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HIGH FREQUENCY RADIO

COMMUNICATIONS ASSESSMENT

FOR THE

MAURITANIA CROP PROTECTION SERVICE

December 1988

This High Frequency Radio communications assessment was prepared for the Office of Foreign Disaster Assistance, U.S. Agency for International Development under contract FDA-0000-0-00-9002-00.

Prepared by: Donald Smith
ASC & Associates
Radio Communications Consultants
647 West Highway 50 (O'Fallon Centre)
O'Fallon, Illinois 62269

HF Radio Communications Assessment

Crop Protection Service
Islamic Republic of Mauritania

Traveler: Donald R. Smith

Days of Travel: 28 October - 20 November 1988

Country Visited: Islamic Republic of Mauritania

SECTION I

Purpose: Train Office of Federal Disaster Assistance and contractor personnel in the use of high frequency radio equipment.

Itinerary:

28 - 29 Oct. 88 Washington D.C. - Received USAID/OFDA briefing and discussed trip objectives. Inventoried, performed operational checks, and packed equipment for shipment to Mauritania.

31 Oct. - 6 Nov. 88 Nouakchott, Mauritania - Received an in-country briefing and status of locust operations. Installed HF radio and erected antenna at the mission locust control office. Provided training to OFDA, contractor, and support personnel in the installation and operation of HF and VHF radios and antennas. Assisted in developing the communications operations concept. Advised team logistician of support requirements at the operating locations.

7 - 12 Nov. 88 R'Kiz, Mauritania - Installed the HF and VHF radios and antennas at the operational location. Conducted basic system performance evaluations. Assisted in establishing the operational facilities for locust operations. Provided additional training to operations personnel.

APPENDICES:

A. Points of contact
B. Personnel Trained
C. Operating Instructions/Procedures
D. Installation Instructions/Procedures
E. Packing Instructions
F. Air/Ground Requirements

Site Visit Reports:

Nouakchott, Mauritania - The Locust Control Operations is located in a vacant residence near the USAID compound. Offices are established for operations control, logistics, and administrative support. Secure storage is available for supplies and equipment. The HF radio is installed in the operations office with the antenna installed on four meter high poles above the roof. The antenna used is a B&W Broadband Dipole 3.5 - 30 MHz. Commercial power is available but is unreliable. Generator backup power is available for the building. A 12 volt battery and battery charger provide the radio a stable power source. The frequency used for the AID in country net is 6260 KHz, upper sideband. No operating procedures or guidance are furnished to users of HF radios on the USAID net. There is question whether this frequency has been properly authorized by the host government for use by USAID. This frequency is allocated to Maritime Mobile paired ship narrow band direct printing telegraphy in accordance with the International Telecommunications Union (ITU) Radio Rules and Regulations. There is continual interference from authorized maritime users of the frequency. If this frequency was assigned by the host nation, request a replacement frequency in band 6765 - 7000 KHz. In addition, the frequency 6260 KHz is used by other AID operations in the lower sideband mode. Again in contradiction to accepted international rules and regulations. Due to propagation characteristics and the international impacts of HF radio operations, it is mandatory that frequencies be properly assigned and used to prevent unnecessary interference and violation of International Rules and Regulations.

R'Kiz, Mauritania - This base camp was established for Desert Locust control operations in the southwest Mauritanian cropping areas. The airfield is a clay based recessional area from the lake. The runway, approximately 3000 feet long, is marked by chalk lines depicting the sides and ends of the runway quarters, operations office, and radio room. An air operations shelter is located at the airfield near the fuel and pesticide stores areas. Generators at the operations location and at the airfield furnish all required power. Power is provided to the radio through a 12 volt battery and battery charger connected to the generator. An inverted L antenna and antenna coupler are located outside the radio room window. Two poles support the antenna. The antenna is twenty feet high by seventy-five feet long. To provide maximum coverage for the handheld Bendix radios the VHF air to ground antenna is mounted on a twenty foot pole attached to the top of the building.

Lessons Learned:

1. All material exceeding 100 pounds in weight or 100 inches combined length and girth cannot be carried as excess baggage. Packages this size must be shipped as cargo.

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2. A Government Bill of Lading prepared for the shipment will minimize shipping delays and customs processing. On scene preparation of customs documents, arranging payments, and coordinating shipping is difficult to complete during non-business hours.

3. Expedited delivery of relief supplies and equipment requires coordination at the trans-shipment points to ensure safe and timely delivery of materials.

Conclusions:

1. Communications is an essential element to ensure effective use of technical assistance teams and properly coordinate in-country assistance operations.

2. The experience and technical skills necessary for planning of desert locust treatment operations are not generally available within the mission. The necessity for full integration of the logistical support, communications, and actual treatment operations is mandatory. USAID personnel in the field have little understanding of the many types of communications-electronics equipment required to support all the facets of Desert Locust operations.

3. Reliance on embassy communications personnel to assist in determining communications requirements is unwise. Embassy communications personnel may or may not have the necessary skills in radio communications, communications equipment, or installation and operations techniques and procedures.

4. Use of existing USAID frequencies and communications equipment to support desert locust operations is inadequate to provide the required communications. Lack of land mobile radios for administrative and logistics support caused many delays, unnecessary use of vehicles, and excessive man-hours in obtaining the supplies and equipment.

5. Lack of a single manager to integrate the total effort created unnecessary delays in obtaining material. Lack of coordination between the operations and logistics support functions created inefficient scheduling of contract haulers to move supplies and equipment, and purchase of unnecessary supplies (fuel drums).

6. Essential aeronautical communications and navigation equipment was not available for operations. The expenditure of unnecessary flight hours detracted from the effectiveness of the operation.

Recommendations:

1. When forming technical assistance teams to conduct Desert Locust control operations, a single manager should be appointed. Before deploying in-country, the manager and key personnel will identify all required communications, operational concepts, procedures, and necessary training. In addition to ensuring more complete operational planning and scheduling, this will provide a single point of contact between the assistance team and AID mission personnel.

2. Total equipment requirements will vary due to the scale of the operations and the locations involved. As a minimum, make provisions for administrative/logistics communications and communications between operating locations and the control agency. If aircraft are used, air/ground communications and aeronautical navigational aids are required to supplement the minimal facilities normally available.

3. Identify communications requirements, forward a request to the host country, through diplomatic channels, for radio frequencies to meet these requirements.

4. All aircraft operating in support of Desert Locust operations must have operable low frequency/medium frequency automatic direction finding and HF radio communications capabilities. Aircraft flight following communications must be available during aeronautical operations.

5. Appropriate installation and operations training materials must be available to train personnel installing and using communications equipment.

6. All communications and navigation equipment should be acquired and shipped from the US. Availability of supplies and equipment in the host countries is questionable. For long term operations provide spare equipment or repair parts with the equipment packages.

7. Provide a communications technician to accomplish the necessary training and install equipment. Long term operations may require a maintenance technician.

FOLLOW-UP ITEMS: None

APPENDIX A

POINTS OF CONTACT

Ambassador Twaddell	US Ambassador to the Islamic Republic of Mauritania (RIM)
Glenn Slocum	Director, USAID/RIM
Joesph Varley	USAID/EXO
Son Hoang Nguyen	ADO
William Thomas	ADO
Paul McDonough	ENG
James Bednar	FFP
Mr Soumare	Dep Director, Crop Protection Service
Mr Dihkite	Logistician/Communications Officer, Crop Protection Service
Mr Sidi Mohammed	Inspector, Dept of Agriculture
Mr Alle Si	Entomologist, Crop Protection Service
Dr. Nsomlie Magema	FAO Representative

APPENDIX B

PERSONNEL TRAINED

Dick Jackson	USDA
Pat McCroy	USDA
Andrew Stancioff	OFDA Contractor
Willaim Thomas	ADO, Locust Project
Earl Springer	Contract Hire
John Przybyszewski	Peace Corp
Greg Griffin	Peace Corp
Sheila Young	Peace Corp
Amanda Sprochi	Peace Corp
Frances West	Peace Corp
Mary Fifles	Peace Corp
Peter Wagner	Peace Corp
Joe Atencio	Peace Corp
Eric Cedergren	Peace Corp
Mary Denham	Peace Corp
Hill Denham	Peace Corp

APPENDIX C

RADIO OPERATING PROCEDURES

Base Station Operation

A. Power Up - Depress the power switch. When the radio is turned on the display will indicate "N O C P L R" for several seconds and will then show the group and channel or frequency. This is the normal indication that the radio is ready for operation.

B. Selecting Channels - On the front panel is a button labeled "GROUP". Depress the group button until an "A" appears in the display. The display will also indicate a channel or frequency. If a frequency is shown, depress the button labeled "Channel/Monitor" once to show the channel number. The tuning knob on the right of the panel may be rotated right or left to change to the desired channel.

C. Operating - The radio is now ready to operate. Adjust the volume control for a comfortable listening level. Depress the microphone switch to talk, release to listen. Speak in a normal tone and voice level with the microphone approximately 1 - 2 inches from the mouth.

Remote Base Operation

A. Power up - Depress the power switch to turn the radio on. When the radio is turned on the display will indicate a group and channel or frequency. If the message "N O C P L R" appears, turn the radio off. Check that the antenna cable is connected to the radio and the antenna coupler. Check for damage to the antenna cable. After connecting or repairing the cable, turn the radio on.

