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SYSTEMS ANALYSIS REVIEW OF US READINESS COMMAND JOINT TASK FORCE (JTF-7) SHELTER NEEDS

by

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The purpose of this effort was to review the operational procedure of the Headquarters Joint Task Force 7 (HQ JTF 7) operation in the field and to evaluate available alternative shelter systems which would improve that operation. The report defines the space requirements for each function in the field and compares five shelter systems capable of supporting these functions. The review is limited to standard or available shelter systems which do not require research and development.

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PREFACE

This report was prepared by the US Army Natick Research and Development Command (NARADCOM) under Exploratory Development Project 1L762723A427, Tactical Rigid Wall Shelters, Work Unit 01–008, entitled, "Systems Analysis Review of US Readiness Command Headquarters Joint Task Force 7 Shelter Needs."

The purpose of this effort was to review the operational procedure of the Headquarters Joint Task Force 7 (HQ JTF 7) operation in the field and to evaluate available alternative shelter systems which would improve that operation. The report defines the space requirements for each function in the field and compares five shelter systems capable of supporting these functions. The review is limited to standard or available shelter systems which do not require research and development.

The Systems Analysis Review considered in this report was performed by Mr. Robert Bourassa and Mr. Harry Kirejczyk, Operations Research/Systems Analysis Office, and Mr. Jack Siegel, Tactical Shelters Branch, NARADCOM.

The authors could not have accomplished this Systems Analysis Review without the complete cooperation of many individuals at US Readiness Command (USREDCOM). In particular, COL Herschel Johnson and MAJ Paul T. Murphy, USREDCOM provided invaluable information and advice during all phases of this study. "This report is dedicated, in memoriam, to MAJ Paul T. Murphy."

TABLE OF CONTENTS

APPENDICES

TABLE OF CONTENTS (cont'd)

LIST OF ILLUSTRATIONS

LIST OF TABLES

LIST OF TABLES (cont'd)

SYSTEMS ANALYSIS REVIEW OF USREDCOM HEADQUARTERS JTF–7 SHELTER NEEDS

I. INTRODUCTION

This Systems Analysis Review is aimed at improving the functional readiness and field capability of the Headquarters Joint Task Force 7 of US Readiness Command. Specifically, the emphasis in this program is to upgrade the functional operation by introducing modern mobile field and tactical shelters for use and evaluation by the HQ JTF. The improved shelters and environmental control equipment to be studied should be compared by the user to the frame-supported tents currently being used by the HQ JFT 7.

The concept of operation of the HQ JTF 7 as well as approved JTF concepts of operation are summarized below (see Supplement B for more definitive information on the mission of USREDCOM).

1. HQ JTF 7 to be manned under Bare Base conditions for periods in excess of 30 days.

2. C141 aircraft are the primary means of shipment of all equipment.

3. Equipment will be augmented as required.

4. Environmental control of communication and electronic equipment required.

5. Only "state-of-the-art" equipment will be utilized in contingency operations.

6. Climatic conditions range from −25° to +125°F with specialized support as required for extreme climatic conditions.

7. All HQ JTF 7 equipment will be maintained in flyaway kits for rapid deployment.

8. Equipment will be exercised three to four times annually.

9. Shelter/life support needs are considered for the JTF staff only.

The information provided by USREDCOM to the reviewers (see Supplement B) included the following information which would have a direct bearing on the study:

1. Existing shelters now being used for the HQ JTF operation consist of General and Special Purpose, Frame-Supported Tents, which are entirely unsatisfactory.

2. Upgraded or new shelters and environmental control equipment must be standard within the military and not designed uniquely for the HQ JTF 7 operation.

The Systems Analysis Review considered in this report was performed by the Operations Research/Systems Analysis Office and Tactical Shelters Branch of US Army Natick Research and Development Command (NARADCOM).

II. BACKGROUND AND OBJECTIVES

USREDCOM requested assistance in the fall of 1975 from NARADCOM in the method of repairing nonstandard, frame-supported tents used primarily for the HQ JTF 7 operation. A representative from NARADCOM attended Brave Shield XIII at Eglin AFB in October 1975 so that shelter experts at NARADCOM could obtain a first hand report of the problem. As a result of this exchange of information, the Commander, NARADCOM, and key personnel provided a briefing to the Deputy Commander in Chief, USREDCOM, and his staff at MacDill AFB during January 1976. At that time, the Commander of NARADCOM agreed to support USREDCOM by providing a systems Analysis Review of the HQ JTF 7 shelter needs.

In February 1976, NARADCOM engineers forwarded a letter to USREDCOM (see Supplement A) requesting specific information on mission and equipment so that a Systems Analysis Review could be undertaken. The requested information was furnished in a letter dated 5 March 1976 (see Supplement B). The information furnished discussed the mission of USREDCOM as well as the HQ JTF 7 and provided specific data on space requirements for various functional operations. This correspondence was followed by a meeting at NARADCOM during April 1976 wherein much useful technical information was exchanged and a summary of significant items addressed prepared (see Supplement C). The significant items addressed during that meeting took the form of a decision on borrowing from other agencies and furnishing from NARADCOM assets various shelters and environmental control equipment for use by the HQ JTF 7 during subsequent exercises. It was agreed that NARADCOM personnel would participate in these exercises and collect information regarding the functional operations conducted in these shelters. The April meeting therefore was a key juncture for defining mutually agreed upon objectives and the technical approach to be taken for the coming year to attain these objectives. The shelters to be used for obtaining information for the Systems Analysis Review would either have an exceptional expansion to packaged ratio or be specially designed for transport in C141 aircraft.

Since the US Air Force Bare Base Shelter Program was designed to expedite shipment in C130 aircraft, key shelters from this program were obtained for the field evaluation phase of the review as follows:

1. The Expandable Shelter/Container (ES/C) (Figure 1) is 8' high by 8' wide by 13' long with a flat bottom base designed to interface with the 463L roller rail system. Two of these shelters were furnished by NARADCOM from the Arctic Test Center, Ft. Greeley, Alaska to MacDill AFB and will be retained by USREDCOM.

Figure 1. Air Force Bare Base Expandable Shelter/Container (ES/C)

2. The latest version of the Expandable Personnel Shelter (EXP) (Figure 2) is 2'8" wide by 8' high by 13' long and designed so that three such shelters can be locked together to ship as an 8x8x13' shelter in a C130 aircraft. The three shelters lock together to form their own pallet to interface with a C130 – 463L rail system. Each of these 2'8" wide shelters expand to 32' to provide an expansion ratio of approximately 11:1. Two of these shelters were furnished by NARADCOM from the Arctic Test Center to MacDill AFB and will be retained by USREDCOM. It would be desirable to obtain one additional 2'8" EXP from Tactical Air Command so the three shelters could be air-transported as one unit.

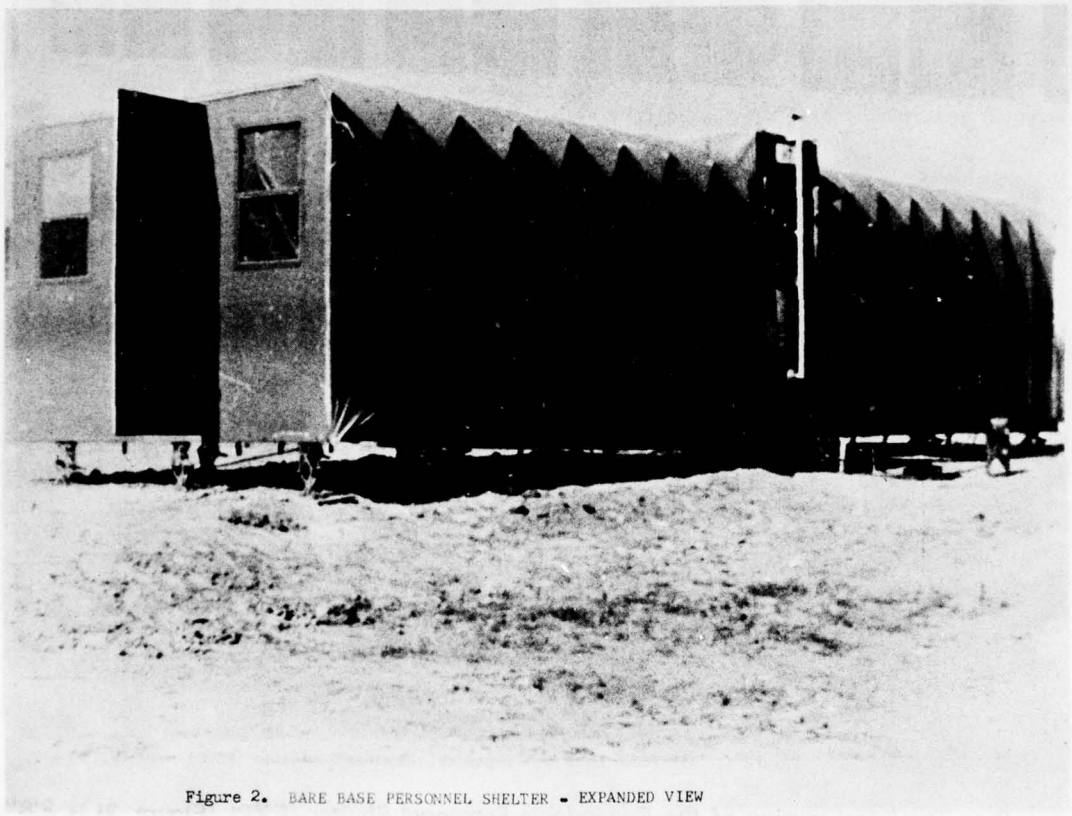


Figure 2. BARE BASE PERSONNEL SHELTER - EXPANDED VIEW

In addition to the above equipment, NARADCOM provided a prototype 50' Accordion Shelter (Figure 3) which expands from a packaged mode of 8x8x20' to an expanded mode in the field of 50' long by 8' high by 20' wide or approximately 1,000 square feet of usable floor space. It was further agreed to borrow the inflatable Medical Unit, Self-Contained, Transportable (MUST) Shelter from the Surgeon General since it has an excellent expansion ratio to packaged volume.

Given the need for environmental control in the various climatic extremes, the following two Environmental Control Units (ECU's) were agreed upon for use during the field evaluation phase of the review.

1. A combination 5-ton air conditioner/32,000 BTU heater (Model C100) (Figure 4) developed as part of the US Air Force Bare Base Program. A small number of these units were borrowed from US Marine Corps assets.

Figure 3. Army 50' Accordion Shelter (X-2)

MODEL C100 AIR CONDITIONER

The Model C100 Portable Air Conditioner has been designed by American Air Filter Company to meet rugged United States Air Force requirements. It is capable of cooling, heating, dehumidifying, filtering, and circulating air to meet the environmental needs of personnel and equipment in shelters, vans, and other enclosed areas. Principal design features are:

- Unattended operation with automatic temperature control is provided.
- Quiet operation permits use in areas where personnel work or sleep.
- Compact, lightweight construction is used.
- Simple, easy-to-use controls are provided.
- U. S. Air Force approved safety controls provide full protection.
- Switching between cooling and heating modes is automatic.
- The unit will start and operate in a wide range of environmental conditions at ambient temperatures between 50° and 125°F.

Extensive testing has been performed to ensure reliable operation under rugged field applications. The Model C100 Air Conditioner has a 60,000 Btu/hr nominal cooling capacity. Heating output is rated at 32,000 Btu/hr. Airflow is adjustable between 1600 and 2600 cfm. The unit may be used to cool or heat a controlled space, with the amount of makeup air adjustable to suit specific needs. The Portable Air Conditioner may also be used as a ventilator when heating or cooling is not required.

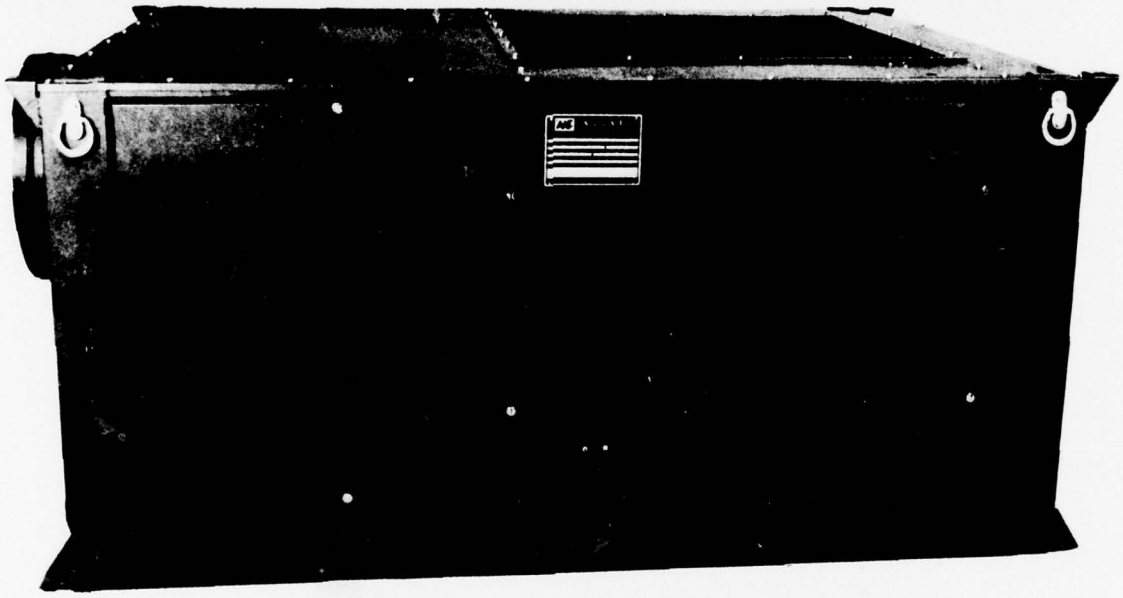
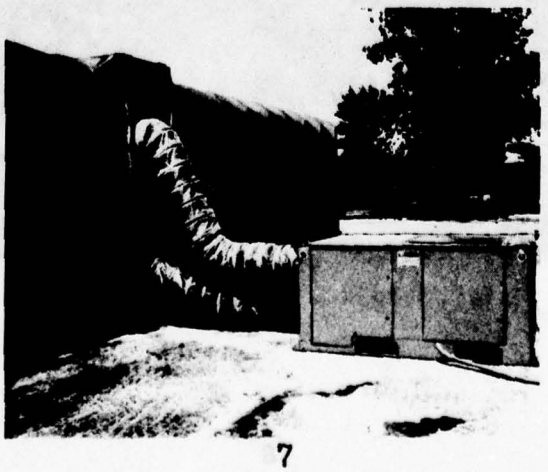


Figure 4. Five-Ton Air Conditioner/Heater

MODEL C100 AIR CONDITIONER

SPECIFICATIONS

Federal Stock Number	**To Be Determined**
Military Specification	**MIL-A-83216 (USAF), Designated A/E32C-39**
Electrical Power Input	**208 volts, 50/60 Hertz, 3 phase, 10 kw nominal**
Cooling Capacity	**60,000 Btu/hr (5 ton) nominal; 54,000 Btu/hr @ 115°F db ambient temperature with an evaporator inlet temperature of 85°F db, 70°F wb**
Heater Capacity (Optional Kit)	**32,400 Btu/hr**
Rated Airflow	**Adjustable 2,000 cfm ± 20% at 1 in. w.g.**
Dimensions (height, width, length)	**32 x 48 x 67 inches**
Weight	**940 pounds (with heater kit)**
Refrigerant	**10 lbs., R-22**
Air Filter	**One, permanent, aluminum construction**
Flexible Duct Size	
Discharge	**16-inch dia. by 9 feet long**
Return	**16-inch dia. by 7 feet long**



2. The Utility Package (U-PACK) turbine generator (Figure 5) of the MUST hospital system. The U-Pack provides hot/cold air and 60-cycle/400-cycle power for the hospital system as well as sufficient air pressure to inflate the double-wall, air-inflated shelters.

As a means to obtain maximum information from the using element, COL Johnson, Deputy Chief of Staff, HQ JTF 7, prepared a questionnaire (see Supplement D) which was handed out to users of each of these new shelters. The responses to the questionnaires were furnished to NARADCOM for analysis. Subjects were asked to comment on the new shelters they were utilizing as well as the other shelters in use by other elements of the HQ JTF. During 1976, USREDCOM joint exercises held at Yakima, Washington and Eglin AFB, Florida were attended by NARADCOM representatives so that functional operations could be monitored within each of the shelters. Photographs were taken of each of the functional operations conducted in these shelters. The information obtained from the questionnaires and direct observations by NARADCOM personnel of the various HQ JTF 7 functions provided sufficient data so that a Systems Analysis Review could be accomplished. The information gained during the field study enabled the technical reviewers to define five pure shelter systems for a Systems Analysis Review.

