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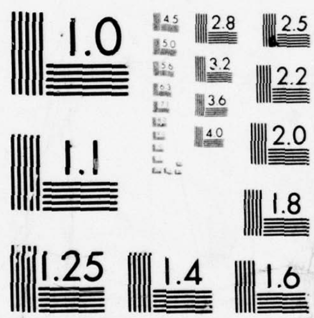

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Propagation Engineering Division
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Performance Analysis Summary of HF Radio Operations for the 5th Special Forces Group (Airborne), Signal Group Exercise JACK FROST 77.

(9) Final rept.,

by

(10) William Alvarez

[redacted]

George Lane

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An analysis of radiowave propagation conditions expected to prevail during Exercise Jack Frost 77 is given. Antenna designs and frequencies that will take full advantage of the ionospheric mode of propagation are presented.

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PREFACE

The Performance Analysis Summary is a reporting format used by this Agency to give a brief engineering synopsis of the analytical output from the USACEEIA HF Prediction Computer Programs. This summary is organized so that the requesting agency can readily verify the input data and assumptions used in making the propagation analysis. This material is followed by a summary of the performance criteria, which is a numerical interpretation of the user's requirements. These sections, i.e., para 2 and 3, should be carefully reviewed to insure that this study is applicable to the situation in question. A verbal synopsis of the computer predictions is given and is followed by the conclusions and recommendations to be drawn from the computer analyses.

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1	Sketch of the radio communications net for JACK FROST - 77	1A

1. TASKING DATA.

1.1 Tasking Agency. Commander, 5th Special Forces Group (Abn), 1st Special Forces, ATTN: AFJK-SF5-CE, Ft Bragg, NC 28307.

1.2 Request. Letter, AFJK-CE, 29 Oct 76, subject: Request for Performance Analysis Summary of HF Radio Communications for Exercise JACK FROST 77.

1.3 Authority. US Army Regulation 10-13.

1.4 Purpose. To provide propagation engineering analysis of conditions expected to prevail during Exercise JACK FROST 77 and to recommend antenna designs and methods of operation that will take full advantage of the ionospheric mode of propagation.

2. CIRCUIT DATA.

2.1 Radio Net Organization. High frequency (HF) radio operations are to be organized in a star-burst net configuration from the central net control at Ft Richardson, AK. As shown in Fig. 1, three primary communication links connect Ft Richardson to Bethel, Ft Greely and Kodiak Naval Station. Additionally, these three stations maintain two way communications with deployed field units. The concept of this organization is that the central location at Ft Richardson can direct field operations and receive field reports through the use of scheduled broadcasts and intercept times. For such operations the weakest link is the intercept of the transmissions from the field unit. The field unit has a low powered transmitter, manportable antenna and requirement to be on the air for as brief a time as possible. Therefore, it is crucial that the propagation analysis accurately assess the situation and precisely establish the "windows" during the radio day when successful intercept can be accomplished. The analysis contained in this report treats each of the three major sub-nets individually. In each of the following chapters, the primary link between Ft Richardson and the sub-net is discussed first, followed by a discussion of the communications to the deployed field units for that sub-net.

2.2 Locations. The locations of the radio units for this exercise are listed in Table I.

2.3 Range and Azimuth. Range in miles and kilometers, true North azimuths and Magnetic azimuths are given in Table II for the three primary circuits based on great circle route calculations.

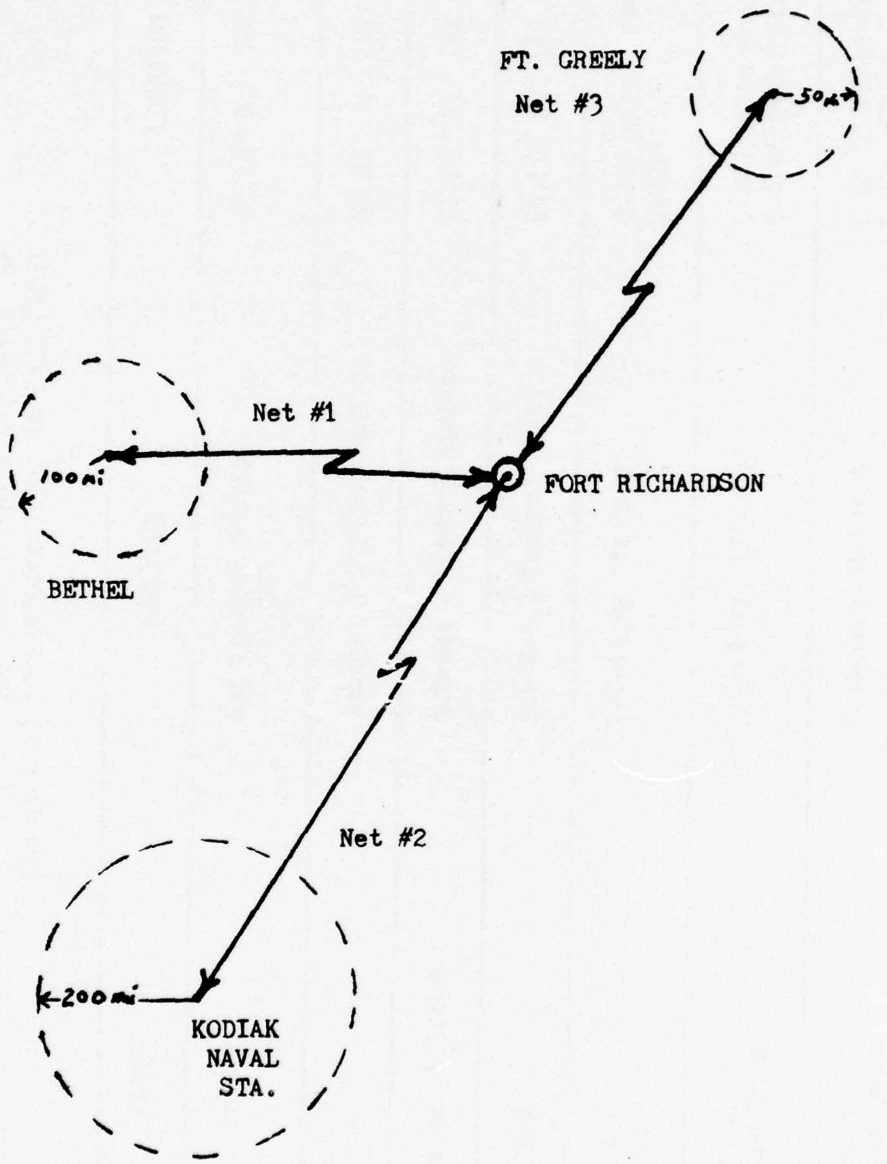

Fig. 1 Sketch of the radio communications net for JACK FROST -77.

TABLE I. Locations of HF Radio Units for 5th Special Forces Operations in JACK FROST 77

NAME	FUNCTION	LOCATION
Ft Richardson	Net Control Station NCS	61.25° N; 149.68° W
Bethel	Sub-Net 1 Control Station	60.82° N; 161.82° W
Kodiak Naval Station	Sub-Net 2 Control Station	57.20° N; 153.40° W
Ft Greely	Sub-Net 3 Control Station	64.50° N; 145.50° W
Sub-Net 1 Deployed Units	Tributary Stations	0-100 miles from Bethel
Sub-Net 2 Deployed Units	Tributary Stations	0-200 miles from Kodiak Naval Station
Sub-Net 3 Deployed Units	Tributary Stations	0 to 50 miles from Ft Greely

TABLE II. Great Circle Route Range and Azimuth for Primary Circuits of 5th Special Forces During JACK FROST 77

CKT #	FROM/TO	RANGE	AZIMUTHS			
			TRUE NORTH		MAGNETIC	
		mi (km)	FORWARD	BACK	FORWARD	BACK
1	Ft Richardson/Bethel	406.7 (654.5)	271.15	80.52	247.15	60.42
2	Ft Richardson/Kodiak	309.1 (497.4)	206.78	23.59	182.78	2.09
3	Ft Richardson/Ft Greely	260.2 (418.8)	28.54	212.26	4.54	184.76

2.4 Terrain Shielding. (Assumed to be negligible.)

2.5 Antenna Foreground. Arctic soil with a dielectric constant of 1.0 and a conductivity of .0001 mhos/m is assumed. This type of soil is extremely poor. Groundwave communications are, thus, extremely limited; thereby making the skywave mode the most practical means for HF radio communications.

