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TECHNICAL REPORT NO. 74-56

EMERGENCY ARCTIC BATTERY

by

Curtis L. Paxton
Communications and Electronics Branch

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March 1974

Final Report

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U. S. ARMY LAND WARFARE LABORATORY
Aberdeen Proving Ground, Maryland 21005

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

This report describes the development and testing of thermal type battery systems for the AN/PRC-77 and AN/PRC-74 radio sets. They were designed as emergency power sources for the radio systems when operating under adverse arctic weather conditions at temperatures as low as -65°F where standard radio batteries are inadequate. Test results indicate that the batteries meet or exceed all important performance requirements under arctic weather conditions in Alaska.

AD-778198

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INTRODUCTION

Available electrical power output of batteries used with Army tactical radio equipment, like most other batteries, is considerably reduced at the -65°F temperatures often encountered in the Arctic. At -65°F, the electrical output can be as low as two percent of its rated value at "room" temperature of 70°F, resulting in a serious limitation in the performance of the associated radio system.

As an expedient solution to the cold weather battery problem, USALWL initiated a program to develop a thermal battery system for the AN/PRC-77 radio. A contract was awarded to Catalyst Research Corporation, Baltimore, Maryland, to develop a limited quantity of engineering prototype models for field evaluation and demonstration. These systems were successfully demonstrated in Alaska during the winter of 1972-1973. Additional PRC-77 batteries were fabricated and a similar battery system was developed for the AN/PRC-74 radio set as a result of this demonstration. Sixty-six AN/PRC-77 and fifteen AN/PRC-74 battery systems were sent to the Arctic Test Center, Fort Greely, Alaska, during the winter of 1973-74 for a follow-on field evaluation. This report describes the results of the evaluation.

DESCRIPTION

Thermal batteries require heat for activation. The electrolyte employed is a mixture of anhydrous salts which conduct electricity when melted. The heat source, which can be ignited by either an electric match or a mechanical primer, is an integral part of the battery. When the battery is ignited, the heat source evolves sufficient heat energy to melt the electrolyte and this permits the battery to deliver electrical power.

The AN/PRC-77 battery system (see Figure 1) is a one-shot device. An M42 percussion type primer is used to ignite the integral pyrotechnic heat source used to melt the electrolyte. The electrical power is supplied to the AN/PRC-77 by means of a J3 power jack. The electrochemical system of the battery consists of calcium deposited on iron anode, Lithium Chloride/Potassium Chloride electrolyte, Silicon Dioxide electrolyte binder, and a calcium chromate cathode. The cathode ($CaCrO_4$) the electrolyte (LiCl/KCl) and electrolyte binder (SiO_2) form a homogeneous pellet whose melting point is approximately 350°C. The heat source pellet ($Fe/KClO_4$) attains temperatures between 1300°C and 1500°C. It is conductive and acts as the cathode current collector.

The entire system is contained in a metal jacket. Fiberfrax insulating material is used to contain heat generated by the battery and thereby protect the operator.

The AN/PRC-74 battery system (see Figure 2) contains essentially the same electrochemical components. Activation of this battery system is obtained through the use of an M1 pull-firing device in conjunction with the M42 percussion primer system.