Primary considerations leading to the selection of the five shelter systems were as follows:

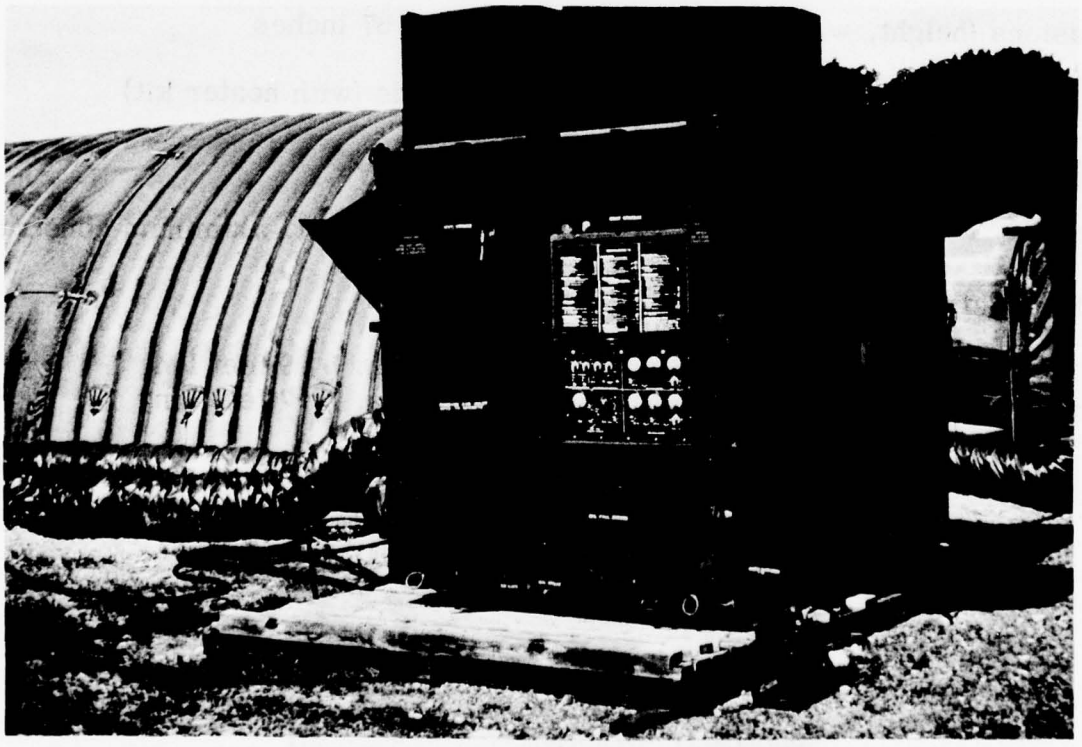


Figure 5. MUST Utility Package

1. The shelter and environmental control system would substantially improve the functional readiness of the HQ JTF 7.

2. The equipment to be considered would be limited to equipment currently available in the military inventory or considered within the state-of-the-art. This requirement was based on the fact that minimal funds would be available to purchase any proposed shelter system and that it was not cost effective to develop a new shelter system for a unique use.

3. The shelter systems to be considered must meet the requirements established by USREDCOM for response readiness and method of shipment.

The outcome of this Systems Analysis Review is a detailed analysis of five shelter design alternatives which fulfill the stated requirements of the program. The information provided with each of the five systems is sufficiently detailed so that the user can mix any of the systems and readily determine the various cost/weight tradeoff analyses that go with each of the hybrid matrices considered.

III. APPROACH TO SYSTEMS ANALYSIS REVIEW

After reviewing all the information obtained through field observations and review of questionnaires, the NARADCOM engineers presented three systems which they proposed to compare to a baseline or fourth system. USREDCOM personnel suggested that a fifth system be added to the study; that is, the Marine Corps Knockdown Shelter System. NARADCOM agreed to this request. The baseline system which the four other systems would be compared to was an improved frame-supported-tent system very similar in design to the tents currently being used by USREDCOM. The improved tent system was established as the baseline because it was recognized that it would be the least expensive to procure and transport. It was also acknowledged that the proposed tent system, although designed with a tent fly for desert and tropic operations, would not provide the level of habitability of the other four systems. The Systems Analysis Review, therefore, would be set up in such a way that USREDCOM could provide their own weighting system to determine the total systems effectiveness of each of the proposed shelter systems. NARADCOM does present a systems effectiveness analysis as well as a relative worth analysis based on weighting systems defined by the NARADCOM representatives. However, the information is presented in such a way that USREDCOM, as the ultimate user of the equipment, can modify the weighting system and do their own sensitivity and relative worth analysis. It is recognized that the user must ultimately assign weighting factors and determine where tradeoffs in systems effectiveness can be made.

As previously indicated, the systems considered are presently or will shortly be made available to the military. The Systems Analysis Review is intended to satisfy the needs of the HQ JTF 7 for the next five to ten years. At that time, the DoD Joint Committee on Tactical Shelters (JOCOTAS) should review the total needs of USREDCOM and develop a program to respond to those needs. The major emphasis of JOCOTAS is on standardizing

on a limited number of shelters for use by all services which conform to International Standards Organization (ISO) standards for intermodal cargo containers. In essence, that constrains the size of the shelters to 8x8x10' and 8x8x20' dimensions in the packaged mode. USREDCOM is, therefore, made cognizant of the fact that there is no current effort at developing shelters designed uniquely for air deployment with maximum expandability in the erected mode. The shelter with the maximum expandable area as currently defined by JOCOTAS will be the Army 50' Accordion Shelter, or 7 for 1 Expandable Shelter, as it is often referred to. If one were to ship the 50' Accordion Shelter on a C130, then two shelters could be shipped as a full load on the C130, which has a 41'-long cargo aircraft bed. When expanded, that would provide 2,000 square feet of usable floor space in the field. This would compare with nine Expandable Personnel Shelters which could be shipped on a C130 for a possible erected floor space of 3,600 square feet. It is possible that other shelters designed uniquely for air transport with maximum expansion ratio could be developed under the auspices of JOCOTAS. However, that problem area is not now currently being considered.

A. Minimum Space Requirements:

Before the NARADCOM technical representatives could determine the types of shelter systems to be considered, it was necessary to determine the minimum space requirements of each functional operation. These space requirements were defined by observation of NARADCOM personnel. The minimum space requirements for each of the functional operations are presented in Table 1.

B. System Descriptions:

Five pure systems have been considered in the Systems Analysis Review. Each of the basic shelter types are described with an artist's conceptual view of a HQ JTF 7 complex for each system considered.

XM–75 Improved Tent System

This system features tents having an aluminum frame and a cotton, wind-resistant, sateen, outer skin. The basic unit of the system is a section 8' deep, 17' wide, 9'8" high at the ridge, and 6'8" high at the eaves. Also included with the tent are liners, floors, fly sheets, and metal eave and ridge extenders. Covers are provided for each tent section. The sections are procurable in various configurations depending on the arrangement and utilization of window and door sections. Large screen openings in the walls and roof of the tent make it suitable for tropical or desert operations, particularly when the flies are installed. The present tent would be modified to accept the HERMAN–NELSON type heaters included in the system. No provisions have been made to air condition the XM–75 tent system. Figure 6 is a photograph of the XM–75 tent and Figure 7 is the conceptual view of an XM–75 tent system.

TABLE 1

MINIMUM USABLE FLOOR SPACE REQUIRED

FUNCTION	FLOOR AREA (SQ. FT.)
AG/GRAPH	400
JOC	1200
RECCE	400
ADMIN	750
CHIEF OF STAFF	750
BRIEFING	750
KEY STAFF (KS)	250
HQ CMDT	400
NEWS	250
PAO	400
JG	400
WEA	400
MISC A (J1, J4, SJA, SURGEON)	675
MISC B	400

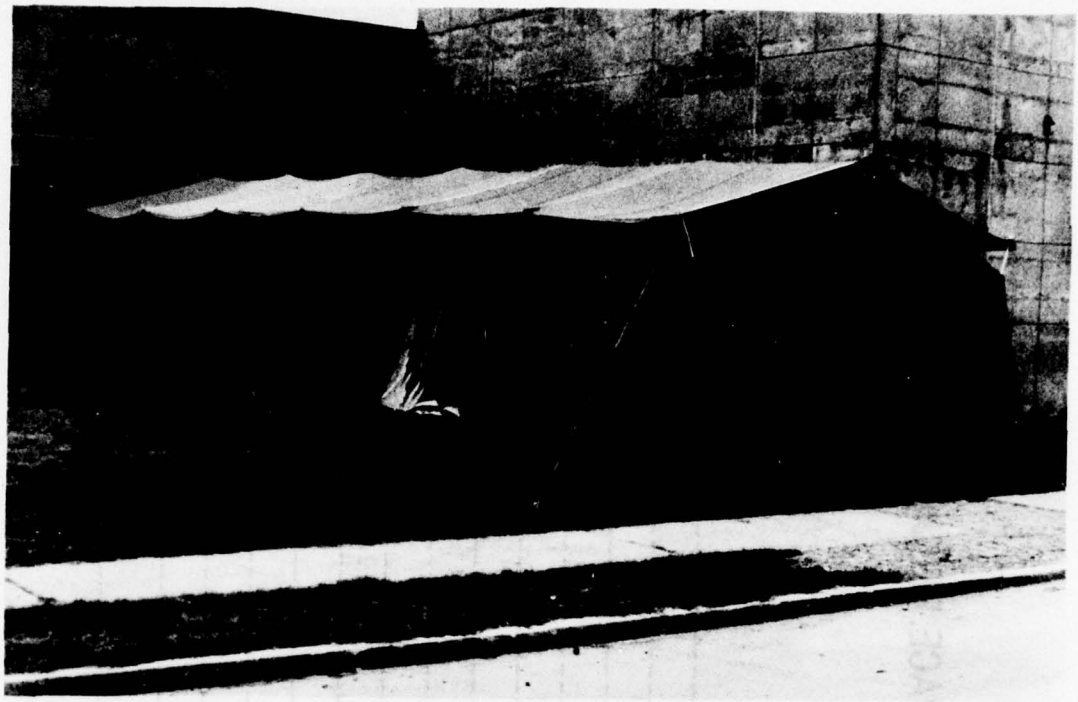


Figure 6. XM-75 Frame Supported Tent

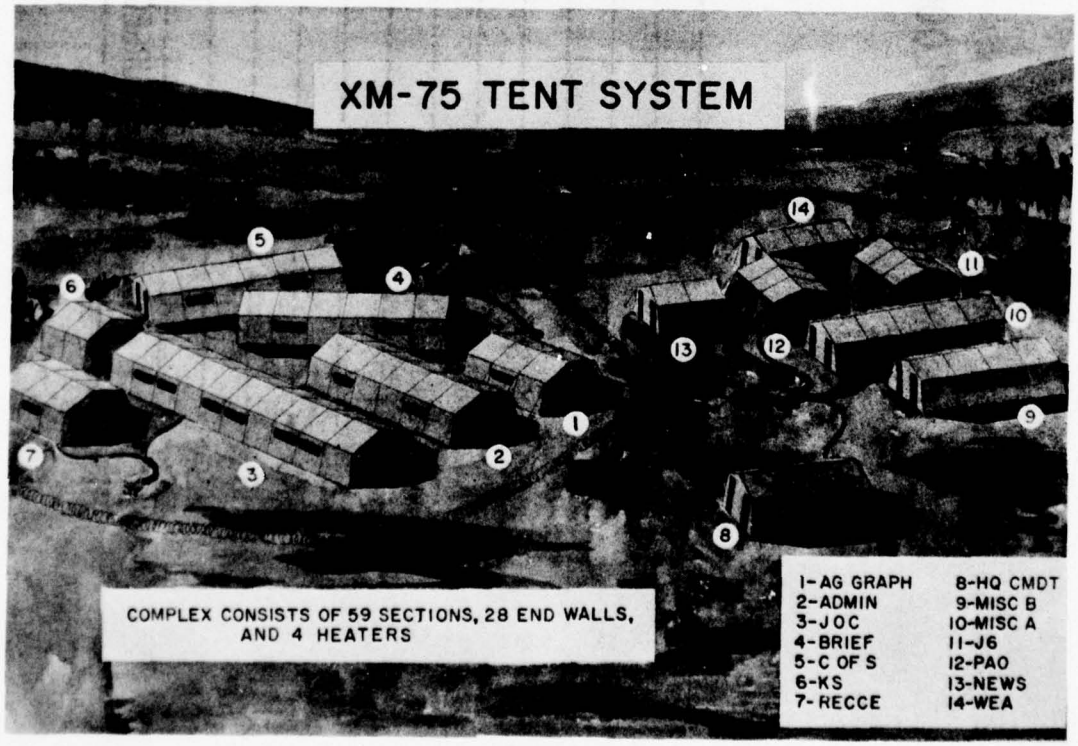


Figure 7

Three-Foot Expandable Personnel Shelter System (EXP)

This system features the older version of the 3' Expandable Personnel Shelter (EXP) originally developed for Bare Base. The basic unit is one shelter having shipping dimensions of 13' long, 3' wide, 8' high (see Figure 8) and operational dimensions 33' long, 13' wide and 8' high. Three units may be joined together for shipping (see Figure 9). Operationally, the shelters would be modified to allow marrying of multiple shelters with the use of connectors. The system incorporates C100 heater/air conditioners for environmental control. Figures 10 and 11 show the outside and inside of the erected shelter and Figure 12 is the conceptual view of a 3' Expandable System.

Marine Corps Knockdown Shelter System

This system incorporates the Marine Corps Knockdown Shelters with C100 ECU's. The basic unit is one shelter which is 20' long, 8' wide and 8' high. The shelters collapse to a 2' height and may be stacked four high for shipping (Figures 13–17). The shelters can be joined on the ends or sides with removal of the appropriate walls. Figure 18 is the conceptual view of a Marine Corps shelter complex.

MUST System With U-Packs

This system utilized one MUST section as the basic unit. The section is 13' long and semicircular with a diameter of 20'. Also provided with the system are MUST end walls, MUST air locks and MUST U-Packs. The U–Pack provides heat, air conditioning and inflating air. Also provided are Multi-Purpose Shelters which serve as shipping containers for the inflatable sections, end walls, and air locks. Figure 19 shows a 4-section MUST inflatable and Figure 20 is the conceptual view of a MUST U-Pack system, except that two U-Packs are required in the secure area.

MUST System With C100's

This system is essentially the same as the MUST System with U-Packs except that the C100 ECU replaces the U-Pack. No provisions have been made for inflation of the sections. Present 400 Hz lights will have to be replaced with 60 Hz lights. Figure 21 is the conceptual view of a MUST complex with C100 ECU's.