3. PERFORMANCE CRITERIA.

3.1 Required Signal-to-Noise Ratio. The required signal-to-noise (S/N) ratio equates to the quality of service that may be excepted for a specified type of radio service. Therefore, the required S/N ratio is an extremely important variable in making radio system performance analyses. Generally, the required S/N ratio is defined as the signal power available at the receiver divided by the noise power in some reference bandwidth. In HF radio, it is common to express this ratio in dB, (i.e., 10 log S/N), for a reference noise power bandwidth of 1 Hz. Strictly speaking, this makes the S/N ratios used in this report S/N density ratios. To convert from a S/N density ratio to the S/N ratio that would be detected at the IF stage of the receiver, one would use the following formula:

$$\underset{(dB)}{\text{S/N at receiver}} = \text{S/N density ratio (dB)} - \text{10 log (IF bandwidth in Hz)}$$

The required S/N density ratio used in making a USACEEIA Frequency Reliability Table is always shown in the heading material as the "REQD S/N". The values of required S/N density ratios used in this report for the user's specified types and grades of service are shown in Table III. The values shown may be useful to the reader in interpreting the circuit reliability data given in the various Frequency Reliability Tables elsewhere in this report.

TABLE III. Required Signal-to-Noise Density Ratios for Various Types and Grades of HF Skywave Radio Service

TYPE OF SERVICE	GRADE OF SERVICE	REQD S/N
1.1F1 - Radioteletype 60 WPM, 1500 Hz bandwidth	not more than one error per 100 characters	57 dB
3A3J - voice, 3 KHz	orderwire quality (operator to operator, 90% sentence intelligibility	50 dB
300 WPM, Burst CW	low grade	44 dB
.1A1 manual CW	90% correct copy at 10 WPM	34 dB

3.2 RF Noise Levels.

3.2.1 General. Alaska and the Artic, in general, should be very quiet areas with regard to radio frequency (RF) noise in the HF band. However, radio operators tend to complain of high levels of white noise or masking noise. Scientific measurements show that the Artic has very low levels of atmospheric noise. The low population density of the Artic indicates that man-made levels of RF noise should also be low. A possible explanation for the observed "high levels" is that the human ear is a signal-to-noise receptor. Due to the fact that signals are greatly attenuated by the high latitude ionosphere and the poor ground conductivity, the AGC of the receiver operates at maximum amplification. Thus, the background noise or set noise (in a poorly maintained receiver) will seem to be masking the signal.

3.2.2 Atmospheric Noise. The controlling noise in the Artic should be the atmospheric noise primarily caused by electrical storms in the lower latitudes. In the USACEEIA HF Skywave Prediction Program the atmospheric noise levels are computed on an hourly and seasonal basis as derived from measurements.

3.2.3 Man-Made Noise. Man-made noise can be a serious problem when operating a radio receiver in the close vicinity of an RF noise source. High voltage power lines and electrical equipment will be primary sources since grounding electrical systems in Artic soil does not constitute a good electrical ground. Radio sites within line-of-sight of high voltage power lines, arc welders, hospitals, generators, busy highways, etc., should be avoided. Man-made noise levels used in this study are for "quiet rural" at all locations except for Ft Richardson, which is assumed to be 14 dB noisier at 3 MHz, (i.e., -150 dBw rather than -164 dBw for "quiet rural".) The assumed level at Ft Richardson is commensurate with a "rural" region which implies careful siting to achieve this level of man-made noise.

3.3 Interfering Signals. Although interfering signals can be a severe problem, no information as to signal density or intensity is available except for the ECAC data bank which is used in the frequency assignment process. In the Artic interference of this nature should be more prevalent during the summer months when the maritime traffic is the heaviest. In this report, interfering signals are only mentioned but are not considered in the analysis.

3.4 Transmitter Power. Since transmitter power has a direct bearing on the received S/N ratio, it is an important design consideration. The available transmitter powers for the radios to be used during Exercise JACK FROST 77 are listed in Table IV.

TABLE IV. Radios to be Used During JACK FROST 77
Including Type of Service as Specified for Each Radio Circuit

CKT #	CIRCUIT DESCRIPTION	RADIO NOMENCLATURE	POWER PEP (watts)	TYPE OF SERVICE
1	Ft Richardson/Bethel	AN/GRC-122	200 W	1.1F1
			400 W	3A3J
			400 W	0.1A1
1	Bethel/Ft Richardson	AN/GRC-122	200 W	1.1F1
			400 W	3A3J
			400 W	0.1A1
		AN/PRC-74B	15 W	Burst CW or 0.1A1 or Voice 3A3J
Sub-Net 1	Bethel to 100 mi omni	AN/PRC-74B	15 W	0.1A1
	Outstations to Bethel	AN/PRC-74B	15 W	Burst CW or 0.1A1
2	Ft Richardson/Kodiak	AN/GRC-122	400 W	3A3J
			200/400 W	Burst CW or 0.1A1
	Kodiak/Ft Richardson	AN/GRC-106	200 W	3A3J, Burst CW and 0.1A1
		AN/PRC-74B	15 W	3A3J, Burst CW and 0.1A1
		AN/PRC-87	30 W	3A3J or 0.1A1
Sub-Net 2	Kodiak to/from 200 mi omni	AN/PRC-87	30 W	3A3J or 0.1A1
3	Ft Richardson/Ft Greely	AN/GRC-122	400 W	3A3J
			200/400 W	Burst CW or 0.1A1
	Ft Greely/Ft Richardson	KWM-2	100 W	0.1A1, Burst CW and 3A3J
		AN/PRC-74B	15 W	3A3J, Burst CW and 0.1A1
Sub-Net 3	Ft Greely to/from 50 miles omni	AN/PRC-74B	15 W	0.1A1, Burst CW and 3A3J Voice

3.5 Hours of the Day. All times specified within this report are given in Universal Time (UT) which is equivalent to Zulu Time.

3.6 Duration of Analysis. January 1977.

4. ANALYSIS SUMMARY.

4.1 General Discussion. The analysis summary is presented with a general discussion of common communication factors to Exercise JACK FROST 77 first, followed by detailed discussion of each of the three proposed nets.

4.1.1 Ionospheric Support.

4.1.1.1 Most Probable Ionospheric Mode. One reflection from the F-layer (1F) is the most probable ionospheric mode for the relatively short paths to be used during this exercise. Radiation should be directed upward at angles between 45 to 89 degrees, with respect to the horizon depending on the length of the path.

4.1.1.2 Sunspot Number. The solar activity during January 1977 is predicted to be at sunspot number (SSN) equal to 13.6. Solar activity is coming out of an all time low in the 11 year solar cycle. A low level of solar activity combined with winter conditions in the Artic will seriously detract from the ionospheric support afforded to HF communications.

4.1.1.3 Ionospheric Conditions. The extended forecast for mid-January 1977 calls for several active periods of the geomagnetic field from 4 to 9 Jan 77. Otherwise the geomagnetic field is expected to be generally quiet to unsettled. The resulting long term forecast for HF propagation conditions are for fair daytime conditions and fair/poor nighttime conditions. Poor propagation conditions will be due to enhanced geomagnetic activity, causing absorption, fading and noise.

4.1.1.4 Ionospheric Disturbances. No major disturbances are predicted during Exercise JACK FROST 77, but unexpected events are always a distinct possibility. Ionospheric disturbances, if they occur, will have a deleterious effect on HF communication with the great likelihood in the Artic regions of radio blackout occuring for periods of time ranging from a few minutes to 5 or 6 hours. A number of commonly occurring disturbances and their effects on HF communication are described in this paragraph. Forecasts of these events and a day-by-day recap of actual events as recorded are available weekly upon request for the USACEEIA Ionospheric Activity Report. A telephonic consulting service is provided by the USAF Global Weather Central at Offutt AFB, NE (forecaster is on-duty 24 hours/day and may be reached at AUTOVON 271-5871).

4.1.1.4.1 Geomagnetic Storm. A geomagnetic storm results from low energy protons and electrons eminating from a solar flare and intercepting the earth's magnetosphere. This leads to the distortion of the magnetic field lines and is termed a geomagnetic storm if the distortion is great enough. The storm results in the heating of the F-layer which results in an erratic depletion of the ionization level. This, in turn, is called an ionospheric storm. In the Artic regions during the winter, an ionospheric storm results in the lowering of the Maximum Usable Frequency (MUF) and D-layer enhancement which leads to increased absorption and a raising of the lowest usable frequency (LUF). Under extreme conditions, radio blackout may occur on a particular circuit.

4.1.1.4.2 Spread-F. Spread-F is a phenomenon which may occur during an ionospheric storm and is particularly disruptive to communications in the Artic where it is sometimes known as "auroral flutter". Spread-F occurs because of the breaking up or dispersion of the F_2 reflecting region. This brings about rapid fading which is disastrous to HF communications including voice.

4.1.1.4.3 Sporadic-E. Sporadic-E in the Artic night is another phenomenon associated with geomagnetic storm activity. This event can be useful to the communicator in that higher than normal frequencies may propagate for a few minutes to a few hours. A patchy E-layer can cause problems since multipath conditions between F-layer and E-layer reflections can be disastrous for radio teletype or data transmission. At lower latitudes sporadic-E layer is a daytime event but tends to occur at night in the Artic regions.