B. Selecting Channels - On the front panel is a button labeled "GROUP". Depress the group button until an "A" appears in the display. The display will also indicate a channel or frequency. If a frequency is shown, depress the button labeled "Channel/Monitor" once to show the channel number. The tuning knob on the right of the panel may be rotated right or left to change to the desired channel.

C. Operating - Depress the microphone switch for approximately five seconds. The message "TUNING" will appear in the display followed by the group and channel number when tuning is complete. If the message "NOTUNE" appears in the display, turn off the radio and check to make sure the antenna is

connected to the coupler and that the antenna is correctly installed. Proceed with all steps to power up and operate the radio. The radio is now ready to operate. Adjust the volume control for a comfortable listening level. Depress the microphone switch to talk, release to listen. Speak in a normal tone and voice level with the microphone approximately 1 - 2 inches from the mouth.

GENERAL RADIO OPERATING PROCEDURES

Due to the characteristics of high frequency radio, and the potential for creating unnecessary interference, certain international rules and regulations have been established for use. The following basic rules and procedures are furnished to ensure compliance.

1. Operators will not make any adjustments to the transmitter that may affect proper operation of the equipment.

2. MAYDAY is the international distress signal. Distress messages have absolute priority at all times.

3. Observe the requirements for proper station identification (call signs).

4. The following are prohibited at all times:

   Use of obscene, indecent, or profane language

   Unauthorized disclosure or use of messages

   Superfluous, false, or deceptive signals or communications

   Transmission of unassigned call signs

5. All radio stations will maintain a station log. This log will contain as a minimum:

   Date Time Station Called Channel or Frequency

6. Keep copies of written messages sent by your station for a period of one week. Annotate on the message the date and time transmitted.

7. Difficult or confusing words will be spelled out using the standard international phonetic alphabet.

8. Use standard procedural words (pro-words) when appropriate.

9. Use of preformatted messages to minimize confusion or misunderstanding and to speed the forwarding of information.

10. Use call signs to minimize confusion and properly identify stations transmitting.

11. Fixed stations will use "Locust Control" and their location as the call sign. An example is: "Locust Control Nouakchott this is Locust Control R'Kiz, over".

12. Mobile stations will use the location they are operating in and a numerical identification. For example: "Locust Control R'Kiz this is R'Kiz Mobile 2, over".

13. Transmissions should end with the word "Over" if you expect a reply or the word "Out" if no reply is expected.

PROCEDURAL WORDS

PRO-WORD	MEANING
Affirmative	Yes, or I agree with what you said
All After.....	Repeat all of your transmission after the word .....
All Before.....	Repeat all of your transmission before the word .....
Negative	No, or I do not agree with what you said
Out	I am finished, I do not expect a response
Over	I am finished, please respond
Roger	I received your transmission
Say again	Please repeat
Standby	I cannot transmit now but I will reply within one minute
Wait	I can not transmit now. I will call when able

INTERNATIONAL PHONETIC ALPHABET

A	Alpha	N	November
B	Bravo	O	Oscar
C	Charlie	P	Papa
D	Delta	Q	Quebec
E	Echo	R	Romeo
F	Foxtrot	S	Sierra
G	Gulf	T	Tango
H	Hotel	U	Uniform
I	India	V	Victor
J	Juliet	W	Whiskey
K	Kilo	X	Xray
L	Lima	Y	Yankee
M	Mike	Z	Zulu

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REMOTE RADIO DAILY CHECKLIST

_____
DATE

	Y	N
1. Is the water level in the battery correct?		
2. Are the power wires for the radio securely connected to the battery?		
3. Are the battery terminals and connections free from corrosion?		
4. Are the power wires and the antenna cable free of cuts, nicks, and abrasions?		
5. Check the antenna and coupler. Are they connected? Is there any damage?		
6. Turn on the radio. Does the power light come on?		
7. Adjust the volume control. Select the proper channel. Do all the radio controls function correctly?		
8. Inspect the microphone, cable, and connector. Is it free of damage? Does the PTT switch work properly?		
9. Is the radio turned off when not in use to prevent damage to the radio and battery?		

_____
SIGNATURE

If any answer is no, have the radio checked by your supervisor or a radio technician.

FIXED RADIO DAILY CHECKLIST

	DATE	
	Y	N
1. Is the water level in the battery correct?		
2. Are the radio power and battery charger wires securely connected to the battery?		
3. Are the battery terminals and connections free from corrosion?		
4. Is the battery charger operating correctly?		
5. Are the power wires and the antenna cable free of cuts, nicks, and abrasions?		
6. Is the radio securely fastened at the operating position?		
7. Check the antenna installation. Check for any damage?		
8. Turn on the radio. Does the power light come on?		
9. Adjust the volume control. Select the proper channel. Do all the radio controls function correctly?		
10. Inspect the microphone, cable, and connector. Is it free of damage? Does the PTT switch work properly?		
11. Is the radio turned off when not in use?		

SIGNATURE

If any answer is no, have the radio checked by your supervisor or a radio technician.

NOTE: The battery charger must be plugged in and operating at all times except while servicing the battery or making electrical connections.

CHANNEL LIST

ROUP	CHANNEL	USER	REMARKS
A	1	USAID/MAURITANIA	Locust Operations
A	2	CPS	5261KHz USB
A	3	CPS	5261KHz LSB
A	4	CPS	7951KHz USB
A	5	CPS	7951KHz LSB
A	6	CPS	8025KHz USB
A	7	CPS	8025KHz LSB, Primary
A	8	CPS	8150KHz USB
A	9	CPS	8150KHz LSB
A	10	CPS	14708KHz USB
A	11	CPS	14708KHz LSB
A	12	BBC	Night
A	13	BBC	Day
A	14	VOA	
A	15	USAID/SENEGAL	Locust Operations

APPENDIX D

INSTALLATION INSTRUCTIONS/PROCEDURES

Antenna Masts:

1. Locate the antenna masts approximately 80 feet (24.5m) apart. Make sure the masts are away from electric power lines, vehicular traffic, or other hazards.

2. Place the guy stakes equally around the base of the antenna mast. Place one guy stake on the opposite side of the mast from the antenna. Guy stakes should be approximately 13 feet (4m) from the antenna mast base.

3. Make sure the halyard ropes are in place before raising the masts into position.

4. Raise the antenna masts into position and secure with ropes to the guy stakes. Adjust the guys until the masts are as vertical as possible.

Inverted L Antenna

1. Attach a ceramic insulator to the free end of wire on the black spool as shown in the attached drawings.

2. Fasten the halyard rope of the most distant antenna mast to the ceramic insulator.

3. Carefully unroll the spool of wire toward the other antenna mast. Be careful not to kink the wire.

4. Measure seventy-five feet (22.9m) of wire from the insulator. Fasten a second ceramic insulator to the wire at this point.

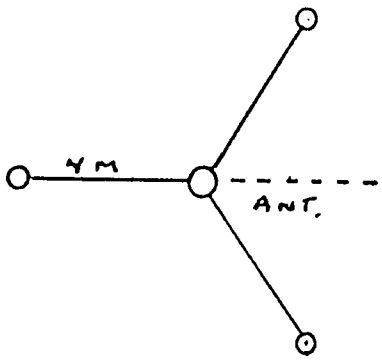
5. Fasten the halyard of the second antenna mast to this insulator. Raise the halyard to approximately 18 inches (.5m) from the top of the mast. Unwind the wire carefully to avoid kinks.

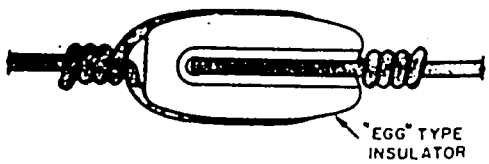
6. Fasten the free end of the wire to the antenna coupler binding post. Make sure there is no slack in the wire. Cut off the excess wire.

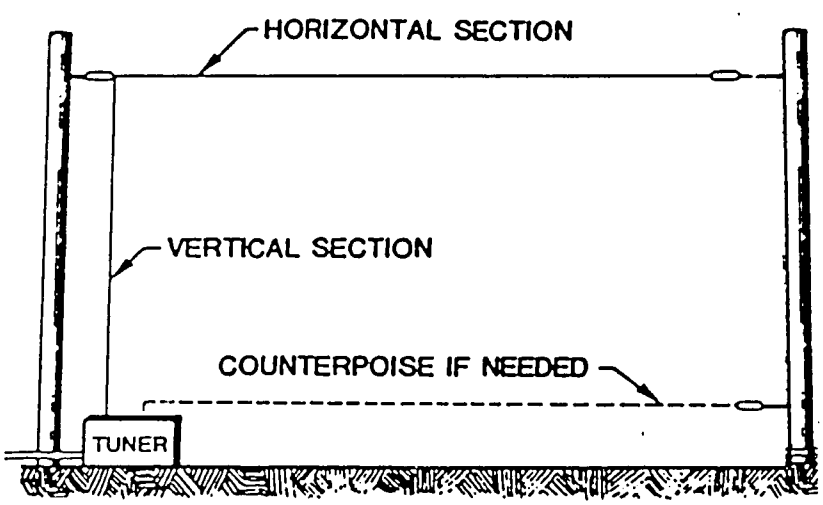
7. Fasten the antenna coupler to the base of the antenna mast making sure the antenna wire does not touch the mast.

