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HUMAN FACTORS AND SAFETY EVALUATION OF THE IMPROVED MESSAGE FACILITY

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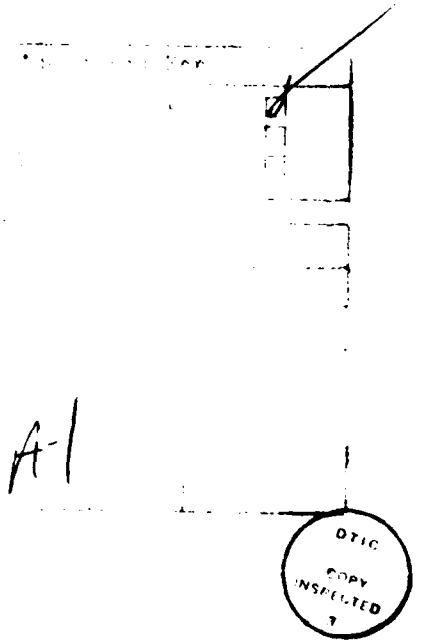
This report presents the results of a human factors and safety evaluation of the Improved Message Facility. The evaluation was part of Operational Test II conducted by the US ARmy Communications-Electronics Board at Fort Hood, Texas in the summer of 1983. Numerous human factors problems and several safety problems were identified. The results were used at the In-Process Review to help reach a decision regarding full-scale production of the system.

FOREWORD

The modern Army is in the midst of being equipped with an unprecedented amount of equipment incorporating a high degree of technological sophistication. The fact that such equipment is expensive and can only be procured in limited quantities makes it imperative that the equipment be utilized to its highest potential.

One of the factors which frequently prevents this is inadequate consideration of the man-machine interface during system design. The result is that the average soldier is precluded from effectively operating the system. In order to identify and help rectify such problems the Army Research Institute is frequently tasked by various Army organizations, such as the U.S. Army Communications-Electronics Board (USACEBD), to conduct human factors and safety evaluations of selected Army equipment in an operational field test environment. The present human factors and safety evaluation of the Improved Message Facility is one product of this effort.

The findings of this report were approved by the US Army Communications-Electronics Board and integrated into the USACEBD report "Final Test Report for Operational Test II of Improved Message Facility, TRADOC TRMS NO. 3-OTN-1032, November 1983." This ARI Human Factors and Safety report has been formally published in its entirety as Appendix E to the referenced USACEBD report.



HUMAN FACTORS AND SAFETY EVALUATION OF THE IMPROVED MESSAGE FACILITY

EXECUTIVE SUMMARY

Requirement:

The Improved Message Facility (IMF) is a semi-automatic, secure telegraph terminal facility which can send, receive and relay record communications traffic. It was developed by the Center for Communication Systems at Fort Monmouth, New Jersey, as an interim facility until a fully automated message switch can be fielded after 1990. The United States Army Communications-Electronics Board conducted an operational test (OT II) of two versions of the IMF (AN/TSC-58A and AN/MSC-29) at Fort Hood, Texas in the summer of 1983, and tasked the ARI Field Unit - Fort Hood, to satisfy the human factors and safety requirement (Objective 5) of that test. The following report is in response to that tasking.

Procedure:

Questionnaires and interviews were administered to operators and maintainers of the system in order to obtain information about the system from a human factors and safety perspective. Areas covered included the immediate environment in which the system was operated, individual equipment characteristics, overall equipment configuration, job procedures and computer software. In addition, a human factors and safety evaluator recorded relevant observations of operations as well as measurements of light levels, sound levels, and physical dimensions of pieces of equipment in those cases where adverse comments had been made by operators and maintainers. The questionnaire results were tabulated, the interviews and evaluator observations were summarized, and the light, sound and physical measurements were compared to appropriate military standards. This information was used to identify user-machine interface problems and to identify ways of solving the problems by equipment redesign, training, or changes in operating procedures.

Findings:

Environment. Operators generally complained that the temperature inside the AN/TSC-58A was too high, especially at the operator's position near the front of the shelter, while the temperature inside the AN/MSC-29 was generally too cool, particularly at the OCR operator position which was directly in the path of air coming from an air conditioner vent. Illumination levels were generally below the minimum levels of 50 footcandles for business machine operation and 30 footcandles for front panels of equipment as specified in Military Standard 1472C, although operators did not complain that illumination levels were inadequate. Finally, the steady state noise level was around 70 dB(A), which exceeds the upper limit of 65 dB(A) which Military Standard 1474B(MI) specifies for systems requiring frequent direct communication at distances up to five feet. There were also numerous operator complaints about the level of noise in the shelters.

Equipment. Glare was a recurring problem with the video display unit (VDU), particularly in the AN/MSC-29 where there was no means for fixing the VDU in place after adjusting its position to reduce the glare. The location of the VDU keyboard required the operator to lean over the optical character reader to reach the keyboard, causing operators to maintain an awkward and tiring posture, and leading to operator complaints of neckaches and backaches. The communications terminals were positioned such that the keyboard was too high for comfortable operator typing, and the physical design of the terminals made it difficult to see information being printed by the terminal, thus requiring frequent advancing of the paper. The locations of the message formatter in the AN/MSC-29 and the processor/controller in both the AN/TSC-58A and the AN/MSC-29 were such that their power and reset switches were sometimes inadvertently flipped by the operators bumping them with their knees or boots. This resulted in unneccessary system down time and could be avoided by putting guards on the switches. Operators commented that an audible or light warning to indicate that the processor/controller memory was getting full also would be helpful. The height of the upper controls on the TH-22 modems in the AN/MSC-29 exceeded the 70 inch maximum specified in Military Standard 1472C. Also requirements in Military Standard 1472C were violated by the use of red and yellow to indicate "power on" conditions.

Storage Space. There was inadequate storage space inside the shelter for personal gear, replacement parts, and printer paper.

Job Procedures. Operators were in almost unanimous agreement as to the usefulness of having a checklist that could be used when starting up and initializing the system. They also indicated that a wall-mounted status board would be useful for indicating the operational status of channels and pieces of equipment. Operators also generally complained that they felt ill-trained to troubleshoot the system.

Software. Operators generally indicated that the operator's manuals did not adequately explain how to use the various software commands of the system.

Maintenance. The problems reported by the maintainers of the system focused on a lack of information on troubleshooting procedures in the maintenance manuals for the processor/controller and the mode 1 communications unit.

Safety. Sharp edges on the drawers of the storage cabinet in the AN/MSC-29 and clips holding patch cords in the AN/TSC-58A were the source of hand cuts and need to be modified. Operators complained of exhaust fumes entering the shelter when the vehicle engine was being used to charge the vehicle batteries, indicating that provision should be made to vent the engine exhaust away from the shelter during that activity. It was noted that the designs of DANGER and CAUTION signs did not conform to Military Standard 1473A, and that a two man lift sign was lacking on the VDU. Finally, the ladders to the shelters were lacking handrails on one side of the steps.

Utilization:

Information from this evaluation was used to help assess the military suitability and operational effectiveness of the Improved Message Facility, and will be used at an Army In-Process Review as input to a decision as to whether or not to enter full-scale production of the system.

The findings of this report were approved by the USACEBD and integrated into the USACEBD report "Final Test Report for Operational Test II of Improved Message Facility, TRADOC TRMS NO. 3-OTN-1032, November 1983." This ARI Human Factors and Safety report has also been formally published in its entirety as Appendix E to the referenced USACBED report.

HUMAN FACTORS AND SAFETY EVALUATION OF THE IMPROVED MESSAGE FACILITY

CONTENTS

INTRODUCTION

The Improved Message Facility (IMF) is a semi-automatic, secure telegraph terminal facility which can send, receive and relay record communication traffic. It is to be employed in division and higher level signal battalions, as well as in Communications-Electronics Warfare and Intelligence organizations where it will be used to receive and transmit sensitive compartmented information. It eliminates the need for torn tape relay of communications traffic and is planned for eventual replacement by a fully automated message switch.

The IMF system is configured in a S-280 shelter mounted on a 2 1/2 ton cargo truck and consists of the following pieces of equipment: five AN/UGC-74 communications terminals, one TT-76/GGC reperforator-transmitter, a processor/controller, a semi-automatic message entry system (SAMES), a mode I communications unit, communications security devices and TH-22 modems. Each AN/UGC-74 communications terminal can support one of the following functional positions: 1) operator - used to route traffic to other communications centers, service traffic, and distribute received traffic to remote or co-located printers; 2) poker - used for entering handwritten or typed messages into the system as record traffic; 3) printer - used to provide a hard copy of messages being received; 4) remote - used as a poker and printer in out-of-shelter areas; and 5) supervisor - used to initialize, monitor and control the operation of the IMF. The microprocessor based Processor/Controller permits the semi-automatic processing (reception, temporary storage) and relay of messages. The SAMES, which consists of an optical character reader, keyboard and video display, allows for entry into the IMF of messages typed on DD Form 173/2 or 173/3 and automatically formats them so that they are indistinguishable to the Processor/Controller from messages entered via a teletypewriter at a poker station. The personnel required to operate the IMF typically include a supervisor and two operators.

The IMF was subjected to operational testing (OT II) by the United States Army Communications-Electronics Board (USACEBD) from 31 May to 19 August, 1983 at Fort Hood, Texas. Two versions of the system were evaluated; the AN/TSC-58A and the AN/MSC-29. The two versions differed only in how the equipment was laid out and organized within the S-280 shelter. The ARI Field Unit-Fort Hood was tasked by USACEBD to perform a human factors and safety evaluation of the IMF system during the operational test in order to satisfy the human factors and safety objective of the test. The following report was the result of that evaluation and was formally published as "Appendix E, Human Factors and Safety" in the Final Test Report for Operational Test II of Improved Message Facility, TRADOC TRMS No. 3-OTN-1032, United States Army Communications-Electronics Board, November 1983. It is reproduced here in the exact format in which it appears in that report. Further details about the operational test and the IMF can be found in the USACEBD report.

APPENDIX E

HUMAN FACTORS AND SAFETY

1.1 HUMAN FACTORS AND SAFETY.

1.1.1 Objective. To gather data on the human factors and safety aspects associated with the system as a result of the product improvement.

1.1.2 Objective. All aspects of installing, operating, and maintainability by using unit will be evaluated during testing. The test unit will evaluate initial receipt of the IMF and its organic resources available to load and off-load the system with the organic 5-ton wrecker. Other evaluations of the safety features or lack of them will bve evaluated in a tactical field exercise.

1.1.3 Test Issues and Associated Criteria.

1.1.3.1 Issue: Do the human factors engineering aspects of the IMF provide for efficient operation of the IMF by operator and maintenance personnel?

1.1.3.2 Issue: Is the IMF safe to operate and maintain?

Criteria:

a. The operator/maintainers shall be provided adequate workspace to efficiently perform their mission. There shall be adequate storage for technical manuals, tools, parts and all other items necessary to perform the mission. The IMF must be convenience oriented.

b. Control displays, label fasteners and other equipment shall be designed in accordance with good principles of human engineering. Adjustment dials, screws, and levers should be easily accessible to the maintenance technicians.

c. The IMF shall be secured, transported and erected in accordance with good principles of human factors engineering and shall conform to the 4-hour time limit.

d. The software and man-to-computer language shall facilitate the performance of the mission.

e. No unsafe conditions will be encountered as a result of the fielding of the IMF.

1.1.4 Method.

1.1.4.1 A human factors questionaire and a safety questionnaire (ANNEX A) were administered to each of 19 operators during the last two weeks of the test. Eleven operators worked in the AN/TSC-58A and eight worked in the AN/MSC-29. Ratings on a five point scale were obtained for questions relating to various aspects of the environment, individual equipment characteristics, overall organization of equipment, job procedures, computer software and safety associated with each configuration of the system. Interviews were conducted with each of the 19 operators in order to permit them to confirm and explain the ratings they gave on the questionnaires.

1.1.4.2 A human factors and safety questionnaire was administered to the two maintainers of the system. Five point scale ratings were obtained for questions in the areas of administrative procedures, maintenance procedures and safety. Interviews were used to permit the maintainers to confirm and explain the ratings that were given.

1.1.4.3 A human factors evaluator recorded relevant observations during the test and recorded measurements of light levels, sound levels, and the physical dimensions of pieces of equipment and workspaces on which adverse comments had been made by test players.

1.1.5 Results.

Results from the human factors questionnaires and interviews administered to IMF operators are shown in Table A-1. Results from the maintenance personnel questionnaires and interviews are shown in Table A-2, results from the safety questionnaire and interviews are shown in Table A-3, and measurements of illumination, sound and temperature levels are shown in Table A-4.

1.1.5.1 Environment.

1.1.5.1.1 Operators of the AN/TSC-58A generally indicated that the temperature inside the van was too high and that the ventilation was not adequate. Operators' comments indicated that it became particularly warm at the operator's position near the front of the van. In contrast, operators of the AN/TSC-29 generally indicated that the temperature was too low in the van, with the ventilation being adequate. One operator commented that it was particularly cold standing at the OCR because the air from one of the air conditioners was directed toward that position.

1.1.5.1.2 Most operators indicated that the lighting levels in the IMF were about right, although a few operators from the AN/TSC-58A version complained that the lights were too bright.

1.1.5.1.3 Several operators indicated that sound levels were too high, especially in the AN/TSC-58A. Comments indicated that this noise was from the air conditioners, the printers and the general level of work activity in the shelter. One operator complained that he had to shout to be heard from one end of the shelter to the other.

1.1.5.1.4 Most operators reported experiencing vibration to some extent, mainly from the air conditioners and the truck engine when charging the batteries. However, only one operator reported this vibration as being extremely uncomfortable.

1.1.5.1.5 a. Measurements of illumination, sound and temperature levels are shown in Table A-4. The illumination levels at the communications terminals ranged from 6 to 59 footcandles in the AN/TSC-58A and from 29 to 35 footcandles in the AN/TSC-29. Light levels at the VDU and OCR keyboards were 40 and 27 footcandles, respectively, for the AN/TSC-58A, and 24 and 22 footcandles, respectively, for the AN/TSC-29. Illumination levels for the

front panels of equipment with which the operators had to periodically interface ranged from 2 footcandles on the power distribution panels in the AN/TSC-58A to 60 footcandles for the TH-22's in the AN/TSC-29.

b. The sound levels in both vans ranged from around 70 dB(A) when there was general activity in the van with none of the communications terminals printing out messages, to 84 dB(A) with two terminals printing messages, to 90 dB(A) when three terminals were printing messages. These latter two sound levels were recorded during periods of peak activity in the van and were in the form of spikes, lasting for only a second or two when the terminals were actually printing, followed by at least a second or two of lower sound levels as the paper advanced for the next line, or the end of a message was reached. The sound level of the TH-22 alarm was measured at 85 dB(A).

c. The temperature levels shown in Table A-4 were those recorded during one day of the test to verify the IMF operators' indications of a contrast between the temperatures inside the AN/TSC-58A and the AN/TSC-29. It can be seen that the effective temperature, as determined from dry bulb and wet bulb measurements, was 78°F near the front of the AN/TSC-58A where the operator sits and 76°F in the middle of the van. Corresponding effective temperatures for the AN/TSC-29 were 67°F and 68°F, respectively.

1.1.5.2 Equipment.

1.1.5.2.1 Video Display Unit (VDU) and Keyboard.

a. The VDU and its keyboard received more negative comments than any other piece of equipment in the system. One major problem concerned glare on the VDU screen. Eight of the operators in the AN/TSC-58A and five of the operators in the AN/TSC-29 indicated that this was a problem. In the AN/TSC-58A the VDU faced the door and the glare was caused by light coming from outside the van when the door to the van was open, while in the AN/TSC-29 the VDU faced into the van and the glare was caused by the overhead florescent lights. In both cases, however, operators indicated that they could partially solve the problem by tilting or turning the VDU, although this was difficult in the AN/TSC-29 because there was no way to lock the VDU in place once one had tilted it.

b. Six of the operators from the AN/TSC-58A and four operators from the AN/TSC-29 gave less than "adequate" ratings to the reach distance of the VDU keyboard. Four operators commented that this was a particular problem for short people and could get very tiring as there was no chair for the operator at this position. Three operators said that a chair or stool would be useful for this position and one operator suggested designing the keyboard so that the operator could move it closer to him. Two operators indicated that the VDU itself was mounted too high in the AN/TSC-29, causing short operators to have to reach out and enter the appropriate information in the keyboard and then step back and look up at the VDU to determine what exactly had been entered. It was stated that this sometimes caused a neckache or a backache. Along this line, several operators also indicated that the VDU was too far away, or the letters were too small, because they had to get near to it in order to read it.

c. Another criticism of the VDU keyboard, made by four operators, was that several of the keys were not operable and satisfactory explanations as to what their functions were had never been given. Three of the operators suggested removing these keys in order to make the keyboard smaller.

d. Four operators commented that the operators manual for the VDU was inadequate in that it was too technical and did not contain certain information, such as how to install the VDU after movement to a new location. Also, one operator commented that the manual did not contain enough information on troubleshooting.

