

TECHNICAL REPORT  
NATICK/TR-84/037

AD \_\_\_\_\_

ADA146628

# AN EMPIRICAL EVALUATION OF AIR FORCE FIELD FEEDING WITH RECOMMENDATIONS FOR A NEW SYSTEM

BY  
EUGENE M. NUSS  
JOSEPH WALL  
PHILIP BRANDLER  
LAWRENCE SYMINGTON

APPROVED FOR  
PUBLIC RELEASE;  
DISTRIBUTION  
UNLIMITED.

JUNE 1984

UNITED STATES ARMY NATICK  
RESEARCH & DEVELOPMENT CENTER  
NATICK, MASSACHUSETTS 01760



DIRECTORATE FOR SYSTEMS ANALYSIS AND CONCEPT  
DEVELOPMENT

DTIC  
ELECTE  
OCT 1 2 1984

#56

84 10 09 091

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

CITATION OF TRADE NAMES IN THIS REPORT DOES NOT  
CONSTITUTE AN OFFICIAL ENDORSEMENT OR APPROVAL OF THE  
USE OF SUCH ITEMS.

DESTROY THIS REPORT WHEN NO LONGER NEEDED. DO NOT  
RETURN IT TO THE ORIGINATOR.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NATICK/TR-84/037	2. GOVT ACCESSION NO. AD-A14662F	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) AN EMPIRICAL EVALUATION OF AIR FORCE FIELD FEEDING WITH RECOMMENDATIONS FOR A NEW SYSTEM	5. TYPE OF REPORT & PERIOD COVERED Final	
	6. PERFORMING ORG. REPORT NUMBER NATICK/TR-84/037	
7. AUTHOR(s) Eugene M. Nuss                      Philip Brandler Joseph M. Wall                      Lawrence E. Symington	8. CONTRACT OR GRANT NUMBER(s)	
	9. PERFORMING ORGANIZATION NAME AND ADDRESS Directorate for Systems Analysis and Concept Development, US Army Natick Research & Development Center Natick, MA 01760	
11. CONTROLLING OFFICE NAME AND ADDRESS Directorate for Systems Analysis and Concept Development, US Army Natick Research & Development Center Natick, MA 01760	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS PE 6.2 IL162724AH99, TASK AA, Work Units 036, 039, 050, 051, 061 066	
	12. REPORT DATE June 1984	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	13. NUMBER OF PAGES 145	
	15. SECURITY CLASS. (of this report) UNCLASSIFIED	
16. DISTRIBUTION STATEMENT (of this Report)  Approved for Public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES  JOINT SERVICE REQUIREMENT: JSR AMAF 81-20 III (formerly MSR USAF 9-1)		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) FIELD FEEDING SYSTEM      SYSTEMS ANALYSIS      MANAGEMENT TRAINING AIR FORCE                      CUSTOMER SATISFACTION      PERSONNEL MANPOWER                      MORAL                              MENU(S) MANHOURS                      FIELD EQUIPMENT		
20. ABSTRACT (Capture on reverse side if necessary and identify by block number) The report documents proceedings and findings of the project to design, develop, and evaluate a field feeding system for Air Force Forward Bases which would minimize manpower requirements while providing near garrison-level service. Phase I reported herein consisted of an empirical study of Air Force Field Feeding Systems at seven field exercises in the U.S. and at overseas locations. At the conclusion of this phase, three food service concepts were presented to the Air Force as viable options, including an all-electric concept, a modified Harvest Bare concept and a new Harvest Eagle concept. The Air Force selected the new		

DTIC  
ELECTE  
OCT 12 1984  
S E D

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Harvest Eagle as the preferred concept. During Phase 2 of the project, also included in this report, a prototype of this concept was assembled and readied for testing. A later report presents the findings of the field evaluations of the prototype and a third report is an instructional manual for the erection and operation of the system.

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input checked="" type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special

**A-1**  
DTIC  
COPY  
IMPAIRED

## PREFACE

Military Service Requirement, MSR USAF 9-1), "The Design of an Air Force Mobility and Augmentation Field Food Service System" was assigned to the US Army Natick Research and Development Laboratories (NLABS),<sup>1</sup> Operations Research and Systems Analysis Office (ORSAO)<sup>2</sup> in fiscal year 1978 as the number one priority of the Department of Defense (DoD), Research Development, Test and Engineering Program (RDT&E). The general objectives of the project were to delineate the operational food service system required for contingencies and tactical exercises where a bare base environment exists, and then to design a system that minimizes Air Force manpower requirements by using the latest state of the art in food product technology, food packaging, food service equipment, and efficient manpower utilization.

The project sponsor was the Air Force Services Office (AFSO), which, during the course of the project, was integrated into the Engineering and Services Center (AFESC) located at Tyndall AFB, Florida. The work was accomplished under DA Project I1162724AH99, Tech Effort AA, Analysis and Design of Military Feeding Systems.

Recently, the name of this installation was changed to the US Army Natick Research and Development Center (NRDC) and the name of the NRDC performing organization was changed to Directorate for Systems Analysis and Concepts Development (DSACD). However, those names in effect during the course of the study are used in the text.

The authors of this report take this opportunity to acknowledge the professional effort and cooperation of the many contributors to the overwhelming success of this project.

Due to the complexity and length of this project, the many organizations contacted, geographic locations visited, and the number of people involved, it is virtually impossible to acknowledge by name all who contributed to its success. However, the authors of this report wish to acknowledge the efforts of those without whose participation the project could not have been completed.

At the Air Force Engineering and Services Center, Tyndall AFB, Florida:

BRIG GEN Wright, Chief of the Center  
LTC Kennington  
LTC Murphy, and,  
Mr. Merwin of the Food Management Directorate, Housing and Services

Also, MAJ GEN Gilbert, the DCS Engineering Services, HQ, USAF, to whom the Center reports.

At Tactical Air Command (TAC) Headquarters, LTC Dooley, CPT Gammon and CMS Bennett.

At Directorate, Engineering and Services, Pacific Air Force (PACAF) Headquarters, COL Hinz, DCS, Engineering and Services,

At Team Spirit 78, COL Elliot, Commander of the Exercise Site; and CMS Bennett, the Food Service Superintendent,

At Dawn Patrol, LTC Constantine, Site Commander, and MSG Simmons, the Food Service Superintendent,

At Brave Shield 17, COL Tyndall, Site Commander, and MSGT Blumberg, Food Service Superintendent,

At Brave Shield 18, LTC Simpson, Site Commander, and MSGT Roberts, Food Service Superintendent.

Appreciation is also expressed to: The 4400 Mobility Support Flight Personnel, who maintained the Harvest Eagle at Robbins AFB, Georgia; the 4449th Mobility Support Squadron, which maintained the Harvest Bare at Holloman AFB, New Mexico; the Joint Communications Support Element, who operated the Expando Kitchen at MacDill AFB, Florida, to Mr. Thaddeus Bonczyk, the original designer of the remote tank burner system for field use who served as chief consultant during the fabrication of the first prototype, and to Arthur D. Little, Inc., and their team led by Dr. Arthur Teixeira whose fabrication work made the remote tank burner system available in time for inclusion in the system.

At NLABS, the project team expresses appreciation to:

The Operations Research and Systems Analysis Office:

Dr. Robert J. Byrne, Chief, (Dr. Byrne is now the Technical Director of the U.S. Army Natick Research and Development Center) for providing the support and resources to successfully conduct the project Dr. Eugene M. Nuss was the project officer; Mr. Dennis Tavano, Program Analyst, for his technical guidance in financial and procedural matters; Mr. George Turk, for advice and assistance with commercial equipment; Mr. George Eccleston; and Ms. Phyllis Bernstein. Special thanks goes to Ms. Lianne LaRhette for consistent support in administrative matters. Also to Ms. Lisa Labanca for her editorial assistance.

Aero-Mechanical Engineering Laboratory

Mr. Donald Shaw and Mr. Ernest Saab, for their assistance with the shelter system;

Food Engineering Laboratory

Mr. Domenic Bumbaca and Mr. Joseph Szczeblowski, for their assistance with field equipment and Tray Packs;

Food Science Laboratory

Dr. Herbert Meiselman, for his assistance in the area of consumer and worker satisfaction;

Joint Technical Staff

LTC Donald Van Dyke, and Staff Agencies.

## TABLE OF CONTENTS

	<b>Page</b>
<b>Preface</b>	iii
<b>List of Figures</b>	vi
<b>List of Tables</b>	vii
<b>Introduction</b>	1
<b>Methodology</b>	2
<b>Findings</b>	4
<b>Relevant Factors and Productivity</b>	4
<b>Customer Satisfaction and Food Service Worker Opinion</b>	14
<b>Recommendations</b>	16
<b>Alternative Food Service Concepts</b>	23
<b>Development of the Preferred Food Service Concept</b>	25
<b>Appendix A. Work Sampling and Productivity Data</b>	35
<b>Appendix B. The Tray-Pack Concept and its Application at Air Force Exercises</b>	45
<b>Appendix C. Customer Satisfaction and Food Service Worker Opinion</b>	57
<b>Appendix D. The Harvest Bare Food Service System: Its Operation at an Exercise and a Proposed Modified Harvest Bare Concept</b>	81
<b>Appendix E. A Description of the All-Electric Food Service Concept</b>	95
<b>Appendix F. The Harvest Eagle Food Service System: Its Operation at Exercises and a Proposed New Harvest Eagle Concept</b>	101
<b>Appendix G. Remote Site Food Service Concepts</b>	131

## LIST OF FIGURES

	Page
Figure 1. A flow chart showing ultimate objectives and sequence of functions characteristic of a field feeding system	3
Figure 2. Integrated food service shelter complex	22
Figure D-1. Proposed Modified Harvest Bare Kitchen	90
Figure D-2. Proposed Modified Harvest Bare Food Service System	92
Figure E-1. Multiple Unit All-Electric Food Service Concept	99
Figure F-1. Basic New Harvest Eagle Shelter Configuration	119
Figure F-2. Basic New Harvest Eagle Kitchen	120
Figure F-3. Multiple Unit New Harvest Eagle Kitchen	122
Figure F-4. Basic New Harvest Eagle Dining Shelter	123
Figure F-5. Multiple Unit New Harvest Eagle Shelter Configuration	124
Figure F-6. Remote Tank Burner System	125
Figure F-7. Basic New Harvest Eagle Sanitation/Storage Configuration	128

## LIST OF TABLES

		<u>Page</u>
Table 1.	Anticipated Daily Meals vs Meals Actually Served at Tactical Exercises	5
Table 2.	Number of Food Service Personnel Deployed to Tactical Exercises	6
Table 3.	Manning Requirement Reductions as a Function of Decreased Nonproductive Time	6
Table 4.	Manpower Costs of Administration at Field Exercises	8
Table 5.	AFESC Recommended Menu for Exercises	9
Table 6.	Summary of Customer Hedonic Ratings of Tray Pack Items and Prepared Menu Items at Four Air Force Field Exercises	11
Table 7.	Estimated Labor Requirements for Washing Nondisposable Ware	12
Table 8.	Manpower Requirements at Different Feeding Levels	18
Table 9.	Meal Production Estimates for Basic and Multiple-Sized Concepts	25
Table 10.	Commercial Food Service Equipment	29
Table 11.	Equipment Provided by NLABS	29
Table A-1.	Accuracy of Work Sampling	36
Table A-2.	Calculation of Number of Food Service Personnel	42-43
Table A-3.	Work Hours Analysis of Daily Hours	43
Table A-4.	Work Hours Calculated Using 25% Nonproductive Factor	44
Table B-1.	Cost of Tray-Pack Foods Tested at Air Force Field Exercises--Brave Shield 17, Dawn Patrol 78, Brave Shield 18, Gallant Eagle 19	47
Table B-2.	Customer Hedonic (Mean) Ratings of Tray-Pack and A Ration Items Served during an Air Force Field Exercise--Brave Shield 17	51
Table B-3.	Customer Hedonic (Mean) Ratings of Tray-Pack and B Ration Items Served during an Air Force Field Exercise--Dawn Patrol 78	52

LIST OF TABLES (cont'd)

	<u>Page</u>
Table B-4. Customer Hedonic (Mean) Ratings of Tray-Pack Items and Two Tray-Pack Breakfast Items Served during an Air Force Field Exercise--Brave Shield 18	53
Table B-5. Customer Hedonic (Mean) Ratings of Tray-Pack Items and A Rations Served during an Air Force Field Exercise--Gallant Eagle 79 Expando Kitchen	54
Table B-6. Food Service Productivity at Four Air Force Field Exercises where Different Type Rations were Served	55
Table C-1. Mean Customer Ratings of Various Aspects of Air Force Field Food Service	61
Table C-2. Mean Customer Breakfast Food Acceptance Ratings at Three Air Force Exercises	63
Table C-3. Mean Customer Lunch/Dinner Food Acceptance Ratings at Three Air Force Exercises	64
Table C-4. Mean Customer Food Acceptance Ratings of Tray Pack Items at Brave Shield 18	66
Table C-5. Mean Customer Ratings of Specific Aspects of Food Quality	67
Table C-6. Mean Customer Rating at Four Air Force Exercises of Amount of Food Given in One Serving	69
Table C-7. Mean Customer Ratings at Four Air Force Exercises of Food Variety for a Given Meal	70
Table C-8. Mean Customer Ratings of Food Variety Over Several Weeks at Four Air Force Exercises	71
Table C-9. Mean Customer Description of the Dining Area at Four Air Force Exercises	72
Table C-10. Cooks' Reported Field Training	73
Table C-11. Mean Cook Responses to Three Scales of the Job Description Index (JDI)	74
Table C-12. Mean Cooks' Ratings of the Status of Nine Factors in their Food Service Operations at Four Air Force Exercises	76
Table C-13. Mean Cooks' Ratings of the Status of Fourteen Aspects of the Field Kitchen at Four Air Force Exercises	78

LIST OF TABLES (cont'd)

	<u>Page</u>
Table C-14. Cook Ratings of Kitchen Workspace	79
Table D-1. Corrective Maintenance Performed on Two Harvest Bare Kitchens During Air Force Exercise Brave Shield 18	85
Table D-2. Contingency Deployment Requirements as per TAC Conceptual Plan and USAF 9-1 Proposal	91
Table D-3. Estimated Cube and Weight of the Modified Harvest Bare Concept	92
Table D-4. Estimated Cost and Other Factors of the Modified Harvest Bare Concept	93
Table E-1. Estimated Cube and Weight of the All-Electric Food Service Concept	98
Table E-2. Estimated Cost and Other Factors of the All-Electric Food Service	98
Table F-1. Reconstitution Costs of Harvest Eagle Components	104
Table F-2. Harvest Eagle Generators per 1100 Troop Kit	105
Table F-3. Harvest Eagle Food Service Equipment Listed in TA 156, Part D and Used at Tactical Exercises	107 -108
Table F-4. Meal, Strength Data at Harvest Eagle Exercises	111
Table F-5. Deployed Strength and Numbers of Meals Served at Team Spirit '78	114
Table F-6. Deployed Strength and Numbers of Meals Served at Brave Shield 17	115
Table F-7. Deployed Strength and Numbers of Meals Served at Dawn Patrol	117
Table F-8. Estimated Cube and Weight of the New Harvest Eagle Concept	129
Table F-9. Estimated Cost and Other Factors of the New Harvest Eagle Concept	129
Table G-1. Expando Kitchen Equipment and Kilowatt Requirements	133

## AN EMPIRICAL EVALUATION OF AIR FORCE

### FIELD FEEDING WITH RECOMMENDATIONS FOR A NEW SYSTEM

#### INTRODUCTION

Changed U.S. Air Force (USAF) contingency scenarios require a shift in emphasis from nearly total dependence on fixed allied air bases for wartime operation to increased use of forward "bare" base sites. The impact of this shift on the food service component is to require more manpower for field feeding, greater system mobility for rapid deployment and ease of relocation, and less cube and weight to allow for increased logistical support to supply the forward bases.

The Air Force tasked the U.S. Army Natick Research and Development Laboratories (NLABS) with defining a field feeding system for its forward "bare" bases requiring a minimum of manpower to operate, and the closest equivalent of normal base dining hall food service. The system was to be designed for a 30- to 90-day operation, and to achieve the highest possible mobility capability.

Beginning in October 1977, NLABS and Air Force personnel began a 15-month joint effort to clearly define the required system. The systems analysis effort was highly empirical and required extensive data collection at field exercises and elsewhere in the Tactical Air Command (TAC), the Pacific Air Force (PACAF), and the US Air Force in Europe (USAFE).

In February, 1979 NLABS proposed to the Air Staff three concepts designed to produce the required field system. The proposals were: A Modified Harvest Bare; A New Harvest Eagle; and an All-Electric Concept. The Air Staff chose the New Harvest Eagle as the preferred concept.

From February, 1979, until May 1980, NLABS procured, fabricated, and assembled a prototype of the new system. All elements of the system were redesigned including manning procedures, personnel selections, management, training, record keeping, menu, equipment, sanitation, ware, and shelters. In June, 1980 the system prototype was shipped to Eglin Air Force Base, FL for initial testing. It was later readied and shipped to Korea to receive a full field evaluation. The initial testing and overseas evaluation are documented in NLABS Technical Report, NATICK/TR-82/033.<sup>1</sup> Another NLABS Technical Report, NATICK/TR-82/034<sup>2</sup> is an instructional manual for erection and operation of the new system.

The report that follows describes the empirical systems analysis conducted during the initial phase of the project during which the proposed field system was defined, and includes the procedures followed in designing and eventually creating a prototype of the preferred concept, the New Harvest Eagle.

## METHODOLOGY

The empirical systems analysis was conducted in operational settings. The analysis had two major purposes: (1) to provide an empirical base for the examination and evaluation of USAF field feeding systems, and (2) to establish a baseline of worker morale and customer acceptance data as required by MSR USAF 9-1.

The primary data collection effort was made at Air Force tactical exercises during field feeding operations. Food service activities were described and defined by recorded observations of investigators. The sites for the exercises were in Sachon, Korea; Nellis AFB, Nevada; Gioia Del Calle, Italy; and Peterson AFB, Colorado.

The project strategy was to describe the contemporary Air Force field feeding system by defining its subsystems and their interrelations. Subsystems were described in the order in which they made their initial impact on the overall system. Fig. 1 represents a flow chart that indicates the functions and objectives of the systems analysis approach. As can be seen, the desired end products were recognized as food service system efficiency and customer satisfaction. Current manpower requirements were also investigated with a view towards their minimization.

Experimental research was conducted to evaluate customer acceptance of several types of disposable dinnerware. In addition, a variety of proposed food items known as "Tray Packs" were evaluated with respect to labor savings and customer acceptance.

In-depth information was gathered on all aspects of Air Force field feeding. For example, data describing the storage, maintenance, refurbishment, and utilization of the Harvest Bare, Harvest Eagle, and electric Expando, were collected at their respective home base storage locations. Extensive interviews were conducted at these sites with maintenance personnel familiar with the systems.

Direct observation of operating Air Force field feeding systems at four contingency exercises in 1978 (Team Spirit 78, Brave Shields 17 and 18, and Dawn Patrol) provided significant amounts of data for in-depth evaluation. Familiarization visits were made to exercise sites Empire Glacier at Ft. Drum, NY and to War Reserve Materiel at Holloman and Robbins Air Force Bases and to remote operations of exercise Gallant Eagle at Eglin Air Force Base, FL. Data collection procedures were designed to ensure development of comprehensive descriptions of the systems.

Customer meal attendance statistics were collected for each exercise by meal for each day. Customers' perceptions of each system were measured in detailed surveys completed at each exercise location.

Food service worker attitudes were described using detailed survey forms and follow-up interviews by trained personnel. Productivity of the food service workforce was measured using work sampling techniques. Appendix A provides a complete explanation of work-sampling procedures and productivity data collected at each exercise.

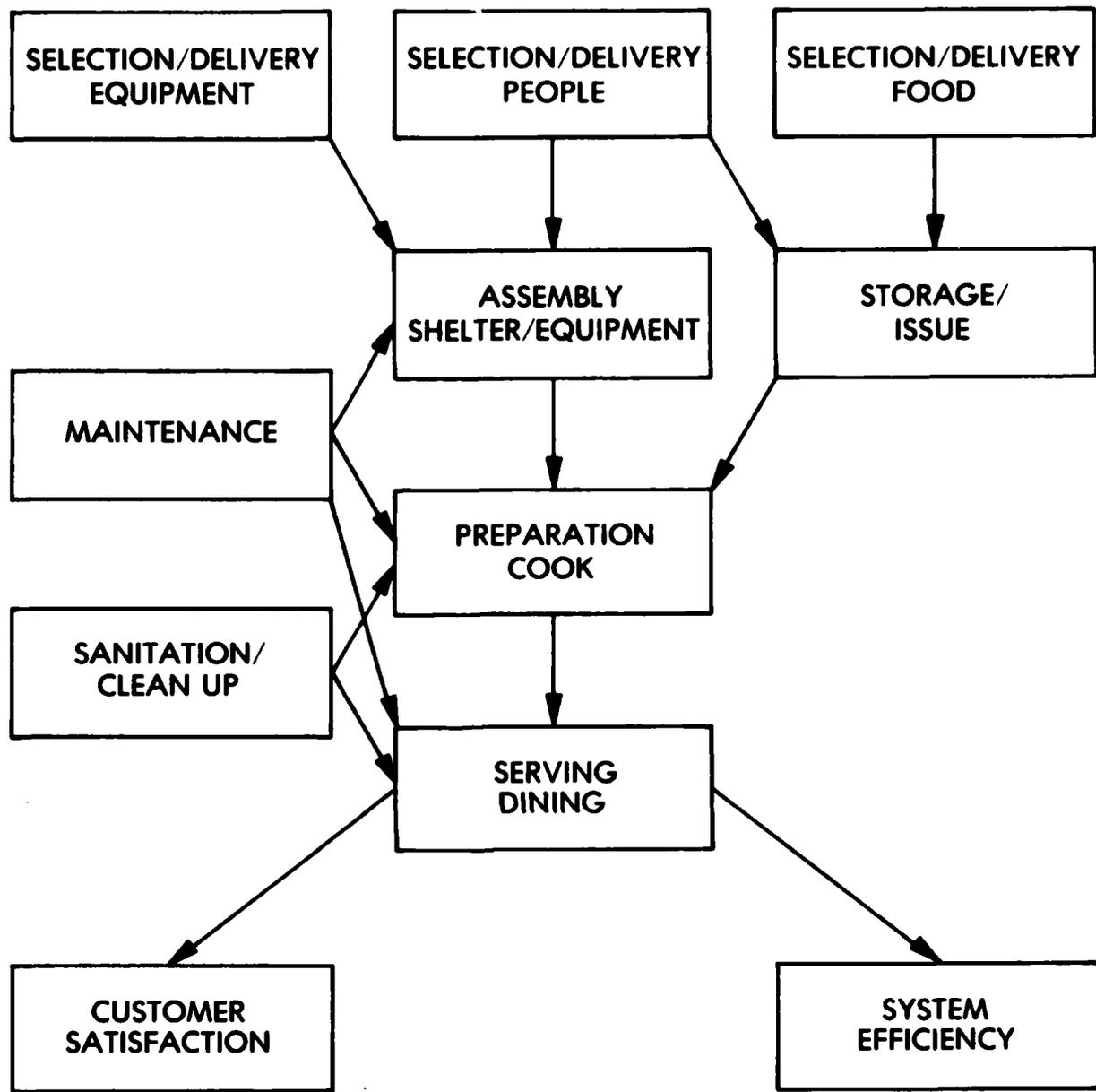


Figure 1. A flow chart showing ultimate objectives and sequence of functions characteristic of a field feeding system.

Menus served by field food service operations were compared to a proposed Air Force Engineering and Service Center (AFESC) standard for field feeding. In addition, food acceptance ratings were gathered at each exercise to determine customer acceptance of food served in the present systems. Acceptance ratings were also collected for prepared food items in a new package referred to as "Tray Packs". The results of their introduction at Air Force field feeding locations are reported in the section on customer satisfaction and food service worker opinion, and in greater detail in Appendix B.

Information was summarized regarding food service field feeding equipment including inventories of equipment and shelters used, sketches of food service area layouts, power required, fuel used, and maintenance problems.

Findings of the data analysis provided the basis for specific recommendations for procedural changes in Air Force field feeding and also led to the development of alternative equipment system concepts. This information was presented to AFESC at Tyndall AFB in February 1979.

Given the Air Force decision on the preferred concept and procedures, actions were planned and implemented to develop a prototype system. Equipments, shelters, and supplies were procured. A contract was awarded to A. D. Little, Inc. for development of a remote tank burner system and a training manual for overall use with the prototype system. During June 1980, the prototype was assembled and shipped to Eglin AFB, FL for operability testing.

## FINDINGS

### Relevant Factors and Productivity

The objective of this project was to define an Air Force mobility contingency food service system that would minimize food service personnel requirements. It was recognized that minimizing personnel requirements could be accomplished by increasing operational efficiency and by reducing the amount of labor required, thus increasing system productivity.

Productivity of the food service workforce at Air Force exercise deployments was found to be influenced by the following factors: manning procedures, personnel selection, management, training, record keeping, menu, sanitation, ware, shelters, and equipment including the burner system.

Basic data collected at exercises consisted of numbers of meals served, personnel deployed, and tasks performed. The average of daily meals served during peak exercise activity periods was used in all calculations in order to describe the productivity of the workforce during its most demanding period.

Numbers of food service personnel included all cooks, bakers, supervisors, and administrative and supply personnel deployed and assigned to the food service operation at exercise locations and the average daily number of rostered food service attendant personnel (KP's).

Analysis of the work sampling data revealed that the percentage of on duty manhours recorded as nonproductive was significantly higher at CONUS exercises (x = 38%) as compared with overseas exercises (x = 26%). A major cause for the CONUS/OVERSEAS productivity variance is seen in Table 1, that is, meal attendance rates tend to be lower in CONUS than OVERSEAS, and manning practices failed to adjust the manpower deployed to the actual requirement, which was less per given number of troops in the CONUS vis-a-vis OVERSEAS.

It was not possible to identify and evaluate every factor that contributed to meal attendance rate variance among exercises. Some apparent factors were: availability of dining options to customers; the ratio of troops on BAS to SIK, and local policy of the site commander. At the exercise where meal attendance was highest, Dawn Patrol, all troops were on SIK (for the exercise only); there were few if any dining options for customers, and the site commander permitted few off base passes. At the exercise where meal attendance rate was lowest, Brave Shield 17, the relevant conditions were different--many options were available (Las Vegas was nearby), private vehicles were permitted, and some troops were actually quartered in off-base contract motels.

It was found that Air Force Exercise manning standards for food service people were based on traditional practice rather than on valid manpower requirements. Table 2 data strongly suggest that the number of food service personnel to be deployed to a given exercise was calculated simply on the basis of how many troops were scheduled to participate in the exercise -- without regard to actual meal attendance rates or other factors. The number of cooks deployed per number of troops deployed was roughly the same at all exercises observed.

TABLE 1. Anticipated Daily Meals\* vs. Meals Actually Served at Tactical Exercises

<u>Exercise</u>	<u>Average Peak Period Strength</u>	<u>Anticipated Daily Meal</u>	<u>Average Daily Actual Peak Meals</u>	<u>Percentage of Anticipated Meals Served</u>
Team Spirit 78 (Korea)	586	1758	82	46.7
Brave Shield 17 (CONUS)	1932	5796	1045	33.5
Dawn Patrol (Italy)	628	1884	1287	68.3
Brave Shield 18 (CONUS)	1244	3732	1717	46.0

\*Derived by multiplying the number of days average peak period by three authorized daily meals.

TABLE 2. Number of Food Service Personnel Deployed to Tactical Exercise

<u>Exercise</u>	<u>Average Peak Troop Strength</u>	<u>Food Service Staff Deployed</u>	<u>No. of Troops Per Cook Deployed</u>
Team Spirit 78	586	18	32.5
Brave Shield 17	1932	55	35.1
Dawn Patrol	628	16	39.1
Brave Shield 18	1244	41	30.3

It is clear, then, that productivity was adversely affected by manning standards based on inaccurate workload forecasting, that is, more cooks were deployed than needed.

A significant increase in productivity and subsequent manpower savings can be projected when more realistic manpower planning is achieved. For instance, the projected number of meals to be served should be the base factor, rather than number of troops deployed. Further, a productivity factor can be calculated based on studies of actual manhours used to serve meals with a 25% worker nonproductivity value factored into the manning formula, again, based on observations of worker job behavior. (See Table 3).

TABLE 3. Manning Requirement Reductions as a Function of Decreased Nonproductive Time

<u>Exercise</u>	<u>Actual Meals<sup>a</sup> Served Per Available Manhour</u>	<u>Projected<sup>b</sup> Meals Per Manhour</u>	<u>Actual<sup>c</sup> Number Food Service Personnel Used</u>	<u>Number Food Service Personnel Required</u>	<u>Personnel Savings</u>
Team Spirit	4.23	5.36	19	15	4 (21%)
Brave Shield 17	2.76	5.18	69	37	32 (46%)
Dawn Patrol	6.0	7.9	21	16	5 (24%)
Brave Shield 18	3.65	7.0	46	24	22 (48%)

<sup>a</sup> Average Daily Meals  
Average Manhours

<sup>b</sup> Average Daily Meals  
75% Productive & 25% non-Productive Hours

<sup>c</sup> Includes Food Service Workers

Other personnel factors were analyzed regarding their efforts on system productivity. For example, at all observed exercises, meals were served to troops who worked at night. The average number of night meals served ranged from 26 to 239, resulting in an average of 3.25 meals served per manhour. Productivity also was affected by untrained workers, approximately 50% of all food service workers observed at exercises were attending their first such activity. Work shifts were arranged much the same as they are at base dining halls--workers, generally, were assigned to 8-hour, 5-day work weeks, rather than to 12-hour, 6-day work weeks, which is Air Force policy for field exercise duty hours.

Additionally, food service personnel were deployed to exercise locations from many home bases resulting in a workforce made up of cooks, most of whom had never worked together previously.

Management deficiencies and low worker motivation were noted. Goals to be met and schedules to be kept were not clearly defined for food service personnel. At one exercise, site construction personnel were fed C rations for 19 days even though food service personnel were present. Erection of the food service complex was delayed at several exercises; the setup and operation of the food service facility within the shortest time period possible was not a high priority.

Food service units were dependent upon other units or groups to establish and sustain their capability. For example, food service shelter erection was an engineer assignment rather than a food service duty. At several exercises, meal hour changes were made without prior coordination with the food service manager. Vehicles were not always assigned with food service as the primary user. A reluctance by commanders to roster food service attendants was evident on occasion.

The above cited inadequacies were in part the result of uncertain policies and procedures and the absence of food service participation in policy formulation, both of which served to make food service management more difficult. At most exercises, there was no visible systematic effort to communicate between the exercise commanders and food service managers. Poor communication between the workforce and food service managers often created problem situations.

Ineffective management of food service personnel was recognized by both supervisors and workers. At several exercises, the dining hall supervisor and the superintendent were rated as ineffective by cooks interviewed and surveyed, and in some instances, the shift leaders were also rated as poor. At one exercise, workers rated supervision at 2.56 on a 7-point scale (1 = very bad; 7 = very good). This was the lowest rating given any factor at any of the exercises.