4.1.1.4.4 Auroral Absorption Event. Often times the Aurora Borealis (Northern lights) and geomagnetic storms occur simultaneously. A large increase in D-layer absorption of HF radio waves generally occurs in and near the Auroral zone sometimes causing Auroral Blackout. Generally, these events affect radio circuits in the post-dawn hours.

4.1.1.4.5 Short Wave Fade. A short wave fade (SWF) is a form of sudden ionospheric disturbance (SID) created when high energy x-rays and ultraviolet rays strike the ionosphere. The impinging radiation causes a sudden enhancement of the D-layer which greatly increases (10 to 30 dB) the absorption of HF radio signals. Typically, a SWF lasts one to four hours and occurs during the daylight hours. Generally, the low end of the high frequency band is affected first. On an HF path the LUF rises rapidly and may cause sudden radio blackout.

4.1.1.4.6 Polar Cap Absorption. High energy protons from the sun are deflected by the earth's magnetic fields toward the poles. Here they produce increased ionization in the D-layer. Severe absorption of HF radio waves results and may last for several days (especially in the sunlit polar cap). Polar cap absorption (PCA) is generally followed by the beginning of a geomagnetic storm.

4.1.2 Antennas.

4.1.2.1 General. Although electrical designs of antennas are only considered in this report, every attempt has been made to make use of simple antennas that lend themselves to use in the Artic.

4.1.2.2 Inverted-L Antennas. The inverted-L antenna is a form of bent vertical antenna. Generally, it is used to launch a groundwave, but it can be designed as a fairly effective skywave antenna. In either case, the antenna efficiency is highly dependent on the ground conductivity. In order to use an inverted-L antenna in the Artic a sizable ground screen will be required to overcome the poor conductivity of Artic soil. Since groundwave is not expected to be useful during Exercise JACK FROST 77 due to the ranges required, and since a simple dipole will outperform an inverted-L at the same pole height on skywave circuits, the inverted-L antenna is not recommended for this exercise. In the situation that imposes use of the inverted-L the antenna should be structured such that the vertical portion is 0.13 to 0.15 wavelengths and the horizontal portion should be approximately 0.5 wavelengths long. This antenna design is optimized for short distance skywave use.

4.1.2.3 Sloping Long Wire. The sloping long wire can be used in two basic configurations, (i.e., a tilted vertical or a long wire stretched along the ground). The tilted vertical usually has a tilt angle of 30 to 60 degrees above the horizon and a length of slightly more than a quarter wavelength. This configuration is used primarily for short range skywave transmissions. Generally, it is built with a counterpoise in line with the antenna wire but pointing in the opposite direction. This antenna is not practical for this exercise because of the low operating frequencies needed. In order to be effective the raised end of the antenna will have to be supported at a height of 70 feet. The other form of this antenna is not recommended either since it launches a wave at low take-off angles rather than the high angles needed for the relative short distance skywave paths planned for Exercise JACK FROST 77.

4.1.2.4 Dipoles. Half-wave, horizontal dipole antennas (sometimes called doublets) are ideally suited for use over Artic soil. The antenna should be elevated to a height of 0.10 to 0.18 wavelengths above ground. At this elevation an upward looking beam will be formed. Outward to 75 miles the antenna orientation will have little effect on circuit performance. For ranges greater than 75 miles the antenna wires should be placed broadside to the desired direction of propagation. The major problem with the dipole is that at frequencies around 2 MHz the support poles should be 75 feet high and not lower than 50 feet. When these conditions cannot be met, nighttime operations on the shorter paths may be impractical. Where only one support pole can be obtained, an inverted-vee dipole can be constructed with the feed point on the central mast and the arms of the dipole forming an upside down "V". The arms should not droop at an angle greater than 45 degrees from the horizontal. Also, the arms of the dipole should be insulated from ground by a height of 10 to 15 feet. The inverted-vee dipole has a radiation pattern similar to that of a horizontal dipole but with up to 3 dB loss in gain.

4.1.3 Circuit Performance. Circuit performance is measured in terms of circuit reliability where circuit reliability is defined as the fraction of the days of the month for a specified hour of the day for which the desired type and grade of service may be expected. For example, a circuit reliability value of .90 at 0200 hours for a "REQD S/N = 50" means that on 27 days of the month (i.e., .90 X 30 days/mo. = 27 days) at 0200 hours an orderwire quality voice signal will be received at the specified frequency shown on the USACEEIA Frequency Reliability Table. It should be remembered when using these tables that the circuit reliability data is only computed for normal or undisturbed ionospheric conditions. Experience has shown that for communications planning purposes, circuit reliabilities of .90 or higher are desirable. Consequently, "operational window" is defined as the block of frequencies and times for which the circuit reliability is 0.90 or higher.

4.2 Net 1: Bethel/Ft Richardson. This is a major net with the base station at Bethel and a connecting circuit to Ft Richardson. Deployed units are located at a distance of 100 miles on any azimuth from Bethel. The circuit data is listed in: Table I (coordinates), Table II (range and azimuths), and Table IV (radios, power levels, and types of service).

4.2.1 Bethel to Ft Richardson. The highest quality service that can be supported with an acceptable reliability throughout most of the day is Burst CW (REQD S/N = 44 dB). This level also corresponds to a low quality voice signal so both voice and manual CW (which requires a much lower signal to noise ratio) are predicted to yield adequate reliabilities. The computed Frequency Reliability Table for this level of service is shown as Table V. As this Table shows, the optimum hours for operation lie between sunrise and sunset. The circled values in Table V indicate those hours and frequencies for which a single channel of radio teletype has a circuit reliability of 0.90 or higher.

4.2.2 Ft Richardson to Bethel. The highest quality service that can be supported on the circuit with an adequate reliability is radio teletype (REQD S/N = 57). The increased time availability for this circuit is predicted because of the assumption that Bethel is in a quiet rural location rather than the "rural" assumption used for Ft Richardson. The computed Frequency Reliability Table

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FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76300.0 DCA SSN 13.6 JANUARY 1977
BETHEL,AK TO FT. RICHARDSON AZIMUTHS MILES KM.
60.82N - 161.82W 61.25N - 149.68W 80.52 271.15 406.7 654.5
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 - 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 - 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .400KW 3MHZ MAN-MADE NOISE = -149DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.87	.98	.99	.99	.99	.97	.85	.51	.15	-	-	REL.
04	.97	.98	.98	.83	.59	.29	-	-	-	-	-	REL.
06	.93	.85	.66	.19	.07	-	-	-	-	-	-	REL.
08	.92	.81	.58	.13	.04	-	-	-	-	-	-	REL.
10	.96	.91	.76	.28	.12	.04	-	-	-	-	-	REL.
12	.96	.94	.86	.47	.27	.13	-	-	-	-	-	REL.
14	.96	.93	.83	.34	.13	-	-	-	-	-	-	REL.
16	.95	.92	.78	.24	.07	-	-	-	-	-	-	REL.
18	.88	.90	.91	.64	.41	.22	.04	-	-	-	-	REL.
20	.51	.83	.86	.90	.91	.88	.66	.36	.14	.05	-	REL.
22	.09	.62	.71	.96	.96	.97	.94	.86	.65	.32	.06	REL.
24	.18	.72	.98	.99	.99	.99	.95	.86	.63	.29	.04	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	8.4	7.0	4.6	3.3	3.2	3.6	4.0	3.7	3.5	4.4	6.6	8.5
FOT	6.7	5.8	3.8	2.4	2.3	2.6	2.9	2.8	2.7	3.5	5.3	6.8

◯ TIMES WHEN RTT IS .90 OR HIGHER

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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TABLE V

for the circuit with radioteletype having a character error rate of not greater than 1 per 100 is shown as Table VI. As shown in Table V, teletype service is possible during daylight hours; but a reversion to marginal voice service or burst CW is predicted during nighttime. As is shown on this Table, the optimum hours of operation are between sunrise and sunset; although a marginal window of operation is predicted to be available throughout the day if frequencies as low as 2 MHz are used during the night.

4.2.3 Bethel to Deployed Detachments. The required types of service for the sub-net are voice and manual CW. Voice service is predicted to provide adequately reliable service on the hours between sunrise and sunset and inadequate reliabilities at night. Optimum windows for these circuits lie between 2.0 and 4.5 MHz between 2200 U.T. and 0200 U.T. Typical charts for manual CW (0.1A1) communications between a base station and out stations at distances between 25-300 miles from the base station are shown in Appendix I. These Tables show that manual CW operations are predicted to have optional reliabilities during daylight hours and limited capability during the night. The night operational window narrows to 2 MHz except for 0500 to 0900 U.T. when the frequency of optimum traffic (FOT) drops below 2 MHz. As the range between the base station and the deployed unit increases, the likelihood of support failure at 2 MHz during the early night deminishes.