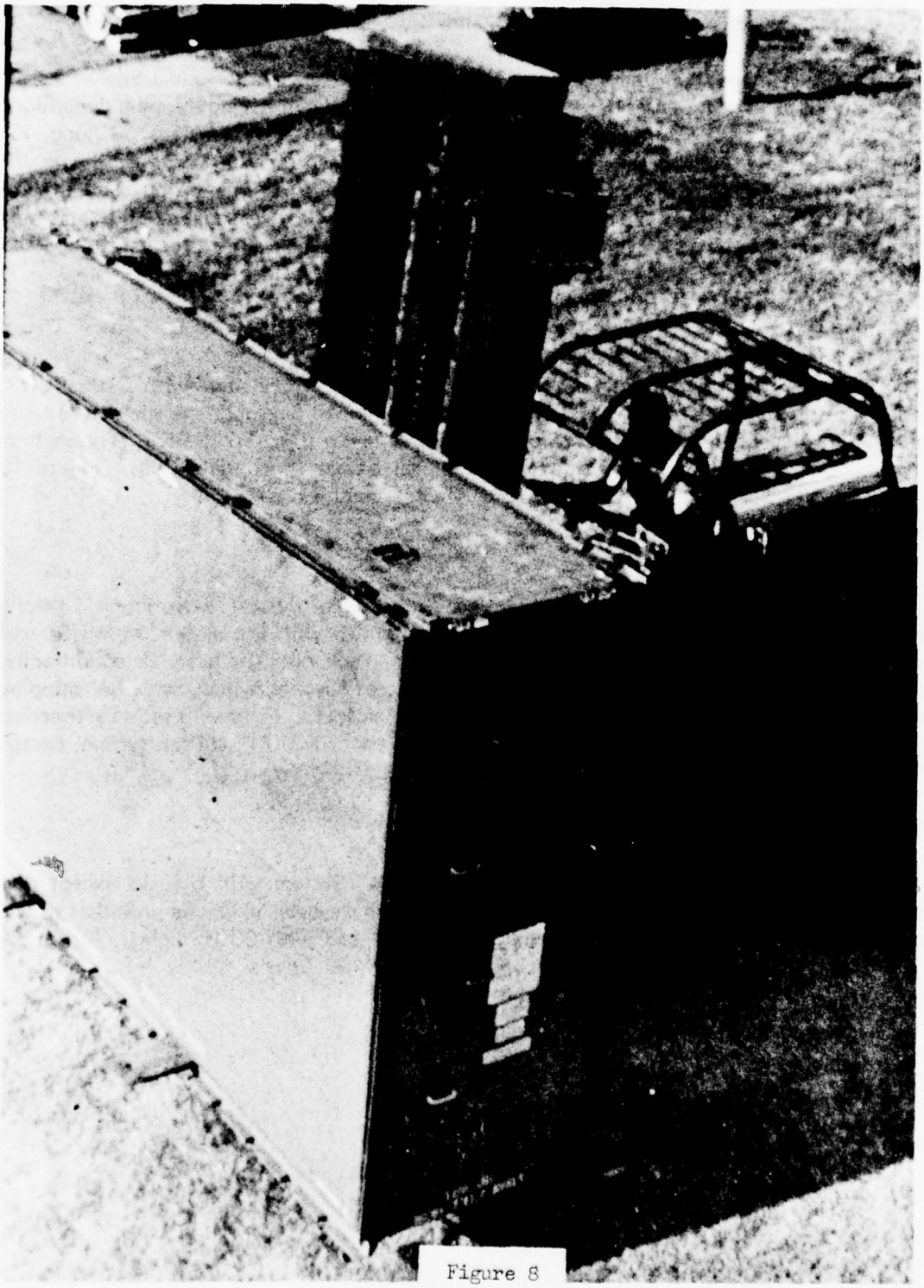


Figure 8

BARE BASE PERSONNEL SHELTER - PACKAGED CUBE - 13 FT LONG BY 3 FT WIDE BY 8 FT HIGH

Figure 9
BARE BASE PERSONNEL SHELTER - THREE UNITS LOCKED TOGETHER FOR SHIPMENT (EXTERIOR DIMENSIONS OF PACKAGE - 13 FT LONG BY 9 FT WIDE BY 8 FT HIGH)

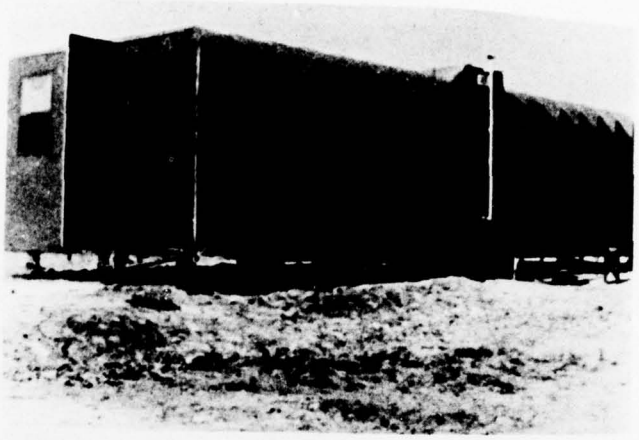


Figure 10. BARE BASE PERSONNEL SHELTER - EXPANDED VIEW

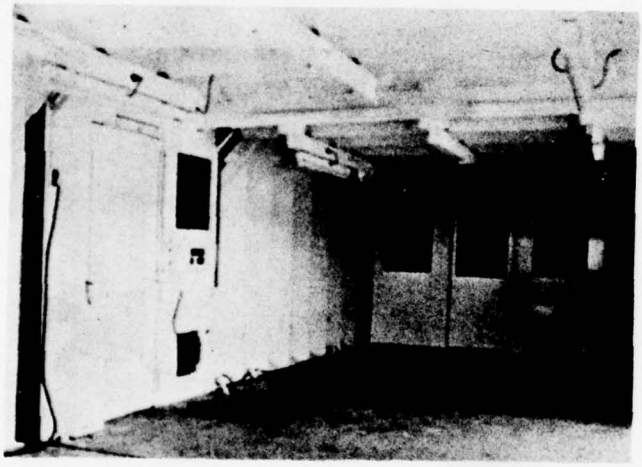


Figure 11. Bare Base Shelter - Interior View

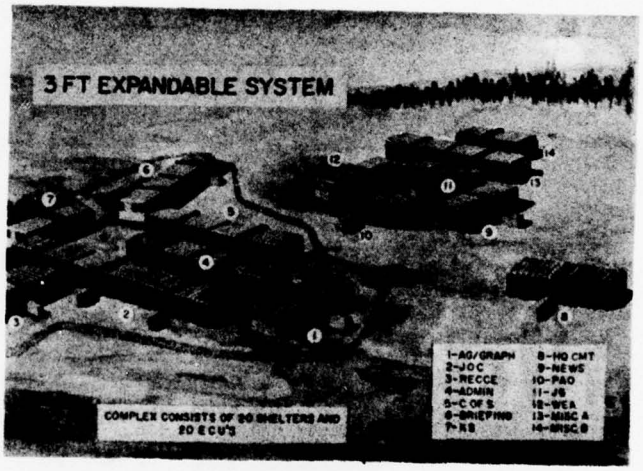


Figure 12

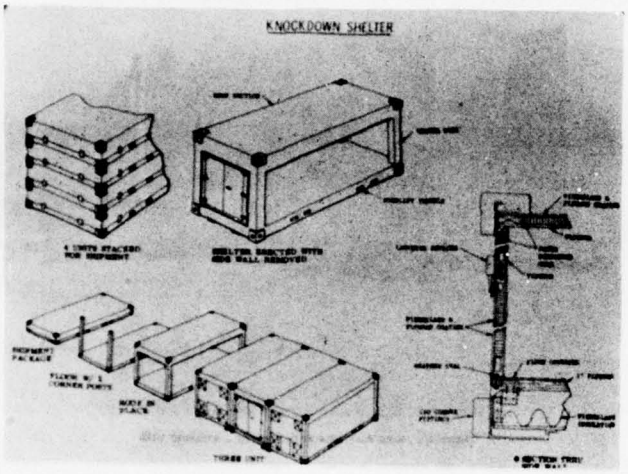


Figure 13. Marine Corps Knockdown Shelter Schematic

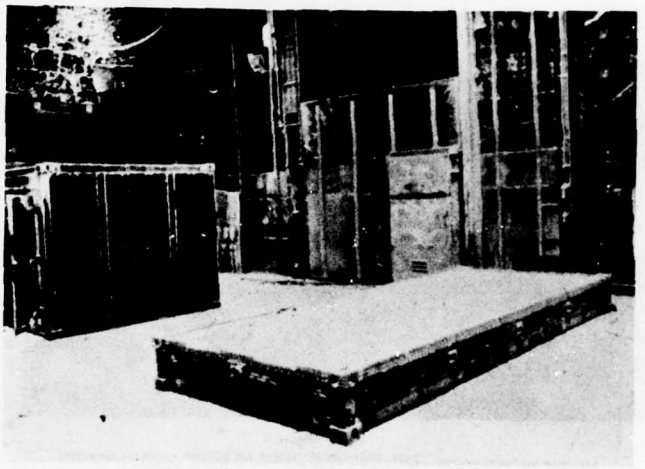


Figure 14. Marine Corps Knockdown Shelter Collapsed

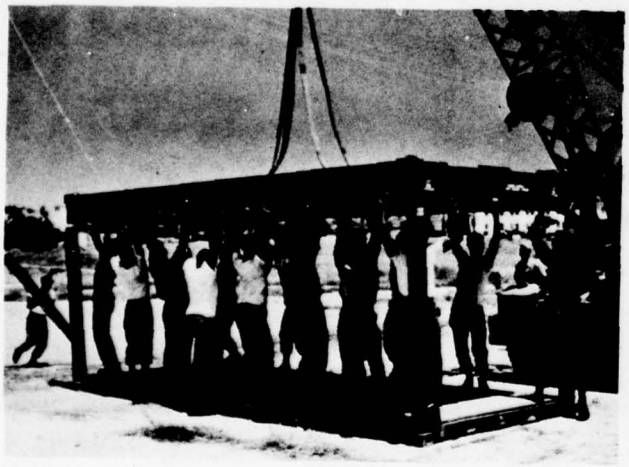


Figure 15. Marine Corps Knockdown Shelter Partially Erected

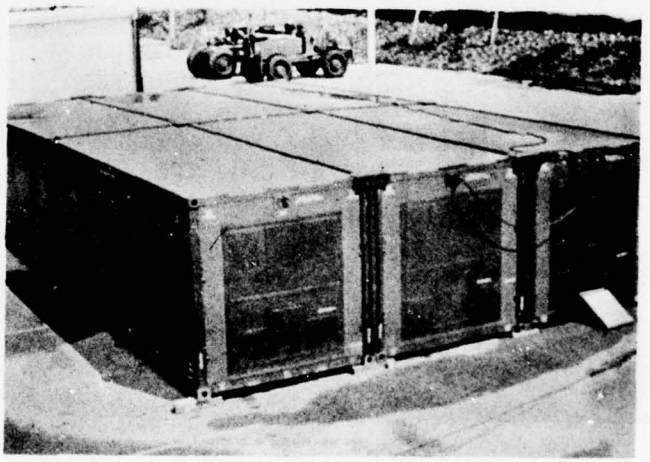


Figure 16. Marine Corps Knockdown Shelter Joined - Exterior View

Figure 17. Marine Corps Knockdown Shelter Joined - Interior View

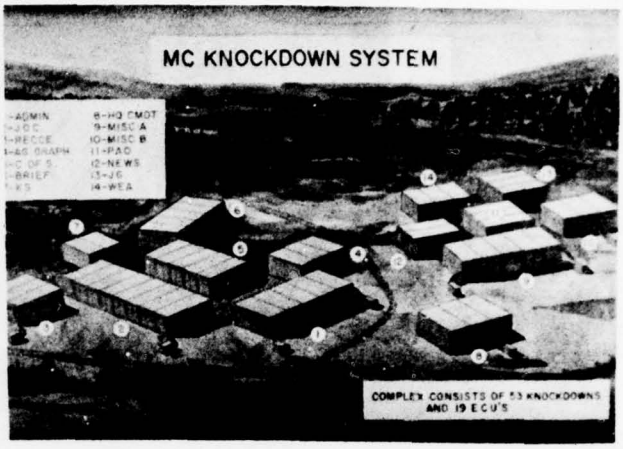


Figure 18

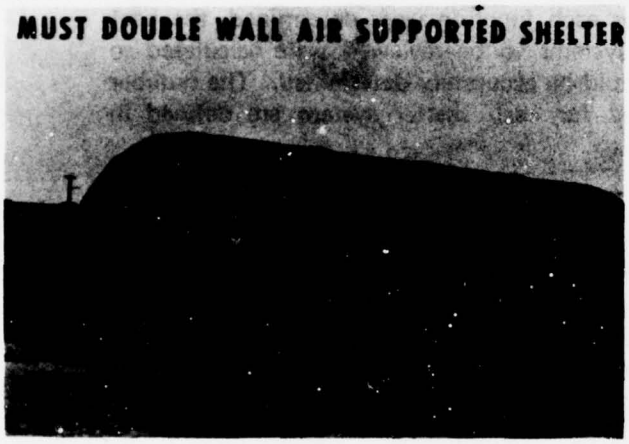


Figure 19

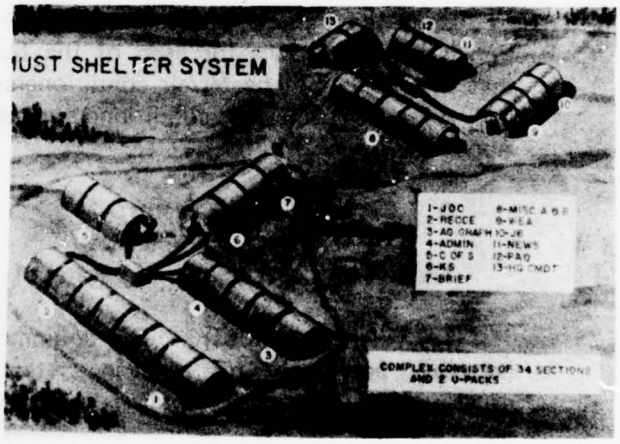


Figure 20

Figure 23

C. Heating/Air Conditioning Requirements:

Once the minimal space requirements for each function were determined, the heat transfer characteristics for each of the five systems to be reviewed were calculated so that the number of heater/air conditioners could be accurately determined. The number and types of heater/air conditioners required for each shelter system are defined in Appendix A.

D. System Cost Elements:

The system cost is the aggregate of four cost elements:

1. **Equipment Cost** – The equipment cost is the cost incurred in purchasing all necessary equipment for a given system including ECU's, modifications if required, generators, and Material Handling Equipment (MHE). This equipment cost is submitted as:

(a) Capitalization Cost – which is the dollar amount needed to buy all required items at one time and;

(b) Uniform Annual Cost – which includes a ten percent capital recovery factor over the economic life of each item in the system.

2. **Transportation Cost** – The transportation cost is based on the operating cost per hour of C141 aircraft. The operating hours were determined by using a 4000-mile round trip mission quarterly. The number of aircraft is determined by the cube/weight of each system.

3. **Maintenance Cost** – The maintenance cost assumes maintenance personnel grade E–5 having a uniform average cost of $13,000 per man-year which includes salary and

benefits, support costs, training costs, rotation costs and initial clothing and accession costs. The above information is based on Army and Marine Corps cost data and may vary somewhat for different MOS's.

4. **Operational Cost** – The operational cost is based on fuel requirements for ECU's, generators, and MHE.

The above four cost centers comprise the total annual cost for each of the five pure systems. The four cost centers break down into the cost of ownership, the cost of transporting the system four times a year, the cost of maintaining the equipment allocated to each system, and the cost of the fuel required to operate each of the systems.

E. System Cost Summaries:

For the pure systems considered, Equipment Costs are summarized in Table 2, Transportation Costs are summarized in Table 3, Maintenance Costs are summarized in Table 4, Operating Costs are summarized in Table 5, and Uniform Annual System Costs are summarized in Table 6. Detailed cost derivations are provided in the Appendices.

The cost of the five pure systems including the detailed cost derivatives provided in the appendices are presented in a format which will enable USREDCOM personnel to readily compare each of the systems. In addition, the information is provided such that combination systems can be readily evaluated. NARADCOM did not provide sample matrix combinations of various shelter systems since it was felt that such matrices would indicate an emphasis or preference which may not be intended. The cost summaries consider only the key functional operations for USREDCOM and do not include other life and support functions such as troop housing, shelters for maintenance of vehicles, supply shelters, and shelters required for kitchens, latrines, etc. It is suggested that many of these functions can be upgraded in the field by utilizing the XM–75 frame supported tent. This would improve the habitability of the personnel in the new shelters over those shelters now being used for the other life and support functions without upgrading the habitability of these functions to the level of essential functions that are addressed in this study report.

F. Systems Effectiveness:

The HQ JTF 7 is a unique unit. Therefore, a large-scale, expensive, research and development effort to develop a shelter system to the specialized needs and requirements of the HQ JTF 7 was considered impractical since the results of such an effort may not be applicable to any other military units. Therefore, only currently available military shelters were considered with modifications as required.

How effective a given shelter system is for HQ JTF 7 is dependent on the effectiveness factors considered important and the relative importance of these factors among one another. Both of these are subjective in nature and thus may vary from person to person.

TABLE 2

EQUIPMENT COST SUMMARY
(DETAILED IN APPENDIX B)

SYSTEM	CAPITALIZATION COST		UNIFORM ANNUAL COST	
	OWNED	TASKED[1]	OWNED	TASKED[1]
XM-75	103,097	87,067	25,713	23,259
3 FT EXP	232,329	142,500	45,940	35,498
MARINE CORPS	785,829	696,000	192,244	181,802
MUST (U-PACK)	834,430	818,400	161,056	158,602
MUST (C100'S)	476,810	380,900	108,570	98,301

NOTE 1. COSTS FOR EACH SYSTEM CONSIDER WHEN SUPPORT EQUIPMENT (I.E., FORKLIFTS, AND GENERATORS) IS OWNED OR TASKED. TASKED EQUIPMENT ASSUME FOUR (4) FTX'S/YEAR FOR ONE MONTH PER FTX OR 1/3 YR/YR.