Supervisor deficiencies suggest a lack of training in the areas of communications, manpower utilization, motivation of worker behavior, and responsiveness to changing requirements.

Training deficiencies were also observed among exercise cooks. Cooks on some exercises were unable to operate the M-2A burners, and, rather than all cooks being taught how to use them, total responsibility for the maintenance and operation of the burners was assumed by special burner experts. At one exercise, a master sergeant maintained all M-2A burners; he was the only one trained to do so.

A large percentage of cooks reported that they were inadequately trained, and at most exercises some cooks were unable to operate certain equipment. The exception was at Dawn Patrol where nearly all cooks were members of the 601st Mobility Squadron and customarily trained and deployed as a unit. Specifically, at the four exercises, approximately 40 percent of the cooks had received no prior training explicitly directed toward field feeding, and of the 60 percent who reported receiving field feeding training, 40 percent felt their training was inadequate.

In summary, no systematic training program was in evidence for food service workers at any observed exercise. Although hands-on field feeding experience was gained, there was no prescribed program to ensure all necessary work aspects were covered in sufficient detail for each individual.

At three of the four observed exercises, the usual base dining hall type food service accounting system was used as directed by AFR 146-7. The three exercises exceeded +2½% of the authorized monetary allowance, even though the usual comprehensive record system was employed as used in base feeding environments. At the fourth exercise, Dawn Patrol, a much abbreviated record system was used: only AF Forms 1650, 287, and 679 were accomplished. Work sampling data collected at the four exercises indicate that the food service operation at Dawn Patrol was the most productive as measured by meals served per manhour, no doubt in part due to the significant reduction in record keeping required as implied by the data in Table 4 below.

TABLE 4. Manpower Costs of Administration at Field Exercises

<u>Exercise</u>	<u>Admin Time as % of a 24-Hour Workday</u>	<u>No. Admin Hours Per 24-Hour Workday</u>	<u>No. FS Personnel that Could Have been Otherwise Utilized</u>
Team Spirit	9.6	15	2
Brave Shield 17	6.1	27.8	3
Brave Shield 18	1.7	35.4	4
Dawn Patrol	0.4	0.7	0

Considerable variance in field menus was observed presumably due to equipment differences, availability of food items, and supervisory preferences. Observed menus did not conform to the AFESC recommended menu for

exercises and did not make advantageous use of labor saving food products. Field feeding equipment observed at exercises, in particular the Harvest Eagle, could not properly prepare all items identified by the AFESC menu indicated in Table 5. For example, the Harvest Eagle system did not include griddles. The covers to the square head roasting pans can be inverted and used as griddles; however, lack of temperature control results in generally poor quality. Cooking eggs to order is difficult, if not impossible; browning meats is difficult; preparing fried entrees requires great skill and persistence, and short order cooking is impractical. Deep fat frying is quite hazardous as little temperature control is possible.

TABLE 5. AFESC Recommended Menu for Exercises

One Fruit and One Juice or Two Juices	Soup (Lunch or Dinner)  Two Entrees	Two Selections from Short Order Menu
Hot and Cold Cereal	Two Potatoes or Substitutes	
Eggs to Order	Two Vegetables	
One Breakfast Meat	Three Salads/Three Dressings	
Creamed Beef	Bread or Hot Rolls	
Griddle Cakes or French Toast	Butter/Margarine	
Hash Brown Potatoes	Two Baked Desserts/ One Other Dessert	
Maple syrup	Coffee, Tea, Milk	
Toast		
Butter/Margarine		
Coffee, Milk, Cocoa		

Both A and B ration items were served in varying proportions at observed exercises. The A ration items have the highest labor requirement and were used most often, while B rations items, requiring less labor and skill, were used less frequently. Thus, most food items used were those requiring the most labor.

At four exercises, the Tray Pack, a recently developed, commercially prepared food concept was tested. Tray Packs are multiserving containers of thermoprocessed starches or desserts. These items need no refrigeration, and

preparation for consumption simply requires heating to serving temperature, suggesting that a significant potential value of the Tray Pack in its military application is labor savings. Customer acceptance data were collected comparing Tray Pack items with A ration items. The results of these comparisons are displayed in Table 6. A more detailed description of Tray Pack items and results from tests of these items is found in Appendix B. The data from these extensive tests indicated the following:

- Tray Packs are acceptable to Air Force diners in the field.
- Tray Pack items can be heated and served without difficulty using conventional food service field equipment.
- Tray Pack meals can be served in the field with convenience and greatly reduced labor.
- The use of Tray Packs as T ration meals (in lieu of A or B ration meals) will result in substantial time and energy savings.



At each of the exercises where the Harvest Eagle system was used, sanitation procedures and equipment were found to be inadequate and inefficient. Of the three exercises observed utilizing Harvest Eagle equipment, disposable ware was used at two; however, in each instance, plastic trays were also used so that washing and sanitizing were not completely eliminated. At the two exercises where tableware was used, the flimsy nature of the paper plates and the additional labor required to sanitize the plastic trays suggested that an improved ware concept should be considered. Accordingly, an evaluation of disposable compartmented trays was designed and conducted at exercise Brave Shield 18.

During the test, surveys were employed to measure customer feelings about the quality of three disposable trays, and the nondisposable tray in the Harvest Bare inventory. Each was tested at different meals (breakfast, lunch, and dinner) in order to observe the holding and carrying characteristics of the trays when used with a variety of food items.

Customer ratings and investigator observations showed clearly that the disposable trays were acceptable to customers in the field. All three disposable trays were rated high and no one disposable tray was rated overwhelmingly better than the others. As might be expected, the non-disposable tray (melamine) was rated the highest of the four trays. On a seven-point scale with 1 being "very bad" and 7 being "very good", the GSA fiber tray received a 5.17 mean rating by a sample of 170 diners; a small styro tray was rated 5.59 by 158 diners; a large styro tray 5.34 by 103 diners, and the melamine tray received a 6.32 mean rating by 115 diners.

Estimates of labor requirements of washing nondisposable ware were made by projecting warewashing manhours taken from the work sampling data of Brave Shield 18 to other observed exercises. (See Table 7.)

TABLE 7. Estimated Labor Requirements for Washing Nondisposable Ware

<u>Exercise</u>	<u>Daily Peak Average Served Meals</u>	<u>Daily Warewashing Time (Manhours) *</u>
Team Spirit	821	9.2773
Brave Shield 17	1945	21.9785
Dawn Patrol	1287	14.5431
Brave Shield 18	1717	19.4021

\* Based on work sample study of warewashing hours expended, i.e., findings of 11.3 manhours per 1000 meals served at Brave Shield 18.

Thus, it can be seen that warewashing is labor intensive, even if done with an efficient system like that in the Harvest Bare. A comprehensive discussion of tableware for exercise/contingency use, including cube, weight, replacement costs and other factors is available in a special unpublished ORSAO report "A Comprehensive Analysis of Types of Field Dinnerware ".<sup>3</sup>

Air Force field feeding systems observed include a variety of shelters that ranged from general purpose medium and large tents to expandable hardwall kitchen shelters. Evaluation of the various shelters in use at exercise locations points to a number of needed changes.

There was no standard layout for the food service shelter complex at deployment locations. At exercises where Harvest Eagle equipment was used, each layout of the food service was unique. Only the Harvest Bare system is designed to actually demand a relatively standard configuration of components.

At Brave Shield 17, where the Harvest Eagle was used, 10 separate tents were set up for use in the food service area. Four of these were used for food preparation and serving, and the remainder for dining. This configuration required workers and customers to pass outside from one tent to another in order to prepare and serve or to be served and eat. The shelters were close enough to each other so that noise, odors, and tent tie-down lines were bothersome and even hazardous. Similar problems were found at Team Spirit and Dawn Patrol, each of which utilized the Harvest Eagle system.

Sanitation shelters are not provided in the Harvest Eagle system; makeshift or no shelter protection was provided. The Harvest Bare system contains an area within the dining shelter for sanitation work. This arrangement was judged ideal by the sanitation workers, but much less so by the customers who were exposed to the sights and sounds of pots, pans, and tray washing.

Temperature control within Harvest Eagle kitchens and dining shelters was primitive and generally ineffective where outside ambient temperature extremes were experienced; for example, Brave Shield 17 (hot) and Team Spirit (cold). The Harvest Bare provided air conditioning for diners, but when outside ambient temperatures were high, the hard shelter kitchen area became excessively hot.

Shelter erection was found to be a problem where the Harvest Eagle (M-48) kitchen shelter was used. Few food service personnel knew how to erect the kitchen shelter, and at two exercises, general-purpose tents replaced the M-48.

Security of food supplies was maintained at a high labor cost because supply tents were located at a distance from kitchen shelters and required someone to be on duty solely to guard the supplies. Similarly, the flow of foodstuffs from supply to preparation was labor-intensive due to the shelter arrangement.

At all exercises, cooks felt that kitchen workspace was too limited. They

were asked to rate kitchen workspace using a scale of 1 to 9, which ranged from "too much" workspace to "much too little" workspace. At two of the four observed exercises, field kitchens were evaluated as being "somewhat too little" to "slightly too little." At the other two exercises, kitchens were rated as being "much too little" to "somewhat too little." The M-48 tent was rated lowest of all kitchens.

Cube and weight comparisons between the soft shelter kitchen of the Harvest Eagle and the hard shelter of the Harvest Bare made clear the disadvantage of the hard shelter when mobility logistics are a prime consideration. The heavier, bigger, hard shelter, even with its many conveniences and other desirable characteristics, cannot be considered (nor was it intended to be) a rapid deployment shelter where logistical support is minimal and heavy equipment cannot be anticipated with confidence.

#### Customer Satisfaction and Food Service Worker Opinion

Customer opinion of the food service systems, food acceptability as determined by the customer, food service worker opinion of the food service systems, and food service worker job satisfaction were described during the course of the empirical evaluation of Air Force field feeding. A project constraint was that any new system at least maintain the existing level of customer acceptance and food service worker satisfaction. To this end, the data reported here and in Appendix C serve as baseline data for the existing field systems. In addition, they suggest several possibilities for recommended system changes.

Surveys and interviews were administered to customers and food service workers at four field exercises. In three of the exercises, a soft shelter kitchen was used; in the fourth, the Harvest Bare, a rigid expandable shelter-based kitchen with environmental controls and electrical cooking equipment, was tested.

General customer opinion was obtained by distributing questionnaires. Food acceptance interviewing was carried out by NLABS personnel on a one-to-one basis at tables in the dining area with customers who had just finished or were about to finish eating. Food service workers completed questionnaires, filled out a standard job satisfaction instrument, the Job Descriptive Index (Smith, et al., 1969)<sup>4</sup> and were interviewed on a one-to-one basis.

Customer opinion of food service systems used in the four exercises was quite high. Customers gave high ratings to the opportunity to sit with friends and to the service by dining facility personnel. Also rated high in three of the exercises were the food related variables (quality, quantity, and variety). Customers eating in the rigid-walled, temperature-controlled environment of the Harvest Bare dining facility gave relatively high ratings to such variables as cleanliness and general eating environment.

The generally high ratings given the food variables in the opinion survey were reflected in the customer food acceptance ratings. Even where the opinion survey ratings of food were lower, the mean food acceptance rating given to the overall meal was 7.01 on the nine-point hedonic scale (1 = dislike extremely; 9 = like extremely). At three of the exercises, where monotony of eating in the same facility and the slowness of service lines were the most frequent criticisms, the mean overall meal food acceptance ratings were 7.18, 7.29, and 7.4. Comparisons of customers' ratings of A rations and T ration items revealed T rations were rated about as high as A rations served at exercises.

The main customer complaint about food quantity centered around the meat or entree portion, with customers saying it was "somewhat too small" to "slightly too small" with ratings ranging from 2.25 to 3.02. NLABS personnel observed differences among the exercises with respect to food choices available to the customer. For example, at one exercise more than two entrees were often featured, and a salad bar and greater dessert variety were offered. Two exercises had a separate short order line. Where no short-order menu was offered, customers expressed a desire for these items. Where short-order service was offered, the customers expressed a desire for greater variety.

The major area of customer concern in the dining environment was that of crowding. From surveys it was determined that the mean rating of the occurrence of crowding in the eating area was 3.28 on five-point scale, between "sometimes" and "often". Customers at Brave Shield 18 and Dawn Patrol reported crowding occurred more frequently than did customers at other exercises.

Regarding temperature, customers at Team Spirit rated the dining area as frequently being too cold 4.52, (5 = almost always) reflecting the cold ambience of a Korean February.

Food service worker opinion and job satisfaction were also measured at the four field exercises. Job satisfaction scores of the cooks were high on most general factors in the overall food service operation. High ratings were given in such areas as cooks' food preparation skills, menu variety, customer satisfaction, cooperation among cooks, and equipment maintenance. Overall, the lowest factor rated by workers was sanitation, which was rated at 4.56 on a seven-point scale.

When asked to rate several aspects of their field kitchens, the cooks gave relatively higher marks to the ease of food preparation, condition of equipment, ease of cleaning up, and the ease of serving the customer. They gave relatively lower marks to the crowding of cooks in the kitchen, temperature of the kitchen, size of the kitchen, and the amount of storage space. Worker response was extremely negative with regard to the size of the GP medium kitchens being rated between 2.5 and 2.9 on seven-point scales (2 = somewhat too little; 3 = slightly too little), and the two M-48 tents used in another exercise being rated 1.33 (1 = much too little).

Food service worker interview data reinforced the concerns cited about workspace, kitchen temperature, and sanitation. In addition, several workers complained about the fumes generated by the M-2A burners used in the Harvest Eagle, and even more cooks were concerned with the safety aspects of these burners. Lastly, when asked what equipment should be added to field kitchens, 81% felt that tilt grill should be added, 65% were in favor of adding a deep fat fryer, and 48% recommended a salad bar.

### RECOMMENDATIONS

Based on the findings cited above, three food service concepts were offered, each of which accommodated the MSR constraints and promised improved productivity and service. In addition, eleven specific recommendations were made to AFESC to be included in the preferred concept to be selected by AFESC.

1. A manning standard was recommended for application to the task of determining the optimum number of food service personnel required to efficiently service exercise and contingency deployments. The manning standard proposed takes cognizance of the size of the deployment, the anticipated meal consumption level of the deployment, the productivity level of the workforce, and the length of the workday and week. The following manning formula was recommended.

$$\frac{(\text{Number of Authorized Meals}) \times (\text{Number of Troops Deployed})}{\text{Anticipated Meal Consumption}} = \text{Meals Required} \quad (1)$$

$$\frac{\text{Meals Required}}{\text{Meals per Manhour}} = \text{Manhours Required} \quad (2)$$

$$\frac{\text{Manhours Required}}{\text{Average Workday Hours per Worker}} = \text{Personnel Required} \quad (3)$$

The following definitions apply to the above formula:

The number of authorized meals is assumed to be three meals per troop per day.

The maximum percent anticipated consumption\* is estimated to be 50% at exercises where a typical BAS/SIK reimbursement obtains--all SIK = 70%; and Contingencies = 80% without regard to type/ratio of reimbursement.

---

\* As discussed earlier in this report, meal attendance at exercises varies widely depending on location and AF policy at a particular exercise. Historical rates in context with exercise policy at a given exercise must be considered in manpower planning.

Meals per manhour is the number of meals that can be expected to be produced per manhour of shift time. Given that recommended changes are adopted, a productivity level of 12 meals per manhour of shift time is estimated.

An average workday consists of 10.3 hours of shift time per deployed food service person. Shift length is assumed to be twelve hours with each person working a six-day week. In order to staff for seven days each week, the 72 hours (twelve-hour shifts x six days) available from each food service person is divided by seven days which yields 10.3 hours.

Personnel required is the number of food service personnel required to support a given exercise or contingency.

As an illustration, the following calculations yield number of personnel required for a contingency deployment of 600 personnel.

3 Authorized Meals x 600 x 80% = 1440 Meals Required

$$\frac{1440 \text{ Meals}}{12 \text{ Meals/Manhour}} = 120 \text{ Manhours Required}$$

$$\frac{120 \text{ Manhours}}{10.3 \text{ Hours/Person}} = 11.65 (12) \text{ Food Service Personnel}$$

Data displayed in Table 8 demonstrate the application of the formula and show how it affects manpower requirements.

TABLE 8. Manpower Requirements at Different Feeding Levels

Exercise	Number Food Service Personnel Deployed	Deploy- ment Size	BAS/ SIK		Food Service Personnel		Conti- gency Daily Meals		Food Service Personnel Required	
			Daily Meals	Required	Daily Meals	Required	Daily Meals	Required	Daily Meals	Required
Team Spirit	19	586	879	8*	1230	10	1406	12		
Brave Shield 17	69	1932	2898	24	4057	34	4636	38		
Dawn Patrol	21	628	942	8*	1318	11	1507	13		
Brave Shield 18	46	1244	1866	16	2612	22	2985	25		

NOTE: The number of food service personnel deployed includes food service workers. The meal consumption rate is a previously described BAS/SIK @ 50%, SIK only @ 70%, and contingency @ 80%.

\* Exercises with small deployments will require 10 (two additional workers), if midnight meal is offered and/or short order is maintained between major meal hours.

2. It is recommended that the night (midnight) meal be served in the dining shelter only if there are fifty or more customers; fewer than fifty customers should be provided take-out service. When a night meal is served in the dining shelter, a minimum assignment of two food service people should be made in the interest of safety, security, and personnel comfort.

The thrust of the recommendations to serve a night meal is based on the requirement to maximize productivity of the food service workforce including night shift workers. However, lack of a night meal could have a negative effect on the deployment contingent: the preparation of take-out meals by food service personnel would certainly help to alleviate any perception by night meal customers that they are treated with less concern than the day meal customers.

3. A team concept for food service workers is recommended to encourage unity and furnish more effective training. A model for the team should configure factors including experience, rank, and home base location. This approach is similar to that used in organizing teams of civil engineering personnel for the exercises called "Red Horse" and "Prime Beef". An alternative is to assign food service personnel to Red Horse and Prime Beef teams which deploy to exercise and contingency locations. The team concept engenders efficiency; personnel who know each other and train together are more likely to work well together. A number of teams should be formed and deployed frequently enough to develop a broad base of experience. Well-planned application of this method will preclude individuals from being burdened with an excessive number of deployments.

4. It is recommended that a management program be specifically designed for field feeding operations to include the following: USAF policies and procedures for field feeding, guidelines for setting performance/operational goals, methods for improving communications, and guidelines for achieving increased self-sufficiency for the food service operation.

5. It is recommended that an OJT program be developed for food service personnel for use in all field exercises. The program should include a task performance inventory as the principal instrument in evaluating and qualifying food service personnel in the area of field feeding; designation of the dining hall supervisor position as understudy to the superintendent and as a prerequisite to being selected a superintendent; recognition of shift supervisor position as a prerequisite experience to qualify for dining hall supervisor, and the appointment of a training supervisor at each exercise, preferably the dining hall supervisor. Training should be emphasized during the buildup phase of an exercise, when the demands are relatively light on the food service operation and people have more time to demonstrate, to teach, and to learn. The recommendation on personnel selection advocates the development of a team concept to provide more effective training. This concept would enable trainers to become more familiar with areas of individual weakness, and thereby tailor training to fit the needs of each food service professional. Cash collection should be eliminated and an abbreviated accounting system should be used at exercises and during the initial phase (30-60 days) of contingencies. The specific makeup of the field accounting

system and the mechanism for moving cash collection from the field should be determined by the Air Force with NLABS' assistance. To reduce the administrative workload, only the following should be maintained:

AF Form 287, as the order, receipt, and inventory form; Vendor receipts, as applicable, as receipt form and inventory; Headcount records for planning and analysis; AF Form 679, as overall food service plan.

The AF Form 287 should be retained because it is an order, a receipt, and an inventory. It can be used by food service personnel to insure that appropriate food items are or have been purchased. Vendor receipts should be retained for the same reason. Compilation of all Forms 287 for an exercise plus the sum of totals of vendor receipts will provide food costs for the field feeding operation.

A headcount should be maintained to provide planning information for the food service supervisor and to aid in analyzing the cost of food for the number fed at field locations. One method by which headcount can easily be obtained is to tally the number of disposable trays dispensed by cooks as customers are served. To make headcount data as useful as possible, a form requiring the following information should be used.

Date	# Breakfast	# Lunches	# Suppers	# Midnight Meals	# Other Meals Served	Total
------	-------------	-----------	-----------	------------------	----------------------	-------

Only one other form is required for this system. The AF Form 679, the food service plan, should be retained. With it, the food service supervisor gives special instructions, plans labor utilization, programs equipment use, and monitors production.

7. Short-order items should be served for breakfast, two entrees should be offered at lunch, and T rations should be served in the evening. In addition, short-order service should be provided during the noon meal and continue until the beginning of the evening meal. During the noon meal the two entrees plus short-order service will more fully utilize the capacity of the equipment, will provide variety, and will contribute to morale. Continuing the short-order service throughout the afternoon is expected to not only increase service levels but also to reduce the number of peak period meals, thus reducing required labor. Generally speaking, at the observed exercises, 20% of the meals were served at breakfast, 35% at noon, and 45% at the evening meal. An early shift prepared and served both breakfast and noon meal, and a later shift helped serve the noon meal and prepared and served the evening meal. The shifts overlapped from 1000 hours through 1500 hours. During this period, the system was overstaffed and labor was wasted. With the use of T rations for the evening meal, which require only heating, opening, and serving, the shifts can be greatly reduced, because food preparation and pot- and pan-washing are virtually eliminated. Minimum manning in situations where the T rations are heated before the serving period begins would require one individual on each of the two serving lines and another individual for backup on each line to open and replace T ration trays. As the evening meal is most often finished at 1900 hours, these four individuals are also available to prepare and serve the noon meal (12-hour shifts).

Because breakfast accounts for just 20% of the meals, and because a full shift is required for preparing and serving the noon meal, sufficient help is on hand to serve items to order at breakfast.

8. Additional equipment should be provided which will support the menu and minimize labor. For example, to include a short-order menu, an upright refrigerator adjacent to the serving line is recommended. A potato extruder would provide French fries and reduce refrigeration requirements. The system selected should also have both griddles and a deep-fat frying capability. To offer T ration meals, hot holding cabinets should be included. A tilt fry pan is recommended to permit frying and braising and also to heat Tray Packs efficiently. The M-2A burner, which requires refueling and repressurization, should be replaced by a remote tank burner system that requires less surveillance and does not require refueling and repressurization by cooks. This will increase efficiency and reduce labor. With the new burner system, the range cabinet should be replaced with the more efficient NLABS-developed ovens and safer, newly modified pot cradles.

9. The sanitation area should be located in a designated section of an integrated shelter system. An improved hot water heater is recommended, and steel sinks, storage racks, and utility tables should be included. Compartmentalized sinks and the M-75 hot water heater will provide food service personnel with the basic requirements of an efficient system. Most pots and pans can be immersed in these sinks for easier washing and sanitizing. Immersion heaters will be eliminated, thereby reducing time-consuming maintenance and cleaning. Hot water will also be available by simply turning a faucet.

Although the M-75 water heater has the capability of providing hot water for both showers and food service, it is recommended that the food service have its own unit. If, however, that is not possible, joint use with another facility would be an alternative. Storage racks and utility tables should be included to provide workspace and storage for soiled pots, pans, and utensils.

10. The recommended ware include (GSA) disposable compartmentalized paper trays, styrofoam cups, and plastic flatware. The use of disposables is recommended only for the initial 30- to 60-day phase of contingencies, after which plastic reusable trays should be used. Disposables should be used at all exercises and prepositioned for overseas contingency use. Disposable ware requires little labor, is not costly relative to other ware, and is acceptable to customers. Because disposables in one form or another seem to be in use at most exercises already, this recommendation serves to formalize and provide a standardized approach to the ware problem.

11. The recommended shelter system includes an integrated food service shelter complex using the NLABS-developed TEMPER (tent, expandable, modular, personnel) shelter. The integrated shelter will enclose the kitchen, the dining area, the food storage/preparation areas, and the sanitation area as shown in Fig. 2. While different configurations can be arranged, a standard layout is recommended primarily to promote efficiency of setup and operation.



Figure 2. Integrated food service shelter complex.

The soft shelter designated "TEMPER" meets the shelter requirements of a field feeding food service operation. It has minimum cube and weight for mobility and requires less equipment and handling expertise than rigid shelters. The TEMPER shelter has inherent nonmechanical provisions for temperature control such as overhead flies, liners, screened windows, and screened roof vents that contribute to customer and worker comfort and to dust and insect control. A white liner and fluorescent lighting can be installed in the kitchen shelter to provide superior light and an aesthetically pleasing work environment. The TEMPER has personnel vestibules that connect one area to another. These vestibules allow any number of tent sections to be integrated into a single shelter system by providing an enclosed walkway between sections. Further, the vestibule permits customers to stand in waiting/serving lines under cover.

The system can be erected in sections by food service personnel. This allows personnel to set up and become operational in the shortest period. The TEMPER is modular and readily adapted to changing requirements. If the demand on the dining tent is increased, extra sections can be added without difficulty. All TEMPER sections must have screening to furnish required ventilation.

Field kitchens should have a hard floor to permit a safe working surface, level positioning of equipment, easy relocation of equipment, and effective sanitation procedures. Sanitation areas as well as the entire kitchen should be floored with nonabsorbent material for easy cleaning of spills and to discourage insects and odor buildup.

Dining areas should be floored only after the initial 30-to 60-day contingency period if it appears that the food service facility will remain in place for an extended period. The recommended delay in flooring the dining shelter takes cognizance of the probable scarcity of logistical support for nonessential items during the early phase of a contingency. A floor in the dining area is a desirable, but not essential feature.

#### ALTERNATIVE FOOD SERVICE CONCEPTS

The Military Service Requirement is clear in specifying that the desired food service system will represent a short range solution, utilizing off-the-shelf items requiring only minor or no modifications. Existing systems were examined for their potential use, as is, or their adaptability to an improved system. Three food service concepts, the Modified Harvest Bare, the New Harvest Eagle, and an All-Electric Concept, were developed as alternatives to the systems currently used by the Air Force. The concepts are based on the present systems with modifications developed from observation and interviews with both workers and customers as well as major command (TAC, USAFE, PACAF) representatives, site commanders and their staffs, and war reserve materiel personnel. It was recognized during the study that there is also a requirement to feed smaller numbers of Air Force personnel located at sites remote from the main force. To meet this need, five alternatives were recommended. They were the Expando Kitchen, the Mobile Field Kitchen/Trailer, the Tray Pack Trailer, the International Standards Organization (ISO) Container, and a mini version of the preferred system. The following considerations were instrumental in shaping the proposed food service concepts.

1. The concepts must adequately subsist deployments during a 30-to 60-day period. Beyond 60 days, the concept will require modifications, which are not treated in detail within this concept.

2. The concepts are intended to function in a bare base environment and also must provide augmentation support where fixed facilities exist but are inadequate. Remote sites of varying sizes are included within the purview of the study, thus, food service concepts appropriate for these sites is also a requirement.

3. All concepts must be compact, portable, efficient, easily erected and maintained, and compatible with the C-130/C-141B aircraft and the 463L cargo system.

4. Flexibility and accommodation must be characteristic of the food service concepts. Deployment size, feeding level, and feeding site locations are critical factors in this regard.

5. The deployment size is important but must be factored in light of the customer participation rate. The manning formula presented in the Recommendations Section of this report was designed to meet the requirement.

6. The menu to be served must be considered. A complete breakfast with eggs to order including omelets requires specific equipment. A two-entree service for the lunch and supper, short-order service, and facilities for heating and holding Tray Pack products are considerations for equipment selection, space allocation, serving line configurations, and dining hall capacities.

7. Based on observations, a flow-through rate of five per minute in a two-serving-line basic kitchen is assumed. This is a projection of what to expect rather than a statement of the capacity of a system. It is estimated that the flow-through rate during the noon meal will break down, on balance, to three per minute in the main line and two per minute on the short-order line, and will, over the period of the meal, average five per minute.

8. The seating must be adequate to accommodate three hundred diners per hour. Assuming three seatings per hour, minimum seating must accommodate one hundred diners.

9. Food preparation requires a significant portion of the labor. Proper preparation requires that the cooks be provided with the right tools, that the space in which the work is to be accomplished is adequate, and that the ingredients to be used are within easy access of the work area.

10. The meal schedule must be considered in terms of the demands of the contingency/exercise as they occur. The system must have sufficient capacity so as to be flexible enough to serve three or four meals per day and/or to provide continuous service.

While differences among concepts are to be expected with regard to their respective hardware and operational characteristics, each concept proposed accommodated the feeding demands of all scenarios of which the project team had been apprised, and at the customer participation levels recorded by actual on-site observation (with the exception, of course, that the contingency feeding level is an estimated level). Each concept was designed to meet varying subsistence requirements by deploying a basic or multiple food service complexes or combinations of both; in this perspective, each system

could be deployed according to specific constraints--deployment size (number of troops), customer participation rate, and location and number of feeding sites. Table 9 shows production estimates for the basic and multiple units.

**TABLE 9. Meal Production Estimates for the Basic and Multiple-Sized Concepts**

	Basic Unit (1100 Troops)	Multiple Unit (4400 Troops)
<b>Serving Capacity:</b>		
Serving Lines	2	4*
Max. Flow-Through (per minute)	5	13
Meal Production per 24-hour Period	3,375	12,000
Dining Shelter Seating Capacity	120	240

\*3 Serving lines for New Harvest Eagle only.

Based on identified requirements, guidelines for system design, and readily available equipment, the three concepts and the remote site options were recommended to the Air Staff. Each concept, its component parts, cost, weight, and cube factors, and its rationale are described in detail in Appendices of this report: Modified Harvest Bare, Appendix D; All-Electric Kitchen, Appendix E; New Harvest Eagle, Appendix F. A description of the five remote-site, food service concepts proposed to the Air Staff is presented in Appendix G.

The Air Staff chose the New Harvest Eagle as the preferred concept; a detailed description of its development follows. The staff also chose the mini version of the Harvest Eagle as the preferred remote site concept.\*

#### **DEVELOPMENT OF THE PREFERRED FOOD SERVICE CONCEPT**

The ultimate objective during the second phase of MSR USAF 9-1 was the development of the New Harvest Eagle field feeding system, chosen by the Air Staff as the most cost effective and feasible of the three concept alternatives offered them. The technical plan for this phase included the

---

\* NLABS was tasked with developing concepts for remote site feeding, but was not asked to develop or test a prototype.

assembly and testing of a system prototype to study its feasibility and to identify possible requirements for modification. The plan also provided for development of managerial, administrative, and training procedures for efficient system operation. Tasks required in this phase were the procurement and fabrication of the components and their configuration into the total system, the writing and contracting for procedural materials, and the design of the initial testing of the prototype in the field.

The scope of the MSR constrained the project to utilize the latest in food product technology, food packaging, food service equipment, and efficient personnel utilization, but not to encompass any major development efforts toward advancing the state of the art in these areas. Thus, the effort was designed as a short-range solution utilizing off-the-shelf items and/or items requiring only minor modifications. The required time estimate for this phase was twelve months. The development of the prototype began as a full-time effort in March 1979 and terminated in June 1980 upon the initial fielding of the prototype. Following is a discussion on each of the subsystems of the preferred concepts.