4.2.4 Deployed Detachments to Bethel. The required type of service for this circuit is 300 wpm Burst CW (REQD S/N = 34). Typical charts for these circuits are shown in Appendix II. As these charts show, Burst CW service is predicted to be reliable throughout the day except for the periods between 0500 U.T. and 1100 U.T. on circuits with less than 75 miles range and decreasing to 0500 U.T. to 0900 U.T. between 75 and 100 miles. Frequencies close to 2 MHz will be needed for nightime operation.

4.3 Net 2: Kodiak Naval Station/Ft Richardson. This is a major net with a base station at Kodiak Naval Station and a connecting circuit to Ft Richardson. Deployed units are located at a distance of 0-200 miles on any azimuth from Kodiak Naval Station. The circuit data is listed in: Table I (coordinates), Table II (range and azimuths), and Table IV (radios, power levels, and types of service).

4.3.1 Kodiak Naval Station to Ft Richardson. The highest level of service that is predicted to be supported with an adequate reliability is voice (REQD S/N = 50 dB). A computed Frequency Reliability Table for this type of service is shown in Table VII. As shown, daytime operation is quite reliable. Low quality voice

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76350.0 DCA SSN 13.6 JANUARY 1977
FT RICHARDSON TO BETHEL,AK AZIMUTHS MILES KM.
61.25N - 149.68W 60.82N - 161.82W 271.15 80.52 406.7 654.5
TYPE OF SERVICE TTY MINIMUM ANGLE = .0 DEGREES
XMTR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .200KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 57DB
MULTIPATH POWER TOLERANCE = 10DB MULTIPATH DELAY TOLERANCE = 2.0MS.

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.82	.97	.98	.99	.99	.97	.85	.51	.15	-	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
04	.95	.96	.96	.82	.57	.28	-	-	-	-	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
06	.89	.81	.63	.18	.07	-	-	-	-	-	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
08	.87	.77	.55	.12	.04	-	-	-	-	-	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
10	.92	.87	.72	.27	.12	.04	-	-	-	-	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
12	.91	.89	.81	.44	.25	.12	-	-	-	-	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
14	.89	.86	.77	.31	.12	-	-	-	-	-	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
16	.91	.86	.73	.22	.06	-	-	-	-	-	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
18	.86	.86	.87	.62	.39	.21	.04	-	-	-	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
20	.51	.82	.86	.87	.88	.85	.64	.34	.14	.04	-	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
22	.18	.62	.71	.95	.96	.97	.93	.84	.64	.31	.06	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB
24	.26	.69	.96	.98	.98	.98	.95	.86	.63	.28	.04	REL.
	-	-	-	-	-	-	-	-	-	-	-	MP PROB

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	8.4	7.0	4.6	3.3	3.2	3.6	4.0	3.7	3.5	4.4	6.6	8.5
FOT	6.7	5.8	3.8	2.4	2.3	2.6	2.9	2.8	2.7	3.5	5.3	6.8

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT
NUMBERS IN MP LINES INDICATE FRACTION OF TIME MP MAY BE A PROBLEM
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TABLE VI

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76200.0 DCA SSN 13.6 JANUARY 1977
KODIAK STATION TO FT RICHARDSON AZIMUTHS MILES KM.
57.20N - 153.40W 61.25N - 149.68W 23.59 206.78 309.1 497.4
TYPE OF SERVICE VOICE MINIMUM ANGLE = .0 DEGREES
XMTR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .200KW 3MHZ MAN-MADE NOISE = -149DBW REQD.S/N = 50DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.92	.95	.96	.97	.95	.88	.52	.12	-	-	-	REL.
04	.92	.94	.91	.46	.15	-	-	-	-	-	-	REL.
06	.84	.70	.44	.06	-	-	-	-	-	-	-	REL.
08	.83	.66	.38	.05	-	-	-	-	-	-	-	REL.
10	.90	.80	.59	.14	.05	-	-	-	-	-	-	REL.
12	.90	.86	.73	.28	.12	.05	-	-	-	-	-	REL.
14	.89	.82	.62	.10	-	-	-	-	-	-	-	REL.
16	.89	.82	.61	.10	-	-	-	-	-	-	-	REL.
18	.75	.79	.80	.53	.32	.16	-	-	-	-	-	REL.
20	.31	.68	.74	.80	.80	.75	.50	.23	.08	-	-	REL.
22	.06	.43	.84	.90	.91	.91	.87	.70	.38	.08	-	REL.
24	.22	.56	.92	.96	.96	.95	.88	.66	.29	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	7.5	6.1	4.0	3.0	2.9	3.2	3.6	3.3	3.2	4.2	6.3	7.8
FOT	6.0	5.0	3.3	2.2	2.1	2.4	2.6	2.5	2.5	3.4	5.0	6.2

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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TABLE VII

may be possible during the night if frequencies close to 2 MHz are used.

4.3.2 Ft Richardson to Kodiak Naval Station. The highest level of service that is predicted to be supported with an adequate reliability is voice service (REQD S/N = 50 dB). Lower grades of service can also be used over this path. A chart for this circuit utilizing voice service is shown in Table VIII.

4.3.3 Kodiak Naval Station to Deployed Detachments. The required levels of service for these circuits are voice (REQD S/N = 50 dB) and manual CW (REQD S/N = 3.4 dB). Reliable 30 watt voice and manual CW communications are predicted to be possible throughout the day except for the hours between 0500-0900 U.T. when the probability of ionospheric support is predicted to be below 90 percent especially at the shorter ranges. Operations during these hours should be avoided. Frequency Reliability Tables for these circuits are shown in Appendix I.

4.3.4 Deployed Units to Kodiak Naval Station. The types of service required on these circuits is voice and Burst CW. Frequency Reliability Tables for these circuits (ranges 25 to 200 miles, power 15 watts) are shown in Appendix II. The type of service shown on these charts (i.e., Burst CW) is equivalent to marginal quality voice service. The optimum times for operation are between 2000 U.T. and 0200 U.T., as shown on the charts. Operations at other hours are predicted to be restricted to a narrow window between 2.0 and 2.5 MHz. The major effect of distance on the reliability of these circuits is in the predicted optimum traffic frequency. As the distances become greater (up to 200 miles), the optimum traffic frequency is predicted to rise and the windows of operation are predicted to increase.

4.4 Net 3: Ft Greely/Ft Richardson. This is a major net with the base station at Ft Greely and a connecting circuit to Ft Richardson Field units will be deployed from 0 to 50 miles around Ft Greely. The circuit data is listed in: Table I (coordinates), Table II (range and azimuths), and Table IV (radios, power levels, and types of service).

4.4.1 Ft Greely to Ft Richardson. The type of service that is predicted to be supported with even a marginal reliability is manual CW. The factor which is limiting the success of this circuit is the proposed use of the KWM-2 radio. The KWM-2 has a 3.4 MHz low-end cut-off frequency. Consequently, use of this radio is limited to daytime hours. This radio should not be used if nighttime operations are required. A typical frequency

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237   RPA 76250.0   DCA   SSN 13.6   JANUARY 1977
FT RICHARDSON   TO KODIAK STATION   AZIMUTHS   MILES   KM.
61.25N - 149.68W   57.20N - 153.40W   206.78   23.59   309.1   497.4
TYPE OF SERVICE VOICE   MINIMUM ANGLE = .0 DEGREES
XMTR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .400KW   3MHZ MAN-MADE NOISE = -166DBW   REQD.S/N = 50DB
MULTIPATH POWER TOLERANCE = 10DB   MULTIPATH DELAY TOLERANCE = 2.0MS.

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.99	.99	.99	.98	.96	.89	.53	.12	-	-	-	REL.
	-	-	-			-	.09	-	-	-	-	MP PROB
04	.99	.99	.95	.48	.16	-	-	-	-	-	-	REL.
	-			.07	-	-	-	-	-	-	-	MP PROB
06	.92	.75	.47	.07	-	-	-	-	-	-	-	REL.
	-	.53	.22	.01	-	-	-	-	-	-	-	MP PROB
08	.91	.71	.41	.05	-	-	-	-	-	-	-	REL.
	-	.50	.19	-	-	-	-	-	-	-	-	MP PROB
10	.96	.85	.62	.15	.05	-	-	-	-	-	-	REL.
	-		.39	.04	-	-	-	-	-	-	-	MP PROB
12	.97	.91	.76	.29	.13	.05	-	-	-	-	-	REL.
	-		.58	.12	.04	-	-	-	-	-	-	MP PROB
14	.95	.87	.65	.11	-	-	-	-	-	-	-	REL.
	-	-	.40	.01	-	-	-	-	-	-	-	MP PROB
16	.96	.88	.65	.10	-	-	-	-	-	-	-	REL.
	-		.39	.01	-	-	-	-	-	-	-	MP PROB
18	.94	.95	.94	.61	.36	.18	-	-	-	-	-	REL.
		-	-	.22	.14	.05	-	-	-	-	-	MP PROB
20	.80	.93	.95	.96	.94	.87	.57	.26	.09	-	-	REL.
	.99	-	-	-	-		.24	.06	.01	-	-	MP PROB
22	.77	.91	.98	.99	.98	.98	.92	.74	.40	.08	-	REL.
		-	-	-	-	-	-	.26	-	-	-	MP PROB
24	.90	.97	.99	.99	.98	.97	.89	.67	.29	-	-	REL.
	-	-	-	-	-	-	-	.17	-	-	-	MP PROB

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	7.5	6.1	4.0	3.0	2.9	3.2	3.6	3.3	3.2	4.2	6.3	7.8
FOT	6.0	5.0	3.3	2.2	2.1	2.4	2.6	2.5	2.5	3.4	5.0	6.2

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TABLE VIII

reliability table for manual CW operation is included in Table IX. Voice service is predicted to be possible only during daylight hours and in a narrow window of operation.