1.1.5.2.2 Optical Character Reader (OCR)

Several operators gave less than "adequate" ratings to various characteristics of the OCR. Four operators gave "borderline" ratings to the absence of glare on the line display. Two operators commented that it was hard to use the OCR keyboard because one had to lean over to look down into the line display, and then lean back to use the keyboard. Several comments focused on error indications from the OCR, such as it not always being readily apparent what letter was causing a problem because one could not see in the line display the whole line that was being read by the OCR. Another comment was that the OCR should directly identify a problem, rather than using symbols that have to be interpreted. Finally, five operators gave "borderline" ratings to the manual for the OCR and two of them commented that the manual did not explain all of the keys on the OCR very well.

1.1.5.2.3 Communications Terminals (AN/UGC-74A[V]3)

Less than "adequate" ratings and comments relating to the communications terminals primarily centered on, but were not restricted to, being able to see what the terminals printed. Eight operators from the AN/TSC-58A and five from the AN/TSC-29 gave less than "adequate" ratings to the viewing distance of the terminals. Similar ratings were given to the angle of view. Seven of the operators commented that one had to lean over and look down through the copy window of the communications terminals in order to see what was being printed. Four operators commented that one had to press the paper feed and advance the paper in order to read the header on a message that had just arrived and determine how to route it. Also, five operators commented that when one typed something on a terminal he could not see what was being printed until he stopped typing. Two operators from the AN/TSC-29 commented that the location of the terminals was somewhat high, causing them to sit in positions which became uncomfortable after awhile. Five of the operators indicated that the keys were somewhat hard to push down. Finally, comments about the manual were that while the manual told you what commands were available, it did not explain how to use them, and the manual did not indicate what command abbreviations were available.

1.1.5.2.4 Teletypewriter (TT-76B/GGC)

Less than "adequate" ratings and comments on the teletypewriter centered on its location. Four operators commented that it needed to be located in a lower position in the AN/TSC-29 so that operators could type on it if they needed to. Most of the operators indicated that they never used the teletypewriter in the IMF.

1.1.5.2.5 Message Formatter.

Most operators gave "adequate" or "very adequate" ratings to characteristics of the message formatter. The few less than adequate ratings that were received were accompanied by comments to the effect that personnel sometimes hit the lock key when trying to hit the reset key because the two were so close together, and the location of the message formatter in the AN/TSC-29 was such that personnel sometimes inadvertently bumped the reset switch with their knees.

1.1.5.2.6 Mode 1 Communications Unit (MCU).

The mode 1 communications unit received mostly "adequate" and "very adequate" ratings from operators, although a few operators gave it less than "adequate" ratings. Their comments focused on the problem of not knowing what all of the controls on the panel were for and not knowing how to troubleshoot the high speed circuit, of which the MCU was an integral part. Also, two operators commented that it was difficult to see the controls and indicators of the MCU in its position in the AN/TSC-29.

1.1.5.2.7 Processor Controller.

Negative ratings and comments directed toward the processor controller focused on three areas. First, two operators indicated that it would be helpful if there were indicator lights on the processor controller front panel that signalled when the memory was getting full, in addition to having that information printed out on the supervisor terminal. Second, three operators indicated that it was difficult to see the indicator lights on the front panel of the processor controller from the operator's position in the AN/TSC-29. Finally, two operators from the AN/TSC-58A and two from the AN/TSC-29 stated that personnel in those vans had on several occasions inadvertently bumped the power switches on the processor controller, forcing them into the "off" position and causing the operators to have to reinitialize the system.

1.1.5.2.8 Line Filter.

The few negative comments directed toward the line filter were that it was situated in a low place and was therefore difficult to see, and a person could inadvertently bump against the power switch and, as with the processor controller, accidently turn it off.

1.1.5.2.9 Modem.

The primary negative comment about the modem, made by six operators, was that one had to be standing directly in front of the power on-off indicator light in order to determine whether or not the power was on.

1.5.5.2.10 Intercom and Switchboard.

One operator from the AN/TSC-58A indicated that the intercom was too high and that it would be better located on the back wall beside the door. Another operator from the AN/TSC-58A stated that the position of the switch-

board near the OCR was bad in that he was always bumping it when operating the OCR.

1.1.5.2.11 TH-22's.

Operators gave less than "adequate" ratings to certain characteristics of the TH-22's. The comments associated with these ratings concerned the loudness of the alarm which sounded when a distant end opened the circuit, the tendency not to notice that a TH-22 has been turned off at some earlier time and continuing to try to send traffic through it, and the high location of the TH-22's in the AN/TSC-29.

1.1.5.2.12 Power Distribution Panel, Signal Entrance Panel, and Other Equipment

Five AN/TSC-58A operators and two AN/TSC-29 operators gave less than "adequate" ratings to visibility of the controls on the power distribution panels. One operator from the AN/TSC-58A indicated that it was hard to reach up to the signal entrance panel and another operator indicated that he never really understood the function of the panel. Finally, one operator indicated that the patch panel was too high.

1.1.5.2.13 Human Factors Evaluator Observations and Measurements of Equipment

a. It was noted that the following pieces of equipment used red lights to indicate the condition of "power on": message formatter, power distribution panel in the AN/TSC-58A, telephones and intercom. Also, the paper feed light on the AN/UGC-74's was red. The following pieces of equipment used amber or yellow lights to indicate the condition of "power on": line filter, TH-22's, mode 1 communications unit, and power distribution panel in the AN/TSC-29. Military Standard (MIL-STD) 1472C, Section 5.2.2.1.18, states that the color green shall be used to indicate conditions such as power on, while red shall be used to indicate no-go or error conditions, and yellow shall be used to indicate marginal conditions.

b. In the AN/TSC-29, the top row of controls on the TH-22's is 73 inches above the floor and the on-off switch is about 71 inches above the floor. MIL-STD-1472C, Section 5.7.2.4, states that normal control placement for standing operators shall be 34 to 70 inches above the standing surface.

c. In the AN/TSC-29, the distance from the floor to the center of the VDU screen is 64.5 inches. MIL-STD-1472C, Section 5.7.2.3, indicates that displays requiring frequent reading for standing operations shall be placed between 50 and 65 inches above the standing surface. The distance from the floor to the top of the keys of the home row on the VDU keyboard is 44 inches. This falls within the 34 to 70 inch limits specified in MIL-STD-1472C, as mentioned in paragraph b above. The distance from the front of the OCR to the home row of keys on the VDU keyboard is 14 inches. The paper feed tray extends three inches out from the front of the OCR, making the distance from the front of a standing OCR operator to the home row on the keyboard about 17 inches. The distance from an operator to the most distant row of keys on the VDU keyboard is about 19 inches. This falls within the functional reach distance of 25.2 inches for 5th percentile

women, as listed in MIL-STD-1472C, Table XIX.

d. In the AN/TSC-58A, folding metal chairs with a vertical seat height of 17.5 inches were provided as seating. MIL-STD-1472C, Section 5.7.3.4.2, indicates that seating shall be adjustable, from 15 to 21 inches vertically.

e. The table tops on which the AN/UGC-74's were placed in the AN/TSC-29 were 31.5 inches above the floor. The surface of the home row of keys was 4.75 inches above the table top (36.25 above the floor). MIL-STD-1472C, Section 5.7.3.2, indicates that work surfaces for seated operations shall be 29 to 31 inches above the floor.

1.1.5.3 Overall Configuration of the IMF.

1.1.5.3.1 Equipment Location.

Less than "adequate" ratings and comments regarding the location of individual pieces of equipment reflected, for the most part, the points operators had made when discussing individual items of equipment. Most dissatisfaction centered on the SAMES, where two operators from the AN/TSC-58A suggested turning the OCR and VDU around 180° in order to avoid the glare that occured on the VDU screen when the door was open. Two operators suggested adding a high chair or stool for use with the OCR. Another operator, from the AN/TSC-29, mentioned that there was not enough room between the OCR and the table behind it for an operator to comfortably stand and operate the SAMES.

1.1.5.3.2 Workspace and Storage Space.

a. A great deal of dissatisfaction was expressed toward workspace and storage space. Nine of eleven AN/TSC-58A operators and five of eight AN/TSC-29 operators gave less than "adequate" ratings to the amount of workspace in the shelters. Their comments generally indicated that three people were needed to operate the system, but that it was somewhat difficult to move around with that many people in the shelters.

b. Seven of eleven AN/TSC-58A operators and five of eight AN/TSC-29 operators gave less than "adequate" ratings to the amount of storage space for tools and spare parts in the shelters. Individual comments indicated problems in storing items like paper for the AN/UGC-74's, or replacement pieces of equipment that were awaiting action by maintenance personnel. All of the operators but one gave less than "adequate" ratings to the amount of storage space available for personal gear. Their comments indicated that personal gear was usually stored in some other location other than the IMF when they were on a field exercise, and when items like steel pots, TA-50, and NBC clothing were stored in the shelter, they were piled in a corner, making it difficult for any one soldier to get to his gear, or piled wherever space could be found, and consequently made the shelter rather cluttered and crowded. One operator commented that storage space could be added to the AN/TSC-29 by putting drawers underneath the AN/UGC-74's on the curbside of the van, and adding shelves to the area above these pieces of equipment.

1.1.5.4 Job Procedures.

1.1.5.4.1 Starting up, Initializing, and Shutting Down.

a. Operators reported few problems with turning on the equipment. Three operators noted that the SAMES had to be turned on in a certain sequence or the VDU would not show the correct display, and three operators commented that there were sometimes problems with the cable to the AN/UGC-74 on-off switch, causing one to have to remove the front cover of the AN/UGC-74 in order to turn it on or off.

b. In the area of initialization, seven operators gave a "borderline" rating to initializing the SAMES. Individual comments indicated that it was sometimes difficult to get the OCR to accept the program definition page, and that sometimes the SAMES locked up. Four operators gave "borderline" ratings and one operator gave a "difficult" rating to checking out internal IMF circuits. Four operators indicated that they never performed that action. Individual comments indicated that the operators received little training in checking out and troubleshooting the IMF, that the manual provided little information in this regard, and that more troubleshooting information was needed.

c. Eighteen of 19 operators indicated that a checklist would be helpful to operators when turning on, initializing and checking out the system.

d. Only two operators indicated that shutting the system down was not easy. Individual comments indicated that there was a tendency to forget correct shutdown procedures if one did not periodically engage in shutting the system down.

1.1.5.4.2 Operating Under Usual Conditions

a. Few negative ratings were given to operating the system. Those that were given primarily focused on the SAMES and repeated criticisms made previously, such as problems in loading the program definition page, having to reach out to use the VDU keyboard, putting tables into the system, and getting an abbreviated error message rather than an error message which completely explained the problem.

b. The AN/UGC-74 also received several "borderline" as well as one "difficult" rating. One operator commented that the keys were somewhat hard to push, especially when one was tired.

c. Eighteen of 19 operators indicated that a status board would be helpful in showing which channels and individual pieces of equipment were operable or inoperable at any given time. This would be especially useful during shift changes.

1.1.5.4. Operting Under Unusual Conditions

Operators were asked how easy or difficult it was to operate the IMF under various unusual conditions, such as without the processor controller (Section IV-4 of the Human Factors Questionnaire). However, operators never

operated the IMF under these conditions during the test and consequently answers other than "Did Not Perform" cannot be accepted as other than indications of what they thought it would be like operating under such conditions.

1.1.5.5. Operator Maintenance

a. Troubleshooting the IMF received by far the most negative ratings in the area of maintenance. Five of 19 operators gave "borderline" ratings to this subject, and five other operators gave "difficult" or "very difficult" ratings. Individual comments indicated that operators felt that their training in this area was inadequate, that the manual provided little information to help them, and that they should have been trained to perform more troubleshooting than they are presently able to do.

1.1.5.6 Transporting the IMF

a. Most operators indicated that it was easy to prepare the IMF for movement or set it up after movement.

b. Operating and transporting the system in NBC clothing was not conducted during the test. However, one individual reported that he tried operating the system with his NBC mask and gloves on and that he found it hard to hit the keys on the keyboards and that he had to get closer to things to see what he was doing.

1.1.5.7 Software

1.1.5.7.1 Commands

a. Most operators indicated satisfaction with the IMF supervisor commands. However, several operators gave "borderline" and "unsatisfactory" ratings in several instances. Individual comments were that several of the commands, such as INTERCEPT, PREEMPT, STOP, TIME, and RECOVER, did not consistently work; sometimes one had to enter the command several times before the system would accept it. In addition, several operators indicated that the manual did not adequately explain what functions certain commands, such as TALK and INTERCEPT, served.

b. Operators were generally satisfied with the IMF operator commands, although one "unsatisfactory" and three "very unsatisfactory" ratings were given to how well the OK ZVA command was explained in the manual. Comments indicated that the manual gave incorrect information on how to execute this command. An additional comment by one operator was that abbreviations for the commands, such as P for PRINT, were discovered somewhat by accident, rather than being found in the manual.

c. The SAMES commands which were indicated as causing the most problems were the WTB/(write tables) and LOG/COMMANDS. Operators commented that the manual did not adequately explain how to use these commands. One operator commented (as have several other operators earlier in this report) that it was easy to erase the tables in the SAMES by using the WTB/command.

1.1.5.7.2 Error Messages and Prompts

a. Several operators gave "borderline" ratings to the adequacy of the error messages and prompts utilized by the software. Individual comments related to these ratings were that one had to go to the manual to understand the error messages (commented on by two operators) and it was difficult to understand the explanations given for some error messages (commented by one operator). One operator complained about the use of terminology, such as "buffer" that was not explained in the manual. Several operators indicated that they had trouble remembering how to operate the system if they didn't do it regularly.

1.1.5.8 Maintenance.

1.1.5.8.1 Administrative Procedures.

One maintainer gave "borderline" ratings to obtaining replacement parts and tools. This maintainer commented that the maintainers did not have replacement parts for the MD701 (modem) and did not have fuses for IMF equipment. Also, a torque wrench for the MCU had not been issued to them. Other comments made by the maintainers were that the maintenance manual for the IMF was very limited in areas such as troubleshooting the processor controller. One maintainer commented that organizational level maintenence personnel could be trained to align the modem, a job that is currently assigned to DS-GS level maintenence.

1.1.5.8.2 Organizational Maintenance Procedures.

Maintainers gave "very easy" and "easy" ratings to performing various maintenance tasks. However, the Organizational Maintenance Manual received "borderline" ratings in two instances. Comments about the manual included such problems as not providing enough information on troubleshooting the processor controller or the mode 1 communications unit, and indicating illogical steps such as changing a power supply before one changes a fuse (SAMES maintenance manual). Maintainers also gave examples of problems caused by operator error, such as not setting the SAMES SYSGEN correctly, not setting correct baud rates and stop bits during initialization procedures, improper strapping of boards, turning on SAMES equipment in the wrong sequence, forgetting to change switch settings when switching a AN/UGC-74 from a printer to a poker, and improperly changing the ribbon on the AN/UGC-74's. One maintainer suggested training operators as operator-maintainers (MOS of 31J).

1.1.5.9 Safety

1.1.5.9.1 Operators

a. Although two operators indicated on the safety questionnaire that they experienced electrical shock while operating the system or setting it up, during the interviews one of them reported that he himself had never been shocked but rather he had seen someone else shocked on the tail gate of one of the vans when a ground rod was not properly emplaced. The other operator reported receiving an electrical shock from the van once when a generator operator had incorrectly hooked up a generator. Other operators reported seeing individuals receive electrical shocks from the KW7 interface box and

the back of the KW7. Several operators said that they checked the category of "I Have Not Experienced But Is A Problem" because with electricity there is always the possibility of being shocked.

b. Six operators reported in the questionnaire that they had received cuts or scrapes while operating the system. Comments from these individuals referred to not having enough elbow room in the AN/TSC-58A for changing paper in the AN/UGC-74's and getting one's fingers pinched and one's elbows banged up as a result, cutting and scraping oneself on the trays on which the KW7's rest, especially when the KW7's were pulled out for maintenance, cutting one's thumb on the top drawer of the storage cabinet in the AN/TSC-29, and cutting one's hand on the clips that hold the patch cords in the AN/TSC-58A when falling against it.

c. Two operators reported that it was too bright in the AN/TSC-58A.

d. Seven operators reported experiencing extreme loudness while operating the system. There were three comments that the alarms on the TH-22's were too loud and uncomfortable, and there were five comments to the effect that all of the equipment and traffic in the van produced a lot of noise, making it necessary to shout in order to be heard. Several of the operators reported that this was annoying and could give one a headache.

e. Three operators reported experiencing noxious fumes in the van. Their comments revealed that this was the exhaust from the truck engine when the truck batteries were being recharged. Operators reported that one would start to feel somewhat sick if he stayed in the van during this period.

f. One operator reported that it became rather hot at the operator's position in the front of the van for the AN/TSC-58A.

1.1.5.9.2 Maintainers

a. One of the maintainers reported that he had been shocked on the banana plugs at the back of one of the KW7's when working on it, but that he knew that a proper safety precaution would have been to turn off the power to the KW7 before working on it. Another maintainer stated that the grounds on the back of the AN/UGC-74's were not very good in that the connectors broke off easily.

b. One maintainer stated that he received scrapes, knicks and cuts when working in the AN/TSC-58A because of a lack of room, but that he did not experience such problems in the AN/TSC-29.

c. One maintainer reported that an operator fell and cut his hand on the clips which hold the patch cords in the AN/TSC-58A, and recommended putting rubberized or plastic coating on them.