TABLE 3

SUMMARY

C-141 AIRCRAFT REQUIRED/COST

OWNED EQPMT
(TASKED EQPMT) (DETAILED IN APPENDIX C)

SYSTEM ECU'S	XM-75 XM-75	MUST U-PACKS	MUST C100'S	3' EXP C100'S	M.C. C100'S
TOTAL WT (LBS)	34,847 (14,847)	79,080 (59,080)	117,400 (60,080)	145,960 (82,560)	298,900 (235,500)
PALLETS REQUIRED	7 (5)	21 (19)	29 (19)	28 (19)	54 (45)
AVE WT/PALLET (LBS)	4,978 (2,969)	3,766 (3,109)	4,048 (3,162)	5,212 (4,345)	5,535 (5,223)
PALLETS/ ARCRFT	10 10	10 10	10 10	10 10	10 10
ARCRFT REQUIRED	0.7 (0.5)	2.1 (1.9)	2.9 (1.9)	2.8 (1.9)	5.4 (4.5)
ANNUAL COST ($)	58,212 (41,580)	174,636 (158,004)	241,164 (158,004)	232,848 (158,004)	449,064 (374,220)

TABLE 4

SUMMARY MAINTENANCE COSTS (SEE APPENDIX D FOR DETAILS)

	MAINT (MAN-YRS)		SYSTEM COST[1]	
	ALL UNIT OWNED	SUPPORT ITEMS TASKED	ALL UNIT OWNED	SUPPORT ITEMS TASKED
XM-75	1.18	0.59	15,340	7,670
3 FT EXP	3.78	2.09	49,140	27,170
MARINE CORPS	3.78	2.09	48,490	26,520
MUST (U-PACKS)	2.88	2.29	37,440	29,770
MUST (C100'S)	4.33	2.27	56,290	29,510

NOTE 1. UNIFORM ANNUAL COST OF AN E-4, TO INCLUDE SALARY AND BENEFITS, SUPPORT COSTS, ROTATION COSTS, ESTIMATED TO BE $13,000.

TABLE 5

SUMMARY OPERATING (FUEL) COSTS
(SEE APPENDIX FOR DETAILED BREAKDOWN)

SYSTEM	TYPE FUEL	ANNUAL REQMTS (GALS)	COST ($)/GAL	ANNUAL COST
XM-75	GASOLINE	5,400	0.316	1,706
BARE BASE	DIESEL	14,300	0.385	5,506
M.C.	DIESEL	14,300	0.385	5,506
MUST (U-PACK)	JP-4	121,000	0.432	52,272
MUST (C100'S)	DIESEL	21,500	0.385	8,278

TABLE 6

UNIFORM ANNUAL SYSTEM COST

(OWNED)

(TASKED)

COST COMPONENT	XM-75	3 FT EXP	MARINE CORPS	MUST (U-PACKS)	MUST (C100'S)
DEPR, EQPMT	25,713 23,259	45,940 35,498	192,244 181,802	161,056 158,602	108,570 98,301
TRANSP	58,212 41,580	232,848 158,004	449,064 374,220	174,636 158,004	241,164 158,004
OPERATING	1,706	5,506	5,506	52,272	8,278
MAINT	15,340 7,670	49,140 27,170	48,490 26,250	37,440 29,770	56,290 29,510
TOTAL	100,971 74,215	333,433 226,178	712,952 605,697	425,405 398,649	414,303 294,094

The effectiveness factors considered to be of importance to the authors and relative importance of each is provided below:

EFFECTIVENESS FACTORS

For the purpose of this analysis, the effectiveness factors considered have been categorized into one of four major subgroups. The four major subgroups and the total weight assigned each subgroup are:

Subgroup	Total Weight
1. Habitability/Environmental Considerations	0.30
2. Flexibility	0.10
3. Supportability	0.20
4. Combat Suitability	0.40

1. Habitability/Environmental Considerations

Four effectiveness factors were included in this subgroup.

a. **Temperature Control (0.15)** – Based on the shelters and environmental control equipment provided each system, this factor indicates the ability to heat (0.075) or cool (0.075) the shelters provided to a desirable working temperature.

b. **Dust Control (0.05)** – This factor basically indicates how open or tight the shelter system is which, in turn, affects the amount of interior dust. For example, the MUST is air tight, thus limiting dust, while the XM–75 is fairly open, thus susceptible to more dust.

c. **Floor (0.05)** – A hard raised floor is considered more desirable than a covered ground floor and thus rated higher.

d. **Noise (0.05)** – This factor indicates the interior noise level produced by the heaters, air conditioner/heaters, U-Packs, and generators provided with each shelter system and operated to heat or cool the shelters as required. These ratings were based on subjective measurements rather than quantitative measurements.

Lighting was not considered since it was assumed that the desired level of lighting could be obtained in any of the shelters if the light fixtures necessary were installed. Thus, all systems would receive identical ratings.

2. Flexibility

Two effectiveness factors were included in this subgroup.

a. **Variations in Desired Width/Depth (0.05)** – This factor indicates the ability to construct a shelter of any desired length or width. For example, the Marine Corps shelters can be connected together lengthwise or widthwise, while the other types of systems can only be connected lengthwise, thus the Marine Corps shelters receive a higher rating for this factor.

b. **Ability To Utilize Shelter System Without Environmental Equipment in Temperate Climates (0.05)** – A shelter system which does not require environmentally controlled equipment in temperate climates is considered more effective than one which does. For example, the MUST shelter system is a closed system and thus requires a U-Pack for air circulation even if ambient temperature is 65°F to 75°F, while the XM–75 system is fairly open with roof vents. Thus, the MUST system received the lowest rating for this factor, while the XM–75 system received the highest rating.

3. **Supportability**

Two effectiveness factors were included in this subgroup.

a. **Shelters (0.05)** – This factor considered whether the shelters utilized are standard or obsolete and whether spare shelters or parts are available when and if required. Standard items were considerably more effective than obsolete items from a support aspect, and thus received a higher rating.

b. **Support Requirements (0.15)** – This factor was subdivided into three subfactors:

(1) **Fuel Requirements (0.05)** – The higher the POL requirement to operate the generators, heaters, air conditioner/heaters, and U-Packs required to heat/cool each shelter system, the lower the rating.

(2) **Personnel Requirement (0.05)** – The shelter system analyzed produced the requirement for various amounts of heating, air conditioning/heating, U-Packs, and generators for heating/cooling purposes plus MHE. The equivalent number of man-years required to operate, maintain, and repair this equivalent when owned and tasked was calculated. The higher the requirement, the lower the rating.

(3) **Tasked Equipment (0.05)** – Making the necessary arrangements for equipment to be tasked is an additional burden. Thus, the larger the number of tasked items required, the lower the rating.

4. **Suitability for Field (Combat) Utilization**

This major subgroup includes three effectiveness factors.

a. **Site Selection (0.20)** – This factor was subdivided into two subfactors.

(1) Level of Restriction (0.10) – This subfactor indicates the level of restriction on the types of terrains on which the shelter system can be set up. For example, if a particular shelter can be set up on almost any type of terrain, then it would receive a higher rating; whereas, if it requires a very specialized type terrain, then it would receive a low rating.

(2) Amount of Ground Preparation Required (0.10) – This subfactor indicates the amount of ground preparation required on the average before the shelter system can be set up. For this subfactor, a shelter system which requires extensive ground preparation receives a low rating, while a shelter system which requires little or not ground preparation receives a high rating.

b. Transportability (0.10) – This factor indicates how specialized the transport and MHE required to move the shelter system from one ground site to another site is. The more specialized or restricted the required equipment, the lower the rating received.

c. Usefulness (0.10) – This factor indicates how useful the shelter system is as a headquarters for the JTF 7 if the heating/cooling and/or power generation equipment provided with the system fails. For example, the MUST system is a closed system and is useless for any extended period of time if the heating/cooling equipment fails, even in temperate ambient conditions.

SYSTEM EFFECTIVENESS RATINGS

The effectiveness of each shelter system, when utilized as a headquarters for the JTF 7, is obtained by summing the rating for each effectiveness factor or subfactor for the given system. The maximum rating possible for a given system is 1.00, which is possible only if the given system is superior to all other systems for each factor or subfactor considered. The lowest possible rating is 0.00.

Table 7 summarizes the ratings for each factor or subfactor along with the totals for two systems. Table 8 is a summary comparison of the system effectiveness of the five systems. For each system, two separate ratings are given for Personnel Requirements and Tasked Equipment under the effectiveness factor Support Requirement. The first rating assumes that the HQ JTF 7 owns all support equipment required by the shelter system considered and is staffed with the personnel required to operate, maintain, and repair this equipment. The second figure assumes that any generators or rough terrain forklifts required by the shelter system are tasked along with the required operators, maintenance, and repair personnel dictated by the tasked equivalent.

Based on the effectiveness factors considered and the weights assigned, the XM–75 system was considered the most effective shelter system with a maximum rating of 0.760 followed by the 3' EXP system with a rating of 0.68. The Marine Corps system, in general, was considered the least acceptable shelter system.

TABLE 7 SAMPLE SYSTEMS EFFECTIVENESS ANALYSIS

	RATING	XM-75		BARE BASE	
HABIT/ENVIRON CONSIDERATIONS	30.0	10.0		26.0	
TEMP CONTROL	-	-		-	
-HEATING	7.5	5.0		7.5	
-COOLING	7.5	0.0		7.5	
DUST CONTROL	5.0	0.0		3.0	
NOISE CONTROL	5.0	3.0		3.0	
TYPE FLOOR	5.0	2.0		5.0	
FLEXIBILITY	10.0	8.0		5.0	
SPACE RQMTS-TOT & SHAPE	5.0	3.0		1.0	
UTLZN W/O ENVIRON EQPMT	5.0	5.0		4.0	
SUPPORTABILITY	20.0	18.0 (1)	17.0 (2)	7.0 (1)	4.0 (2)
SHLTR EQPMTS	-	-	-	-	-
-STD/OBS,SPRS/RPLCMTS	5.0	3.0	3.0	0.0	0.0
SPT RQMTS	-	-	-	-	-
-FUEL	5.0	5.0	5.0	4.0	4.0
-PERSONNEL	5.0	5.0	5.0	0.0	0.0
-EQPMT (TRNSPT,ETC.)	5.0	5.0	4.0	3.0	0.0
COMBAT SUITABILITY	40.0	40.0		30.0	
SITE SELECTION	-	-		-	
-LEVEL RESTRCTN	10.0	10.0		10.0	
-RQ'D GRND PREP	10.0	10.0		10.0	
TRNSPRTABLTY - LAND	10.0	10.0		4.0	
USEFLNS-IF ENVIRN EQ FAILS	10.0	10.0		6.0	
	100.0	76.0	75.0	68.0	65.0

NOTES:
(1) Eqpmt Owned (Typ)
(2) Eqpmt Tasked (Typ)

TABLE 8

COMPARISON OF SYSTEM EFFECTIVENESS
(Details in Table F-2)

	RATING	XM-75	BARE BASE	MARINE CORPS	MUST (U-PACKS)	MUST (C-100)
HABITABILITY/ ENVIRONMENTAL CONSIDERATIONS	30.0	10.0	26.0	27.0	25.0	27.0
FLEXIBILITY	10.0	8.0	5.0	8.0	3.0	3.0
SUPPORTABILITY	20.0	18.0(1) 17.0(2)	7.0 4.0	9.0 6.0	11.0 7.0	9.0 6.0
COMBAT SUITABILITY	40.0	40.0	30.0	2.0	18.0	18.0
SYSTEM EFFECTIVENESS	100.0	76.0(1) 75.0(2)	68.0 65.0	46.0 43.0	57.0 53.0	57.0 54.0

NOTES:

(1) Equipment Owned (typ)

(2) Equipment Tasked (typ)

G. Relative Worth:

Relative worth of a system is a function of the systems relative cost and relative effectiveness. In essence, a given system may be more effective than another system, but may also cost more. By utilizing relative worth, one may establish whether the increased effectiveness provided by the more effective system is worth the additional cost.

$$\text{Relative Cost} = \frac{\text{Annual Cost Alternative System}}{\text{Annual Cost Baseline System}}$$

$$\text{Relative Effectiveness} = \frac{\text{Effectiveness Alternative System}}{\text{Effectiveness Baseline System}}$$

and

$$\text{Relative Worth} = \frac{\text{Relative Effectiveness}}{\text{Relative Cost}}$$

Relative worth, in essence, normalizes the cost and operational effectiveness relationships with the baseiine system assigned the unit value.

To calculate relative worth, the XM–75 system was taken as the baseline system since it is the closest to the current shelter system utilized which consisted of frame supported tents. Based on the uniform annual cost, the XM–75 system is the cheapest system considered. Based on the Systems Effectiveness Analyses, the XM–75 system is the most effective system. Therefore, the relative worth of the four other systems considered will be considerably less than the relative worth of the XM–75 system. The relative worth of each system is detailed in Table 9. As can be seen, the relative worth of the alternative systems, as compared to the XM–75 system, decreased from 71% to 93%.

The only area where any of the alternative systems are considered to be more effective than the baseline system is in the subgroup Habitability/Environmental Considerations. Thus, if a larger portion of the total weight was given to this subgroup and less to the other subgroups, combined at some point, the relative worth of an alternative system may be greater than the relative worth of the baseline systems. A sensitivity analysis, detailed in Appendix F, was performed to determine if this might happen. This analysis only assumes that the relative weights within the subgroup Habitability/Environmental Considerations remain the same and that the relative weights within the other subgroups combined remained the same. Based on the sensitivity analysis performed for the alternative systems, where the unit owns all support equipment, between 110% and 129% of the total effectiveness points allowed must be given to the subgroup Habitability/Environmental Considerations, and thus between -10% and -29% to all of the other subgroups combined for the relative worth of any of the alternative systems to

TABLE 9

RELATIVE WORTH [1]

	XM-75		3 FT EXP		MARINE CORPS		MUST(U-PACS)		MUST(C100'S)	
	UNIT	TASKED	UNIT	TASKED	UNIT	TASKED	UNIT	TASKED	UNIT	TASKED
ANNUAL COST (1000'S $)	100.9	74.3	333.3	226.2	695.3	588.0	425.4	398.7	414.4	294.1
RELATIVE COST[2]	1.00	1.00	3.30	3.04	6.89	7.91	4.22	5.37	4.11	3.96
SYSTEMS EFFECTIVENESS	0.760	0.750	0.680	0.650	0.460	0.430	0.570	0.530	0.570	0.540
RELATIVE EFFECTIVENESS[3]	1.00	1.00	0.89	0.87	0.61	0.57	0.75	0.71	0.75	0.72
RELATIVE WORTH[4]	1.00	1.00	0.27	0.29	0.09	0.07	0.18	0.13	0.18	0.18

NOTES:

1. THE XM-75 IS TAKEN AS THE BASELINE SYSTEM.
2. RELATIVE COST = $\frac{\text{ANNUAL COST OF ALTERNATIVE SYSTEM}}{\text{ANNUAL COST OF BASELINE SYSTEM}}$
3. RELATIVE EFFECTIVENESS = $\frac{\text{EFFECTIVENESS OF ALTERNATIVE SYSTEM}}{\text{EFFECTIVENESS OF BASELINE SYSTEM}}$
4. RELATIVE WORTH = $\frac{\text{RELATIVE EFFECTIVENESS}}{\text{RELATIVE COST}}$

be equal to the relative worth of the XM–75 system. This is impossible since the percent allowed must be equal to or less than 100%. This is due to the low cost of the XM–75 system. Even if all the effectiveness points are assigned to the subgroup Habitability/Environmental Considerations and none to the other subgroups, the relative worth of each of the determined systems will be less than that of the XM–75 system.

IV. INITIAL OPERATIONAL CAPABILITY (IOC) FOR EACH OF THE FIVE SYSTEMS

In order to make a rational decision regarding the time required to field a system, it is necessary to consider such things as the availability of system components, engineering or other unique support required to assemble the system, and the ability to maintain the system in operating condition. The standardization status of components impacts on the availability of those components as well as the support of the various components in the field via the use of spare parts.

A. Availability of Shelters/Components

The shelters provided by NARADCOM for use during the Systems Analysis Review of USREDCOM, as well as the components for the five shelter systems considered, are discussed below with respect to availability (Table 10). Some of the information provided is not considered germaine to the study, but may be of interest to the reader who wishes to consider certain shelters for other uses.

1. Expandable Shelter/Container (ES/C)

The ES/C is described in Section II. Two of these shelters were provided by NARADCOM for use in this systems analysis study and will remain with the HQ JTF 7 for future use. The remainder of the ES/C's are part of the AF Bare Base System stored at Holloman AFB and are the property of the Tactical Air Command. It should be noted that the Army recently purchased this basic shelter without a flat bottom base; that is, with skids and other modifications for use as helicopter maintenance shops. There are currently no other known uses for this shelter nor is it anticipated that there will be any procurements in the immediate future.