8. Raise the antenna at the far mast taking all slack out of the wire.

9. Drive a ground stake at least 6 feet (2m) long into the ground near the antenna coupler. Connect the antenna coupler ground to the ground stake with the excess wire.







ANTENNA INSTALLATION DRAWINGS

FIXED STATION BATTERY INSTALLATION

1. Batteries for fixed operations must be 100 AH capacity.

2. Locate batteries in a well ventilated area.

3. Fasten battery chargers securely to a wall near the battery location.

4. Wiring between the battery charger and the battery should be 10 gauge or larger.

5. Post warning signs at each battery location.

   " NO SMOKING, MATCHES, OPEN FLAME, OR SPARK

   PRODUCING DEVICES WITHIN 10 METERS"

6. All battery terminals and connections must be clean and free of corrosion.

7. Install connectors and wires to the battery. Tighten securely.

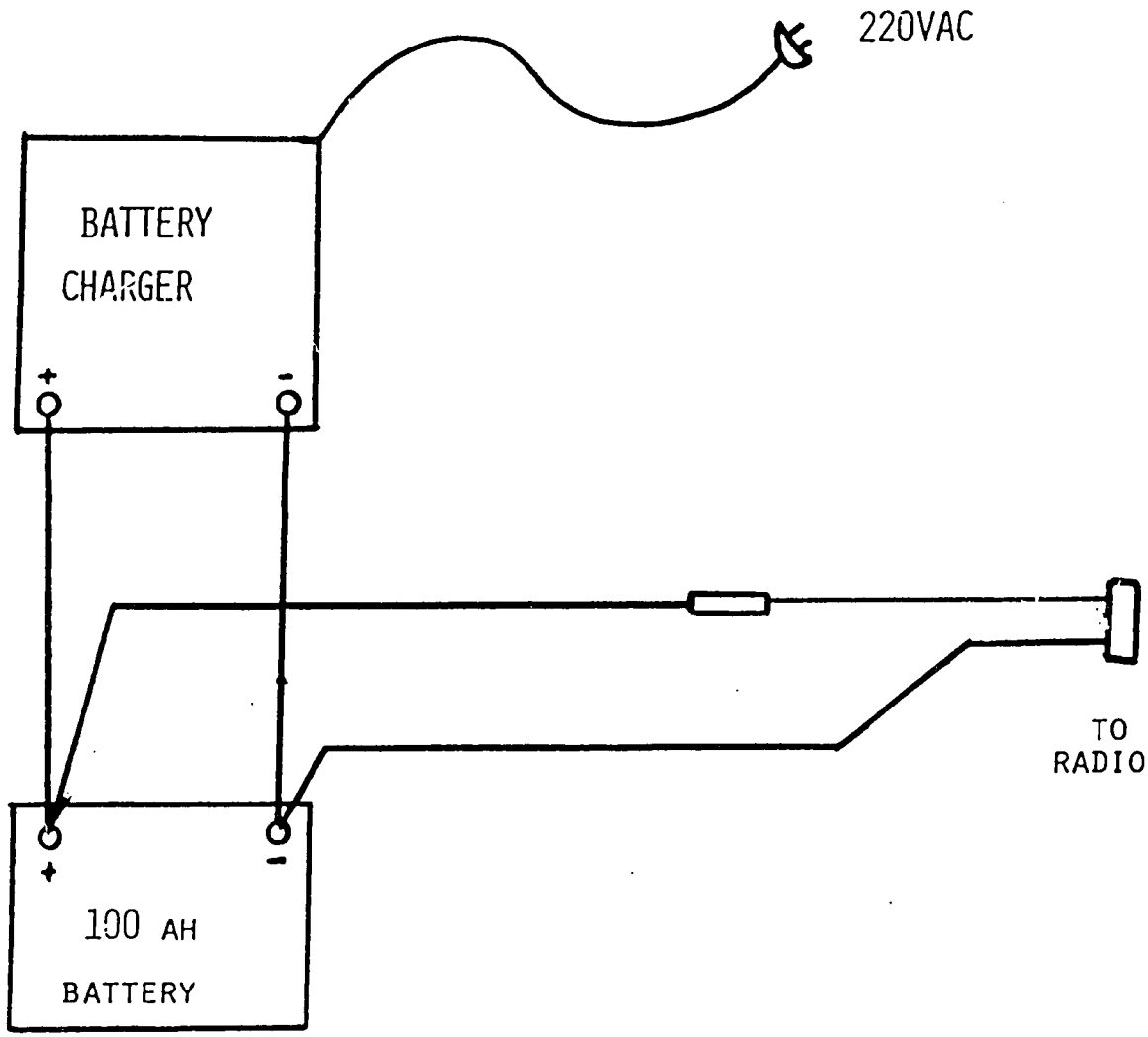
8. Check battery liquid levels once each week. Remove the caps from each cell and check the level. If the level is below the fill indicator, add distilled water until the level is at the fill indicator.

"C A U T I O N"

Battery solution is extremely corrosive. Do not get the solution on skin, eyes, or clothing. If the solution is spilled on you seek immediate medical attention.

9. Operate the battery charger at all times except when servicing the battery or when making connections to the battery.

BATTERY INSTALLATION DIAGRAM



APPENDIX E

PACKING INSTRUCTIONS

The following instructions are furnished to assist in packing and shipping the OFDA supplied radios upon completion of the current operations:

1. Open the case and remove all packing material.

2. Coil all cables and place in the bottom recesses in the shipping box.

3. Place the divided panel in the box.

4. Wrap the two antenna couplers and place side by side at one end of the shipping case.

5. Place the black accessory case for the RF3200T vertically in the case next to the antenna couplers.

6. Wrap the RF3200T radio and place next to the accessory case.

7. Place the empty handheld battery cases around the side of the RF3200T to fill the loose areas.

8. Place the air/ground base station antennas on top of the antenna couplers at the sides of the shipping case. Wrap the RF3200 radios and place between the base station antennas.

9. Place the six Bendix handheld radios next to the RF3200's in the center of the case.

10. Place the top packing material over the radios and fasten the lid of the shipping case. Place shipping labels on all sides, top, and bottom of the shipping case.

11. The approximate shipping weight is 260 pounds.

APPENDIX F

AIR/GROUND REQUIREMENTS

This appendix is divided into two distinct areas involving aeronautical communications and navigation. While some recommendations are difficult to quantify in terms of dollar value of savings, their importance cannot be diminished. All recommendations made are to improve efficiency, increase safety, and enhance overall program effectiveness.

Communications:

The use of aircraft in large scale Desert Locust treatment programs is essential because of the large areas of infestation, the topography of the country involved, and the "window" of effectiveness for treatment during the life cycle of the Desert Locust. Timely communications with the aircraft is essential to relay information on changing meteorological conditions, alternate spray treatment areas, and aircraft emergency communications. With the limited range of VHF communications and the wide areas of operation, a high frequency (HF) radio system is necessary. During the current operations two separate incidents highlighted the need for communications to meet safety requirements. In the first instance, a pilot made a precautionary landing due to impaired visibility, remaining overnight at an alternate airport. When notified the aircraft failed to arrive and no way of determining the status of the aircraft, actions were begun to start a downed aircraft search. Information was finally relayed on the aircraft arrival just prior to host country notification. In the second incident, an engine failure required an emergency landing. Fortunately the pilot was able to land on a paved highway with no problem, and information was relayed within an hour that the plane was down and there were no injuries. In the first case an expensive search and rescue operation was barely averted, and in the second only the timing of the engine failure near a highway prevented a potentially serious accident with with no means of summoning assistance.

1. All aircraft involved in Desert Locust air operations, survey, spotters, and applicators, must have operable HF radios installed. A HF flight following net will be operational whenever aircraft are airborne.

2. Survey and flagging personnel must be able to contact aircraft when meteorological or other conditions change impacting spraying operations. Two factors limit the range of the current handheld VHF AM radios. The first of these is the low transmit power of the handheld and the second is the sensitivity of the airborne radio equipment. Airborne radio sensitivities typically vary between 1 and 6 microvolts with the squelch set. Nominal

range with the aircraft at spray altitude is 1 - 3 miles. The handheld radios with either magnetic mobile antennas or full length whip antennas meet this requirement adequately.

Aeronautical Radio-Navigation

Precise navigation within much of the country is severely restricted by the lack of existing navigational aids. With few identifiable terrain landmarks many flight hours are expended by "dead reckoning" navigation between airfields and spraying areas. During this operation, ten hours of of flight time was expended just in locating and identifying the airfield at R'Kiz. This was after the field had been marked with 3000 foot long white stripes. An estimated twenty minutes additional flight time was consumed on each flight between Nouakchott and R'Kiz by not flying direct routes. This totaled to over three additional flight hours. As the majority of spraying was done within a 30 mile radius of R'Kiz, it is difficult to estimate how much additional flight time was required in locating the spraying areas, ferry time between the airfield and the areas, and the accuracy of the spray blocks when flaggers were not used. With small aircraft thirteen hours of additional flying would purchase a portable non-directional beacon. As indicated by the cable information provided by USAID/Niger, the reduction of ferry times, and the increased accuracy of locating spray blocks significantly increases the effectiveness of the Desert Locust control programs.