1.1.5.9.3 Evaluator Observations and Measurements of Equipment

a. It was observed that the DANGER signs for the power distribution panels did not conform to MIL-STD-1473A, Section 5.9.2, in that DANGER was printed in red letters on an aluminum background and the wording which followed was printed in aluminum letters on a red background. Also, the

WARNING-CAUTION signs on the portable heaters and the power entrance box on the outside of the AN/TSC-29 did not conform to military standards in that the colors red and aluminum were used rather than yellow and black.

b. It was observed that the ladders (MX-3391/G) to the AN/TSC-58G had no handrails, while the ladder to the AN/TSC-29 had just one handrail. MIL-STD-1472C, Section 5.7.7.1.3, states that stair-ladders shall have handrails on each side. Also, the diameter of the handrail on the AN/TSC-29 ladder was four inches, exceeding the maximum of three inches specified in Section 5.7.7.3 of the above mentioned standard. The ladder width was 14.5 inches and the riser depth was four inches, both of which fall short of the minimum military standard dimensions of 21 inches and 6 inches (for 50° rise stair-ladders) respectively, as stated in Section 5.7.7.3 of MIL-STD-1472C.

c. It was observed that the VDU, which weighs 45 pounds, was not labeled with a caution sign indicating its weight and the requirement for a two man lift. This does not meet requirements in MIL-STD-1472C, Section 5.9.11.3.1.

1.1.6 Analysis.

1.1.6.1 Environment.

a. The temperature within the AN/TSC-58A, although falling within the 85°F effective temperature limit specified in MIL-STD-1472C, Section 5.8.1.3., was commented on by numerous operators as being too high, especially in the operator's position near the front of the van. The air conditioning units did not appear to be powerful enough to keep the inside temperature at a level that was comfortable to operators working inside the shelter on a hot day. The larger air conditioners in the AN/TSC-29, however, proved to be fully capable of keeping the inside of the van cool, to the extent that some operators complained that it was too cool. Although, the temperature fell above the 65°F effective temperature limit specified in MIL-STD-1472C, Section 5.8.1.1., it should be noted that air from the road-side air conditioner inside the shelter was directed at the OCR operator position. This was a source of complaint by one operator and in violation of MIL-STD-1472C, Section 5.8.1.3, which specifies that cold-air discharge shall not be directed on personnel. Adjusting the vents on the roadside air conditioner so that it discharges air up toward the ceiling would likely solve this problem.

b. Illumination levels at the various working positions inside the shelter were generally below the minumum levels of 50 footcandles for business machine operation and 30 footcandles for front panels of equipment as specified in Military Standard 1472C, Section 5.8.2. The three places where the standards were met were at the supervisor and printer positions in the AN/TSC-58A and the teletypewriter position in the AN/TSC-29. All three of these positions were elevated and closer to the light source than were other positions or pieces of equipment. However, even though the illumination levels did not meet military standards, operators did not feel that they were inadequate, and in fact two of the operators from the AN/TSC-58A even complained that they were too high. This complaint was likely caused by the

relatively wide variation in lighting levels within the AN/TSC-58A where, for example, an operator working at the communications terminal at the operators position where the lighting levels was relatively low (6 footcandles) would have to periodically look up at the communications terminal at the supervisor's position and at the same time look into the overhead florescent lights which were positioned just above the supervisor's position. This problem did not occur in the AN/TSC-29 where the communications terminals were side by side rather than in a stacked arrangement.

c. Although peak sound levels momentarily reached 90 dB(A) at times, the steady state noise level in both the AN/TSC-58A and the AN/TSC-29 was in the 68 to 70 dB(A) range. While this steady state level is not a level which requires hearing protection, it is close to the upper limit of 75 dB(A) specified in MIL-STD-1474B (MI), Section 5.1.1, for systems requiring occasional communication for distances up to five feet, and exceeds the upper limit of 65 dB(A) for systems requiring frequent direct communication at distances up to five feet. This fact, in conjunction with numerous operator complaints about the amount of noise in the vans and the need to sometimes shout in order to be heard, suggests that steps should be taken to reduce the amount of noise in the vans.

d. Vibration was not found to pose a problem to operators.

1.1.6.2 Equipment.

1.1.6.2.1 Video Display Unit and Keyboard.

a. One of the major problems with the video display unit is glare. The operators were able to reduce this by turning and tilting the VDU, but in the AN/TSC-29 there was no way to fix the VDU in a tilted position. The mechanism which allowed this to be done on the VDU in the AN/TSC-58A was not present on the VDU in the AN/TSC-29. Consequently, operators resorted to using books and other materials to keep the VDU in a convenient position. Reinstalling the mechanism which allows the VDU to be fixed in a given position would solve this problem.

b. A problem associated with the use of the VDU keyboard concerns its location on top of the OCR, making it necessary for an operator to use an extended reach in order to operate the keyboard (Figure 1). This is a position which becomes tiring if maintained for very long, especially for short operators. In the AN/TSC-29, this position of the keyboard in conjunction with the height of the VDU makes for rather awkward operating procedures in that an operator must reach out to use the keyboard and then tilt his head up in order to see what image appears on the VDU. Although the locations of these pieces of equipment are within the height and distance limitations of military standards, operator complaints of the difficulty of working in this position and the resulting neckaches and backaches that sometimes occur, especially with short oeprators, would dictate that the system be redesigned in order to ameliorate this problem. Lowering the VDU in the AN/TSC-29 and mounting the keyboard on a movable tray that could be pulled closer to the operator are possible solutions to this problem.

Figure E-1. OCR Operator

c. The VDU keyboard is a piece of equipment that is used in other automated systems and is not unique to the IMF. Several of the keys having no function with respect to the IMF are inoperable and some of the IMF operators complained that they did not understand what these keys were for. The human factors evaluator has found this to be a common type of complaint among operators of automated systems. Such complaints can be mitigated during training by briefly explaining that the keyboard is not unique to the IMF but is used in other systems as well and that given keys are relevant only to other systems.

d. The operators and organizational maintenance manual does not contain information on how to install the VDU after the IMF has moved to a new location. Such information should be incorporated into future revisions of the manual.

1.1.6.2.2 Optical Character Reader.

The most serious problem with the OCR was its position with respect to the VDU and keyboard, which, as just discussed, required operators to reach over it to use the keyboard. Also, comments on the operators manual for the OCR indicate that it did not adequately explain all of the keys on the OCR.

1.1.6.2.3 Communications Terminal (AN/UGC-74A[V]3).

There were several problems with the communications terminals from a human factors point of view. The configuration of the terminal made it difficult to see what was being printed and required frequent advancing of the paper to see the headers on incoming messages. Additionally, the terminals in the AN/TSC-29 sat rather high relative to the operator in a seated position, resulting in a rather uncomfortable position for typing (Figure 2). The height of the tables on which the terminals sat met military standards, but the configuration of the terminals was such that the keyboard was rather elevated. Recessing the terminals into the tables in the AN/TSC-29 by three or four inches would bring the keyboards down to a level which would allow an operator to adopt a comfortable typing position with arms parallel to the floor when using the terminals.

1.1.6.2.4 Message Formatter.

A major problem existed with the location of the message formatter in the AN/TSC-29 in that the power and reset switches were at such a level that operators seated at the operator-supervisor position sometimes bumped them with their knees when turning on their chairs (Figure 3). This sometimes resulted in having to reinitialize the SAMES in the middle of a work cycle. Placing guards or covers on these switches would solve this problem.

1.1.6.2.5 Mode 1 Communications Unit (MCU)

The only serious problem with the MCU was that several of the operators never acquired an understanding of the functions of all the controls and indicator lights. This is a training problem.

Figure E-2. AN/UGC-74 Operator

Figure E-3. Message Formatter (AN/MSC-29) Power and Reset Switches Being Bumped by an Operator's Knee

1.1.6.2.6 Processor Controller

Consideration should be given to designing the processor controller so that an alarm of some sort, like a light or buzzer, would indicate when memory was getting full. Operators sometimes did not notice the warnings printed out on the supervisor terminal to indicate this condition. Additionally, it was somewhat difficult to see the indicator lights on the processor controller in the AN/TSC-29 when one was sitting in the operator's position. Moving it forward so that it is close to being flush with the front of the cabinet in which it is secured would mitigate this problem. At the same time it should be noted that there were reports by operators of personnel bumping against the power switches of the processor controller and accidently turning the power off. In the AN/TSC-58A, this was caused by personnel bumping against the switches with their legs (Figure 4) and in the AN/TSC-29 this was caused by personnel having their foot resting on the lower shelf of the cabinet housing the processor controller and bumping the power switches with the toe of their boot. This problem can be solved by placing guards over the power switches on the processor controller.

1.1.6.2.7 Line Filter

A guard should be placed over the power switch of the line filter to prevent operators from inadvertently bumping against the power switch and turning it off.

1.1.6.2.8 TH-22's

Although the sound level of the TH-22 alarm reached 85 db(A), which is the level at which MIL-STD-1474A requires hearing protection for steady state noise, and was the subject of several operator complaints regarding loudness, this alarm was under the control of the operators and could be shut off shortly after it sounded. Thus, there is no requirement for hearing protection. A more serious problem with the TH-22's is their high location in the AN/TSC-29. The upper controls and the power on-off switches of the top row of TH-22's are 73 and 71 inches respectively, above the floor. Since this exceeds the upper limit of 70 inches specified in Military Standard 1472C and was the source of comments by short operators, consideration should be given to lowering the rack which houses the TA-22's by three inches.

1.1.6.2.9 Power Distribution Panels

Although seven operators felt that the visibility of the power distribution panels was not adequate, the primary problem seemed to be that they were not readily visible from the operator's position, but rather one had to stand up and walk over to the doorway and stoop down to see the panels. Since the panels were accessible and there was no requirement to regularly check them, their location does not appear to be a serious human factors problem.

1.1.6.2.10 Indicator Lights

Requirements in MIL-STD-1472C were violated by the use of red and yellow indicator lights to signal a "power on" condition. Consistency should be introduced into the IMF by making all "power on" lights green.

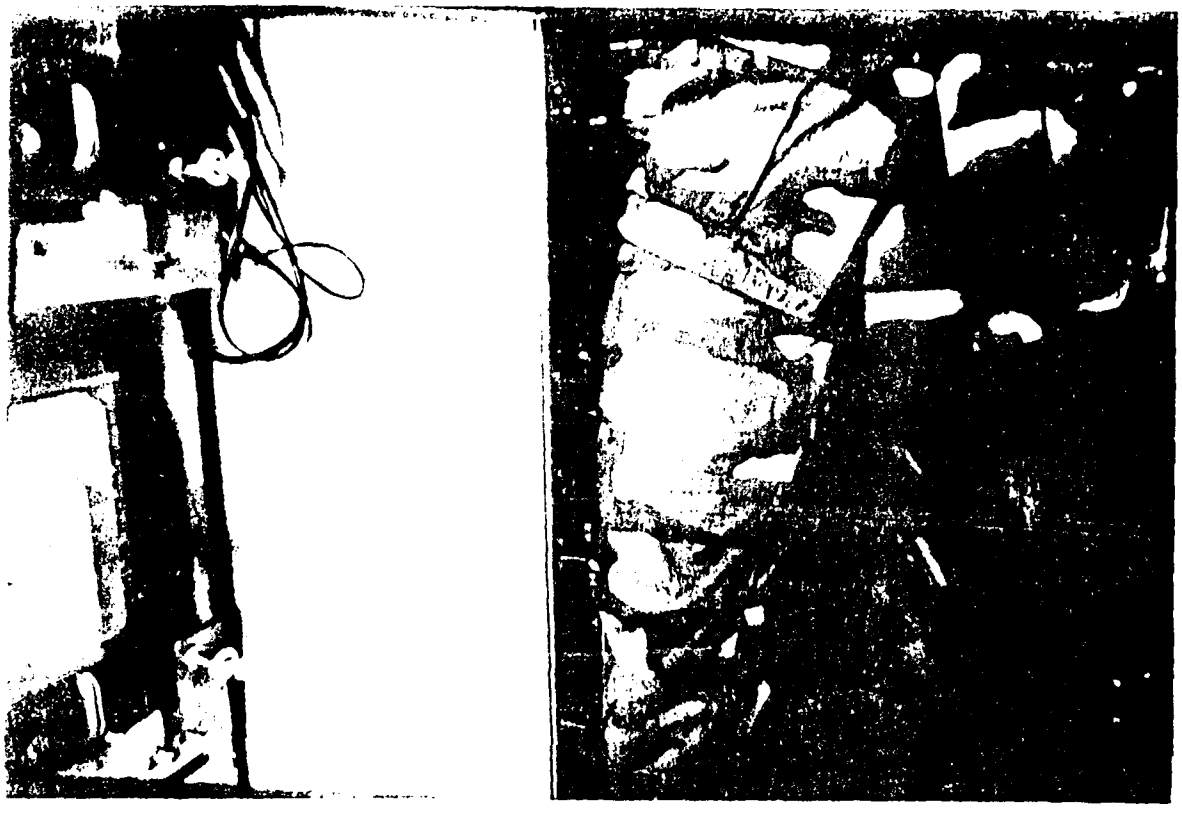


Figure F-4. P/C (AN/TSC-58) Power Switch Being Bumped by an Operator's Leg.

1.1.6.2.11 Seating

Seating in the AN/TSC-58A involved the use of metal folding chairs. These should be replaced with chairs having a vertical adjustment of 15 to 21 inches in order to meet military standards. Also, a workbench type chair or stool should be provided for use at the SAMES operator position in the AN/TSC-58A. In the AN/TSC-29 there is currently not enough room for a stool at the SAMES operator position. Consideration should be given to expanding the area in which the operator stands at this position so that seating could be made available. It should be noted that these recommendations do not suggest converting the SAMES operator position from a standing to a seated work position. The configuration of the SAMES requires that the work position be a standing one, but provision should be made for a place for the SAMES operator to sit down and rest during lulls in his workload.

1.1.6.3 Workspace and Storage Space

Typically, three operators were needed in the van to operate the system at any given time. While it was somewhat crowded with three people in the van in that it was difficult for two people to pass by each other, most of the work was done with operators seated at given terminals. Thus, the amount of workspace, especially in the AN/TSC-29, appears to be sufficient from a human factors perspective. However, there are serious problems with respect to the amount of storage space that is available. There is simply not nearly enough room for operators to store personal gear. Although there are positions for three weapons in each van, there is no place where operators can place three sets of personal field gear and also have ready access to essential parts of it, such as the NBC gear. Additionally, there is no place to store large system items like replacement pieces of equipment and boxes of paper for the AN/UGC-74's. In the AN/TSC-29, this problem could be mitigated by placing a storage cabinet in the space that is in between and below the two AN/UGC-74's on the curbside of the van, and by placing another storage cabinet on the wall just above these two terminals.

1.1.6.4 Job Procedures

a. Operators were in almost unanimous agreement as to the usefulness of having a checklist to refer to when starting up and initializing the system. Consideration should be given to drawing up such a list, especially for use with initializing the SAMES, since operators had more difficulty with it than with the rest of the IMF. Also, operators were in agreement on the usefulness of a wall-mounted status board in the van which could be used to indicate the operational status of various channels and pieces of equipment.

b. The most serious complaint made by operators with respect to job procedures concerned troubleshooting the system. At numerous points throughout the questionnaires and interviews operators indicated that they were ill-trained to determine what was wrong with the system when it started working incorrectly. Operators complained that neither their training nor their manuals provided them with the capability to keep the system going when problems occurred, and that they felt they should have this capability. In addition, one of the maintainers even suggested that the operators be trained

as operator-maintainers rather than just operators. Consideration should be given to including troubleshooting procedures in the training of operators, and to training team chiefs of the system as operator-maintainers.

1.1.6.5 Transporting the IMF

No substantial human factors problems were found with respect to transporting the system. Transporting or preparing to transport the system while wearing NBC clothing was not done during this test.

1.1.6.6 Software

a. Operator dissatisfaction with the commands used to operate the system focused on the operator's manual. In addition to comments about some inaccuracies in the manual, operator comments made throughout the questionnaire and interview indicated that the manuals did not adequately explain how to use the various commands of the system. What appears to be needed is a discussion and examples of how the various commands fit into and are utilized in the sequence of operations of the IMF. In addition, special emphasis in training and in the SAMES operator's manual should be placed on reading and writing tables into SAMES memory since several operators had problems with this and expressed some confusion over the exact procedures that were involved.

1.1.6.7 Maintenance

Maintenance problems with respect to parts and tools appeared to be a matter of never having received those items, such as spare fuses and a torque wrench, which according to the IMF TOE they were intended to have. Their problems with respect to the maintenance manuals focused on a lack of information on troubleshooting procedures for the processor controller and the mode 1 communications unit. Consideration should be given to reviewing and revising maintainers manuals in these areas. The areas which maintainers identified as ones in which operators had repeated problems, such as incorrect initialization procedures, should receive special emphasis during operator training.