4.4.2 Ft Richardson to Ft Greely. The highest level of service that is predicted to be supported with an adequate reliability is voice (REQD S/N = 50 dB). A Computed Frequency Reliability Table for this type of service is shown in Table X. However, the return link from Ft Greely is only capable of supporting manual CW for most hours of the day primarily due to the low-end cut-off frequency of the KWM-2 radio. Voice operation may have to be limited to the hours between 2200 U.T. and 0200 U.T. unless another radio capable of operating at 2 MHz is used at Ft Greely.

4.4.3 Ft Greely to Deployed Units. The required levels of service are voice and manual CW. Voice service is predicted to be of poor quality and unreliable. Optimum hours of operation are between sunrise and sunset. The hours between 0400 and 0900 should be avoided due to a low probability of ionospheric support. Frequency Reliability Tables showing this type of service are included in Appendix I.

4.4.4 Deployed Units to Ft Greely. The type of service required on this circuit are voice and Burst CW. A set of frequency reliability tables for ranges from 25 to 50 miles utilizing Burst CW service (REQD S/N = 44 dB) are shown in Appendix II. A poor quality voice service is possible on circuits with a signal quality equal to that used for Burst CW communications. As the charts show, the optimum traffic frequency is predicted to rise as the circuits become longer in length. Thus, the available window of operation is predicted to become larger also.

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76400.0 DCA SSN 13.6 JANUARY 1977
FT GREELY TO FT RICHARDSON AZIMUTHS MILES KM.
64.50N - 145.50W 61.25N - 149.68W 212.26 28.54 260.2 418.8
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .100KW 3MHZ MAN-MADE NOISE = -149DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.94	.95	.95	.92	.83	.65	.16	-	-	-	-	REL.
04	.93	.86	.70	.23	.09	-	-	-	-	-	-	REL.
06	.79	.54	.25	-	-	-	-	-	-	-	-	REL.
08	.90	.65	.33	-	-	-	-	-	-	-	-	REL.
10	.96	.84	.61	.14	.04	-	-	-	-	-	-	REL.
12	.94	.89	.73	.19	.04	-	-	-	-	-	-	REL.
14	.91	.81	.55	.06	-	-	-	-	-	-	-	REL.
16	.94	.84	.52	.07	-	-	-	-	-	-	-	REL.
18	.79	.81	.78	.38	.19	.08	-	-	-	-	-	REL.
20	.79	.88	.89	.88	.83	.72	.29	-	-	-	-	REL.
22	.75	.87	.89	.90	.90	.88	.74	.42	.08	-	-	REL.
24	.95	.99	.99	.99	.98	.95	.76	.35	.06	-	-	REL.

3.4 MHZ CUT-OFF

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.6	5.3	3.4	2.6	2.7	3.2	3.4	3.1	3.1	3.9	5.6	6.9
FOT	5.4	4.4	2.5	1.9	2.0	2.4	2.6	2.4	2.5	3.1	4.5	5.5

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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TABLE IX

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76450.0 DCA SSN 13.6 JANUARY 1977
FT RICHARDSON TO FT GREELY AZIMUTHS MILES KM.
61.25N - 149.68W 64.50N - 145.50W 28.54 212.26 260.2 418.8
TYPE OF SERVICE VOICE MINIMUM ANGLE = .0 DEGREES
XMTR 2 ⇒ 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 ⇒ 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .400KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 50DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.95	.96	.97	.93	.84	.65	.16	-	-	-	-	REL.
04	.94	.86	.69	.23	.09	-	-	-	-	-	-	REL.
06	.79	.54	.25	-	-	-	-	-	-	-	-	REL.
08	.89	.65	.33	-	-	-	-	-	-	-	-	REL.
10	.95	.84	.60	.14	.04	-	-	-	-	-	-	REL.
12	.93	.87	.72	.18	.04	-	-	-	-	-	-	REL.
14	.90	.80	.53	.05	-	-	-	-	-	-	-	REL.
16	.95	.84	.53	.07	-	-	-	-	-	-	-	REL.
18	.84	.86	.81	.40	.20	.09	-	-	-	-	-	REL.
20	.84	.91	.92	.89	.84	.73	.29	-	-	-	-	REL.
22	.82	.90	.92	.93	.92	.89	.75	.42	.08	-	-	REL.
24	.96	.99	.99	.99	.98	.95	.76	.35	.06	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.6	5.3	3.4	2.6	2.7	3.2	3.4	3.1	3.1	3.9	5.6	6.9
FOT	5.4	4.4	2.5	1.9	2.0	2.4	2.6	2.4	2.5	3.1	4.5	5.5

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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TABLE X

APPENDIX I

BASE STATION TO DEPLOYED UNITS

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76100.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 25 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 61.25N - 148.93W 89.59 270.41 30.9 49.7
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 → 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.97	.97	.97	.82	.57	.27	-	-	-	-	-	REL.
04	.92	.77	.50	.08	-	-	-	-	-	-	-	REL.
06	.69	.34	.10	-	-	-	-	-	-	-	-	REL.
08	.77	.40	.13	-	-	-	-	-	-	-	-	REL.
10	.90	.66	.33	-	-	-	-	-	-	-	-	REL.
12	.92	.78	.48	.03	-	-	-	-	-	-	-	REL.
14	.88	.64	.28	-	-	-	-	-	-	-	-	REL.
16	.93	.65	.28	-	-	-	-	-	-	-	-	REL.
18	.87	.86	.69	.15	.07	-	-	-	-	-	-	REL.
20	.92	.93	.93	.83	.66	.39	-	-	-	-	-	REL.
22	-	.93	.94	.93	.89	.81	.43	.05	-	-	-	REL.
24	.99	.99	.99	.98	.93	.82	.38	.05	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	5.8	4.6	3.0	2.3	2.4	2.8	3.0	2.7	2.7	3.5	4.9	5.9
FOT	4.7	3.8	2.2	1.7	1.8	2.0	2.3	2.1	2.2	2.8	3.9	4.7

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

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FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76200.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 50 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 61.24N - 148.18W 89.97 271.45 55.8 89.9
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 - 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 - 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

LT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.97	.97	.97	.82	.57	.28	-	-	-	-	-	REL.
04	.92	.77	.50	.08	-	-	-	-	-	-	-	REL.
06	.69	.34	.10	-	-	-	-	-	-	-	-	REL.
08	.77	.41	.13	-	-	-	-	-	-	-	-	REL.
10	.90	.66	.34	-	-	-	-	-	-	-	-	REL.
12	.92	.79	.49	.04	-	-	-	-	-	-	-	REL.
14	.88	.65	.29	-	-	-	-	-	-	-	-	REL.
16	.93	.66	.28	-	-	-	-	-	-	-	-	REL.
18	.86	.86	.70	.20	.07	-	-	-	-	-	-	REL.
20	.92	.93	.93	.84	.67	.41	-	-	-	-	-	REL.
22	.93	.93	.94	.93	.89	.81	.45	.06	-	-	-	REL.
24	.99	.99	.99	.98	.93	.83	.39	.05	-	-	-	REL.