1. All aircraft involved in Desert Locust control operations will have and operable LF/MF ADF (low frequency/medium frequency automatic direction finder) capability.

2. A portable LF/MF beacon must be installed at all remote operating airfields more than fifty nautical miles from fixed navigational aids when Omega systems are not used for navigation by the application aircraft.

SECTION II

PURPOSE:

To design a radio system to support the grasshopper and locust control operations for the government of Mauritania. Specifically to:

- assess the immediate and short term communications equipment needs for the Crop Protection Service (CPS) for Locust and Grasshopper control operations including, but not limited to , land mobile, aeronautical mobile, and aeronautical navigational requirements.

- identify and provide written specifications for equipment, including installation specifications.

- review and rate local, and if necessary, regional firms on their ability to install and maintain the recommended equipment.

- provide a short training outline for users. This can be based on manuals provided by the contractor which may be translated and distributed locally.

ITINERARY:

14 Nov. 88 R'Kiz, Mauritania - Visited the local Crop Protection Service office, reviewed the HF radio installation, and discussed communications problems with the technician.

15 - 16 Nov. 88 Nouakchott, Mauritania - Visited the Crop Protection headquarters and local communications site. Discussed communications problems with the Deputy Director and communications officer. Reviewed operating procedures, available frequencies, and equipment installations.

APPENDICES:

A - Concept of Operations and Network Architecture
B - Propagation Predictions and Frequency Requirements
C - Equipment Recommendations
D - Maintenance Recommendations
E - Installation Procedures
F - Users Training Guide

17 - 19 Nov. 88 Nouakchott, Mauritania - Visited local radio and electronics maintenance facilities. Determined available facilities, status of training, test equipment, and spares available. Reviewed radios awaiting repair and their status.

Site Visit Reports:

R'Kiz, Mauritania - The local Crop Protection Service (CPS) office is located in a building in the village of R'Kiz. The radio equipment used is an Icom Model 735 powered by a 12 volt automotive battery. The antenna used is a dipole, cut approximately to frequency, and mounted 4 meters above ground. The ground conditions are sandy, dry soil. No counter-poise was used. Frequency used was 8025 KHz USB for communications with the department office in Rosso, Mauritania. Frequency 8025 KHz LSB was used for communications with the CPS headquarters in Nouakchott.

Nouakchott, Mauritania - The CPS headquarters is located in the Ministry of Rural Development building the Department of Agriculture. Discussions with CPS personnel reflected concern over the life expectancy of radios being furnished by donors. There is additional concern with the problems of obtaining adequate maintenance for all equipment. The frequencies available to the Department of Agriculture and the CPS are: 5261 KHz, 5415 KHz, 5465 KHz, 7951 KHz, 8025 KHz, 8150 KHz, and 14708 KHz. Of these frequencies, 5415 and 5465 KHz are assigned to the Department of Agriculture with the balance being OCLALAV frequencies. The primary frequencies for CPS operations are 5261 and 8025 KHz using both upper and lower sideband mode.

The CPS communications facility is located at the edge of town next to the storage yards. Two Icom 735 HF radios are in use. Commercial mains furnish power to Icom power supplies. A generator is available to provide backup power. Antennas are dipoles at the operating frequency. The antenna installation is poor. There is excessive coax to the antennas. With only end supports there is considerable sag in the middle of the antenna. Although communications are only required during daylight hours, there is only sporadic contact with many stations. Many departmental stations do not have commercial power and operate only from automotive batteries. Recharging batteries is a continuing problem at most locations. Radios are improperly tuned (over driven) and usually off frequency. The is no formal training program for operators or published operating instructions. Operators complain the existing radios are to complicated to use and they break to often. Users remove covers and attempt unauthorized repairs and adjustments. The FAO recently provided another ten Icom 735 radios to the CPS.

The CPS has no communications maintenance personnel. All

equipment requiring repair is sent to local businesses in town. The majority of electronic repair establisnments service only consumer appliances. Service is usually limited to cannabalization of circuit boards between units. One of the primary repair shops used by the CPS has twenty-four inoperable HF transcievers on hand. This shop has no test equipment for transmitting equipment. The technicians have had no training in solid state or digital theory and no training in trouble-shooting techniques. The primary repair technique is to replace circuit boards where possible. Often circuit boards are no longer available. There are few component parts on hand and no knowledge of how to order parts from outside suppliers. All service manuals are the english language version instead of french.

Lessons Learned: N/A

Conclusions:

1. The most effective means of communication available to support the CPS desert locust and grasshopper control operations is high frequency (HF) radio. This is based on requirements for many dispersed operational locations, the peculiar characteristics of each CPS department, and the topography of Mauritania.

2. The existing HF communications has developed with no concept of operations or defined network architecture. This limits to integration and effectiveness of the existing communications assets.

3. The CPS has insufficient frequencies assigned to support the operational requirements. Frequencies currently in use are residual assets previously used for OCLALAV operations. Some of these frequencies have other users in Mauritania and adjacent countries within the Sahel.

4. Without a concept of operations, or defined network architecture, attempts by various donor countries to provide communications equipment have not been fully effective. This contributes to the difficulties of providing an integrated and responsive communications system.

5. There are insufficient radios available to the CPS. The radios that are available are inappropriate for use by untrained operators. This prevents effectively meeting the operational communication requirements for control of the desert locust and grasshopper operations. As a direct result, the CPS has difficulty [illegible]ly responding, integrating, and using all available resources.

6. Country restrictions on the importation of transmitting equipment and contracting with outside companies for turnkey major communications installations has hindered the development of an adequate technological experience base of in all types of mobile radio communications.

7. The lack of installation and maintenance facilities severely limits the life expectancy of the existing radio assets.

8. Little emphasis is being placed on user preventive maintenance inspections and services to equipment. This contributes to degradation of the communications capability and shortens the life expectancy of the equipment.

9. Lack of reliable commercial power in most areas of the country restricts the effective use of the radio assets. Alternative power sources should be employed to the maximum extent possible.

Recommendations:

1. Establish and disseminate a concept of operations and network architecture to define the communications requirements of the CPS. Based on discussions with CPS officials, technicians, and field survey personnel a proposed concept of operations and network architecture is furnished as Appendix A.

2. The CPS should request frequencies from the Ministry of Posts and Telecommunications (OPT) to support the network architecture. Typical propagation predictions are furnished and the required frequency ranges provided. These are included in Appendix B.

3. Additional HF radios and ancillary equipment are required to provide the essential communications capability of the CPS. Equipment specifications furnished in Appendix C reflect the technical characteristics necessary to support the concept of operations contained in Appendix A.

4. Radio frequency interference suppression devices are needed on all CPS vehicles with installed mobile radios. This will significantly reduce ignition and/or electrical system noise, improve operational performance of the mobile radios. This incidentally will reduce many of the dead battery problems associated with the current mobile installations.

5. For vehicles with mounted agricultural spray equipment. Mount radio components inside the vehicle cab with the antenna mount and connections mounted as high on the cab as possible. Pesticides used are extremely corrosive and any equipment exposed to these sprays must be thoroughly cleaned as soon as possible after exposure.

6. Provide solar panels for charging of batteries for all fixed locations. Adequate sunshine is available to maintain the electrical charge for battery operation. This will eliminate the problems caused by unreliable commercial power.

7. Provide all maintenance and instruction manuals in the French language version or appropriately translated by a translator versed in communications verbiage. Few available maintenance personnel are conversant in the English language. Local translation of technical material may not be cost effective.

8. Assist in the reproduction and distribution of the installation, maintenance, and radio operating procedures furnished in Appendices E and F.

9. AGRHYMET has an established training program for HF radio theory and maintenance to support the AGRHYMET HF radio network. In addition AGRHYMET presents an extensive program on electronics test equipment and maintenance of remote sensor and electronic data collection equipment. AGRHYMET is receptive to adding a course in HF antennas and radio operating procedures to the existing courses. This would provide a regional training center for radio maintenance technicians of the Crop Protection Services throughout the Sahel. Additional investigation and study of means to implement this training is warranted to provide a sustaining capability for CPS communications systems.

APPENDIX A

CONCEPT OF OPERATIONS

The lack of a concept of operations defining communications requirements, levels of control and coordination, operating elements, and typical locations inhibits development of a viable, integrated network architecture. This lack of architecture correlates directly with the ability to respond in the most efficient manner making the most effective use of crop protection assets.

Discussion with Crop Protection Service personnel, survey technicians, aeronautical spray technicians, and other parties involved in desert locust and grasshopper control operations identified: types of information, time periods required, methods of operation, and equipment limitations during operations.

As a result of visits and discussions the following proposed concept of operations and network architecture is submitted for consideration.

CONCEPT OF OPERATIONS

CROP PROTECTION SERVICE
HF COMMUNICATIONS NETWORK

I. PURPOSE:

The Crop Protection Service HF radio network is designed to identify essential control and coordination communications requirements between CPS headquarters, CPS region and department headquarters, dispersed field survey and treatment elements.

The Crop Protection Service has many responsibilities. Among these are; monitoring potential crop hazards, coordinating and controlling personnel, equipment, and supplies in response to threats to crop production. The lack of an extensive communications infra-structure within the country's agricultural areas requires an effective, efficient, and timely communications network. The topography of Mauritania and the distances between operating elements eliminates virtually all communications modes except high frequency (HF) radio.