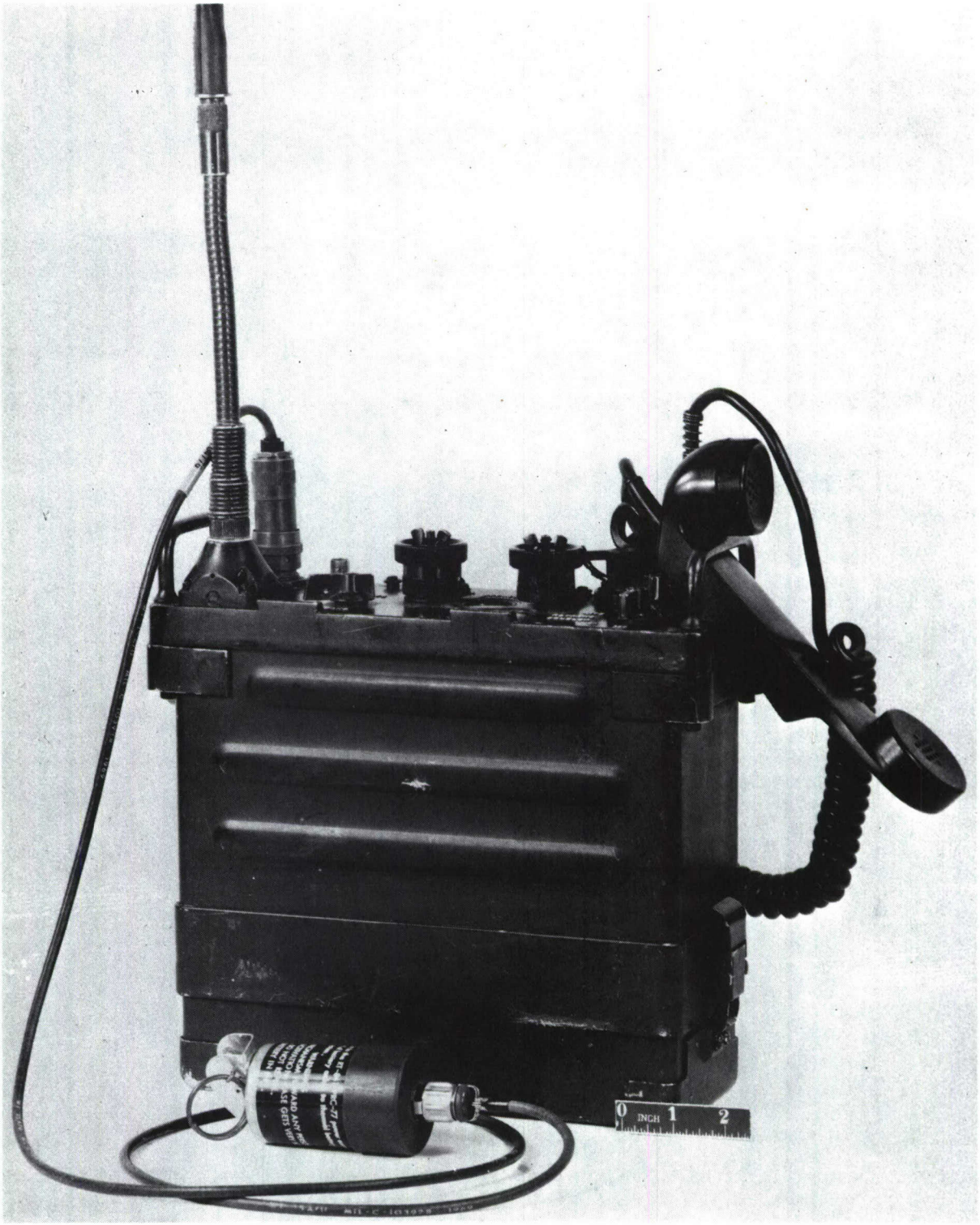

Figure 1. Emergency Arctic Battery, AN/PRC-77

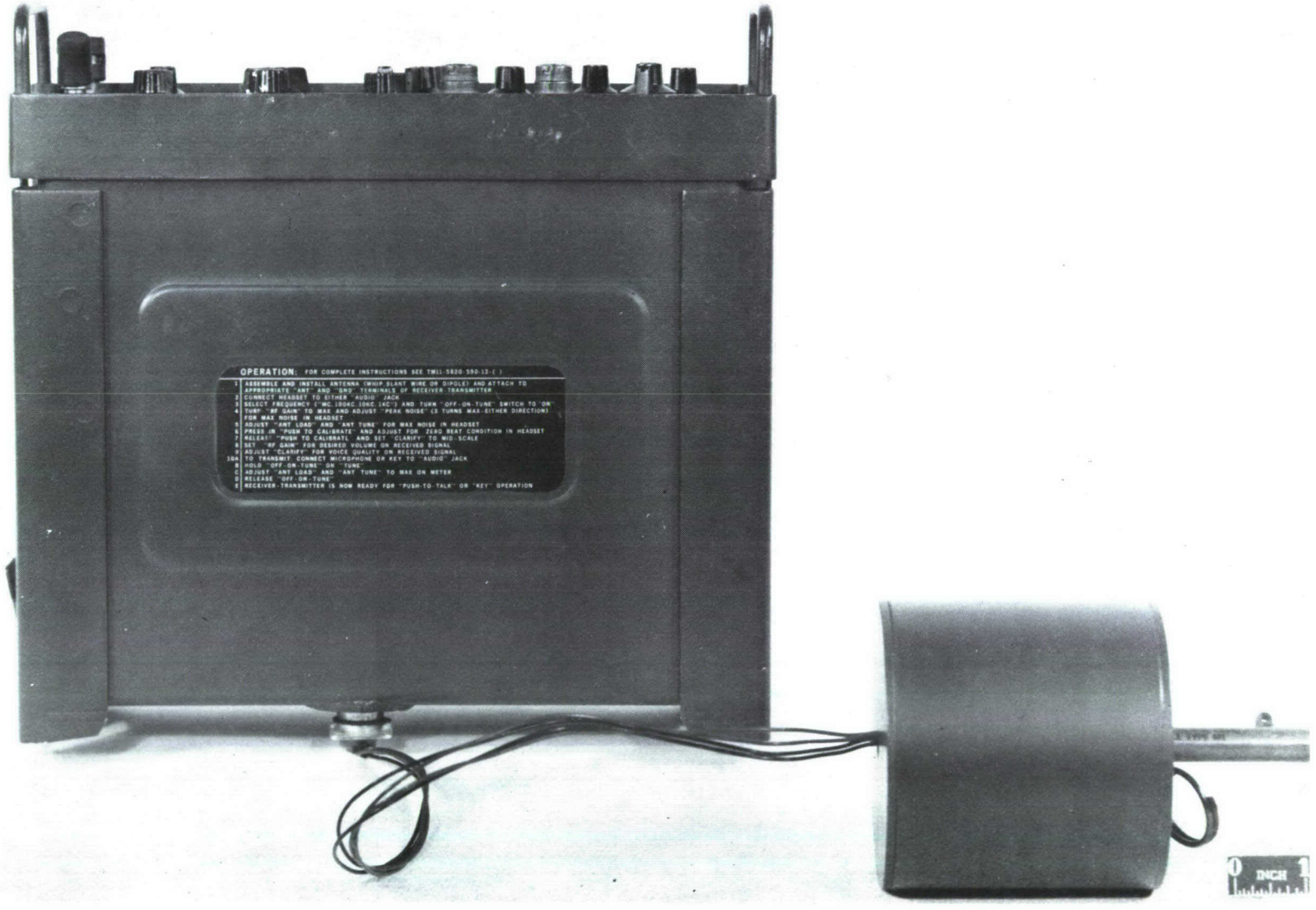

Figure 2. Emergency Arctic Battery, AN/PRC-74

CHARACTERISTICS

AN/PRC-77 Battery

Size - 2" dia x 3-1/2" long

Weight - 1/2 pound

Duty Cycle - 5 minutes minimum transmit plus 5 minutes receive

Shelf life - 10 years

Temperature - -60°F to +165°F

Voltage - 15 volts output

Current - 780 ma

Power - nominal power output 10 watts

AN/PRC-74 Battery

Size - 3-1/2" dia x 2-5/8" long

Weight - 2 pounds

Duty Cycle - 5 minutes minimum transmit plus 5 minutes receive

Shelf life - 10 years

Temperature - -60°F to +165°F

Voltage - 15 volts output

Current - 6 amperes

Power - nominal power output 90 watts

TEST PROCEDURE AND RESULTS

The batteries were tested under realistic operating conditions at the US Army Arctic Test Center, Fort Greely, Alaska. Details of the test sites and environmental conditions are given in Appendixes A & B. The tests which included preoperational inspection, functional performance, transportability, airdrop, human factors, safety, and value engineering were intended to determine feasibility for use under arctic winter conditions and the desirability of producing the batteries in operational quantities.