LT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	5.8	4.6	3.0	2.3	2.4	2.8	3.0	2.7	2.7	3.5	4.9	6.0
FOT	4.7	3.8	2.2	1.7	1.8	2.0	2.3	2.1	2.2	2.8	3.9	4.8

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76300.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 75 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 61.23N - 147.42W 89.91 272.05 81.1 130.6
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 # 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 # 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.97	.97	.97	.83	.59	.29	-	-	-	-	-	REL.
04	.92	.77	.51	.09	-	-	-	-	-	-	-	REL.
06	.70	.35	.11	-	-	-	-	-	-	-	-	REL.
08	.78	.43	.14	-	-	-	-	-	-	-	-	REL.
10	.91	.68	.36	.04	-	-	-	-	-	-	-	REL.
12	.92	.79	.50	.04	-	-	-	-	-	-	-	REL.
14	.88	.65	.29	-	-	-	-	-	-	-	-	REL.
16	.94	.67	.30	-	-	-	-	-	-	-	-	REL.
18	.86	.86	.71	.21	.08	-	-	-	-	-	-	REL.
20	.92	.93	.93	.85	.70	.45	-	-	-	-	-	REL.
22	.93	.92	.93	.93	.90	.83	.48	.07	-	-	-	REL.
24	.99	.99	.99	.98	.94	.84	.41	.06	-	-	-	REL.

LT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	5.8	4.7	3.0	2.4	2.4	2.8	3.0	2.7	2.7	3.5	5.0	6.0
FOT	4.8	3.8	2.2	1.7	1.8	2.1	2.3	2.1	2.2	2.8	4.0	4.8

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76400.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 100 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 61.22N - 146.67W 89.72 272.52 106.1 170.7
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 / 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 / 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.97	.97	.97	.84	.61	.31	-	-	-	-	-	REL.
04	.92	.78	.52	.09	-	-	-	-	-	-	-	REL.
06	.71	.37	.12	-	-	-	-	-	-	-	-	REL.
08	.79	.44	.16	-	-	-	-	-	-	-	-	REL.
10	.91	.69	.38	.04	-	-	-	-	-	-	-	REL.
12	.92	.80	.52	.05	-	-	-	-	-	-	-	REL.
14	.88	.66	.31	-	-	-	-	-	-	-	-	REL.
16	.94	.69	.32	-	-	-	-	-	-	-	-	REL.
18	.86	.86	.73	.23	.09	-	-	-	-	-	-	REL.
20	.91	.93	.93	.86	.72	.49	.04	-	-	-	-	REL.
22	.92	.92	.93	.93	.90	.84	.51	.10	-	-	-	REL.
24	.99	.99	.99	.98	.95	.86	.44	.07	-	-	-	REL.

LT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	5.9	4.7	3.1	2.4	2.4	2.8	3.1	2.8	2.8	3.6	5.0	6.1
FOT	4.8	3.9	2.2	1.7	1.8	2.1	2.3	2.1	2.2	2.9	4.0	4.9

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76700.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 125 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 61.20N - 145.92W 89.78 273.24 131.1 210.9
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 # 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 # 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.96	.97	.97	.85	.64	.34	-	-	-	-	-	REL.
04	.92	.79	.54	.10	-	-	-	-	-	-	-	REL.
06	.72	.39	.13	-	-	-	-	-	-	-	-	REL.
08	.81	.47	.17	-	-	-	-	-	-	-	-	REL.
10	.92	.71	.40	.05	-	-	-	-	-	-	-	REL.
12	.92	.81	.55	.06	-	-	-	-	-	-	-	REL.
14	.89	.68	.33	-	-	-	-	-	-	-	-	REL.
16	.95	.72	.34	-	-	-	-	-	-	-	-	REL.
18	.86	.87	.75	.26	.11	.04	-	-	-	-	-	REL.
20	.92	.92	.93	.87	.75	.54	.06	-	-	-	-	REL.
22	.91	.92	.93	.93	.91	.85	.56	.13	-	-	-	REL.
24	.99	.99	.99	.98	.95	.87	.48	.10	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.0	4.8	3.1	2.4	2.5	2.9	3.1	2.8	2.8	3.6	5.1	6.2
FOT	4.9	3.9	2.3	1.8	1.8	2.1	2.4	2.1	2.2	2.9	4.1	5.0

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76500.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 150 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 61.18N - 145.17W 89.72 273.83 156.1 251.2
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 # 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 # 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.96	.97	.97	.87	.68	.39	-	-	-	-	-	REL.
04	.93	.60	.56	.11	.03	-	-	-	-	-	-	REL.
06	.73	.41	.14	-	-	-	-	-	-	-	-	REL.
08	.82	.50	.19	-	-	-	-	-	-	-	-	REL.
10	.92	.73	.43	.06	-	-	-	-	-	-	-	REL.
12	.93	.62	.57	.07	-	-	-	-	-	-	-	REL.
14	.89	.70	.35	-	-	-	-	-	-	-	-	REL.
16	.95	.74	.37	.03	-	-	-	-	-	-	-	REL.
18	.85	.87	.77	.29	.13	.05	-	-	-	-	-	REL.
20	.91	.92	.93	.68	.76	.59	.10	-	-	-	-	REL.
22	.90	.92	.93	.93	.91	.87	.61	.19	-	-	-	REL.
24	.99	.99	.99	.98	.96	.89	.54	.13	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.1	4.8	3.1	2.4	2.5	2.9	3.2	2.6	2.8	3.7	5.2	6.3
FOT	5.0	4.0	2.3	1.8	1.9	2.2	2.4	2.2	2.3	3.0	4.2	5.1

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76800.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 175 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 61.15N - 144.43W 89.81 274.57 180.8 291.0
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 @ 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 @ 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.96	.97	.97	.88	.72	.44	.04	-	-	-	-	REL.
04	.93	.81	.58	.13	.04	-	-	-	-	-	-	REL.
06	.75	.43	.16	-	-	-	-	-	-	-	-	REL.
08	.84	.53	.22	-	-	-	-	-	-	-	-	REL.
10	.93	.75	.46	.07	-	-	-	-	-	-	-	REL.
12	.93	.84	.60	.09	-	-	-	-	-	-	-	REL.
14	.89	.71	.38	-	-	-	-	-	-	-	-	REL.
16	.95	.77	.41	.04	-	-	-	-	-	-	-	REL.
18	.85	.87	.79	.33	.15	.06	-	-	-	-	-	REL.
20	.90	.92	.93	.89	.80	.64	.16	-	-	-	-	REL.
22	.88	.91	.93	.93	.92	.88	.66	.25	-	-	-	REL.
24	.99	.99	.99	.99	.97	.91	.60	.17	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.2	4.9	3.2	2.5	2.6	3.0	3.2	2.9	2.9	3.8	5.4	6.5
FOT	5.1	4.0	2.3	1.8	1.9	2.2	2.4	2.2	2.3	3.0	4.3	5.2

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76600.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 200 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 61.12N - 143.68W 89.79 275.20 205.9 331.4
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 TO 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 TO 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.96	.97	.97	.90	.76	.50	.07	-	-	-	-	REL.
04	.93	.83	.62	.16	.05	-	-	-	-	-	-	REL.
06	.76	.47	.18	-	-	-	-	-	-	-	-	REL.
08	.86	.56	.24	-	-	-	-	-	-	-	-	REL.
10	.94	.78	.50	.08	-	-	-	-	-	-	-	REL.
12	.93	.85	.63	.11	-	-	-	-	-	-	-	REL.
14	.89	.73	.41	-	-	-	-	-	-	-	-	REL.
16	.96	.80	.45	.05	-	-	-	-	-	-	-	REL.
18	.85	.86	.60	.38	.19	.08	-	-	-	-	-	REL.
20	.87	.92	.93	.90	.83	.70	.23	-	-	-	-	REL.
22	.86	.91	.92	.93	.92	.89	.71	.33	-	-	-	REL.
24	.98	.99	.99	.99	.97	.93	.66	.23	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.4	5.0	3.3	2.5	2.6	3.0	3.3	2.9	3.0	3.9	5.5	6.7
FOT	5.2	4.1	2.4	1.8	1.9	2.2	2.5	2.2	2.4	3.1	4.4	5.3

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76110.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 250 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 61.04N - 142.19W 89.88 276.60 256.0 412.0
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 → 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.95	.96	.97	.93	.83	.63	.15	-	-	-	-	REL.
04	.94	.86	.68	.21	.08	-	-	-	-	-	-	REL.
06	.80	.55	.25	-	-	-	-	-	-	-	-	REL.
08	.89	.65	.33	-	-	-	-	-	-	-	-	REL.
10	.95	.83	.59	.13	.04	-	-	-	-	-	-	REL.
12	.93	.87	.71	.17	.04	-	-	-	-	-	-	REL.
14	.90	.78	.49	.04	-	-	-	-	-	-	-	REL.
16	.96	.86	.55	.08	-	-	-	-	-	-	-	REL.
18	.84	.86	.85	.49	.27	.13	-	-	-	-	-	REL.
20	.82	.91	.92	.91	.87	.78	.41	.04	-	-	-	REL.
22	.79	.90	.92	.93	.93	.91	.79	.50	.13	-	-	REL.
24	.96	.99	.99	.99	.98	.96	.78	.38	.08	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.7	5.3	3.4	2.6	2.7	3.2	3.4	3.0	3.1	4.1	5.9	7.1
FOT	5.5	4.3	2.5	1.9	2.0	2.4	2.6	2.3	2.5	3.3	4.7	5.7