### The Shelter System

Based on observations of Air Force food service shelters used at field exercises, design criteria were formulated for an improved shelter system. These criteria provided the guidelines for selecting the type shelter and the shelter configurations. Most critical of these criteria were the need to keep food warm, clean, and dry, the need to keep the customer comfortable and dry, the need to minimize food service manpower, the need to minimize shipping cube and weight; and the need of ease of erection and striking with minimum equipment.

The tent, extendable, modular, personnel (TEMPER), was chosen as the appropriate shelter system and procured according to specific prototype requirements. The TEMPER was the latest concept in tentage; it met all food service shelter requirements, and the technical data package was available, having been prepared by NLABS' personnel of the Shelter Division of Aero-Mechanical Engineering Laboratory (AMEL).

Two procurement contracts for TEMPER components were awarded. In December 1979, Camel Mfg. of Knoxville, TN received the contract for the tent fabric. In August 1979, the Magline Co. of Pinconning, MI was awarded the contract for TEMPER frames. The procurement of the TEMPER items was accomplished as part of a larger contract that included TEMPER items for the US Navy and the US Air Force Surgeon General. This contract effort was effected by AMEL personnel in support of the project.

An electric lighting system, including outlets, for the dining area was to be procured by AMEL. However, this contract was not awarded, and the incandescent lighting system currently used in the Harvest Eagle field kit was substituted as an interim system.

A unique feature was planned for the kitchen shelter. White desert tropical ceiling liners were fabricated by AMEL personnel. The liners were made from two different materials: one set from standard 5-oz. cotton oxford material, and another set from 10-oz. vinyl coated nylon. The planned initial fielding was seen as an opportunity to evaluate both sets with regard to their appropriateness for field kitchen use. Both materials were fire-retardant treated.

The TEMPER is extendable in multiples of eight feet. Each eight-foot section is 20 feet wide and, accordingly, has the capability of many configurations. For the initial fielding of the New Harvest Eagle it was decided to configure an 1100-troop (size) food service system consisting of an eleven-section dining shelter (20 ft x 88 ft), a five-section kitchen shelter (20 ft x 40 ft), and an eight-section sani/storage shelter (20 ft x 64 ft). Vestibules were designed and fabricated to connect the three shelter areas to provide shelter for customers upon entering and departing the dining areas, and to afford dust and insect control. The vestibules were fabricated in 10-foot lengths, each 4.5 feet wide. As with the shelter sections, their design made variations in configuration possible.

The shelter system, as procured for USAF 9-1, was considered appropriate for all climates except the arctic and antarctic. The dining shelter was designed to include sections with stove pipe openings, whereas the kitchen sections were desert/tropical with a three-foot by six-foot screen and flap in each section. The sani-storage shelter was designed to provide desert/tropical sections in the sanitation area. A fly was procured to be placed over all shelter sections.

The TEMPER frames and fabric were shipped directly to the initial fielding site from the manufacturers. The frame sections arrived at the site 10 April 1980; the blankets (tent material) arrived the first week in June 1980.

#### The Burner System

It was determined, and the Air Staff concurred, that a need existed to replace the burner system used in the standard Harvest Eagle field kitchen. The existing system, the M-2A burner system, was found to be highly labor-intensive, of marginal reliability, and of questionable safety.

It was recommended by the project team that a field burner system should include burners that require less surveillance and labor to maintain and that are safer than the M-2A burner. The fuel supply for the improved system would be located at a distance from the cook and customers, that is, at a site remote from the food service complex.

A burner system concept that met the above requirements had been observed in the field on two different occasions and was judged feasible for prototype development and testing. It was designated the Remote Tank Burner System, and plans were implemented to fabricate and assemble the new system utilizing an engineering services contract with Arthur D. Little, Inc. of

Cambridge, MA. Subsequently an 18-burner prototype was fabricated and safety tested by the Factory Mutual Research Corporation of Norwood, MA.

The safety test produced a projected 98% reliability rate for the system. Factory Mutual advised NLABS a reasonable fire scenario for the system could not be identified, therefore a fire test was not accomplished. A safety statement was prepared by the NLABS Safety Officer and the prototype was prepared for field testing.

Burner system specifications are presented in context with the proposed Harvest Eagle in Appendix F, and in NATICK/TR-82/034, "An Instructional Manual for the US Air Force New Harvest Eagle Field Feeding System."<sup>2</sup>

### The Sanitation System

With the exception of the Harvest Bare Food Service system, field sanitation procedures and equipment used at AF exercises were found to be inefficient. Hot water was provided by gasoline-fired immersion heaters placed in 32-gallon cans too small to accommodate the larger pots and pans. Sinks were not available for washing ware or hands, nor was there a shelter for sanitation areas. In short, the Air Force field feeding system was found seriously deficient in the sani area and an improved sanitation system was recommended to and concurred with by the Air Staff.

Paper compartmented trays, available from GSA, were selected to reduce the sanitation requirements. The recommended T-ration Tray Pack evening meal would eliminate altogether the need for pot and pan sanitation after the evening meal.

Three compartmentalized sinks, storage racks, and drain boards were obtained from the M-75 sanitation system developed by NLABS' personnel. The sinks were modified by the addition of faucets, and were large enough to accommodate standard pots and pans. A burner unit was placed under one of the sinks to maintain sanitizing water temperature for final rinse.

A hand washing sink was procured for use by cooks. It was planned to be located in the prototype kitchen area to be connected to cold and hot water lines running to the sanitation area.

The actual sanitizing/washing operation was planned to be located in one end of the eight-section (64-foot) sani/storage shelter. Approximately one eight-foot section was allocated to the sanitation center; nonslip, non-absorbent, floor cover of vinyl-covered polyester was fabricated for use in the sani area as a precaution against accidents and poor sanitation.

An automated water heater, the M-77, and a circulation pump were provided for inclusion in the prototype food system. The water heater is an automated version of the heater referred to as "bath unit, automated, multi-head", already found in the Harvest Eagle bath/shower kit. It is designed to maintain a water temperature of  $160^{\circ} \text{F} \pm 10$ .

The grease trap designed originally for the Harvest Bare system was added to the sanitation complex. Its purpose was to trap grease from the sinks and a submersible heater (calrod type) was installed to maintain water temperature to avoid grease congealing and water freezing.

The Equipment

Three categories of equipment were included in the New Harvest Eagle system. Table 10 lists the commercial equipment; Table 11 lists equipment for the new system provided by NLABS. A third category consisted primarily of miscellaneous utensils and furniture such as work tables, dining tables, and the dining area lighting system, all of which were selected from the inventory of the existing Harvest Eagle.

TABLE 10. Commercial Food Service Equipment

<u>Table</u>	<u>Qty</u>	<u>Manufacturer</u>	<u>Model</u>	<u>1979 Cost Each</u>
Deep Fat Fryer	1	Toaster	1456-TC	\$ 884.39
Filter for Deep Fat Fryer	1	Dean Industries	MF-90AV/80	588.03
Proximity Ventilator	1	Jenn Industries	PV-300	1260.00
Potato Extruder, Auto	1	American Potato	550	3142.35
Potato Extruder, Manual	1	American Potato	Frispe-ette	795.00
Tilt Frying & Braising Pan	1	Groen	FPC-4	2223.37
Upright Refrigerator	1	Hobart	HS-1	1585.00
Hot Holding Cabinets	2	Crescent Metal	H-138-COD-1834	930.00
Vegetable Slicer, Grater, Shredder	1	Qualheim	440	1030.00
Coffee Brewer, 5 pot	1	Bunn	RL 35	390.95
Coffee Brewer, 2 pot	1	Bunn	OL 15	325.95
Handwashing Sink	1	Metal Master	1818-1	230.00
T-Ration Can Opener	2	Edlund	1-R	59.50
Shelving	2	Metropolitan Wire		1726.40

TABLE 11. Equipment Provided by NLABS

<u>Item</u>	<u>Quantity</u>
Ovens	4
Griddles	2
Steam Tables	2
Pot Cradles	3
M77 Water Heater/and Pump	1
Herman Nelson Heaters, 400,00 Btu, NSN 4520-00-905-7789	2

## The Menu

Two major factors influenced the menu concept for the New Harvest Eagle. The first, in consonance with the objectives of the study, was the reduction of labor requirements, and the second was the AFESC concept of multiple entrees with short order service. As mentioned previously, the thinking was that the menu would dictate the equipment, not vice versa. The nutritional adequacy was not of overriding concern because sufficient variety is to be available to satisfy individual needs and because the menu is short term (30 to 60 days). The cost of particular food items was of secondary concern as the saving in labor was the objective; in addition, MSR guidelines explicitly waived the Basic Daily Food Allowance (BDFA) constraint.

The only major change from the menu supported by the BDFA was T rations.\* It is anticipated that as commercial Tray Pack production increases, its cost will decrease.

During June 1979, the AFESC published the Air Force 31-Day Field Feeding Menu in four sections. Section 1 is a 10-day field menu using only the Meal, Combat, Individual (MCI) and the Food Packet, In-Flight (IF) for the buildup and phase-down stages of the exercise. Section 2 is a recapitulation of menu issues for Section 1. Section 3 is the 21-day field operational menu. Section 4 is the recapitulation of menu items issued for Section 3. Because this menu was available and because it was endorsed by AFESC, it was deemed appropriate to simply adapt that menu to the MSR USAF 9-1 concept. This was done by substituting Tray-Pack items for the entrees of the evening meal on an item-for-item basis insofar as possible. In some instances, the noon meal was changed to reflect the new frying capability. Copies of the revised menu were sent to AFESC.

As indicated in the menu, the breakfast meal, made possible by the equipment additions, will be as one would expect to find in a normal base dining hall -- fruit, cereal, eggs to order, breakfast meats, creamed beef, potatoes and beverages. Likewise, the noon meal will offer a selection of entrees, vegetables, starches, salads, and desserts. A short order service is to be available during the noon meal and continue until just before the evening meal. The evening meal will be exclusively T rations. With the use of T rations, it is expected that the later or second shift will be half as large as the early or first shift. An exclusive T ration meal does not include salads; however, breads and beverages will be served. Everything else, dessert included, will be served from Tray-Pack containers. The menu will provide ample variety so as not to be monotonous.

---

\*The term "T Ration" is adopted to reference meal menus exclusively or primarily consisting of Tray Pack items.

## Training

The need for training food service personnel for improved operations in field feeding was recognized during field visits to tactical exercises. No systematic on-the-job training (OJT) for cooks was seen at any of the six exercises observed. At several exercises, food service management was weak. Further, the successful operation of the New Harvest Eagle prototype would require new skills to manage a greatly reduced work force operating new equipment and producing a new menu within a totally different shelter system and general physical environment.

An outline of training requirements was prepared; priority areas for management training were: communications, work force utilization, performance evaluation, and safety. This training was recommended for food service superintendents, supervisors, shift leaders, and other senior enlisted field feeding personnel. All workers would receive OJT in which specific tasks would be identified and performance standards set, thus providing a task/skill orientation.

A strategy was conceptualized to train a cadre of Air Force personnel in the management and operation of the field feeding system during the initial fielding of the system. Members of the cadre, in turn, would become trainers of other Air Force service personnel at a later exercise where the system would be evaluated and defined. In this manner, select Air Force people would acquire the necessary skills to operate the system, to train others in its use, and to implement an OJT program in the field. Money was budgeted in the A.D. Little contract for services in the training area. After an on-site data collection visit to a field feeding training site at Eglin AFB and numerous coordination sessions between contractor personnel and USAF 9-1 project members, a training proposal was made to NLABS and Air Force planners on 17 January 1980. The proposal was accepted by the project team and A.D. Little was authorized by written work assignment to proceed with its implementation.

In April 1980, the project team was advised that the exercise at which the field food system was to be evaluated, and for which the cadre of Air Force food service specialists was to be trained (by A. D. Little, Inc.), would not be available for testing. Further, no Tactical Air Command (TAC) food service people would attend the June 1980 initial fielding of the prototype to receive training. Thus, it became necessary to change the objectives and scope of work.

The scope of work was reduced to remove the requirement to train the Air Force cadre but to assist in subsequent training at the evaluation exercise. Consequently, the emphasis of the A.D. Little work assignments was on preparing training materials to be accomplished before and during the June initial fielding of the system prototype at Eglin AFB, including management training, OJT programs, and system erection/assembly procedures. The videotaping and refinement of the written procedural manuals at the Eglin AFB shakedown test are described in Technical Report NATICK/TR-82/033.<sup>1</sup>

The NLABS-developed equipment and supplies were shipped to Eglin AFB in a 40-foot trailer on 11 June 1980. The TEMPER shelter, frame, and blankets were shipped directly to Eglin AFB from the respective manufacturers. All components for the New Harvest Eagle were on hand at Field 4, Site B-2, Eglin AFB, FL on 15 June 1980; there AFESC Engineers, food service personnel and NLABS team members readied and assembled for prototype operation the New Harvest Eagle.<sup>1</sup>

## LIST OF REFERENCES

1. E. M. Nuss, P. Brandler, L. E. Symington, G. Turk, and J. M. Wall, Field Evaluations and Definition of the Proposed Air Force Forward Base Food Service System - The New Harvest Eagle, NATICK/TR-82/033. U.S. Army Natick R&D Laboratories, 1982.
2. E. M. Nuss, G. Turk, and P. Brandler, An Instructional Manual for The U.S. Air Force New Harvest Eagle Feeding System, NATICK/TR-82/034, U.S. Army Natick R&D Laboratories, Natick, MA 01760, July 1982.
3. Air Force Regulation 146-7, Food Service Management; 17 May 1984.
4. "A Comprehensive Analysis of Types of Field Dinnerware" - An Unpublished Report, [U.S. Army Natick R&D Laboratories, Natick, MA 01760, Sept 1980.] (Available from STRNC-OA files, NRDC).
5. P. C. Smith, L. M. Kendall, and C. L. Hulin, The Measurement of Satisfaction in Work and Retirement. Chicago: Rand McNally & Co., 1969.
6. J. W. Szczablowski and E. A. Nebesky, Tray Pack Foods. Technical paper NLABS TP1491 presented at the IUFOST/CIIA Symposium 23-24 August 1977 Karlsruhe, Germany.
7. Army Regulation 40-25, Daily Dietary Allowances for Military Personnel, Department of the U.S. Army, the U.S. Navy and the U.S. Air Force, Washington, DC 10 August 1972.
8. J. W. Szczablowski, Tray Packs for Thermally Processed Foods. Activities Report, R&D Associates for Military Food and Packaging Systems, Inc., 25, (1) 1973.
9. S. J. Baritz, R. L. Bustead, T. S. Bonczyk, M. M. Davis, H. J. Kirejczyk, H. L. Meiselman, G. L. Silverman, R. S. Smith, I. E. Stefaniw, and L. E. Symington, The Camp Edwards Experiment in Battalion Level Consolidated Field Feeding, U.S. Army Natick Research and Development Command, TR 76-45-OR/SA 1975. (AD A024 070)
10. S. J. Baritz, R. L. Bustead, H. J. Kirejczyk, M. B. Kulinski, H. L. Meiselman, G. L. Silverman, R. S. Smith, I. E. Stefanew, and L. E. Symington, The Camp Pendleton Experiment in Battalion Level Field Feeding. U.S. Army Natick Research and Development Command, TR 7T-4-OR/SA, 1976. (AD A028 346)
11. L. G. Branch, H. L. Meiselman, and L. E. Symington, A Consumer Evaluation of Air Force Food Service. U.S. Army Natick Laboratories TR 7T 75-22-FSL, 1974. (AD A003 825)
12. H. L. Meiselman, L. E. Symington, E. Smutz, H. Moskowitz, T. Nichols, and F. T. Eggemier, "Field Feeding." Behavioral Sciences Studies. U.S. Army Natick Development Center TR 76-03-FSL, 1975. (AD A018 521)

13. E. M. Nuss, L. E. Symington, and T. T. Mattus, Jr. The Impact of a Modified Training Course on Performance of U.S. Coast Guard Subsistence Specialists. U. S. Army Natick Research and Development Command, TR 7T-13-OR/SA, October 1976.
14. L. E. Symington, & H. L. Meiselman. The Food Service Worker and the Travis Air Force Base Experimental Food System; Opinion and Job Satisfaction. U.S. Army Natick Laboratories TR 75-94-FSL, 1975. (AD A016 894)

**APPENDIX A**  
**WORK SAMPLING AND PRODUCTIVITY DATA**

## APPENDIX A. Work Sampling and Productivity Data

In order to analyze the productivity of Air Force food service personnel in the field, a quantitative description of their on-duty time at exercise locations was essential. Work sampling provided quantitative data that were amenable to the needs of the study, and the technique provided reasonable accuracy at an acceptable cost.

Because the relative significance of jobs (supervisor, cook, baker, etc.) to tasks (cooking, sanitation, supply, etc.) was unknown prior to collection of data, both areas were subdivided substantially to ensure that important labor areas were not ignored because they were grouped. Analysis of data divided as shown in the Job and Task Listing validated this approach by pinpointing tasks that greatly affected productivity of food service personnel. Among these were dishwashing, administration and burner maintenance. Each is discussed in applicable sections of this report. Primary importance, however, was attached to two groupings of all work sampling data. These were productive and nonproductive time.

The following formula was used to calculate the accuracy of the productive and nonproductive observations at the 95% confidence level:

$$S = 2 p (1_N - p) \quad (A-1)$$

where, S = actual accuracy

p = percentage occurrence of the task measured

N = sample size (total observations)

Table A-1 details the accuracy of the work sampling data for each exercise with respect to productive and nonproductive time.

TABLE A-1. Accuracy of Work Sampling

<u>Exercise</u>	<u>Accuracy</u>	<u>% Non-Productive</u>
Team Spirit	+ 1.17%	26.8%
Brave Shield 17	+ 1.07%	38.4%
Dawn Patrol	+ 1.14%	26.8%
Brave Shield 18	+ 0.9%	28.7%

In essence, there is a 95% certainty that food service personnel were nonproductive 26.8% of the time at the Team Spirit exercise. At the 95% confidence level, it is probable that in 95 cases out of 100, the observed nonproductive time represents the actual value. This value depends on the accuracy of the data.

Again, at Team Spirit, the accuracy was  $\pm 1.17\%$ . This means that the actual value of nonproductive time was within the  $\pm 1.17\%$  of  $26.8\%$  ( $\pm 1.17\% \times 26.8 = \pm 0.31$ ), or that the true value was between  $26.49\%$  and  $27.11\%$ .

To collect sufficient data to obtain the desired accuracy, observers monitored food service operations at each exercise. Where possible, a different observer was used each time so that observer error and bias would be neutralized.

This procedure resulted in three days being observed by work sampling personnel, with data being reduced by averaging in order to describe the average food service productivity on the average exercise day. Observations were made at five-minute intervals where possible.

The work sampling worksheet (Figure A-1) and job and task definitions that follow are the same as the ones used by observers in the field. The Work Sampling Worksheet was used as follows:

Column

- |       |   |
|-------|---|
| 1     | Identified the facility being observed.   |
| 2-5   | The month and the day.  |
| 6-8   | The beginning time for the sheet using the first three digits of the 24-hour clock.   |
| 9     | Each observer was assigned a number for reference.  |
| 10    | The day of the week was entered with Sunday being one and Saturday being seven.   |
| 11-14 | The four-digit time was recorded at either 5-minute or 10-minute intervals.   |
| 16-18 | The activity observed was recorded here. The first digit identifies the job and the second digit identifies the task. For example, if the supervisor (1) was supervising, instructing, or inspecting (50), the entry would be 150 or, if the cook (2) was doing salad preparation (01) the entry would be 201. The space above the column was provided to the observer for notation for individual identification of those being observed as an aid in recording all people at each interval. |
| 20-79 | These columns were filled in the same manner as 16-18.  |

## JOB DEFINITIONS

1. Supervisor. Includes the dining hall supervisor, assistant dining hall supervisor, and shift supervisor. This does not include the food service officer and superintendent unless they are performing duty as dining hall supervisor.
2. Cook. Persons performing in AFSC 622x0 and not performing as a supervisor.
3. Baker. Persons performing in AFSC 621x0 and not performing as a supervisor.
4. Food Service Workers. Persons working and assigned to the food service facility not in categories 1, 2, and 3 above. These people are normally involved in clean up, service, and utility functions.
5. Civil Engineering Personnel. Personnel who are on civil engineer Prime Beef or Red Horse teams or other groups that maintain food service equipment that is beyond the expertise of food service personnel.
6. Supply Personnel. Persons who possess a Supply AFSC, but who are assigned to food service.
7. Administrative Personnel. Persons who possess an Administrative AFSC, but who are assigned to food service.

## TASK DEFINITIONS

- 01 Salad Preparation. Obtains ingredients, cuts, chops, and cleans lettuce, cabbage, onion, beets, tomatoes and other salad ingredients. Mixes all salads and stores until needed. Delivers and replenishes customer service areas.
- 02 Meat Preparation. Obtains meat items from storage, opens cans, bags, boxes, and other packages, cuts, grinds, chops, or otherwise processes meat prior to cooking. Places in appropriate container for cooking.
- 03 Vegetable Preparation. Obtains ingredients from storage, opens packages, cuts, chops, and otherwise prepares for cooking. Places in appropriate containers for cooking.
- 04 Baking Preparation. Obtains ingredients, opens containers, blends, beats, and mixes ingredients, and places in suitable container for baking. This task includes all dessert preparation.
- 05 Other Preparation. All preparation not included above. This may include preparing soup, gravy, fruits, and similar complementary items.
- 06 Cooking. Selects proper temperature setting, monitors food being cooked or reconstituted, and seasons food as required; removes food from cooking containers and places in serving containers.
- 07 Short Order Cooking. Includes all cooking to order, such items as eggs, hot cakes, french toast, hamburg, hot dogs, sandwich making, and other items.
- 08 Serving. Sets up serving line, obtains utensils. Slices food, if required, places meal on plate according to customer request, and delivers meal to the customer; replenishes line, and at the appointed time breaks the line down. This also includes time in position and ready to serve even though there are no customers.
- 09 Baking. Selects proper temperature setting, monitors products being baked, removes product and places in serving tray or individual portions; includes preparation of puddings, custards, and similar desserts; does not include baking main meal items (meats, potatoes, etc.).
- 10 Decorating. Includes frosting, creating designs, and employment of other methods utilized by the baker to make his product more appealing.
- 11 Other Productive Activities.

- 12 Nonproductive. Includes all the time that the individual is not contributing to the preparation, cooking, serving, cleaning and similar food service activities whether voluntarily or involuntarily. Nonproductive time includes designated break periods, meal periods, working without apparent purpose, and time when the individual cannot be located.
- 20 Sanitation. Includes personal hygiene and other functions that promote high standards of cleanliness that are not included in 21, 22 and 23. This includes such things as floor washing, table cleaning, trash and garbage disposal, temperature checking, and similar activities.
- 21 Dishwashing. This includes washing dishes, cups, and customer eating utensils, prerinsing and placing clean items in receptacles or returning them to the serving area.
- 22 Pot and Pan Washing. This includes the cleaning of all pots, pans, and cooking utensils and returning the items to their designated location for reuse.
- 23 Equipment Sanitation. Cleans and sanitizes ranges, preparation tables, kettles, grills, and all other food service equipment.
- 30 Administration. This includes cash collection and signature records, preparation of correspondence, records and reports, publishing work schedules, cooks' worksheets, and other internal reports; answers telephone and relays messages; does not include supply administration.
- 40 Supply. Maintains records and inventories.
- 41 Trucking. This includes the movement of subsistence and supplies from source to storage area and from storage area to the food service facility when performed by assigned food service personnel.
- 42 Receiving. Unloads all incoming subsistence and supplies. Uncrates, unpacks, and stores supplies in appropriate location (perishable/non-perishable).
- 43 Issuing. Issues subsistence and supplies to the senior cooks and records the issue.
- 50 Supervising, Instructing & Inspecting. Includes instructing by a supervisor in procedures and methods, inspects dining area to ensure cleanliness, maintenance of high standards of sanitation, quality control, workforce efficiency and similar control practices.
- 51 Receiving Instruction. An assigned individual receiving instruction and direction in rules, procedures, and methods.

- 60 Maintenance. Preventative or corrective performed by assigned cooks or food service workers. Does not include maintenance by maintenance specialists.
- 61 Burner Maintenance. Preventative or corrective, performed by food service personnel or others at the food service facility.
- 70 Beverage Service. Normally a food service worker's responsibility and includes keeping beverage equipment fully serviceable and clean.
- 80 Opening Tray Packs. Remove Tray Packs from heating units or heated storage, open with can opener, place in storage or steam table.

Work sampling data were collected during the peak exercise activity at four exercises. Peak exercise activity was considered to be the period during which the peak deployment level was reached thereby being the period when the most people were likely to eat. This coincided with the peak overall exercise activity so that the work activity was closest to what might be expected during a contingency.

In addition to the number of cooks that were known to be assigned to a particular exercise, there were, at three exercises, food service attendant personnel who were rostered. Each day different persons performed the duties, and the number who reported varied from day to day and during the day. Although these people were not deployed for food service duties, their presence and use indicate that had they not been deployed, additional cooks would have been deployed for the same duties at a legitimate labor cost. Due to the variables indicated, the work sampling data were relied on to determine the number of food service attendants at each exercise. The number of food service attendants in Table A-2 were calculated using the following two formulas;

$$\frac{\text{No. of Observations}}{\text{No. Observations per Hour} \times 3 \text{ Days}} = \text{No. Hours Per Day} \quad (\text{A-1})$$

$$\frac{\text{No. Hrs per Day}}{12 \text{ Hours per Shift}} = \text{No. Personnel} \quad (\text{A-2})$$

TABLE A-2. Work Sampling Data for Food Service Personnel

<u>Calculations:</u>	<u>Food Service Attendants</u>	<u>Deployed Cooks</u>	<u>Total Food Service Personnel</u>
Team Spirit:			
$\frac{180}{36} = 5$			
$\frac{5}{12} = 0.41$	1	18	19
Brave Shield 17:*			
$\frac{2540}{18*} = 141$			
$\frac{141}{12} = 11.75$	12	55	67

TABLE A-2. Work Sampling Data for Food Service Personnel (cont'd)

<u>Calculations:</u>	<u>Food Service Attendants</u>	<u>Deployed Cooks</u>	<u>Total Food Service Personnel</u>
Dawn Patrol:			
$\frac{1619}{36} = 45$			
$\frac{45}{12} = 3.75$	4	16	20
Brave Shield 18:			
$\frac{2054}{36} = 57$			
$\frac{57}{12} = 4.75$	5	41	46

\* Observation interval was 10 minutes rather than five minutes as at other exercises.

Also, from the work sampling data collected, the amount of productive and non-productive time spent by personnel assigned to food service was calculated and converted to manhours per day. These manhours, with meals served and manhours available, based on food service personnel deployed working 12-hour shifts, six days per week, were combined to arrive at productivity levels.

Table A-3 presents the basic productivity data collected at each exercise. It shows that of the duty hours spent by food service personnel in the food service operation, 26 to 38 percent of their time was recorded as non-productive.

Table A-3. Analysis of Daily Workhours

<u>Exercise</u>	<u>Total Meals</u>	<u>No. Food Service Personnel</u>	<u>Productive Hours</u>	<u>Non-productive Hours</u>	<u>Total Hours</u>	<u>%Non-productive</u>
Team Spirit	16,662	19	115	42	157	26.7
Brave Shield 17	38,317	67	281	75	456	38.3
Dawn Patrol	23,893	20	121	44	165	26.6
Brave Shield 18	28,983	46	184	17	301	38.8

Nonproductive time included food service personnel eating their own meals while on duty and taking breaks for personal reasons. Observations include those present for duty at the time of observation and those known to be absent for a specific purpose, such as making a ration run. Not included are those with a day off or who were released from duty early.

Workers in any activity must have nonproductive time planned into their work schedule, hence, nonproductive time is not a negative concept. To accomplish personal tasks, take rest breaks, and eat regular meals, the data suggest that workers should be allowed approximately 25 percent nonproductive time in their schedules.

Because of the lower nonproductive times observed at overseas exercises, it appears that a 25 percent goal is attainable. CONUS exercises show excess nonproductive time largely because the numbers of food service personnel deployed were too large.

Calculations for Table A-4 utilize observed productive time to arrive at a target level (25% rather than 26% to 38%) of nonproductive time. The following equation guides this calculation:

$$\frac{\text{Productive Time}}{x} = \frac{0.75}{0.25} \quad (\text{A-4})$$

Table A-4. Workhours Calculated using 25% NonProductive Factor

<u>Exercise</u>	<u>Observed Productive Hours</u>	<u>Projected Nonproductive Hours</u>	<u>Projected Total</u>
Team Spirit	115	38	153
Brave Shield 17	281	94	375
Dawn Patrol	121	40	161
Brave Shield 18	184	61	245

**APPENDIX B**  
**THE TRAY-PACK CONCEPT AND**  
**ITS APPLICATION AT AIR FORCE EXERCISES**

## APPENDIX B. The Tray-Pack Concept and Its Application at Force Exercises

"Tray-Pack" is the generic name applied to a recently developed multiserving-size package for thermoprocessing foods. As a concept, the Tray-Pack became possible with a breakthrough in packaging that produced the smooth-wall foil container that could be hermetically sealed and thermally processed. Further development resulted in a heavier duty, drawn container of multiserving size with application to food service systems.

This new package is commercially produced as a half-sized steam table container that holds 10 to 26 servings of food depending upon the type of entree or vegetable. Its volume compares with the No. 10 can (105 fluid ounces). The tray construction is one piece with a step shoulder on the container wall to support it in the steam table top opening, wherein two trays can be inserted side by side.

The tray lids are designed for double-seaming with conventional can closing machinery to form a positive hermetic seal. The double seam also allows opening with standard can-opening devices. Another important feature of the Tray Pack is its flat shape. It significantly reduces thermal process time and contributes to the quality of the food product by making possible a rapid and even distribution of heat throughout the product during processing, cooking, and reheating to serving temperature. Studies indicate that food in the tray container requires 50% less time (thus, less energy) for heating than identical food packed in No. 10 cans.

The Tray-Pack container provides multiple functions as a vessel for processing, transporting, storing, heating, and serving food. It is disposable and thus reduces pot and pan washing which, in turn, saves labor and fuel costs. Further, and of great importance to field food systems, the Tray-Pack requires no refrigeration. NLABS tests have established the shelf-life of Tray-Pack items as exceeding the military minimum shelf-life requirement of two years at 70°F and six months at 100°F.<sup>5</sup>

During its early stage of development, the median cost of the Tray-Pack containers tested by NLABS was \$0.45 per container, compared with \$0.30 for a No. 10 can. The cost differential favoring the No. 10 can is offset by savings in labor, energy, and materials required to wash pots and pans when No. 10 cans are used, but which are not needed when Tray-Pack meals are served. Cost factors for Tray-Pack items used at Brave Shield 17, Dawn Patrol, and Brave Shield 18 are presented in Table B-1 including the items used, the packer, cost per unit, and cost per portion.