Results of the tests are detailed in Appendix A for the AN/PRC-77 batteries and in Appendix B for the AN/PRC-74 batteries. In all important respects, both batteries met or exceeded performance requirements. They proved to be safe, reliable emergency sources of power under severe, arctic, operational conditions.

CONCLUSIONS

1. It has been determined that both thermal battery systems met or exceeded requirements as emergency Arctic power sources for Army tactical radio sets.

2. The batteries are suitable for production in operational quantities.

RECOMMENDATION

It is recommended that the thermal batteries be considered for type classification as emergency power sources to operate tactical radio sets under Arctic weather conditions in place of the standard BA-4386, BA-386, or the BA-398/U batteries.

APPENDIX A

TEST REPORT ON THE EMERGENCY ARCTIC BATTERY FOR RADIO SET AN/PRC-77

DEPARTMENT OF THE ARMY
UNITED STATES ARMY ARCTIC TEST CENTER
APO SEATTLE 98733

STEAC-PL-TS

12 March 1974

SUBJECT: Final Letter Report on the Emergency Arctic Battery for Radio Set AN/PRC-77, TECOM Project No. 6-EE-PRC-077-008.

Commander
U.S. Army Land Warfare Laboratory
ATTN: AMXLW-TS
Aberdeen Proving Ground, Maryland 21005

1. REFERENCE:

Letter, AMSTE-EL, TECOM, 13 December 1973, subject: Customer Test Directive, TECOM Project No. 6-EE-PRC-077-008, Emergency Arctic Battery for Radio Set AN/PRC-77.