II. FUNCTIONAL ORGANIZATION:

A. The Crop Protection Service headquarters is located in Nouakchott. Communications is required between the CPS hqs and the twelve regional offices. Of the forty three departmental CPS offices each region requires communications with those departments within its geographic area of responsibility. Types of information to be discussed are; operational coordinations, scheduling, status of supplies and equipment, and control of assets necessary to meet operational requirements.

B. Within the departments the CPS offices must have a communications capability with dispersed field survey teams, treatment teams, and agricultural support aircraft. Timely reporting of types of pests, stages of development, location of infestations, and movements are essential to plan and coordinate treatment operations.

C. Field operating elements, survey teams, aircraft, aircraft support, and observation and marking teams, require inter-team communications. These communications provide positioning information, request maintenance assistance, coordinate spraying paths, and report coverage effectiveness.

III. EQUIPMENT REQUIREMENTS:

A. CPS Hqs/Region/Department Offices

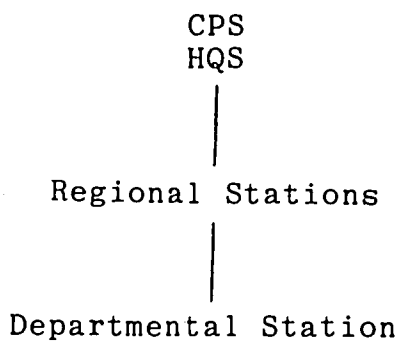
Facilities require HF radios capable of communication with all dispersed locations and should have scanning capability to monitor assigned frequencies. To provide for interchangeability and eliminate dependence on unreliable power all radios must operate on 13.8 VDC. Stations must have antennas capable of using all assigned CPS frequencies. Fixed stations will be equipped with batteries for operation capable of a minimum 4 hours operating capacity. Solar powered or automatic battery chargers will be provided to maintain battery charging capacity.

B. Mobile Installations

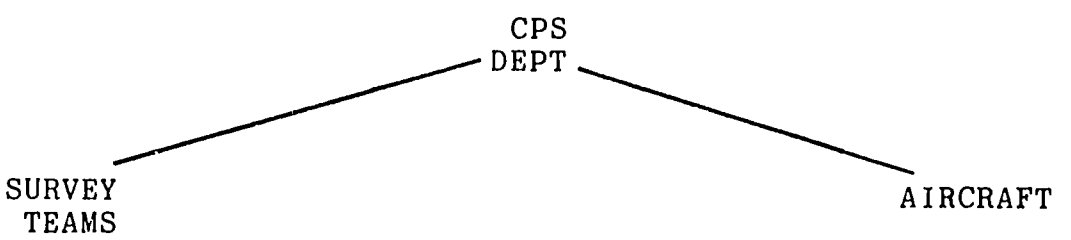
Mobile equipment must be fully capable of operating on assigned CPS frequencies while in motion or stationary. Due to inherent antenna limitations, automatic antenna couplers which are capable of providing matching for all assigned CPS frequencies must be provided. Radio equipped vehicles must have appropriate radio frequency interference suppression devices installed. All equipment will operate on 13.8 VDC with the exception of aircraft mounted/installed equipment.

IV. NET/SUB-NET STRUCTURES

A. CPS Net



B. Department Sub-Net



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C. Air Ground Coordination Net

APPENDIX B

PROPAGATION PREDICTIONS AND FREQUENCY REQUIREMENTS

The frequencies currently in use by the CPS are residual assets used by OCLALAV. In addition, the frequency range and quantities are inadequate to meet the communication requirements of the CPS.

Typical propagation predictions were prepared to identify necessary frequency ranges for CPS operations. These predictions along with the proposed concept of operations define the requirements.

Frequency requirements should be submitted through appropriate ministerial channels to the OPT for necessary action. The following technical information is furnished to assist in frequency assignment action:

For the CPS Headquarters/Regional/Departmental Net:

User: Crop Protection Service

Emission: 3K00J3E Power: 100 Watts

Station class: FX

1 Frequency in Band 3200-3400 KHz

1 Frequency in band 5060-5480 KHz

1 Frequency in band 7300-8100 KHz

1 Frequency in band 10250-11275 KHz

Operating Locations are: Country wide

For the Departmental Operations Sub-Net:

User: Crop Protection Service

Emission: 3K00J3E Power: 100 Watts

Station class: FX/MO

1 Frequency in band 4750-4995 KHz

1 Frequency in band 6765-7000 KHz

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1 Frequency in band 9040-9500 KHz

Operating Locations: Country wide

For the Air/Ground Support Sub-Net:

User: Crop Protection Service

Emission: 3K00J3E Power: 100 Watts

Station class: MO

1 Frequency in band 5680-5730 KHz

1 Frequency in band 8965-9040 KHz

Operating Locations: Country wide

User: Crop Protection Service

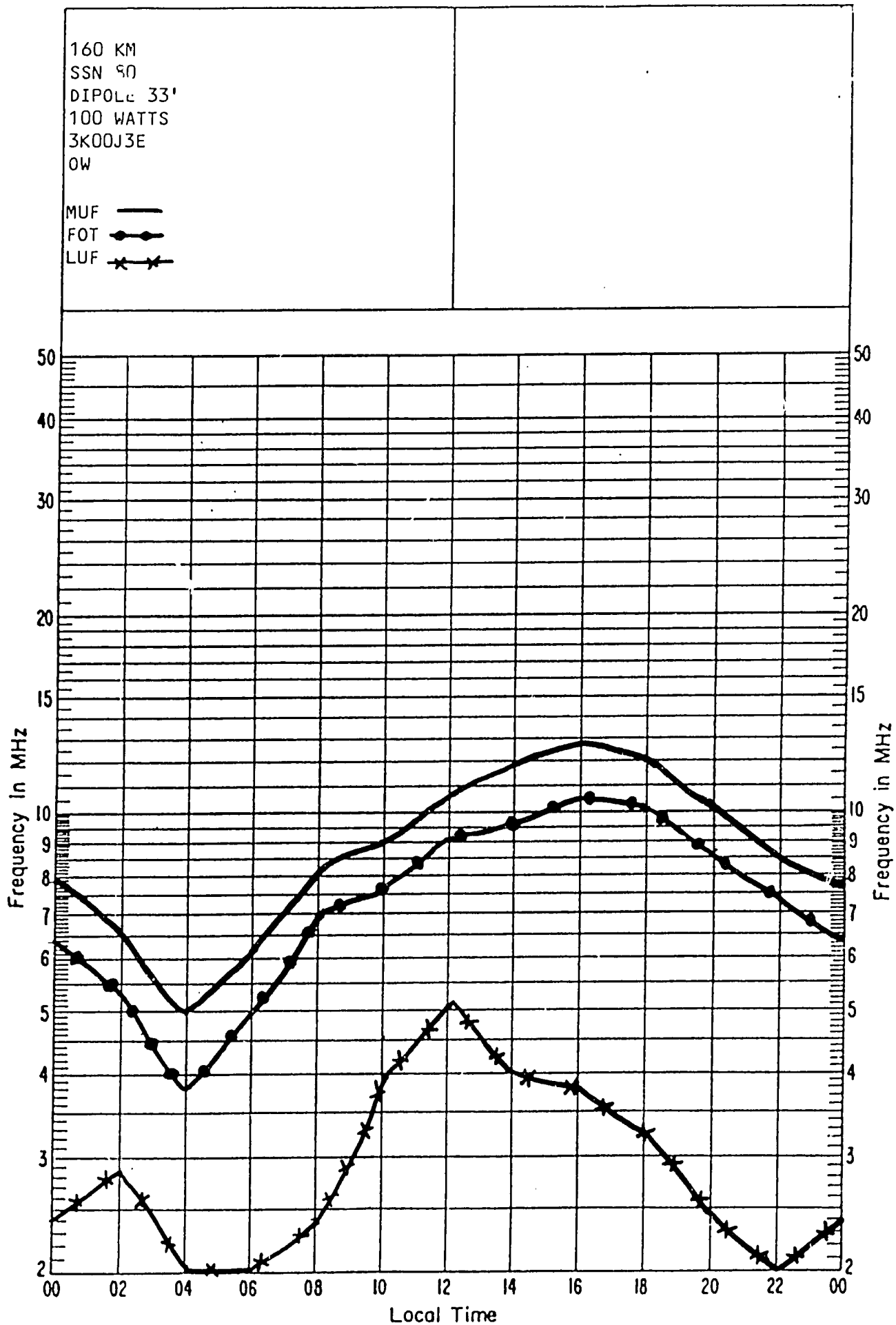
Emission: 6K00A3E Power: 10 Watts

Station class: MO

1 Frequency in band 132-133 MHz

Operating Locations: Country wide

Separate nets/sub-nets are required to permit multiple operations simultaneously within the country and still provide reliable communications.