2. The 2'8" Expandable Personnel Shelter (EXP)

The EXP is described in Section II. Two of these shelters were furnished by NARADCOM for use during the Systems Analysis Review and continued use by USREDCOM thereafter. Over 800 additional 2'8" EXP's are part of the AF Bare Base System stored at Holloman AFB and are the property of Tactical Air Command. It is assumed that there will be no future production of these shelters for use by Tactical Air Command. If three of these shelters are locked together in the shipping mode, they can be readily transported as an 8' wide by 8' high by 13' long shipppng container. In addition, this package of three shelters has a flat bottom with 463L rail system to interface

TABLE 10

AVAILABILITY OF SHELTERS/COMPONENTS

ITEM	STDZN STATUS	AVAILABILITY	RESUPPLY	IOC(1)
ES/C	AF LTD STD	TAC RESERVES	LTD SPARES	N/A
2'8" EXP	AF LTD STD	TAC RESERVES	LTD SPARES	N/A
50'	EXPERMNTL	NO TDP(2) AVLBL	N/A	FY86 EST.
XM-75	EXPERMNTL	TDP(2) AVLBL	N/A	12-16 MOS
250,000 BTU DUCT TYPE HTR	STD	IN SPLY SYS	UPON RQST	IMMEDIATE
3' EXP	NONSTD/OBS	APPROX. 50 SHLTRS TO BE EXCESSED	NONE	18 MOS WITH MAX PRIORITY
5 TON AC/HTR MODEL C100	AF/MC LTD STD	DURING PROD	LTD COMPNTS	18 MOS IF RQSTD IN 4 MOS
MC KNCKDN	EXPERMNTL	UNPROVEN TDP(2)	NONE	NOT READILY DETERMINED
MUST INFLATABLE	STD	IN SPLY SYS	UPON RQST	IMMEDIATE
MUST MULTI-PURP	STD	IN SPLY SYS	UPON RQST	IMMEDIATE
MUST UTIL PKG	STD	ADD TO PROD PROC	UPON RQST	APPROX 1 YR

1. INITIAL OPERATIONAL CAPABILITY AFTER FUNDS ARE MADE AVAILABLE
2. TECHNICAL DATA PACKAGE (TDP)

with the C130 and C141 roller system. It would, therefore, be highly desirable for USREDCOM to obtain one additional 2'8" EXP from Tactical Air Command so that the three shelters can always be shipped as a unit. This would improve the efficiency of the aircraft load as well as reduce damage inflicted to the shelters during transport.

3. The 50' Accordion Shelter

This prototype shelter is shipped as an 8x8x20' container which expands in the field to 8' high by 20' wide by 50' long providing approximately 1000 square feet of usable floor space in the erected mode. The prototype used by USREDCOM is currently being upgraded by the contractor with two new accordion shells. USREDCOM will continue to use the shelter so that NARADCOM can obtain additional information on potential field applications for this novel prototype. It is currently anticipated that this will be the last of the Army Standard Family of Tactical Shelters to be developed and will not be fielded in any quantities until 1985 to 1987.

4. XM–75 Frame Supported Tent

A prototype XM–75 was fabricated by NARADCOM for use by the Marine Corps as a kitchen facility for battalion feeding. A technical data package, including drawings for procurement of this item, have been furnished to the Marine Corps. At this time, there have been no production contracts awarded for fabrication of this item. The Marine Corps has a planned procurement during FY78. It is assumed that this shelter would be modified for use by USREDCOM by adding heater inlet openings to accommodate the 250,000 Btu heater and insulated liners. If USREDCOM desired this shelter, NARADCOM would update the technical data package and have the tents fabricated by a contractor under the technical monitorship of NARADCOM. It would take from 12 to 16 months to field this shelter after funds were made available to NARADCOM.

5. 250,000 Btu Heater

This is a standard item which can be readily obtained from stock.

6. 3' Expandable Personnel Shelter (EXP)

Approximately 300 of the 3' EXP's were produced in the 1968–69 time frame for the first generation AF Bare Base System. A number of these original 3' EXP's are being replaced by the 2'8" EXP's during an 18-month maintenance cycle for all Bare Base equipment now underway at Holloman AFB. Approximately 50 more of these 3' EXP shelters will be replaced and declared excess. Five of these shelters have been furnished to USREDCOM at no cost. However, given the quality of some of the components of these five shelters, it is believed that four satisfactory shelters can be made out of the five units not at MacDill AFB. It is noted that the shelters received from Holloman AFB were not preselected or corrected for deficiencies prior to shipment to USREDCOM. Suffficient 3' EXP's to satisfy the functional needs of the HQ JTF 7 with additional shelters for cannibalizing of spare parts, as required, could be obtained over the next 18 months if USREDCOM establishes a priority for obtaining this shelter.

7. Five-Ton Air conditioner/32,000 Btu Heater (Model C100)

This ECU was developed for the AF Bare Base System. Approximately 800 of these ECU's were purchased by the Air Force and another 400 were purchased by the Marine Corps. USREDCOM has borrowed a number of these units for use in their exercises. The manufacturer believes a limited number of additional ECU's (approximately 100) will be purchased by the Air Force and Marine Corps. If USREDCOM is interested in obtaining these units, a decision would have to be made in the next 2 to 4 months in order to take advantage of this upcoming procurement. Given the smaller number of ECU's to be purchased this time and 4 to 5 years of inflation, the unit price will go up significantly (between $3500 and $4000 per unit vs. approximately $1700).

8. Marine Corps Knockdown Shelter

A small number of prototype knockdown shelters were fabricated as part of the Marine Corps Expeditionary Shelter System Conceptual Feasibility Effort. A second limited purchase of these shelters has run into significant delays due to discrepancies in the technical data package. Another procurement is scheduled for FY78 with a limited number of these shelters to be subjected to engineering development testing by the Navy leading towards type classification. Since a small number of these shelters were originally purchased, no data has been obtained regarding the durability of the hardware or of the composite panel itself. Based on the current problems with the technical data package and inability of the contractor to furnish the shelters per schedule, it is difficult to estimate the future availability of field durability of this item.

9. MUST Inflatable

This shelter is considered Standard A for the Army Surgeon General's field hospital. If concurrence is obtained from the Surgeon General and the MUST Project Manager, inflatable shelters could be obtained from inventory.

10. MUST Multi-Purpose Shelter

This shelter is considered Standard A by the Army's Surgeon General. If concurrence is obtained from the Surgeon General and MUST Project Manager, the Multi-Purpose Shelter could be obtained from inventory.

11. Utility Package (U-Pack)

The U-Pack is considered Standard A by the Army's Surgeon General. Availability of these power units would have to be coordinated with the Surgeon General and the MUST Project Manager. USREDCOM would most likely have to add on to an ongoing production effort in order to obtain U-Packs.

B. Engineering/Modifications Required for Each of the Five Systems:

1. XM–75 System

The Technical Data Package, including the drawings, would be revised as required to support a limited production contract of XM–75 frame supported tents for USREDCOM. NARADCOM would oversee the fabrication of the shelters. NARADCOM and USREDCOM would determine the system of lights to be employed with the XM–75 shelter system.

2. 3' EXP

These shelters would be reconditioned at Holloman AFB and inspected by NARADCOM, and flexible air conditioning ducts fabricated under contract. End walls would be cut out and a joining connector made, where required, so the EXP's could be joined end to end in the field. These objectives would be obtained by technical monitorship of NARADCOM under contract with the developer. Extra support jacks would be incorporated where unusual or heavy traffic is anticipated.

3. Marine Corps Knockdown Shelter System

Modifications would be required to interface the C100 ECU's with the Marine Corps Knockdown Shelters. Also, leveling jacks and base supports would have to be added to the kit to insure that the shelters could be erected on terrain that was not perfectly level. Comments regarding existing hardware on these shelters cannot be accurately made until the shelters have been evaluated by NARADCOM personnel.

4. MUST Shelter System With U-Packs

This standard system should require no additional engineering interface.

5. MUST Shelter System With C100 ECU's

This hybrid MUST System would require the following three changes:

(a) A 60-cycle light would be used in lieu of the 400-cycle light normally furnished with the inflatable shelters. The manufactuer of the 400-cycle lights will be able to produce the same size light as a 60-cycle light.

(b) The C100 ECU's with 16" ducts will have to be interfaced into the inflatable shelters with 20" openings. Also, the end walls may need to be modified where additional ECU's are required.

(c) Small blowers will be required to furnish 1.5 psi air pressure to the inflatable shelter. The above efforts could best be accomplished by NARADCOM in conjunction with USREDCOM personnel.

C. Standardization Status/Spare Parts:

Given the five-year life assumed for each of the systems considered, this section covers how each system would be maintained over that period of time.

1. XM–75

Nonstandard at this time, but may be classified standard for Marine Corps and Office of the Surgeon General during FY78–79: However, the frame is reasonably rugged and should require no spare parts. The fabric can be repaired with a repair kit which would be furnished by NARADCOM.

2. 3' EXP

Nonstandard/Obsolete: With reasonable care, this shelter can be opened and closed many times without damage. Most of the items which might become damaged can be readily repaired such as delaminated panels or broken hardware. The most vulnerable items are the accordion shells and the fly sheets. It is recommended that sufficient spare EXP's be obtained so that they can be cannibalized, as required, to maintain the functional EXP's in operating condition.

3. Marine Corps Knockdown Shelter System

Nonstandard: If the basic shelters can be obtained, it will be necessary to purchase additional spares of those hardware items most likely to fail. Since there is little use history for this item, NARADCOM cannot estimate the type and location of the potential failures.

4. MUST System With U-Packs

Standard: Since the item is standard, repair parts should be available through normal supply channels. A repair kit should be integral with the system for maintaining the inflatable shelters. The U-Pack will require trained personnel to operate as well as maintain the power generation system. It should be recognized that the entire shelter system would be shut down if the U-Pack failed, since it provides air pressure for the inflated tubes, power generation and air conditioning for a closed shelter system.

5. MUST With C100 ECU's

Standard/Modified: The shelters and their parts could be maintained through the normal supply system. The blowers would require spare parts or spare blowers. Also, 60-cycle lights would require spare backups.

V. CONCLUSIONS

A. Shelter Matrices:

It was determined that it would not be in the best interests of the user of this Systems Analysis Review to instill preconceived notions or prejudices into this study effort. Instead, the data has been presented such that the information can be readily extracted to allow USREDCOM to consider a variety of shelter mixes based on the needs of the HQ JTF 7. It is assumed that USREDCOM will continue to use the two 2'8" EXP's, two ESC's, 50' Accordion Shelter, and two MUST experimental sections provided by NARADCOM. Therefore, a hybrid system of sorts would exist regardless of which of the five pure shelter systems were selected. However, the information can be readily extracted from tables so that USREDCOM personnel can retain maximum flexibility in their own selection process.

B. System Costs:

The costs of the various systems and modifications proposed herein should be considered as budgetary estimates rather than firm fixed prices for services or materials. These prices were obtained over the past year and may not currently reflect a unique market position for any one item. For example, if the C100 ECU's were obtained from existing Air Force or Marine Corps stock, the cost per unit would be under $1700 based on a procurement of 1200 of these ECU's in the 1973 timeframe. New ECU's obtained during a planned procurement of 100 ECU's are estimated to cost between $3500 and $4000. Funds cited in this report were checked for reasonableness, but were considered as budgetary estimates which could be effectively used for comparison purposes. Therefore, the costs associated with each of the systems is essentially correct relative to each of the other systems. Once USREDCOM has selected its preferred system of shelters, then a detailed cost analysis could be readily provided by NARADCOM for each of the components of the system selected.

C. Mission Profile:

In the Introduction Section of this report, the operating criteria established by USREDCOM for the purposes of this review are cited. Supplement B further discusses various operating requirements. The five systems considered are responsive with respect to the following essential operational criteria:

1. The equipment can be prepackaged in kit form for rapid deployment.

2. The kits can be organized in a modular fashion so that additional components can be added depending on whether the deployment will be for an Alpha package, Bravo package or Charlie package.

3. The equipment can be transported by C141 cargo aircraft.

An essential requirement of this review was to insure that the prepackaged kits could be used in an actual contingency operation. If the support/tasked equipment described in this review is available, then it is believed that this criteria can be satisfied for each of the five systems discussed. It is considered far more likely to the authors, however, that the predominant use of this equipment will be in support of training exercises such as the ongoing Brave Shield series of exercises. The uniform annual system cost data and relative worth analysis provide an order of ranking for each system where in the XM–75 tent system is rated the highest for these training exercises. However, different system effectiveness factors such as the need for environmental control of electronic equipment could alter the order of ranking.

APPENDIX A

HEATING/AIR CONDITIONING REQUIREMENTS

APPENDIX A

HEATING/AIR CONDITIONING REQUIREMENTS

GENERAL:

Temperature range – 30°F to 120°F

Air Condition from 120°F down to 80°F dT = 40°F

Heating from 30°F up to 65°F dT = 35°F

Heating/Air Conditioning Capacities

MUST Utility pack (U-pack) – 20 Tons Air Conditioning and 350,000 Btu/hr.

C100 Air Conditioner/Heater – 5 Tons Air Conditioning and 32,000 Btu/hr. Heating.

Herman-Nelson Heater – 250,000 Btu/hr. Heating.

Effective Heating/Air Conditioning Areas by Type Shelter

XM–75 Tents

Section = 240 ft^2

End Wall = 134 ft^2

3 ft. Expandable Shelter

End Wall = 104 ft^2

Section = 1386 ft^2

Complete Shelter = 1594 ft^2

Connector = 84 ft^2

Marine Corps Knockdown Shelters

Side Wall = 160 ft^2

Roof = 160 ft^2

Floor = 160 ft^2

End Wall = 64 ft^2

One complete shelter = 768 ft^2

MUST Shelters

Section = 669 ft^2

End Wall = 157 ft^2

Heat Transfer Considerations

Q = UdTA where: U = Btu/hr/°F/ft^2

$\int$ dT = °F

A = ft^2

XM–75 Tents with liners U = 0.75 Btu/hr/°F/ft^2

3 ft. Expandable Shelters U = 0.35 Btu/hr/°F/ft^2

Marine Corps Knockdowns U = 0.40 Btu/hr/°F/ft^2

MUST SHELTERS U = 0.56 Btu/hr/°F/ft^2

$\int$ dT_{AC} = (120°F – 80°F) = 40°F dT_H = (65°F – 30°F) = 35°F

$Q_{A.C.}$ = Btu/hr required for air conditioning (1 ton = 12,000 Btu/hr)

Q_H = Btu/hr required for heating

$Q_{AV.}$ = Btu/hr or Tons generated per unit

$N_{A.C.}$ = number of A.C. units required

$N_{H.}$ = number of heating units required

and

$$N_{A.C.} = \frac{Q_{A.C.}}{Q_{AV.}} \qquad N_H = \frac{Q_H}{Q_{AV}}$$

TABLE A-1

XM-75 SYSTEM WITH HERMAN-NELSON HEATERS

SECURE AREA

FUNCTION	SECTIONS	END WALLS	AREA (ft^2)
RECCE	3	2	988
JOC	10	2	2668
KEY STAFF	2	2	748
C of S	6	2	1708
BRIEFING	6	2	1708
ADMIN	6	2	1708
AG/GRAPH	3	2	988
TOTAL	36	14	10516

$Q_H = (.75)\ (35)\ (10516) = 276{,}045$ Btu/HR

$N_H = Q_H/Q_{AV} = 276{,}045/250{,}000 = 1.10$

NON-SECURE AREA

FUNCTION	SECTIONS	END WALLS	AREA
WEA	3	2	988
NEWS	2	2	748
PAO	3	2	988
J6	3	2	988
MISC A	5	2	1468
MISC B	4	2	1228
			6408

$Q_H = (.75)\ (35)\ (6408) = 168{,}210$ Btu/HR

$N_H = Q_H/Q_{AV} = 168{,}210/250{,}000 = 0.67$

H_Q CMDT 3 SECTIONS 2 ENDWALLS 988 ft^2

$Q_H = (.75)\ (35)\ (988) = 25{,}935$ Btu/HR

$= 25{,}935$ Btu/HR

TABLE A-1 (Cont'd)

$N_H = Q_H/Q_{AV} = 25,935/250,000 = 0.10$

Rounding up yields a requirement of two Herman-Nelson heaters for the secure area, two for the non-secure area, or a total of 4.