2. BACKGROUND:

a. History:

(1) The reliability of tactical radio equipment is adversely affected by the short and unpredictable life of standard batteries when exposed to extreme cold temperatures. A proposed solution to this problem is the thermal battery, as developed for use in the missile field.

(2) During the past 2 years, Land Warfare Laboratory (LWL) has developed a thermal battery for use as an emergency arctic battery for the AN/PRC-77 Radio. The purpose of this battery is to provide power when all conventional power sources have been expended.

(3) The emergency arctic battery (test battery) was tested at the contractor's plant in 1972. These tests, conducted in a controlled temperature environment of -65°F, indicated the test battery would provide adequate power to operate the radio transmitter for 5 minutes (minimum) and the receiver for an additional 5 minutes (minimum). The test battery was also successfully demonstrated at Fort Richardson, Alaska, in March of 1972 by the 33rd Signal Group, USARAL.

(4) The Arctic Test Center (ATC) was directed to conduct a customer test of the emergency arctic battery (reference 1).

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b. Description of Materiel:

The test battery is a cylindrical, one shot, thermal, inert electrolyte type battery. The battery is operated by pulling an activation pin, which releases a spring loaded firing pin. The test battery is 2 inches in diameter by 4 inches long and weighs 0.5 lb. The battery components, including the heat source, are contained in a waterproof and thermally insulated case. The test battery was designed to produce a nominal power output of 10 watts (15 volts at 780 ma) for a transmission time of 5 minutes (minimum). The test battery was designed with sufficient capacity to operate the receiver for an additional 5 minutes (minimum).

. Scope:

(1) ATC conducted a user evaluation test of the test battery from 16 January until 11 February 1974 at Fort Greely, Alaska. Testing was conducted in temperatures ranging from 7°F to -54°F and at distances between radios from 0.5 to 6 kilometers.

(2) Preoperational inspection, functional performance, transportability, airdrop, human factors, safety, and value engineering subtests were conducted.

(3) Since no criteria were provided, qualitative evaluations based on the experience and judgment of the test team were conducted. A limited quantitative evaluation of the transmit and receive times was performed, and a point estimate of the reliability was calculated.

(4) A total of 66 test batteries were received from LWL on 16 January 1974. All of the batteries were expended in testing.

(5) An AN/PRC-77 Radio with a 10-foot whip antenna and a standard battery was used as a base station. One or two AN/PRC-77 Radios with 10-foot whip antennas were used as test stations. All testing was conducted at 63.50 mhz. Prior to testing, all communication nets were checked with standard batteries.

(6) During functional performance testing, maximum use of the test stations' transmitter(s) was made until the base station could no longer receive the test station's(s') signal. The base station then transmitted continuously until the test station(s) could no longer receive.

(7) During testing all test participants wore appropriate components of the cold-dry uniform. A variety of handwear was worn by the test participants, including the arctic mitten set, black leather gloves with inserts, and anticontact gloves.

3. OBJECTIVES:

a. To determine if the test battery is feasible for use under arctic winter conditions (climatic categories 6, 7, and 8).

b. To determine if the test battery shows sufficient promise under arctic winter conditions to be considered for production in operational quantities.

4. SUMMARY OF RESULTS:

a. A visual inspection of all the test batteries was performed prior to functional testing. There was no detectable damage to any of the 66 test batteries.

b. Prior to functional testing, all of the test batteries were stored in covered, unheated shelter. The storage period ranged from 24 hours to 26 days. During the storage period, the temperature ranged from 18°F to -59°F. The cold storage had no apparent effect on the test battery's performance.

c. All of the test batteries provided a minimum of 5 minutes transmit time and at least 10 minutes of total operation, including transmit time and receive time. No failures were observed and the point estimate of the reliability was calculated to be 1.0. The individual transmit receive, and total operation times are shown in table 1, inclosure 1.

d. The transmit time, from test battery activation to loss of signal from the test station was recorded. The mean transmit time was found to be 8.7 minutes with a standard deviation of 1.5 minutes. The mean of the transmit time exceeds the expected value of 5 minutes (tested at the 0.05 significance level).

e. After the test station could no longer transmit, the receive time was recorded until the test station lost the signal from the base station. The mean receive time was found to be 5.2 minutes with a standard deviation of 1.4 minutes. The mean of the receive time did not exceed the expected value of 5 minutes (tested at the 0.05 significance level). However, since the transmit time exceeded the expected value by such a significant amount, the total time, including the transmit time is a more meaningful measure of the test batteries' performance.