TABLE B-1. Cost of Tray-Pack Foods Tested at Air Force Field Exercises Brave Shield 17, Dawn Patrol 78, Brave Shield 18, Gallant Eagle 79

Exercise	Item	Packer *	Cost/Tray	Cost/Portion**
Brave Shield 17	Sliced Roast Beef	V	\$13.11	\$1.09
	Beef Burgundy	V	10.94	0.91
	Chicken Stew	V	6.23	0.52
	Italian Sausage	V	9.38	0.70
	Beef Stroganoff	V	10.60	0.88
	Sliced Roast Beef	V	7.94	0.66
Dawn Patrol 78	Braised Beef Tips w/Brown Gravy	V	10.40	0.87
	Beef w/BBQ Sauce	V	8.30	0.69
	Salisbury Steak	G	5.40	0.45
	Beef Stew	V	6.16	0.51
	Lasagna	G	5.13	0.43
	Chicken a la King	G	6.24	0.52
	Peas	G	2.88	0.11
	Corn	G	2.41	0.09
	Apple Cobbler	G	4.21	0.35
	Blueberry Cobbler	G	5.18	0.43
	Cherry Cobbler	G	5.03	0.42
	Brave Shield 18	Sliced Roast Pork	V	13.11
Beef Burgundy		V	10.94	0.91
Beef Stroganoff		V	10.60	0.88
Beef w/BBQ Sauce		V	8.30	0.69
Lasagna		K	5.89	0.49
Stuffed Peppers		K	7.06	0.59
Creamed Beef		B	5.51	0.46
Corned Beef Hash		K	7.94	0.66
Corn		G	2.41	0.09
Peas		G	2.88	0.11
Lima Beans		G	2.44	0.09
Green Beans		G	2.88	0.11
Potatoes		G	3.00	0.12
Apple Cobbler		G	4.21	0.35
Blueberry Cobbler		G	5.18	0.43
Cherry Cobbler	G	5.03	0.42	
Gallant Eagle 79	Lasagna	B	7.01	0.58
	Beef Stew	B	8.19	0.68
	Chili	B	5.05	0.42

\* V = Vanee; G=Green Giant; K = Kraft; B = Bryan

\*\* Portions per Tray: Entrees = 12; Starches = 17; Vegetables = 26; Desserts = 12

Basic nutritional data obtained from studies at NLABS show differences between frozen foods, No. 10 can packed items, and Tray-Pack products. Of seven vitamins assayed (carotene, thiamin, riboflavin, niacin, pyridoxine, Vitamin B<sub>12</sub>, and Vitamin E), two are heat-sensitive and show significant differences. The two are thiamin (B<sub>1</sub>) and pyridoxine (B<sub>6</sub>). The vitamin contents found after processing indicate that thiamin in all the No. 10 can products (in the test) was significantly lower than in the Tray-Pack and frozen products. The Tray-Pack products were also significantly lower in thiamin as compared with frozen products.

Pyridoxine in chicken cacciatore, beef burgundy, and smoked pork was likewise significantly different in the same relative order as thiamin. Translated into equivalents of the recommended Daily Dietary Allowances for military personnel moderately active in a temperate climate,<sup>6</sup> the thiamin content of smoked pork in the Tray Pack is approximately 30% of the RDA for men and 40% for women.

An important implication of these early studies of nutrition is that, with regard to heat-sensitive vitamins, Tray-Pack items will prove more nutritionally valuable than products packed in No. 10 cans, but less so than frozen items.

Availability of Tray-Pack items has been evaluated for the near term. As of May 1979, some 31 entrees, 4 vegetables, 4 starches, and 3 desserts were available in quantity from seven different commercial packers. A listing of Tray-Pack items that are currently available follows.

Commercially Produced Tray Packs and Packers \*  
(as of May 1979)

ENTREES

Beef Bourguignon (V)  
Beef in Barbecue Sauce (V, BS)  
Beef Ravioli in Sauce (K, P)  
Beef Stew (B, G, L, V, BS)  
Beef Stroganoff (V, B)  
Brown Gravy with Braised Beef tips (V)  
Cheese Ravioli in Sauce (P, G)  
Chicken a la King (B, V, G, BS)  
Chicken Breast (V)  
Chicken & Noodles (B)  
Chicken Stew (V)  
Chili (B, G, K, V)  
Chow Mein, Vegetable (G, K)  
Corned Beef Hash (K)  
Creamed Chicken (K)  
Creamed Wafer Slices Beef (B)  
Italian Sausage in Sauce (V)  
Lasagna (B, G, K, V, BS)  
Macaroni & Beef in Tomato Sauce (V)  
Macaroni & Cheese (K, V)  
Mushroom Gravy with Braised Beef Tips (V)  
Salisbury Steak (G, K, V, BS)  
Skinned & Boned Chicken Breasts  
in Sauce (BS)  
Sliced Beef in Italian Sauce (V)  
Sliced Roast Beef & Gravy (V)  
Sliced Roast Pork in Gravy (V)  
Sliced Turkey in Gravy (V)  
Sloppy Joe's (V)  
Stuffed Cabbage (K, G, BS)  
Whole Leg Chicken Cacciatore (BS)

VEGETABLES

Corn (G)  
Green Beans (G)  
Lima Beans (G)  
Sweet Peas (G)

STARCHES

Baked Beans (BWB)  
German Potato Salad (BS)  
Potatoes in Brine (G)  
Scalloped Potatoes & Ham (BS)

DESSERTS

Apple Slices in Sauce (G)  
Blueberries in Sauce (G)  
Cherries in Sauce (G)

\*KEY TO PACKERS

B - Bryan Packing Co.  
G - Green Giant Co.  
K - Kraft Inc.  
P - Prince Macaroni Mfg. Co.  
V - Vanee Foods Co.  
BS - Blue Star Foods, Inc.  
BWB - BWB Foods, Inc.

Development of the Tray-Pack concept has been underway at NLABS since 1962.<sup>7</sup> Engineers, scientists, and technologists are working on product formulations in an effort to increase the variety of Tray-Pack items available and to improve the quality of existing items. Also, a project is in progress to define and document effective container packing procedures to ensure safe shipping over long distances and by various modes of transport.

Prior to the studies reported here, no testing of Tray-Packs had been conducted with military personnel in a field feeding environment. During the data collection phase of MSR USAF 9-1, several tests of Tray-Pack items were conducted at four different tactical field exercises. The tests were designed to establish customer satisfaction levels (hedonic ratings) for the Tray-Pack items (in their own right) and as they compared with other type menu items served -- A ration and B ration items. Worker attitudes toward the Tray Pack were assessed, and close attention was given to the packing, ordering, delivery, storage, heating, cooking, and serving procedures.

Consistent with a major purpose of the USAF 9-1 project to identify labor savings practices, equipment and products, two meals were served and work sample studies were conducted to determine labor required for serving T ration meals. Results showed that the Tray-Pack items did offer substantial labor savings. A further requirement of the new feeding system was that customers perceive it to be at least equal in the quality of the meals served and in the level of service compared to the older system. The Tray Pack study design included measures of customer satisfaction expressed as hedonic scale ratings, and worker attitudes as recorded during personal, one-to-one interviews. The rating scale used to collect customer data is included in Appendix D of this report.

Four exercises were chosen to measure customer satisfaction relative to Tray Pack items and to study manpower requirements for serving Tray-Pack meals. Findings from these studies are displayed for each exercise in Tables B-2 through B-5. Table B-6 shows summaries of customer hedonic ratings for Tray-Pack items and for prepared items at exercises where comparisons were made. It is apparent that T ration Tray-Pack items are evaluated favorably when compared with A and B rations as rated on hedonic scales by Air Force personnel serving on field exercises.

TABLE B-2. Customer Hedonic (Mean) Ratings of Tray-Pack and A Ration Items Served during Air Force Field Exercise Brave Shield 17

<u>Item</u>	<u>Tray-Pack</u>		<u>A Ration</u>		
	<u>Hedonic Rating</u>	<u>Sample Size</u>	<u>Item</u>	<u>Hedonic Rating</u>	<u>Sample Size</u>
Chicken Stew	7.68	28	Ham Steak	7.80	54
Beef Slices	6.92	48	Spaghetti	6.84	67
Pork Slices	7.23	86	Fried Chicken	7.19	105
Beef Stroganoff	7.56	39	Turkey	7.51	97
Beef Burgundy	6.95	73	Fried Fish	7.35	31
Italian Sausage	5.53	38	Meatballs	6.60	35
Pork Slices	5.40	49	Roast Beef	5.70	66

\* Ratings were remeasured on a nine-point scale where 1 = "dislike extremely" and 9 = "like extremely." All hedonic ratings reported in this appendix were measured on the same scale.

TABLE B-3. Customer Hedonic (Mean) Ratings of Tray-Pack and B Ration Items  
Served during Air Force Field Exercise Dawn Patrol 78

<u>Tray-Pack</u>			<u>A Ration</u>		
<u>Item</u>	<u>Hedonic Rating</u>	<u>Sample Size</u>	<u>Item</u>	<u>Hedonic Rating</u>	<u>Sample Size</u>
Beef Stew	6.14	111	Spanish Franks	6.23	92
Beef Barbeque	7.24	57	Pork Roast	7.38	49
Beef Tips w/Gravy	7.80	79	Shrimp Creole	6.88	18
Salisbury Steak	6.87	80	Spaghetti	6.69	65
Lasagna	7.36	88	Ham Steak	7.25	20
Chicken a la King	7.77	78	Beef Tips	6.60	45
Corn	7.26	140	Hamburger Steaks	6.80	65
Peas	7.12	56	Tuna Casserole	7.00	20
Cherries in Sauce	7.79	43	Roast Beef	7.50	54
Apple Slices	7.40	58	Corn	7.92	18
Blueberries in Sauce	7.83	47	Beets	6.92	14
			Peaches	7.83	24

TABLE B-4. Customer Hedonic (Mean) Ratings of All Tray-Pack Meals and Two Tray-Pack Breakfast Items Served during Air Force Field Exercise Brave Shield 18

	<u>Tray-Pack Menu</u>	<u>Hedonic Rating</u>	<u>Sample Size</u>
Lunch	Pork Slices	5.70	43
	Lasagna	6.62	71
	Potatoes	7.82	73
	Peas	7.30	50
	Corn	7.25	89
	Cherries in Sauce	6.94	33
Dinner	Beef Burgundy	7.00	113
	Stuffed Peppers	7.78	23
	Beef Stroganoff	5.68	22
	BBQ Beef	5.73	48
	Potatoes	6.75	73
	Green Beans	6.64	67
	Lima Beans	7.08	13
	Apple Slices in Sauce	7.61	23
	Blueberries in Sauce	7.57	14
Breakfast	Creamed Wafer Beef	7.73	34
	Corned Beef Hash	7.35	20

TABLE B-5. Customer Hedonic (Mean) Ratings of Tray-Pack Items and A Ration Items Served during Air Force Field Exercise Gallant Eagle 78, Expando Kitchen

<u>Tray-Pack</u>			<u>A Ration</u>		
<u>Item</u>	<u>Hedonic Rating</u>	<u>Sample Size</u>	<u>Item</u>	<u>Hedonic Rating</u>	<u>Sample Size</u>
Lasagna	6.78	37	Pork Slices	7.39	41
Beef Stew	7.08	12	Roast Beef	7.46	52
Chili	7.36	22			

The work-sample study showed clearly that the preparation of a T ration meal requires significantly less labor than preparation of A and B ration meals. This finding was predictable in that the preparation of Tray-Pack items is solely a matter of raising their temperature (ambient) to a serving temperature fo 165°F. Table B-6 below displays comparative meals per productive hour of T ration Tray Pack and prepared menu items.

The Tray Packs were prepared by heating them in boiling water for approximately 30 minutes for entrees, 10 minutes for starches, and 15 minutes for other vegetables. At both Brave Shield 17 and Dawn Patrol, the heating was done in standard stock pots (each of which accommodates eight trays) heated with M-2A burners. At Brave Shield 18, steam table wells were used as heating pots, and at a remote site on Brave Shield 17, a tilt grill was used to heat the trays.

TABLE B-6. Food Service Productivity at Air Force Field

Exercises where Different Type Rations were Served \*

<u>Exercise</u>	<u>Type Ration</u>	<u>Meals Per Productive Manhour</u>	
		<u>Lunch</u>	<u>Dinner</u>
Team Spirit 78	A	12.30	14.88
Brave Shield 17	A	7.98	12.10
Dawn Patrol	A&B	14.15	14.49
Brave Shield 18	T	29.18	34.04
Brave Shield 18	A	13.42	19.90

\* As measured in a work sample study where productivity is expressed as meals served per productive manhour.

Boiling water is the best way to heat Tray-Packs; however, other methods can be used including oven heating, in which case the Tray-Packs would be opened prior to heating so as to prevent excessive expansion of the product. Oven temperature would need to be closely monitored to prevent burning.

**APPENDIX C**

**CUSTOMER SATISFACTION AND FOOD SERVICE WORKER OPINION**

## APPENDIX C. Customer Satisfaction and Food Service Worker Opinion

Behavioral Sciences Division (BSD), Food Sciences Laboratory, NLABS was asked to provide support in defining of the USAF, Mobility and Augmentation Food Service System in the areas of measurement of customer opinion of the food service system, food acceptability as determined by the customer, food service worker opinion of the food service system, and food service worker job satisfaction. The Air Force requirement asked that any new system at least maintain the existing level of customer acceptance and food service worker satisfaction. To this end, the data reported here serve as baseline data for the existing field systems. In addition, they suggest several possibilities for recommended system changes. This appendix summarizes the data collected by BSD in the evaluation of existing USAF contingency food service operations.

### Exercise and Field Kitchen Descriptions

Surveys and interviews were administered to customers and food service workers in four Air Force 1978 Field exercises. Team Spirit 78, a Pacific Air Force (PACAF) exercise in Sachon, Korea; Brave Shield 17, a Tactical Air Command (TAC) exercise at Nellis AFB, Nevada; Dawn Patrol, a US Air Force Europe (USAFE) exercise in Gioia Del Colle, Italy; and Brave Shield 18, a TAC exercise at Peterson AFB, Colorado. In the first three exercises listed above, the Harvest Eagle kitchen was used; and in the last exercise, the Harvest Bare kitchen was used.

The Harvest Eagle is a tent-based kitchen using field feeding equipment similar to that traditionally used by the US Army and Marines. In practice, however, the precise make-up and configuration of each Harvest Eagle kitchen was substantially different at each of the three exercises. In the Team Spirit exercise, the kitchen and serving line were in the same General Purpose (GP) medium tent erected over plywood walls and floors; M-1948 kitchen tents were supplied, but not used. Five GP medium dining tents were erected with no flooring (three were used). In the Brave Shield 17 exercise, a total of ten tents were used in the food service operation. There were two food preparation GP medium tents, a salad and dessert service GP medium, a GP large with two serving lines, a GP medium for pot and pan washing, a GP large for supplies and storage, a GP medium VIP dining tent, and three GP large dining tents. The VIP tent had its own serving line; all four dining tents had plywood floors. In the Dawn Patrol exercise, two M-1948 kitchen tents were placed back to back to shelter both the kitchen and serving line. Two dining tents, one GP medium and one GP large, doubled as serving areas for beverages, salads, and desserts. Supplies were stored in an additional GP large.

While the Harvest Eagle was used in each of the exercises, each kitchen was essentially very different. Other differences also existed, mostly in the Brave Shield 17 exercise. Brave Shield 17 was the only one of the three with a separate short order line. In addition, each exercise supplemented the standard equipment. Dawn Patrol cooks, for example, brought extra M-2A burners and two steam tables and borrowed a sink from the hospital for installation in the kitchen. The Brave Shield 17 kitchen was supplied with

two six-foot gas griddles (from salvage), four charcoal grills, four beverage dispensers, and two 30-cup coffee makers.

The Harvest Bare kitchen was used in the Brave Shield 18 exercise. The Harvest Bare food complex consisted of rigid, expandable shelters -- two kitchens and two general purpose shelters used for dining areas, all connected to form a single unit with a kitchen at both ends of a large dining area. Since Harvest Bare has its own power generation capability, electrical cooking equipment was used rather than the standard field equipment.

#### Customer Opinion Survey

Administering surveys in the military field situation is difficult, particularly in a military exercise which precludes assembling relatively large numbers of customers in a single location. Because of such procedural difficulties, it was decided to ask the first sergeants of each exercise to distribute and collect surveys. At each exercise, the first sergeant was given 200 blank survey forms and instructions to distribute them among both enlisted personnel and officers so that all grade levels would be surveyed. Clearly, this is far from a random sampling method; however, the completed surveys actually received in each exercise were representative of both enlisted and officer grades.

The survey itself contained an evaluation of eleven factors involved in field food service; detailed questions about food quality, quantity, and variety; questions about sanitation, the environmental characteristics of the eating situation, and the food service workers.

#### Food Acceptance Rating

At all four exercises, food acceptance ratings were obtained in a person-to-person interview format. The interviewer approached a customer at a table in the dining tent who was finished or about to finish eating. The customer was shown a card containing the standard nine-point hedonic scale ranging from 1, "dislike extremely" to 9, "like extremely" and asked to rate each item he or she had consumed. In addition, the customer was asked to give the meal an overall rating. At each meal, the interviewer attempted to interview approximately 20 customers varying in grade (both enlisted and officer), race, and gender. In the Team Spirit exercise, environmental conditions (the cold) precluded breakfast food acceptance interviews on three different days as had been planned. Lunch and dinner food acceptance ratings were obtained on five different days (four in Team Spirit). Lastly, in the Brave Shield exercise, the same food acceptance technique was used to evaluate various Tray-Pack items.

#### Food Service Worker Surveys and Interviews

At each exercise, opinion surveys and a job satisfaction instrument, the Job Description Index (Smith et al., 1969<sup>4</sup>) were administered in group settings to all accessible food service workers. The surveys included questions concerning the present status of the food service operation, the

present status of the field kitchen and job satisfaction. The Job Description Index (JDI) is a standard instrument which measures satisfaction within five areas of a job (the work itself, the supervision, the co-workers on the job, the opportunities for promotion, and the pay). Each area is evaluated by response to a list of adjectives and descriptive phrases. In addition to the surveys and JDI's, interviews were administered on a one-to-one basis in an attempt to deal with some aspects of the field feeding situation on a more complex level. Generally, fewer personnel were interviewed than surveyed; in some instances, cooks were interviewed and not surveyed, and vice versa.

#### General Opinion

Table C-1 shows the mean customer ratings of eleven aspects of the field feeding situation. Data from three of the exercises display a great deal of similarity while those from Brave Shield 18 tend to be different. These differences hold up over much of the customer data to be discussed and are not too surprising considering the "unfieldlike" nature of the rigid-walled, temperature-controlled shelters used in Brave Shield 18. In addition, as will be discussed later, the Brave Shield 18 food operation had a serious supervision problem. Accordingly, Brave Shield 18 customers were more critical about the entire food service operation, and particularly, as can be seen in Table C-1, about food variety and quantity.

Notwithstanding the lower ratings from this one exercise, the data in Table C-1 depict a generally satisfied customer. Only one category in one of the three other exercises (Dawn Patrol), speed of service was given a mean rating below the scale mid-point of 4. Looking at the mean data for all four exercises, three factors stand out as being rated the highest: chance to sit with friends, service by dining facility personnel, and food quality. If one ignores Brave Shield 18 data, two other food related factors, quantity and variety also received relatively high ratings. The two factors rated lowest overall were the speed of service and the monotony of the same facility.

Some differences among the data from the four exercises were apparent. For example, in Brave Shield 17, customers gave particularly high ratings to food quantity and variety; observations of NLABS personnel would support these ratings. The lines in Dawn Patrol were the longest observed in the four exercises, extending credibility to the low rating given by the customers.

As mentioned previously, the relatively low food ratings given by Brave Shield 18 customers were probably to a great extent related to the food service supervisory problem. Conversely, however, Brave Shield 18 customers who ate in the aforementioned "unfieldlike" environment of the Harvest Bare dining facility gave relatively high ratings to such variables as cleanliness, general environment, and the lack of military atmosphere.

TABLE C-1. Mean Customer Ratings of Various Aspects of  
Air Force Field Food Service

	<u>Team Spirit (N=97)</u>	<u>Brave Shield 17 (N=108)</u>	<u>Dawn Patrol (N=107)</u>	<u>Brave Shield 18 (N=71)</u>	<u>Mean</u>
1. Chance to sit with friends	6.11 (1)*	5.86 (1)*	5.84 (1.5)*	5.53 (1)*	5.86 (1)*
2. Service by dining facility personnel	6.04 (2)	5.66 (4)	5.59 (3)	4.29 (6)	5.48 (2)
3. Food quality	5.48 (4)	5.59 (5)	5.84 (1.5)	4.32 (5)	5.40 (3)
4. Food variety	4.96 (5)	5.73 (3)	5.50 (4)	3.71 (7)	5.10 (4)
5. Food quantity	5.49 (3)	5.78 (2)	4.98 (6)	3.44 (11)	5.05 (5)
6. Cleanliness	4.72 (7)	5.04 (7)	5.37 (5)	4.83 (2)	5.01 (6)
7. General environment	4.36 (8)	4.68 (10)	4.86 (10)	4.71 (3)	4.66 (7)
8. Hours of operation	4.77 (6)	5.55 (6)	4.36 (9)	3.53 (8)	4.65 (8)
9. Military atmosphere	4.3.2 (9)	4.81 (9)	4.74 (8)	4.50 (4)	4.61 (9)
10. Monotony of same facility	4.30 (10)	4.36 (11)	4.35 (10)	3.47 (9)	4.18 (10)
11. Speed of service or lines	4.16 (11)	4.94 (8)	3.43 (11)	3.45 (10)	4.04 (11)

\*Rank order within sample.

Scale: 1 - Very Bad; 2 - Moderately Bad; 3 - Slightly Bad; 4 - Neither Bad Nor Good; 5 - Slightly Good; 6 - Moderately Good; 7 - Very Good.

## Food Quality and Food Acceptance

The high ratings given food quality in response to the question concerning various aspects of the food service system were reflected in the customer food acceptance ratings. In previous Army (Baritz, et al., 1975)<sup>8</sup> and Marine (Baritz, et al., 1976)<sup>9</sup> field exercises, food acceptance ratings averaged between 4.00 and 6.00 on the standard, nine-point hedonic scale. Here, as can be seen in Tables C-2 and C-3, the ratings fall between 6.00 and 9.00. Even on the Brave Shield 18 exercise where the opinion survey ratings of food were lower, the mean food acceptance ratings for the overall meal were 6.85 for breakfast, between "like slightly" and "like moderately" and 7.01, virtually at "like moderately", for lunch/dinner. At the three exercises overall meal food acceptance ratings were between "like moderately" and "like very much": 7.18, 7.29, and 7.48 for lunch/dinner and 7.55 and 7.58 for breakfast (no breakfast ratings from Team Spirit). Furthermore, the high ratings still apply if one breaks them into ratings for the various food classes. The lowest rated food class was lunch/dinner starch, and even this category was rated well above 6.00 on each exercise.

TABLE C-2. Mean Customer Breakfast Food Acceptance Ratings  
at Three Air Force Exercises

<u>Food Class</u>	<u>Brave Shield 17</u>	<u>Dawn Patrol</u>	<u>Brave Shield 18</u>	<u>Mean</u>
Eggs	7.41	7.62	6.83	7.27
Meats	7.12	7.33	7.15	7.21
Other Entrees	7.19	6.00	7.00	6.74
Starches	6.88	6.97	6.00	6.79
Milk	8.25		8.08	8.18
Juice	7.89	8.40	7.40	8.11
Coffee	8.00	7.56	8.11	7.90
Fruit	7.85	8.50	7.83	8.01
OVERALL	7.55	7.58	6.85	7.32

Scale: 9 - Like extremely; 8 - Like very much; 7 - Like moderately  
6 - Like slightly; 5 - Neither like nor dislike; 4 - Dislike slightly  
3 - Dislike moderately; 2 - Dislike very much; 1 - Dislike extremely

**Table C-3. Mean Customer Lunch/Dinner Food Acceptance Ratings  
at Three Air Force Exercises**

<u>Food Class</u>	<u>Team Spirit</u>	<u>Brave Shield 17</u>	<u>Dawn Patrol</u>	<u>Brave Shield 18</u>	<u>Mean</u>
Entrees	7.36	7.15	7.47	6.97	7.24
Salads	6.56	7.49	7.34	7.90	7.27
Starches	6.59	6.34	6.95	6.48	6.60
Vegetables	6.91	6.98	7.42	7.12	7.14
Milk	8.09	8.30		8.68	8.28
Other Drinks	7.30	7.60	7.22	7.29	7.34
Dessert	7.17	7.39	7.96	6.44	7.46
OVERALL	7.29	7.18	7.48	7.01	7.24

Scale: 9 - Like extremely; 8 - Like very much; 7 - Like moderately  
6 - Like slightly; 5 - Neither like nor dislike; 4 - Dislike slightly  
3 - Dislike very much; 2 - Dislike very much; 1 - Dislike extremely

Because these ratings were comparatively high for the field with previous non-Air Force food ratings, some customers on the last two exercises surveyed (Dawn Patrol and Brave Shield 18) were asked informally about their ratings. Their answers suggest that in at least some instances the high food acceptance ratings reflect the customers' appreciation of the difficulty of field preparation and of the efforts of the food service workers as well as the actual quality of the food.

While the new Tray Pack items were evaluated in each exercise, only at Brave Shield 18 were face-to-face Tray Pack food acceptance ratings conducted. The mean ratings are summarized in Table C-4. The ratings approach, and in many instances exceed, the ratings given A-ration items by Brave Shield 18 customers. The biggest difference occurred between the lunch/dinner entrees, with the overall Tray-Pack entree rating averaging 6.30 and the rating for A ration entrees averaging 6.97. Even here the difference was not large, and half of the Tray-Pack entrees tested were rated above 6.50. The Tray-Pack vegetables, starches, and desserts were all rated quite highly with all ratings exceeding 6.60 and many being above 7.00.

Table C-5 shows responses to a question concerning how frequently the food was perceived to have various quality problems. As can be seen, the worst mean rating given was 2.47 on a five-point scale, between "not often" and "sometimes". In other words, the food quality was not frequently perceived as a problem by the customers. When it was, customers tended to judge the food as being mainly tasteless, cold, greasy, or tough.

TABLE C-4. Mean Customer Food Acceptance Ratings of Tray Pack

Items at Brave Shield 18

<u>ITEM</u>	<u>N</u>	<u>MEAN</u>
Creamed Beef	34	7.73
Corned Beef Hash	20	7.35
<b>Lunch/Dinner Entrees</b>		
Stuffed Peppers	23	7.78
Beef Burgundy	13	7.00
Lasagna	71	6.62
Barbequed Beef	48	5.73
Pork Slices	43	5.70
Beef Stroganoff	22	5.68
<b>Lunch/Dinner starches</b>		
Cut Potatoes	83	6.86
Sliced Potatoes	73	6.75
<b>Lunch/Dinner Vegetables</b>		
Peas	50	7.30
Corn	89	7.25
Lima Beans	13	7.08
Green Beans	67	6.64
<b>Lunch/Dinner Desserts</b>		
Apples in Sauce	23	7.61
Blueberries in Sauce	14	7.57
Cherries in Sauce	33	6.94

TABLE C-5. Mean Customer Ratings of Specific Aspects of Food Quality

How often is the food:

	<u>Almost Never</u> 1	<u>Not Often</u> 2	<u>Some- times</u> 3	<u>Often</u> 4	<u>Almost Always</u> 5
a. Spoiled	1.23				
b. Still frozen	1.31				
c. Stale	1.54				
d. Too Spicy	1.56				
e. Burned	1.69				
f. Overcooked	1.92				
g. Dried Out	2.04				
h. Undercooked	2.07				
i. Tough	2.26				
j. Greasy	2.32				
k. Cold	2.42				
l. Tasteless bland	2.47				

### Food Quality

In the typical Air Force Garrison situation (Branch et al., 1974)<sup>10</sup> and in field situations in other services (Meiselman et al., 1975)<sup>11</sup>, the major complaints about food quantity focus on meats or entrees, with customers also often reporting that they are served slightly too much starch. Customers on these exercises did not differ from the norm in their ratings of the portion size of meats, saying that this category had the smallest portion sizes (Table C-6). They also reported that the portion sizes of vegetables and desserts ranged between "slightly too small" and "somewhat too small" (3 and 2 on a seven-point scale). Starch portion size ratings approached "just about right" on two exercises and fell between "just about right" (4) and "slightly too small" (3) on the others. This contrasts with the data referred to above in garrison and other service field exercises where starch servings are reported as too large. Brave Shield 18 customers were more critical of portion sizes on all four food classes than those on the other exercises.

### Food Variety

As has been mentioned above, the exercises differed in terms of food choices available to the customer. Although all four exercises featured at least two entrees, there were observable differences in other facets of each meal. Only two exercises, Brave Shield 17 and 18 had a separate short order line; there was a far greater variety in desserts at Brave Shield 17; the two Brave Shields were the only exercises with salad bar arrangements. In addition, Brave Shield 17 often featured more than two entrees.

TABLE C-6. Mean Customer Ratings at Air Force Exercises of Amount of Food Given in One Serving

	<u>Team Spirit</u> (N=97)	<u>Brave Shield 17</u> (N=108)	<u>Dawn Patrol</u> (N=107)	<u>Brave Shield 18</u> (N=71)	<u>Mean</u>
a. Starches	3.89 (1)*	3.87 (1)*	3.49 (2)*	3.04 (1)*	3.62 (1)*
b. Vegetables	3.53 (2)	3.64 (3)	3.37 (3)	3.02 (2)	3.42 (2)
c. Dessert	3.03 (3)	3.75 (2)	3.70 (1)	2.94 (3)	3.40 (3)
d. Meat	3.02 (4)	3.21 (4)	2.80 (4)	2.25 (4)	2.87 (4)

\* Rank order within sample.

These observations of increased level of choice at Brave Shield 17 are borne out by customer ratings of variety, both for a given meal (Table C-7) and over several weeks (Table C-8). Note that the worst ratings for variety were obtained at Brave Shield 18.

The customer ratings of food variety for a given meal (Table C-7) can be summarized as follows. Basically, the customers reported desiring the largest increase in choice in desserts and short order and the next largest in meats, beverages, salads, and vegetables. While more satisfied with the variety of starches, they still reported desiring a bit more choice. Note that the two exercises with separate short order lines, Brave Shield 17 and 18, had better ratings for short order.

The ratings for food variety over several weeks were quite similar (Table C-8) with the major difference being a switch in the rank order positions of beverages and vegetables. The classes reported as having the smallest amount of choice were, again, short order and desserts.