160 KM
SSN 90
DIPOLE 33'
100 WATTS
3K00J3E
OW
MUF
FOT
LUF
Frequency in MHz
Local Time
50
40
30
20
15
10
9
8
7
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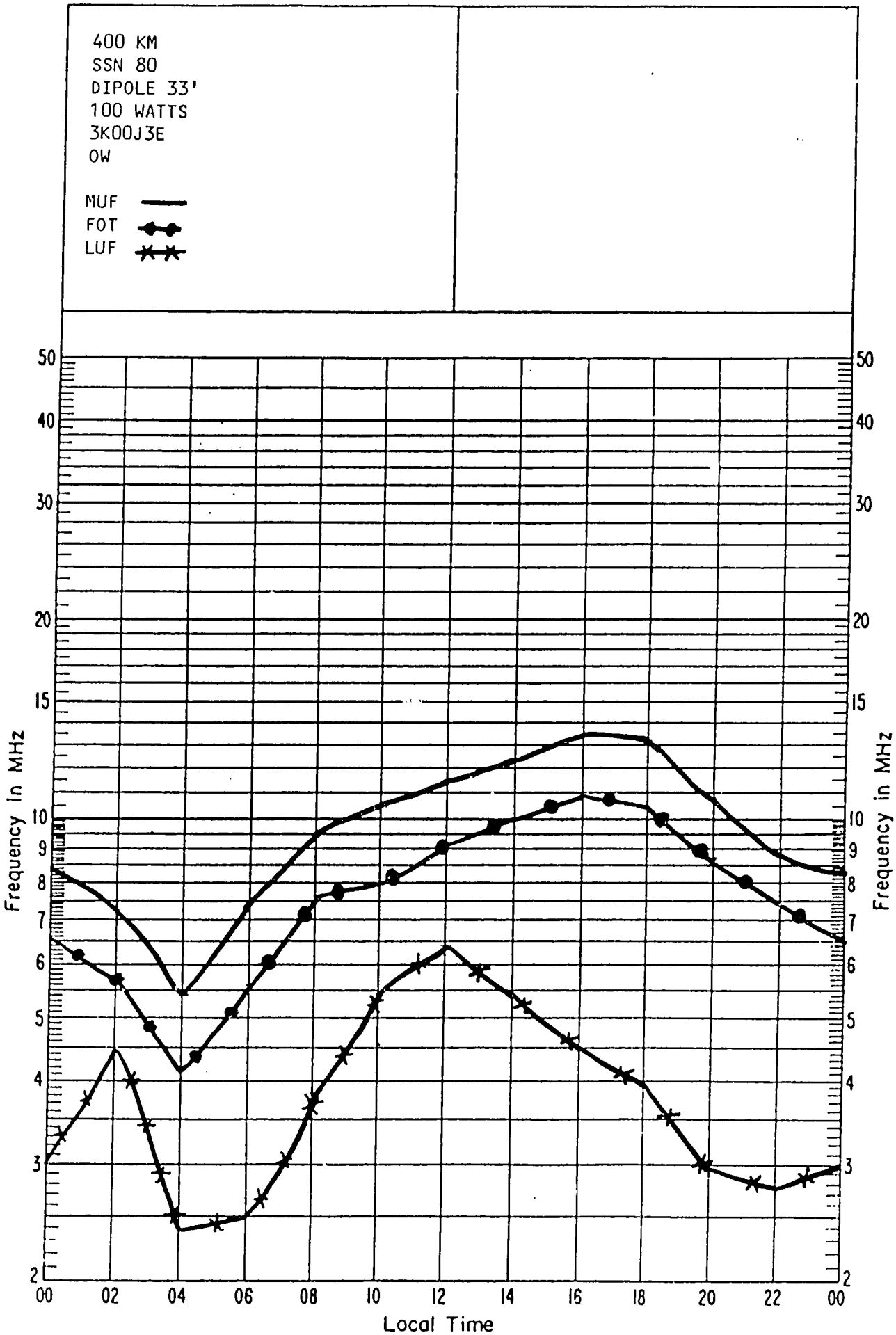
400 KM
SSN 80
DIPOLE 33'
100 WATTS
3K00J3E
OW
MUF
FOT
LUF
Frequency in MHz
Local Time
50
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30
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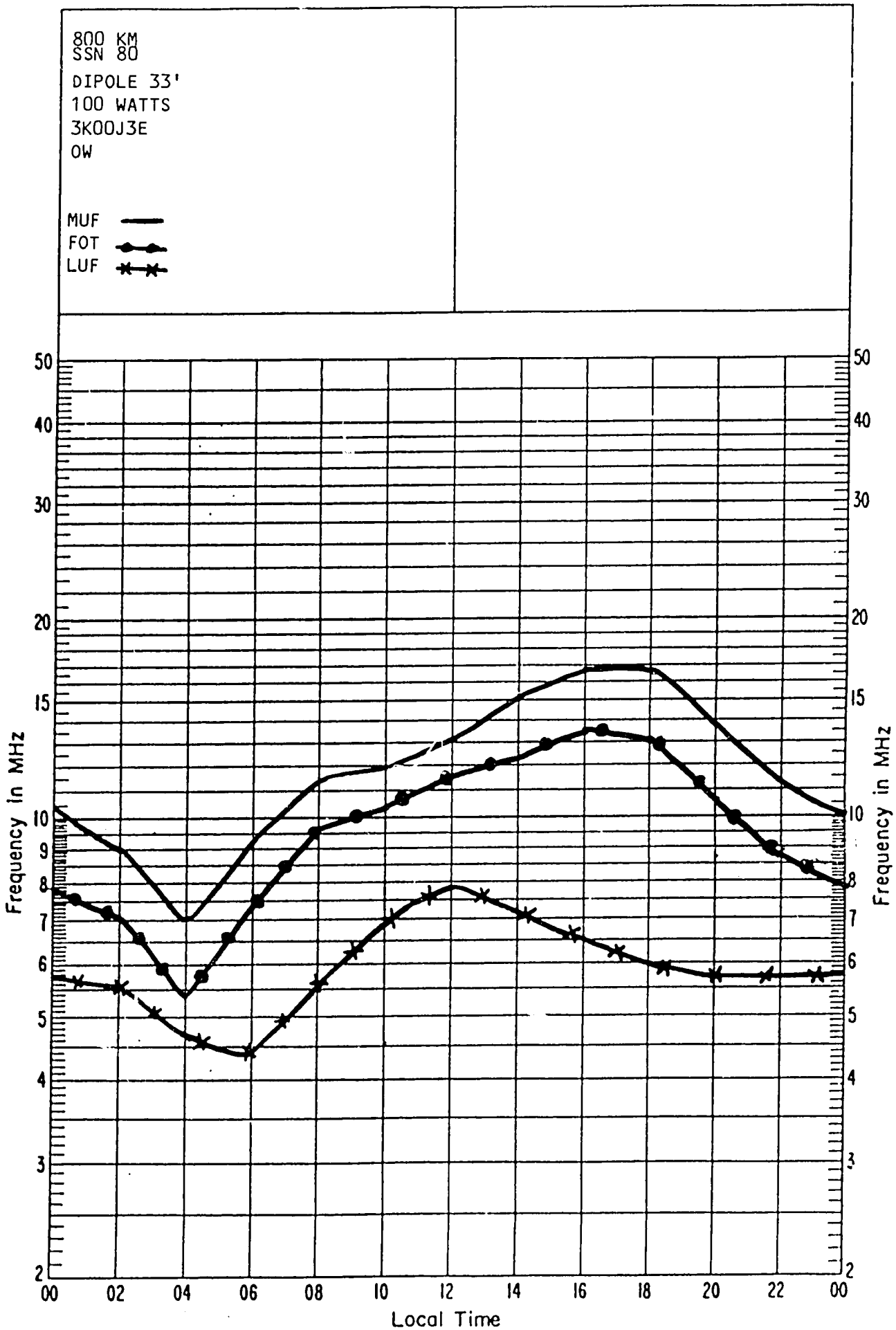
800 KM
SSN 80
DIPOLE 33'
100 WATTS
3K00J3E
OW
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FOT
LUF
Frequency in MHz
Local Time
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APPENDIX C

EQUIPMENT RECOMMENDATIONS

The following communications equipment recommendations are made to support the Crop Protection Service HF network. These recommendations are made to:

1. Provide equipment meeting the minimum essential requirements

2. Provide equipment that is both easy to operate and maintain in the normal operating environment

3. Simplify installation and maintenance procedures

4. Simplify operator training

RADIO:

High frequency single sideband radio, tuning range minimum 3 - 12 MHz, output power 100 watts PEP minimum, upper and lower sideband capability, minimum 4 channel fixed frequency operation, with noise blanker, hand microphone, and mobile mounting bracket. Radio must have a minmum of operating controls. Radio must operate on 13.8 VDC. If radio is programmable, access to programmng controls must be restriced from users.

ANCILLARY ITEMS:

Mobile antenna tuner, capable of tuning any frequency used by the radio.

Mobile antenna, 9 foot steel whip

Mobile antenna mounting bracket, with spring

Broadband Dipole Base station antenna covering the frequency range of the radio

Battery charger, solar powered with float regulator or

Battery charger, 220VAC input 13.8VDC output

Parts repair kits should be provided to support the radios acquired if a maintenance capability is available.