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76120.0 DCA SSN 13.6 JANUARY 1977
BASESTATION TO 300 MILES AZIMUTHS MILES KM.
61.25N - 149.86W 60.95N - 140.71W 89.87 277.88 306.0 492.4
TYPE OF SERVICE MANUAL CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 ø 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
RCVR 2 ø 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 34DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.95	.96	.96	.94	.88	.75	.28	-	-	-	-	REL.
04	.94	.88	.74	.29	.13	.05	-	-	-	-	-	REL.
06	.82	.62	.33	-	-	-	-	-	-	-	-	REL.
08	.92	.72	.42	.05	-	-	-	-	-	-	-	REL.
10	.95	.87	.67	.19	.07	-	-	-	-	-	-	REL.
12	.93	.89	.77	.26	.06	-	-	-	-	-	-	REL.
14	.91	.82	.58	.08	-	-	-	-	-	-	-	REL.
16	.95	.90	.66	.13	.04	-	-	-	-	-	-	REL.
18	.82	.85	.86	.60	.38	.20	.04	-	-	-	-	REL.
20	.75	.90	.91	.92	.89	.84	.58	.16	-	-	-	REL.
22	.71	.80	.91	.93	.93	.92	.85	.65	.30	.04	-	REL.
24	.91	.99	.99	.99	.99	.98	.87	.56	.19	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	7.1	5.6	3.6	2.8	2.9	3.4	3.6	3.2	3.3	4.4	6.3	7.6
FOT	5.9	4.6	2.6	2.0	2.1	2.5	2.7	2.4	2.6	3.5	5.0	6.1

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

APPENDIX II

DEPLOYED UNITS TO BASE STATION

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76110.0 DCA SSN 13.6 JANUARY 1977
25 MILES EAST TO BASESTATION AZIMUTHS MILES KM.
61.25N - 148.93W 61.25N - 149.68W 270.33 89.67 24.9 40.1
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 → 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
RCVR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.92	.93	.93	.78	.54	.25	-	-	-	-	-	REL.
04	.87	.72	.46	.07	-	-	-	-	-	-	-	REL.
06	.63	.30	.09	-	-	-	-	-	-	-	-	REL.
08	.73	.37	.12	-	-	-	-	-	-	-	-	REL.
10	.85	.62	.30	-	-	-	-	-	-	-	-	REL.
12	.85	.72	.43	-	-	-	-	-	-	-	-	REL.
14	.78	.56	.23	-	-	-	-	-	-	-	-	REL.
16	.86	.59	.24	-	-	-	-	-	-	-	-	REL.
18	.77	.77	.61	.16	.06	-	-	-	-	-	-	REL.
20	.85	.87	.88	.79	.62	.36	-	-	-	-	-	REL.
22	-	.87	.89	.88	.85	.77	.40	.05	-	-	-	REL.
24	.97	.98	.98	.97	.93	.82	.37	.05	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	5.7	4.6	3.0	2.3	2.4	2.8	3.0	2.7	2.7	3.5	4.9	5.9
FOT	4.7	3.8	2.2	1.7	1.8	2.0	2.3	2.1	2.2	2.8	3.9	4.7

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76120.0 DCA SSN 13.6 JANUARY 1977

50 MILES EAST TO BASESTATION AZIMUTHS MILES KM.

61.24N - 148.18W 61.25N - 149.68W 271.45 90.14 49.9 80.2

TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES

XMTR 2 → 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0

RCVR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0

POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.92	.93	.93	.78	.54	.25	-	-	-	-	-	REL.
04	.87	.72	.46	.07	-	-	-	-	-	-	-	REL.
06	.63	.30	.09	-	-	-	-	-	-	-	-	REL.
08	.73	.38	.12	-	-	-	-	-	-	-	-	REL.
10	.85	.62	.31	-	-	-	-	-	-	-	-	REL.
12	.85	.72	.44	-	-	-	-	-	-	-	-	REL.
14	.79	.56	.24	-	-	-	-	-	-	-	-	REL.
16	.86	.60	.25	-	-	-	-	-	-	-	-	REL.
18	.77	.78	.62	.17	.06	-	-	-	-	-	-	REL.
20	.85	.87	.88	.80	.63	.38	-	-	-	-	-	REL.
22	.89	.87	.88	.88	.85	.78	.41	.05	-	-	-	REL.
24	.97	.98	.98	.98	.93	.83	.38	.05	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	5.9	4.6	3.0	2.3	2.4	2.8	3.0	2.7	2.7	3.5	4.9	6.0
FOT	4.7	3.8	2.2	1.7	1.8	2.0	2.3	2.1	2.2	2.8	3.9	4.8

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76100.0 DCA SSN 13.6 JANUARY 1977
75 MILES EAST TO BASESTATION AZIMUTHS MILES KM.
61.23N - 147.42W 61.25N - 149.68W 272.04 90.06 75.1 120.9
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 + 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
RCVR 2 + 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.92	.93	.93	.79	.55	.27	-	-	-	-	-	REL.
04	.87	.72	.47	.08	-	-	-	-	-	-	-	REL.
06	.63	.31	.09	-	-	-	-	-	-	-	-	REL.
08	.74	.39	.13	-	-	-	-	-	-	-	-	REL.
10	.86	.63	.32	-	-	-	-	-	-	-	-	REL.
12	.85	.73	.45	.03	-	-	-	-	-	-	-	REL.
14	.79	.57	.24	-	-	-	-	-	-	-	-	REL.
16	.86	.61	.26	-	-	-	-	-	-	-	-	REL.
18	.77	.78	.63	.18	.07	-	-	-	-	-	-	REL.
20	.85	.87	.88	.81	.65	.42	-	-	-	-	-	REL.
22	.88	.87	.88	.88	.86	.79	.44	.07	-	-	-	REL.
24	.97	.98	.98	.98	.94	.84	.40	.06	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	5.8	4.7	3.0	2.3	2.4	2.8	3.0	2.7	2.7	3.5	5.0	6.0
FOT	4.9	3.8	2.2	1.7	1.8	2.1	2.3	2.1	2.2	2.8	4.0	4.8

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76200.0 DCA SSN 13.6 JANUARY 1977
100 MILES EAST TO BASESTATION AZIMUTHS MILES KM.
61.22N - 146.67W 61.25N - 149.68W 272.51 89.87 100.1 161.1
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 + 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
RCVR 2 + 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.92	.93	.93	.80	.57	.29	-	-	-	-	-	REL.
04	.87	.73	.48	.08	-	-	-	-	-	-	-	REL.
06	.64	.32	.10	-	-	-	-	-	-	-	-	REL.
08	.75	.41	.14	-	-	-	-	-	-	-	-	REL.
10	.86	.65	.34	.04	-	-	-	-	-	-	-	REL.
12	.85	.73	.47	.04	-	-	-	-	-	-	-	REL.
14	.78	.58	.26	-	-	-	-	-	-	-	-	REL.
16	.86	.62	.28	-	-	-	-	-	-	-	-	REL.
18	.77	.78	.65	.20	.08	-	-	-	-	-	-	REL.
20	.85	.87	.88	.82	.67	.45	.04	-	-	-	-	REL.
22	.87	.86	.88	.88	.86	.80	.48	.09	-	-	-	REL.
24	.97	.98	.98	.98	.94	.85	.43	.07	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	5.9	4.7	3.1	2.4	2.4	2.8	3.1	2.8	2.8	3.6	5.0	6.1
FOT	4.8	3.8	2.2	1.7	1.8	2.1	2.3	2.1	2.2	2.9	4.0	4.9

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76300.C DCA SSN 13.6 JANUARY 1977
125 MILES EAST TO BASESTATION AZIMUTHS MILES KM.
61.20N - 145.92W 61.25N - 149.68W 273.23 89.93 125.1 201.3
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 - 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
RCVR 2 - 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.91	.93	.93	.81	.60	.31	-	-	-	-	-	REL.
04	.87	.73	.49	.09	-	-	-	-	-	-	-	REL.
06	.65	.34	.11	-	-	-	-	-	-	-	-	REL.
08	.76	.43	.16	-	-	-	-	-	-	-	-	REL.
10	.87	.66	.37	.04	-	-	-	-	-	-	-	REL.
12	.85	.74	.49	.05	-	-	-	-	-	-	-	REL.
14	.78	.59	.27	-	-	-	-	-	-	-	-	REL.
16	.87	.64	.30	-	-	-	-	-	-	-	-	REL.
18	.76	.78	.66	.23	.09	-	-	-	-	-	-	REL.
20	.87	.87	.88	.83	.70	.50	.06	-	-	-	-	REL.
22	.85	.86	.88	.89	.86	.81	.52	.12	-	-	-	REL.
24	.98	.98	.98	.98	.95	.87	.47	.09	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	5.9	4.7	3.1	2.4	2.5	2.9	3.1	2.8	2.8	3.6	5.1	6.2
FOT	4.9	3.9	2.3	1.7	1.8	2.1	2.4	2.1	2.2	2.9	4.1	4.9