TABLE C-7. Mean Customer Ratings at Air Force Exercises of  
Food Variety for a Given Meal

	<u>Team Spirit</u> (N=97)	<u>Brave Shield 17</u> (N=108)	<u>Dawn Patrol</u> (N=107)	<u>Brave Shield 18</u> (N=71)	<u>Mean</u>
a. Starches	3.53 (2)*	3.89 (1)*	3.58 (1)*	3.38 (1)*	3.57 (1)*
b. Vegetables	3.12 (4)	3.49 (6)	3.37 (3)	3.08 (3)	3.29 (2)
c. Salads	3.25 (3)	3.65 (2)	3.09 (4)	3.04 (4)	3.28 (3)
d. Beverages	3.37 (1)	3.59 (3)	2.75 (7)	3.12 (2)	3.21 (4)
e. Meats	3.17 (5)	3.51 (5)	3.43 (2)	2.35 (7)	3.19 (5)
f. Short Order	2.79 (6)	3.45 (7)	2.67 (6)	2.94 (5)	2.97 (6)
g. Desserts	2.56 (7)	3.54 (4)	3.08 (5)	2.45 (6)	2.96 (7)

\* Rank order within sample

Scale: 1 - Need much more choice; 2-Need somewhat more choice; 3-Need slightly more choice; 4-Choice not enough; 5-Need slightly less choice; 6-Need somewhat less choice; 7-Need much less choice.

TABLE C-8. Mean Customer Ratings at Air Force Exercises of  
Food Variety Over Several Weeks

	<u>Team Spirit (N=97)</u>	<u>Brave Shield 17 (N=108)</u>	<u>Dawn Patrol (N=107)</u>	<u>Brave Shield 18 (N=71)</u>	<u>Mean</u>
a. Starches	3.23 (2)*	3.86 (1)*	3.53 (1)*	3.16 (1)*	3.48 (1)*
b. Beverages	3.41 (1)	3.63 (3)	3.02 (6)	3.14 (2)	3.31 (2)
c. Salads	3.19 (3)	3.63 (2)	3.19 (4)	3.10 (3)	3.30 (3)
d. Vegetables	3.16 (4)	3.61 (4)	3.26 (3)	2.92 (4)	3.27 (4)
e. Meats	3.08 (5)	3.48 (6)	3.35 (2)	2.66 (6)	3.19 (5)
f. Desserts	2.65 (7)	3.53 (5)	3.18 (5)	2.64 (7)	3.04 (6)
g. Short Order	2.75 (6)	3.43 (7)	2.78 (7)	2.90 (5)	2.98 (7)

\* Rank order within sample

Scale: 1 - Need much more choice; 2-Need somewhat more choice; 3-Need slightly more choice; 4-Choice not enough; 5-Need slightly less choice; 6-Need somewhat less choice; 7-Need much less choice.

## Eating Environment

Crowding in the eating area was the customer's major concern about the eating environment, with Brave Shield 18 and Dawn Patrol customers reporting crowding more frequently than customers in the other exercises (Table C-9). In the three exercises using the Harvest Eagle tents, customers reported that it was "not often" too noisy. In the Harvest Bare eating shelter, the noise was more of a problem (probably a combination of generator noise plus echoing from the hard shelter walls). Two observations can be made concerning the customers' perceptions of environmental temperature. First, the Team Spirit responses reflect the cold ambients of a Korean February; and to a lesser degree, Brave Shield 17 and Dawn Patrol responses were consistent with the warm late spring of Las Vegas and southern Italy. Secondly, although summer ambients at Brave Shield 18 were high, the customer responses appear to have been affected by the environmental control systems of the Harvest Bare.

Table C-9. Mean Customer Description of the Dining Area at

### Air Force Exercises

<u>How Often is Dining Area</u>	<u>Team Spirit (N=97)</u>	<u>Brave Shield 17 (N=108)</u>	<u>Dawn Patrol (N=107)</u>	<u>Brave Shield 18 (N=71)</u>	<u>Mean</u>
a. Too Noisy	2.13 (2)*	2.19 (1)*	2.26 (1)*	3.05 (3)*	2.35 (1)*
b. Too Hot	1.35 (1)	3.00 (4)	2.82 (33)	2.65 (2)	2.47 (2)
c. Too Cold	4.52 (4)	2.43 (2)	2.30 (2)	2.39 (1)	2.92 (3)
d. Too Crowded	3.01(3)	2.98 (3)	3.56 (4)	3.66 (4)	3.28 (4)

\* Rank order within sample

Scale: 1-Almost never; 2-Not often; 3-Sometimes; 4-Often; 5-Almost always

## Results and Discussions: Food Service Workers

### Previous Field Experience and Training

Only 30% of the food service workers interviewed reported having participated in more than one previous field exercise (9% reporting two, 5% reporting three, and 16% reporting four or more). Another 28% said that they had participated in one previous exercise while almost half, 42%, had never been in the field before as a cook. Furthermore, included in this "no previous field" experience category was the food service superintendent on the Brave Shield 18 exercise. Such lack of experience is disturbing, especially in the latter case where the senior man in the field was inexperienced.

The workers' evaluations of their own training in field feeding are also of some concern. As Table C-10 shows, slightly less than half the cooks interviewed (49%)\* felt that they were sufficiently trained for the field. Twenty-one percent reported having received no training while 19% reported only receiving "no-hands-on" training (basically this meant that they had read a manual and/or watched someone else operate field equipment).

Almost all (93%) of those who reported receiving training and who also felt that it was sufficient had experienced some degree of hands-on training. As has been the case in other assessments of food service workers, (E.M. Nuss et al. 1976)<sup>12</sup> the importance of hands-on experience cannot be overemphasized.

Furthermore, in this case, the data in Table C-10 point to the efficiency of previous field exercise experience as a training vehicle. In other words, the cooks themselves seem to be suggesting that the best trained field feeding workforce would be one which had hands-on experience on an exercise itself, if at all possible, occurring at frequent intervals.

TABLE C-10. Cooks' Reported Field Training

<u>Type of Training</u>		<u>Cooks Report Sufficient</u>
Received no training	17 (21%)	N/A
Hands-on at exercises and at base	39 (48%)	34 (87%)
Hands-on at base only	10 (12%)	5 (50%)
No hands-on training	15 (19%)	1 (7%)

As a final note, concerning previous experience and training, the cooks on Brave Shield 18 were asked if they had been exposed to the Harvest Bare kitchen before the exercise. Of the twenty cooks interviewed, only one said that he had been trained on the Harvest Bare, and that training had occurred six years ago.

\*49% say trained sufficiently. Of these, 97% received hands-on training.

**Job Satisfaction** Each of the five areas of the Job Description Index (JDI) is evaluated by food service worker responses to a list of adjectives or descriptive phrases. For each scale, the range of possible scores is from 0 (lowest satisfaction) to 54 (highest satisfaction). Table C-11 shows the mean responses of food service workers at all four exercises to the work, supervision, and co-worker scales of the JDI. Since one would not anticipate an impact of the field feeding situation on the other two scales, pay and promotion, and since such differences did not occur among the four exercises, the means for these scales are not included in the table. For comparison purposes, the table also provides the mean responses from a sample of garrison military food service workers from three Air Force Bases -- Travis, Minot, and Homestead (Symington and Meiselman, 1975).<sup>13</sup>

TABLE C-11. Mean Cook Responses to Three Scales of the Job Description Index (JDI)\*

	<u>Team Spirit</u> (N=11)	<u>Brave Shield</u> (N=25)	<u>Dawn Patrol</u> (N=15)	<u>Brave Shield</u> (N=16)	<u>Mean</u>
Work	18.73	19.64	25.13	21.81	21.24
Supervision	31.09	32.48	42.86	19.31	31.434
Co-Workers	28.45	34.17	42.07	34.50	35.08

Air Force Cook Norms

Work	23.72
Supervision	38.89
Co-Workers	34.98

\* Data from Travis, Minot, and Homestead AFB's.

Table C-11 can be summarized as follows: combining the responses from all four exercises, the field mean score for satisfaction with co-workers was virtually identical to the garrison norm; for satisfaction with the work itself, the field mean was slightly lower than that of the garrison norm; and the field mean for satisfaction with supervision was somewhat lower still than the garrison norm. There are, however, two other important aspects of these data. First, extremely low satisfaction supervision was reported by the Brave Shield 18 cooks. This low rating is consistent with the previously mentioned food service superintendent's lack of experience. Second, Dawn Patrol cooks

gave the highest job satisfaction ratings on all three scales, exceeding the garrison norms for each scale. It seems probable that these high satisfaction scores are related to the fact that most of the Dawn Patrol cooks and their supervisors were members of a single, specialized field unit.

These data, combined with the data reported above concerning training and field experience, imply that the ideal field food preparation workforce would be a unit or group of units of individuals who train together in field exercises.

#### General Opinion of the Field Food Service Operation

Table C-12 presents the cooks' mean ratings of the present status of nine factors in their field food service operation. The data in the table represents responses on seven-point scales by all cooks surveyed, and can be summarized as follows. In general, these responses seem reasonably high. For comparison purposes, an as yet unpublished set of responses from Navy cooks concerning their ships' food service operations showed 12 or 14 factors being given mean ratings at or below 4.61, whereas here, only sanitation was rated that low. As might be anticipated from data previously discussed, the highest ratings were given by Dawn Patrol cooks and the lowest by those from Brave Shield 18. While there are obviously some large differences among exercises, some consistency does exist among the findings. The cooks tended to give favorable seven-point scale ratings to such areas as their own food preparation skills (6.00), menu variety for a given meal (5.76), customer satisfaction (5.74), leadership of the shift leader (5.67), menu variety from day to day (5.64), and cooperation among cooks (5.56). Equipment maintenance (5.31) and leadership of the dining facility supervisor (5.06) were lower but still can be considered as favorable ratings, particularly the latter which was obviously influenced by the extremely low rating given the food service superintendent on Brave Shield 18. Even the lowest rated factor, sanitation, was given a mean rating of 4.56, a rating above the neutral point on a seven point scale.

A few other "inconsistent" data points might be explored. Team Spirit cooks were particularly supportive of their shift leaders. Brave Shield 17 cooks were particularly positive about customer satisfaction. Dawn Patrol cooks gave a high rating to their food service superintendent (consistent with the high JDI satisfaction with supervision). As has been the case, Brave Shield 18 cooks gave the most divergent ratings. In addition to their low rating of the superintendent, they also gave a relatively low rating to variety at a given meal (consistent with the customers' perceptions detailed in Table C-7). Conversely, their rating of equipment maintenance was quite high -- and not surprising when it is recognized that a Harvest Bare maintenance crew from Holloman AFB was assigned to the exercise. Similarly, their rating of cooperation among cooks was relatively high.

TABLE C-12. Mean Cooks' Ratings of the Status of Nine Factors in their Food Service Operations at Air Force Exercises

	<u>Team Spirit</u> (N=13)	<u>Brave Shield 17</u> (N=31)	<u>Dawn Patrol</u> (N=15)	<u>Brave Shield 18</u> (N=19)	<u>Mean</u>
a. Food preparation skills of cooks	6.00(2)*	6.13(2)*	6.60(2)	5.28(3)*	6.00(1)*
b. Menu variety for a given meal	5.61(3)	5.86(3)	6.50(3)	6.06(6)	5.76(2)
c. Customer satisfaction	5.42(6)	6.15(1)	6.40(4)	5.00(70)	5.74(3)
d. Leadership of Shift leader	6.38(1)	5.00(70)	6.13(7)	5.17(4)	5.67(4)
e. Menu variety day to day	5.46(5)	5.77(4)	6.20(6)	5.11(5)	5.64(5)
f. Cooperation among cooks	5.00(7)	5.66(5)	6.21(5)	5.39(2)	5.56(6)
g. Equipment maintenance	4.92(8)	4.93(8)	5.80(8)	5.59(1)	5.31(7)
h. Leadership of dining facility supervisor	5.58(4)	5.39(6)	6.71(1)	2.56(9)	5.06(8)
i. Sanitation	4.23(9)	4.16(9)	5.40(9)	4.44(8)	4.56(9)

\* Rank order within sample

Scale: 7 - Very Good; 6 - Moderately good; 5 - Slightly good; 4 - Neither bad or good; 3 - Slightly bad; 2 - Moderately bad; 1 - Very bad.

## Opinion of the Field Kitchen and Equipment

In addition to the question concerning opinion of the food service system, another seven-point scale survey question asked the cooks to evaluate several aspects of the field kitchen and equipment. As can be seen in Table C-13, these ratings were not as high as those given the food service system factors. An extremely similar question concerning field kitchens and equipment was addressed to Marine cooks on a field exercise at Camp Pendleton, CA whereas three alternative field kitchens were being tested (Baritz, op. cit.). The range of mean responses shown in Table C-13 for the four Air Force field exercises (from 2.8 to 4.9) is quite similar to that for the Marine ratings of a GP medium tent based kitchen (2.2 to 5.7) and a mobile kitchen-trailer-based kitchen (2.1 to 5.3). The third field kitchen evaluated by the Marines, the XM-75 tent-based kitchen, received ratings from 4.0 to 6.7. In other words, the Air Force cooks' ratings of their kitchen and equipment on these exercises are not out of line with Marine cooks' ratings of field kitchens currently in their inventory.

Returning to Table C-13, some generalizations concerning the Air Force cooks' opinions about their field kitchens and equipment are possible. The cooks were most positive about the ease of food preparation, condition of equipment, ease of cleaning up, and ease of serving the customer. They were most critical of the crowding of cooks in the kitchen (particularly in the two M-1948 tents of Dawn Patrol and the Harvest Bare kitchen of Brave Shield 18), temperature of the kitchen (with the notable exception of the Harvest Bare with its environmental control equipment), size of kitchen, and the amount of storage space. The six other factors addressed received ratings centered around the neutral point.

Divergent ratings in Table C-13 indicate that specific problems can arise on a particular exercise (e.g., the speed of service and storage space on Team Spirit, the lighting on Brave Shield 17). Similarly, a few factors had divergently high ratings on a given exercise (e.g., the lack of noise on Team Spirit and Brave Shield 17, and the speed of service on Brave Shield 17). In the case of Brave Shield 18, the unique cooking shelter apparently gave rise to higher ratings for temperature and lighting and lower ones for noise.

TABLE C-13. Cooks' Mean Ratings of the Status of Fourteen Aspects of the Field Kitchens at Air Force Exercises

Aspects	Team Spirit 78 (N=13)	Brave Shield 17 (N=31)	Dawn Patrol (N=15)	Brave Shield 18 (N=18)	Mean
a. Ease of food preparation	4.77(1)*	5.03(1)*	5.33(2)*	4.62(6)*	4.94(1)*
b. Condition of equipment	4.08(5)	4.08(5)	5.40(1)	4.89(4)	4.61(2)
c. Ease of cleaning up	4.00(7)	4.06(7)	5.07(3)	4.83(5)	4.49(3)
d. Ease of serving customer	3.83(8)	4.31(3)	4.47(5)	5.17(2)	4.45(4)
e. Lighting	4.15(4)	2.53(13)	4.60(4)	5.33(1)	4.15(5)
f. Speed of service	3.54(11)	4.52(2)	4.27(8)	4.00(9)	4.08(6)
g. Ease of access to supplies	3.77(9)	4.07(6)	4.28(7)	3.65(10)	3.94(7)
h. Ease of setting up kitchen	4.23(3)	3.72(8)	3.21(11)	4.35(7)	3.88(8)
i. Noise	4.38(2)	4.13(4)	3.47(9)	2.83(13)	3.70(9)
j. Ease of moving kitchen	4.07(6)	3.18(12)	3.33(10)	4.12(8)	3.68(10)
k. Amount of storage space	2.69(14)	3.68(10)	4.40(6)	3.17(11)	3.49(11)
l. Size of kitchen	3.67(10)	3.54(11)	2.33(13)	2.94(12)	3.23(12)
m. Temperature	2.92(13)	2.06(14)	2.13(14)	4.94(3)	3.01(13)
n. Crowding of cooks	3.00(12)	3.70(9)	2.47(12)	2.06(14)	2.81(14)

\* Rank order within sample

Scale: 7 - Very good; 6 - Moderately good; 5 - Slightly good; 4 - Neither bad or good; 3 - Slightly bad; 2 - Moderately bad; 1 - Very bad.

The problem indicated by the cooks' low ratings of crowding and kitchen size was verified by responses to another survey question dealing with workspace in the kitchen (table C-14). Worker response was extremely negative; even the highest rated kitchens, the GP Mediums in Team Spirit and Brave Shield 17, received low mean ratings of 2.92 to 2.52, respectively, on a seven-point scale (between "somewhat too little" and "slightly too little"). The Harvest Bare kitchen was rated even more harshly at 1.61 (between "much too little" and "somewhat too little"). The two-M-1948-tent kitchen in Dawn Patrol was given a mean rating of 1.33, extremely low for a seven-point scale.

Table C-14 Cook Ratings of Kitchen Workspace

	Much Too Little	Somewhat Too Little	Slightly Too Little	Just Right	Much Too Much
	1	2	3	4	7
Team Spirit (GL Medium)	XXXXXXXXXXXXXXXXXXXXXXXXXXXX(2.92)				
Brave Shield 17 (GP Medium)	XXXXXXXXXXXXXXXXXXXXXXXXXXXX(2.52)				
Brave Shield 18 (Harvest Bare)	XXXXXXXXXXXXXXXXXXXX(1.61)				
Dawn Patrol (2 M1948's)	XXXXXXXXXX(1.33)				

Food service worker interview data reinforced the concerns cited above about workspace, kitchen temperatures, and sanitation. In addition, interview questions revealed concerns about the M-2A burner and its use as a heat source. The group of cooks who were most positive about the M-2A burner were those from Dawn Patrol who had a relatively large amount of field experience. Even here where 94% of the cooks felt that the burners were adequate, 20% were concerned about their safety when asked if the burners could be improved in any way and 69% mentioned "routine maintenance problems" with the M-2A burners when asked if any piece of equipment in the kitchen required maintenance. The Brave Shield 17 cooks were more concerned about the M-2A burner. Only 59% felt that they were adequate, 71% expressed concern about their safety, and 28% mentioned them as a maintenance problem. Another complaint about improving the M-2A's surfaced only at this exercise when 64% of the cooks complained about the fumes from the burners. The cooks at Team Spirit were perhaps the most negative group, 75% saying that the burners were inadequate. Half the cooks complained about burner safety and 62.5% about burner maintenance.

The cooks on Brave Shield 18 used the electric ovens of Harvest Bare, 80% feeling that they were adequate. When asked if they would prefer the Harvest Bare ovens or M-2A burners, seven of the nine cooks who had previously used M-2A's (78%) said they preferred the Harvest Bare ovens. Incidentally, the main complaint of 75% of the cooks concerned the breakdowns in the provision of steam.

**APPENDIX D**

**THE HARVEST BARE FOOD SERVICE SYSTEM,  
ITS OPERATION AT AN EXERCISE, AND A  
PROPOSED MODIFIED HARVEST BARE CONCEPT**

APPENDIX D. The Harvest Bare Food Service System, Its Operation at an Exercise and a Proposed Modified Harvest Bare Concept

The Harvest Bare food service complex was designed and developed in the late 1960's as part of the Base Augmentation Support Set (BASS). The BASS is a grouping of reusable lightweight, air transportable equipment and facilities to provide air base operating and housekeeping support where only a runway and water exist, i.e., at a "bare base." Designed as a mobility package, the BASS is maintained in a state of readiness, but is projected for deployment only after it has been determined that bare base support will be required for an extended time period. The complete BASS has never been deployed for exercising or in support of contingencies; rather, a mobility support kit, the Harvest Eagle, is currently the system deployed for such purposes.

The Harvest Bare food service system was designed as an integral part of the BASS but can operate independently if electricity is provided. There are at present 26 Harvest Bare food service complexes, 13 assigned to each of two BASS sets located at Holloman AFB. Each set is designed to support 4500 troops in a bare base environment.

Equipment

The Harvest Bare kitchen complex is a complete food service system with facilities to refrigerate, store, prepare, and serve food, to prepare baked goods, to sanitize dining ware, and to provide customer dining comfort. Equipment that distinguishes the Harvest Bare from other existing field feeding systems includes a multifuel-fired convection oven, griddle and a steam boiler with a built-in pressure cooker, three 15-gallon steam-jacketed kettles, a soft serve ice cream machine, and a dishwasher with complementary items, including a drainage system with disposable grease traps. These and other food service items of a more conventional design are shipped within the kitchen shelter which, in its closed configuration, is eight feet high, eight feet wide, and 13 feet long. The air conditioned/heated dining shelter accommodates 16 eight-person tables and is constructed in sections that are packed in shipping containers for transport. The two 150-cu.-ft. refrigerators that accompany each kitchen are shipped independently.

The complete food service complex is compatible with the C 130/C 141 aircraft and the 463L Cargo system. A 10,000 lb forklift is required to move the equipment from the transporter to the operational site. At the Brave Shield 18 exercise, three C 141 cargo aircraft were dedicated to the transport of two kitchen complexes to Peterson AFB, CO from Holloman AFB, NM. The food service equipment transported to Peterson AFB is shown below:

<u>Quantity</u>	<u>Item</u>
1	150-cu.-ft. walk-in field freezer
4	150-cu.-ft. walk-in field refrigerator
2	Stainless steel 2-compartment sink
	Sanitation center including dishwasher, 2-compartment sink, scraping and sorting tables
2	Fuel-fired convection oven
2	Steam pressure cooker

<u>Quantity</u>	<u>Item</u>
2	Verticle cutter/mixer
2	Soft serve ice cream machine
2	Hot plate (2-burner)
2	Countertop ice machine
Varied Quantities	Miscellaneous wood and metal shelving
6	Beverage dispensers
2	Coffee brewer
2	Toaster (conveyor type)
2	Warming cabinet
2	Meat slicer
2	Storage cabinet
2	Milk machine (2-nozzle)
2	Cashier stand
30	Dining tables with benches
7	General purpose tables (4' x 3')
6	General purpose tables (6' x 3')
1	Ice machine (250 lb/day)

### Personnel

The cooks who were deployed to Brave Shield 18 came from thirteen Air Force bases, and four were on active duty for training from the Air National Guard. The largest number from any individual AFB was three. Generally, they traveled by commercial transportation. Some drove in their personally-owned vehicles.

### Food

The food service supervisor had made a coordination trip to the exercise site prior to the beginning of the exercise. At that time, arrangements for the initial food supply were made. The food was obtained from the Air Force Academy, which serves as the central food distribution point for all Air Force activities in the Colorado Springs area.

Initially, a three-day supply of food was obtained. Subsequent orders were based on projected exercise strength. The menu was designed by the assistant supervisor. Resupply was by truck.

### Assemble Shelter/Equipment

At the Brave Shield 18 exercise, a support team of 12 enlisted technicians erected the system and assembled the equipment. The technicians were from the 4449th Mobility Support Squadron (MOBSS) located at Holloman AFB. Although food service personnel could have erected the kitchen/dining shelter system, they were not expected to assemble, connect, and maintain the highly technical heating equipment. In addition to training in the basic skills required to operate/maintain heating equipment, special training on the unique Harvest Bare heating equipment is required of those who will maintain it.

Problems noted during system assembly at Brave Shield 18 included the following: loose wires, defective solenoids, dried packing around the condensate pump, and a seized bearing on a fuel pump--all likely due to long-term storage without adequate periodic inspection/correction. Other problems noted early on during the exercise attributable to either storage or transportation were a loose time delay tube, a bent dasher arm on an ice cream machine, plugged nozzles and erratic fire eye controls.

It was not possible to make an exact calculation of manhours required to erect and assemble the Harvest Bare kitchen complex. Observers reported that the erection team worked only intermittently and at a leisurely pace. The system arrived at the exercise site on a Monday and the first meal served was on the following Friday. In the judgment of experienced engineering people who have worked with the Harvest Bare, the erection/assembly requirements of the system should permit serving hot meals two days after arrival at the site. The Harvest Bare food service complex at Brave Shield 18 was comprised of two kitchens, one at each end with the dining shelter between them.

#### Maintenance

Of the twelve 4449th MOBSS maintenance personnel deployed to Brave Shield 18, four were heating (burner) specialists, two were refrigeration experts, two were electricians, two were sanitation specialists, and two were food personnel.

The maintenance requirements for the Harvest Bare complex were of special interest and importance in view of the Harvest Bare's highly technical nature. The 4449th MOBSS team kept maintenance records. A maintenance listing of manhours found in the log is displayed in Table D-1. As indicated in the log, the maintenance problems associated with the Harvest Bare kitchen equipment occurred during the first 10 days of operation. The higher frequency of maintenance requirements during the early phase of the exercise seems reasonable in view of the prior 32-month period of storage without inspection. The absence of serious problems after the initial phase indicates the kitchen equipment is reliable. It is also apparent that a need exists to shorten the time period between inspections of the Harvest Bare while it is in storage.

Of the 32.5 hours of corrective maintenance reported by the combustion maintenance people, 16.5 or 50.7% of their time was spent on the steam generator.

Maintenance performed by the refrigeration specialists was reported as 23 hours; however, these hours also included such activities as adjusting the air compressor and "checking out" the ice makers.

Plumbing experts reported 19 manhours of maintenance of which approximately six hours were spent in corrective maintenance on the dishwashers. One plumber indicated that the mixing valve on the steam generator which supplies hot water to the dishwasher, was frequently a problem.

TABLE D-1. Corrective Maintenance Performed on Two Harvest Bare Kitchens during Air Force Exercise Brave Shield 18

<u>Maintenance Category</u>	<u>Item</u>	<u>Maintenance Manhours</u>	<u>Totals</u>
Combustion	Steam Generator	16.5	
	Oven	10.0	
	Griddle	<u>6.0</u>	32.5
Plumbing	Steam Table	2.5	
	Ice Machine	5.0	
	Sinks	3.5	
	Dishwasher	6.0	
	Grease Trap	<u>2.0</u>	19.0
Electrical	Hot Plates		6.0
Refrigeration	Ice Machine	14.0	
	Air Compressor	<u>9.0</u>	<u>23.0</u>
	Total Maintenance Hours:		<u>80.5</u>

Electrical maintenance that was reported as having been performed was exclusively on the kitchen's electric hot plates. Approximately six hours of maintenance were reported to replace wires burned out by grease spills and deposits of residue. The electric specialist reported that the burnouts were the result of cooks using the hot plates to deep fat fry and failing to properly clean them.

#### Storage/Issue

Two 150-cu.-ft. refrigerators are standard items in each Harvest Bare kitchen unit. At Brave Shield 18, a fifth 150-cu.-ft. refrigerator was added to make a total of 750 cu. ft. of refrigerator/freezer space.

Dry storage rooms are provided for each kitchen unit. An expandable shelter, 13' x 13' x 8' (when expanded) is attached to each kitchen unit and serves as storage room, food preparation, and administrative center. At Brave Shield 18, two storage/preparation shelters were utilized, although one of the two rooms was used principally as an administrative center.

Regular ration delivery was made each Monday, Wednesday, and Friday. Out-of-cycle pickups were also made. The food was drawn from the Air Force Academy Commissary located approximately 45 minutes from the exercise site.

Storeroom personnel consisted of two individuals who worked regular shifts in the storage room. Supplemental personnel assisted with the administrative paperwork on an as-needed basis. One additional individual made the ration pickup and delivery. The paperwork at this exercise was the same as required in a normal Air Force dining hall.

#### Sanitation

The Harvest Bare sanitation center is located within the dining hall, positioned next to the kitchen shelter and separated from the diners by a canvas curtain suspended on an overhead track. Sanitation equipment includes two prewash sink tables, one prewash scullery sink, one dishwasher table, and one dishwasher. A spray nozzle serves as a prewash. All work areas, tray racks, and utensil holders are made of stainless steel.

The sanitation program at Brave Shield 18 consisted of washing and sanitizing melamine trays, bowls, mugs and cups, flatware, pots and pans, and various cooking utensils that are standard items in the Harvest Bare kit. At the exercise, two sanitation centers were set up within the "double" dining hall, with one center used exclusively to wash pots and pans.

Other sanitation functions such as table cleaning and floor mopping, were also accomplished without apparent difficulty. It was the consensus of the observers and of the workers that the Harvest Bare sanitation center is highly effective. Veterinarians reported that the system met acceptable sanitation standards at Brave Shield 18. No instances of food-borne illness were reported.

### Food Preparation/Cooking

The Harvest Bare kitchen has sufficient equipment and preparation facilities to prepare and serve the AFESC-recommended multi-entree A ration menu. One of the two kitchen complexes deployed to Brave Shield 18 was used exclusively to prepare and serve a short order menu. This menu was offered during the lunch and dinner meals and between the major meal periods. A mid-night meal was served throughout the exercise.

Approximately 30,000 meals were served from the two Bare kitchens over a 26-day period during the Brave Shield exercise. The number of meals served daily ranged from 336 meals during the buildup phase of the exercise to 2081 during the maximum buildup period.

To prepare and cook the meals, 41 food service personnel were deployed to the Brave Shield 18 exercise. Included in the food service complement were four USAF National Guardsmen and five Army cooks. One of the Army cooks prepared the baked goods for the menu. The workforce was sectioned and assigned to three shifts as follows: Shift 1 - 0430-1330, consisting of 1 supervisor, 8 cooks, 3 mess attendants; Shift 2 - 1000-1900, 1 supervisor, 8 cooks, 3 mess attendants; and Shift 3 - 1900-0430, 1 supervisor, 6 cooks, and 2 mess attendants. The cooks on Shift 1 worked 66 hours per week, cooks on Shift 2 worked 54 hours per week, and 3rd shift personnel were scheduled for 57 hours per week.

### Serving/Dining

Two kitchens operated simultaneously throughout the exercise, thus two serving lines were open (after the breakfast meal) until the dinner meal was completed. One line offered full service while the other line served a short order menu. Approximately 20% of all meals consumed were served from the short order line. Counts of diners going through the serving line showed that a maximum of 4 per minute and 2 per minute were served through the main service and short order lines, respectively. An actual average hourly rate of 300 customers during meal periods was calculated for the two serving lines in Brave Shield 18. Waiting lines were seldom seen.

The number of food service personnel involved in the serving function varied. The minimum number of persons used on the serving lines was two on the main line and one on the short order line. The maximum number used was five on the main line and four on the short order line.

Meal hours varied somewhat during the course of the exercise; however, the kitchens generally served meals as follows:

Breakfast	0430-0800
Lunch	1030-1330
Dinner	1600-1900
Midnight	2200-0200
Short Order	1030-2100

Harvest Bare diners eat their meals in melamine compartmentalized trays, bowls, and cups which are integral components of the system. Stainless steel flatware is used. The dining hall, which interfaces with the kitchen, is a special-purpose-type shelter providing over 1400 square feet of space. When expanded, the shelter is 30.5 ft. by 46 ft. by 11.5 ft. and weighs 3.95 tons. It will accommodate 16 eight-person tables and two service tables, but its capacity is readily changed by adding or removing the appropriate number of eight-foot panels of which the shelter is comprised. A floor is not included in the Harvest Bare dining hall inventory; however, at Brave Shield 18 and when used at Holloman AFB as a substitute for a dining hall being renovated, the Harvest Bare dining hall was floored with aluminum runway planking covered by a smooth vinyl cloth. The dining hall contains a sanitizing area where trays, utensils, and cooking ware are washed and sanitized. Temperature within the dining hall is controlled by air conditioners and heaters.