APPENDIX D

MAINTENANCE RECOMMENDATIONS

At this time a number of Crop Protection Service and other agencies radios are awaiting maintenance at a local repair shop. Discussion with the technician reveals the following:

- there is no test equipment available to trouble-shoot or align the radios properly

- there are no spare parts to repair the radios

- many of the maintenance manuals are in english instead of french

- the technician has had no training in solid-state or digital electronics theory

- the technician cannot locate any source of repair parts for many of the radios

It is doubtful if there will be any improvement in the local maintenance and repair capabilities in the near future. Investigation of other maintenance facilities in the region was generally without success. With few exceptions, the closest repair stations for CPS radio equipment are located in Europe.

A list of radio equipment currently in the local repair shop is as follows:

PYE Telecommunications SSB-125	6 ea
PYE Telecommunications SSB-130	6 ea
Scientific Radio SR-204	4 ea
Thompson-CSF	1 ea
Icom 735	1 ea
Icom 745	1 ea
UTS Communications Ltd SSB-10S-4	2 ea
CAI	4 ea

Although not all of the above radios belong to the CPS, the following information on repair sources may be furnished as required.

THOMPSON-CSF	Thompson-CSF Dakar, Senegal
ICOM	Icom Europe, G.M.B.H. Himmelgeister Strasse 100 4000 Duesseldorf 1 West Germany Telex 41-8588082
SCIENTIFIC RADIO	Scientific Radio Systems 367 Orchard St. Rochester N.y., 14606 USA Telex 978-368

APPENDIX E

INSTALLATION PROCEDURES

Several installation procedures have been developed to assist in the establishment of the CPS HF radio net. Recommend that this procedures be translated to French language. Reduce in size to 5 X 7 inches. Laminate and distribute to all personnel involved with the installation and maintenance of the CPS HF radios.

1 - Fixed Station Battery Installation

2 - Fixed Station Antenna Installation

3 - Mobile Radio Installation Tips

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FIXED STATION BATTERY INSTALLATION

1. Batteries for fixed operations must be 100 AH capacity.

2. Locate batteries in a well ventilated area.

3. Fasten battery chargers securely to a wall near the battery location.

4. Wiring between the battery charger and the battery should be 10 gauge or larger.

5. Post warning signs at each battery location.

" NO SMOKING, MATCHES, OPEN FLAME, OR SPARK

PRODUCING DEVICES WITHIN 10 METERS"

6. All battery terminals and connections must be clean and free of corrosion.

7. Install connectors and wires to the battery. Tighten securely and then apply a thick coat of grease to the terminals and connections to prevent corrosion.

8. Check battery liguid levels once each week. Remove the caps from each cell and check the level. If the level is below the fill indicator, add distilled water until the level is at the fill indicator.

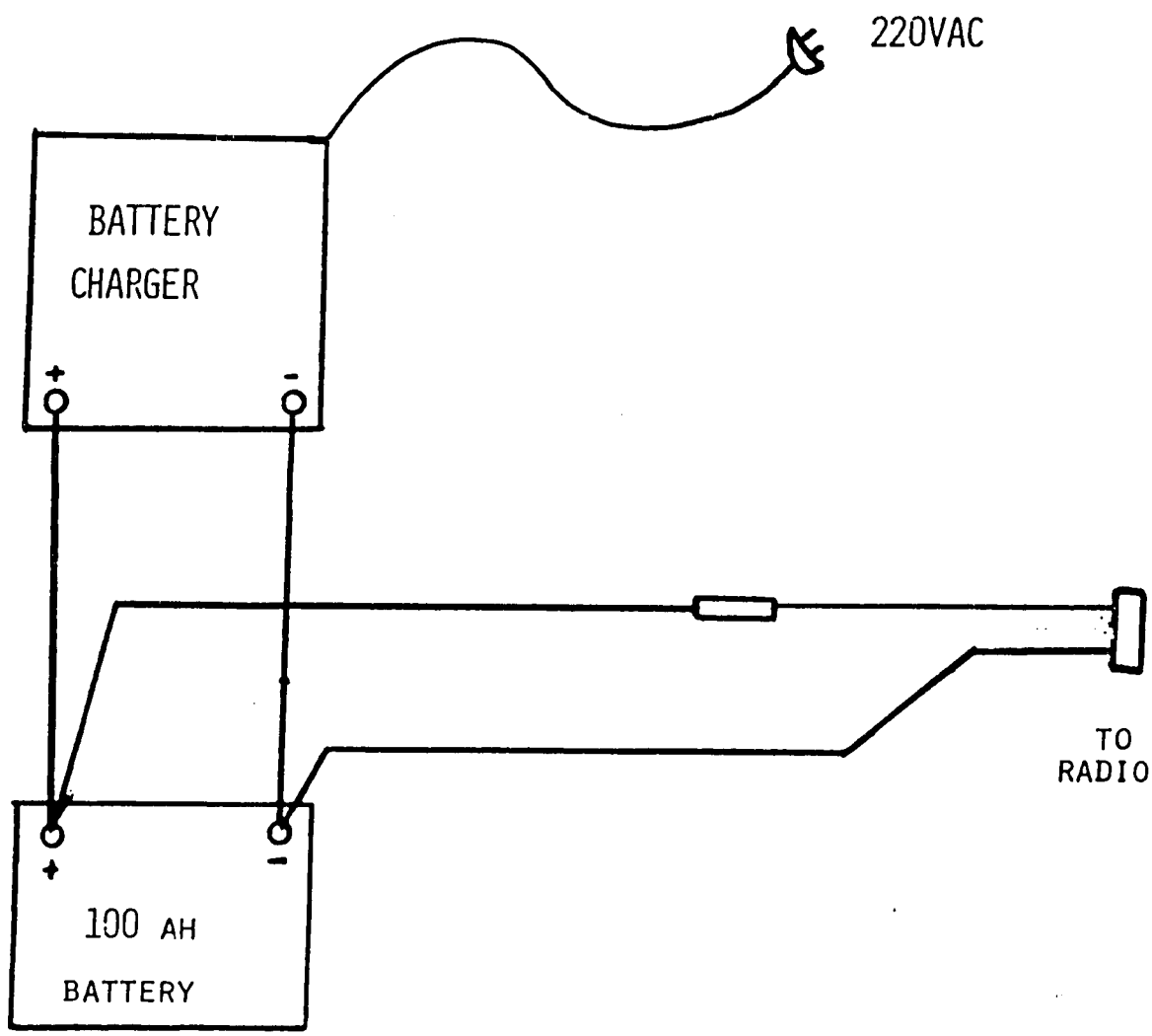
"C A U T I O N"

Battery solution is extremely corrosive. Do not get the solution on skin, eyes, or clothing. If the solution is spilled on you seek immediate medical attention.

9. Operate the battery charger at all times except when servicing the battery or when making connections to the battery.

10. After each six month period, check the battery solution with a battery hydrometer. If the solution is not correct, have a battery technician service the battery.

BATTERY INSTALLATION DIAGRAM



FIXED RADIO ANTENNA INSTALLATION

1. Antenna poles must be no closer than 15 meters to electric power wires.

2. The distance between the antenna poles should be 2 meters greater than the length of the antenna.

3. Antenna must be 6 and 10 meters above the ground and 10 meters from the nearest building.

4. The antenna support wires will have insulators installed as shown on the drawings.

5. Place anchors for the antenna support wires 4 -8 meters distant from the antenna mast base. Anchors for antenna support wires are typically placed at a distance from the tower base of 65 - 75 percent of the tower height. Since the mast height is specified as 6 to 10 meters, the anchor distance is specified as 4 - 8 meters.

6. Drive a ground rod 3 meters in length into the ground at the base of the antenna mast.

7. Connect the antenna mast and ground rod with 2 gauge wire or larger.

8. Details of the antenna base, antenna support anchors, and installation details are shown in the diagrams.

9. The coaxial cable must be at a 90 degree angle to the antenna.

ANTENNA INSTALLATION DIAGRAM

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MOBILE RADIO INSTALLATION TIPS

1. Mount the radio in a suitable location that will permit access while the vehicle is in motion. The location must protect the radio from damage, and not offer a hazard to the driver or passenger. Specific location, drilling, and fastening information was not furnished due to variations in the vehicles utilized. Installation instructions are furnished with the radio mounting kits on placement and sizes of mounting holes.

2. Locate antenna mount where it will not interfer with other mounted equipment.

3. Install the antenna coupler as close to the antenna mount as possible.

4. Route all power wires directly to the battery.

5. Where wiring must pass through walls, use protective grommets. If necessary to preserve watertight integrity, use bulkhead connectors.

6. Use correct size cable clamps to hold wiring in place and protect from abrasion.

7. Install appropriate RFI suppression devices on the vehicle. With the varying makes and models of vehicles being used, specific radio frequency interference suppression devices were not identified. The user should coordinate with the vehicle dealer or servicing agency for the proper device(s) for each vehicle. The following information is furnished to assist in determining where RFI suppression devices may be required:

Diesel Vehicles -

1. Electrical charging system, e.g.; alternator, generator, regulator, etc..

2. Electric winches and motor driven accessories.

Gasoline(Benzene) Vehicles -

1. Ignition system, e.g.; Spark plugs, spark plug wiring, distributor, and coil.

2. Electrical charging system, e.g.; alternator, generator, regulator, etc..

3. Electric winches and motor driven accessories.

Mounted motor driven equipment -

1. Ignition system, e.g.; Spark plugs, spark plug wiring, distributor, and coil.

-43'

2. Electrical charging system, e.g.; alternator, generator, regulator, etc..

3. Electric winches and motor driven accessories.

APPENDIX F

RADIO OPERATING PROCEDURES

The attached radio operating procedures provide a standard training guide for users of the Crop Protection Service HF Radio System. When additional frequencies and radios become available, certain small changes in the procedures will be necessary. Recommend that these pages be translated, reduced to 5 X 7 inch size, and laminated for durable ready reference by the operators.