1.1.6.8 Safety

a. No instances were found where personnel received electrical shock because of improper design of the IMF. The instances where electrical shock was experienced were accounted for by improper grounding procedures, improperly hooking up a generator, and the failure of a maintainer to cut the electrical power to a piece of equipment (KW7) on which he was working and on which he could not completely see the electrical components (banana plugs) which he was handling.

b. Two pieces of equipment which were the source of hand cuts need to be modified. The drawers to the storage cabinet in the AN/TSC-29 have sharp edges that should be corrected and the clips which hold the patch cords could be covered with rubber or plastic sleeves. Based upon system safety requirements in MIL-STD-882A, Sections 5.4.3.1 and 5.4.3.2, the hazard severity of this problem is classified as Category III-Marginal, and the hazard probability is classified as Level C-Occasional.

c. Sound levels, while high enough to somewhat interfere with effective communication, do not pose a safety problem.

d. Operator complaints about the presence of exhaust fumes in the shelter when the truck engine was being run to charge the vehicle batteries indicates that provisions should be made to vent the truck exhaust away from the shelter, or procedures should be implemented for having operators leave the shelter during that activity. The hazard severity of this problem is classified as Category III - Marginal, and the hazard probability is classified as Level B - Reasonably Probable.

e. DANGER and CAUTION signs should be changed to conform to MIL-STD-1473A, Section 5.9.2. This standard specifies that the word DANGER be printed in white letters on a red oval background which is bordered in black. Subsequent wording should be in black letters on a white background. Specifications for caution signs are that CAUTION be printed in yellow on a black background, with subsequent wording printed in black on a yellow background. The problem of personnel receiving an electrical shock because of the nonconformance of the danger and caution signs to military standards is classified as Category I - Catastrophic with respect to hazard severity, and Level D - Remote with respect to hazard probability.

f. Ladders to the shelter should be modified to include a handrail on each side of the steps. Handrail diameter, riser depth and ladder width should be modified to meet military standards. This would involve reducing the handrail diameter to three inches, increasing the riser depth to six inches, and increasing ladder width (handrail to handrail) to 21 inches. The hazard severity resulting from the nonconformance of the stair-ladders to military standards is classified as Category III-Marginal, and the hazard probability is classified as Level C-Occasional.

g. A two man lift sign which includes the weight of the VDU should be attached to the VDU. The hazard severity resulting from the absence of the two man lift sign on the VDU is classified as Category III-Marginal, and the hazard probability is classified as Level D-Remote.

1.1.7 Conclusions

Criteria d - met.

Criteria a, b, e - not met.

Criteria c - not tested.

References

MIL-STD-882A, Military Standard System Safety Program Requirements, 18 June 1977.

MIL-STD-1472C, Military Standard Human Engineering Design Criteria for Military Systems, Equipment and Facilities, 2 May 1981.

MIL-STD-1473A (MI), Military Standard General Requirements for Color and Marking of Army Materiel, 10 February 1976.

MIL-STD-1474B (MI), Military Standard Noise Limits for Army Materiel, 18 June 1979.

ANNEX A

TO

APPENDIX E

Table A-1

Human Factors Questionnaire for Operators

1. Responses to Section I of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

I. ENVIRONMENT

1. Was the temperature inside the IMF too high or too low for you?

5/ Much Too High

3/ Somewhat Too High

2/4 About Right

1/3 Somewhat Too Low

/ Much Too Low

2. How adequate was the ventilation in the IMF?

/2 Very Adequate

3/4 Adequate

4/1 Borderline

3/ Inadequate

1/ Very Inadequate

3. Was the lighting level in the IMF too high or too low for you?

/ Much Too High

3/1 Somewhat Too High

8/7 About Right

/ Somewhat Too Low

/ Much Too Low

Section I continued

4. Was the sound level in the IMF too high for you?

   4/1 Much Too High

   1/1 Somewhat Too High

   6/6 About Right

5. How uncomfortable was any vibration which you experienced?

   1/ Extremely Uncomfortable

   1/ Moderately Uncomfortable

   2/ Mildly Uncomfortable

   4/5 Noticeable But Not Uncomfortable

   2/3 No Vibration Was Experienced

Comments to Section I of the Human Factors Questionnaire for Operators

	Comment	Occurrence AN/TSC-58A	AN/TSC-29
1.	It didn't stay cool enough, especially near the front of the van.	4	
2.	It was too cold in the van.		3
3.	It was too cold in front of the OCR where the air conditioner blows on your back. Went outside to warm up sometimes.		1
4.	Air conditioning ducts blew air up toward ceiling and it never got down to operator's position.	5	
5.	Ventilation was not good.	1	

Comments to Section I continued

Comment	Occurrence AN/TSC-58A	AN/TSC-29
6. Only one row of lights was kept on in order to reduce the heat.	1	
7. Lights were too bright. Certain parts of the van were too dark, and then you would look into a bright area.	1	
8. There was a lot of noise in the van.	1	
9. Supervisor and operator can't hear when they are at the front of the van and someone is talking to them from the rear. Noise comes from the printers and air conditioners.	1	
10. There was vibration from the air conditioners.	5	2
11. There was vibration from the truck when it was running to charge up the batteries.	3	1

2. Responses to Section II-A of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8).

II. EQUIPMENT CHARACTERISTICS

A. VIDEO DISPLAY UNIT (VDU)

Indicate how adequate the Video Display Unit is in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. VDU DISPLAY					
a. Display brightnesss	4/	6/7	/	1/1	/
b. Absence of glare	1/	2/3	6/3	1/2	1/
c. Absence of flicker	1/	9/7	1/1	/	/
d. Letter discrimination	2/	7/8	1/	/	/
e. Viewing distance	1/	7/5	3/1	/1	/1
f. Angle of view	2/	8/4	1/3	/	1/1
g. Location of display	3/	5/3	2/2	1/2	/1
h. Description of display in Operator's Manual	1/	3/7	4/	1/	/
2. VDU KEYBOARD AND CONTROLS					
a. Size	4/2	4/5	/1	3/	/
b. Shape	3/2	6/6	2/	/	/
c. Spacing between controls	2/1	5/7	3/	1/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	1/2	7/6	2/	1/	/
e. Correct labels	2/3	8/5	1/	/	/
f. Understandable labels	1/2	5/5	4/1	1/	/
g. Size of labels	1/1	9/7	1/	/	/

Section II-A continued

		Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
h.	Location of labels	1/1	7/5	3/2	/	/
i.	Absence of unrelated or confusing markings	2/1	2/7	5/	2/	/
j.	Visibility of controls	1/1	6/5	2/1	2/1	/
k.	Angle of view	1/1	6/3	2/2	1/1	1/1
l.	Location of controls	/1	7/4	2/1	1/1	1/1
m.	Reach distance of controls	1/	4/4	2/2	1/1	3/1
n.	Functional grouping (controls with related functions are grouped together)	2/1	6/5	2/1	1/	/
o.	Control type (type of control is appropriate for type of function)	1/	7/8	3/	/	/
p.	Description of keyboard in Operator's Manual	/1	5/5	5/1	/	/
q.	Other (specify) Keyboard controls not used	/	/	/	/	1/

Comments to Section II-A of the Human Factors Questionnaire for Operators

	Comments	Occurrence AN/TSC-58A	AN/TSC-29
1.	There is glare on the VDU screen when the door to the van is open.	10	
2.	Turning or tilting the VDU helps reduce the glare somewhat.	3	

Comments to Section II-A continued

	Comments	Occurrence AN/TSC-58A	AN/TSC-29
3.	Turning the whole system (VDU, OCR, keyboard) around 180^{0} would help the glare problem.	1	
4.	There is glare on the VDU screen from the lights in the van.		5
5.	Sometimes the letters on the screen would flicker, but it was not really a problem.	2	1
6.	When you have to stand and operate the VDU and OCR for long shifts, you get tired.	1	1
7.	If you are short you have to reach out to use the VDU keyboard, then look up at the screen to see if the response is correct, and so forth. It is tiresome, you can get a neckache or backache.	2	2
8.	The VDU screen and keyboard are too high.		2
9.	A chair or stool for the OCR-VDU position would be helpful.	2	1
10.	It would be easier to see the letters on the screen if they were larger.		1
11.	The VDU is too far away. I have to get close to read it.		1
12.	The letters on the VDU screen are too bright. It can cause eye strain often working with it for five hours.		1
13.	It would be useful to design the VDU keyboard so you could move it close to the operator.	1	
14.	The labels on the VDU keyboard should be located so that they are easier for the operator to see. The keyboard is too far away from the operator.		1
15.	The VDU keyboard keys are so easy to press that you can easily accidentally press one.	1	

Comments to Section II-A continued

	Comments	Occurrence AN/TSC-58A	AN/TSC-29
16.	Several of the keys on the VDU keyboard are not operable, but we were never given good explanations as to why.	4	
17.	The keys that don't work on the keyboard should be removed and the keyboard make smaller.	3	
18.	The manual for the VDU and OCR is inadequate; too technical; not enough details, such as how to hook up the VDU.	4	1
19.	The IMF manual does not have enough information on how to troubleshoot. Once the system has been turned on, the manual offers little on how to keep it going when problems occur. Operators, for instance, don't know how to use the patch panel.		1

3. Responses to Section II-B of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8).

B. OPTICAL CHARACTER READER (OCR)

Indicate how adequate the OCR is in each of the following areas:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. LINE DISPLAY					
a. Brightness	2/2	8/6	1/	/	/
b. Absence of glare	2/1	5/7	4/	/	/
c. Absence of flicker	2/1	8/7	1/	/	/
d. Viewing distance	1/	5/7	2/	2/1	1/
e. Angle of view	1/	5/7	4/1	/	1/
f. Correct labels	2/1	7/7	2/	/	/
g. Location of indicators	2/1	7/7	2/	/	/
h. Indicators inform you of what you need to know					
(1) in a timely manner	3/1	6/6	2/	/	/
(2) with enough precision	2/1	5/7	2/	2/	/
(3) with relevant information	1/1	4/5	3/	2/	1/
i. Description of display in Operator's Manual	/	6/6	3/1	/	2/
2. CONTROLS AND KEYBOARD					
a. Size	1/1	7/5	1/2	1/	1/
b. Shape	1/1	8/5	1/2	1/	/
c. Spacing between controls	1/1	7/6	2/1	1/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	1/1	8/5	2/1	/1	/

Section II-B continued

		Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
e.	Correct labels	1/1	8/7	2/	/	/
f.	Understandable labels	1/1	8/7	2/	/	/
g.	Size of labels	1/1	9/7	/	1/	/
h.	Location of labels	2/1	8/7	1/	/	/
i.	Absence of unrelated or confusing markings	1/1	8/7	1/	/	/
j.	Visibility of controls	2/	7/8	2/	/	/
k.	Angle of view	1/	8/6	2/2	/	/
l.	Location of controls	2/1	8/6	1/	/1	/
m.	Reach distance of controls	2/	7/6	1/1	/1	1/
n.	Functional grouping (controls with related functions are grouped together)	1/1	7/7	3/	/	/
o.	Control type (type of control is appropriate for type of function)	1/	7/7	3/1	/	/
p.	Description of controls and keyboard in Operator's Manual	/	6/7	5/	/	/

Comments to Section II-B of the Human Factors Questionnaire for Operators

	Comment	Occurrence AN/TSC-58A	AN/TSC-29
1.	Don't understand all of the keys on the OCR. The manual does not explain them very well.	2	
2.	There is a problem understanding error indications from the OCR. Sometimes you won't know why it isn't recognizing characters and you have to reject the message and feed it through again.	1	
3.	One should be able to see the whole line that the OCR is reading. It would be easier to determine what letter is causing a problem when a blinking arrow comes on.	1	
4.	You get some glare from the OCR line display. You can get around it by shifting your body.	1	
5.	The OCR should tell you exactly what the problem is rather than use symbols to indicate errors.	1	
6.	The OCR is so big there is not enough room to move around.	1	
7.	It is hard to use the OCR keyboard with the line display. You have to look down into the line display and then lean back to use the OCR keyboard.		2

4. Responses to Section II-C of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

C. COMMUNICATIONS TERMINAL (AN/UGC-74A(V)3)

Indicate how adequate the Communications Terminal is in each of the following areas:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. DISPLAY					
a. Letter discrimination	1/	6/6	3/1	1/1	/
b. Viewing distance	1/	2/3	5/3	1/2	2/
c. Angle of view	1/	2/2	4/2	2/4	2/
d. Location of display	1/	5/5	3/1	2/2	/
e. Description of display in Operator's Manual	/	5/6	6/1	/	/
2. INDICATOR LIGHTS					
a. Brightness	2/	8/6	1/2	/	/
b. Absence of glare	1/	8/7	2/1	/	/
c. Absence of flicker	1/	7/7	3/1	/	/
d. Viewing distance	1/	7/7	2/1	1/	/
e. Angle of view	1/	5/7	3/1	1/	/
f. Correct labels	1/	8/8	2/	/	/
g. Location of indicators	1/	8/8	2/	/	/
h. Description of indicators in Operator's Manual	1/	6/7	4/1	/	/
3. KEYBOARD AND CONTROLS					
a. Size	1/	8/8	2/	/	/
b. Shape	1/	8/8	2/	/	/

Section II-C continued

		Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
c.	Spacing between controls	1/1	7/7	2/	1/	/
d.	Resistance (too easy to turn or push, or too hard to turn or push)	1/	7/4	1/4	1/	1/
e.	Correct labels	1/	7/8	3/	/	/
f.	Understandable labels	1/	8/8	2/	/	/
g.	Size of labels	1/	8/8	2/	/	/
h.	Location of labels	1/	8/8	2/	/	/
i.	Absence of unrelated or confusing markings	1/1	5/7	5/	/	/
j.	Visibility of controls	1/	8/7	2/1	/	/
k.	Angle of view	1/	6/6	4/2	/	/
l.	Location of controls	1/	8/7	2/1	/	/
m.	Reach distance of controls	2/	7/7	2/1	/	/
n.	Functional grouping (controls with related functions are grouped together)	2/	6/8	3/	/	/
o.	Control type (type of control is appropriate for type of function)	2/	6/9	3/	/	/
p.	Description of keyboard and controls in Operator's Manual	/	7/6	4/1	/	/

Comments to Section II-C of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. Trying to see what is coming through without wasting a lot of paper is a problem. You have to feed a message until you can read the header before you can use the commands to send it out.	3	1
2. Sometimes messages run together with no space in between. After you receive a message there should be some sort of break.	1	
3. There is no alarm. The message receive light is supposed to flicker when you have a flash or immediate message coming in, but it does not do that.	1	
4. You have to lean over and look down through the glass window of the communications terminal to see what is being printed.	5	2
5. When you type something on the -74, you have to wait for the ribbon to fall back down in order to see what was typed and if you made a mistake then you have to go back and start over again.	2	3
6. It is somewhat hard to push the keys down.	3	2
7. Some of the keys are never used.	2	
8. The desks where the UGC-74 sit are quite high. I find myself sitting up a bit. It is an uncomfortable position for typing for very long.		2
9. The manual tells you what the commands are but it doesn't tell you how to use them.	1	
10. The manuals do not tell you the abbreviations that can be used for commands, such as P for print.	1	

5. Responses to Section II-D of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

D. TELETYPEWRITER (TT-76B/GGC)

Indicate how adequate the Teletypewriter is in each of the following areas:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. INDICATOR LIGHTS					
a. Brightness	1/1	6/7	3/	/	/
b. Absence of glare	1/	6/7	3/	/	/
c. Absence of flicker	1/	7/7	2/	/	/
d. Viewing distance	1/	4/6	2/	2/1	1/1
e. Angle of view	1/	4/5	4/	/2	1/1
f. Correct labels	1/	7/8	2/	/	/
g. Location of indicators	1/	7/7	2/1	/	/
h. Counters and Indicators inform you of what you need to know					
(1) in a timely manner	1/	4/6	2/	2/	/
(2) with enough precision	1/	4/7	2/	2/	/
(3) with relevant information	1/	3/6	3/	2/	/
i. Description of indicator lights in Operator's Manual	1/	4/6	2/1	2/	/
2. KEYBOARD AND CONTROLS					
a. Size	1/	5/8	2/	2/	/
b. Shape	1/	5/8	3/	1/	/
c. Spacing between controls	1/	5/6	2/1	1/1	/

Section II-D continued

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
d. Resistance (too easy to turn or push, or too hard to turn or push)	1/	5/5	2/2	1/1	1/
e. Correct labels	1/	6/8	3/	/	/
f. Understandable labels	1/	7/8	2/	/	/
g. Size of labels	1/	7/8	2/	/	/
h. Location of labels	1/	6/8	3/	/	/
i. Visibility of controls	1/	5/8	2/1	1/1	1/
j. Angle of view	1/	3/6	4/	1/2	1/
k. Location of controls	1/	5/7	4/	/1	/
l. Reach distance of controls	1/	4/6	3/	1/2	/1
m. Description of keyboard and controls in Operator's Manual	/	7/6	3/1	/	/

Comments to Section II-D of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. Did not use the TT-76B.	9	3
2. The TT-76B is back on the wall in the corner and not used.	1	
3. The TT-76B needs to be lower so you can type on the keyboard.	1	4

6. Responses to Section II-E of the Human Factors Questionnaire for operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

E. MESSAGE FORMATTER (MP/100)

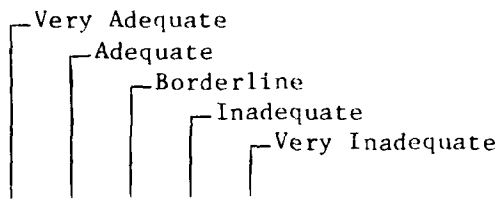
Indicate how adequate the Message Formatter is in each of the following areas:

Very Adequate | Adequate | Borderline | Inadequate | Very Inadequate

1. CONTROLS

a. Size	4/1	7/7	/	/	/
b. Shape	3/1	8/7	/	/	/
c. Spacing between controls	2/1	6/7	1/	1/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	2/	7/6	1/1	/1	/
e. Correct labels	2/1	7/7	1/	/	/
f. Understandable labels	2/1	7/7	1/	/	/
g. Size of labels	2/	7/8	1/	/	/
h. Location of labels	2/	6/8	2/	/	/
i. Absence of unrelated or confusing markings	2/1	7/7	1/	/	/
j. Visibility of controls	1/	6/6	2/2	1/	/
k. Angle of view	1/	6/6	2/1	1/1	/
l. Location of controls	1/	6/6	4/	/2	/
m. Reach distance of controls	1/	6/7	4/	/1	/
n. Functional grouping (controls with related functions are grouped together)	2/	5/6	2/1	/	/

Section II-E continued



o. Control type (type of control is appropriate for type of function) 2/1 7/7 2/ / /

p. Description of controls in Operator's Manual 1/ 7/8 3/ / /

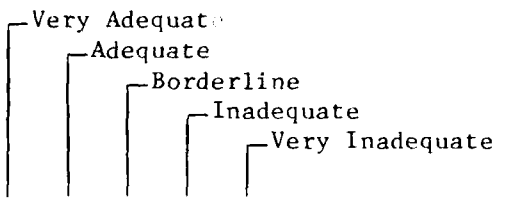
Comments to Section II-E of the Human Factors Questionnaire for Operators

Comments	Occurrence AN/TSC-58A	AN/TSC-29
1. Sometimes you hit the lock key instead of the reset key because they are so close together.	2	
2. Sometimes you have to press the reset key several times before the system will be reset.	1	
3. The message formatter sits too low in the AN/TSC-29. People inadvertently bump the reset switch with their knees.		2
4. When you are operating the SAMES, you can't see the indicator lights on the message formatter.	1	
5. The location is satisfactory but the shift supervisor should be able to pull some maintenance on it, such as taking the cover off, changing cards and doing a battery check.	1	

7. Responses to Section II-F of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

F. MODE 1 COMMUNICATIONS UNIT (MCU)

Indicate how adequate the the MCU is in each of the following areas:



1.	INDICATOR LIGHTS					
	a. Brightness	1/1	9/7	1/	/	/
	b. Absence of glare	1/1	9/6	1/	/1	/
	c. Absence of flicker	1/1	8/6	2/1	/	/
	d. Viewing distance	1/	9/7	1/	/	/1
	e. Angle of view	1/	8/6	2/1	/	/1
	f. Correct labels	1/	8/8	2/	/	/
	g. Location of indicators	1/	8/7	2/	/	/1
	h. Indicators inform you of what you need to know					
	(1) in a timely manner	2/	6/7	3/	/	/
	(2) with enough precision	2/	6/9	3/	/	/
	(3) with relevant information	2/	6/7	3/	/	/
	i. Description of indicator lights in Operator's Manual	/	7/8	3/	/	/
2.	CONTROLS					
	a. Size	2/	7/7	2/1	/	/
	b. Shape	2/	7/8	2/	/	/
	c. Spacing between controls	2/1	8/7	/	/	/

Section II-F continued

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
d. Resistance (too easy to turn or push, or too hard to turn or push)	2/	7/8	1/	/	/
e. Correct labels	2/	7/8	1/	/	/
f. Understandable labels	1/	6/8	3/	/	/
g. Size of labels	2/	7/8	1/	/	/
h. Location of labels	2/	6/8	2/	/	/
i. Absence of unrelated or confusing markings	1/	7/8	2/	/	/
j. Visibility of controls	/	6/7	4/1	/	/
k. Angle of view	/	6/6	4/1	/	/1
l. Location of controls	/	7/8	3/	/	/
m. Reach distance of controls	1/	6/6	3/1	/	/1
n. Functional grouping (controls with related functions are grouped together)	1/1	8/7	1/	/	/
o. Control type (type of control is appropriate for type of function)	1/1	6/7	3/	/	/
p. Description of controls and keyboard in Operator's Manual	1/	7/7	2/	/	/

Comments to Section II-F of the Human Factors Questionnaire for Operators

Comments	Occurrence AN/TSC-58A	AN/TSC-29
1. All we know is that there is a sync light and a frame light. We don't know what all the controls are for or how to troubleshoot the high speed line.	3	
2. I really don't know what it is for.	1	
3. Indicator lights on the MCU are lighter than the other lights in the van.	1	
4. The labels on the controls of the MCU are above the little shield over each control. At first glance a label appears to go with the control above it rather than below it.	1	
5. It is difficult to see the controls on the MCU in its position in the AN/TSC-29. You have to bend down to see it.		2
6. Setting the MCU up for emergency operation, as in the book, would take too long to be practical for an effective back-up.		1

8. Responses to Section II-G of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

G. PROCESSOR CONTROLLER

Indicate how adequate the Processor Controller is in each of the following areas:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. INDICATOR LIGHTS					
a. Brightness	3/1	7/6	1/1	/	/
b. Absence of glare	3/1	7/6	/1	/	/
c. Absence of flicker	3/1	5/7	2/	/	/
d. Viewing distance	3/	6/8	1/	/	/
e. Angle of view	3/	6/6	1/2	/	/
f. Correct labels	2/	7/8	1/	/	/
g. Location of indicators	2/	6/8	2/	/	/
h. Indicator lights inform you of what you need need to know					
(1) in a timely manner	1/	4/6	5/1	/	/
(2) with enough precision	1/	4/7	5/1	/	/
(3) with relevant information	1/	5/6	4/1	/	/
i. Description of indicator lights in Operator's Manual	/	7/7	3/	/	/
j. Other (specify) Heat	/	/	/	/	1/

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
2. CONTROLS					
a. Size	2/	6/8	3/	/	/
b. Shape	2/	7/8	2/	/	/
c. Spacing between controls	2/	7/7	1/1	/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	2/1	6/6	1/	1/1	/
e. Correct labels	1/	7/8	2/	/	/
f. Understandable labels	1/	7/8	1/	1/	/
g. Size of labels	1/	8/8	1/	/	/
h. Location of labels	1/	7/8	1/	1/	/
i. Visibility of controls	1/	7/8	2/	/	/
j. Angle of view	1/	6/7	3/	/1	/
k. Location of controls	1/	6/7	2/	/1	1/
l. Reach distance of controls	1/	7/6	2/	/1	/1
m. Description of controls in Operator's Manual	/	6/7	4/	/	/

Comments to Section II-G of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. It would be helpful if there were indicator lights on the PC to indicate purge and intercept, rather than just having it printed out on the supervisor.	2	
2. I don't understand all of it; it has so many things I don't know what to do with.	1	
3. The PC is low. You have to bend down to look at it.	1	
4. The indicator lights should be brighter.	1	
5. Several times someone inadvertently bumped the power switches on the PC and we had to start the system up again.	2	2
6. It is difficult to see the indicator lights on the PC from the operator's or supervisor's position.		3

9. Responses to Section II-H of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

H. LINE FILTER (Deltac 1260)

Indicate how adequate the Line Filter is in each of the following areas:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. INDICATOR LIGHTS AND METERS					
a. Brightness	4/1	6/7	/	/	/
b. Absence of glare	4/1	6/7	/	/	/
c. Absence of flicker	4/1	6/7	/	/	/
d. Viewing distance	4/1	6/8	/	/	/
e. Angle of view	4/	6/8	/	/	/
f. Correct labels	3/	7/8	/	/	/
g. Location of indicators	3/	5/8	1/	1/	/
h. Indicators inform you of what you need to know					
(1) in a timely manner	3/	4/7	2/1	/	/
(2) with enough precision	3/	4/6	2/1	/	/
(3) with relevant information	3/	4/6	2/1	/	/
i. Description of lights and meters in Operator's Manual	/	8/7	1/	/	/
2. CONTROL SWITCH					
a. Size	2/	7/8	/	/	1/
b. Shape	2/	8/8	/	/	/
c. Spacing between controls	3/	7/8	/	/	/

Section II-H continued

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
d. Resistance (too easy to turn or push, or too hard to turn or push)	3/1	6/7	/	1/	/
e. Correct labels	3/	6/8	1/	/	/
f. Understandable labels	2/	7/8	/	/	/
g. Size of labels	3/	7/8	/	/	/
h. Location of labels	3/	6/8	/	/	1/
i. Visibility of controls	3/	7/8	/	/	/
j. Angle of view	3/	7/8	/	/	/
k. Location of controls	3/	7/8	/	/	/
l. Reach distance of controls	3/	7/8	/	/	/
m. Description of controls in Operator's Manual	1/	9/7	/	/	/

Comments to Section II-H of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. The line filter is low and is difficult to see.	1	1
2. One person could inadvertently hit the power switch on the line filter when walking past it.	1	

10. Responses to Section II-I of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

I. MODEM

Indicate how adequate the Modem is in each of the following areas:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. INDICATOR LIGHTS					
a. Brightness	1/1	5/4	2/3	/	1/
b. Absence of glare	2/1	5/6	1/1	/	1/
c. Absence of flicker	2/1	5/6	/1	/	1/
d. Viewing distance	1/	4/8	2/	1/	1/
e. Angle of view	1/	5/7	2/1	/	1/
f. Correct labels	2/	5/8	1/	/	/
g. Location of indicators	2/	5/7	1/1	/	1/
h. Indicators inform you of what you need to know					
(1) in a timely manner	1/	6/7	1/1	/	/
(2) with enough precision	1/	6/7	1/	/	/
(3) with relevant information	1/	5/7	2/	/	/
i. Description of indicator lights in Operator's Manual	/	6/7	3/	/	/

Comments to Section II-I of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. We should be trained to check the switches on the modem, so we can troubleshoot better.	1	
2. The modem is up high in the AN/TSC-58A and is hard to see.	1	
3. It is difficult to see the color of the power light. You have to stand right in front of it to see if it is on.	3	3

11. Responses to Section II-J of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

J. INTERCOM (LS-147C/FI)

Indicate how adequate the Intercom is in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. CONTROLS					
a. Size	3/	6/8	1/	/	/
b. Shape	3/	6/8	1/	/	/
c. Spacing between controls	3/	6/8	/	/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	2/	6/8	/	1/	/
e. Correct labels	2/	7/8	/	/	/
f. Understandable labels	2/	7/8	/	/	/
g. Size of labels	2/	7/8	/	/	/
h. Location of labels	2/	7/8	/	/	/
i. Absence of unrelated or confusing markings	2/	7/8	/	/	/
j. Visibility of controls	2/	7/8	/	/	/
k. Angle of view	2/	7/8	/	/	/

Responses to Section II-J continued

		Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
l.	Location of controls	2/	7/8	/	/	/
m.	Reach distance of controls	2/	7/8	1/	/	/
n.	Functional grouping (controls with related functions are grouped together)	2/	6/7	/	/	/
o.	Control type (type of control is appropriate for type of function)	2/	7/8	/	/	/
p.	Description of controls in Operator's Manual	2/	6/7	2/	/	/

Comments to Section II-J of the Human Factors Questionnaire for Operators

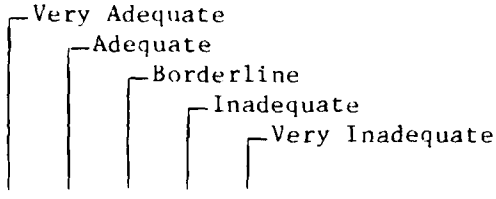
	Comment	Occurrence AN/TSC-58A	AN/TSC-29
1.	*Did not use during test.*	1	2
2.	The manual does not tell you how to troubleshoot if something goes wrong.	1	
3.	The intercom is too high. A better location would be on the back wall right beside the door.	1	

12. Responses to the Section II-K of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

K. SWITCHBOARD (SB-22A/PT)

Indicate how adequate the Switchboard is in each of the following areas:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. CONTROLS					
a. Size	2/	5/7	1/1	1/	/
b. Shape	2/	5/8	1/	1/	/
c. Spacing between controls	2/	5/8	1/	/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	2/	5/8	1/	/	/
e. Correct labels	1/	6/8	1/	/	/
f. Understandable labels	1/	5/8	2/	/	/
g. Size of labels	1/	6/8	1/	/	/
h. Location of labels	1/	6/8	1/	/	/
i. Absence of unrelated or confusing markings	1/1	6/7	1/	/	/
j. Visibility of controls	1/	6/8	1/	/	/
k. Angle of view	1/	6/8	1/	/	/
l. Location of controls	1/	6/8	1/	/	/
m. Reach distance of controls	1/	5/8	1/	/	1/
n. Functional grouping (controls with related functions are grouped together)	1/	6/8	1/	/	/
o. Control type (type of control is appropriate for type of function)	1/	6/8	2/	/	/

Responses to Section II-K continued



p. Description of controls in Operator's Manual	1/	5/6	3/1	/	/

Comments to Section II-K of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. Did not use during test.	4	2
2. It sits right next to the OCR and we are always bumping it.	1	

13. Reponses to Section II-L of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

L. TELEPHONE SET (TA-312/PT)

Indicate how adequate the Telephone Set is in each of the following Areas:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. CONTROLS					
a. Size	1/	8/7	1/	/	/
b. Shape	1/	8/7	1/	/	/
c. Spacing between controls	1/1	9/7	/	/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	1/	7/7	1/1	1/	/
e. Correct labels	1/	7/8	1/	/	/
f. Understandable labels	1/	7/8	1/	/	/
g. Size of labels	1/	7/8	1/	/	/
h. Location of labels	1/	7/8	1/	/	/
i. Absence of unrelated or confusing markings	1/1	7/7	1/	/	/
j. Visibility of controls	1/1	9/7	/	/	/
k. Angle of view	1/1	9/7	/	/	/
l. Location of controls	1/	8/8	/	/	1/
m. Reach distance of controls	1/	9/8	/	/	/
n. Functional grouping (controls with related functions are grouped together)	1/	7/7	1/	/	/

Responses to Section II-L continued

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
o. Control type (type of control is appropriate for type of function)	1/	9/7	/	/	/
p. Description of controls in Operator's Manual	1/	9/7	/	/	/

Comments to Section II-L of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. Did not use during test.	3	2
2. Was not detachable from the wall, even though it was supposed to be.	1	

14. Responses to Section II-M of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

M. TH-22/TG's

Indicate how adequate the TH-22/TG's are in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. INDICATORS					
a. Brightness	1/1	8/7	1/	/	/
b. Absence of glare	1/1	8/7	1/	/	/
c. Absence of flicker	1/1	6/6	2/1	/	1/
d. Viewing distance	/	7/8	2/	1/	/
e. Angle of view	/	8/8	2/	/	/
f. Correct labels	1/	9/8	/	/	/
g. Location of indicators	/	9/8	1/	/	/
h. Description of indicators in Operator's Manual	/	8/6	2/1	/	/
i. Other (specify) Noise	/	/	/	1/	/
2. CONTROLS					
a. Size	1/	9/8	/	/	/
b. Shape	1/	9/8	/	/	/
c. Spacing between controls	1/	9/8	/	/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	1/1	8/7	1/	/	/
e. Correct labels	1/	9/8	/	/	/
f. Understandable labels	1/	6/7	3/1	/	/

Responses to Section II-M continued

		Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
g.	Size of labels	1/	8/8	1/	/	/
h.	Location of labels	1/	8/8	1/	/	/
i.	Absence of unrelated or confusing markings	1/1	7/6	2/1	/	/
j.	Visibility of controls	/	8/8	1/	/	/
k.	Angle of view	/1	7/7	2/	/	/
l.	Location of controls	/1	8/6	1/1	/	/
m.	Reach distance of controls	/	6/6	3/2	/	/
n.	Functional grouping (controls with related functions are grouped together)	1/	8/7	/	/	/
o.	Control type (type of control is appropriate for type of function)	1/	8/7	/	/	/
p.	Description of controls in Operator's Manual	/	9/6	/1	/	/

Comments to Section II-M of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-59
1. Sometimes someone will shut off a TH-22 to cut off the alarm and an operator will not know it and will continue to send messages over that line.	1	

Comments to Section II-M of the Human Factors Questionnaire for Operators

	Comment	Occurrence AN/TSC-58A	AN/TSC-29
2.	The power on lights are too bright.	1	
3.	The alarm is very loud.	1	1
4.	They are high for me.		1
5.	I don't know what all the labels on the TH-22's mean.		1

15. Responses to Section II-N of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

N. POWER DISTRIBUTION PANELS

Indicate how adequate the Power Distribution Panels are in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. METERS AND INDICATORS					
a. Brightness	1/	7/8	1/	1/	/
b. Absence of glare	1/	7/8	1/	1/	/
c. Absence of flicker	1/	8/8	/	1/	/
d. Number discrimination	1/1	7/7	2/	/	/
e. Viewing distance	1/	6/8	1/	1/	/
f. Angle of view	1/	5/6	3/2	1/	/
g. Correct labels	1/	7/7	2/1	/	/
h. Location of meters and indicators	1/	8/6	1/2	/	/
i. Description of meters and indicators in Operator's Manual	1/	8/6	1/2	/	/
2. SWITCHES					
a. Size	1/	8/8	1/	/	/
b. Shape	1/	8/8	1/	/	/
c. Spacing between switches	1/	8/8	1/	/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	1/1	8/7	1/	/	/
e. Correct labels	1/	8/8	1/	/	/
f. Understandable labels	1/	8/8	1/	/	/