At Brave Shield 18, nine sections of dining hall shelter were used (of a total of 10 sections normally deployed with two kitchens). Seating was provided by 30 tables with attached benches which gave the dining hall a seating capacity of 240 persons. However, even though the tables/benches were constructed to accommodate eight persons each, the realistic seating capacity based on observations is more likely to be six persons per table or a total of 180 in the dining hall as configured at Brave Shield 18. Further, it was observed that diners utilized approximately 20 minutes to eat their meals. Thus, with a 20-minute eating period (3 sittings per hour) the feeding capacity is 540-720 per hour. By varying the length of the meal period, the system can accommodate a wide range in number of diners.

The dining hall was viewed by the customers as a comfortable, pleasant environment in which to eat and socialize with friends. The inside of the shelter sections were white, which gave the appearance of cleanliness. The floor was level and cleaned frequently. The sole factor of a negative nature in the dining hall was the presence of the two sanitizing centers. Noise and unsightly garbage created some unpleasantness for diners. Cross-traffic problems were observed when customers taking their trays to be cleaned were forced to go through lines of other customers who were waiting to be served food or who had been served and were on their way to dining tables.

The only reported dining shelter problem observed at Brave Shield 18 was that the dining hall leaked in the fabric flashing connecting each section. Engineers believe the fabric became porous during long-term storage.

#### Customer Satisfaction

The assessment of customer satisfaction was approached from a behavioral point of view. Hedonic ratings and general acceptance data were collected by survey and interviews.

At the Brave Shield 18 exercise, customers indicated that quality of food and service personnel were acceptable, but that portion size, in particular that of meat entrees, was too small. The general environment, the military atmosphere, and cleanliness were rated as acceptable.

### Proposed Harvest Bare Modifications

The Modified Harvest Bare concept proposed to the Air Force includes the following equipment and function changes. A second griddle and steam table should be added to the serving line, creating, in effect, two serving lines. This change can be accomplished by removing a work table from the present serving line and by modifying the kitchen shelter to accommodate the griddle exhaust and steamtable lines.

The addition of a second serving line will give each Harvest Bare kitchen the capacity for serving short order items as well as A rations, a present AFESC field-menu recommendation, and will increase customer flow-through capacity by 100% during breakfast and other meals when short order items are not offered.

It is proposed that for prototype test purposes, a griddle and steam table be removed from a Harvest Bare kitchen and installed in a second Harvest Bare kitchen.

The present coffee maker should be removed from the Harvest Bare serving line. This change will permit a faster customer flow rate, and will eliminate presently required work activity, for example, filling and cleaning the coffee maker, from the restricted kitchen work area. Coffee making equipment should be relocated to dining shelters. Further, it is proposed that a single pot drip system replace the present system so as to provide more freshly made coffee, an accommodation to the low per capita coffee consumption found among today's airmen.

A deep fat fryer should be added to guarantee the short order menu an adequate supply of French fries, and to enable the A ration menu to include deep fried items. An exhaust system would be required.

A French fry extruder should be added to the Harvest Bare equipment inventory. The extruder eliminates the requirement for frozen French fries and their refrigeration while at the same time demanding relatively little by way of increased electric and cube/weight requirements. See Fig. D-1.

The sanitizing function should be removed from the dining shelter to a sanitation/storage shelter located adjacent to the kitchen shelter. The removal of the sanitizing function enables customers to enter the kitchen through a large door in the side of the kitchen shelter. This entrance is not open in the present Harvest Bare configuration, but is required in the Modified Harvest Bare to make possible the ready use of two serving lines.

The modified sanitizing area will include hot water supply, sinks, and racks for drying/storing cleaning utensils. It will not include a dishwasher (included in the Harvest Bare kitchen) since no requirement will exist for dishwashing (or traywashing) during the 30 to 60 day period for which these plans are projected. Should the presence of the Bare Base support set be required beyond the 30- to 60-day initial period, it is recommended that the melamine plastic ware and stainless steel flatware, now included in the Harvest Bare inventory, replace disposable trays. In this case, the dishwasher should be added to the sanitizing system and installed in the sani/storage shelter.

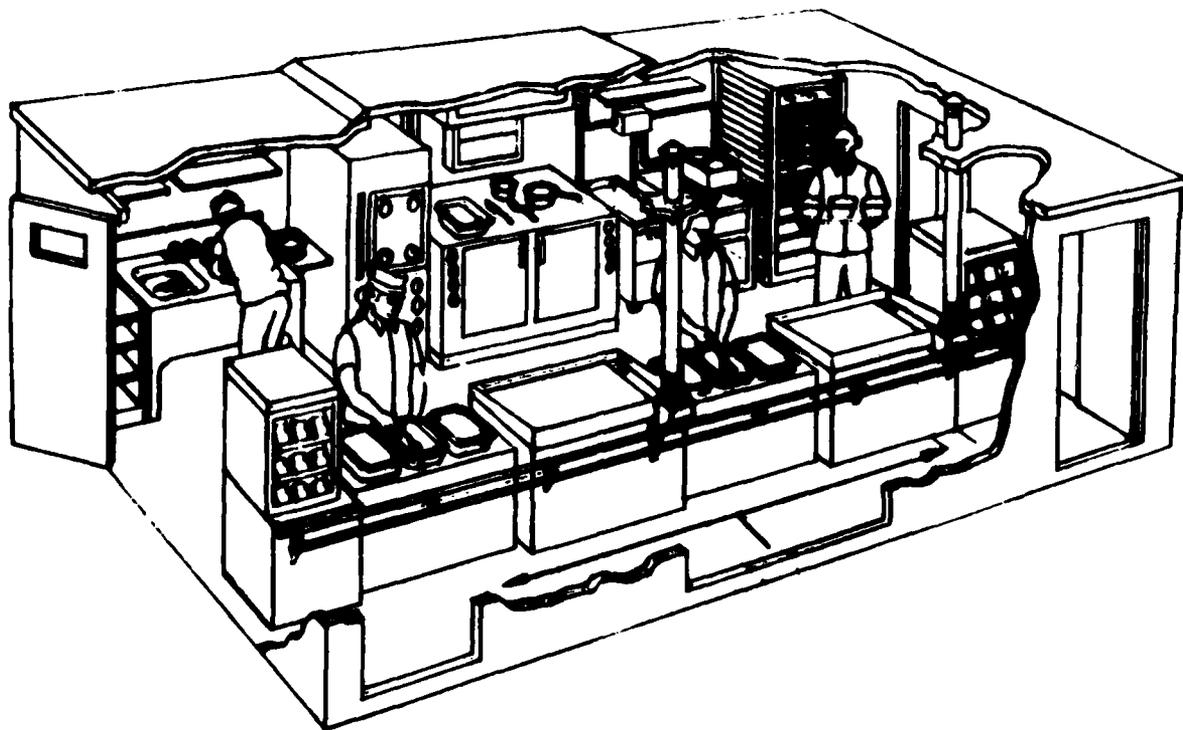


Figure D-1. Proposed Modified Harvest Bare Kitchen

It is recommended that an integrated soft shelter complex replace the present expandable dining shelter and that the shelter complex include a sanitation/storage shelter attached to the kitchen shelter. The proposed shelter complex is a tent, extendable, modular, personnel (TEMPER) developed by NLABS engineers. Its improvements over the present Harvest Bare shelter configuration are:

- o Reduced cube of the dining shelter (14%)

- o Easier erection of the dining shelter, e.g., no special equipment is required to reduce interior temperature. Cross ventilation is possible through sidewall and roof screened openings; over-roof flys give additional protection from heat and from the sun. In short, a variety of integral characteristics of the TEMPER provide substantial, though not complete, internal environmental control.

o Surveillance of storage area is facilitated by connecting storage shelter to kitchen shelter; further, cooks need not leave shelter to retrieve storage items. Fig. D-2 displays a drawing of the proposed Modified Harvest Bare food service system.

o The Modified Harvest Bare kitchen complex can be configured as a basic or multiple unit concept, or a combination of both. The flexibility permits the kitchen to adapt to a variety of deployment conditions and requirements. For example, the basic unit is intended to subsist a deployment of up to 1100 troops feeding at one site. Adding a second modified kitchen for a total of four serving lines and a second 100-person dining shelter to form a multiple unit concept, up to 4400 troops can be subsisted at one site. Combinations of basic and/or multiple kitchens should be configured to meet the subsistence needs of the deployment.

o As indicated in the section on design requirements, the Modified Harvest Bare kitchen will far exceed the original design capacity of 250 troops. In fact, the addition of a second serving line and the substitution of a T ration for an A ration dinner meal give the Harvest Bare kitchen a feeding capacity much greater than has been previously observed. This greatly expanded capacity is presented in Table D-2 in a comparison with the implied capacity inherent in a TAC conceptual plan 15 February 1974, for deployment of the two existing Harvest Bare sets.

Table D-2 Contingency Deployment Requirements as per TAC Conceptual Plan and USAF 9-1 Proposal

	<u>TAC Plan</u>	<u>USAF 9-1 Proposal</u>
No. Troops	9000	9000
No. Kitchens	26	8
No. Troops per Kitchen	346	1125
No. Daily Meals per Kitchen*	830	2700
*Assumes 80% feeding level		

Projecting the total capacity of the 26 Harvest Bare kitchens presently located at Holloman AFB, assuming each is modified as recommended, it is estimated that a total of 29,250 troops may be subsisted at 26 different locations.

An estimate of cube and weight characteristics descriptive of the Modified Harvest Bare concept is displayed in Table D-3. Additional estimates of costs of shelters, equipment and materials, as well as fuel consumption and maintenance requirements, are included in Table D-4.

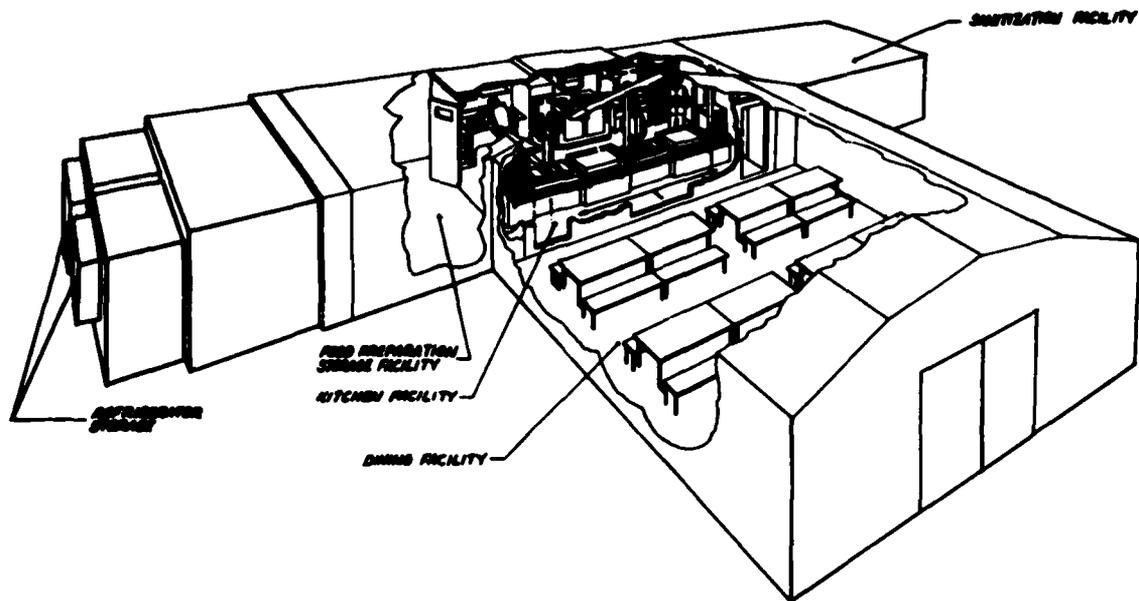


Figure D-2. Proposed Modified Harvest Bare Food Service System

TABLE D-3. Estimated Cube and Weight of the Modified Harvest Bare Concept (Cube ft<sup>3</sup>)

<u>Basic Concept</u>	<u>Item</u>	<u>Multiple Unit Concept</u>
832	Kitchen Shelter	1,664
72	Prep/Storage Shelter	72
1,272	Refrigerators, Walk-In	3,816
<u>170</u>	Dining Shelter(s)	<u>341</u>
<u>830</u>	Sub Total	<u>919</u>
	Equipment	
3,176	Total	6,812
	Weight (lb)	
7,000	Kitchen Shelter	14,000
874	Prep/Storage Shelter	874
5,400	Refrigerators, Walk-In	16,000
<u>1,831</u>	Dining Shelter(s)	<u>3,662</u>
<u>15,105</u>	Sub Total	<u>34,736</u>
<u>6,265</u>	Equipment	<u>8,788</u>
21,370	Total	43,524

TABLE D-4. Estimated Cost and Other Factors of the  
Modified Harvest Bare Concept Cost

<u>Basic Concept</u>	<u>Item</u>	<u>Multiple Unit Concept</u>
19,800	Shelters	33,260
7,500	Deep Fryer/Modifications	7,500
2,000	French Fry Extruder	2,000
4,000	Materials/Supplies	5,000
12,500	Labor	25,000
5,000	Transport to Natick	10,000
20,000	Griddle/Exhaust	40,000
<u>14,000</u>	Steam Table	<u>28,000</u>
84,000	Total	150,760
	<u>Other Factors</u>	
97	Daily Fuel Consumption (Gal)	194
2	Daily Maintenance (Mandays)	2
10	Life Expectancy (yrs)	10
30	Electrical Requirement (kW)	60

APPENDIX E  
A DESCRIPTION OF THE ALL-ELECTRIC  
FOOD SERVICE CONCEPT

## APPENDIX E. A Description of the All-Electric Food Service Concept

### All-Electric Kitchen

An all-electric field feeding system was conceptually configured using commercially available food service equipment.

### Equipment and Fuel Consumption

All equipment proposed is powered by electricity. Major electrical equipment items include tilt grills, steam pressure cookers, convection ovens, steam tables, griddles, and deep fat fryers.

Based upon generators operating 24 hours per day, a 100-kilowatt generator for the basic system would require 204 gallons of fuel per day. The 200-kilowatt generator used in the multiple unit system would require 384 gallons per day.

The following commercially available equipment is recommended for inclusion in the all-electric basic unit:

<u>Quantity</u>	<u>Item</u>
3	Convection oven
1	Steamer
1	Kettle
1	Tilt frying and braising pan
1	Countertop refrigerator
2	Hot holding cabinets
2	Griddles
2	Steam tables
1	Hot top burner
1	Deep fryer
1	Potato extruder

### Sanitation

The hot water heater for the sanitizing center is the same as that in the New Harvest Eagle.

Layout of the sanitation/storage/preparation area allows for space for preparation located near foodstuffs and clean pots and pans and enables efficient flow of foodstuffs within the system.

Plywood flooring is recommended for the kitchen and sanitation/storage/preparation areas.

### Cube and Weight Factors

Estimated cube and weight factors for the all-electric kitchen are displayed in Table E-1. Estimates of cost and other factors such as fuel consumption, maintenance requirements, and electrical demands are presented in Table E-2.

## Shelters

Recommended shelters for an all-electric field feeding system are variations of the Tent, Extendable, Modular, Personnel (TEMPER). Configurations are based upon the same requirements as those of the New Harvest Eagle.

Shelters for the basic unit consist of a 20 ft by 40 ft sanitation/storage/preparation area, a 20 ft by 40 ft kitchen, and a 20 ft by 88 ft dining area with a maximum seating capacity of 120 personnel. Shelters for the multiple unit (Fig. E-1) consist of a 20 ft by 56 ft sanitation/storage/preparation area, a 20 ft by 40 ft kitchen, and two 20 ft by 88 ft dining tents with seating for a maximum of 648 personnel per hour.

Dining shelters are basically designed to accommodate 100 people at each sitting with five people per table. Six chairs are provided at each table to increase capacity if necessary. Three feet of space is provided between tables. Additional tent sections can also be added to dining shelters or additional dining shelters can be used when more seating for diners is required.

Benefits of the all-electric concept include:

- o Use of off-the-shelf equipment is possible.
- o Cooks are familiar with electrical equipment and would require less training.
- o Field and dining hall equipment are interchangeable.
- o Equipment is easy to operate.
- o The electric field feeding system has the capability to serve the A, B, or T ration.
- o Short order cooking can be readily accomplished.

TABLE E-1. Estimated Cube and Weight of the All Electric Concept  
(Cube ft<sup>3</sup>)

<u>Basic Concept</u>	<u>Item</u>	<u>Multiple Unit Concept</u>
68	Kitchen Shelter	136
83	Prep/Storage Shelter	128
1,272	Refrigerators, Walk In	3,816
<u>194</u>	Dining Shelter(s)	<u>391</u>
1,617	- Sub Total -	4,471
<u>1,048</u>	Equipment*	<u>2,166</u>
2,665	Total	6,637
	Weight (lb)	
755	Kitchen Shelter	1,508
996	Prep/Storage Shelter	1,516
5,400	Refrigerators, Walk In	16,200
<u>2,087</u>	Dining Shelter(s)	<u>4,208</u>
9,238	- Sub Total -	23,432
<u>13,198</u>	Equipment*	<u>24,310</u>
22,436	Total	47,742

\*Excludes Generators

Table E-2 Estimated Cost and Other Factors of the  
All Electric Concept Cost

<u>Basic Concept</u>	<u>Item</u>	<u>Multiple Unit Concept</u>
\$25,251	Shelters	\$ 47,241
36,334	Equipment	58,119
4,000	Materials	6,000
<u>12,500</u>	Labor	<u>15,000</u>
\$78,085	Total	\$126,360
	Other Factors	
214	Daily Fuel Consumption	394
.3	Daily Maintenance (Mandays)	.3
20	Life Expectancy (Yrs)	20
128	Electrical Requirement (Kw)	214

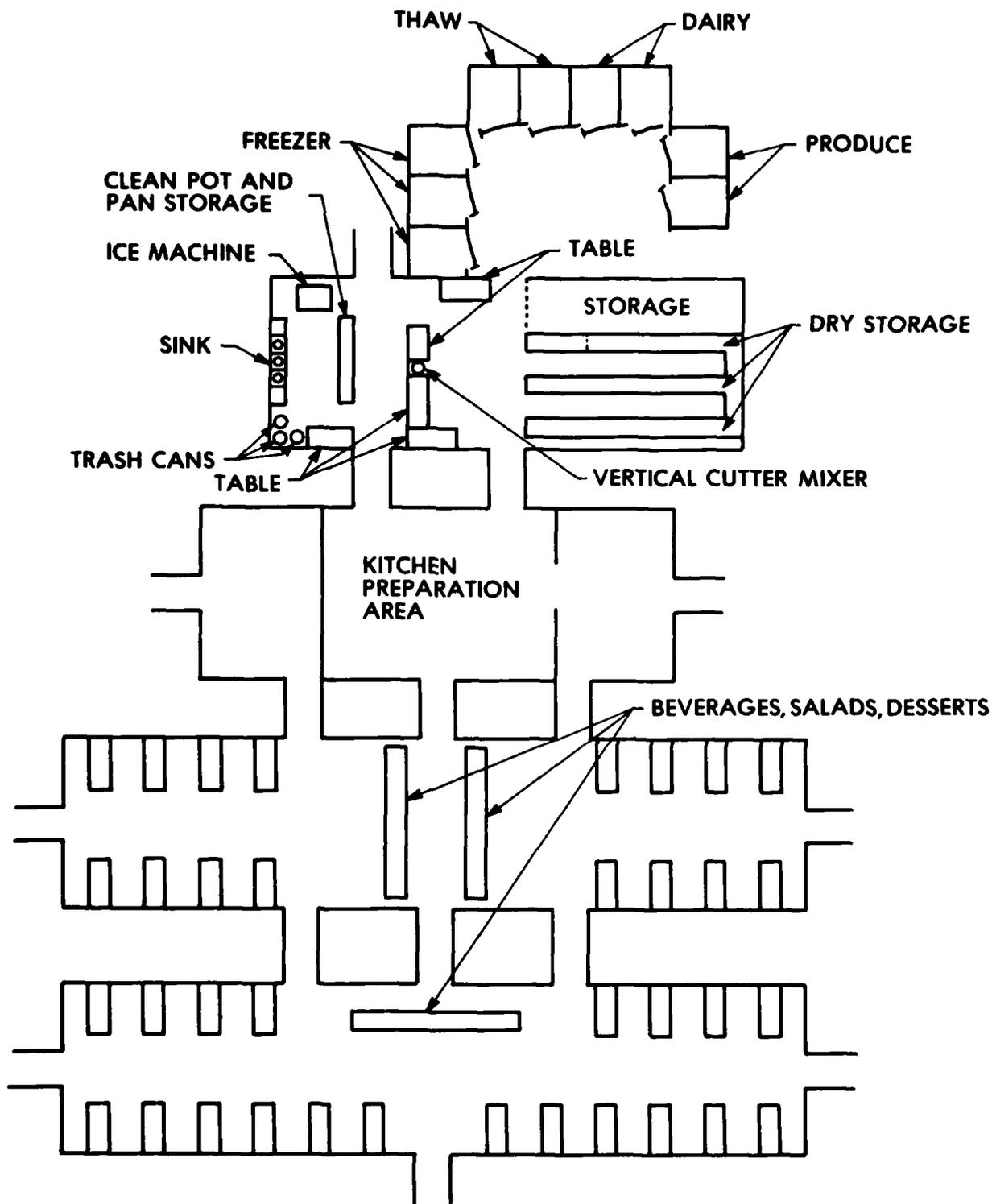


Figure E-1. Multiple Unit All-Electric Food Service Concept

**APPENDIX F**

**THE HARVEST EAGLE FOOD SERVICE SYSTEM: ITS OPERATION  
AT EXERCISES, AND A PROPOSED NEW HARVEST EAGLE CONCEPT**

**PREVIOUS PAGE  
IS BLANK**

APPENDIX F. The Harvest Eagle Food Service System: Its Operation at Exercises, and a Proposed New Harvest Eagle Concept

The Harvest Eagle Food Service System

The Harvest Eagle package is defined by TACR 400-12 as "A selected package of essential items of equipment and supplies required to support general purpose forces/personnel under bare base conditions." The Harvest Eagle package is air transportable and is designed to support 1100 personnel at four different locations or a total of 4400 personnel at one location. As of this writing, there is one package in the CONUS, one in USAFE, and one in PACAF.

The CONUS Harvest Eagle equipment is maintained at Robins AFB by the 4400 Mobility Support Flight (MSF). The flight is composed of two officers and 34 enlisted personnel and is responsible for the maintenance, storage, refurbishment, and delivery to and retrieval from exercise/contingency sites.

Packaging

Most Harvest Eagle equipment is packaged in 31-cubic-foot wooden boxes with measurements of 48" x 40" x 28". Field ranges are filled with accessory items (spoons, kettles, etc) and then packed inside cardboard sleeves. Over-size items like ice machines are individually crated. Garbage cans are stacked, one inside another. Items are palletized on 463L loading system pallets.

Storage

Of the four 1100-man kits stored at Robins AFB, two are kept as war readiness materiel (WRM) and are not used for exercises: two kits are dedicated to exercise support. These palletized kits are stored in rows in a predetermined order, which provides for the 12 kitchen pallets to be located onto the first, second, or third aircraft of a deployment operation. The kitchen unit uses 12 pallet positions of the 132 required for the entire kit. The exercise kits are stored by item in stacks or rows as warehousing procedures allow. Field ranges, for example, are stored in a row approximately 50 feet long. The 4400 MSF prefers these storage techniques for exercise kits as it precludes unneeded items being inadvertently shipped to exercises. Generators and refrigerators are inspected every six months, and the entire kit is inventoried once each year. Equipment is replaced when it is beyond economical repair.

Delivery Characteristics

The Air Force can accommodate one 1100-man kit in 11 C-141 aircraft. One C-141 is required for the kitchen equipment portion of the kit and another for two pallet spaces. However, the unit is shipped by truck whenever possible in the United States, because this method is much less costly than using MAC airlift.

## Configurations

For utilization of both WRM kits and exercise kits, planning personnel establish the configuration of the Harvest Eagle Kit used at each deployment. This results in varied selections of items and in a lack of a standard layout for food service operations. The Air Force allows for further breakdown based on operational requirements. The WRM kits are arranged so that support packages for Air Force Headquarters for Field Operations (AFFOR HQ) can be removed from each 1100-man kit, rather than using the entire kit. For example, there are AFFOR groups of 86, 203, and 250 personnel. These packages include only enough tents, cots, etc., for the specified number of people. However, an 1100-man kitchen is always sent, regardless of the number to be fed.

## Reconstitution

Table F-1 provides a detailed summary of reconstitution costs after a number of exercises as provided by the 4400 MSF. The following average reconstitution cost figures for 1978 were developed by averaging the data in the table.

Cost projections for the reconstitution of equipments used in an 1100-man food service operation, as presented below, must be considered as approximations only, due to varying costs. Estimates of power required by the food service operation as developed by 4400 MSF personnel indicate that approximately 120 kW would be required on two MB-17 generators, if no commercial power were available. At least one MB-17 would be needed for backup. Eight field refrigerators would be used as would approximately eight field ranges and 16 burner units. Therefore, the following would be used and would require reconstitution/refurbishment:

	<u>Average Repair (each)</u>	<u>Cost to Replace</u>
Reefer	215.72	
MB-18 Generator	512.02	
MB-17 Generator	430.60	
Range Parts		380.84
Miscellaneous		1682.20
Burner Units		127.33
Burner Units	62.30	

TABLE F-1. Reconstitution Costs of Harvest Eagle Components

Exercise	Item	Action: Repair or Replace	Quantity	Total Cost
Gallant Crew 77	Reefer	Repair	6	2993.10
" " "	MB-18	Repair	9	9253.74
" " "	MB-17	Repair	5	4,757.74
				<u>17004.58</u>
Brave Shield 15	Reefer	Repair	10	3459.20
" " "	MB-18	Repair	11	3691.85
" " "	MB-17	Repair	7	2026.30
				<u>9177.35</u>
Bold Eagle	MB-17	Repair	8	1625.09
" "	MB-18	Repair	13	4711.43
" "	Reefer	Repair	16	2775.69
" "	Range Parts	Replace	Asstd	575.00
" "	Range Accessory Kit	Replace	Asstd	90.18
" "	Burner Units	Repair	44	528.00
" "	Burner Units	Replace	9	1145.97
" "	72" Table	Replace	12	756.00
" "	Misc Food Service	Replace	Asstd	1900.00
				<u>14107.36</u>
Brave Shield 16	Reefer	Repair	16	895.27
" " "	MB-18	Repair	10	3930.55
" " "	MB-17	Repair	3	1200.42
" " "	Range Parts	Replace	Asstd	186.68
" " "	1 Toaster & 15 72" Tables	Replace	1 & 15	1100.00
				<u>7312.92</u>
Solid Shield 77	Reefer	Repair	1	447.20
" " "	MB-17	Repair	3	1588.17
" " "	MB-18	Repair	3	2477.50
				<u>4512.87</u>

	Quantity	Total Refurbishment Cost
MB-17	3	\$1292.04
Refrigerator	8	1725.76
Burner Units (Repair)	15	934.50
Burner Units (Replace)	1	127.33
Miscellaneous	--	500.00
Total		<u>\$4579.63</u>

These estimated refurbishment costs could vary considerably depending upon exercise size, duration, and experience of cooks. However, it does demonstrate the fact that the Harvest Eagle requires substantial refurbishment cost expenditures after each use. Factors that accelerate the normal wear on Harvest Eagle items include the lack of equipment operation know-how evidenced by Air Force cooks. Another factor is the lack of a sense of responsibility for equipment that the cook will use only for a short time. These conditions indicate a need for better training of cooks by the Air Force and a need for developing a sense of unit identity among food service personnel deployed on exercises.

#### Power Production

Table F-2 lists Harvest Eagle generators for 1100-man units. Of the 700 kW available in each Harvest Eagle kit, the following approximate distribution is likely.

	<u>Demand</u>	<u>Backup</u>	<u>Total</u>
8 Refrigerators	23 kW*	23	46
4 Toasters	16 kW	16	32
Remainder of Food Service	65 kW	65	130
Tent Lighting	27 kW	27	54
Runway Lighting	60 kW	60	120
Part F of Kit (Motor Pool)	30 kW	30	60
Part G of Kit (Civil Engineers)	30 kW	30	60
Total	<u>251 kW</u>	<u>251</u>	<u>502</u>

\* At surge, each reefer demands 8.4 kW. However, the likelihood of all reefers surging simultaneously is remote.

Ideally, a one-for-one backup is preferred to allow the use of generators on a 12 hours off basis. This permits for proper preventative maintenance.

TABLE F-2. Harvest Eagle Generators per 1100-Troop Kit

<u>Type</u>	<u>Quantity</u>	<u>Kilowatts (each)</u>	<u>Type Fuel</u>	<u>Fuel Consumption</u>
MEP-017A	10	5 kW	Gas	0.85 GPH
EMU 11/u	10	5 kW	Gas	1.3-2.5 GPH
MB-5A	5	10 kW	Diesel	1.85 GPH
MB-18	8	30 kW	Diesel	3.31 GPH
MB-17	6	60 kW	Diesel	5.72 GPH
	<b>TOTAL</b>	<b>700 kW</b>		

Including the backup, 502 kW of the 700 kW available are committed. Therefore, there is a 198 kW potential excess which could be available to the food service operation in addition to the 208 kW already committed, making a potential total of 406 kW available for food service use including backup.

Various suggestions on additions or deletions to the Harvest Eagle kitchen have been offered. The 4400 MSF wants to delete the seldom used ice cream maker which is part of the kit. It also wants to add a steam cleaner and a better kitchen tent since the present one is rarely requested or used. Users have suggested additions to the Harvest Eagle inventory including tilt fry pans, electric grills, deep fat fryers, and menu boards.

The mainstay of the food service portion of the Harvest Eagle package is the M-1959 range cabinet with the M-2A burner. There is a small amount of equipment that dates back to 1937.

### Harvest Eagle Operations at Exercises

#### Selection/Delivery - Equipment

The equipment delivered to each exercise is listed in Table F-3.

At each of the exercises, the equipment was delivered over land from locations where the equipment had been prepositioned. At Team Spirit and Brave Shield 17, it was delivered by truck, and at Dawn Patrol, the equipment was delivered by train. At Brave Shield 17 and Dawn Patrol, the equipment arrived on schedule prior to the arrival of cooks. At Team Spirit in Korea, the equipment was reportedly delivered a few containers at a time over approximately seven days. Also at Team Spirit, refrigeration was delivered three to four days after the other equipment. The amount of refrigeration delivered was not sufficient at any exercise, and a refrigerator/freezer van was rented at Team Spirit and Brave Shield 17. While at Dawn Patrol, the lack of refrigeration was compensated for by not serving milk. At Team Spirit, Prime Beef and other advance party personnel (50-60 people) subsisted on C-rations for approximately nineteen days. At each location, a forklift was required to unload and move equipment. Generators were used only at Dawn Patrol. Commercial power was available and used at Team Spirit and Brave Shield 17. The primary heat source was the M-2A burner.