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76400.0 DCA SSN 13.6 JANUARY 1977
150 MILES EAST TO BASESTATION AZIMUTHS MILES KM.
61.18N - 145.17W 61.25N - 149.68W 273.82 89.87 150.1 241.6
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 + 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
RCVR 2 + 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.91	.92	.93	.82	.63	.35	-	-	-	-	-	REL.
04	.87	.74	.51	.10	-	-	-	-	-	-	-	REL.
06	.66	.36	.12	-	-	-	-	-	-	-	-	REL.
08	.78	.46	.17	-	-	-	-	-	-	-	-	REL.
10	.87	.68	.39	.05	-	-	-	-	-	-	-	REL.
12	.85	.75	.51	.06	-	-	-	-	-	-	-	REL.
14	.78	.60	.29	-	-	-	-	-	-	-	-	REL.
16	.87	.67	.32	-	-	-	-	-	-	-	-	REL.
18	.76	.78	.68	.25	.11	.04	-	-	-	-	-	REL.
20	.85	.86	.88	.84	.73	.55	.09	-	-	-	-	REL.
22	.83	.86	.87	.89	.87	.83	.56	.16	-	-	-	REL.
24	.97	.97	.98	.98	.96	.89	.52	.12	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.1	4.8	3.1	2.4	2.5	2.9	3.1	2.8	2.8	3.7	5.2	6.3
FOT	5.0	3.9	2.3	1.8	1.9	2.1	2.4	2.1	2.3	3.0	4.2	5.0

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76700.0 DCA SSN 13.6 JANUARY 1977
175 MILES EAST TO BASESTATION AZIMUTHS MILES KM.
61.15N - 144.43W 61.25N - 149.68W 274.56 89.96 174.9 281.4
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 + 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
RCVR 2 + 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.91	.92	.93	.84	.67	.40	.04	-	-	-	-	REL.
04	.87	.76	.54	.11	.03	-	-	-	-	-	-	REL.
06	.67	.38	.14	-	-	-	-	-	-	-	-	REL.
08	.79	.49	.19	-	-	-	-	-	-	-	-	REL.
10	.88	.70	.42	.06	-	-	-	-	-	-	-	REL.
12	.85	.76	.54	.07	-	-	-	-	-	-	-	REL.
14	.79	.62	.31	-	-	-	-	-	-	-	-	REL.
16	.87	.69	.35	.03	-	-	-	-	-	-	-	REL.
18	.75	.77	.69	.28	.13	.05	-	-	-	-	-	REL.
20	.83	.86	.87	.85	.75	.60	.14	-	-	-	-	REL.
22	.79	.85	.87	.89	.87	.84	.61	.22	-	-	-	REL.
24	.96	.97	.98	.98	.96	.91	.58	.16	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.2	4.9	3.2	2.5	2.5	2.9	3.2	2.9	2.9	3.8	5.4	6.5
FOT	5.1	4.0	2.3	1.8	1.9	2.2	2.4	2.2	2.3	3.0	4.3	5.2

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76500.0 DCA SSN 13.6 JANUARY 1977
200 MILES EAST TO BASESTATION AZIMUTHS MILES KM.
61.12N - 143.68W 61.25N - 149.63W 275.20 89.94 200.0 321.8
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 + 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
RCVR 2 + 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.90	.92	.93	.85	.71	.46	.06	-	-	-	-	REL.
04	.87	.77	.57	.14	.04	-	-	-	-	-	-	REL.
06	.69	.41	.16	-	-	-	-	-	-	-	-	REL.
08	.80	.52	.22	-	-	-	-	-	-	-	-	REL.
10	.89	.72	.45	.07	-	-	-	-	-	-	-	REL.
12	.85	.77	.57	.09	-	-	-	-	-	-	-	REL.
14	.79	.63	.34	-	-	-	-	-	-	-	-	REL.
16	.87	.71	.39	.04	-	-	-	-	-	-	-	REL.
18	.74	.77	.71	.33	.16	.07	-	-	-	-	-	REL.
20	.82	.85	.87	.85	.77	.65	.20	-	-	-	-	REL.
22	.76	.84	.86	.88	.88	.85	.66	.29	-	-	-	REL.
24	.93	.97	.98	.98	.97	.92	.64	.21	-	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.3	5.0	3.2	2.5	2.6	3.0	3.2	2.9	2.9	3.9	5.5	6.6
FOT	5.2	4.1	2.4	1.8	1.9	2.2	2.5	2.2	2.4	3.1	4.4	5.3

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76800.0 DCA SSN 13.6 JANUARY 1977
250 MILES EAST TO BASESTATION AZIMUTHS MILES KM.
61.04N - 142.19W 61.25N - 149.68W 276.60 90.04 250.0 402.4
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 → 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
RCVR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.89	.91	.92	.88	.78	.58	.13	-	-	-	-	REL.
04	.87	.79	.62	.19	.07	-	-	-	-	-	-	REL.
06	.71	.48	.22	-	-	-	-	-	-	-	-	REL.
08	.83	.60	.30	-	-	-	-	-	-	-	-	REL.
10	.89	.77	.54	.11	.03	-	-	-	-	-	-	REL.
12	.95	.79	.63	.15	-	-	-	-	-	-	-	REL.
14	.78	.67	.41	-	-	-	-	-	-	-	-	REL.
16	.86	.76	.46	.07	-	-	-	-	-	-	-	REL.
18	.73	.76	.73	.42	.23	.11	-	-	-	-	-	REL.
20	.70	.84	.86	.86	.81	.73	.37	-	-	-	-	REL.
22	.65	.83	.85	.88	.88	.87	.74	.45	.11	-	-	REL.
24	.85	.96	.97	.98	.98	.95	.76	.36	.06	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	6.7	5.2	3.4	2.6	2.7	3.2	3.4	3.0	3.1	4.1	5.8	7.0
FOT	5.5	4.3	2.5	1.9	2.0	2.3	2.6	2.3	2.5	3.3	4.7	5.6

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

PROVIDE UPDATE INFORMATION TO THIS AGENCY ATTN: CCC-EED-PED

FORT HUACHUCA, ARIZONA 85613
AUTOVON 879-6779

U.S.ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY

FREQUENCY RELIABILITY TABLE

PROJECT 237 RPA 76600.0 DCA SSN 13.6 JANUARY 1977
300 MILES EAST TO BASESTATION AZIMUTHS MILES KM.
60.95N - 140.71W 61.25N - 149.68W 277.88 90.02 300.0 482.8
TYPE OF SERVICE BURST CW MINIMUM ANGLE = .0 DEGREES
XMTR 2 → 30 HW DIPOLE [H 3.05] [L -.50] [A -0] OFF AZ = 0
RCVR 2 → 30 HW DIPOLE [H 12.19] [L -.50] [A -0] OFF AZ = 0
POWER = .015KW 3MHZ MAN-MADE NOISE = -166DBW REQD.S/N = 44DB

FREQUENCIES IN MHZ

UT	2.0	2.5	3.0	4.0	4.5	5.0	6.0	7.0	8.0	9.0	10.0	
02	.88	.90	.92	.89	.83	.70	.24	-	-	-	-	REL.
04	.87	.81	.68	.25	.11	.04	-	-	-	-	-	REL.
06	.73	.54	.28	-	-	-	-	-	-	-	-	REL.
08	.85	.67	.38	.05	-	-	-	-	-	-	-	REL.
10	.88	.80	.61	.17	.06	-	-	-	-	-	-	REL.
12	.84	.80	.68	.22	.07	-	-	-	-	-	-	REL.
14	.78	.69	.48	.06	-	-	-	-	-	-	-	REL.
16	.85	.80	.57	.11	.03	-	-	-	-	-	-	REL.
18	.71	.74	.73	.52	.32	.17	.03	-	-	-	-	REL.
20	.59	.82	.85	.87	.83	.76	.53	.14	-	-	-	REL.
22	.52	.66	.84	.87	.88	.87	.79	.60	.26	-	-	REL.
24	.73	.95	.97	.98	.98	.97	.86	.53	.17	-	-	REL.

UT	00	02	04	06	08	10	12	14	16	18	20	22
MUF	7.1	5.5	3.6	2.8	2.9	3.3	3.6	3.2	3.3	4.4	6.2	7.5
FOT	5.8	4.5	2.6	2.0	2.1	2.5	2.7	2.4	2.6	3.5	5.0	6.0

DASHES IN RELIABILITY LINES SIGNIFY RELIABILITIES OF 00 PERCENT

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