The mean total operating time was 13.9 minutes with a standard deviation of 1.9 minutes. The mean total operating time exceeds the expected value of 10 minutes (tested at the 0.05 significance level).

f. As each test battery reached the end of its operating life, the loss of both the transmitted and received signal was abrupt and complete. There was no noticeable decrease in either transmitted or received signal strength prior to cessation of the signal.

g. After four tests, the test station operators learned to detect that their set had lost transmitter power by the presence of a low frequency buzz in the headset.

h. Nineteen of the 66 batteries were tested using a radio net of three stations. One of the test stations was located at 0.5 to 1 km, while the other was located at 5 to 6 km from the base station. During these trials, loss of transmitted and received signals was found to be independent of range.

i. Five of the test batteries were tested during a cross-country skiing exercise. The test participants skied 8 miles in temperatures ranging from 0°F to 10°F. The test participants stopped every hour and simulated an emergency situation. Each of the batteries provided ample time to establish communications and transmit the simulated emergency message.

j. Six of the test batteries were transported loose in the bed of a 1/4-ton trailer for 50 miles on secondary roads and 25 miles cross country. Six additional batteries were transported loose for 25 miles cross country in an M-113 tracked vehicle. All of these batteries were tested and functioned normally.

k. Two of the test batteries were airdropped as part of a load on a Sled, Scow-Type, 200-lb Capacity (Ahkio). The drop was made from 500 feet AGL. The temperature on the drop zone was -47°F. Two additional batteries were carried during a personnel jump. The jump was made from 1000 feet AGL. The temperature on the drop zone was -40°F. One of the batteries was dropped free-fall from 100 feet AGL. The temperature on the drop zone was -47°F. All of the airdrops were made onto a level drop zone that was free of snow. A visual inspection of the batteries revealed no apparent damage caused by the airdrops. Each of the batteries functioned normally during functional testing.

STEAC-PL-TS
SUBJECT: Final Letter Report on the Emergency Arctic Battery for Radio Set AN/PRC-77, TECOM Project No. 6-EE-PRC-077-008.

1. Throughout testing the test participants were observed and questioned with respect to the human factors engineering of the test battery. A questionnaire provided by LWL was completed by the six test participants. The responses are shown in table 2, inclosure 1. All of the test participants reported that the test battery was difficult to connect to the power cable while wearing arctic mittens. No difficulties were reported when using anti-contact gloves to connect the cable to the battery. It was also reported that the cable was difficult to connect in the dark. Neither of these problems were considered serious by the test participants or the test team. No other human factors problems were encountered.

m. No safety hazards were encountered. The temperature on the outside of the carrying case of one activated test battery was recorded. The maximum temperature measured was 164°F. The test team did not consider this to pose any significant safety hazard.

n. No areas of possible value engineering improvement were noted.

5. CONCLUSIONS:

a. The test battery for the AN/PRC-77 Radio provides a safe, reliable, and adequate power source for use in emergency situations under typical arctic winter conditions.

b. The test battery demonstrated adequate performance to be considered for production in operational quantities.

6. RECOMMENDATION: Recommend that

a. The test batteries be considered functionally adequate for quantity procurement to meet valid operational requirements.

b. DT III be conducted if quantity production introduces major changes in suppliers, materiels, or fabrication techniques.

FOR THE COMMANDER:

Lloyd R. Summers

2 Incl
as

LLOYD R. SUMMERS
CPT, AG
Adjutant

CF:
TECOM, AMSTE-EL (2 copies)

TABLE 1.--Summary of Test Data
for Emergency Batteries for AN/PRC-77

Trial No.	Transmit Time (min)	Receive Time (min)	Total Operating Time* (min)	Tempera-ture (°F)	Test History
1	10.3	5.0	15.3	-36	
2	8.9	3.9	12.8	-37	(5)
3	8.6	3.7	12.3	-37	
4	7.6	6.7	14.3	-38	
5	8.5	4.0	12.5	-38	
6	8.7	2.7	11.4	-38	
7	9.9	4.8	14.7	-38	
8	8.2	4.6	12.8	-38	(4)
9	7.5	4.8	12.3	-53	
10	7.7	4.7	12.3	-54	
11	7.8	5.5	13.3	-52	(5)
12	10.0	5.3	15.3	-52	
13	11.0	5.8	16.8	-50	
14	5.8	4.3	10.1	-49	
15	13.3	3.4	16.8	-45	(4)
16	9.8	6.6	16.5	-45	
17	11.4	6.4	17.8	-45	
18	9.5	2.6	12.1	-52	
19	10.9	4.4	15.3	-52	
20	11.1	4.0	15.1	-52	
21	9.9	5.3	15.2	-52	
22	8.4	6.5	14.8	-52	(2)
23	9.3	7.2	16.4	-52	
24	7.7	4.8	12.5	-52	
25	8.3	5.0	13.3	-52	
26	7.7	5.8	13.5	-48	(2)
27	7.2	5.2	12.5	-48	(4)
28	6.7	5.8	12.5	-45	
29	7.9	5.8	13.6	-45	
30	8.3	5.8	14.1	-42	
31	7.9	6.5	14.4	-42	(5)
32	7.4	6.6	13.9	-41	
33	7.6	6.3	13.9	-41	
34	7.2	5.5	12.7	-41	
35	6.4	5.7	12.1	-41	(5)
36	6.5	6.3	12.9	-41	
37	6.7	5.4	12.1	-41	(5)
38	6.6	4.9	11.4	-41	
39	7.5	6.2	13.7	-41	
40	7.7	6.1	13.8	-41	

Incl 1, page 1

TABLE 1.--Summary of Test Data for Emergency Batteries for AN/PRC-77 (Cont'd)

Trial No.	Transmit Time (min)	Receive Time (min)	Total Operating Time* (min)	Temperature (°F)	Test History**
41	11.3	5.1	16.3	5	
42	10.5	11.9	22.4	5	
43	8.8	3.9	12.8	7	
44	10.5	5.7	16.2	7	(5)
45	11.0	5.3	16.3	7	
46	7.6	6.5	14.1	-43	
47	7.9	6.8	14.7	-43	
48	9.0	3.2	12.2	-43	(1)
49	11.0	3.8	14.8	-43	
50	8.5	3.9	12.4	-43	
51	9.1	4.7	13.8	-44	
52	9.1	4.4	13.5	-47	(4)
53	8.6	5.3	13.9	-45	(1)
54	9.0	4.9	13.9	-45	
55	7.9	4.7	12.6	-46	(4)
56	10.4	3.6	14.0	-46	(4)
57	9.2	4.3	13.5	-46	
58	8.3	4.8	13.0	-48	
59	8.3	4.8	13.2	-47	
60	8.1	3.2	11.3	-48	
61	8.4	4.5	13.9	-47	
62	9.0	4.7	13.7	-43	
63	8.5	5.3	13.8	-44	(3)
64	8.2	5.4	13.6	-47	
65	8.1	4.5	12.7	-46	
66	---	---	---	---	(6)
Mean Time	8.7	5.2	13.9	---	

*Total time - was converted from minutes and seconds to minutes separately. Therefore, the total time in this column equals the transmission time plus the receive time ± 0.1 minute.

**Test History

(1) Batteries that were airdropped as Ahkio cargo.
(2) Batteries that were carried in parachute jump.
(3) Battery that was dropped in free-fall.
(4) Batteries that were transported by wheeled vehicles.
(5) Batteries that were transported by tracked vehicles.
(6) Battery used for safety test.

Incl 1, page 2

TABLE 2.--Summary of Results of Operator's Questionnaire for Emergency Arctic Battery for Radio Set AN/PRC-77

The following summary is based on the responses of six test participants for 65 test batteries.

1. Were the instructions provided adequate to operate the system? Yes 6 No 0

2. Is the size and weight acceptable? Yes 6 No 0

3. Was battery operating life satisfactory? Yes 6 No 0

4. Did changing of batteries present a problem? Yes 2 No 4 (If yes, explain) The arctic mitten sets could not be worn while changing batteries.

5. Was the carrying case satisfactory? Yes 6 No 0

6. Was reliable performance obtained? Yes 6 No 0

7. Was method of activation considered satisfactory? Yes 6 No 0

8. Was the system difficult to operate while wearing gloves? Yes 2 No 4 (If yes, explain) Test battery could not be activated and connected while wearing arctic mittens.

9. Was equipment operated at -65°F? Yes 0 No 6

10. If not at -65°F, what was the temperature under which systems were tested? See table 1, inclosure 1.

11. Is the present method of attaching battery to radio satisfactory? Yes 6 No 0

12. Was system difficult to operate while in carrying case? Yes 0 No 6

13. Was the method of carrying system considered satisfactory? Yes 6 No 0

14. Was test based on 5 minutes transmit followed by 5 minutes receive time? No See table 1, inclosure 1.

15. If answer to 14 is no, specify the duty cycle under which test was conducted. See table 1, inclosure 1.

16. Additional comments: None.

Incl 2

APPENDIX B

TEST REPORT ON THE EMERGENCY ARCTIC BATTERY FOR RADIO SET AN/PRC-74

DEPARTMENT OF THE ARMY
UNITED STATES ARMY ARCTIC TEST CENTER
APO SEATTLE 98733

STEAC-MT-EB 12 March 1974

SUBJECT: Final Letter Report on the Emergency Arctic Battery for Radio Set AN/PRC-74, TECOM Project No. 6-EE-PRC-074-004.

Commander
U.S. Army Land Warfare Laboratory
ATTN: AMXLW-TS
Aberdeen Proving Ground, Maryland 21005

1. REFERENCE:

Letter, AMSTE-EL, TECOM, 13 December 1973, subject: Customer Test Directive, TECOM Project No. 6-EE-PRC-074-004, Emergency Arctic Battery for Radio Set AN/PRC-74.

2. BACKGROUND:

a. History:

(1) The reliability of tactical radio equipment is adversely affected by the short and unpredictable life of standard batteries when exposed to extreme cold temperatures. A proposed solution to this problem is the thermal battery, as developed for use in the missile field.

(2) During the past 2 years, Land Warfare Laboratory (LWL) has developed a thermal battery for use as an emergency arctic battery for the AN/PRC-74 Radio. The purpose of this battery is to provide power when all conventional power sources have been expended.

(3) The emergency arctic battery (test battery) was tested at the contractor's plant in 1972. These tests, conducted in a controlled temperature environment of -65°F, showed the test battery would provide adequate power to operate the radio transmitter for a minimum of 5 minutes and the receiver for an additional 5 minutes.

(4) The Arctic Test Center (ATC) was directed to conduct a customer test of the emergency arctic battery (reference 1).

b. Description of Materiel:

The test battery is a cylindrical, one shot, thermal, inert electrolyte type battery. The battery is activated by an M1 firing device. The test battery is 4.3 inches in diameter by 4 inches long and weighs 3.5 pounds. The battery components, including the heat source, are contained in a waterproof and thermally insulated case. The test battery was designed to produce a nominal power output of 10 watts (15 volts at 780 ma) for an expected transmit time of 5 minutes (minimum). The test battery was designed with sufficient capacity to operate the receiver for an additional 5 minutes (minimum). The test battery is provided with a canvas carrying case with a shoulder strap.

c. Scope:

(1) ATC conducted a user evaluation test of the test battery from 16 January until 11 February 1974 at Fort Greely, Alaska. Testing was conducted in temperatures ranging from -43°F to -49°F and at distances between radios from 9 to 18 kilometers.

(2) Preoperational inspection, functional performance, airdrop, transportability, human factors, safety, and value engineering subtests were performed.

(3) Since no criteria were provided, qualitative evaluations based on the experience and judgment of the test team were conducted. A limited quantitative evaluation of the transmit and receive times was performed. A point estimate of the reliability was also calculated.

(4) A total of 15 test batteries were received from LWL on 16 January 1974. All of the batteries were expended in testing.

(5) An AN/PRC-74 Radio with a dipole antenna and standard battery was used as a base station. Another AN/PRC-74 Radio with a 10-foot whip antenna was used as a test station. All testing was conducted at a frequency of 45.30 khz.

(6) After communication was established and checked, using standard batteries, the test station activated a test battery and began transmitting. Maximum use of the test station transmitter was made until the test station's signal could no longer be received by the base station. The base station then transmitted continuously until the test station could no longer receive.

(7) The two test participants (MOS 31M20) wore appropriate components of the cold-dry uniform. A variety of handwear was worn by the test participants, including the arctic mitten set, black leather gloves with inserts, and anticontact gloves.

3. OBJECTIVES:

a. To determine if the test battery is feasible for use under arctic conditions (climatic categories 6, 7, and 8).

b. To determine if the test battery shows sufficient promise under arctic winter conditions to be considered for production in operational quantities.

4. SUMMARY OF RESULTS:

a. A visual inspection of all test batteries was performed prior to functional testing. There was no visible damage to any of the 15 test batteries.

b. Prior to testing, all batteries were stored in covered, unheated shelter from a minimum of 12 days to a maximum of 25 days. Storage temperatures ranged from 18°F to -57°F. The cold storage did not cause any known effect on the performance of the test batteries.

c. All of the test batteries provided a minimum of 5 minutes transmit time and 5 minutes of receive time. No failures were observed, and the point estimate of the reliability was calculated to be 1.0. The individual transmit, receive, and total operation times are shown in table 1, inclosure 1. The cause of the significant increase in receive time for trials 8 through 14 is attributable to tuning and interference.

d. The transmit time, from test battery activation to loss of signal from the test station, was recorded. The mean transmit time was 18.4 minutes, with a standard deviation of 4.8 minutes. The mean of the transmit time significantly exceeds the expected value of 5 minutes (tested at the 0.05 significance level).