#### Selection/Delivery - People

HQ, PACAF personnel indicated that they believed it was in the best interest of the food service element to have cooks deployed from the same base. As a result, cooks were deployed to Team Spirit primarily from Hickman and Clark AFB. At Brave Shield 17, fifteen active bases and the National Guard were represented. At Dawn Patrol, with the exception of the baker, all the cooks were from Sembach AFB, Germany.

Although the distance traveled, home base location, active or reserve status, and time of arrival of food service personnel do not preclude adequate operation of the Harvest Eagle food service system, it was the consensus of

TABLE F-3. Harvest Eagle Food Service Equipment Listed in TA 156, Part D and Used at Tactical Exercises

Item	Nomenclature	TA 156 Basis of Issue	Number of Items Used		
			Team Spirit 78	Brave Shield 17	Dawn Patrol
1	Refrigeration, Walk-In	8	3	12	4
2	Ice Making Machine, 400 lb	2	1	0	1
3	Ice Cream Plant	2	0	0	0
4	Compressor Air, Portable	4	1	0	1
5	Heater - Immersion Liquid	30	10	10	8
6	Hose - Rubber, Water	10	4	12	3
7	Padlock, Combination	8	5	12	2
8	Chair, Folding	200	192	355	50
9	Safe, Field Portable	2	1	1	1
10	Table, Folding, 72-in.	32	26	73	0
11	Pillow Case	240	0	0	60
12	Pail, Metal	20	20	0	5
13	Measure, Liquid	4	0	0	2
14	Can, Ash and Garbage	96	29	10	24
15	Cover, Can, Ash	96	0	72	24
16	Spout Can	20	3	18	5
17	Can, Gasoline, 5-gal	20	17	25	5
18	Dust Pan	4	2	0	1
19	Pan - Steam Table, 7½ qt	8	8	0	2
20	Pan - Steam Table, 15 qt	8	8	0	2
21	Table - Steam Elec, 4-Opening PACAF/TAC	4	4	7	0
22	Toaster, Elec Conveyor	4	2	4	1
23	Cold Food Counter, Refrigerated, PACAF	1	1	0	0
24	Coffee Maker Percolator, TAC/PACF	4	3	4	0
25	Burner Unit - Gasoline	16	14	50	10
26	Vegetable Cutting and Slicing, Manual	4	0	2	1
27	Mixing Machine - Electric	1	1	1	1
28	Slicing Machine - Electric	4	1	4	1
29	Table Food Preparation	8	8	5	2
30	Cabinet Delivery & Storage	8	5	6	2
31	Machine, Tenderizer Meat Electric	4	1	2	1
32	Dispenser - Condiment	4	1	0	0
33	Slicer - Meat Hand Operator	1	0	0	1
34	Board - Food Chopping	4	4	5	1
35	Rolling Pin, Wood	4	2	3	1
36	Sifter, Flour	4	1	0	1
37	Dishpan Round	4	1	9	1
38	Scraper - Bakers	4	1	0	1
39	Opener, Can	4	4	1	1
40	Egg Whip, French Style	4	4	0	1

TABLE F-3. (Cont'd)

Item	Nomenclature	Number of Items Used			
		TA 156 Basis of Issue	Team Spirit 78	Brave Shield 17	Dawn Patrol
41	Pot, Cooking, Aluminum, 40-qt	6	6	0	2
42	Pot, Cooking, Aluminum, 60-qt	10	5	8	3
43	Food Container, Insulated	10	4	45	3
44	Peeler, Potato, Hand	24	0	6	6
45	Bowl, Food Mixing, 20-gal	4	4	2	1
46	Bowl, Food Mixing, 7½-gal	4	4	4	1
47	Colander, 16-qt	4	2	7	1
48	Dipper, 1-qt	6	5	5	1
49	Jug, Insulated, 2-gal	20	8	27	5
50	Paddle, Food Stirring	6	2	2	2
51	Pad, Bakery PACAF	24	24	5	0
52	Tongs, 12-in.	20	0	24	5
53	Pan, Baking	88	4	84	22
54	Turner, Plastic Handle	6	2	0	0
55	Scoop, Ice Cream	8	4	12	2
56	Ladle, 4-oz	4	4	12	2
57	Jug, Vacuum, 10-gal	10	5	12	3
58	Pan, Pie	40	0	0	10
59	Spoon, Slotted	8	0	41	4
60	Fork, Food Prep	8	8	0	2
61	Spoon, Basting	8	0	12	0
62	Knife, Steak	8	8	8	2
63	Fork, Food Prep, PACAF	8	6	0	0
64	Spoon, Iced Tea	2	0	0	1
65	Pitcher, Water, 5-qt	24	6	2	6
66	Dispenser, Paper Napkin	128	60	132	32
67	Dispenser, Sugar, 12-oz	144	0	0	36
68	Salt Shakers, 2-oz	144	144	0	36
69	Pepper Shakers, 2-oz	144	0	0	36
70	Toothpick, Wood	180	0	0	45
71	Range Outfit, Field Gasoline 31 Components	16	10	20	0
72	Accessory Outfit, Gasoline 27 Components	8	8	12	1
73	Machine, Calculating	1	1	2	1
74	Case, Field Office Machine	3	3	3	3
75	Adding & Subtracting Machine	1	1	1	1
76	Typewriter	1	1	1	1
77	Cash Box	4	2	1	1
78	Scouring Block	24	4	12	6
79	Tent, Kitchen 18 ft x 12 ft	4	4	0	2
80	Tent, GP Large	4	4	11	5
81	Apron	100	100	50	25
82	Cap, Food Handlers, Box	4	4	0	1
83	Foil, Aluminum, Box	6	0	6	1

NLABS observers that those exercises, Team Spirit and Dawn Patrol, where the cooks had worked together prior to the exercise, were significantly more efficient than those exercises where there was no prior interworker contact.

#### Selection/Delivery - Food

The Air Force commissary system provided subsistence to Brave Shield 17 from the Nellis AFB commissary and to Dawn Patrol from the San Vito AFB commissary. The US Army Supply Point 14, Hialeah Compound, Pusan, provided subsistence to Team Spirit at Sachon, Korea.

At Team Spirit and Dawn Patrol, contracted commercial vehicles were used to pick up subsistence. At Brave Shield 18, Air Force vehicles were used.

#### Kitchen Shelter

The M-48 kitchen tent that is part of the Harvest Eagle equipment was used only at Dawn Patrol. At Team Spirit and Brave Shield 17, general purpose tents were used.

At Team Spirit, it was reported that no one knew how to erect the M-48 tent, that poles were missing, and that the tent was in poor repair. Therefore, the engineering group constructed a plywood floor and plywood walls four feet high and placed a general purpose tent over the plywood support structure. No other assembly problems were reported or observed.

#### Maintenance

The Harvest Eagle food service system is generally not a high maintenance system in the sense that equipment fails to function and requires a technician or replacement parts. However, the time involved in burner maintenance is significant. At Team Spirit one individual was assigned full time to maintain the burners. During the filling and relocation phases he was assisted by others. At Brave Shield 17, three individuals spent the majority of their time on burners. At Dawn Patrol, one person was fully occupied with the burners, and because of the extensive use of immersion burners in the mess kit cleaning process, additional manhours were required to check temperatures and to adjust the heat output.

#### Storage/Issue

At Team Spirit and Brave Shield 17, the storage/issue function was conducted in the same manner as at a base dining hall. Goods were requested on an AF Form 287, Subsistence Request; accounted for with AF Form 147, Stock Record Card; and issued to the kitchen on AF Form 129, Tally In/Out Sheet. At Dawn Patrol, only the Subsistence Request was used.

General purpose tents were used for dry storage. Team Spirit used two, Brave Shield and Dawn Patrol used one each. For refrigeration, Team Spirit used three refrigerated 150-cu.-ft. boxes and a rented truck that provided

approximately 600 cu. ft. Brave Shield 17 used ten field refrigerators, four field freezers and a refrigerated truck. Dawn Patrol used two 150-cu.-ft. refrigerators and two 150-cu.-ft. freezers.

In regard to manpower assigned to the storage/issue functions, Team Spirit utilized two people, one of whom also acted as cashier. At Brave Shield 17, three personnel were assigned during the day, and one was on duty at night. They did not perform any other duties. At Dawn Patrol, no one was assigned to the storage function as no paperwork was maintained and, therefore, there was no continuing work requirement. Whatever work was required (unloading, stacking, and kitchen resupply), was accomplished by the shift on duty at that time.

#### Sanitation

The Harvest Eagle TA provides immersion heaters, 32-gallon cans, and a 20-quart dishpan for the primary sanitation functions of cleaning messgear, pots, pans, and other utensils. The immersion heaters were used at the three exercises. Food service attendants were rostered at Brave Shield 17 and Dawn Patrol. The cooks provided cleanup and sanitation themselves at Team Spirit.

Disposables with trays were used at Team Spirit and at Brave Shield 17. At Team Spirit, the trays, if wiped at all, were wiped by the customer. At Brave Shield 17, a food service attendant stationed in the dining tent wiped trays with a sponge and water with detergent. At Dawn Patrol, mess kits were used and cleaned by the customer.

At two exercises, the customers had no facilities to wash their hands before or after the meal. At Brave Shield 17, a container with water was available to the customer, but, as the water was not changed during the course of the meal, it was seldom used.

#### Preparation/Cooking

It was noted that the Harvest Eagle equipment was deficient in its capability to produce grilled and fried items. The top of the roasting pan provides a surface for grilling, when used upside down. When filled with oil, the roasting pan was used for frying. These adaptations were awkward due to the height of the cabinet and the lack of temperature control. At Brave Shield 17, two griddles were obtained that were about to be accessed for redistribution and marketing. M-2 burners on concrete blocks were placed under the griddle surface, and the unit performed satisfactorily.

Planning the meal schedule and manpower needed for food preparation and cooking required projections of the number of meals to be served, the meal hours, and the shift hours. Table F-4 displays the types of data which can be collected at exercises and used for planning.

TABLE F-4. Meal, Strength Data at Harvest Eagle Exercises

Meals	Team Spirit '78'			Brave Shield 17			Dawn Patrol		
	<u>3-15 Mar 78</u>			<u>28 Mar-17 Apr 78</u>			<u>8-25 May 78</u>		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Breakfast	127	175	228	122	419	600	80	253	337
Lunch	184	285	372	202	480	778	165	441	552
Dinner	238	279	321	203	592	816	150	411	522
Midnight	48	67	91	39	155	212	20	26	37
Daily Avg		786			1615			1071	
All Meals Strength	416	571	646	320	1429	2002	145	535	648
Avg Meals/Person	1.23	1.38	1.54	.81	1.25	1.99	.46	2.10	2.91
<u>Shifts</u>									
First	1000-1900			0430-1300			0330-1400		
Second	0400-1300			1030-1900			1000-1930		
Third	2000-0400			1800-0430			1900-0300		
Other									
<u>Meal Hours</u>									
Breakfast	0600-0730			0430-0800			0600-0800/0500-0800		
Lunch	1100-1300			1100-1300			1100-1300		
Dinner	1700-1900/1800-2000			1600-1845			1600-1800		
Midnight	2300-0030			2300-0130			2330-0030		
Short Order				1100-2000					
<u>Shift Assignment - Number of People</u>									
First	5			14			6		
Second	5			14			6		
Third	2			6			2		
Other	-			4			-		

## Food Preparation/Cooking

At Team Spirit, the preparation cooking and serving were accomplished in a single tent. However, the track to the dry storage supply tents, refrigeration units, and burner maintenance and lighting area located a short distance away, crossed the customer traffic pattern. Although there were facilities for two lines, only one was used, and no short order service was provided. No baking of dessert items was accomplished even though a baker was assigned. Dessert service was provided in the form of canned fruit. Also, some commercial pastry was made available at about the halfway point in the exercise. The cooks worked alternating shifts. The shift that reported for work between 1000 and 1900 worked the following day between 0400 and 1300 and vice versa. No food service attendants were rostered to assist. The breakfast meal did not provide eggs to order even though the cooks worksheet called for them. The midnight meal was a breakfast meal. The other two meals offered two entrees, three vegetables, soup, and butter, a variety of salads and dressings and a selection of beverages. Generally, A ration items were served; however, some B rations were used. More B ration items were desired by the cooks, primarily because of the lack of refrigeration.

At Brave Shield 17, a number of tents were used. Two tents were used for preparation, and two for serving. Cooking was accomplished in one tent and hand-carried to one of the serving tents. The salads were prepared in another tent and also hand-carried to a second serving tent. Commercially prepared desserts were sliced and served in the same tent in which the salads were served. The number and location of the tents required the cooks to be outdoors when transferring food products from the cooking tent to the serving tent. The tents were also arranged in such a manner that a conscious effort was required to avoid tripping over tent tie downs. The standard Harvest Eagle equipment was supplemented with two six-foot griddles which Nellis AFB was discarding. The bottom panel was cut off the grills so that M-2A burner units could be placed beneath the grills and used as the heat source. The grills provided a great deal of flexibility for breakfast and short order cooking. Some irritation to the eyes was noted due to the location of M-2A burners under the grills. Food service attendants were rostered and used in a number of tasks, over and above the traditional cleaning and beverage. They provided butter and condiments, portioning and plating of cakes and pies, and occasionally did some salad preparations.

At Dawn Patrol, one serving line was operated, and no short order service was provided. Of the three exercises, this was the only one that used the M-48 kitchen tent that is part of the Harvest Eagle package. Two kitchen tents were used back to back. The track to the dry storage area, which was in a separate tent, did cause some crosstraffic interference with customer waiting lines. The refrigeration area, however, was conveniently situated. The cooks worked two day shifts with six cooks assigned to each shift. The shifts ran from 0330 to 1400 and from 1000 to 1930 hours. The night shifts started at 1900 hours and generally finished at 0100. The shifts overlapped from 1000 to 1200 hours, and it appeared that during that period there were too many cooks on duty. Food service attendants were rostered and used primarily for washing pots and pans. The cooks cleaned the greens and prepared the salad. More B rations were used at Dawn Patrol than at any of the other exercises. This was also the only exercise where baking was done in the field kitchen.

## Serving/Dining

Team Spirit - Initially, customers at Team Spirit were required to carry their meals on squares of 3/4" plywood. Standard trays were later secured and used. The serving area was not closed off from the outside and was subject to ambient temperature variations. The processed fruit (e.g., fruit cocktails, canned peaches) were self-served from steam table inserts without the benefit of any cover to protect them from dust and other contaminants. Prechilled beverages were served via insulated containers. Coffee was served via two household-type percolators (20-30 cups). Hot chocolate was served from the steam table. Salad dressings and jellies were served from their original commercial containers (8 to 32 oz.) causing spilling and dripping. Cups were served by piling tubes on the table. They tended to roll about and because of their size (6 oz.); customers generally used 2 or 3 per meal. Having obtained his meal, the customer was required to leave the kitchen tent to walk outdoors to the dining tents. Customers exited the serving line at the rate of three per minute. The customer could choose one of four tents to dine in. Two were located convenient to the exit and the other two were located on the opposite side of the kitchen tent. The dining tents were equipped with diesel burning space heaters; however, these heaters did not raise the temperature sufficiently to provide comfortable dining. Further, during the course of the exercise, heater parts were removed for use elsewhere and some units became inoperable. This problem of uncomfortably cool dining tent temperatures was most noticeable at breakfast. Later in the day, the solar heat was sufficient for comfort. Total customers, numbers of meals served, strength and average meals per person are presented in Table F-5.

At Brave Shield 17, the customers used plastic trays with paper plates and associated disposables. The menu selections offered a greater variety than seen at the other two exercises that utilized the Harvest Eagle system. Along with the short order line, there were at least two other beverages. The serving area consisted of two tents. The first contained the cashier and a double line offering a selection of salads, assorted fruits, and a variety of desserts. With these items on the tray, the customer proceeded to the next tent, which was ten feet from and in line with the first and housed the hot items. The customer proceeded through either of the lines, A ration or short order. With his meal selections he could choose coffee or milk. Upon leaving the serving tent, the customer could select any of the three dining tents that were readily accessible. In the dining tent, carbonated and non-carbonated beverages were available. Total customers, numbers of meals served, strength and average meals per person are presented in Table F-6.

At Dawn Patrol, there was only one serving line. No trays were available as each customer had his own mess kit. The serving line was approximately twelve feet in length, and the customer stood outside the tent to receive the food. Two entrees were offered with a selection of starch and vegetables. B rations were used extensively, and no short order service was available. The customer walked from the serving line to either of two dining tents. One dining tent was conveniently located near the serving line. The second was on the opposite end of the kitchen tent. In order to get to the second dining

TABLE F-5. Deployed Strength and Numbers of Meals Served  
at Team Spirit '78

<u>Date</u>	<u># Breakfast</u>	<u># Lunch</u>	<u># Dinner</u>	<u># Midnight</u>	<u>Total Meals</u>	<u>Strength</u>	<u>Avg Meals/ Person</u>
3/3/78	127	184	238	N.S.	549	416	1.32
3/4/78	182	242	266	N.S.	690	515	1.34
3/5/78	228	290	243	N.S.	761	518	1.47
3/6/78	200	279	296	N.S.	775	513	1.51
3/7/78	226	304	261	48	839	567	1.48
3/8/78	179	323	308	59	869	564	1.54
3/9/78	208	268	254	64	794	646	1.23
3/10/78	185	281	267	62	795	580	1.37
3/11/78	134	252	278	54	718	584	1.23
3/12/78	149	372	291	91	903	640	1.41
3/13/78	162	299	321	89	871	631	1.38
3/14/78	140	308	312	69	829	633	1.31
3/15/78	157	309	293	68	827	617	1.34

N.S. - Meal Not Served

TABLE F-6. Deployed Strength and Numbers of Meals Served Brave Shield 17

<u>Day of Feeding</u>	<u>Date</u>	<u># Breakfast</u>	<u># Lunch</u>	<u># Dinner</u>	<u># Midnight</u>	<u>Total Meals</u>	<u>Strength</u>	<u>Avg Meals/ Person</u>
1	3/28/78	122	202	203	N.S.	527	320	1.64
2	3/29/78	246	226	204	N.S.	736	480	1.53
3	3/30/78	306	296	338	N.S.	940	490	1.91
4	3/31/78	301	326	415	39	1081	522	2.01
5	4/1/78	394	858	*	94	1346	767	1.75
6	4/2/78	490	1115	*	116	1721	935	1.84
7	4/3/78	366	600	763	101	1830	1442	1.26
8	4/4/78	558	496	699	112	1865	1623	1.14
9	4/5/78	600	778	585	145	2108	1763	1.19
10	4/6/78	593	716	602	166	2077	1820	1.14
11	4/7/78	498	590	816	141	2045	1845	1.10
12	4/8/78	367	1360	*	154	1881	1926	.97
13	4/9/78	469	944	*	144	1557	1910	.81
14	4/10/78	510	528	802	182	2022	1919	1.05
15	4/11/78	514	520	762	214	2010	1927	1.04
16	4/12/78	479	521	764	208	1972	2002	.98
17	4/13/78	477	493	703	209	1882	1917	.98
18	4/14/78	430	465	694	212	1801	1897	.95
19	4/15/78	396	1173	*	197	1766	1845	.95
20	4/16/78	393	1258	*	194	1845	1569	1.17
21	4/17/78	290	312	344	156	1102	1084	1.01
22	4/18/78		160	170				

N.S. - Meal Not Served

\* - Combination Two Meal Concept

tent, the customer passed through the sanitation area. The second dining tent also used thirty square tables instead of the Harvest Eagle standard dining table (seventy two by thirty inches). In the dining tents, salad, dessert, ice, and beverages were available. Beverages were limited to soft drinks and coffee. The customers, numbers of meals served, strength and average meals per person is presented in Table F-7.

#### Customer Satisfaction

Customer satisfaction was measured in several areas through the use of surveys and interviews. This subject is addressed in a separate section of this report.

TABLE F-7. Deployed Strength and Numbers of Meals Served At Dawn Patrol

<u>Day of Feeding</u>	<u>Date</u>	<u># Breakfast</u>	<u># Lunch</u>	<u># Dinner</u>	<u># Midnight</u>	<u>Total Meals</u>	<u>Strength</u>	<u>Avg Meals/ Person</u>
1	5/8/78	80	165	160	N.S.	395	145	2.72
2	5/9/78	140	174	155	N.S.	469	171	2.74
3	5/10/78	160	180	162	N.S.	502	172	2.91
4	5/11/78	225	276	325	N.S.	826	392	2.10
5	5/12/78	203	518	474	N.S.	1195	538	2.22
6	5/13/78	275	523	462	N.S.	1260	639	2.34
7	5/14/78	301	552	516	N.S.	1369	648	2.14
8	5/15/78	317	518	475	N.S.	1310	646	2.02
9	5/16/78	337	476	469	20	1302	647	2.01
10	5/17/78	274	482	463	37	1256	637	1.94
11	5/18/78	281	543	522	25	1371	632	2.11
12	5/19/78	310	536	517	27	1390	620	2.18
13	5/20/78	276	526	490	23	1315	638	2.08
14	5/21/78	283	513	460	23	1279	638	2.06
15	5/22/78	275	476	425	26	1202	638	1.88
16	5/23/78	286	523	465	30	1304	638	2.04
17	5/24/78	253	513	460	27	1253		1.96
8	5/25/78	273			22	295		.46

N.S. = Meal Not Served

### The Proposed New Harvest Eagle Concept

The New Harvest Eagle concept proposed to the Air Force includes the following equipment and functional changes.

The equipment was selected first for its labor saving contribution and, secondly, to support the AFESC recommended field feeding menu. For the comfort of the customers and to prevent subsistence from freezing, the addition of two 400,000 Btu Herman Nelson Heaters is recommended.

The New Harvest Eagle is conceived of as containing a basic system and a multiple unit system. Both systems use the same types of equipment and shelters; however, the multiple unit system has three serving lines while the basic has two. Fig. F-1 depicts the basic New Harvest Eagle shelter configuration.

Designed to accommodate both the customer and the workers, the customer enters the dining tent and proceeds to the kitchen shelter which is connected to the dining shelter by a vestibule, thereby allowing the customer to be indoors while waiting, being served, and dining. Upon entering the kitchen shelter, the customer may choose to turn left for short order service or right for the full entree service. The customer returns to the dining tent for salads, beverages, desserts, and dining. At the completion of the meal, the customer may freely exit at either end of the dining tent.

From the workers' standpoint, all activity is indoors and protected from the elements.

The basic kitchen, Fig. F-2, as mentioned, allows the customer to make a choice of full service or short order when entering the center of the kitchen shelter.

The serving line is configured so that griddle items will be served first and steam table items second. This facilitates serving hot food hot.

When facing the customer, the short order service is on the right and the two entrees (full meals) are on the left side. Sufficient space is available at the end of the line should the cooks need to exit in that direction. Each serving line has a utility table behind it to facilitate the placing of empty steam table inserts and receiving full replacements. It is planned that at other than the highest demand periods, one person will serve on each line. The short order line also has a reach-in refrigerator (not now in the inventory) for the storage of hamburger patties, frankfurters, cold cuts, and similar items that are in constant use and should be readily available. This refrigerator is intended to reduce trips to the walk-in for resupply, thereby increasing efficiency. This also eliminates exposing food products to higher than the recommended temperatures and the resultant contamination.

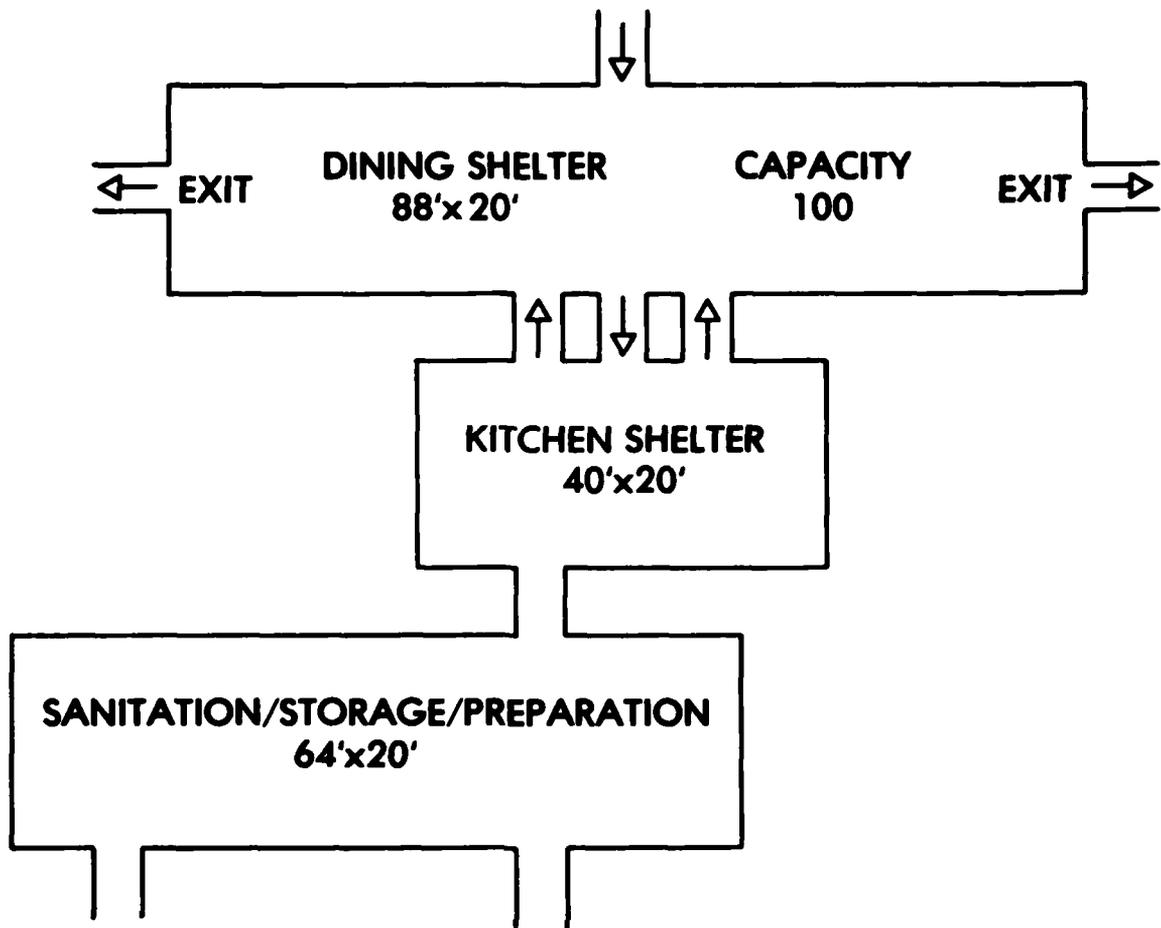
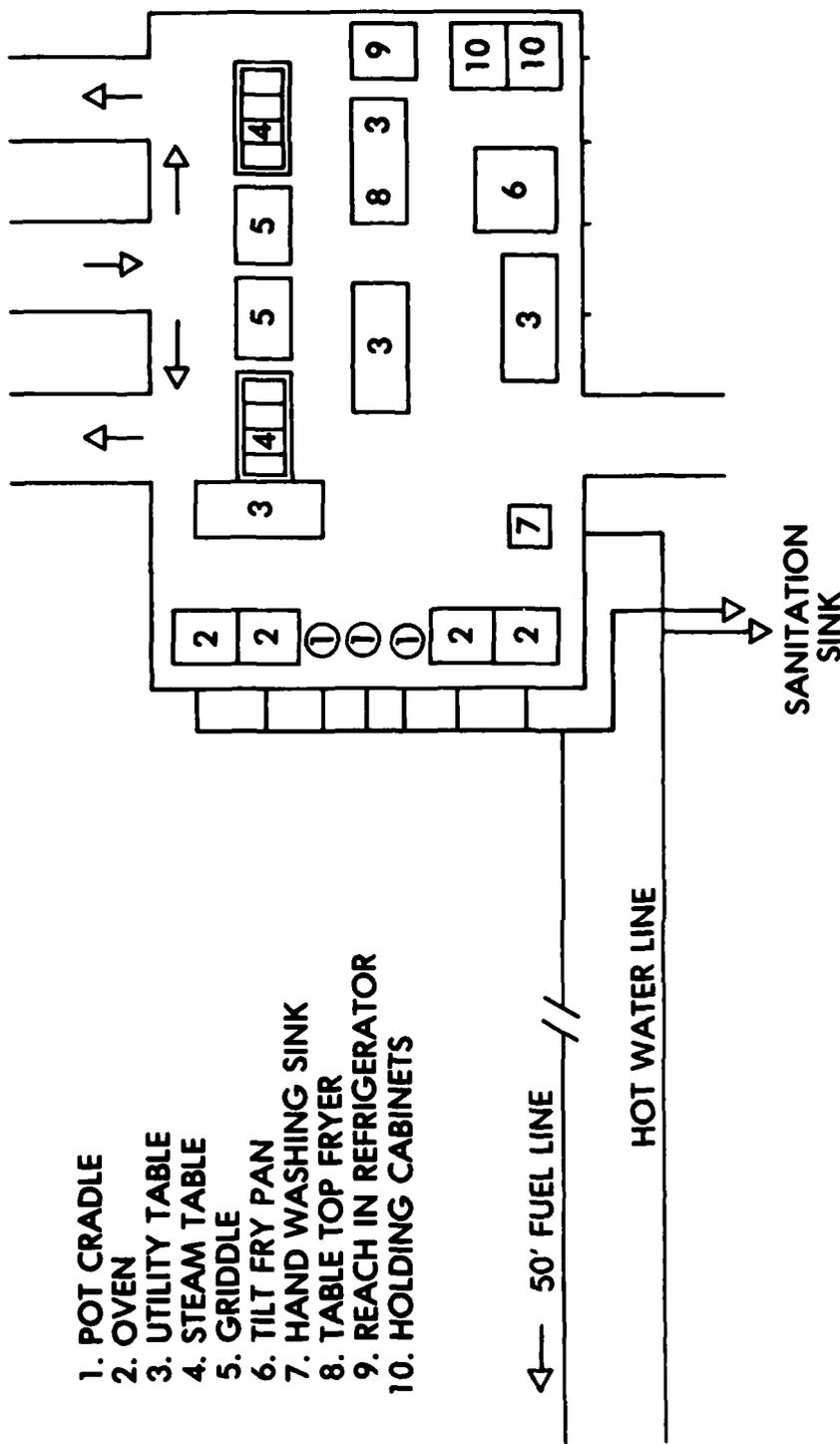


Figure F-1. Basic New Harvest Eagle Shelter Configuration



- 1. POT CRADLE
- 2. OVEN
- 3. UTILITY TABLE
- 4. STEAM TABLE
- 5. GRIDDLE
- 6. TILT FRY PAN
- 7. HAND WASHING SINK
- 8. TABLE TOP FRYER
- 9. REACH IN REFRIGERATOR
- 10. HOLDING CABINETS

Figure F-2. Basic New Harvest Eagle Kitchen

The ovens and pot cradles are located together at the end of the tent for convenience and to minimize fuel lines crossing the work area. As the griddles are located on the serving line, fuel lines must extend from outside the tent to the griddle; therefore, care must be taken so as not to create a hazard. One solution, assuming a plywood floor, would be to place the line under the floor. The alternative would be to extend the line on top of the floor under the utility table and close to the steam table so the only exposed area remaining would be between the ovens and the utility tables. This exposed area could then be covered with a bridge to reduce the potential tripping problem.