TABLE A-2

3-FT EXPANDABLE SHELTERS WITH C100 HEATER/AIR CONDITIONER

SECURE AREA

FUNCTION	SECTION	END WALLS	CONNECTORS	AREA (FT^2)	Q_{AC} (TONS)	N AC	Q_H (Btu/hr)	N H
RECCE	1	2	---	1594	1.86	0.37	19527	0.61
JOC	3	2	2	4534	5.29	1.06	55542	1.74
KEY STAFF	1	2	---	1594	1.86	0.37	19527	0.61
ADMIN	2	2	1	3064	3.57	0.71	37534	1.17
BRIEFING	2	2	1	3064	3.57	0.71	37534	1.17
C of S	2	2	1	3064	3.57	0.71	37534	1.17
AG/GRAPH	2	2	1	3064	3.57	0.71	37534	1.17

NON-SECURE AREA

FUNCTION	SECTION	END WALLS	CONNECTORS	AREA (FT^2)	Q_{AC} (TONS)	N AC	Q_H (Btu/hr)	N H
WEA	1	2	---	1594	1.86	0.37	19527	0.61
PAO	1	2	---	1594	1.86	0.37	19527	0.61
J6	1	2	---	1594	1.86	0.37	19527	0.61
NEWS	1	2	---	1594	1.86	0.37	19527	0.61
MISC A	2	2	1	3064	3.57	0.71	37534	1.17
MISC B	1	2	---	1594	1.86	0.37	19527	0.61
H_Q CMDT	1	2	---	1594	1.86	0.37	19527	0.61

Similarly, the number of C-100 units required for each shelter for heating purposes is greater than the number required for air conditioning purposes. Thus, rounding the number of units required for each shelter for heating purposes yields a requirement of 12 C-100's for the secure area and 8 for the non-secure area for a total of 20.

TABLE A-3

MARINE CORPS KNOCKDOWN SHELTER WITH C100 AIR CONDITIONER/HEATER

SECURE AREA

FUNCTION	END WALLS	FLOORS	ROOFS	SIDE WALLS	AREA (FT^2)	$Q_{A.C.}$ (TONS)	N A.C.	Q_H (Btu/HR)	N H
RECCE	6	3	3	2	1664	2.22	0.44	23296	0.73
KEY STAFF	4	2	2	2	1216	1.62	0.32	17024	0.53
JOC	16	8	8	2	3904	5.21	1.04	54656	1.71
C of S	10	5	5	2	2560	3.41	0.68	35840	1.12
BRIEFING	10	5	5	2	2560	3.41	0.68	35840	1.12
ADMIN	10	5	5	2	2560	3.41	0.68	35840	1.12
AG/GRAPH	6	3	3	2	1664	2.22	0.44	23296	0.73

NON-SECURE AREA

FUNCTION	END WALLS	FLOORS	ROOFS	SIDE WALLS	AREA (FT^2)	$Q_{A.C.}$ (TONS)	N A.C.	Q_H (Btu/HR)	N H
NEWS	4	2	2	2	1216	1.62	0.32	17024	0.53
PAO	6	3	3	2	1664	2.22	0.44	23296	0.73
WEA	6	3	3	2	1664	2.22	0.44	23296	0.73
J6	6	3	3	2	1664	2.22	0.44	23296	0.73
MISC A	10	5	5	2	2560	3.41	0.68	35840	1.12
MISC B	6	3	3	2	1664	2.22	0.44	23296	0.73
HQ CMDT	6	3	3	2	1664	2.22	0.44	23296	0.73

Similarly, the number of C-100 units required for heating purposes is greater than the number of required air conditioning purposes for each shelter. Thus, rounding the C-100 requirement for each shelter for heating purposes up, yields a C-100 total requirement of 11 for the secure area and 8 for the non-secure area for a total of 19.

TABLE A-4

MUST SYSTEM WITH U-PACKS

SECURE AREA

FUNCTION	SECTIONS	ENDWALLS	AREA (FT^2)
Joc & Recce	8	2	5666
C of S	3	2	2321
Admin & AG/Graph	5	2	3659
Key Staff & Briefing	4	2	2990
Totals	20	8	14,636

$Q_{A.C.} = UdT_{A.C.} A$

$= (0.56)\ (40)\ (14636)$

$= 327,846$ Btu/hr or 27.32 Tons

$N_{A.C.} = Q_{A.C.}/Q_{AV} = 27.32/20.00 = 1.37$

$Q_H = Ud\ T_H\ A$

$= (0.56)\ (35)\ (14636)$

$= 286,866$ Btu/hr

$N_H = Q_H/\ Q_{AV} = 286,866/350,000 = 0.82$

NON-SECURE AREA

FUNCTION	SECTIONS	ENDWALLS	AREA (FT^2)
MISCA & B	5	2	3659
WEA & J6	4	2	2990
PAO & NEWS	3	2	2321
HQ CMDT	2	2	1652
Totals	14	8	10,622

$Q_{A.C.} = Ud\ T_{A.C.}\ A$

$= (0.56)\ (40)\ (10622)$

$= 237,933$ Btu/hr or 19.83 tons

$N_{A.C.} = Q_{A.C.}/Q_{AV} = 1983/20.00 = 0.99$

TABLE A-4 (Cont'd)

Q_H = $U_d T_H A$

= (0.56) (35) (10622)

= 208,191 Btu/hr

N_H = $Q_H / Q_{H\ AV}$ = 208,191/350,000 = 0.60

Heating and air conditioning are both provided by the U-Pack. Thus, two U-Packs are required for the secure area and 1 UPAC is required for the non-secure area.

TABLE A-5
MUST SYSTEM USING C100 AIR CONDITIONER/HEATER

SECURE AREA

FUNCTION	AREA (FT^2)	$Q_{A.C.}$ (TONS)	$N_{A.C.}$	$Q_{H(Btu/HR)}$	N_H
RECCE	1652	3.08	0.62	32379	1.01
JOC	4328	8.08	1.62	84829	2.65
C of S	2321	4.22	0.87	45492	1.42
KEY STAFF	983	1.83	0.37	19267	0.60
ADMIN	2321	4.33	0.87	45492	1.42
BRIEFING	2321	4.33	0.87	45492	1.42
AG/GRAPH	1652	3.08	0.62	32379	1.01

NON-SECURE AREA

FUNCTION	AREA (FT^2)	$Q_{A.C.}$ (TONS)	$N_{A.C.}$	$Q_{H(Btu/HR)}$	N_H
MISC A	2321	4.33	0.87	45492	1.42
MISC B	1652	3.08	0.62	32379	1.01
PAO	1652	3.08	0.62	32379	1.01
WEA	1652	3.08	0.62	32379	1.01
J6	1652	3.08	0.62	32379	1.01
NEWS	983	1.83	0.37	19267	0.60
HQ CMDT	1652	3.08	0.62	32379	1.01

Heating and air conditioning are both provided by the C-100 unit. For each shelter, the number of C-100's required for heating purposes is greater than the number required for air conditioning purposes. Thus, taking the number of units required for each shelter for heating purposes and rounding up, except for those shelters requiring 1.01 C-100 units which is rounded down to 1, a total of 12 C-100's are required for the secure area and 8 for the non-secure area.

TABLE A-6

HEATING/AIR CONDITIONING/GENERATOR AUTHORIZATIONS

ITEM	NO. SECURE AREA	NO. NON-SECURE AREA	TOTAL REQ'D	SPARE FACTOR	NO. AUTH
XM-75 SYSTEM:					
250,000 BTU HTRS	2	2	4	50%	6
EXP SYSTEM:					
100 KW GEN	1	1	2	50%	3
C-100'S	12	8	20	25%	25
M.C. SYSTEM:					
100 KW GEN	1	1	2	50%	3
C-100'S	11	8	19	25%	24
MUST (U-PACKS):					
U-PACKS	2	1	3	67%	5
MUST (C-100'S):					
100 KW GEN	1	1	2	100%	4
C-100'S	12	8	20	25%	25

APPENDIX B

EQUIPMENT COSTS

APPENDIX B

EQUIPMENT COSTS

Capital costs are calculated for each system for when support equipment (i.e., forklifts and generators) is owned and also for when it is tasked. Uniform annual costs are also calculated for when the support equipment is owned and when tasked. To establish the uniform annual equipment for tasked equipment, it was assumed the equipment is tasked for four exercises per year for one month per exercise or on an annual basis for four months (1/3 yr.) per year. Thus, uniform annual cost of tasked equipment is equal to 1/3 of cost incurred when owned.

TABLE B-1
XM-75 SYSTEM

ITEM	COST/ UNIT	NO AUTH	ECON LIFE	CAPITAL COST	UNIFORM ANNUAL COST
TENT, EXTEND, SECT	$ 425	59	5	$25,075	$ 6,615
LINER, EXTEND, SECT	80	59	5	4,720	1,245
FLOOR, SECT, 8 FT	100	59	5	5,900	1,556
FLY, 8 FT	95	59	5	5,605	1,479
TENT, END SECT	300	28	5	8,400	2,216
LINER, END SECT	50	28	5	1,400	369
ARCH, W HEADER	165	73	5	12,045	3,177
PURLINS, SET OF 5	270	59	5	15,930	4,202
HEATER, 250,000 Btuh	1332	6	12	7,992	1,173
SHELTER EQUIPMENT - TOTAL				$87,067	$22,032
SUPPORT EQUIPMENT OWNED					
TRUCK, LIFT, FORK, RT, 6K	$16030	1	6	$16,030	$ 3,681
SYSTEM TOTAL (SUPPORT EQUIPMENT OWNED)				$103,097	$25,713
SUPPORT EQUIPMENT TASKED					
TRUCK, LIFT, FORK, RT, 6K	$16030	1	6	---	1,227
SYSTEM TOTAL (SUPPORT EQUIPMENT TASKED)				$ 87,067	$23,259

TABLE B-2
3 FT EXPANDABLE SYSTEM

ITEM	COST/ UNIT	NO AUTH	ECON LIFE	CAPITAL COST	UNIFORM ANNUAL COST
MODIFICATION CONTRACT	*	--	5	$70,000	$18,466
A/C DUCT KITS	1,000	10	5	10,000	2,638
C100's	2,500	25	12	62,500	9,173
SHELTER EQUIPMENT - TOTAL				$142,500	$30,277
SUPPORT EQUIPMENT OWNED					
100 KW GEN	$19,970	3	12	$ 59,910	$ 8,793
10K FORK LIFT, RT	$29,919	1	6	$ 29,919	$ 6,870
SYSTEM TOTAL (SUPPORT EQUIPMENT OWNED)				$232,329	$45,940
SUPPORT EQUIPMENT TASKED					
100 KW GEN	$19,970	3	12	---	$ 2,931
10K FORK LIFT, RT	29,919	1	6	---	$2,290
SYSTEM TOTAL (SUPPORT EQUIPMENT TASKED)				$142,500	$35,498

* Modification contract for joining 11 Expandable Personnel Shelters end to end at an estimated cost of $70,000.

TABLE B-3
MARINE CORPS SYSTEM

ITEM	COST/ UNIT	NO AUTH	ECON LIFE	CAPITAL COST	UNIFORM ANNUAL COST
8x8x20 KNOCK DOWN	$12,000	53	5	$636,000	$167,775
C100's	2,500	24	12	60,000	8,806
SHELTER SYSTEM - TOTAL				$696,000	$176,581
SUPPORT EQUIPMENT OWNED					
100 KW GEN	$19,970	3	12	$ 59,910	$ 8,793
10K FORK LIFT, RT	29,919	1	6	29,919	6,870
SYSTEM TOTAL (SUPPORT EQUIPMENT OWNED)				$785,829	$192,244
SUPPORT EQUIPMENT TASKED					
100 KW GEN	$19,970	3	12	---	$ 2,931
10K FORK LIFT, RT	29,919	1	6	---	$ 2,290
SYSTEM TOTAL (SUPPORT EQUIPMENT TASKED)				$696,000	$181,802

TABLE B-4
MUST SYSTEM (UPACKS)

ITEM	COST/ UNIT	NO AUTH	ECON LIFE	CAPITAL COST	UNIFORM ANNUAL COST
MUST, SECTIONS	$ 5000	34	5	$170,000	$ 44,846
END WALLS	1500	28	5	42,000	11,079
AIR LOCKS	300	28	5	8,400	2,216
WARD CONTAINERS	14000	7	5	98,000	25,852
UTILITY PACKS	100000	5	12	500,000	73,382
SHELTER EQUIPMENT - TOTAL				$818,400	$157,375
SUPPORT EQUIPMENT OWNED					
TRUCK, LIFT, FORK, RT, 6K	$16030	1	6	$ 16,030	$ 3,681
SYSTEM TOTAL (SUPPORT EQUIPMENT OWNED)				$834,430	$161,056
SUPPORT EQUIPMENT TASKED					
TRUCK, LIFT, FORK, RT, 6K	$16030	1	6	---	$ 1,227
SYSTEM TOTAL (SUPPORT EQUIPMENT TASKED)				$818,400	$158,602

TABLE B-5
MUST SYSTEM (C100's)

ITEM	COST/ UNIT	NO AUTH	ECON LIFE	CAPITAL COST	UNIFORM ANNUAL COST
MUST SECTIONS	$ 5,000	34	5	$170,000	$ 44,846
END WALLS	1,500	28	5	42,000	11,079
AIR LOCKS	300	28	5	8,400	2,216
WARD CONTAINERS	14,000	7	5	98,000	25,852
C100's	2,500	25	12	62,500	9,173
SHELTER EQUIPMENT - TOTAL				$380,900	$ 93,166
SUPPORT EQUIPMENT OWNED					
100 KW, GEN	$19,970	4	12	$ 79,880	$ 11,723
TRUCK, LIFT, FORK, RT, 6K	$16,030	1	6	16,030	3,681
SYSTEM TOTAL (SUPPORT EQUIPMENT OWNED)				$476,810	$108,570
SUPPORT EQUIPMENT TASKED					
100 KW, GEN	$19,970	4	12	---	$ 3,908
TRUCK, LIFT, FORK, RT, 6K	$16,030	1	6	---	1,227
SYSTEM TOTAL (SUPPORT EQUIPMENT OWNED)				$380,900	$ 98,301

APPENDIX C

C141 AIRCRAFT COST

APPENDIX C

C141 AIRCRAFT COST

Gross Weight: 270,000 lbs.

Aircraft Weight (less cargo and fuel): 140,000 lbs.

Cargo and Fuel Weight Available: 130,000 lbs.

Average Fuel Consumption Rate: 12,500 lbs./hr.

Average Air Speed: 420 knots/484 m.p.h.

Mission Distance: 2,000 miles (one way)

Mission Flight Time: 4.2 hours

Mission Fuel Requirements: 52,500 lbs.

One Hour Additional Fuel: 12,500 lbs.

Total Fuel Weight: 65,000 lbs.

Available Cargo Weight: 65,000 lbs.

Aircraft Cost Per Round Trip: 2.75 x H x $1,800
where H = flying hours one way or 4.2 hours

Aircraft Cost Per Mission: $20,790.00

Annual Aircraft Cost: $83,160.00

TABLE C-1
XM-75 SYSTEM

SHELTERS

ITEM	WT	FT^3	NO AUTH	TOTALS WT	TOTALS FT^3
ARCH W HEADER	50	2.25	73	3650	164.25
SET, 5 PURLINS	45	6.75	59	2655	398.25
TENT, EXTEND SECT	41	3.13	59	2419	184.67
LINER, EXTEND SECT	16	1.00	59	944	59.00
8' FLY	17	0.80	59	1003	47.20
8' FLOOR SECT	20	1.50	59	1180	88.50
TENT, END SECT	22	1.50	28	616	42.00
LINER, END SECT	10	0.80	28	280	22.40
TOTALS				12747	1006.27

SYSTEM TOTAL

ITEM	DIMENSIONS	NO. UNITS/ PALLETS	NO. AUTH	TOTAL WT	TOTAL PALLETS
SHELTERS	--			12,747	3
HEATERS	4.8'H x 5.5'L x 2.7'W	3/1	6	2,100	2
TOTAL SUPPORT EQUIPMENT TASKED				14,847	5
FORK LIFT, 6K, RT	8.2'H x 15.6'L x 7.3'W	1/2	1	20,000	2
TOTAL SUPPORT EQUIPMENT OWNED				34,847	7

TABLE C-2
3 FT EXPANDABLE SYSTEM

ITEM	UNIT DIMENSIONS	WT/ UNIT	NO. UNITS/ PALLETS	NO. UNITS AUTH	TOTAL WT	TOTAL PALLETS
3' EXP	8'H x 3'W x 13'L	3,000	3/2	20	60,000	14
C-100's	4'H x 2.7'W x 5.6'L	940	5-6/1	24	22,560	5
	TOTAL (SUPPORT EQUIPMENT TASKED)				82,560	19
100 KW GEN	6.7'H x 8.1'W x 15.6'L	9,330	1/2	3	28,000	6
FORKLIFT 10, RT	8.5'H x 8.8'W x 18.7'L	35,400	1/3	1	35,400	3
	TOTAL (SUPPORT EQUIPMENT OWNED)				145,960	28

TABLE C-3
MARINE CORP SYSTEM

ITEM	UNIT DIMENSIONS	WT/UNIT	UNIT(S) PALLET(S)	NO. UNITS AUTH	TOTAL WT	TOTAL PALLETS
SHELTERS	2'H x 8'W x 20'L	4,000	4/3	53	212,000	40
AC/HEATERS	4'H x 2.7'W x 5.6'L	940	5-6/1	25	23,500	5
	TOTAL (SUPPORT EQUIPMENT TASKED)				235,500	45
GEN 100 KW	6.7'H x 8.1'W x 15.6'L	9,330	1/2	3	28,000	6
FORKLIFT	8.5'H x 8.8'W x 18.7'L	35,400	1/3	1	35,400	3
	TOTAL (SUPPORT EQUIPMENT TASKED)				298,900	54

TABLE C-4
MUST SYSTEM (UPACS)

ITEM	DIMENSIONS	WT/UNIT	NO. UNIT(S) PALLET(S)	NO AUTH	TOTAL WT	TOTAL PALLETS
WARD CONTAINER W CONTENTS	7.25'H x 7'W x 12'L	5225	1/2	7	36,580	14
UTILITY PACS	7.25'H x 6'W x 9.6'L	4500	1/1	5	22,500	5
TOTAL WITH SUPPORT EQUIPMENT TASKED					59,080	19
FORK LIFT RT 6K	8.2'H x 7.3'W x 15.6'L	20,000	1/2	1	20,000	2
TOTAL WITH SUPPORT EQUIPMENT OWNED					79,080	21

TABLE C-5
MUST WITH C-100's

ITEM	WT/UNIT	NO. UNIT(S) PALLETS(S)	NO. AUTH	TOTAL WT	TOTAL PALLETS
WARD CONT/CONTENTS	5,225	1/2	7	36,580	14
C-100's	940	5-6/1	25	23,500	5
	TOTAL (WITH SUPPORT EQUIPMENT TASKED)			60,080	19
100 KW GENERATORS	9,330	1/2	4	37,320	8
6K FORKLIFT	20,000	1/2	1	20,000	2
	TOTAL (WITH SUPPORT EQUIPMENT TASKED)			117,400	29

APPENDIX D

MAINTENANCE REQUIREMENT

APPENDIX D

MAINTENANCE REQUIREMENT

Table D–1 summarizes the maintenance requirement for each shelter system considered on an equivalent man-years basis. For cost purposes, maintenance personnel assumed to be of rank E–4. Uniform annual cost of an E–4, to include salary and benefits, support costs, rotation costs, initial clothing and ascension costs, estimated to be $13,000.

