CCS in unique situations. Normally, in system tests the entire SLF would function under the control of the CCS and associated TCS.

c. Subsystem functions are:

(1) TEST CONTROL STATION

* CONTROL AND MANAGEMENT OF REAL-TIME OPERATIONS

* TIMING INFORMATION ACQUISITION

* AUDIO INTERFACE WITH ALL SLF SUBSYSTEMS

* OPERATOR INTERFACE FOR OFF-LINE OPERATIONS FOR TEST PLANNING, SCENARIO DEVELOPMENT AND EMITTER PARAMETER FILE MAINTENANCE

(2) CENTRAL COMPUTER SUBSYSTEM

* INTEGRATED TEST CONTROL

* DATA REDUCTION AND ANALYSIS FOR BOTH QUICK-LOOK AND POST TEST REQUIREMENTS

* UPDATING AND MANAGEMENT OF DATA BASE(S) CONTAINING THE PRE-TEST CALIBRATION AND REAL-TIME TEST DATA

* GENERATION OF THE INTEGRATED SCENARIO FOR THE ENTIRE TEST TO BE RUN IN THE SLF

* GENERATION OF THE INDIVIDUAL SIMULATOR SUBSYSTEM SCENARIOS AND ASSOCIATED SCENARIO FILES

* CREATION, UPDATING, AND MAINTENANCE OF EMITTER PARAMETER FILES

* CREATION, UPDATING, AND MAINTENANCE OF DATA MESSAGE FILES

* SLF SOFTWARE MANAGEMENT

(3) COMMUNICATIONS THREAT SIMULATOR

* GENERATE VOICE AND NON-VOICE COMMUNICATIONS SIGNALS, 0.5 TO 500 MHz

* CONTROLS ASSOCIATED SOFTWARE USING INTERNAL PROCESSOR

* RUNS PREDESIGNATED SCENARIOS

* AUTOMATIC CONTROL OF MODULATION, RF SOURCES, AND RF DISTRIBUTION

* SCENARIO GENERATION CAPABILITY FOR STAND ALONE MODE

(4) NON-COMMUNICATIONS THREAT SIMULATOR

* GENERATE PULSED RADAR, NAVIGATION, AND OTHER NON-COMMUNICATIONS SIGNALS, 0.5 GHz TO 18.0 GHz
* CONTROLS ASSOCIATED SOFTWARE USING INTERNAL PROCESSOR
* RUNS PREDESIGNATED SCENARIOS
* AUTOMATIC CONTROL OF MODULATION, RF SOURCES, AND RF DISTRIBUTION
* SCENARIO GENERATION CAPABILITY FOR STAND ALONE MODE

(5) FUNCTIONAL SYSTEMS SIMULATOR

* SIMULATES EXTERNAL FUNCTIONS THAT NEED TO BE ACTIVATED, STIMULATED, CONTROLLED, OR CHECKED FOR STATUS
* SIMULATION OF SUPPORT/CONTROL SYSTEMS TO THE SUT
* SIMULATION OF C3I SYSTEMS THAT THE SUT WOULD NORMALLY INTERFACE/INTEROPERATE WITH
* SIMULATION OF ADDITIONAL UNITS OF THE SUT NOT AVAILABLE
* SUT EQUIPMENT/SYSTEM STATUS MONITORING
* CONTROLS ASSOCIATED SOFTWARE USING INTERNAL PROCESSOR
* RUNS PREDESIGNATED SCENARIOS
* SCENARIO GENERATION CAPABILITY

(6) TEST DATA MONITORING SUBSYSTEM

* PERFORMS PRE-TEST CALIBRATION
* PERFORMS PRE-TEST READINESS CHECKS
* PERFORMS ENVIRONMENT MONITORING
* PERFORMS SUT PARAMETER MONITORING
* PERFORMS POST TEST MEASUREMENTS (DRIFT)
* PERFORMS REAL-TIME QUICKLOOK DATA

d. The RF distribution designs for the CTS and NCTS are generic as far as possible. However, each system to be tested will have to be looked at in detail to determine the system specific interface applique that will be required. The same approach applies to the FSS.