Four NLABS - developed ovens are recommended to allow for sufficient capacity. These will replace the present range cabinets. The ovens have four shelves each. In the roasting mode, two shelves would be utilized, each measuring 20 x 23 3/4. This oven has better temperature control than the range cabinet, and as it operates in the same manner as a standard oven, the training requirement is reduced. The pot cradles are in the existing inventory, but shielding will be added to increase heat transfer efficiency. The utility table between the oven and the main line steam table is to be used in conjunction with the ovens and pot cradles.

A hand washing sink is included for use of the workers; no such sinks exist in the present system. Hot water will be provided from the same source that provides hot water to the sanitation (pot and pan washing) area. Opposite the hand washing sink, across the vestibule, is an additional utility table. This can be used in conjunction with the tilt fry pan which is located next to the table. The two holding cabinets are available primarily to facilitate the use of Tray-Pack products, but their capability to hold food can be used with any meal.

A tabletop fryer is recommended for use with the short order line to provide French fried potatoes. Fried food for the two entree lines that was not previously available would be prepared in the tilt fry pan and the deep fat fryer.

To field the New Harvest Eagle basic kitchen, the following new equipment will be required.

<u>Quantity</u>	<u>Item</u>
4	Oven
2	Griddle
1	Tilt Fry Pan
1	Handwashing Sink
1	Deep Fat Fryer
1	Reach-In Refrigerator
2	Hot Holding Cabinets

The New Harvest Eagle multiple unit kitchen utilizes the same equipment as the basic with the following new additional items:

<u>Quantity</u>	<u>Item</u>
1	Oven
1	Griddle
1	Tilt Fry Pan

The multiple unit kitchen, Fig. F-3, adds a third serving line, thereby providing two main service lines and one short order line. This requires one additional 8' shelter section, bringing the overall length to 48'. A second entrance to the short order line is provided on the side of the shelter. This configuration allows for all customers to flow into the same dining shelter.

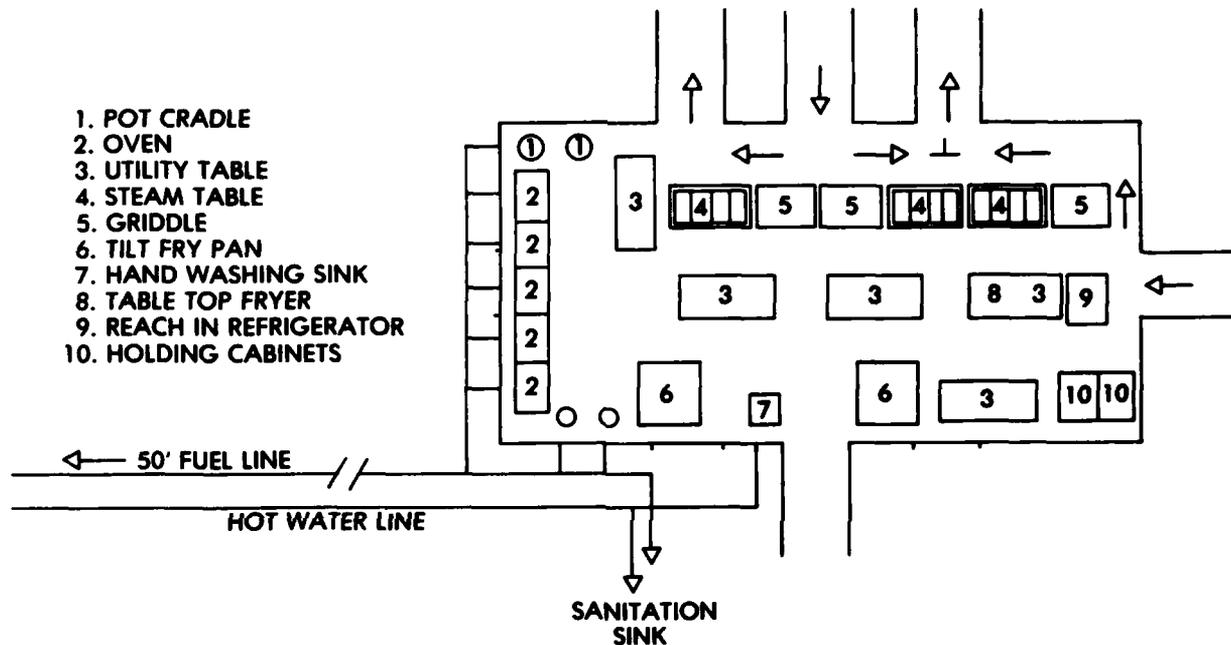


Figure F-3. Multiple Unit New Harvest Eagle Kitchen

The intent is to facilitate customers dining together even though they may have made different meal (full service/short order) selections. This also allows consolidation of beverages, salads, and desserts in the dining area. This kitchen functions in the same manner as the basic unit kitchen.

The configuration of the dining shelters for the multiple unit is the same as the basic with one additional 88 ft x 20 ft shelter added to increase the seating capacity. The second dining shelter is situated on the side as this configuration provides for the largest number of tables and limited traffic flow. Customers entering for the main lines have shelter from the elements as in the basic dining shelter. Those entering for the short order line have shelter in the 10-foot vestibule and an additional 8 feet from the point they enter the kitchen shelter to the beginning of the short order line.

The center entrance provides a straight line flow very similar to a base dining hall, wherein the customer is protected from the elements while waiting for and receiving the meal. After receiving the meal and re-entering the dining shelter, the customer may pick up the beverage, salad, and dessert, or the customer may choose a seat and return for beverage, salad, and dessert. The tables hold the beverage, salad, and dessert and are located so as to provide access from any side. This reduces congestion created by the mix of first time and repeat customers, although seating capacity is reduced.

The basic dining shelter (Fig. F-4) has 20 six-foot tables, assuming use of those that exist in the Harvest Eagle Kit. Assuming five people per table, this will provide reasonable seating for 100 people, with a maximum capacity of 120.

In the multiple unit New Eagle configuration, Fig. F-5, a second dining tent is located to the side. The side location was selected to preclude customers entering through two shelters as would be the case with a parallel location. The reduction in customer traffic will contribute to a quiet dining environment. The side location was also selected to be opposite the side having the entrance so as to keep at a minimum the distances between entrances. This also relates to the customer survey feedback indicating that a desirable dining feature is the ability to sit with friends. Although the second dining shelter has the same dimensions as the basic dining shelter, it has a greater capacity because no provision is required for a customer entrance area. This second shelter accommodates twenty-two tables, and again,

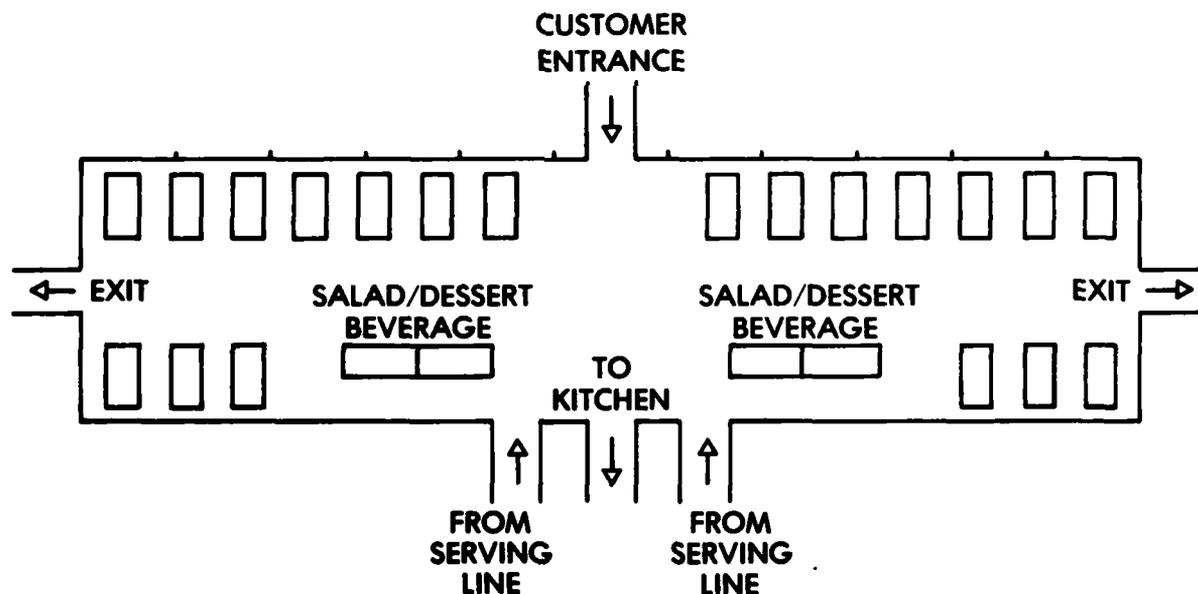


Figure F-4. Basic New Harvest Eagle Dining Shelter Capacity 100

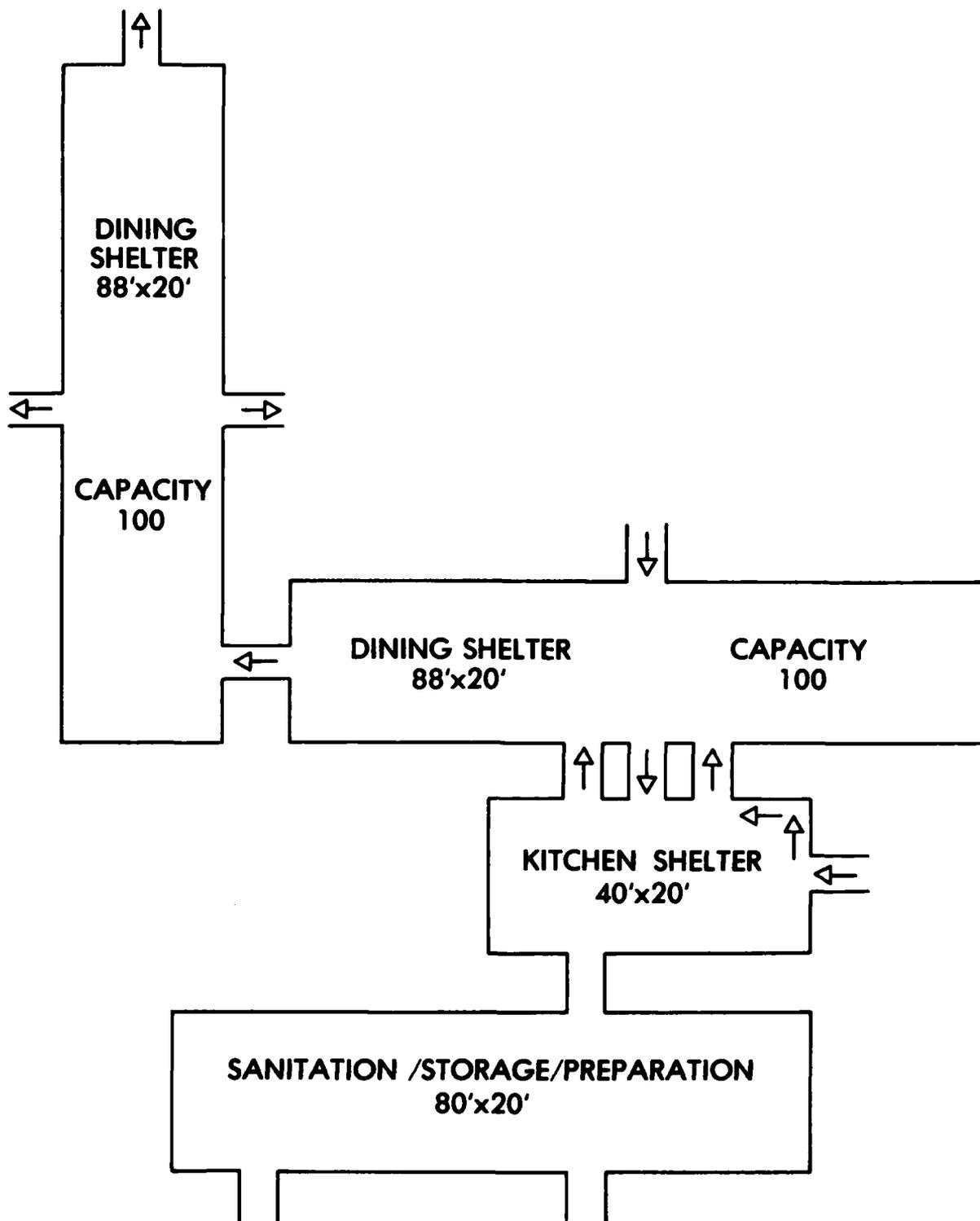


Figure F-5. Multiple Unit New Harvest Eagle Shelter Configuration

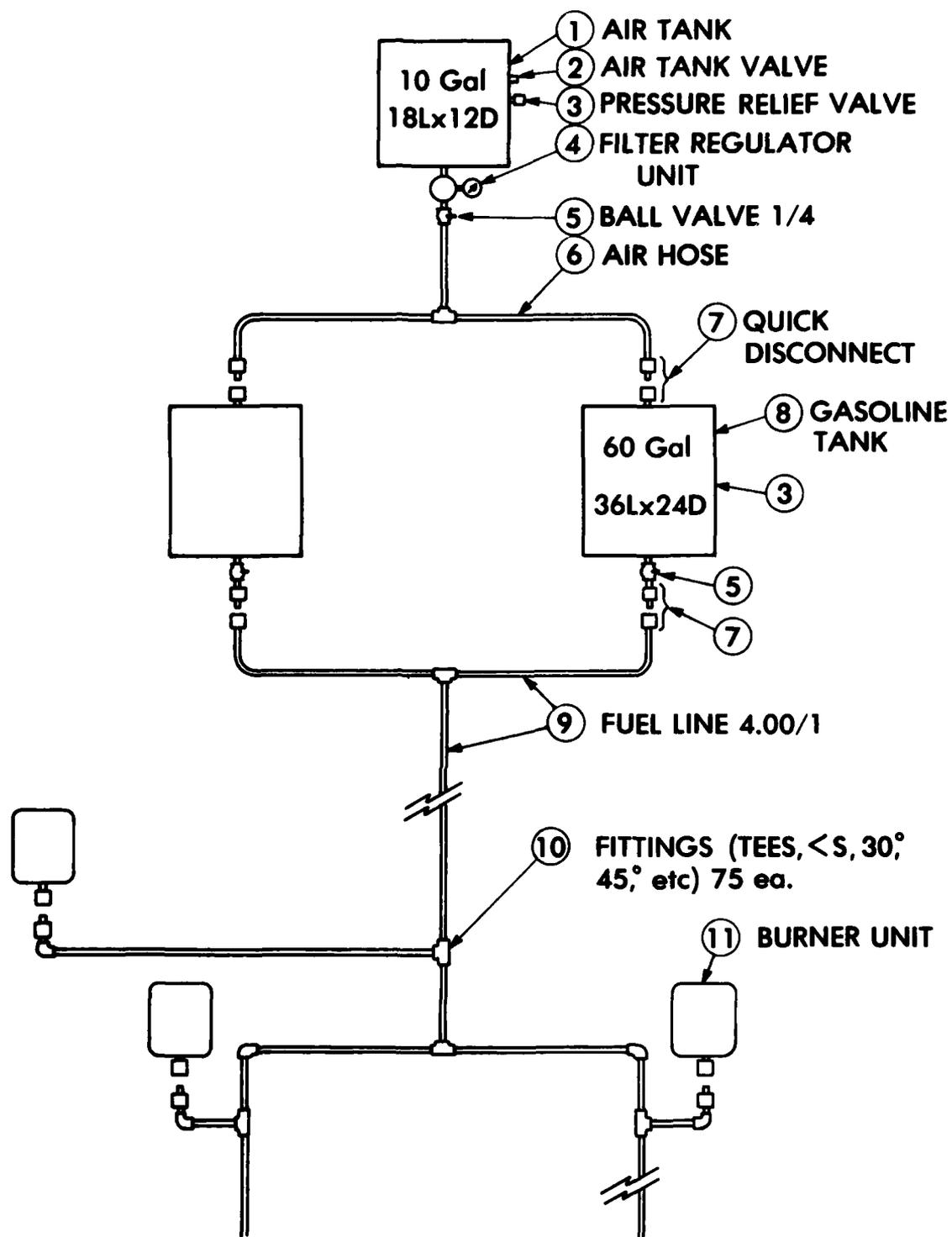


Figure F-6. Remote Tank Burner System

assuming five per table, seats 110 for a total seating capacity in the multiple configuration of 210. If necessary, six can sit at each table making the potential capacity 252.

In the Harvest Eagle, as presently operated, each M-2A burner contains its own internal fuel supply. Gasoline, being inherently volatile, presents a hazard. At the beginning of each day, each burner to be used is manually filled with fuel and pressurized. During the day, as each burner consumes its fuel, it must be removed, refueled, repressurized, restarted, and returned to its place. The present manual system is manpower-intensive and the presence of gasoline is a real hazard. Surveys of cooks indicate they fear the M-2A burners, a condition that may well account for the fact that so many cooks do not know how to operate them. A remote tank burner system, Fig. F-6, would reduce manpower requirements and, by reducing the amount of fuel in the shelter would improve safety. The major components of the fuel system are two remotely located fuel tanks, a pressure source, and the star burner in a redesigned container.

Use of the remote tank burner system would reduce the amount of gasoline in the basic kitchen to approximately 0.7 gallons as compared to approximately 25-30 gallons with the standard M-2A burner unit. The 0.7 gallons that remains is not located in the high heat zone of the burner as is now the case. With the removal of quantities of fuel, the possibility of explosion is virtually eliminated. Once the system is set up, it will operate indefinitely, eliminating the filling and pressurization process and saving manhours. Constant pressure and fuel supply permit a wider range of flame control. The mixing chamber would be maintained at a higher and more constant temperature than the M-2A burner, thereby improving vaporization of the liquid fuel. The cleaner and more efficient burning should result in less fuel consumption and cleaner pots and pans with less soot formation. The hazard of liquid fuel use is further reduced with the central pressurization. With the release of air pressure in the fuel tank, burners would be extinguished within a minute, and fuel in the lines would be forced back toward the fuel tanks.

With the exception of heating water over an M-2A burner, there is no provision in the present Harvest Eagle food service system for hot water for cooking, personal hygiene, or pot and pan washing.

NLABS has modified the portable field water heater, typically used for personnel showers in the field, to operate automatically and to specifically fit the needs of a field sanitizing center. The water heater is automatically controlled to maintain a constant water temperature. A water pump and hoses are included to pump the cold water from a source to the heater and then to the kitchen. The heater is equipped with forklift openings for materials handling equipment. A lifting bar is attached for movement by manpower.

This heater will provide 8 gallons per minute of heated water with a 100°F rise in temperature and will burn 5 gallons of fuel per hour. The production capacity of this heater is in excess of the amount of hot water estimated to be required. To increase its efficiency, there are two alternatives that could be explored. First, the heater could be co-located with a shower/laundry to maximize use of the capacity. Second, it is technically feasible to reduce the size of the heater by approximately one-half.

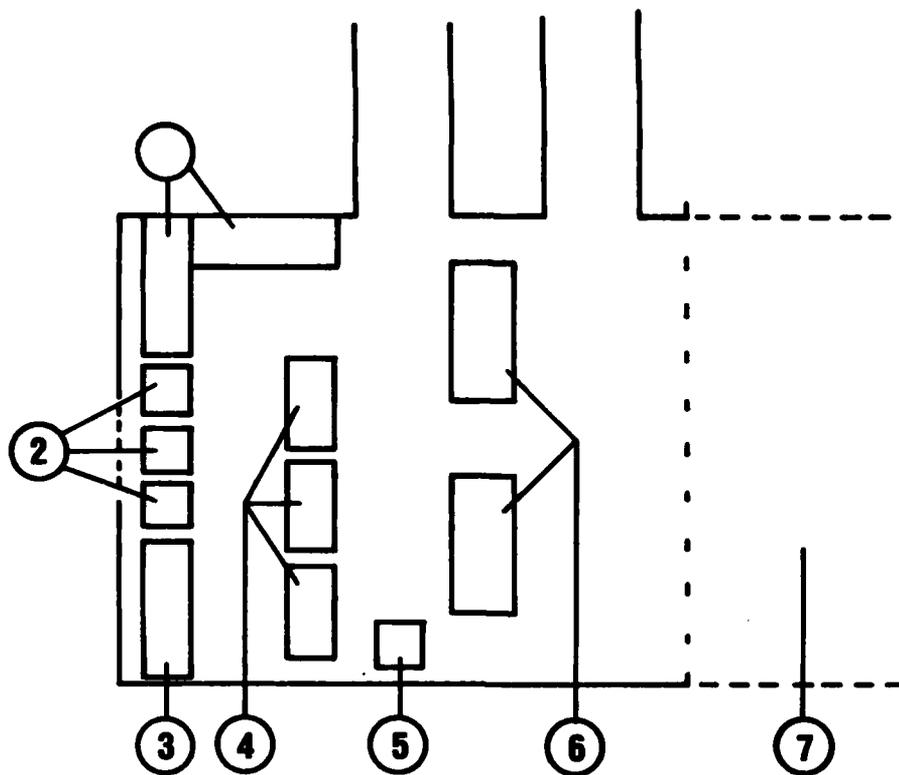
A major advantage of the New Harvest Eagle food service system lies in its ability to operate with different power sources. If both fuel and electricity are available, it will operate at peak efficiency.

To serve the A-ration, refrigeration is required, and hence, electricity is required. Without refrigeration, the menu would have to be B ration or T ration. If electricity were temporarily unavailable, the system could still produce a meal utilizing the griddles, ovens and pot cradles; if fuel were not available, meals could be served utilizing a tilt fry pan and short order items.

The sanitation storage tent located at the rear of the kitchen is a multi-purpose tent. On one end, as shown in Fig. F-7 is the sanitation area. As disposable trays are used by the customer, and pots and pans are not required for the evening meal, this function has been greatly reduced. It is recommended that the cooks perform this function as noted at Team Spirit 78. With cooks performing this function, it can be expected that fewer utensils will be used and pots and pans scraped and rinsed rather than allowing residual food to harden on the surface. The racks for clean pots, pans, and utensils, Item 4 on Fig. F-7, serve as a storage location and as a barrier separating the soiled pots and pans and the wash area from the storage area. Preparation tables, Item 6 on Fig. F-7 are positioned to provide a convenient location to retrieve clean pots and pans, to remove the food product from its containers, and to place the raw product into its cooking vessel. The raw food goes to the cooking area, and the accumulated packaging and other trash goes out the rear entrance. Two exits/entrances between the kitchen and sanitation storage allow further separation of clean from soiled areas as well as providing smooth traffic flow. The remainder of the tent holds dry storage. Walk-in refrigerators are adjacent to and outside the sanitation/storage tent.

Maintenance on the present Harvest Eagle is minimal. The addition of some electrical items on the New Harvest Eagle kitchen does not significantly increase the maintenance requirement. In any case, unique specializations in the maintenance area will not be required to maintain the New Harvest Eagle.

An estimate of cube and weight characteristics of the New Harvest Eagle is presented in Table F-8. Estimates of shelter, equipment, and other costs, and fuel consumption and maintenance requirements are included in Table F-9.



- ① SOILED POT AND PAN AREA
- ② POT AND PAN SINKS
- ③ CLEAN POT AND PAN DRAIN BOARD
- ④ POT AND PAN STORAGE RACKS
- ⑤ PREPARATION SINK (SALADS, ETC)
- ⑥ PREPARATION TABLES
- ⑦ STORAGE AREA

Figure F-7. Basic New Harvest Eagle Sanitation/Storage Configuration

TABLE F-8. Estimated Cube and Weight of the New Harvest Eagle Concept  
Cube (ft<sup>3</sup>)

<u>Basic Concept</u>	<u>Item</u>	<u>Multiple Unit Concept</u>
87	Kitchen Shelter	105
128	Prep/Storage Shelter	187
1,272	Refrigerator Walk-In	3,816
<u>194</u>	Dining Shelter(s)	<u>388</u>
1,681	Sub-Total	4,496
<u>1,889</u>	Equipment	<u>4,230</u>
<u>3,570</u>	Total	<u>8,726</u>
	Weight (LB)	
945	Kitchen Shelter	1,135
1,516	Prep/Storage Shelter	1,897
5,400	Refrigerators, Walk-In	18,200
<u>2,087</u>	Dining Shelter(s)	<u>4,175</u>
9,948	Sub-Total	23,407
<u>13,606</u>	Equipment	<u>24,208</u>
<u>23,554</u>	Total	<u>47,613</u>

TABLE F-9. Estimated Cost and Other Factors of the  
New Harvest Eagle Concept Cost

<u>Basic Concept</u>		<u>Multiple Unit Concept</u>
29,770	Shelters	47,126
20,862	Equipment	<u>25,062</u>
50,632	Total	<u>72,188</u>
	Other Factors	
204	Daily Fuel Consumption (Gal)	274
0.3	Daily Maintenance (Mandays)	0.3
20	Life Expectancy (Yrs)	20
60	Electrical Requirement (kW)	100

**APPENDIX G**

**REMOTE SITE FOOD SERVICE CONCEPTS**

## APPENDIX G. Remote Site Food Service Concepts

### The Expando Kitchen

The Readiness Command's Joint Communications Support Element (JCSE), stationed at MacDill AFB, Florida, has used an all-electric field kitchen since 1971. The kitchen shelter and packaging for transportation of equipment are both provided by the same container, an expandable trailer termed "the Expando". This trailer, purchased in 1971, cost \$25,000. Equipment and installation costs of approximately \$20,000 raised the total cost to approximately \$45,000.

The Expando kitchen (excluding tires and hitch tongue) is 18 ft. long and slightly over 8 ft. wide when closed for travel. It is towed by a 2½-ton military truck. When expanded for use, its length remains the same, while its width increases to be over 14 ft. wide.

All powered equipment in the Expando kitchen requires electricity which is provided by a 60-kilowatt generator. According to the equipment manufacturer's nameplates, the total power requirements exceed 60 kilowatts. However, at one field exercise, a direct measure of power being drawn by the kitchen when all equipment was turned on showed real demand to be 45 kilowatts, 75% of the possible output of a 60-kW generator. (See equipment list and respective power requirements in Table G-1).

According to JCSE personnel, the largest number of personnel fed by the Expando kitchen during one meal period was 275. The food service supervisor suggested that menu changes could increase this number to about 300.

A storage/sanitation shelter is not available, and additional refrigerator space would be useful. The Expando interior lacks a hood over the deep fat fryer, has ineffective exhaust fans, and lacks sufficient air conditioning capacity.

Favorable characteristics of the Expando kitchen include the minor maintenance requirement for the electrical equipment, the ease of use by cooks familiar with electrical food service equipment, and the ease of movement, setup, operations, and teardown.

For units with feeding requirements at levels up to 300 troops, with generators available, and with electrical maintenance personnel on hand, the Expando kitchen may be the ideal field feeding system. For the past eight years, the Readiness Command JCSE has been very pleased with the Expando.

### The Mobile Field Kitchen Trailer

The Mobile Field Kitchen Trailer (MKT-75) was designed and developed by food engineering personnel at NLABS. It is an expandable, self-contained, trailer-mounted, field food-service system. As a highly mobile unit mounted on a standard 1½-ton M-103A3 trailer chassis, it can be towed by a standard military truck.

TABLE G-1. Expando Kitchen Equipment and Kilowatt Requirements

<u>Item</u>	<u>Kilowatts</u>	<u>Quantity</u>
3-ft. Grill	16.2	1
4-Hole Steam table	3.5	1
Mobile Warming Cab	.5 ea	3
Space Saver Stack Oven	7.8 ea	2
Exhaust Hood	--	2
Air Conditioner	--	1
Range w/3 Top Cooking Plates	21.9	1
Exhaust Fans	.11 ea	2
Refrigerated Salad Bar w/2 Reefer Compartments Below	1	1
Meat Slicer	1	1
Deep Fat Fryer	13.5	1
Microwave Oven	<u>2.5</u>	1
TOTAL	<u>77 kW</u>	

The trailer kitchen is covered by a manually raised roof with fabric sides for environmental protection. Six M-2 burner units provide the energy for cooking; electrical energy is not required by the kitchen. The kitchen was designed to produce and serve approximately 250 A or B rations. However, by extending feeding hours and effecting menu changes, more than 250 troops could be subsisted from the MKT.

The trailer kitchen lacks preparation, sanitation, and storage facilities. The kitchen equipment is demountable for ease of cleaning and flexibility of use. Data descriptive of the MKT are:

Overall Size (in inches)	Travel Mode	Operational Mode
Height	96	132
Width	96	156
Length	174	202
<u>Weight</u>	5,730 lb	5,730 lb

Approximate Cost - \$15,800

The US Army has adopted the MKT for certain forward area feeding. Where there is a need for highly mobile, exclusively fuel-fired field kitchen, the MKT offers a viable option.

#### The Tray-Pack Trailer

The Tray-Pack Trailer is in the concept development stage. This trailer is designed to heat and serve Tray Pack products. The trailer is equipped with a generator and a pumping system. A closed hot water system circulates water around containers holding Tray Packs and brings the Tray Pack product to serving temperature. Salads, beverages, and desserts would have to be prepared in another manner to provide a complete meal.

The M116A1 3/4-ton trailer (96 inches by 66 inches) is an example of an existing trailer that could be used. The equipment could also be used independent of the trailer if rapid mobility is not a factor.

A fuel-driven generator such as MIL-G-52732, 3-kW, 60-Hz is required to operate the pump and to provide power to the burner unit.

#### International Standards Organization Container

The International Standards Organization (ISO) container for ocean shipment is designed to house an electrical kitchen for the Marine Corps. This container was selected to be compatible with Marine plans to utilize container ships, e.g., Sea Land, for overseas deployments.

The container is 8'x8'x20' and will hold various types of electrical equipment; however, if the concept were adopted by the Air Force, equipment selection would differ. The ISO, as designed, does not have wheels, which

would be required for Air Force use. Also, since the customer portion of the serving line is outside the container, an awning or other suitable shelter would be desirable. A dining and storage area would be appropriate to make the system fully operational.

The ISO basic kitchen is designed to subsist 200 troops and has an electric requirement of 65 kW.

#### Mini Version of the Primary System

Because conditions change from location to location, the best approach to satisfying remote feeding needs may not be a uniform approach but rather an individual approach tailoring the food service system to the particular conditions as they become known.

In order to have a food service system that can be tailored, a supply of equipment and shelters from which to draw would be required. In the interest of cost effectiveness, this pool of equipment and shelters should be put to maximum use. One method of accomplishing this is to have the remote and small site feeding equipment the same as the primary base feeding system. Planners could then select the type and quantities of equipment desired.

The advantages of this approach accrue from its uniformity with the major system. The training burden is lessened since most cooks are already familiar with the system, its equipment, and its shelter. The depth in equipment and shelters provides for good rotation and equal use. New equipment is easily entered into the system; old equipment is rotated out of the system so that no individual unit would be relegated to use outdated equipment, and, additionally, centralized control facilitates inventory management.