System	Item	No. AUTH	Maint./Unit[1] (Man-Yrs.)		Item[2] Unit	Support[3] Tasked	System Cost All Unit Items	System Cost Support Items Tasked
XM-75	Heater, 250,000 BTU	6	0.05		0.30	-----		
	Truck, Lift, Fork, 6K	1	0.88		0.88	0.29		
				Total	1.18	0.59	15,340	7,670
3 Ft EXP	C-100's	25	0.05		1.25	-----		
	100 KW Gen	3	0.55		1.65	0.55		
	Truck, Lift, Fork, 10K	1	0.88		0.88	0.29		
				Total	3.78	2.09	49,140	27,170
Marine Corps	c-100's	24	0.05		1.20	-----		
	100 KW, Gen	3	0.55		1.65	0.55		
	Truck, Lift, Fork, 10K	1	0.88		0.88	0.29		
				Total	3.73	2.04	48,490	26,520
MUST (U-Packs)	U-Packs	5	----		2.00	-----		
	Truck, Lift, Fork, 6K	1	0.88		0.88	0.29		
				Total	2.88	2.29	37,440	29,770
MUST (C-100's)	C-100's	25	0.05		1.25	-----		
	100 KW, Gen	4	0.55		2.20	0.73		
	Truck, Lift, Fork, 6K	1	0.88		0.88	0.29		
				Total	4.33	2.27	56,290	29,510

NOTES:

1. Based on AR 570-2, maintenance requirement (organic, direct, and general) per unit per year.
2. Man-year equivalents, assumes HQ JTF 7 is authorized maintenance personnel required on full time basis, added to JTF-7's TOE.
3. Assumes maintenance personnel are not organic to HQ JTF 7, but rather assigned to HQ JTF 7 for FTX purposes. Assume four FTX's per year. Assume maintenance personnel required one week prior to FTX, two weeks during FTX, one week after FTX, or one month total per FTX times four FTX's or 1/3 year per year. Thus, support personnel required equals one third unit personnel required on man-year equivalents basis.

TABLE D-1 MAINTENANCE COSTS

APPENDIX E

FUEL CONSUMPTION

APPENDIX E

FUEL CONSUMPTION

ASSUMPTIONS

Exercises/Year 4

Days/Exercise 14

Fuel Consumption Rates

Utility Pac	30.0 gph
250,000 Btu Heaters	3.0 gph
C–100's	0.0 gph
100 KW Gen.	8.0 gph

Utilization Rates

Utility Pacs – 3/Day, 24 Hours/Day

250,000 Btu Heaters – 4/Day, 8 Hours/Day

C–100's

with MUST – 20/Day, 24 Hours/Day

with BARE BASE – 20/Day, 16 Hours/Day

with MARINE CORPS – 19/Day, 16 Hours/Day

100 KW Generators

with XM–75 – 0/Day

with BARE BASE – 2/Day, 16 Hours/Day

with MARINE CORPS – 2/Day, 16 Hours/Day

with MUST (UPACS) – 0/Day

with MUST (C–100's) – 2/Day, 24 Hours/Day

XM–75 System

250,000 Btu Heaters

Gas (Gal/Yr) = $\frac{4 \text{ Exercises}}{\text{Year}} \times \frac{14 \text{ Days}}{\text{Exercise}} \times \frac{4 \text{ Heaters}}{\text{Day}} \times \frac{8 \text{ Hours}}{\text{Heater}} \times \frac{3.0 \text{ Gals}}{\text{Hour}}$

= 5,400 Gal/Yr (5376)

Bare Base System

100 Kw Generators

Diesel (Gals/Yr) = $\frac{4 \text{ Exercises}}{\text{Year}} \times \frac{14 \text{ Days}}{\text{Exercise}} \times \frac{2 \text{ Generators}}{\text{Day}} \times \frac{16 \text{ Hours}}{\text{Generator}} \times \frac{8.0 \text{ Gals}}{\text{Hour}}$

= 14,300 Gal/Yr (14336)

Marine Corp System

100 Kw Generators

Same as for Bare Base System Above

MUST (Utility Pacs)

Utility Pacs

JP4 (Gals/Yr) = $\frac{4 \text{ Exercises}}{\text{Year}} \times \frac{14 \text{ Days}}{\text{Exercise}} \times \frac{3 \text{ U Pacs}}{\text{Day}} \times \frac{24 \text{ Hours}}{\text{Day}} \times \frac{30 \text{ Gals}}{\text{Hour}}$

= 121,000 Gal/Yr (120960)

MUST (C–100's)

100 Kw Generator

Same as Bare Base System Except 24 Hours/Day rather than 16 Hours/Day

Thus, require 21,500 (21504) Gals/Yr.

APPENDIX F

SENSITIVITY ANALYSIS/ SYSTEMS EFFECTIVENESS SUMMARY

APPENDIX F

SENSITIVITY ANALYSIS

Let:

a = effectiveness rating for baseline system for subgroup habitability/environmental considerations, divided by total points allowed for this subgroup.

b = effectiveness rating for baseline system for all other subgroups combined, divided by total points allowed for all other subgroups.

c = effectiveness rating for alternative system for subgroup habitability/environmental considerations, divided by total points allowed this subgroup.

d = effectiveness rating for alternative system for all other subgroups combined, divided by total number of points allowed for all other subgroups.

e = cost of alternative system divided by cost of baseline system.

p = fraction of total points which must be given to subgroup habitability/environmental considerations for system relative worth of alternative system to be equal to relative worth of baseline system. This is the variable which must be solved for where the values for a, b, c, d, and e are summarized in Table F–1.

Thus:

$$\frac{pc + (1-p)\,d}{\frac{pa + (1-p)\,b}{e}} \geq 1$$

$$\frac{pc + d - pd}{pa + b - pb} \geq e$$

$$pc + d - pd \geq epa + eb - epb$$

$$pc - pd - epa + epb \geq eb - d$$

$$p\,(c - d - ea + eb) \geq eb - d$$

$$p \geq \frac{eb - d}{c - d + e\,(b - a)}$$

Thus:

Bare Base Unit

$$= \frac{(3.30)\ (0.9429) - 0.6000}{0.8667 - 0.6000 + 3.30\ (0.9429 - 0.3333)}$$

$$= \frac{3.1116 - 0.6000}{0.2667 + 2.0117} = \frac{2.5116}{2.2784} = 1.10$$

Marine Corp Unit

$$= \frac{6.89\ (0.9429) - 0.2714}{0.9000 - 0.2714 + 6.89\ (0.6096)}$$

$$= \frac{6.4966 - 0.2714}{0.6286 + 4.200} = \frac{6.2252}{4.8286} = 1.29$$

MUST (UPACS)

$$= \frac{4.22\ (0.9429) - 0.4571}{0.8333 - 0.4571 + 4.22\ (0.6096)}$$

$$= \frac{3.9790 - 0.4571}{0.3762 + 2.5725} = \frac{3.5219}{2.9487} = 1.19$$

MUST (C–100's)

$$= \frac{4.11\ (0.9429) - 0.4286}{0.9000 - 0.4286 + 4.11\ (0.6096)}$$

$$= \frac{3.8753 - 0.4286}{0.4714 + 2.5055} = \frac{3.4467}{2.9769} = 1.16$$

The value of p is constrained to be between 0 and 1. The calculated value of p for each alternative system, the value of which the relative worth of the alternative system equals the relative worth of the baseline system, is greater than 1.0. For larger value of p, the relative worth of the alternative system exceeds the relative worth of the baseline system. Thus, regardless of the portion of the effectiveness points assigned to the subgroup habitability/environmental considerations, even if all the points are assigned to this subgroup and none to the other subgroups, the relative worth of each alternative system will always be considered to be less that the relative worth of the XM–75 system.

TABLE F-1

SUMMARY VARIABLE VALUES

	XM-75		BARE-BASE		MARINE CORPS		MUST (UPACS)		MUST (C-100)	
	UNIT	TASKED	UNIT	TASKED	UNIT	TASKED	UNIT	TASKED	UNIT	TASKED
a	10/30 0.3333	10/30 0.3333	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --
b	66/70 0.9429	65/70 0.9286	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --
c	-- --	-- --	26/30 0.8667	26/30 0.8667	27/30 0.9000	27/30 0.9000	25/30 0.8333	25/30 0.8333	27/30 0.9000	27/30 0.9000
d	-- --	-- --	42/70 0.6000	39/70 0.5571	19/70 0.2714	16/70 0.2286	32/70 0.4571	28/70 0.4000	30/70 0.4286	27/70 0.3857
e	--	--	3.30	3.04	6.89	7.91	4.22	5.37	4.11	3.96

TABLE F-2

SYSTEMS EFFECTIVENESS SUMMARY

	RATING	SYSTEM XM-75		BARE BASE		MARINE CORPS		MUST (UPACS)		MUST (C-100)	
HABITABILITY/ENVIRONMENTAL CONSIDERATIONS	30.0	10.0		26.0		27.0		25.0		27.0	
Temperature Control	--	--		--		--		--		--	
- Heating	7.5	5.0		7.5		7.5		7.5		7.5	
- Cooling	7.5	0.0		7.5		7.5		7.5		7.5	
Dust Control	5.0	0.0		3.0		4.0		5.0		5.0	
Noise Control	5.0	3.0		3.0		3.0		3.0		5.0	
Type Floor	5.0	2.0		5.0		5.0		2.0		2.0	
FLEXIBILITY	10.0	8.0		5.0		8.0		3.0		3.0	
Space Requirements - Total and Shape	5.0	3.0		1.0		5.0		3.0		3.0	
Utilization wo Environmental Equipment (Temp Climates)	5.0	5.0		4.0		3.0		0.0		0.0	
SUPPORTABILITY	20.0	18.0	17.0	7.0	4.0	9.0	6.0	11.0	7.0	9.0	6.0
Shelter Equipments	--	-	-	-	-	-	-	-	-	-	-
- Standard/Obsolete, Spares/Replacements	5.0	3.0	3.0	0.0	0.0	3.0	3.0	5.0	5.0	3.0	3.0
Support Requirements	--	-	-	-	-	-	-	-	-	-	-
- Fuel	5.0	5.0	5.0	4.0	4.0	3.0	3.0	0.0	0.0	3.0	3.0
- Personnel	5.0	5.0	5.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0
- Equipment (Transport, Etc.)	5.0	5.0	4.0	3.0	0.0	3.0	0.0	3.0	2.0	3.0	0.0
COMBAT SUITABILITY	40.0	40.0		30.0		2.0		18.0		18.0	
Site Selection	--	--		--		--		--		--	
- Level Restriction	10	10.0		10.0		0.0		8.0		8.0	
- Required Ground Preparation	10	10.0		10.0		0.0		6.0		6.0	
Transportability - Land	10	10.0		4.0		0.0		4.0		4.0	
Usefullness - If Environmental Equipment Fails	10	10.0		6.0		2.0		0.0		0.0	
	100.0	76.0	75.0	68.0	65.0	46.0	43.0	57.0	53.0	57.0	54.0

SUPPLEMENTS

SUPPLEMENT A

DEPARTMENT OF THE ARMY
US ARMY NATICK RESEARCH and DEVELOPMENT COMMAND
NATICK, MASSACHUSETTS 01760

REPLY TO ATTENTION OF:

DRXNM-Z

17 FEB 1976

BG Nathaniel R. Thompson, Jr., USA
Director of Logistics, J-4
United States Readiness Command
MacDill Air Force Base, Florida 33608

Dear General Thompson:

Reference is made to the US Army Natick Research and Development Command presentation to the Deputy Commander in Chief, Readiness Command, and staff on 9 January 1976, regarding Natick Research and Development Command's technical capabilities.

This Command has agreed to review the shelter and life support needs of the Readiness Command in the field. This review would enable our technologists to define a systems analysis study with the objective to provide specific recommendations for the acquisition of an effective complement of shelters and their associated organizational equipment.

It is understood that members of Readiness Command will meet with our technical staff during March 1976 to outline specific requirements. In order to assist the briefer(s) in understanding this Command's needs for information, a listing of areas of interest is provided as Inclosure 1. Of course, any other areas of concern which your Command deems to be pertinent to the systems analysis study should also be presented.

Sincerely,

Original Signed
RUFUS E. LESTER, JR.
Colonel, QMC
Commanding

1 Incl
as

AREAS OF INTEREST

1. The mission of the Readiness Command.

2. The variety of scenarios that the study should include, from training exercises to general mobilization.

3. For each scenario, the approximate number of personnel requiring billeting, feeding, sanitation and the desired level of habitability. Also, the existing structures used and whether they are satisfactory.

4. For each scenario, the amount, type, weight and cube of equipment, and numbers of personnel to be housed in tactical shelters for the accomplishment of operational functions. Also, identification of sensitive equipment requiring environmental control or freedom from electromagnetic interference and new, sophisticated electronic equipment that may emerge in the near future.

5. For each scenario, the environmental conditions that will be encountered and the degree of anticipated local support.

6. The level of field support obtained from other organizations.

7. The level of mobility required for the main task group and satellite activities including the reaction times required for the various functions. Initial reaction time and method of movement of all supplies to first destination. Extent of prepackaging of equipment to support the various scenarios. Present and planned availability of prime movers, trailers, and dolly sets for shelter transport.

SUPPLEMENT B

UNITED STATES READINESS COMMAND
MACDILL AIR FORCE BASE, FLORIDA, 33608

RCJ4

5 March 1976

Colonel Rufus E. Lester, Jr.
US Army Natick Development Center
Natick, Massachusetts 01760

Dear Colonel Lester,

Your offer to review our Joint Task Force 7 Headquarters shelter and life support needs is greatly appreciated. We have carefully reviewed the information you indicated your staff would need in the "Areas of Interest" inclosure to your letter, and have included such information as Inclosure 1.

We now anticipate that the earliest time our people could come to Natick would be the week of 29 March 1976. If this time frame is acceptable to you, our HQ JTF 7 Chief of Staff, Colonel Turnipseed, will contact your office to make detailed arrangements.

1 Incl
as

NATHANIEL R. THOMPSON, JR.
Brigadier General, USA
Director of Logistics, J4

AREAS OF INTEREST

1. The Commander in Chief, US Readiness Command (USCINCRED), is the commander of a unified command comprising assigned major combatant General Purpose Forces. He has no general geographic area of responsibility for normal operations.

a. USCINCRED is responsible for providing a general reserve of combat-ready forces to reinforce other unified or specified commands when and as directed.

b. USCINCRED is responsible for deployment planning for assigned or programmed forces to reinforce the other unified or specified commands.

c. USCINCRED is responsible for joint training, including joint training exercises, of assigned forces and the development of appropriate recommendations to the Joint Chiefs of Staff regarding joint tactics, techniques, and procedures for the joint employment of forces assigned.

d. USCINCRED will, as directed by the Joint Chiefs of Staff, provide -- for areas not assigned to another unified command -- contingency planning, Joint Task Force Headquarters, and forces for conduct of contingency operations. Such operations may be executed under direction of the National Command Authorities through the Joint Chiefs of Staff, under USCINCRED operational command, or under operational command of another designated commander.

e. USCINCRED will be prepared to conduct disaster relief activities or evacuation operations in areas not assigned to another unified or specified command when directed by the Joint Chiefs of Staff.