Responses to Section II-N continued

		Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
g.	Size of labels	1/	8/7	1/1	/	/
h.	Location of labels	1/	8/7	/1	1/	/
i.	Absence of unrelated or confusing markings	1/1	8/6	1/1	/	/
j.	Visibility of controls	1/	4/6	3/2	2/	/
k.	Angle of view	1/	4/6	4/2	1/	/
l.	Location of switches	1/	5/7	3/1	1/	/
m.	Reach distance of switches	1/	6/7	1/1	2/	/
n.	Functional grouping (switches with related functions are grouped together)	/	9/7	1/1	/	/
o.	Switch type (type of switch is appropriate for type of function)	1/	7/8	2/	/	/
p.	Description of switches in Operator's Manual	/	9/6	1/1	/	/

Comments to Section II-N of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. You can't see the power distribution panels from the OCR portion.	1	
2. The power distribution panels are low and behind the TH-22's. You have to bend down to look closely at them.	5	
3. The power distribution panels are right behind the SAMES and you have to look closely at them to discriminate them. It is just inconvenient to get to.		3

16. Responses to Section II-O of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

O. SIGNAL ENTRANCE PANEL

Indicate how adequate the Signal Entrance Panel is in each of the following areas:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. SWITCHES					
a. Size	2/	7/7	/1	/	/
b. Shape	2/	7/7	/1	/	/
c. Spacing between switches	2/	7/8	/	/	/
d. Resistance (too easy to turn or push, or too hard to turn or push)	2/	5/7	2/1	/	/
e. Correct labels	2/	6/8	1/	/	/
f. Understandable labels	2/	5/7	2/1	/	/
g. Size of labels	2/	6/7	/1	1/	/
h. Location of labels	2/	6/7	/1	1/	/
i. Absence of unrelated or confusing markings	2/1	6/7	1/	/	/
j. Visibility of switches	2/	5/8	1/	1/	/
k. Angle of view	2/	5/7	1/1	1/	/
l. Location of switches	2/	5/8	1/	1/	/
m. Reach distance of switches	2/	5/7	1/1	1/	/
n. Functional grouping (switches with related functions are grouped together)	2/	5/6	1/1	/	/

Responses to Section II-O continued

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
o. Switch type (type of control is appropriate for type of function)	2/	6/6	1/1	/	/
p. Description of switches in Operator's Manual	1/	7/6	1/1	/	/

Comments to Section II-O of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	Occurrence AN/TSC-29
1. It is hard to reach up there because it is so high.	1	
2. I never really understood it.		1

17. Responses to Section II-P of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

P. OTHER EQUIPMENT

Indicate how adequate the design is of each of the following pieces of equipment from an operator's point of view.	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. Signal Entrance Box	2/	6/8	1/	/	/
2. Power Entrance Box	1/	8/8	1/	/	/
3. Patch Panel	1/	6/8	1/	1/	/
4. COMSEC Junction Box	1/	6/8	1/	1/	/
5. Description of above equipment in Operator's Manual	/	6/5	4/1	/	/

Comments to Section II-P of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. The patch panel is high.	1	

18. Responses to Section III-A of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

III. OVERALL CONFIGURATION OF IMF

A. EQUIPMENT LOCATION

Indicate the adequacy of the location within the shelter of each of the following pieces of equipment:

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. VDU Display	1/	7/5	2/3	1/	/
2. VDU Keyboard	/	5/4	3/3	3/1	/
3. Optical Character Reader	1/	5/7	4/	1/	/1
4. Communications Terminals [AN/UGC-74A(V)3]	1/1	7/7	2/	1/	/
5. Teletypewriter (TT-76B/GGC)	1/	5/4	3/2	2/2	/
6. Message Formatter (MP/100)	1/	7/6	3/	/2	/
7. Mode 1 Commo Unit (MCU)	/	8/6	3/1	/1	/
8. Processor Controller	/	8/6	3/2	/	/
9. Line Filter (DELTAC 1260)	/	8/8	2/	/	1/
10. Modem (MD-701B/UY)	1/	5/7	4/1	/	/
11. COMSEC Junction Box	1/	9/8	1/	/	/
12. Intercom	1/	8/8	1/	/	/
13. Switchboard	1/	8/8	/	1/	/
14. Telephone Set	1/	8/8	1/	1/	/
15. TH 22/TG's	/	8/8	3/	/	/
16. Patch Panel	1/	5/8	4/	/	/

Responses to Section III-A continued

	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
17. Signal Entrance Panel	1/	8/8	1/	/	/
18. Black Power Distribution Panel	1/	7/8	2/	1/	/
19. Red Power Distribution Panel	1/	7/8	2/	1/	/
20. Signal Entrance Box	2/	7/8	2/	/	/
21. Power Entrance Box	2/	7/8	2/	/	/

Comments to Section III-A of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. The modem, patch panel, and signal entrance panel are up too high.	1	
2. It is inconvenient to reach up or down to turn on and off pieces that are located in high and low locations.	1	
3. Rotating the OCR around 180^0 would help reduce the glare on the VDU.	2	
4. A high chair with a back on it would be useful for the OCR.	2	
5. The chairs at the poker positions could be a little bit higher.	1	
6. There is not enough room between the OCR and the desk for an operator to easily move.		1

19. Responses to Section III-B of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

Indicate the adequacy of the workspace and storage space of each of the following pieces of equipment:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
B. WORKSPACE AND STORAGE SPACE					
1. Amount of workspace	/1	2/2	2/2	4/2	3/1
2. Amount of storage space for tools	/	4/3	3/2	2/2	2/1
3. Amount of storage space for manuals	/	7/4	2/1	2/2	2/1
4. Amount of storage space for parts	/	4/3	2/1	4/3	/1
5. Amount of storage space for personal gear	/	/1	4/3	6/1	1/3
6. Amount of storage space for other items (specify)	/	/1	2/3	/1	1/1

Comments to Section III-B of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. Three or four people can work in the van well enough.	2	
2. Three people is a reasonable number to have in the van at once; an operator, a poker, and one at the OCR. The supervisor would be in and out.	2	1

Comments to Section III-B continued

Comment	Occurrence AN/TSC-58A	AN/TSC-29
3. Three people can work in the van with enough room, but you really need four.	1	
4. With two or three people in the van, you bump into each other. You can barely walk down the middle.		2
5. If there is any more than two people you are tripping over each other.		1
6. There is not enough storage space for all of the manuals that we have.	1	1
7. There is no place in the -29 van to temporarily store replacement parts (e.g., KW7's) without them being in the way.		1
8. There is no place to store paper, so we just put it wherever we can fit it; on the floor, on the desk, on 74's.		1
9. If three people are working in the van, it would be very crowded if all their personal gear were also in there.	1	
10. When we went to the field it was difficult finding a place to hang your web gear, steel pot, and protective mask except on the floor.	2	2
11. There is no room for CBR jacket and trousers. In the field we put it under the jeep or in a corner of another van.	1	1
12. In the field we piled all of our personal gear in a corner and behind the OCR.	2	
13. There is not any space for your personal gear.	3	1

Comments to Section III-B continued

Comment	Occurrence AN/TSC-58A	Occurrence AN/TSC-29
14. In the field I only kept my helmet and gas mask in the van.	1	
15. A good place for adding drawers is underneath the UGC-74's on the curbside of the van. More storage could be added to the area just above two UGC-74's.		1

20. Responses to Section IV-A of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

IV. JOB PROCEDURES

Indicate how easy or difficult it is to perform each of the following procedures:

Very Easy | Easy | Borderline | Difficult | Very Difficult | Did Not Perform

A. TURNING THE FOLLOWING EQUIPMENT ON OR OFF:

1.	Intercom	4/2	5/5	2/	/	/	/1
2.	Telephone Set	4/1	4/6	2/	/	/	1/1
3.	Switchboard (SB-22A/PT)	2/1	4/5	1/	/	/	4/2
4.	Telegraph Terminal (TH-22/TG)	4/1	6/7	1/	/	/	/
5.	Modem (MD-701B/UY)	2/1	6/7	1/	1/	/	/
6.	Teletypewriter (TT-76B/GGC)	4/1	6/5	1/	/	/	/2
7.	Mode 1 Communications Unit (MCU)	3/1	6/7	1/	/	/	1/
8.	Communications Terminal [AN/UGC-74A(V)3]	2/	7/6	1/2	1/	/	/
9.	SAMES	3/1	4/7	3/	/	/	/
10.	Processor Controller	3/1	7/7	1/	/	/	/
11.	Using the Operator's Manual when turning on equipment	3/1	8/6	/	/	/	/
12.	Other procedures (specify) KW-7's	/	/1	/	/	/	/

Comments to Section IV continued

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. The on-off knobs on the intercoms in the different vans do not all turn the same way for a given function. If an operator starts working in a different van he may turn an intercom off while thinking he was turning it on.	1	
2. It is difficult to turn the modem on and off because it is high.	1	
3. Sometimes the -74 will not turn on because of problems with the cable behind the on-off switch, and so you have to remove the front cover to turn it on or off, which is inconvenient.	1	2
4. The SAMES has to be turned on in a certain sequence, or the VDU won't show the correct display.	3	

21. Responses to Section IV-B of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

B. INITIALIZING AND CHECKING OUT THE SYSTEM	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Initialize the processor/ controller (warm or cold start, read track 1 or 3, rebuild directory, set date and time).	6/1	3/6	1/1	/	1/	/
2. Set-up channels.	4/1	4/6	3/1	/	/	/
3. Start channels.	4/1	5/6	2/1	/	/	/
4. Initialize SAMES	3/1	3/5	5/2	/	/	/
5. Check out internal IMF circuits.	3/	3/4	3/1	/1	/	2/2
6. Using the operators manual to do the above functions	1/1	5/5	4/1	/	/	/

7. Would a checklist which briefly lists the steps involved in turning on, initializing, and checking out the system be a help or a hindrance to you in operating the IMF?

6/6 A great help
4/2 Somewhat of a help
1/ Neither a help nor a hindrance
/ Somewhat of a hindrance
/ A great hindrance

Comments to Section IV-B of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. Sometimes, when starting up the system, you can give the supervisor a command and it does not respond. They call it a sleepy supervisor.		

Comments to Section IV-B continued

Comment	Occurrence AN/TSC-58A	AN/TSC-29
2. I just need more practice initializing the system.		1
3. Sometimes it is difficult to get the SAMES to read the program definition page.	2	
4. Sometimes the SAMES will lock up and maintenance will have to come and change a bad board.		1
5. We don't know enough about checking out the internal IMF circuits.	1	
6. I had never checked out internal lines and circuits before the test.		1
7. The manual for the IMF system does not go far enough in explaining commands and how to troubleshoot the system.	1	
8. The manual does not explain why you cannot enter certain commands in certain situations.	1	
9. A lot of information in the operator's manual is wrong.		1
10. It would be useful to have a checklist for start-up procedures, especially for people who are just becoming familiar with the system.	2	
11. A checklist hung on the wall would be helpful when the manual is not there.	1	
12. A checklist would be helpful for indicating the sequence of steps for starting up the system.		4
13. Initializing and checking out the system is a long procedure, which you forget if you don't keep doing it.		

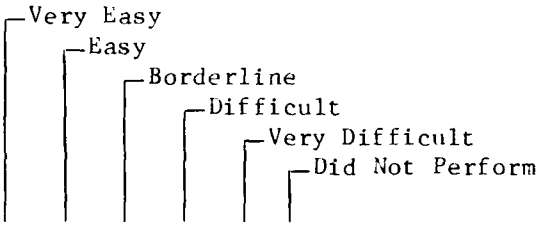
22. Responses to Section IV-C of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and th AN/TSC-29 (n=8)

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
C. SHUTTING DOWN THE SYSTEM						
1. Doing a WARM shutdown.	4/2	5/5	2/1	/	/	/
2. Doing a COLD shutdown.	4/1	3/4	2/1	/	/	2/2
3. Using the operator's manual in shutting down the system.	3/1	6/6	2/	/	/	/

Comments to Section IV-C of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. If you don't shut the system down for awhile, you forget how.	1	
2. I checked borderline for doing a cold shutdown because I had not done it for so long. I never had any problems with it.	1	
3. Operators sometimes have problems shutting the system down because they don't proceed in the correct sequence and wipe everything out. The manual does not go into enough depth here. Perhaps a checklist would be useful here.	1	
4. I need more practice shutting down the system.		1

23. Responses to Section IV-D of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and th AN/TSC-29 (n=8)



D. OPERATING THE FOLLOWING POSITIONS UNDER USUAL CONDITIONS

1.	Supervisor Position	3/	8/7	/1	/	/	/
2.	Operator Position	3/	8/7	/1	/	/	/
3.	Poker Position (-74 terminal)	3/	6/6	1/2	1/	/	/
4.	SAMES Position	3/	6/6	2/2	/	/	/
5.	Printer Position	3/	8/7	/1	/	/	/
6.	Remote Position	2/	7/4	/1	/	/	2/3
7.	Using Operator's Manual to operate IMF under usual conditions	1/	8/5	2/2	/	/	/

8. Would a status board which showed the status of various aspects of the IMF, such as which communications channels were operable, what internal equipment was inoperable, and so forth, be a help or a hindrance to you in operating the IMF?

6/5 A great help
4/3 Somewhat of a help
1/ Neither a help nor a hindrance
/ Somewhat of a hindrance
/ A great hindrance

Comments to Section IV-D of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. It would be helpful if the system kept count of how many messages were received/sent on a given channel so that the operator could easily call up that information for officers who request it.	1	
2. I need more practice at the various positions.		1
3. The keys on the AN/UGS-74 are somewhat hard to push, especially when you are tired.	1	
4. There are problems operating the SAMES such as in loading the program definition page.	1	
5. I have a hard time putting the tables in the SAMES. Also with the OCR, we can't feed more than one message at a time. But the only time I get confused is when the error light on the OCR comes on; the paper error or something.		1
6. When there is an error message on the VDU, why doesn't it just print out what the message is rather than making you look it up in the manual?		1
7. Reaching out to use the VDU keyboard on the SAMES is difficult, plus the keyboard locks up a lot.	1	
8. The oprators manual is not organized well, generally speaking.		1
9. A status board would be useful for indicating what circuits are down and at what time they went down. Especially helpful during shift changes where operators and supervisors forget to pass along such information to the new shift.	1	

Comments to Section IV-D continued

Comment	Occurrence AN/TSC-58A	Occurrence AN/TSC-29
10. A status board would be helpful because now when a piece of equipment is down you just write a note and tape it on the equipment, and sometimes it gets knocked off and thrown away. A status board should indicate not just which equipment is down, but also indicate the errors it is making.		1

24. Responses to Section IV-E of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and th AN/TSC-29 (n=8)

E. USING SUPERVISOR COMMANDS WITH THE AN/UGC-74 COMMUNICATIONS TERMINAL.

1. TALK Command

a. About how many times did you use this command during the test?

a.	5/3	Never
b.	5/3	1-5 times
c.	/	6-10 times
d.	/	10-25 times
e.	/1	25-50 times
f.	1/1	More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

1/	Very Satisfactorily
5/4	Satisfactorily
/1	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

1/	Very Satisfactorily
4/5	Satisfactorily
1/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

2. SETUP Command

a. About how many times did you use this command during the test?

a.	/1	Never
b.	/	1-5 times
c.	/	6-10 times
d.	1/1	10-25 times
e.	1/1	25-50 times
f.	9/5	More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

7/4 Very Satisfactorily
4/3 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

3/2 Very Satisfactorily
8/4 Satisfactorily
/1 Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

3. START Command

a. About how many times did you use this command during the test?

a. /1 Never
b. / 1-5 times
c. / 6-10 times
d. 1/ 10-25 times
e. /2 25-50 times
f. 10/5 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

6/3 Very Satisfactorily
5/4 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

5/2 Very Satisfactorily
6/5 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

Responses to Section IV-E continued

4. STATUS Command

   a. About how many times did you use this command during the test?

      a. /1 Never
      b. / 1-5 times
      c. / 6-10 times
      d. 1/ 10-25 times
      e. 3/1 25-50 times
      f. 7/6 More than 50 times

   b. How satisfactorily or unsatisfactorily did this command work?

      7/3 Very Satisfactorily
      4/4 Satisfactorily
      / Borderline
      / Unsatisfactorily
      / Very Unsatisfactorily

   c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

      6/3 Very Satisfactorily
      5/4 Satisfactorily
      / Borderline
      / Unsatisfactorily
      / Very Unsatisfactorily

5. TIME Command

   a. About how many times did you use this command during the test?

      a. 3/1 Never
      b. 3/2 1-5 times
      c. 2/1 6-10 times
      d. 1/2 10-25 times
      e. 1/ 25-50 times
      f. 1/2 More than 50 times

Responses to Section IV-E continued

b. How satisfactorily or unsatisfactorily did this command work?

1/2 Very Satisfactorily
4/5 Satisfactorily
1/ Borderline
/ Unsatisfactorily
2/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

1/2 Very Satisfactorily
5/5 Satisfactorily
1/ Borderline
/ Unsatisfactorily
1/ Very Unsatisfactorily

6. SERVICE Command

a. About how many times did you use this command during the test?

a. 1/1 Never
b. / 1-5 times
c. / 6-10 times
d. 4/3 10-25 times
e. 3/2 25-50 times
f. 3/2 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

2/3 Very Satisfactorily
6/4 Satisfactorily
2/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

1/2 Very Satisfactorily
6/5 Satisfactorily
2/ Borderline
1/ Unsatisfactorily
/ Very Unsatisfactorily

Responses to Section IV-E continued

7. LOG Command

a. About how many times did you use this command during the test?

a.	/	Never
b.	1/1	1-5 times
c.	/	6-10 times
d.	/	10-25 times
e.	2/	25-50 times
f.	8/7	More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

6/4	Very Satisfactorily
5/4	Satisfactorily
/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

4/3	Very Satisfactorily
6/4	Satisfactorily
1/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

8. INTERCEPT Command

a. About how many times did you use this command during the test?

a.	1/1	Never
b.	2/	1-5 times
c.	/	6-10 times
d.	2/2	10-25 times
e.	4/3	25-50 times
f.	2/2	More than 50 times

Responses to Section IV-E continued

b. How satisfactorily or unsatisfactorily did this command work?

2/2 Very Satisfactorily
6/3 Satisfactorily
2/2 Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

1/2 Very Satisfactorily
6/5 Satisfactorily
3/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

9. RELEASE Command

a. About how many times did you use this command during the test?

a. 2/ Never
b. 1/ 1-5 times
c. / 6-10 times
d. 4/1 10-25 times
e. 2/4 25-50 times
f. 2/2 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

2/3 Very Satisfactorily
6/4 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

2/2 Very Satisfactorily
5/5 Satisfactorily
2/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

Responses to Section IV-E continued

10. PREEMPT Command

a. About how many times did you use this command during the test?

a. 7/4 Never
b. 2/1 1-5 times
c. 1/ 6-10 times
d. /2 10-25 times
e. 1/1 25-50 times
f. / More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

/1 Very Satisfactorily
2/2 Satisfactorily
2/ Borderline
/1 Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

/2 Very Satisfactorily
2/2 Satisfactorily
1/ Borderline
1/ Unsatisfactorily
/ Very Unsatisfactorily

11. RECOVER Command

a. About how many times did you use this command during the test?

a. /1 Never
b. 2/ 1-5 times
c. / 6-10 times
d. / 10-25 times
e. 3/2 25-50 times
f. 6/5 More than 50 times

Responses to Section IV-E continued

b. How satisfactorily or unsatisfactorily did this command work?

4/3 Very Satisfactorily
7/4 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

4/3 Very Satisfactorily
7/4 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

12. READDRESS Command

a. About how many times did you use this command during the test?

a. 11/7 Never
b. / 1-5 times
c. / 6-10 times
d. / 10-25 times
e. / 25-50 times
f. /1 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

/ Very Satisfactorily
/1 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

/ Very Satisfactorily
/1 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

Responses to Section IV-E continued

13. STOP Command

a. About how many times did you use this command during the test?

a. / Never
b. 1/1 1-5 times
c. / 6-10 times
d. / 10-25 times
e. 2/1 25-50 times
f. 8/6 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

3/3 Very Satisfactorily
6/5 Satisfactorily
2/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

2/2 Very Satisfactorily
8/5 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

14. SHUTDOWN Command

a. About how many times did you use this command during the test?

a. / Never
b. 2/1 1-5 times
c. 1/1 6-10 times
d. 2/1 10-25 times
e. 2/1 25-50 times
f. 4/4 More than 50 times

Responses to Section IV-E continued

b. How satisfactorily or unsatisfactorily did this command work?

3/3 Very Satisfactorily
8/5 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

2/2 Very Satisfactorily
9/5 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

Comments to Section IV-E of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	Occurrence AN/TSC-29
1. I don't know what some of the commands mean or how to use them. If I punch them in I don't know what to do after that. We can read and understand it, but we get confused when we actually do it.	1	
2. The manual doesn't really tell you what the TALK command is for or what it does.	1	1
3. The manual does not clearly explain how to use the SET-UP command.		1
4. Sometimes you would try to enter the TIME command and you would keep getting invalid command.	1	

Comments to Section IV-E continued

Comment	Occurrence AN/TSC-58A	AN/TSC-29
5. The TIME command loses about 15 minutes per day.	1	
6. Sometimes the system does not accept the INTERCEPT command, and you have to enter it several times before it is finally accepted.	1	
7. The manual doesn't explain how INTERCEPT fits in with everything you have to do.	1	
8. Sometimes the INTERCEPT command would not work; it would just say ZVA was busy or something like that. I would give up on it. Same with PREEMPT.		1
9. You can't seem to use the RECOVER command when you have a memory warning.	1	
10. Sometimes the system does not accept the STOP command. You think that you have stopped a channel and suddenly after hitting STATUS you realize that the channel has not been stopped. Channel 8, the high speed channel, is very hard to remove.	1	

25. Responses to Section IV-F of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and th AN/TSC-29 (n=8)

F. USING OPERATOR COMMANDS WITH THE AN/UGC-74 COMMUNICATIONS TERMINAL.

1. MESSAGE Command.

a. About how many times did you use this command during the test?

a.	1/3	Never
b.	1/1	1-5 times
c.	3/	6-10 times
d.	5/	10-25 times
e.	/	25-50 times
f.	1/4	More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

3/3	Very Satisfactorily
6/2	Satisfactorily
1/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

2/2	Very Satisfactorily
7/3	Satisfactorily
1/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

2. TRAILER Command.

a. About how many times did you use this command during the test?

a.	/1	Never
b.	2/5	1-5 times
c.	2/	6-10 times
d.	5/	10-25 times
e.	1/	25-50 times
f.	1/2	More than 50 times

Responses to Section IV-F continued

b. How satisfactorily or unsatisfactorily did this command work?

2/3 Very Satisfactorily
7/4 Satisfactorily
2/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

1/2 Very Satisfactorily
8/4 Satisfactorily
2/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

3. OK PRINT Command.

a. About how many times did you use this command during the test?

a. / Never
b. /1 1-5 times
c. / 6-10 times
d. / 10-25 times
e. / 25-50 times
f. 11/7 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

9/4 Very Satisfactorily
2/4 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

6/3 Very Satisfactorily
5/4 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

Responses to Section IV-F continued

4. OK CHANNEL Command.

   a. About how many times did you use this command during the test?

      a. /1 Never
      b. / 1-5 times
      c. / 6-10 times
      d. / 10-25 times
      e. / 25-50 times
      f. 11/7 More than 50 times

   b. How satisfactorily or unsatisfactorily did this command work?

      7/3 Very Satisfactorily
      4/4 Satisfactorily
      / Borderline
      / Unsatisfactorily
      / Very Unsatisfactorily

   c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

      4/2 Very Satisfactorily
      6/5 Satisfactorily
      1/ Borderline
      / Unsatisfactorily
      / Very Unsatisfactorily

5. OK SERVICE Command.

   a. About how many times did you use this command during the test?

      a. 3/3 Never
      b. /3 1-5 times
      c. 3/ 6-10 times
      d. 2/1 10-25 times
      e. / 25-50 times
      f. 3/1 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

1/2 Very Satisfactorily
5/3 Satisfactorily
2/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

1/2 Very Satisfactorily
5/3 Satisfactorily
2/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

6. SET CSN Command.

a. About how many times did you use this command during the test?

a. 6/4 Never
b. 2/2 1-5 times
c. /1 6-10 times
d. 2/ 10-25 times
e. 1/ 25-50 times
f. /1 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

/2 Very Satisfactorily
4/2 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

/2 Very Satisfactorily
4/2 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

7. OK ZVA Command.

   a. About how many times did you use this command during the test?

      a. /1 Never
      b. / 1-5 times
      c. / 6-10 times
      d. 1/ 10-25 times
      e. 1/ 25-50 times
      f. 9/7 More than 50 times

   b. How satisfactorily or unsatisfactorily did this command work?

      7/3 Very Satisfactorily
      4/4 Satisfactorily
      / Borderline
      / Unsatisfactorily
      / Very Unsatisfactorily

   c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

      3/2 Very Satisfactorily
      5/4 Satisfactorily
      / Borderline
      /1 Unsatisfactorily
      3/ Very Unsatisfactorily

8. PILOT Command.

   a. About how many times did you use this command during the test?

      a. 11/7 Never
      b. / 1-5 times
      c. /1 6-10 times
      d. / 10-25 times
      e. / 25-50 times
      f. / More than 50 times

Responses to Section IV-F continued

b. How satisfactorily or unsatisfactorily did this command work?

/ Very Satisfactorily
/1 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

/ Very Satisfactorily
/1 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

9. REJECT Command.

a. About how many times did you use this command during the test?

a. 3/1 Never
b. 2/1 1-5 times
c. /1 6-10 times
d. 3/1 10-25 times
e. 2/1 25-50 times
f. 1/3 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

3/3 Very Satisfactorily
4/4 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

2/2 Very Satisfactorily
5/4 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

Responses to Section IV-F continued

10. SERVICE Command.

a. About how many times did you use this command during the test?

a.	3/3	Never
b.	1/1	1-5 times
c.	1/	6-10 times
d.	2/1	10-25 times
e.	2/1	25-50 times
f.	2/2	More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

1/2	Very Satisfactorily
6/3	Satisfactorily
1/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (TM 11-5805-741-12)?

1/2	Very Satisfactorily
5/3	Satisfactorily
2/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

Comments to Section IV-F of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. Using the MESSAGE command just takes a lot of time and wastes a lot of paper because it prints out the whole message. It works but it slows things down. Same with the TRAILER command.	1	

Comments to Section IV-F continued

Comment	Occurrence AN/TSC-58A	AN/TSC-29
2. I learned how to use the SERVICE command through trial and error.	1	
3. The book was totally wrong in its explanation of the OK ZVA command. The operator's final response with this command is to just enter the channel number.	3	1
4. I learned the abbreviations for the commands just by making mistakes, like accidentally pushing just P and finding that the system would accept it.		1

26. Responses to Section IV-G of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and th AN/TSC-29 (n=8)

G. USING SYSTEM COMMANDS WITH THE SAMES

1. DATE AND TIME Command.

a. About how many times did you use this command during the test?

a.	/	Never
b.	/	1-5 times
c.	/1	6-10 times
d.	1/	10-25 times
e.	1/	25-50 times
f.	9/7	More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

5/3	Very Satisfactorily
6/5	Satisfactorily
/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

4/1	Very Satisfactorily
7/6	Satisfactorily
/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

2. SSN Command.

a. About how many times did you use this command during the test?

a.	/	Never
b.	1/	1-5 times
c.	/1	6-10 times
d.	2/	10-25 times
e.	1/1	25-50 times
f.	7/6	More than 50 times

Responses to Section IV-G continued

b. How satisfactorily or unsatisfactorily did this command work?

3/3 Very Satisfactorily
8/5 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

3/3 Very Satisfactorily
8/4 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

3. SEC Command.

a. About how many times did you use this command during the test?

a. 10/6 Never
b. /1 1-5 times
c. / 6-10 times
d. / 10-25 times
e. / 25-50 times
f. 1/1 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

/ Very Satisfactorily
1/2 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

/ Very Satisfactorily
1/1 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

Responses to Section IV-G continued

4. WTB/ Command.

   a. About how many times did you use this command during the test?

      a. /__ Never
      b. /__ 1-5 times
      c. /1 6-10 times
      d. 1/1 10-25 times
      e. 4/3 25-50 times
      f. 6/3 More than 50 times

   b. How satisfactorily or unsatisfactorily did this command work?

      2/2 Very Satisfactorily
      7/6 Satisfactorily
      2/ Borderline
      /__ Unsatisfactorily
      /__ Very Unsatisfactorily

   c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

      2/1 Very Satisfactorily
      6/5 Satisfactorily
      3/ Borderline
      /1 Unsatisfactorily
      /__ Very Unsatisfactorily

5. RTB Command.

   a. About how many times did you use this command during the test?

      a. /__ Never
      b. /__ 1-5 times
      c. /1 6-10 times
      d. 1/ 10-25 times
      e. 1/3 25-50 times
      f. 9/4 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

2/2 Very Satisfactorily
9/6 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

2/1 Very Satisfactorily
8/6 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

6. TBL Command.

a. About how many times did you use this command during the test?

a. / Never
b. / 1-5 times
c. /1 6-10 times
d. / 10-25 times
e. 1/1 25-50 times
f. 10/6 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

4/2 Very Satisfactorily
6/6 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

2/1 Very Satisfactorily
8/6 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

Responses to Section IV-G continued

7. TAR Command.

   a. About how many times did you use this command during the test?

      a. 11/6 Never
      b. /_ 1-5 times
      c. /_ 6-10 times
      d. /1 10-25 times
      e. /1 25-50 times
      f. /_ More than 50 times

   b. How satisfactorily or unsatisfactorily did this command work?

      /_ Very Satisfactorily
      /2 Satisfactorily
      /_ Borderline
      /_ Unsatisfactorily
      /_ Very Unsatisfactorily

   c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

      /_ Very Satisfactorily
      /2 Satisfactorily
      /_ Borderline
      /_ Unsatisfactorily
      /_ Very Unsatisfactorily

8. DUM/ Command.

   a. About how many times did you use this command during the test?

      a. 11/8 Never
      b. /_ 1-5 times
      c. /_ 6-10 times
      d. /_ 10-25 times
      e. /_ 25-50 times
      f. /_ More than 50 times

Responses to Section IV-G continued

b. How satisfactorily or unsatisfactorily did this command work?

/ Very Satisfactorily
/ Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

/ Very Satisfactorily
/ Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

9. DIS Command.

a. About how many times did you use this command during the test?

a. 10/7 Never
b. 1/ 1-5 times
c. / 6-10 times
d. /1 10-25 times
e. / 25-50 times
f. / More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

/ Very Satisfactorily
/1 Satisfactorily
1/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

/ Very Satisfactorily
/1 Satisfactorily
/ Borderline
1/ Unsatisfactorily
/ Very Unsatisfactorily

Responses to Section IV-G continued

10. LOG/ Command.

a. About how many times did you use this command during the test?

a.	2/1	Never
b.	3/1	1-5 times
c.	2/1	6-10 times
d.	3/1	10-25 times
e.	/2	25-50 times
f.	1/2	More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

2/1	Very Satisfactorily
5/6	Satisfactorily
2/	Borderline
/	Unsatisfactorily
/	Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

1/1	Very Satisfactorily
4/5	Satisfactorily
3/	Borderline
/	Unsatisfactorily
1/	Very Unsatisfactorily

11. CSN Command.

a. About how many times did you use this command during the test?

a.	2/1	Never
b.	2/	1-5 times
c.	1/	6-10 times
d.	1/	10-25 times
e.	/1	25-50 times
f.	5/6	More than 50 times

Responses to Section IV-G continued

b. How satisfactorily or unsatisfactorily did this command work?

1/2 Very Satisfactorily
7/5 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

/1 Very Satisfactorily
6/6 Satisfactorily
3/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

12. HDR PASSWORD Command.

a. About how many times did you use this command during the test?

a. / Never
b. / 1-5 times
c. /1 6-10 times
d. 1/ 10-25 times
e. 2/2 25-50 times
f. 8/5 More than 50 times

b. How satisfactorily or unsatisfactorily did this command work?

4/2 Very Satisfactorily
7/6 Satisfactorily
/ Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

c. How satisfactorily or unsatisfactorily was this command explained in the operator's manual (PDEP 11-5895-1193-10)?