MOBILE RADIO DAILY CHECKLIST

_____
DATE

	Y	N
1. Is the water level in the battery correct?		
2. Are the power wires for the radio securely connected to the battery?		
3. Are the battery terminals and connections free from corrosion?		
4. Are the power wires and the antenna cable free of cuts, nicks, and abrasions?		
5. Are all the radio components securely fastened to the vehicle?		
6. Check the antenna and mount. Is there any damage?		
7. Is there a tie-down for the antenna?		
8. Turn on the radio. Does the power light come on?		
9. Adjust the volume and squelch controls. Select the proper channel and sideband position. Do all the radio controls function correctly?		
9. Inspect the microphone, cable and connector. Is it free of damage? Does the PTT switch work properly?		
10. Is the radio turned off when not in use to prevent damage to the radio and battery?		

_____
SIGNATURE

If any answer is no, have the radio checked by your supervisor or a radio technician.

FIXED RADIO DAILY CHECKLIST

_____
DATE

	Y	N
1. Is the water level in the battery correct?		
2. Are the radio power and battery charger wires securely connected to the battery?		
3. Are the battery terminals and connections free from corrosion?		
4. Is the battery charger operating correctly?		
5. Are the power wires and the antenna cable free of cuts, nicks, and abrasions?		
6. Is the radio securely fastened at the operating position?		
7. Check the antenna and antenna masts. Is there any damage?		
8. Turn on the radio. Does the power light come on?		
9. Adjust the volume and squelch controls. Select the proper channel and sideband position. Do all the radio controls function correctly?		
9. Inspect the microphone, cable, and connector. Is it free of damage? Does the PTT switch work properly?		
10. Is the radio turned off when not in use?		

_____
SIGNATURE

If any answer is no, have the radio checked by your supervisor or a radio technician.

NOTE: The battery charger must be plugged in and operating at all times except while servicing the battery or making electrical connections.

GENERAL RADIO OPERATING PROCEDURES

1. All radio stations will maintain a station log. This log will contain as a minimum:

Date Time Station Called Channel or Frequency

2. Keep copies of written messages sent by your station for a period of one week. Annotate on the message the date and time transmitted.

3. Difficult or confusing words will be spelled out using the standard international phonetic alphabet.

4. Use standard procedural words (pro-words) when appropriate.

5. Use of preformatted messages to minimize confusion or misunderstanding and to speed the forwarding of information.

6. Use call signs to minimize confusion and properly identify stations transmitting.

7. Fixed stations will use their location as the call sign. An example is: "Rosso this is Nouakchott, over".

8. Mobile stations will use the department they are operating in and a numerical identification. For example; "Rosso this is Rosso Mobile 2, over".

9. Transmissions should end with the word "Over" if you expect a reply or the word "Out" if no reply is expected.

PROCEDURAL WORDS

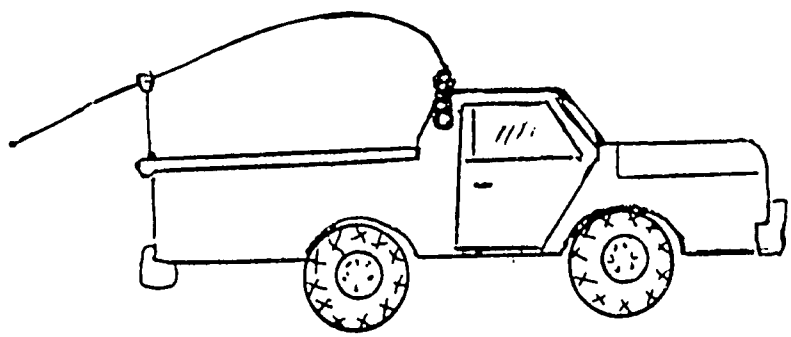
PRO-WORD	MEANING
Affirmative	Yes, or I agree with what you said
All After.....	Repeat all of your transmission after the word .....
All Before.....	Repeat all of your transmission before the word .....
Negative	No, or I do not agree with what you said
Out	I am finished, I do not expect a response
Over	I am finished, please respond
Roger	I received your transmission
Say again	Please repeat
Standby	I cannot transmit now but I will reply within one minute
Wait	I can not transmit now. I will call when able

INTERNATIONAL PHONETIC ALPHABET

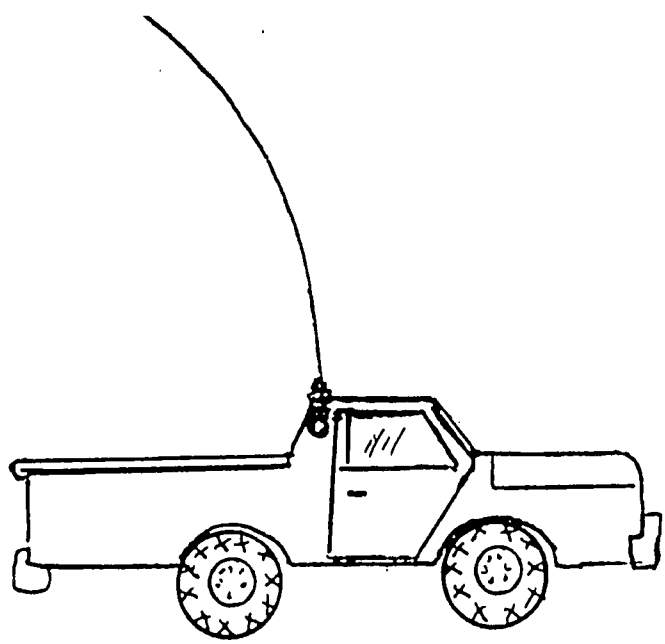
A	Alpha	N	November
B	Bravo	O	Oscar
C	Charlie	P	Papa
D	Delta	Q	Quebec
E	Echo	R	Romeo
F	Foxtrot	S	Sierra
G	Gulf	T	Tango
H	Hotel	U	Uniform
I	India	V	Victor
J	Juliet	W	Whiskey
K	Kilo	X	Xray
L	Lima	Y	Yankee
M	Mike	Z	Zulu

MOBILE ANTENNAS

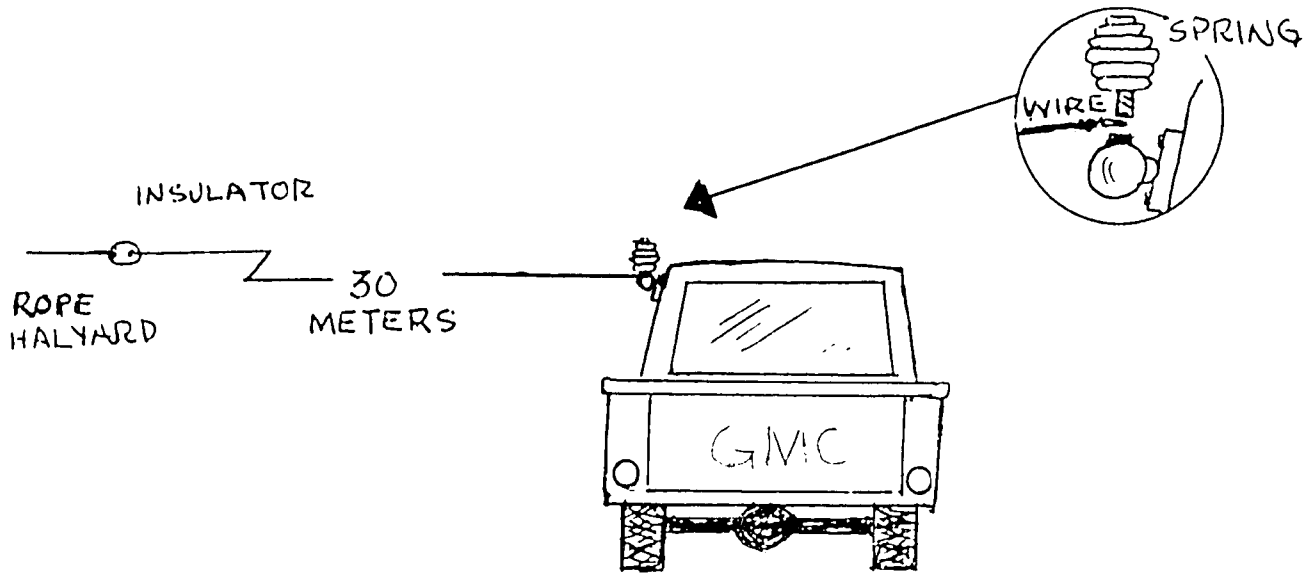
To increase the reliability of HF radio communications, mobile stations will sometimes need to change the antenna configuration.



Preferred configuration within 400 KM of the Base station



Preferred configuration over 400 KM to Base station



Expedient Antenna

If the whip antenna should break, you may use the above as a temporary antenna to maintain communications until the whip antenna is replaced.