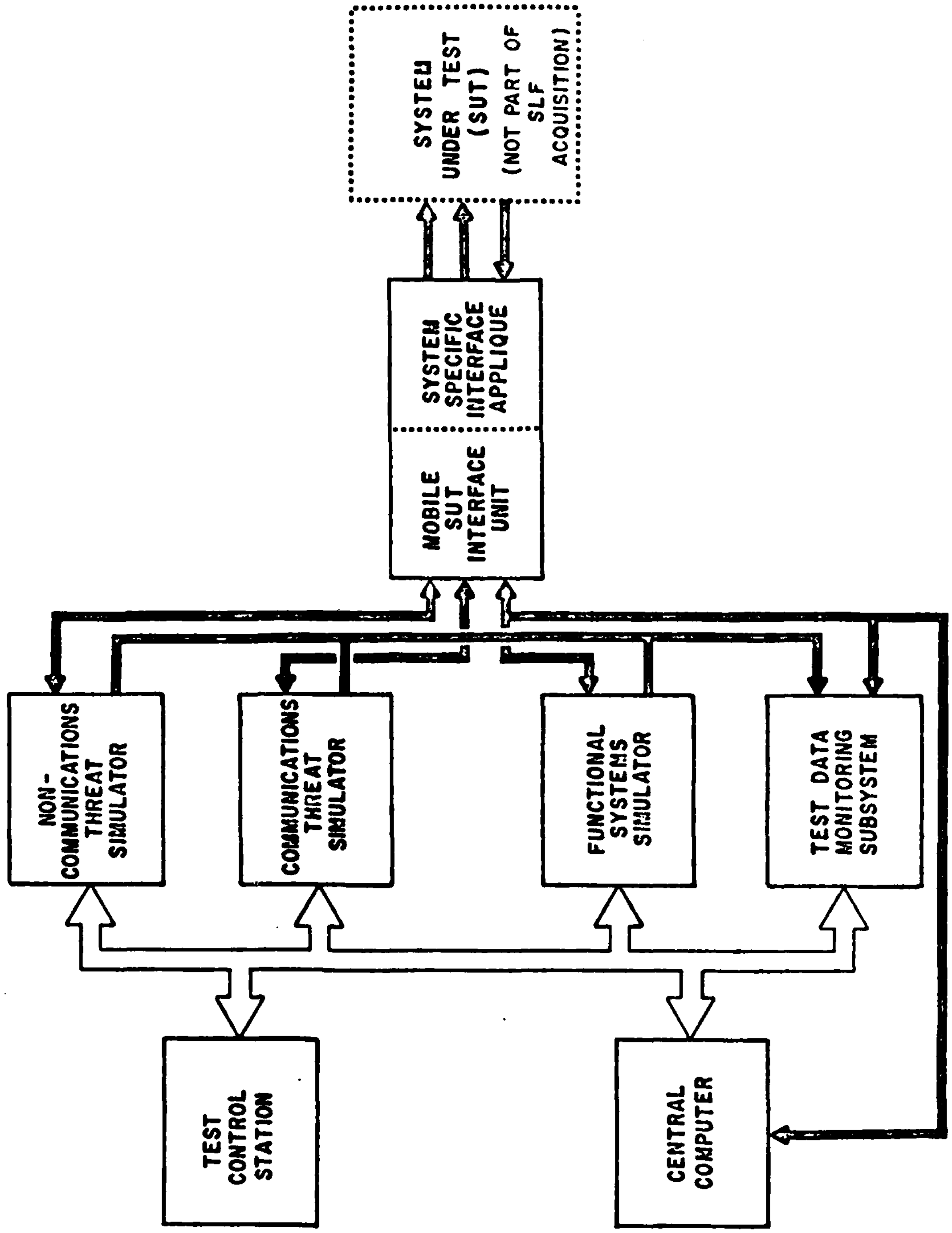


FIGURE D-1 STRESS LOADING FACILITY BLOCK DIAGRAM

APPENDIX E
REFERENCES

E.1 Modernization Requirements and Plan, USAEPG, March 1985.

E.2 AMC Regulation 310-6, 31 May 1982, Product Assurance and Test Publications.

E.3 EWI DT Methodology Study, USAEPG, 15 February 1980.

E.4 TECOM Pam 70-3, Project Engineers' Handbook.

E.5 TECOM Reg 70-24, Documenting TECOM Testing

E.6 TECOM Pam 310-4, Index of Test Operations Procedures.

E.7 DVAL Methodology, Executive summary, 1 Nov 84, AD-B087 900

APPENDIX F
ABBREVIATIONS

AM Amplitude Modulation

AVSCOM Aviation Systems Command

BITE Built In Test Equipment

C2 Command and Control

CW Continous Wave

C3I Command, Control, Communications and Intelligence

DT Development Test

ECM Electronic Countermeasures

ESM Electronic Support Measures

EWI Electronic Warfare Intelligence

FM Frequency Modulation

FSK Frequency Shift Keying

HF High Frequency

IEW Intelligence Electronic Warfare

LOB Line of Bearing

MOP Measures of Performance

OB Order of Battle

RF Radio Frequency

SLF Stress Loading Facility

SOP Standard Operating Procedures

SSB Single Side Band

SUT System Under Test

TECOM Test and Evaluation Command

TIS Test Item Stimulator

TOP Test Operations Procedure

TRMS Test Resources Management System

TTY Teletype

UHF Ultra High Frequency

USAEPG United States Army Electronic Proving Ground

VHF Very High Frequency

END

FILMED

10-85

DTIC