e. After the test station could no longer transmit, the receive time was recorded until the test station lost the signal from the base station. The mean receive time was 10.8 minutes with a standard deviation of 5.8 minutes. The mean of the receive time significantly exceeded the expected value of 5 minutes (at the 0.05 significance level).

f. Two of the test batteries were airdropped as part of the load on a Sled, Scow-Type, 200-lb Capacity (Ahkio). The drop was made from 500 feet AGL. The temperature on the drop zone was -47°F with no wind. Two additional test batteries were carried by personnel during a jump from 1000 feet AGL. The temperature on the drop zone was -40°F with a wind of 3 knots. One test battery was dropped, free-fall, from 100 feet AGL. The temperature on the drop zone was -47°F with no wind. All of the airdrops were made on a flat drop zone. There was snow on the drop zone. A visual inspection of the batteries revealed no damage caused by airdrop. Each of the batteries performed normally during functional testing.

g. Two of the test batteries were transported loose in the bed of a 1/4-ton trailer for 50 miles over secondary roads and 25 miles cross-country. Two additional batteries were transported loose for 25 miles cross-country in an M-113 tracked vehicle. All of these batteries were tested and functioned as intended.

h. No human factor problems were reported. Throughout testing the test participants were observed and questioned with respect to the human factors and engineering of the test battery. A questionnaire provided by LWL was also completed by the two operators. The responses were in agreement and are presented in inclosure 2.

i. No safety hazards were encountered. The temperature on the outside of one of the activated batteries was measured. The maximum temperature recorded was 65°F. The test participants and the test team did not consider this to pose any significant safety hazard. Adequate and noticeable warning is provided, on the batteries, of any potential hazard due to surface heating or improper operation and disposal.

j. No areas of possible value engineering improvement were recorded.

5. CONCLUSIONS: In temperatures as low as -49°F, (the lowest encountered) the test battery for the AN/PRC-74 Radio provides a safe, reliable, and adequate power source for use in emergency situations.

6. RECOMMENDATIONS: Recommended that

a. The test batteries be considered functionally adequate for quantity procurement to meet valid operational requirements.

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b. That DT III be conducted if quantity production introduces a major change in suppliers, materiels, or fabrication techniques.

FOR THE COMMANDER:

2 Incl
as

LLOYD R. SUMMERS
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CF:
TECOM, AMSTE-EL (2 copies)

TABLE 1.--Summary of Test Data For Arctic Emergency Batteries for the AN/PRC-74 Radio

Trial No.	Transmit Time (min)	Receive Time (min)	Total Time of Operation (min)	Temperature (°F)	Test History*
1	15.7	5.3	21.0	-43	(1)
2	18.7	3.3	22.0	-47	(2)
3	16.0	9.0	25.0	-48	---
4	24.3	3.8	28.1	-48	(2)
5	21.9	5.0	26.9	-48	---
6	26.0	9.2	35.2	-48	(1)
7	13.5	6.5	20.0	-47	(3)
8	15.7	12.8	28.5	-48	(3)
9	16.7	13.9	30.6	-47	(5)
10	13.8	13.4	27.2	-47	(4)
11	27.2	17.1	44.3	-47	---
12	14.2	12.4	26.6	-47	---
13	13.2	22.6	35.8	-48	(4)
14	21.1	16.9	38.0	-49	---
15	Safety Test	---	---	---	---
Mean Times	18.4	10.8	29.2	---	---

*Test History
(1) Wheeled vehicle transport
(2) Tracked vehicle transport
(3) Airdrop, cargo load
(4) Airdrop, personnel jump
(5) Airdrop, free-fall

Incl 1

TABLE 2.--Summary of Results of Operator's Questionnaire for Emergency Arctic Battery for Radio Set AN/PRC-74

The following summary is based on the responses of two test participants for 14 test batteries.

1. Were the instructions provided adequate to operate the system? Yes

2. Is the size and weight acceptable? Yes

3. Was battery operating life satisfactory? Yes

4. Did changing of batteries present a problem? No

5. Was the carrying case satisfactory? Yes

6. Was reliable performance obtained? Yes

7. Was method of activation considered satisfactory? Yes

8. Was the system difficult to operate while wearing gloves? No

9. Was equipment operated at -65°F? No

10. If not at -65°F, what was the temperature under which systems were tested? See table 1, inclosure 1.

11. Is the present method of attaching battery to radio satisfactory? Yes

12. Was system difficult to operate while in carrying case? No

13. Was the method of carrying system considered satisfactory? Yes

14. Was test based on 5 minutes transmit followed by 5 minutes receive time? No

15. If answer to 14 is no, specify the duty cycle under which test was conducted. See table 1, inclosure 1.

16. Additional comments: None.

Incl 2

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