2/1 Very Satisfactorily
8/5 Satisfactorily
1/1 Borderline
/ Unsatisfactorily
/ Very Unsatisfactorily

Comments to Section IV-G of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	Occurrence AN/TSC-29
1. You really don't have any problems understanding the commands; it's just that the system doesn't work very well.	1	
2. The manual doesn't really tell you how to use the WTB and LOG commands.	1	
3. The manual does not tell you when to read and write the tables in.	1	
4. It was to easy to erase your tables in the SAMES by writing in nothing.		1

27. Responses to Section IV-H of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and th AN/TSC-29 (n=8)

H. OPERATING UNDER UNUSUAL CONDITIONS

Indicate how easy or difficult it is to perform each of the following procedures:	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Without the MCU	/	1/1	3/1	/	/	7/6
2. Without the Processor Controller	/	/1	/1	1/	3/	7/6
3. Mode I Emergency Operation	1/	1/2	/	1/	1/	7/6
4. Mode II Emergency Operation	1/	1/2	1/	1/	/	7/6
5. Emergency Stopping Procedures	/	2/2	1/	/	/	7/6
6. Using the Operator's Manual to operate the IMF under unusual conditions	/	1/3	3/	/	/	7/5

Comments to Section IV-H of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	Occurrence AN/TSC-29
1. Without the processor controller you could only send messages from one position to another inside the van. It wasn't really difficult, just boring.	1	

28. Responses to Section IV-I of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

I. PERFORMING OPERATOR MAINTENANCE

Indicate how easy or difficult it is to perform the following procedures:	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Performing preventive maintenance checks and services on the IMF.	1/	5/7	2/	2/	/	1/
2. Troubleshooting the IMF	/	3/1	4/1	3/1	/1	1/4
3. Using the operator's troubleshooting chart in the Operator's Manual	/	4/1	3/2	4/1	/1	/3
4. Cleaning the Equipment	1/	6/6	3/	/	/	1/2
5. Lubricating hinges and locks	1/	2/4	1/	1/	/	6/4
6. Replacing fuses	/	2/2	1/2	1/	/	7/4
7. Replacing lamps	/	3/4	1/	1/	/	6/4
8. Using the Operator's Manual to perform maintenance procedures	1/	3/7	3/	/	/	4/

Comments to Section IV-I of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. All we can do in maintenance is change bulbs. If I were trained in troubleshooting I would be a better team chief. PMCS just involves making sure everything turns on. There should be more.	1	

Comments to Section IV-I of the Human Factors Questionnaire for Operators

	Comment	Occurrence AN/TSC-58A	AN/TSC-29
2.	It took too long to perform PMCS, at least an hour or two.	1	
3.	I don't know how to fix the system; I'm not sure what to do.	2	
4.	A lot of operators had problems trouble-shooting. The manual could have gone into a little more detail.	1	
5.	The manual lets us change the ribbon and paper, and we have to call that maintenance. We have fuses, so they let us change them ourselves and do all the maintenance we can do. Operators would enjoy the equipment more if they could troubleshoot it.	1	
6.	I did not know how to troubleshoot until we were given the class (near the end of the test).	1	
7.	I get lost trying to troubleshoot the system.	1	1
8.	As an operator you are limited in trouble-shooting. You can do more but they tell you only to do certain things because you are an operator.	1	
9.	The troubleshooting chart in the manual covers four pages. That is not enough. A lot of the problems we encountered were not in the manual. The manual should state a specific problem and tell you what to do about it. The manual doesn't even have anything on how to replace a fuse in a TH-22, for example.		1
10.	Some people who were not experienced tried to perform maintenance using the operator's manual, but they could not do it.		1
11.	The magnetic tape log cannot be changed by an operator. He has to wait for a maintenance man to come and change it.		1

29. Responses to Section IV-J of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

J. TRANSPORTING THE IMF

Using the scale to the right indicate with a check mark ( ) how easy or difficult it is to perform each of the following procedures:

Very Easy
Easy
Borderline
Difficult
Very Difficult
Did Not Perform

1. Preparing the IMF for transport.	3/	6/5	2/	/	/	/3
2. Setting the IMF up for transport	3	6/5	2/	/	/	/3
3. Using the Operator's Manual in the above tasks	1/	2/4	3/1	/	/	5/3
4. Performing the above tasks while wearing NBC protective clothing	/	/1	1/	1/	/	9/7

Comments to Section IV-J of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	Occurrence AN/TSC-29
1. It takes time to make sure all of the equipment is well tied down.	1	
2. It is kind of hard hitting the keys with NBC gear on, and you have to get a little closer so you can see.	1	

30. Responses to Section V of the Human Factors Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

V. COMPUTER SOFTWARE

Indicate the adequacy of the SAMES software in each of the following areas:	Very Adequate	Adequate	Borderline	Inadequate	Very Inadequate
1. Language used to interact with the SAMES through the VDU	1/	5/8	4/	1/	/
2. Consistency of display formats	1/	6/8	4/	/	/
3. Clarity of prompts	1/	4/8	5/	/	/
4. Usefulness of prompts	1/	5/8	4/	/	/
5. Timeliness of prompts	1/	5/8	4/	/	/
6. Clarity of error messages	1/	6/7	3/1	/	1/
7. Usefulness of error messages	3/	3/5	4/3	1/	/
8. Timeliness of error messages	1/	5/6	5/2	/	/
9. Requirements for remembering related information while operating the system	1/	4/7	5/1	1/	/

Comments to Section V of the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. I don't understand the explanations of all of the error messages in the manual.	1	

Comments to Section V continued

Comment	Occurrence AN/TSC-58A	AN/TSC-29
2. If you don't keep operating the system you are going to forget. I have problems remembering what to do and how to start it up and shut it down.	2	
3. You have to go to the manual to understand error messages.	1	1
4. I would like to have a more complete understanding of the SYSGEN.	1	
5. Some things we did not understand, like what a buffer was. We looked it up in the manual, but there wasn't any information on it.	1	

31. Additional Responses to the Human Factors Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. Operators need two or three weeks of training on each piece of equipment in the IMF.	1	
2. Operators need about six weeks of training on the IMF.	2	
3. Operators need five or six weeks of training on the IMF.	1	
4. Operators need three or four weeks of training on the IMF.	1	1
5. Operators need one to two weeks of training on the IMF.	2	
6. Only certain people should be allowed to type up the program definition page, such as the S2.	1	
7. The steps out of the van are steep; if you ask me to carry any equipment out of the van I think I would fall flat on my face.	1	
8. There is no way of knowing that a distant end has received a message; that it really did go out. In the test environment you can run over and ask, but if you are 10 or 12 miles away you can't.		1
9. A high chair at the OCR would be helpful. It is rough standing there transmitting messages for five or six hours.		1

ANNEX A

TO

APPENDIX E

TABLE A-2

Human Factors Questionnaire for Maintainers

1. Responses to Section I of the Human Factors Questionnaire for Maintainers (n=2)

I. ADMINISTRATIVE PROCEDURES FOR SERVICING THE IMF SYSTEM

Indicate how easy or difficult it is to perform each of the following procedures:	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
1. Use technical manuals in general		2				
2. Prepare maintenance forms, records and reports	1	1				
3. Obtain adequate replacement parts	1		1			
4. Obtain adequate repair and calibration tools	1		1			

Comments to Section I of the Human Factors Questionnaire for Maintainers

	Comment	Occurrence
1.	The -12 manual for the IMF needs to be updated. In some areas, such as troubleshooting the processor controller, it is very limited.	1
2.	Alignment of the MD701 is supposed to be done by DS-GS level maintenance personnel, but organizational level maintenance personnel could be trained to do this.	1
3.	We don't have replacement parts for the MD701, and we don't have enough fuses. We are also supposed to have a torque wrench for the MCU, but we don't have it.	1

2. Responses to Section II of the Human Factors Questionnaire for Maintainers (n=2)

II. ORGANIZATIONAL MAINTENANCE PROCEDURES FOR THE IMF EQUIPMENT

Indicate how easy or difficult it is to perform each of the following procedures:	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
A. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)						
1. Perform PMCS	2					
2. Use Operator's and Organizational Maintenance Manual to perform PMCS	2					
B. TROUBLESHOOTING						
1. Perform troubleshooting procedures.	1	1				
2. Use the Operator's and Organizational Maintenance Manual to troubleshoot the system.			1			1
C. REPAIRING						
1. Remove and replace rack-mounted components		2				
2. Repair red or black power distribution panels		1				1
3. Repair processor controller	1	1				
4. Repair TSEC/KN-7 interface	1					1
5. Repair Mode 1 Communications Unit	1	1				

Responses to Section II continued

	Very Easy	Easy	Borderline	Difficult	Very Difficult	Did Not Perform
6. Use Operator's and Organizational Maintenance Manual to repair the system			1			1
7. Other procedures (specify)						
8. Other maintenance manuals (specify) MD 701		1				

Comments to Section II of the Human Factors Questionnaire for Maintainers

	Comment	Occurrence
1.	The manuals do not give you enough information for troubleshooting the processor controller or the Mode 1 Communications Unit. It gives you no guidance, any symptoms, or any probable cause of a problem. It just tells you how to go through built in diagnostic procedures. Sometimes the wording is a bit confusing.	1
2.	The maintenance manual wasn't very good. For example, in the troubleshooting chart one of the steps is to do a loop back test if a channel fails, but if channel 0 fails you cannot do a loop back test because you need the supervisor to do a loop back but the supervisor operates on channel 0. Also, one step in the SAMES maintenance manual says to change the power supply before you change a fuse.	1

Comments to Section II continued

Comment	Occurrence
3. Most problems were with the KW7's and operators. If the operators do not set their SYSGEN correctly when initializing the system, then the processor will not accept messages. This has been a recurring problem.	1
4. Other operator problems have been improperly setting up channels during initialization so that things like baud rates and stop bits are not the same for both ends of a circuit.	1
5. An early problem, which cleared up later in the test after some operator training, was improper strapping of the boards within the Mode 1 unit, resulting in the wrong baud rate.	1
6. Operators turning the SAMES equipment on in the incorrect order has been a problem.	1
7. Sometimes a switch on the signal entrance panel will be in the "binding post" position rather than in the "26-pair cable" position, creating an open circuit and preventing messages from being sent over that channel.	1
8. Operators pulled the leader loose from the bottom ribbon spool on four or five AN/TSC-74's, causing those -74's to be deadlined, because that leader is permanent and is not intended to be removed when the ribbon is changed.	1
9. Some operators have watched the maintenance personnel repair part of the OCR, have learned how to get to the inside of the OCR and have changed the settings on some of the switches, which has caused the system to malfunction.	1

Comments to Section II continued

	Comment	Occurrence
10.	It would be useful if the 72E operators of the IMF were trained as 31J operator maintainers. Or perhaps the team chief should be a 31J.	1
11.	Sometimes the operators would accidentally write tables when there was nothing to be written in, and the tables in memory would then get erased and they would not be able to read tables and would not know why. We just reset the formatter and had them load the tables again. That was mostly at the beginning of the test.	1
12.	Sometimes operators will forget to change switch settings on a AN/UGC-74 when they change one from a printer to a poker or vice versa.	1

3. Responses to Section III of the Human Factors Questionnaire for Maintainers (n=2)

III. SAFETY

Indicate whether any of the following were safety hazards while maintaining the system.

Safety Hazard	I Have Experienced And Is A Problem	I Have Not Experienced But Is A Problem	Not A Problem	Was Not In A Position Say
a. Electrical Shock	1		1	
b. Burns			2	
c. Cuts or Scrapes			2	
d. Extreme Brightness			2	
e. Extreme Loudness			2	
f. Noxious Fumes			2	

Comments to Section III of the Human Factors Questionnaire for Maintainers

Comment	Occurrence
1. I have been shocked when checking out that portion of a circuit involving the KW7's. If you slide the KW7 just partially out you can't see behind it, so you reach back there blindly and if one of the banana plugs has come out and you touch it you can get shocked. The cables are not long enough to allow you to pull the KW7 out far enough to tilt it down and see what you are doing. A precaution would be to turn off the KW7 before you pull it out, but this slows you down.	1

Comments to Section III continued

	Comment	Occurrence
2.	In the AN/TSC-58A you get your fingers smashed, scraped, cut and knicked because there is not very much room to work. I have never experienced this in the AN/TSC-29, where there is more room.	1
3.	The clips that hold the patch cords on the roadside wall by the TH-22's in the AN/TSC-58A, have sharp edges on them. An individual fell, put his hand on them and cut his hand. There needs to be a rubberized or plastic coating on them.	1
4.	The grounds on the back of the AN/UGC-74's are very bad. The connectors break very easily.	1

ANNEX A

TO

APPENDIX E

Table A-3

Safety Questionnaire for Operators

Responses to the Safety Questionnaire for Operators of the AN/TSC-58A (n=11) and the AN/TSC-29 (n=8)

1. Indicate whether any of the following were safety hazards while operating the IMF under usual conditions.

Safety Hazard	I Have Experienced And Is A Problem	I Have Not Experienced But Is A Problem	Not A Problem	Was Not In A Position To Say
a. Electrical Shock	/	4/1	6/7	1/
b. Burns	/	1/	9/7	1/1
c. Cuts or Scrapes	3/3	1/	6/5	1/
d. Extreme Brightness	2/	2/	7/7	/1
e. Extreme Loudness	4/3	1/	6/5	/
f. Noxious Fumes	3/	1/	6/7	1/1
g. Other (specify)				
Heat	1/	/	/	/

2. Indicate whether any of the following were safety hazards while operating the IMF under usual conditions.

Safety Hazard	I Have Experienced And Is A Problem	I Have Not Experienced But Is A Problem	Not A Problem	Was Not In A Position To Say
a. Electrical Shock	/1	3/	2/4	4/3
b. Burns	/	1/	4/5	4/3
c. Cuts or Scrapes	1/	2/	2/5	4/3
d. Extreme Brightness	1/	1/	4/5	3/3
e. Extreme Loudness	1/2	2/	3/3	3/3
f. Noxious Fumes	1/1	1/	3/4	4/3

3. Indicate whether any of the following were safety hazards while performing operator maintenance on the system.

Safety Hazard	I Have Experienced And Is A Problem	I Have Not Experienced But Is A Problem	Not A Problem	Was Not In A Position To Say
a. Electrical Shock	/	2/	7/6	2/2
b. Burns	/	1/	8/6	2/2
c. Cuts or Scrapes	2/	1/	7/6	1/2
d. Extreme Brightness	2/	1/	8/6	/2
e. Extreme Loudness	3/	1/	6/6	3/2
f. Noxious Fumes	3/	1/	6/6	1/2

4. Indicate whether any of the following were safety hazards while setting up the IMF after transporting it to another location.

Safety Hazard	I Have Experienced And Is A Problem	I Have Not Experienced But Is A Problem	Not A Problem	Was Not In A Position To Say
a. Electrical Shock	1/	1/	4/6	5/2
b. Burns	/	1/	5/6	5/2
c. Cuts or Scrapes	2/	1/	4/6	4/2
d. Extreme Brightness	2/	1/	6/6	2/2
e. Extreme Loudness	2/	/	6/6	3/2
f. Noxious Fumes	2/	1/	5/6	3/2

5. Indicate whether any of the following were safety hazards while preparing the IMF for transportation to another location.

Safety Hazard	I Have Experienced And Is A Problem	I Have Not Experienced But Is A Problem	Not A Problem	Was Not In A Position To Say
a. Electrical Shock	/	1/	6/5	2/3
b. Burns	/	/	7/5	2/3
c. Cuts or Scrapes	2/	2/	5/5	/3
d. Extreme Brightness	1/	/	8/5	/3
e. Extreme Loudness	1/	/	8/5	/3
f. Noxious Fumes	2/	1/	6/5	/3

Comments to the Safety Questionnaire for Operators

Comment	Occurrence AN/TSC-58A	AN/TSC-29
1. I never got shocked, but my sargeant got shocked one time when sitting on the tail gate. We installed another ground rod and that solved the problem.	1	
2. I saw a data collector get shocked in the KW7 interface box once.	1	
3. There is a chance of getting shocked from the back of the KW7's.	1	
4. In the field, several people got shocked on the van when a generator operator incorrectly hooked the van up to a generator.		1
5. One person got shocked one time when they turned on the main power breaker without having previously turned off all the other equipment.	1	
6. The PC gets hot. You could get burned from it, but I never saw anyone get burned from it.	1	
7. When you are changing the paper in the AN/UGC-74 you can get pinched and bang your elbows because you don't have enough room in the van.	1	
8. I have scraped and cut myself on the trays that the KW7's sit on, when a KW7 is pulled out.	2	
9. The top drawer in the storage cabinet of the AN/TSC-29 has a very sharp edge. I cut my thumb on it.		1
10. I cut myself on the jacks (clips that hold the patch cords) in the AN/TSC-58A when I fell against it.		1
11. The lights are too bright. Some parts of the van are dark, and the lights are bright. It's uncomfortable.	1	

Comments to the Safety Questionaire for Operators continued

Comment	Occurrence AN/TSC-58A	AN/TSC-29
12. The alarm on the TH22 is loud and uncomfortable.	2	1
13. There is a lot of traffic in and out of the van, and with the machines working there is a lot of noise. It is annoying. You have to shout to be heard. It can give you a headache.	3	2
14. The exhaust from the truck comes into the van when the truck is running and charging the batteries. My eyes hurt and water. It makes you feel a little sick if you don't get out.	3	
15. It gets hot back near the front wall of the van where the operator sits.	1	

ANNEX A

TO

APPENDIX E

Table A-4

Illumination, Sound and Temperature Levels
Inside the AN/TSC-58A and the AN/TSC-29

Table A-4. Illumination, Sound and Temperature Levels Inside the AN/TSC-58A and the AN/TSC-29.

ILLUMINATION LEVELS (fc = footcandles)
(measured with all four rows of florescent lights on)

	AN/TSC-58A	AN/TSC-29
Communications Terminals:		
Operator, Channel 12	6 fc	29 fc
Supervisor, Channel 0	55 fc	35 fc
Poker, Channel 11	12 fc	34 fc
Printer, Channel 10	59 fc	33 fc
Other	6 fc	30 fc
VDU Keyboard	40 fc	24 fc
OCR Keyboard	27 fc	22 fc
Teletypewriter	25 fc	51 fc
Front Panel of:		
Message Formatter (MP/100)	29 fc	10 fc
Mode 1 Communications Unit	14 fc	7 fc
Processor Controller	12 fc	5 fc
Power Distribution Boxes	2 fc	7 fc

SOUND LEVELS (dB(A) = decibels on A weighted scale)

	AN/TSC-58A	AN/TSC-29
No Communications Terminals Printing	68 dB(A)	70 dB(A)
Two Communications Terminals Printing	84 dB(A)	84 dB(A)
Three Communications Terminals Printing	90 dB(A)	89 dB(A)
TH-22 Alarm		85 db(A)

TEMPERATURE LEVELS (DB = dry bulb, WB = wet bulb, ET = effective temperature)

	AN/TSC-58A (#1)	AN/TSC-58A (#2)	AN/TSC-29
Operator Position	87°F DB	89°F DB	74°F DB
Near Front of Van	71°F WB	70°F WB	60°F WB
	78°F ET	78°F ET	67°F ET
	85°F DB	86°F DB	76°F DB
Middle of Van	69°F WB	69°F WB	60°F WB