2. Although the tasking in paragraph 1.d. above implies that the Joint Task Force Headquarters (HQ JTF-7) would be provided only "for areas not assigned to another unified command," it is considered possible that HQ JTF-7 could be deployed as part of a force under paragraph 1.a. to reinforce other commands. Accordingly, the equipment necessary for support of HQ JTF-7 must be designed to be deployed and employed worldwide.

3. The scenarios that the study should include are listed below, following pertinent extracts of the approved JTF concept of operations:

a. Concepts:

(1) The JTF Headquarters will be manned and equipped for operations in the field under bare-base conditions for periods in excess of 30 days.

(2) Support equipment provided for the JTF Headquarters Packages will not be outsized to C-141 aircraft.

(3) Augmentation of equipment assets may be required to provide specialized functions dictated by a particular situation.

(4) Support facilities will provide for the environmental control of communications and electronic equipment organic to the JTF Headquarters.

(5) For contingency operations, the JTF Headquarters Package will contain only "state of the art" equipment that can be operated and maintained by assigned personnel.

(6) The JTF Headquarters Packages will be equipped for geographical areas and climatic conditions where involvement is most feasible. Command agreements will be developed for specialized support of a JTF Headquarters supporting another commander in areas having extreme geographical and climatic conditions, e.g., Alaska.

(7) The JTF Headquarters will be equipped for possible displacement within the theater.

(8) Each staff agency will maintain fly away kits with equipment and publications essential to the operations of the largest JTF Headquarters Package. These kits will be maintained in a state of readiness for deployment.

(9) Equipment will be exercised three to four times annually.

(10) The JTF Headquarters Packages will be supported by the Joint Communications Support Element and the Army Aviation Support Element, both located at MacDill AFB, Florida.

(11) Shelter/life support needs are required for the support of the JTF staff only. Any additional requirements for augmentation functions would be satisfied using additive shelters/equipment of the same type prescribed for the JTF.

b. Scenarios: The JTF deployments will be in support of combat operations. Although the equipment may be used during training exercises, its design should be influenced by its primary mission role and lend itself to camouflaging techniques. The worldwide range of possible deployment areas preclude multiple scenario development; therefore, the study should be limited to an analysis of shelters/life support needs in regions ranging from cold (-25° F) to extremely hot (125° F) climatic conditions.

3. a. The HQ JTF-7 staff size varies in accordance with the mission assigned, however, three basic packages have been designated as follows:

(1) ALFA Package consists of 109 personnel and is designed to provide the command and control of a joint force of up to brigade/squadron size. This package, or a portion of it, may also serve as the ADVON of a larger package.

(2) BRAVO Package consists of 154 personnel and is designed to provide the command and control of a joint force of up to division/wing size.

(3) CHARLIE Package consists of 192 personnel and is designed to provide command and control of a joint force of up to corps/air force size.

b. While the desired level of shelter habitability should be austere, adequate internal temperatures must be maintained for operations in an ambient temperature range of -25° to +125° F. Shelters should provide optimum light discipline and sound suppression during tactical employment.

c. Existing shelters consist of worn out general and special purpose tents and are entirely unsatisfactory.

4. a. Space requirements for work areas are described below. Billeting area requirements are left to application of US Army factors. Certain staff functions must have a distinct and separate facility; in other instances, certain functions could

be collocated if your analysis determined such to provide an optimum solution. These functions are annotated accordingly.

WORK AREA REQUIREMENTS (in sq ft)

FUNCTION	"A" PKG	"B" PKG	"C" PKG
(1) Must have separate facilities.			
Command Section	1000	1000	1000
Joint Operations Center	1000	1000	1250
J2/J3 Administrative Area	750	750	1100
Briefing Area	700	700	700
Information Office	500	500	500
News Center	300	300	300
(2) Could be collocated as required.			
J1	125	200	250
J4	400	480	600
Surgeon	250	250	350
SJA	80	80	80
AG	300	300	300
J6	500	500	500
Weather	250	250	500
(3) Locate close to billets.			
HQ Commandant	500	500	500
Supply	750	750	750
Mess	1500	2000	2000
Vehicle Maint/Dispatch	1000	1000	1000

b. Significant Equipment Requirements. All functions will require a normal distribution of 110 V electrical outlets. The Joint Operations Center (JOC) would require dust and humidity control sufficient to permit operation of state of the art computer terminal equipment, CRT display devices, and a secure facsimile transmitter/receiver. The AG office environment should support operation of office copiers (present requirements are 40° - 78° F & low humidity). The Information Office (IO) would require a 208 V 4-phase power supply and outlet.

5. Some local or external support from augmentation forces may occur under most deployment conditions, but such cannot be identified at this time. An example of what could be encountered can be seen in a recent HQ Commandant study, which estimated such support would require 140 augmentation personnel for the "ALFA" Package and 185 for either the "BRAVO" or "CHARLIE" Packages. As stated earlier, more shelter/life support items chosen for HQ JTF-7 would have to be added.

Precise numbers of support personnel and equipment depends on area of employment, possible collocation with component headquarters and existing in-theater assets. This being the case, the Natick analysis of HQ JTF-7 shelter/life support needs should logically be confined to the HQ JTF-7 with one exception. At this time, it is anticipated that the USREDCOM Army Aviation Support Element (AASE) will deploy two UH-1 helicopters and two U-21 aircraft in support of HQ JTF-7. Shelter recommendations for support of this element are solicited. The AASE will have a total of 30 personnel (8 aviators and 22 technicians). In a temperate climate, two separate 600 sq ft work areas would be required. In extreme climates, a work area large enough to bring each type aircraft inside for maintenance would be required. An office area for Operations of 250 sq ft and 600 sq ft of closed storage area for parts and equipment would also be necessary. In a cold climate, five 100,000 BTU heaters of the Herman-Nelson type would be needed.

6. With the exception of equipment such as generators, power units, air conditioners, etc. which the analysis might identify as requiring frequent maintenance or operational checks, most equipment should be prepackaged in order to respond to airlift within 24 hours after an execute order is given. Shelters/equipment should be capable of operational use within 12 hours after arrival at destination.

The present JTF vehicle inventory consists of:

5 1/4 ton trucks

4 3/4 ton trucks with M 101A1 trailers

1 2 1/2 ton truck with M 103A trailer

1 2 1/2 ton truck with no trailer

2 2 1/2 ton trucks with M 107A2 water trailers

The planned vehicle inventory would consist of:

8 2 1/2 ton trucks, M 35A2

6 trailers, M 103A

2 water trailers, M 107A2

7. The analysis of shelter/life support needs should contain the number of C-141 aircraft it would take to move the various packages. The planned vehicle requirements shown above may be inconsistent with support requirements resulting from the analysis. Therefore, recommendations for a planned vehicle inventory are also appropriate.

SUPPLEMENT C

SUMMARY OF SIGNIFICANT ITEMS ADDRESSED DURING READINESS COMMAND

AND NARADCOM MEETING ON 14-15 APRIL 1976

SUBJECT: Short and Long Range Systems Analysis Review of REDCOM HQS Joint Task Force-7 Operational Needs.

1. This two day meeting has been primarily aimed at providing a number of NARADCOM technical personnel with an understanding of at least a superficial nature of the current mission capability of REDCOM. Simultaneously, REDCOM personnel, of course, have had the opportunity to gain some insight into the technical capabilities available at NARADCOM in the way of systems analysis techniques and life support, including shelters, feeding systems, latrines, etc. The limited resources available by both Commands for this particular systems analysis effort is recognized by all parties. Based on these limited resources, it was agreed that a short range approach to identify the base line capability and a method of significantly improving that capability would be to utilize existing shelters wherever possible. Both Commands will endeavor to borrow or obtain on loan necessary life support equipment essential to evaluating improved field capability. This approach should allow REDCOM to obtain maximum exposure to state-of-the-art life support equipment for the field at minimal expense, while providing NARADCOM personnel with an understanding, at least in a general way, of the equipment and mission function of a JTF-7 HQS operation. To assist REDCOM personnel in making maximum use of equipment, test reports, TO's, erection manuals, and repair procedures will be provided as available for any equipment furnished.

2. To initiate action on this short term study, NARADCOM will make available on a loan basis the following equipment now at the Arctic Test Center, Ft. Greeley, Alaska.

a. Two expandable shelters/containers (ES/C's) from the Air Force Bare Base Program. External dimensions of these shelters are 8' wide by 8' high by 13' long.

b. Two expandable personnel shelters (EXP). External dimensions of these shelters are 8' high by 2'8" wide by 13' long. The two accordion shells for one of these shelters were damaged in test this past winter, therefore, it is understood that REDCOM has requisitioned replacement shells from Warner-Robins Air Force Base. NARADCOM will assist if requested in expediting delivery of these replacement shells.

c. Four, 120,000 BTU Heaters from the Bare Base System will be furnished.

d. Field office furniture such as desks, bunks and chairs will be furnished.

NARADCOM has agreed to fund the transportation of the above items from Alaska to MacDill Air Force Base, Florida. The Arctic Test Center has been notified to expedite shipment of these items to REDCOM. NARADCOM personnel will attempt to contact Commander, Ft. Greeley and request expedited transportation of all this equipment to Eilson Air Force Base, Alaska. REDCOM will then assist on expediting air shipment of this equipment to MacDill Air Force Base. It should be noted that both parties recognize that there is no way to determine in advance the condition of this equipment and a survey of the equipment will therefore have to be made upon receipt by REDCOM.

3. The following equipment from the Medical Unit Self-Contained Transportable (MUST) Field Hospital will be requested on a loan basis from the Surgeon General for evaluation during this short term study.

a. 15 Inflatable sections including lights and ancillary equipment.

b. Three multi-purpose (WARD) containers.

c. One turbine generator unit (UPAC)

d. Corridor connectors, passage ways, ducting, wiring or other ancillary equipment necessary to support this complex.

e. The second prototype 50' Army accordion type shelter now at Ft. Bragg, NC.

It is understood that REDCOM has requested 3.a. thru 3.d. above from Mr. Balderson of the Surgeon General's Office. NARADCOM will also contact Mr. Balderson on the above. It is noted that the UPAC provides electrical power, conditioned air for inflation of the WARD shelters and hot water. Electrical connectors and conditioned air ducting from the UPAC can be readily accepted by the shelters listed above.

4. The short response time of the REDCOM and the normal shipment of equipment to first destination by C-141 cargo aircraft suggests that emphasis be placed on the short term evaluation on a hard look at Air Force bare base type shelters. The rationale for this is that the shelters are designed with continuous flat bottoms and 463L rail systems for rapid deployment by cargo aircraft. NARADCOM will therefore attempt to obtain on a loan basis the following equipment:

a. One 2'8" expandable personnel shelter. This additional shelter, when complexed with the two EXP's being furnished from Alaska, allows for shipment of the three shelters as an 8 x 8 x 13 ft. package on cargo aircraft.

b. Three 3' expandable personnel shelters if available or if on surplus status at Holloman Air Force Base.

c. Sufficient combination 5-ton air conditioners/32,000 BTU heaters designed for the Bare Base System.

d. Input power cables or secondary distribution, if necessary, in order to power the 120 volts/208 volt electrical system of the Air Force Bare Base System.

e. If 3' EXP's are available, insure that wiring system, that is, 5-wire MIL-STD connectors, is compatible with these shelters.

It is understood that NARADCOM will take necessary action to locate all the above equipment. REDCOM will then assist as required in obtaining such equipment on a loan basis.

5. NARADCOM will review availability of new types of display boards for use by the Joint Operational Center of REDCOM. Information regarding availability of such equipment will be furnished to REDCOM for necessary action. NARADCOM will also determine availability of a mobile kitchen trailer and advise REDCOM of same.

6. NARADCOM will provide necessary support to assist REDCOM personnel in utilizing the new shelters as they arrive at MacDill Air Force Base. NARADCOM will also recommend potential functional layouts utilizing these various shelter types. NARADCOM will attend field exercises at MacDill Air Force Base in an effort to better understand functional requirements and operational capability of REDCOM prior to the Brave Shield XIV exercise at Yakima, Washington. It must be noted that the above commitment and the extent of the execution of that commitment is dependent upon the availability of in-house travel funds. Both parties agreed that it is essential to the success of this short term study that there be continuous communication between each Command. Until further notice, the point of contact at REDCOM is designated as LTC Wilcox and the point of contact at NARADCOM is designated as CPT Clark.

7. The emphasis during this short term study will be on weight and cube of the equipment based on shipment by C-141 cargo aircraft. The method of transporting these shelters and other equipment in the field is a necessary adjunct to this study. It is recognized that the use of standard equipment is emphasized and highly desirable.

8. In addition to the evaluation of the functional capability of REDCOM, life support items such as billeting, field feeding, latrines, etc. will be reviewed and considered to the extent possible within the scope of the study. NARADCOM Research & Development life support type equipment may be offered to REDCOM from time to time for use during their field exercises. Test information so obtained will be carefully evaluated by NARADCOM technical personnel.

9. The short term study approach suggested above is considered to be the most cost effective approach in determining the technical level of effort required to significantly improve the functional capability of REDCOM. At the completion of this short range effort, the need for a long range in-depth systems analysis can be mutually determined by the participating Commands.

Original Signed
HERSCHEL L. JOHNSON, JR.
COL, USMC
Deputy Chief of Staff
JTF-7

Original Signed
IRVING M. WEITZLER
for Acting Director
Aero-Mechanical Engineering
Laboratory

SUPPLEMENT D

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

REFERENCE OR OFFICE SYMBOL	SUBJECT
RCJ3-J	Evaluation of HQ JTF 7 Shelters

TO SEE DISTRIBUTION FROM Dep CofS, HQ JTF 7 BS XV DATE 8 Oct 76 CMT 1

1. During BRAVE SHIELD XV, HQ JTF 7 will be occupying borrowed shelters for the second time under field conditions. These shelters are as follows:

Medical unit, self-contained, transportable (MUST)

13' X 21' Expandable Shelter/Container (ESC)

13' X 32' Expandable Personnel Shelter (EXP)

20' X 50' Expandable Multipurpose Shelter (EXS)

2. These shelters are on loan to USREDCOM and addressees are charged to insure no damage due to careless use by our personnel.

3. In order to evaluate these various shelters and related equipment during BRAVE SHIELD XV, addressees will complete Inclosure 1 or 2 and submit to the Deputy Chief of Staff by 18 Oct 76. Inclosure 1 is for addressees occupying the same shelter as BS XIV. Inclosure 2 for addressees occupying shelter for the first time.

4. Subsequent to redeployment, J1 (HC) will submit an evaluation report on the deployability, erection, maintenance, camouflage, breakdown, damage and redeployment of all shelters and related equipment.

2 Incl
as

H. L. JOHNSON, JR.
Colonel, USMC
Deputy Chief of Staff
JTF 7 BS XV

DISTRIBUTION:

JTF 7 J1	JTF 7 AG
JTF 7 J2	JTF 7 HC
JTF 7 J3	JTF 7 SG
JTF 7 J4	JTF 7 PAO
JTF 7 J5	JTF 7 SJA
JTF 7 J6	JTF 7 WEA
	JUWTF CofS

HQ JTF 7
BRAVE SHIELD XV

SHELTER EVALUATION

_____
(Date)

FROM:

TO: DEPUTY CHIEF OF STAFF

1. Circle type shelter evaluated: MUST ESC EXP EXS

2. Attach detailed scale drawing of internal office space layout, to include use of electrical outlets (one drawing for joint use areas).

3. Was environmental control adequate?
If not, why?

4. Considering your experiences on BS XIV, what changes made for BS XV, if any, do you consider most significant?

5. Recommendations for future employment:

6. List any damage or maintenance required.

7. Was internal lighting adequate?

8. Did shelter provide adequate light discipline during blackout periods? If not, recommended modification.

9. Did shelter provide adequate protection from outside noise interference?

10. Were electrical outlets adequate? If not, recommended modifications.

11. Which other type(s) of shelter used on BRAVE SHIELD XV would meet your requirement?

12. Considering all types of shelters available on BRAVE SHIELD XV, list your overall preferences in descending order.

13. Considering the overall command post physical layout used on BRAVE SHIELD XV, what changes would you recommend and why?

14. List any damage or maintenance required.

15. Miscellaneous comments/suggestions: