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AN EVALUATION OF THE PROPOSED MARINE CORPS EXPEDITIONARY FOOD SERVICE SYSTEM CONCEPT

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COMBAT FEEDING	SHELTERS	ISO CONTAINER
FIELD FEEDING	HARD SHELTERS	MILITARY EQUIPMENT
RATIONS	SHELTERIZED	SANITATION
KITCHENS	MCESS	

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

A concept test of the proposed Marine Corps Shelterized Expeditionary Food Service System was conducted during July 1980. The principal objective of the test was to determine whether the proposed configuration of the foodservice unit could be operated at the prescribed feeding levels of 1000 men, 500 men, and 200 men. Another objective of the test was to measure the functional performance of the unit.

This report presents the results of the concept test. The results demon-

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strated that the equipment in the galley was reliable but that additional equipment would be needed to prepare an A-Ration meal for 1000 men, that service could be provided at each of the prescribed feeding levels within an acceptable time period, that the system operated within the design constraints on power, and that the overall system was perceived by cooks and managers as acceptable.

This report also contains some recommendations for improving the galley layout and incorporating additional equipment items. In addition, a recommendation to further test the galley with the sanitation unit in a field environment is also included.

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PREFACE

This report describes effort expended on Service Requirement JSR AMAF 81-20, Appendix II, "Evaluation and Development of a New System For Supporting USMC Air-Ground Task Force Elements Aboard Merchant Ships and Ashore." This service requirement is included in the Department of Defense (DoD) Food RDT&E Program under Project No. 1L162724 AH99A and was sponsored by Headquarters, Marine Corps.

The effective conduct of this project was dependent on the participation of several organizations and individuals, and on the advice of several others. It would be impossible to acknowledge the help of every person who aided the authors at one time or another during this period. Nonetheless, we would like to recognize the following individuals who assisted the project team on numerous occasions and deserve special credit:

- United States Marine Corps. We would like to acknowledge Lt. Col. Brendt Barents, Project Officer; Major William Kastner, Marine Corps Liaison Officer; and Gunnery Sergeant Samuel Jackson, who in his capacity as Deputy Project Officer oversaw the shipping and testing of the ISO galley.

- The Food Engineering Laboratory (FEL) of the US Army Natick Research and Development Laboratories (NLABS). Special thanks to Mr. Robert J. Buffone, the FEL Project Officer; Mrs. Nancy Kelley, for developing several Tray-Pack menu items for the test; Mr. Domenic Bumbaca, for his guidance and support at Camp Upshur concerning the operation and maintenance of the equipment; and Ms. Virginia White, for her assistance in developing the menu for the test.

- The Operations Research and Systems Analysis Office of NLABS. Appreciation is due to Dr. Robert J. Byrne, Chief, OR/SA for his technical guidance and support; Mr. Brian M. Hill, for guiding this project from its concept stage through its prototype testing stage; Ms. Jane Ahern, Mr. Jay Harmon, Mr. Peter Larson, Mr. Michael Ostrowsky, and Mr. Keith Schroeder, for their assistance during the data collection phase of the test, and finally, Mrs. Patricia Yow, Miss Deborah Brooke and Mrs. Maryellen Jennings, who provided secretarial support for the project.

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INTRODUCTION

In FY 1978 the US Army Natick Research and Development Laboratories (NLABS) was tasked to develop a food service unit for the Marine Corps Expeditionary Shelter System (MCESS). In an earlier report,[1] the alternatives were described and analyzed to develop a concept for prototype fabrication and evaluation. Upon Marine Corps approval of the recommended concept a prototype unit was constructed and tested. The purpose of this report is to present the results of the concept test, and to propose recommendations for some improvements in the galley equipment and work space layouts.

The MCESS concept was developed at a time when Marine Corps doctrine was to transport assault forces to points of conflict by sea. A combination of naval and commercial shipping was then required. Since naval vessels were not available in sufficient quantity, plans were developed whereby commercial container ships would be used to augment existing Navy capabilities. The MCESS concept was one part of that plan.

In recent times, Marine Corps doctrine has shifted. Current plans now envision airlifting Marine assault force personnel to points where pre-positioned materials are available and then to the point of conflict. This change in emphasis crystallized after the concept test described in this report was conducted. The need for further development of the MCESS foodservice module has therefore been substantially reduced.

Although the MCESS concept seems no longer viable, a "containerized" foodservice module could still play a role in Marine Corps amphibious assault concepts or in other service applications. Shelf stable foods such as tray packs and a food service module could, for example, be part of the pre-positioned materials and/or force.

To avoid any duplication of effort, the design concept of the foodservice unit will not be discussed in this report. The reader is referred to the earlier report for a full description of the foodservice unit's design concept and for the analysis of the unit's projected operating parameters (for example, water and fuel consumption rates, food storage requirements, and personnel requirements). It is intended that this report, together with the earlier report, will provide the reader with a complete documentation of the history and current status of the MCESS food service unit.

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[1] N. D. Roberts, A. L. Murphy Jr., R. J. Buffone, "Marine Corps Shelterized Expeditionary Food Service System", NATICK/TR-80/033, US Army Natick Research and Development Laboratories, Natick, MA 01760, August 1980.

TEST PLAN

SITE SELECTION

There were two major criteria for selecting a test site for the concept test of the MCESS galley section. They were: (1) the site had to feed, on a regular basis and as close as possible, 1000 patrons at each meal, and (2) the site had to be a field setting. Further, the search for the test site was limited to locations on the east coast so that the transportation costs for both the galley section and for the personnel supporting the test could be kept to a minimum.

After evaluating available Marine Corps installations which satisfied the selection criteria, Camp Upshur, Quantico, VA, was finally chosen. Camp Upshur was chosen primarily because it offered high, constant headcounts and, in addition, is geographically located near both Headquarters Marine Corps and the Army's Natick Laboratories.

Camp Upshur, located 20 miles from Quantico Marine Corps Base, Quantico, VA, is the training ground for first year Marine Corps Officer Candidates. Officers Candidate School (OCS) runs from May to September each year, as the candidates are college students who attend university classes during the normal school year. When the OCS is not in session, Camp Upshur is closed. The support facilities (for example, the dining facility) at Camp Upshur are operated by Quantico-based personnel who are assigned on a temporary basis.

Within Camp Upshur, two alternate test sites were evaluated. The first site was a grassy field area, located approximately 150 feet from the dining facility. The advantage of this site was that it was far enough removed from the dining facility to deter the cooks from augmenting operations in the MCESS galley by cooking in the dining facility. In other words, it was felt that this site would allow the MCESS galley to operate independently. The disadvantage of this site was that significant site preparation expenses would have been incurred to allow operation of the International Standards Organization container galley (ISO galley) in a muddy environment, as July and August are the rainy season months in Quantico, VA. Other negative factors included the concern for showing any growth in activity near the bordering farm land and the proximity of a stream roughly 100 yards from the proposed site.

The site that was selected was a hardtopped area, located approximately 20 feet from the dining facility. The advantages of this site were that no significant site preparation expenses would be incurred and that the ISO galley could easily tap into the dining facility's water and power resources. The disadvantage of this site was that the cooks had to be monitored so that they would not prepare menu items in the dining facility.

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MENU

The five principal criteria for menu planning were: (1) the menu had to consist of easily prepared items, (2) it had to be compatible with equipment constraints, (3) each meal had to be prepared during the time constraints established between meal periods, (4) the required raw ingredients for the menu were available to the dining facility manager, and (5) the menu had to adhere, as much as possible, to the standard military 42-day A-ration menu. The menu design for the concept test is shown in Appendix A. The menu was developed in conjunction with personnel in the Experimental Kitchens of the Food Engineering Laboratory, (FEL), OR/SA, and the dining facility manager at Camp Upshur. Only lunch and dinner are included on the menu. The Commander at Camp Upshur strongly requested that breakfast not be included in the test since he felt that it was not possible to feed breakfast to all the candidates within the established constraints on arrival and feeding times created by the demanding training schedule. However, one breakfast meal was served in order to gain some confidence that the galley and personnel could function as designed. The nine day menu consisted of four days of tray pack meals and five days of A-ration meals.

Each day, the menu consisted of one entree, one starch, two vegetables, salad, bread and butter, dessert and cold beverages. With the exception of the salads, the menu items were prepared in the MCESS galley. Salads, served in the MCESS galley, were prepared in the dining facility kitchen. Non-carbonated juices were pre-mixed and were dispensed in the MCESS galley. Milk, additional non-carbonated juices, bread, and salads were also available in the dining facility.

Each patron was only allowed one pass through the serving line in the MCESS galley per meal. Thus, second helpings were not served, with the exception of salads, bread, and beverages, which were offered in the dining facility.

SYSTEM DESCRIPTION

The MCESS Galley Section, as configured at Camp Upshur, consisted of a galley complex, two storage containers for perishable food items, a hot water heater, and a fuel container. Storage areas for non-perishable food items were allocated in the dining facility and in several Quonset huts which were located in the general vicinity of the MCESS galley.

Five shelters housed the food production and serving operations. The configuration of these shelters is shown in Figure 1. The two outer containers were identical and were designed to function as passageways to guide customers past the serving lines and were also used to store and dispense serving ware and beverages from the tables shown in

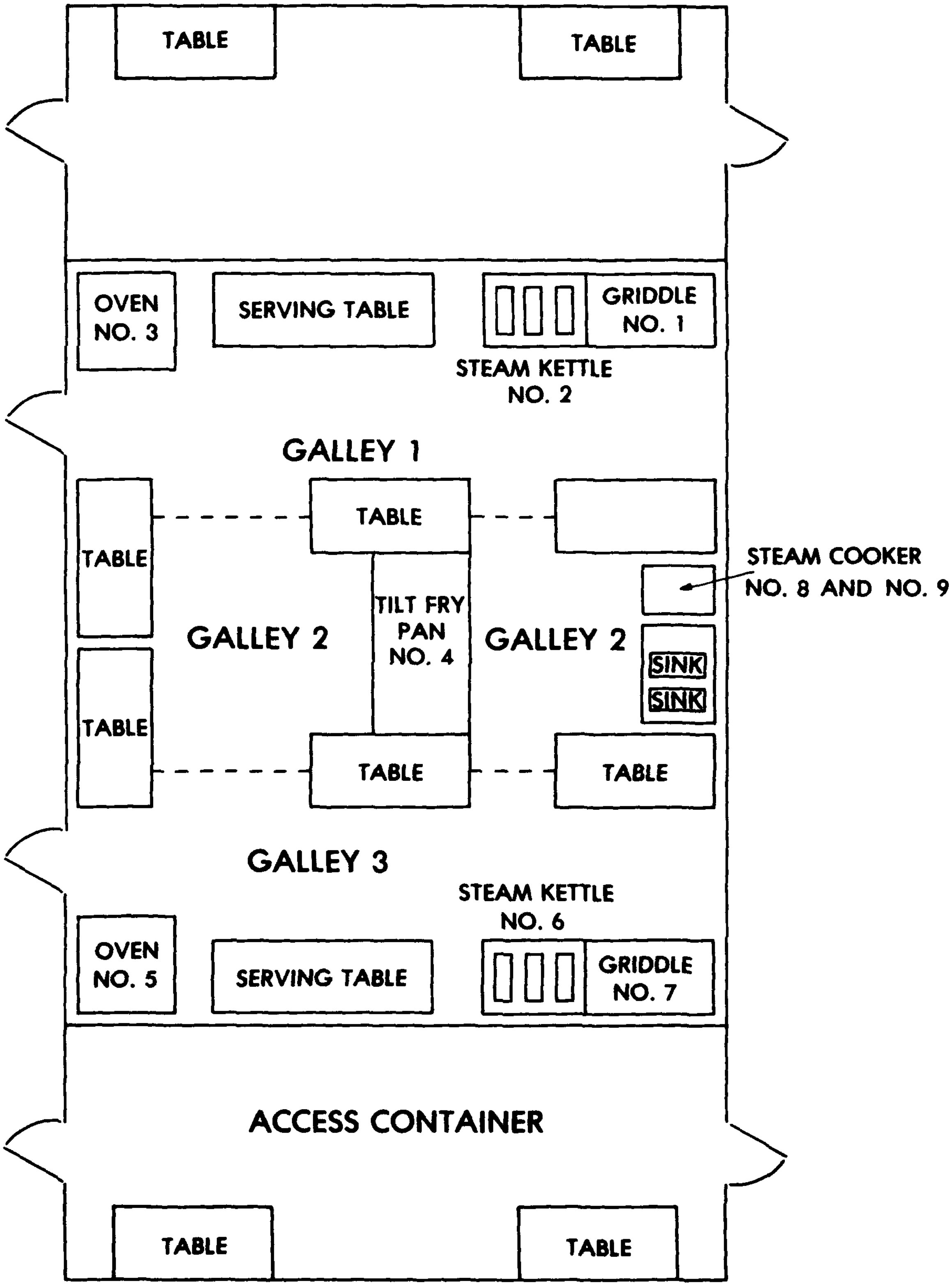

FIGURE 1: MCESS GALLEY SECTION

Figure 1. The three middle containers were designed to function as the main food preparation areas and are shown as galley 1, galley 2, and galley 3 in Figure 1. Nine major items of equipment were located in the three center containers and for data collection purposes were assigned numerical identifiers, starting with 1 in the upper right hand corner of galley 1 and moving counterclockwise to 9 in galley 2. The breakdown of equipment by number for each galley container is given below:

Equipment Item	Galley 1	Galley 2	Galley 3
Griddle	#1		#5
Steam Jacketed Kettle	#2		#6
Oven	#3		#7
Tilt Fry Pan		#4	
Steam Cooker		#8, #9	

The entire five-container complex as configured and tested at Camp Upshur was designed to support a battalion of 1000 men with three A-ration meals per day.[2] The symmetry and equipment duplication designed into the five container complex, allowed the battalion-sized module to be separated into two, smaller, independently operating galleys. This was done by separating one of the cooking/serving shelters, together with its attached access shelter, from the battalion-sized module. It was estimated that the two-shelter galley module could support 200 men and that the three-shelter module could support 500 men.[3]

The storage containers utilized at Camp Upshur for refrigerated food storage were two 8' x 8' x 10' ISO reefers. These reefers are standard Marine Corps items and comply with ISO Container Specifications.

The hot water heater utilized during the test was the M-80 hot water heater. The M-77 was the hot water heater that was initially proposed for use with the galley section in the concept development.

Power for the ISO galley complex was provided by commercial sources. Generators were not utilized during the concept test of the MCESS galley section for two reasons: (1) it was believed that the generators currently available to the Marine Corps would become obsolete by the time of a full procurement, and (2) personnel to maintain the generators were not available during the test period.

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2 Ibid.
3 Ibid.

OPERATIVE MODES

The concept test of the MCESS galley section was designed to test three different modes of operation. These modes were:

1. The large galley module or the 1000 man-mode: This mode consists of all three center shelters operating as one integral kitchen. It was previously estimated that when all three galley containers operate as one unit, that this configuration would be capable of feeding 1000 patrons.[4]

2. The intermediate galley module or the 500-man mode: This mode employs either galleys 2 and 1 or galleys 2 and 3, operating as one kitchen. It was estimated that this configuration could support 500 patrons.[5]

3. The small galley module or the 200-man mode: This mode consists of either galley 1 or galley 3 operating independently. It was estimated that when either of the two outer galley shelters operate independently, this configuration would be capable of supporting 200 patrons.[6]

The concept test was also designed to test these three modes of operation for both A ration and tray-pack operations. The following designations have been established to segregate each mode by ration type:

A-1000: Serving A-rations in the 1000-man mode.
A-500 : Serving A-rations in the 500-man mode.
A-200 : Serving A-rations in the 200-man mode.
T-1000: Serving tray packs in the 1000-man mode.
T-500 : Serving tray packs in the 500-man mode.
T-200 : Serving tray packs in the 200-man mode.

The test at Camp Upshur was conducted over the two-week period 22 July to 31 July 1980. From 22 July to 25 July the ISO galley operated in the 1000-man mode, with two days allocated to an A-ration menu and two days to a tray pack menu. During the first four days of the second week, the ISO galley complex was separated into the 200-man and 500-man modes with two days of A-ration and two days of tray pack operations. Galley 1 and the adjacent access container were designed as the small galley module, or the 200-man mode, and galleys 2 and 3 and the adjacent access shelter were designated as the intermediate galley module or the

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4 Op. cit.
5 Op. cit.
6 Op. cit.

500-man mode. The separation of the galley complex into the 200-man and 500-man modes was accomplished by placing a partition between galley 1 and galley 2. The galley was not physically split apart because personnel and equipment, such as forklifts, were not available during the test and the training schedule required that the troops be fed within a limited time period necessitating an equal utilization of the two serving lines in the galley.

TEST OBJECTIVES

The principal objective was to determine whether the proposed configuration of the ISO galley could be operated at the prescribed feeding levels (1000 men, 500 men, and 200 men). Another objective of the test was to measure the functional performance of the MCESS foodservice unit. In particular, ten parameters were identified for measuring the capabilities of the ISO galley complex:

Equipment Utilization
Work Measurement
Service Rates
Power Consumption
Fuel Usage
Water Usage
Refuse Generation
Worker Interviews
Food Acceptance Interviews
Temperature and Humidity Readings

DATA COLLECTION PLAN

As mentioned above, ten different types of data were collected during the test at Camp Upshur. This section discusses, for each data type, its relevance, or use, and the methodology that was utilized to collect it.

Equipment Utilization. An equipment utilization study was conducted to evaluate the major items of galley equipment in terms of their applicability to the concept design of the MCESS galley section.

A work sampling technique was used to perform the equipment utilization study. That is, equipment items in the galley were observed and one of five predetermined categories of equipment activity were recorded at the time of observation. Specifically, the equipment items that were observed included the two griddles, the two steam-jacketed kettles, the two ovens, the two steam cookers, and the tilt fry pan. The five categories of equipment activity are presented in Table 1. The fifth category was utilized to record such instances as a griddle in the off mode being used as a holding table.

The form shown in Figure 2 was used to record the data. Before the beginning of each observation period, the observer recorded his or her name, the type of ration being served that day, the mode of operation (1000, 500, or 200-man mode), and the date. The time of each observation was recorded in the left hand column. The interval between observations was established at 15 minutes. The equipment names and their identifier numbers, as shown in Figure 1, were pre-recorded as column labels on the equipment sampling form. For each observation, a one-digit number specifying the observed mode of equipment operation was recorded in the appropriate box. Equipment sampling data were collected to represent one composite day of operation in each mode of operation under each type of ration being served. While operating in the split mode, griddle #1, steam kettle #2, and oven #3 constituted the 200-man kitchen. The 500-man kitchen was comprised of the other six major equipment items. The 1000-man kitchen was comprised of all nine items of equipment.

Work Measurement. Work measurement data were collected to determine the staffing levels that would be required to effectively manage and operate the ISO galley in the large, intermediate, and small galley modules. Work sampling consists of taking a large number of observations on individuals performing tasks in a work environment. The task being performed at each observation is recorded. From the ratio of the number of observations of personnel performing a specific task to the total number of observations, one can infer the proportion of time that is actually spent by personnel in that particular activity.

In order to determine proper staffing levels required to operate the MCESS galley section, observations were recorded on only those cooks and messcooks actually seen in the galley area. Management functions and some work activities (for example, warewashing) performed in the dining facility were not recorded since these functions were not considered in the purview of the galley section. Since bread was locally procured and since some beverages were prepared in the camp galley, work sampling did not include these activities. The interval between observations was established at 10 minutes.

Personnel were classified into two numerical categories: 1= cooks, and 2 - messcooks. The activities of the observed personnel were divided into nine categories. The numerical codes and definitions of each task category are presented in Figure 3.

During the actual work sampling period, data collectors recorded their observations on the Interval Work Sheet shown in Figure 4. Before the beginning of each observation period, the observer recorded his/her name and the date. The time of each observation was recorded in the left hand column, utilizing a 24-hour clock. During the period of observation, the data collector recorded the job category code number of each person observed in the appropriate task category number column. Thus, if a cook was observed slicing ham, the number 1 was recorded in column 1 on the appropriate time line.

TABLE 1. EQUIPMENT OPERATING ACTIVITIES

CODE	OPERATING ACTIVITIES
1	OFF
2	ON
3	ON AND IN USE
4	OFF AND AWAITING CLEANING
5	OFF AND IN USE

EQUIPMENT UTILIZATION

DATA COLLECTOR: ______________

DAY MTH YR

DATE: |__|__|__|__|__|__|
01 02 03 04 05 06

RATION: |__|
9

MODE: |__|
10

|2|
11

TIME			GRIDL 1	STKTL 2	OVEN 3	TFP 4	OVEN 5	STKTL 6	GRIDL 7	STCK 8	STCK 9	COMMENTS
	12	13	14	15	16	17	18	19	20	21	22	

FIGURE 2: EQUIPMENT SAMPLING FORM

1. Prepares for cooking

   a) Walks, loaded, (not serving line)
   b) Turns on/off equipment
   c) Prepares meats, vegetables, and starches for cooking
   d) Prepares salads and desserts
   e) Opens tray packs for cooking

2. Cooks

   a) Places food in ovens, tilt fry pan, griddle, etc.
   b) Stirs food as they are cooking
   c) Removing food from equipment, garnish, add spices, etc.
   d) Opens tray packs after cooking, removes excess water.

3. Supplies

   a) Obtain supplies from refrigerator, dry storage
   b) Issues supplies - brings supplies from dry storage and refrigerator into ISO galley
   c) Receives supplies - supplies brought in from outside sources and placed in dry storage and refrigerators.

4. Serves

   a) Assists customers
   b) Serves customers

5. Replenishes serving line

   a) Brings food to serving line for consumption
   b) Brings beverages to serving line

6. Replenishes salad area

   a) Replenishes salad bar in ISO galley
   b) Desserts
   c) Bread and Pastry
   d) Fruits

7. Cleaning

   a) Storing utensils, pots and pans
   b) Cleans equipment
   c) Cleans serving line
   d) Cleans floor, etc.

FIGURE 3. TASK DEFINITIONS

8. Supervision

a) Assists cooks
b) Instructs cooks
c) Receiving instructions
d) Other management functions

9. Non-Productive

a) Talking non-work related
b) Walking empty

FIGURE 3. TASK DEFINITIONS (Cont'd)

INTERVAL WORK SHEET

DATE: ________ OBSERVER: ____________

OBS / TIME	TASK CATEGORY								
	1	2	3	4	5	6	7	8	9
$\sum =$									

FIGURE 4: INTERVAL WORKSHEET

At the end of the work sampling period, the data collector completed the Work Sampling Form, shown in Figure 5. In addition to completing the blocks in the uppermost portion of this form, the data collector transcribed onto the appropriate time and task block the total number of observations recorded on the Interval Work Sheets. As shown on the Work Sampling Form, the number of cooks observed performing each task were recorded in the upper half of the form and messcooks were recorded in the lower half. This form was later submitted for keypunching and used in conjunction with specific computer programs.

Service Rates. Data were collected to determine the patron service rate of the MCESS galley complex. It was also expected that the analysis of the service rate data would determine whether the galley design and selected equipment were suitable to serve the required number of patrons for the different modes of operations.

Service rate data were recorded on the form shown in Figure 6. Before the start of selected meal periods, the data collector recorded his/her name, the date, meal, serving line number, type of ration being served at that meal, and the mode of operation. The data were collected on a continuous basis throughout the meal serving period. As the first person exited the access shelter to enter the serving area at the start of the meal period, the time was recorded on the first line of the TIME column. Each subsequent line was incremented by five minutes until the end of the meal period. In columns 12 and 13 the data collector wrote a two-digit number commencing with 00 on the first line and incrementing each subsequent line by 01. A hash mark for each patron exiting the serving line during the five minute interval being measured was recorded in the PATRON column. At the end of the meal period, the data collector recorded the total number of hash marks in each line in the TOTAL column. Finally, any comments pertaining to the data were noted in the COMMENT column (for example, runouts, pre-poured beverages, slow service etc.).

Service rate data were collected for a minimum of three meals per operating mode for each ration type. Since breakfast was not regularly served in the MCESS galley during the test, only the lunch and dinner meals were observed and were assumed to be equitable for this analysis.

Power Consumption. Identification of the power consumption of the MCESS galley in the different modular configurations is extremely important in assessing shipboard and field operating requirements. The actual power consumed will be used to verify that the MCESS foodservice unit can operate within the specified power constraints of:

180 kW in the 1000 man-mode

120 kW in the 500 man-mode

60 kW in the 200 man-mode

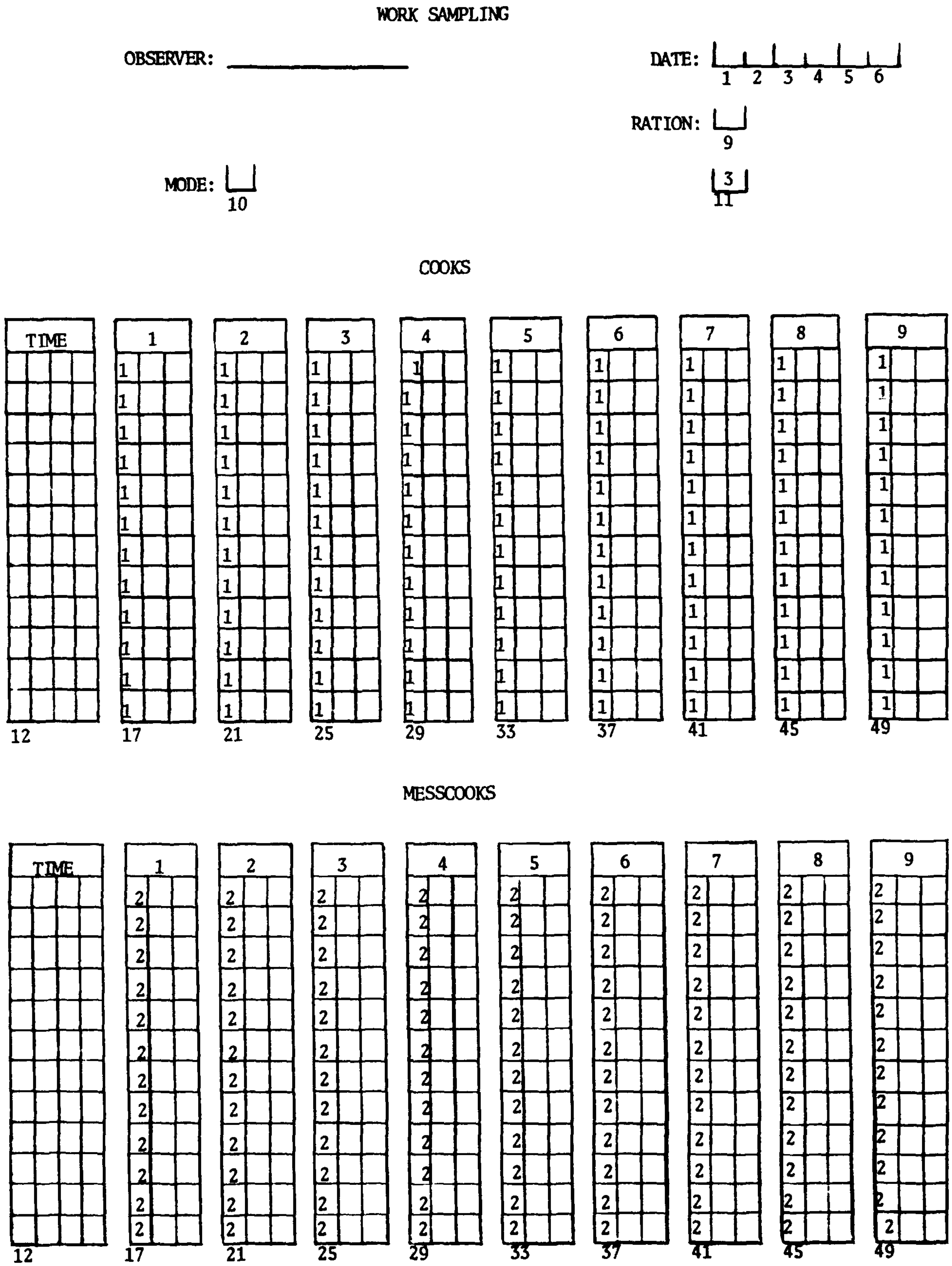

FIGURE 5: WORK SAMPLING FORM

DATA COLLECTION FORM

SERVICE TIME

DATA COLLECTOR: ____________________

DATE: DAY (01 02) MTH (03 04) YR (05 06)

MEAL [ ] 07

LINE NO [ ] 08

RATION [ ] 09

MODE [ ] 10

[1] 11

TIME			PATRONS	TOTAL			COMMENTS
	12	13		14	15	16	

FIGURE 6: SERVICE TIME

The MCESS galley section was initially designed to operate with a 60-kW generator providing power to each of the 3 center containers forming the food preparation area. Since, as previously mentioned, personnel were not available to maintain these generators, power was provided by commercial sources, that is, by tapping into the electrical power lines of the dining facility. To measure the power consumed by the MCESS galley, a metering device that continously recorded power demand over time on a strip chart was installed on the electrical wiring to the circuit breaker panel of each of the three center galley containers - galley 1, 2, and 3.

The three electrical metering devices were arbitrarily assigned a letter designation and recorded the power draw of the following:

Meter A - installed on the electrical wiring to galley 1 and recorded the power draw of griddle #1, steam kettle #2, oven #3, the exhaust fan over griddle #1, the overhead lighting in galley 1 and its adjacent access shelter, one walk-in refrigerator, and two air curtains located in the access shelter.*

Meter B - installed on the electrical wiring to galley 2 and recorded the power draw of tilt fry pan #4, steam cookers #8 and #9, the exhaust fan over the tilt fry pan, the overhead lighting in galley 2 and one walk-in refrigerator.

Meter C - installed on the electrical wiring to galley 3 and recorded the power draw of griddle #7, steam kettle #6, oven #5, the exhaust fan over the griddle, overhead lighting to galley 3 and the adjacent access shelter, the hot water recirculating system, and the two air curtains in the adjacent access shelter.*

Fuel Usage. Fuel usage data was collected to determine the logistical requirements for diesel fuel shipboard and field operations of the ISO galley complex.

As mentioned previously, power to the MCESS galley was provided by commercial sources. Therefore, the M-80 hot water heater was the only piece of equipment that consumed diesel fuel. This unit consumed fuel only when its motor was activated by personnel drawing hot water at the sink in the MCESS galley.

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* The air curtains in galleys 1 and 3 were added to the system on 25 July to alleviate the flying insect problems at Camp Upshur.

A clocking mechanism is located on the burner unit of the M-80 which registers the total cumulative number of hours that the burner motor is on. Data collectors recorded these clock readings twice each day — at the start and at the end of the MCESS galley operations. These readings were recorded on the form shown in Figure 7 in the "GALLON" column under "FUEL." The date and time of these readings were recorded on the water usage portion of this form.

Water Consumption. A critical element for shipboard and field operations is the water required to operate the MCESS galley section since outside sources may be unreliable.

All water used by the ISO galley was drawn from a single spigot located at the dining facility. A hose from this spigot extended approximately 20 feet to a multiple hose connector that branched out into four separate hoses. Three of these hoses were connected to the water intake of the three center containers of the MCESS galley, and the fourth hose was connected to the water intake of the M-80 hot water heater. A metering device which measured cumulative water usage was strategically placed on each of these five hoses. One meter was located on the main hose which lead from the spigot at the dining facility. This meter measured total water consumption. Meters were placed on each of the intake hoses to the three center containers. These meters measured the amount of food preparation water used by each of the galleys. Finally, the last meter was attached to the hose that lead from the M-80 hot water heater to the sink in the MCESS galley, thus measuring hot water usage.

Readings from all five meters were recorded twice a day — once at the start and once at the end of daily operations of the ISO galley complex. These readings were recorded on the Water and Fuel Usage form shown in Figure 7. In addition to recording the date, time, ration, and mode of operation at the time of each reading, the data collectors recorded the gallons of water registered on the meters under the appropriate column heading with total water usage recorded in the "OUTPUT" column. Also, any observations which pertained to water usage, such as leaks, were written in the "COMMENTS" column.

Water used in food preparation and from Tray Packs was normally discarded in the sinks located in the MCESS galley. Since metering devices were not available for measuring waste water during the test, the sinks were stoppered up and allowed to accumulate sufficient waste water for direct measurement by the data collectors. After these measurements were recorded, the sinks were allowed to drain, after which they were again stoppered up for additional waste water accumulation and further measurements. This data collection procedure was executed every day throughout the test. After each measurement the data collectors recorded the data on one line of the data worksheet shown in Figure 8. In addition to recording the measurement in the AMOUNT column, the data collector

WATER & FUEL USAGE

DATE	TIME	RATION	MODE	GALLEY 1 (gal)	GALLEY 2 (gal)	GALLEY 3 (gal)	HOT WATER HEATER (gal)	OUTPUT	COMMENTS

FUEL	
GALLON	COMMENTS

FIGURE 7: WATER & FUEL USAGE FORM

DATA WORKSHEET

DATE	TIME	SOURCE	TYPE	AMOUNT	REASON	INITIALS	COMMENTS

FIGURE 8. DATA WORKSHEET

recorded the date and time of the measurement, initialed the form, and wrote "sink" in the SOURCE column, discharge water in the TYPE column, and "no form" in the REASON column.

Refuse Generated. In order to determine disposal requirements for shipboard and field operations, data were collected on the weight and volume of refuse generated by the patrons and by ISO galley operations.

Patron refuse consisted of wet garbage defined as "discarded plate waste" and dry trash defined as "discarded disposable serving ware" used throughout the test. MCESS galley waste consisted of wet garbage resulting mainly from over-production of food for the meals and dry trash, such as packaging waste resulting from food preparation. All refuse was kept separate by type and origin, patron refuse from galley waste, and dry trash from wet garbage and placed in plastic bags that were disposed of in dumpsters located nearby.

During those meals selected for data collection, the refuse weight data were collected in the following manner:

o All garbage bags originating from the MCESS galley were weighed on a Detecto scale, just prior to their disposal in the dumpster. These weights were recorded in the appropriate columns on the trash log form shown in Figure 9.

o A sample of approximately 10 garbage bags of patron waste were weighed and recorded accordingly on the trash log form. A count of the remaining garbage bags of patron waste for that meal was recorded in the COMMENT section of the trash log form. This allowed the analysts to calculate the average weight per garbage bag for the sample and extend it over the total number of bags of patron waste recorded for that meal, to arrive at an estimate of the total weight of refuse generated by patrons at each meal.

The volume of trash generated by patrons and the MCESS galley operations was recorded at the end of each day. During the test, eight dumpsters were available for disposal of trash. Of these, four were designated for patron waste, two for wet kitchen waste, and two for dry kitchen trash. At the end of each day the fill rate of each dumpster was estimated and recorded by type and origination in the appropriate columns on the trash log form. In addition to all the above, the date, mode of operation, meal, and ration type served were completed as necessary on the Trash Log form.

DATE	MODE	MEAL	RATION	KITCHEN DRY		KITCHEN WET		PATRON DRY		PATRON WET		COMMENTS
				WGT	CUBE	WGT	CUBE	WGT	CUBE	WGT	CUBE	

FIGURE 9: TRASH LOG

Customer Food Acceptance. Data were obtained in the dining facility. The interviewer would approach one of the officer candidates who had nearly or just completed his meal and ask his permission to be interviewed. The interviewer then would proceed to show the Marine a card on which was printed the standard nine-point hedonic scale of food acceptability and ask him to rate every food item he was eating as well as the meal overall on that scale. A reproduction of the rating card shown to the diner is on the next page (Figure 10).

Customer acceptability data for both A and T-rations were collected at the noon and evening meals. An attempt was made to interview 60 customers at each meal. As can be seen in Table 2, there were some deviations from this plan, the largest being on 24 July when travel delays led to the interviewer arriving on site during the final third of the noon meal and on 30 July when two companies of Marines did not subsist from the galley.

Food Service Worker Opinion. Data from workers were obtained on the MCESS galley and the T-ration by using a brief paper and pencil survey and interviews administered on a one-to-one basis to thirteen Marine cooks including the chief cooks and the dining facility supervisor. The survey included questions about the cooks' satisfaction with military service, field experience, opinions concerning the MCESS galley foodservice operation, and opinions concerning the characteristics of the ISO galley itself (See Appendix B for a copy of the survey).

The food service worker interviews probed some of the same areas more deeply and added questions specifically addressing individual pieces of equipment in the ISO galley. In addition, interview questions were asked concerning the T-ration, safety in the ISO galley, and the cooks' feelings about the entire test. A copy of the interview can be found in Appendix B.

Human Factors. Observations were carried out periodically throughout the exercise and potential problems were noted whenever observed. One human factors aspect, temperature in the MCESS galley, was more systematically sampled with temperature readings being taken daily at approximately 1000, 1200, 1400, and 1600 hours. Dry bulb and wet bulb temperature readings were taken using a battery powered Atkins Model 90023 Portable Thermistor Psychrometer.

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

FIGURE 10. FOOD RATING CARD

TABLE 2. NUMBER OF CUSTOMERS RATING FOOD ACCEPTABILITY

	A-Ration		T-Ration	
Date	Noon Meal	Evening Meal	Noon Meal	Evening Meal
24 July	-	-	32[a]	61
25 July	-	-	60	60
26 July	60	-	-	-
28 July	60	60	-	-
29 July	60	60	-	-
30 July	-	-	40[b]	60
31 July	-	-	60	-

[a] Interviews incomplete

[b] Absence of two Marine Companies

RESULTS AND CONCLUSIONS

EQUIPMENT UTILIZATION

The equipment sampling study, as previously mentioned, represents a composite day of operation for the nine major items of equipment in the MCESS galley complex in each mode of operation and for each ration type. Of the five categories of equipment activities, the "on" and "on and in use" categories have been defined as productive utilization of the equipment. The other three categories have been classified as non-productive.

The utilization rates for each major item of equipment in each of the equipment activity categories is presented in Table 3. These rates are a composite of equipment activity aggregated for the entire test period. Of the equipment sampled, the tilt fry pan, both ovens, and both steam kettles were recorded as productive more then 34% of the data collection period. The two griddles and the two steam cookers were recorded as productive less than 7% of the time (Table 3).

The low rates of productivity demonstrated by the griddles can be attributed to the fact that data on griddle type items, that is, items that would be prepared for breakfast or short order menus, were simply not recorded during the test. It is interesting to note that although the griddles were recorded as "off" most of the time, they were recorded as "off and in use" more often than any of the other items of equipment. In fact, it was observed that the griddles were utilized as serving tables and held such items as pans of cooked ham and tray packs. This may be a result of the griddles' location on the serving line and their proximity to the steam kettles.

The low utilization of the steam cookers may be a result of the cooks' expressed concern that the steam cookers provided insufficient capacity to maintain the production rate necessary to service the candidate population. This, coupled with most military cooks' inexperience with steam cookers in general, yielded a low usage rate for these items of equipment.

A more detailed delineation of the productivity rates of the five items of equipment recorded as productive at least 10% of the time for each of the galley configurations under each ration operation is presented in Table 4. In addition, a comparative analysis for each of these items of equipment between each mode and ration operation is shown in Table 4 and Table 5.

TABLE 3. EQUIPMENT UTILIZATION RATES THROUGHOUT TEST

	Off	On	On in Use	Off Awaiting Cleaning	Off in Use
Steam Kettle (6)	20.7%	5.2%	57.3%	9.8%	7.0%
Steam Kettle (2)	22.8%	5.1	58.6	8.8	4.7
Oven (5)	26.8	13.6	38.0	7.5	14.1
Oven (3)	36.6	9.9	36.6	6.1	10.8
Tilt Fry Pan (4)	47.9	3.8	30.5	12.2	5.6
Griddle (7)	69.5	.9	5.7	4.2	19.7
Griddle (1)	72.8	.9	.5	4.7	21.1
Steam Cooker (8)	93.0	0	.9	0	6.1
Steam Cooker (9)	93.9	0	.5	0	5.6

TABLE 4. PERCENTAGE OF OBSERVATIONS IN WHICH EQUIPMENT WAS "ON" OR "ON AND IN USE"

Equipment	A-1000	A-500/200	T-1000	T-500/200
Steam Kettle #2	37.5%	52.0%	72.1%	89.6%
Oven #3	50.0	60.0	55.8	43.7
Tilt Fry Pan #4	29.2	10.0	62.8	50.0
Oven #5	35.4	72.0	58.1	60.5
Steam Kettle #6	29.2	58.0	74.5	87.5

TABLE 5. COMPARISON OF EQUIPMENT USAGE IN A-RATION AND T-RATION MODES OF OPERATION

Equipment	A-1000 vs A-500/200	A-1000 vs T-1000	T-1000 vs T-500/200	A-500/200 vs T-500/200
Steam Kettle #2	ns	+24.6%*	+17.5%	=37.6%*
Oven #3	ns	ns	ns	ns
Tilt Fry Pan #4	-19.2%	33.6%*	ns	40.0*
Oven #5	36.6%*	22.7%*	ns	ns
Steam Kettle #6	28.8%*	45.3%*	ns	29.5%*

* Numerical entries in this table are the statistically reliable differences (p 0.05). Where differences are not statistically reliable; "ns" is used to indicate that the percentage difference in the two modes of operation being compared is not statistically significant.

From Table 4, both steam kettles and both ovens demonstrated a higher utilization factor in the 500/200-man modes than in the 1000-man mode for both ration operations. In fact, this higher productivity for the steam kettle and oven in the 500-man, A-ration operation and both steam kettles in the Tray Pack operations was statistically significant, as shown in Table 5.

During the test a maximum of 750 patrons were served from the MCESS galley, which is approximately 250 patrons fewer than the rated capacity of the 1000-man module. While operating in the 500/200-man modes, the cooks were requested to maintain unit integrity; to prepare food for 500 men in the 500-man module and for 200 men in the 200-man module. Thus, when the MCESS galley operated in the split mode, both the 500-man and 200-man modules were operated at, or close to, their rated capabilities. Hence, for feeding the same population, the cooks in the split modes perceived that they had to prepare an equivalent amount of food with less equipment while operating in the split mode than in the 1000-man mode, and thus allowed themselves more cooking time. This result is also reflected in the raw equipment sampling data where both steam kettles and ovens are recorded as "on" thirty minutes to an hour earlier at each meal for the 500/200-man mode operations than the 1000-man mode.

When comparing different rations operations both steam kettles and the tilt fry pan exhibit a higher utilization during Tray Pack operations than during A-ration operations as shown in Table 4. In fact, when comparing similar galley configurations, T-1000 vs A-1000, the differences in utilization were found to be statistically significant at the 5% level, as depicted in Table 5. This is a logical result since, although the steam kettles were used for serving during both ration operations, they and the tilt fry pan were used almost exclusively for the heating of Tray Packs.

Although not reflected in the data, the equipment was extremely reliable during the testing period. Only two periods of equipment downtime occurred: both steam kettles on July 22 and 23. The cause of this problem can be attributed to attempts by untrained personnel to operate the equipment.

The equipment sampling data demonstrate that most of the equipment was used extensively throughout the test. What is not shown in the data is that some of the preparation and cooking of menu items such as meat loaf and chicken cacciatore was performed in the dining facility. Cooks reported that they were concerned that the equipment capacity of the MCESS galley could not meet the population food requirements within the time constraints established by the candidate training schedule at Camp Upshur. Because of personnel constraints, it was impossible to monitor the equipment utilized in the dining facility.

The following conclusions were drawn:

1. The low productivity reported for the steam cookers clearly indicates that due to the large population fed and lower cooking capacity of the steam cookers these items of equipment will not be used and can be eliminated.

2. Although the griddles demonstrated low utilization, the extensive use of the griddles as observed during the preparation of the one breakfast meal on the 29th of July, precludes the changing or elimination of this item of equipment prior to further testing.

3. Precluding power availability, additional major items of equipment could be added to alleviate cooking and storage capacity problems. In particular, one or two extra wells could be added to the steam kettles to allow for continuous cooking during serving periods, as well as more room for serving. In addition, one or two extra ovens would increase A-ration menu preparation capabilities and hot food storage capacity.

4. Given the infrequent mixing operation experienced during the test, a mixer does not appear necessary. All mixing was performed by hand and since no complaints were reported did not create any undo hardship for the cooks. On the other hand, if a bakery operation were initiated in the galley then a mixer would be required. In this case, the choice of a mixer must conform to space and power available.

5. Any future testing of the MCESS galley complex should be conducted in an area that is significantly distant from a dining facility, in order to maintain independence of galley operations.

WORK MEASUREMENT

Work sampling data was collected on only those foodservice workers observed in the MCESS galley area, as was mentioned in the Test Design section. With the exception of salad preparation, all activities performed in the dining facility (e.g., additional cooking and all warewashing) were not recorded.* Salad preparation activities in the dining facility were recorded because this function was considered part of MCESS galley operations.

The work sampling data collected represent a composite day of cooks' and messcooks' activities for each mode and ration operation of the ISO galley. But, because of problems and events that occurred during the test, the work sampling data collected during the 1000-man operations was confounded and was eliminated from the analysis. These events included:

* Since some food preparation was performed in the dining facility as described in the equipment usage section, results reported are slight underestimates of equipment use and work load requirement.

1) both steam kettles were inoperable on the 22nd and 23rd of July, the consequences of which were that considerable food preparation and cooking was performed in the dining facility and that the work sampling scheduled for these days had to be cancelled; 2) the work sampling was rescheduled to the 26th of July which was a shortened workday with a reduced headcount because of the candidates who were granted leave; and 3) a visit to Camp Upshur by members of the Marine Corps East Coast Food Management Team, during the first week of the test some of whom participated in the food preparation and cooking activities in the MCESS galley. These circumstances were the basis for concluding that the work sampling data collected during the A-1000 and T-1000 MCESS galley operations was compromised.*

Of particular interest are those activities to which cooks and messcooks allocated their productive time for A-ration operations during the day. Productive activities have been defined as the first eight tasks listed in Figure 3.

Table 6 illustrates how the cooks allocated their time among the various productive activities in each of the two smaller operating modes. As can be seen in Table 6, the majority of the cooks' productive time was spent in preparing for cooking, and cleaning. When the percentages of cooks' time spent in preparing to cook and cooking are summed together, the allocation of cooks' productive time is approximately equal to 44% for each mode. The cooks allocated as much, or more, time to cleaning than any other individual productive activity.

The messcooks allocation of productive time for the two smaller modes is shown in Table 7. In the 500-man mode for A-ration operations, considerable time was spent by the messcooks preparing for cooking. Since messcooks are not qualified to cook, this represents their efforts in the preparation of the salads. During the split mode operation, the salad for both the 500-man mode and 200-man mode was prepared by one or two messcooks at the same time. Since it was difficult to determine at which point the salad was intended for the 500-man mode or the 200-man mode, the data collectors were instructed to record salad preparation as an activity exclusive to the 500-man mode. Excluding the first task in Table 7, the majority of the messcooks' productive time was spent in the serving and cleaning tasks, their main job function.

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* The suggested reductions in staffing levels for the T 500/200 mode of operations were not implemented, thus the work measurement data for these modes are not reported.

TABLE 6. COOKS ALLOCATION OF PRODUCTIVE TIME

	Task	A-500	A-200
1.	Prepares for Cooking	19.5%	3.2%
2.	Cooking	25.1	41.5
3.	Receives & Issues Supplies	7.8	2.1
4.	Serves	13.3	18.1
5.	Replenish	-	-
6.	Replenish Beverages	-	-
7.	Cleaning	24.6	33.0
8.	Supervision	9.7	2.1

The productive man hours expended by cooks by hour of the day in each of the smaller modes in A-ration operations is presented in Table 8. Because of the wide range of man hours expended each hour, a liberal staffing level can be determined by taking the maximum man hours expended during any hour of the day. Thus for the 500-man A-ration operation, a staffing of 4 cooks per shift would be more than adequate to provide service to 500 men. Applying similar logic, 2 cooks could provide adequate foodservice in the 200-man MCESS galley unit.

TABLE 7. MESSCOOKS ALLOCATION OF PRODUCTIVE TIME

	Task	A-500	A-200
1.	Prepares for Cooking	29.5%	-
2.	Cooking	-	-
3.	Receives & Issues Supplies	14.5	-
4.	Serves	30.6	65.6
5.	Replenish Serving Line	NM	4.3
6.	Replenish Beverages	3.9	12.9
7.	Cleaning	21.5	17.2
8.	Supervision	-	-

TABLE 8. COOKS PRODUCTIVE MAN HOURS BY HOUR OF DAY

Hour	A-500	A-200
0600	2.33	0.83
0700	2.17	1.00
0800	2.17	1.00
0900	2.17	1.83
1000	2.00	0.50
1100	2.00	0.67
1200	2.33	1.17
1300	4.00	1.83
1400	3.33	1.83
1500	3.33	1.67
1600	2.67	1.17
1700	3.33	1.50
1800	0.50	0.33
TOTAL	33.33	15.33

Similarly, the productive man hours expended by messcooks by hour of the day in each of the smaller modes for A-ration operations is presented in Table 9. Using a similar technique as above, and keeping in mind that at least one messcook was assigned to prepare beverages during the serving period, the number of messcooks required per shift would be 5 personnel in the 500-man unit and 4 personnel in the 200-man unit.

TABLE 9. MESSCOOKS PRODUCTIVE MAN HOURS BY HOUR OF DAY

Hour	A-500	A-200
0600	1.50	0.33
0700	3.33	-
0800	4.00	0.17
0900	2.50	0.17
1000	0.33	0.33
1100	4.17	3.67
1200	1.83	1.33
1300	0.67	0.17
1400	1.50	0.17
1500	3.83	-
1600	1.50	3.33
1700	1.33	1.83
1800	0.50	0.33
TOTAL	26.99	11.83

The following conclusions are drawn on service rates:

1. Insofar as the data for the A-1000 and T-1000 operations were confounded, an estimate of the required cooks and messcooks per shift in the A-1000 and T-1000 modes of operation has not been attempted.

2. Assuming a two shift operation of the ISO galley, the total staffing requirement for the smaller modes of operation would be:

	A-500	A-200
Dining Facility Manager	1	1
Cooks	8	4
Messcooks	10	8
TOTAL	19	13

SERVICE RATES

The 675 Officer Candidates at Camp Upshur during the concept test of the ISO galley constituted the galley's customer base. Candidates arrived for meals at the ISO galley by company. Each company was allocated 30 minutes to be served, eat and be back in company formation. Given that there were approximately 225 men per company, this meant that candidates had to be served at the rate of approximately fourteen men per minute in order to feed each company within the time allowed.

To assure that this minimum serving rate constraint (7 men a minute per line) would be satisfied, two specific operating procedures were established for the test: (1) Beverages were pre-poured for the candidates, and (2) all of the A-ration food and most of the tray-pack items were prepared and ready to serve before the serving lines opened so that the cooks and messcooks could devotė their attention towards serving the candidates during the actual meal period.

The results of particular interest were those rates of service that occurred after a waiting line of candidates had formed. An average service rate of 5 men per minute per line was considered sufficient to constitute a waiting line. Table 10 depicts the average service rate and standard deviation experienced in each mode of operation and each ration type when the candidates were being served at the line rate of at least 5 men per minute. The results shown in Table 10 are given in terms of only one serving line.

TABLE 10. SERVICE RATES

Mode	1000-Man		500/200-Man		Total	
Ration	Mean Men/Min.	Standard Deviation	Mean Men/Min.	Standard Deviation	Mean Men/Min.	Standard Deviation
A-Ration	7.74	1.42	7.43	1.51	7.59	1.47
Tray Pack	7.27	1.30	7.27	1.54	7.27	1.37
Total	7.48	1.35	7.36	1.52	7.43	1.42

It can be seen in Table 10 that the average service rate per line throughout the test was 7.4 men per minute. At this rate, the MCESS galley could potentially serve 1000 men in 70 minutes utilizing two lines, 500 men in 70 minutes with one line, and 200 men in 30 minutes with one line. These rates assume a continuous line of patrons, which may not always exist. A second assumption is that storage areas for prepared food would be available so that most, if not all, of the food would be ready to serve before the beginning of a meal period.

Table 10 also indicates that operating modes had little or no effect on service rates. This result is quite logical since most, if not all, of the food was prepared before the ISO galley was open for service. Thus, when the galley opened, all of the cooks' and messcooks' attention could be devoted towards serving the candidates.

Not listed in the table is the range of rates for serving. Of particular interest are those service rates that were considerably higher than those indicated in the table. Service rates attained values of up to 13 men per minute and were sustained for a minimum of five minutes. These rates indicate that a higher rate of service is possible than the above averages indicate.

It was concluded that the existing ISO galley can serve the noon and evening meal to a battalion-size population, about 1000 men, within an adequate time period, provided the food is ready to serve prior to opening the serving line, and adequate storage for this food is available.

POWER

An important area of consideration concerning the operation of the entire ISO galley was whether one 60-kW generator for each galley container could provide sufficient power for all the equipment in that container. To determine this, electrical metering devices were connected to the power lines for each container. These devices recorded the power consumption of each container on strip charts. A small section of a strip chart taken from galley 3 during the test is shown in Figure 11. The horizontal curved lines represent time intervals of 10 minutes and the vertical straight lines are the power readings in increments of 2 kW. The darker jagged lines appearing on the chart are the recordings of actual power usage. For purposes of this analysis, peak power demand for any segment of time was defined as the highest recorded value of power usage during that time. For example, the peak power demand between 7 AM and 8 AM on the sample strip chart shown in Figure 11 is 30 kW.

Unfortunately, the recorders to galleys 1 and 2 developed some malfunctions during the test, causing them to exhibit unreliable readings. The data taken from these recorders, therefore, were not used in determining the results and conclusions of this test. However, the power recorder for galley 3 did provide reliable readings throughout the entire test period. Since, according to manufacturers' specifications, the total power draw of the equipment items in galley 1 and the kilowatt draw of the equipment in galley 2 was considerably less than that of galley 3, it was assumed that the readings from galley 3 would be indicative of the power demand of all three galley containers.

Moreover, electrical air curtains were installed on the entrance and exit doors of the two access shelters on 25 July 1980. Since these curtains were not included in the original MCESS galley design concept, they were not included in the calculation of the projected power requirements. In addition, the coffee makers and toasters, originally specified in the design concept, were removed from the MCESS galley, since coffee and toast was not served during the test. The impact of including these items of equipment will be addressed in the recommendations section of this report.

Table 11 shows the peak power demand for galley 3 for each day of the test period. The maximum draw for power of 51 kW was noted on July 23 and July 29. This peak power demand occurred while the ISO galley was in the 1000-man and the 500-man modes of operation, indicating that power requirements are related more to the menu offered than to the mode of operation.

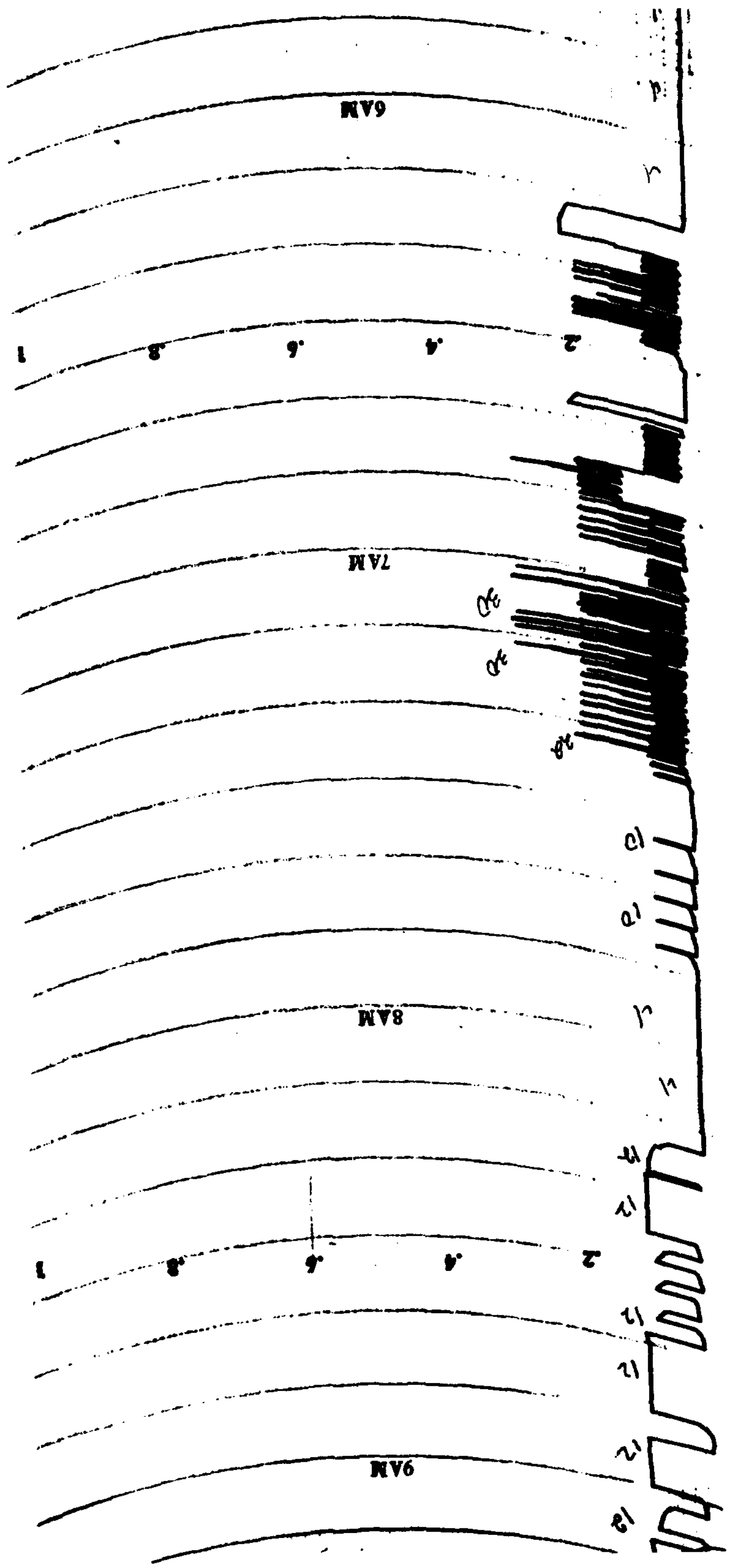

FIGURE 11: SAMPLE POWER STRIP CHART

TABLE 11. DAILY PEAK POWER DEMAND (GALLEY 3)

Date	Ration Served	Mode of Operation	Readings
July 22	A	Large Module	31 kW
23	A	Large Module	51
24	Tray Pack	Large Module	45
25	Tray Pack	Large Module	41
26	A	Large Module	38
28	A	Intermediate Module	40
29	A	Intermediate Module	51
30	Tray Pack	Intermediate Module	33
31	Tray Pack	Intermediate Module	44

Although the above analysis discussed power consumption in terms of peak power demand, peak power demands occurred over small intervals of time rather than for an entire day. This particular point is borne out in Figure 12, which shows graphically the changes in peak power demand by half-hour increments on July 29th. On this date, the highest recorded power consumption between 0100 and 0130 hours was 51 kW, which then fell to a high of 27 kW during the next half-hour period. As can be seen in Figure 12, this decline in power consumption did not occur instantaneously, nor was the 51-kW draw maintained for the entire half-hour period between 0100 and 0130.A non-peak draw of 2 kW was also recorded on the strip chart. Hence, it must be emphasized that since this analysis addressed peak power demands„a worst-case situation is being presented.

Table 12 presents, by operation, the maximum and minimum peak power draws recorded on the 29th of July 1980. Since this was the only day that breakfast was prepared and served in the MCESS galley, the 29th represents the projected daily power usage which could be expected during an entire day of galley operations.

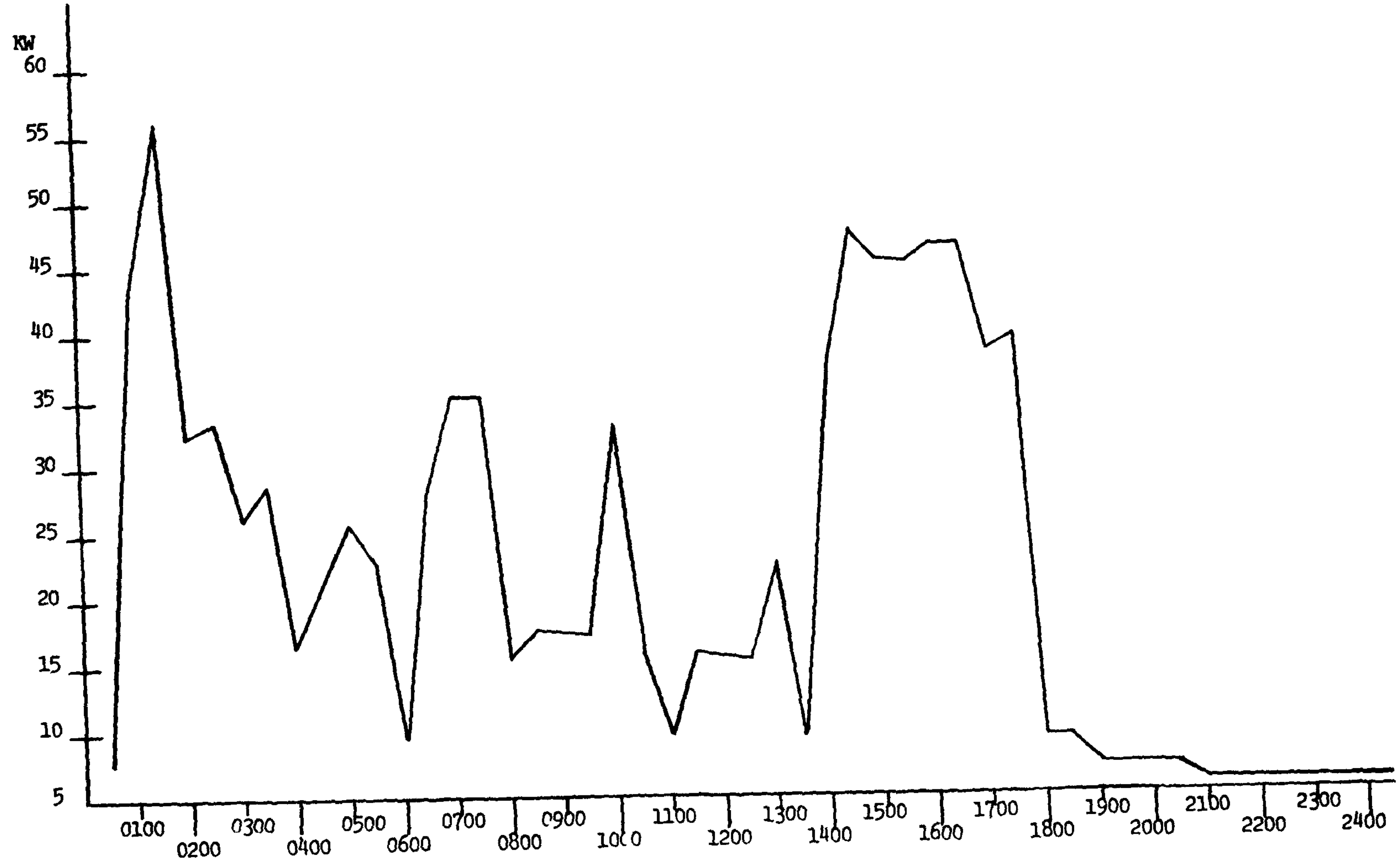

FIGURE 12: PEAK POWER DEMAND

TABLE 12. MINIMUM AND MAXIMUM PEAK POWER DEMANDS BY OPERATION (29 July 1980)

	POWER	DEMANDS
Operation	Minimum	Maximum
Preparing Breakfast	23 kW	51 kW
Serving Breakfast	17	20
Preparing Lunch	12	30
Serving Lunch	10	17
Preparing Dinner	32	42
Serving Dinner	37	41
ISO Galley Secured	1	2

Maximum power draw occurred when breakfast was being prepared. During this time, all of the equipment being metered was productive — the oven had bacon cooking in it, the steam kettle was boiling water, and the griddle was being used to cook hash browns and French toast. In general, more kilowatts of power were consumed when a meal was being prepared than when it was being served. The approximate equivalent power draws for preparing and serving the dinner meal is attributed to the fact that a runout of ham occurred which caused the cooks to re-start the ovens during the serving period. Although the ovens were in use during the meal due to extraordinary circumstances, it can be inferred from this that some progressive cooking can be accomplished in the MCESS galley.

The following conclusions were drawn:

1. The inclusion of the coffee urn and toaster in galley 3 removed at the start of the test may incur a power requirement in excess of the power available from a 60-kW generator. These items, according to manufacturers' specifications, would draw approximately 12 kW of additional power, which when added to the peak power demand of 51 kW is 3 kW over the 60-kW constraint. However, suitable items requiring less power could be substituted to enable all the equipment in galley 3 to operate within the established power constraint.

2. Any changes to the configuration of galley 3 and for that matter galley 1, such as the addition of electrical equipment, will require a more detailed analysis of the power requirements of the individual items of equipment in the MCESS galley.

FUEL

The M-80 hot water heater was the only item of equipment that required diesel fuel during the test. From the manufacturer's specification, and from tests performed at NLABS,[7] it is known that the M-80 hot water heater consumes 5 gallons of diesel gas for every hour the burner motor is on. As previously mentioned, a record of the total time that the burner unit was on was maintained by the data collectors. During the entire test, the M-80 hot water heater was recorded as "on" for a total of 1.7 hours. Given the requirement of 5 gallons of diesel fuel per hour of operation, the total fuel required to operate the M-80 heater for the two weeks of the test was 8.5 gallons. This result is logical since most, if not all, of the warewashing activities (a function requiring considerable amounts of hot water) were performed in the dining facility, and hot water required for food preparation was generally heated within the cooking vessels themselves, that is, the steam kettles and the tilt fry pan. Warewashing was performed in the dining facility since this function is not a part of the ISO galley but is relegated to the sanitation section of the MCESS foodservice unit which is scheduled for testing in FY 1982.

Although power for the ISO galley was provided by commercial sources, an estimate of the fuel required to operate the generators as specified in the concept design was undertaken. Initially, three 60-kW generators were to provide power to the ISO galley, one generator to each of the three center containers, for a total power availability of 180 kW. As an alternative, it has been suggested that one 200-kW generator be used. This 200-kW generator would provide power to a junction box from which each of the three center containers of the ISO galley would derive their power. Both concepts of power generation are analyzed herein.

From the manufacturer's specifications, a 60-kW generator, designated MEP006, consumes 10 gallons of diesel fuel for every 100-kW hours of power used, and a 200-kW generator, designated MEP009, consumes 5 gallons of diesel gas for 100-kW hours of power used. Since the power-time recorders for galley 1 and 2 were unreliable, the hourly peak power usage of galley 3 for July 29th, as shown in Figure 11, was summed to estimate the daily power usage in kilowatt-hours for one container, assuming that the peak power usage recorded in any hour would remain constant for the entire hour.

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7 Aero-Mechanical Engineering Laboratory, Heater, Water and Circulation System for Field Kitchen M1975 (Hot Water Heater M-80), Draft Technical Manual, August 1977.

The 29th of July was chosen since breakfast as well as lunch and dinner were prepared and served in the MCESS galley. The peak power usage for this day totaled 516 kilowatts-hours amounting to 51.6 gallons of fuel required to operate a 60-kW generator or 25.8 gallons of fuel required to operate a 200-kW generator.

The following conclusions were drawn:

1. Since the warewashing function is to be performed in the sanitation section of the MCESS foodservice unit, only a minimal amount of preheated water will be required by the galley. Thus, the M-80 hot water heater connected to the galley will require only a small amount of diesel fuel.

2. Assuming that the peak power usage recorded for galley 3 during the test is the maximum power usage for any three of the center containers, then the maximum amount of diesel fuel required to operate each generator set would be:

3 - 60-kW generator (MEP006) = 154.8 gallons/day

1 - 200-kW generator (MEP009) 77.4 gallons/day

WATER

During the test, the following three types of water consumption measurements were taken: (1) total water usage, (2) food preparation water usage, and (3) discharge water usage. Unfortunately, the hot water meter became inoperative before the test began, and measurements could not be taken for hot water usage.

As mentioned in the discussion of the results of the equipment sampling study, during A-1000 operations, the steam kettles became inoperable and as a result all cooking activities had to be performed in the dining facility. This situation has compromised the water usage data for the A-1000 operation and therefore, the A-1000 operation has been eliminated from this analysis.

The average amount of water used to feed 500 men is presented in Table 13 by type of water for each mode and ration operation. Although hot water usage is not directly portrayed in Table 13, a gross indication of the amount of hot water used to feed 500 men in each mode and ration operation can be obtained by subtracting Food Preparation water from Total water. However, this difference also includes water which was lost due to leaks and bursting hoses. Also, the difference between the amounts of food preparation and discharge water used represents the water which was absorbed by the food which was prepared in the galley, spills, and some water used for cleaning.

Although a wide variation in water usage was noted during the test, the average water usage data in Table 13 is indicative of the water usage to be expected in each mode at the 500-man feeding level. The average water usage data for the intermediate/small modules is a combined average for each of the two small modes of operation since the Total and Discharge water usage rates could not be separated by mode.

Average total water usage varied by no more than 40 gallons per meal at the 500-man feeding level. Food preparation water amounted to 50%-70% of the total water usage in each ration operation. Between 50 and 60% of the food preparation water was disposed of in the sink of the galley.

TABLE 13. WATER USAGE PER 500 MEN/MEAL (GALLONS)

MODE	TOTAL	FOOD PREPARATION	DISCHARGE
A-Large Galley Module*	-	-	-
T-Large Galley Module	145.8	87.9	50
A-Intermediate/Small Module**	144.6	78.3	47.3
T-Intermediate/Small Module**	109.6	81.5	40.4

* Test was compromised.

** Combined.

Beverages were purchased already blended; thus no water was required to prepare beverages during this test. The average water consumption for food preparation, excluding beverages, in each mode for A-ration operations per meal, would be:

Large Galley Module:	176 gal/1000 men
Intermediate Galley Module:	80 gal/500 men
Small Galley Module:	39 gal/200 men

It can be concluded that the overall average water consumption rate for 500 men would be approximately 125 gallons of which 80 gallons would be used in food preparation.

REFUSE

Table 14 presents the average weight of refuse generated in the MCESS galley and by patrons at each meal based on a feeding level of 500 men. The data shown for the intermediate/small module is the combined weight for both modules, since circumstances at the test site did not allow refuse from each of the two smaller modes of operation to be separated. Patron refuse, as defined in the methodology section, consisted mainly of disposables and plate waste. However, since the candidates were under considerable physical stress (and thus hungry) and since second helpings were not allowed, very little plate waste was noted. Kitchen waste consisted of both dry trash and wet garbage as defined earlier.

Although Table 14 indicates that the average weight of all refuse varied by only 70 pounds, in actual fact the total weight of refuse generated in the galley and by patrons at the 500 man feeding level varied from a low of 275 pounds to a high of 500 pounds at each meal. Table 14 also indicates that the weight of kitchen waste amounted to slightly more than half the weight of refuse generated by the patrons.

TABLE 14: WEIGHT OF REFUSE (POUNDS)

	PATRON	KITCHEN	TOTAL
Large Module	276	143	419
Intermediate/Small Module	200	148	348

Table 15 lists the average volume of refuse generated by the ISO galley and patrons at each meal based on a feeding level of 500 men. The volume of kitchen waste never exceeded one-third the volume of patron waste. This is logical since kitchen waste consisted of proportionately higher amounts of wet garbage than the patron waste did -- the kitchen waste had a higher density than patron refuse. The total volume of refuse generated by a 500 man feeding level amounted to no more than one dumpster.

TABLE 15: VOLUME OF REFUSE

	PATRON	KITCHEN	TOTAL
Large Module	147 ft^3	44 ft^3	191 ft^3
Intermediate/Small Module	138 ft^3	40 ft^3	178 ft^3

Assuming that Tables 14 and 15 can be extended to include a breakfast meal, then it can be concluded that average daily weight and volume of refuse generated by the ISO galley and by patrons using disposables, for each of the three ISO galley levels of service, is as presented in Table 16.

TABLE 16. DAILY REFUSE DISPOSAL

MODE	FEEDING LEVEL	WEIGHT	VOLUME
Large	1000 men	2300 lbs	1100 ft^3
Intermediate	500 men	1150 lbs	550 ft^3
Small	200 men	460 lbs	220 ft^3

CUSTOMER FOOD ACCEPTANCE

The customer food acceptance ratings are summarized in Table 17. All Tray Pack entrees, starches, and vegetables were rated between 6 and 7 on the hedonic scale — between "like slightly" and "like moderately." The Tray Pack desserts received higher ratings. Tray Packs have been rated in previous Air Force field exercises and were typically rated from one to two hedonic scale points higher by Air Force personnel. However, the Air Force serves more than one entree at a field meal and one would expect that to lead to higher customer ratings.

TABLE 17. A COMPARISON OF A-RATION AND TRAY PACK FOODSERVICE DURING THE MCESS GALLEY TEST IN JULY 1980

A-RATION

Entrees

N *		Hedonic Mean	
(120)	Baked Ham	6.85	
(58)	Chicken Cacciatore	6.43	
(60)	Pork Chop Sue	6.42	
(60)	Meatloaf	6.33	
	Overall Mean		6.51

Starches

N *			
(114)	Rice	6.13	
(19)	Sweet Potatoes	6.05	
(54)	Mashed Potatoes	5.94	
(56)	Buttered Noodles	5.29	
	Overall Mean		5.85

Vegetables

N *			
(11)	Cauliflower	6.79	
(43)	Frozen Mixed Vegetables	6.67	
(47)	Corn	6.55	
(35)	Creamed Corn	6.51	
(16)	Peas	6.44	
(11)	Green Beans	6.27	
(32)	Lima Beans	6.16	
(45)	Wax Beans	6.15	
	Overall Mean		6.43

T-RATION

Entrees

N*		Hedonic Mean	
(61)	Chicken Stew	6.98	
(60)	Chicken A la King	6.82	
(32)	Beef Stroganoff	6.78	
(61)	Lasagna	6.67	
(60)	Salisbury Steak	6.42	
(39)	Stuffed Peppers	6.03	
(60)	Sliced Turkey	6.00	
	Overall Mean		6.53

Starches

N *			
(230)	Diced Potatoes	6.24	
	Overall Mean		6.24

Vegetables

N *			
(122)	Corn	6.78	
(11)	Lima Beans	6.73	
(28)	Green Beans	6.61	
(21)	Stewed Tomatoes	6.48	
(118)	Peas	6.31	
	Overall Mean		6.56

*Number of subjects sampled

TABLE 17
(Continued)

A-RATION

Entrees	Hedonic Mean
Desserts	
N *	
(170) Cookies	7.69
(74) Cake	7.50
(75) Brownies	7.34
Overall Mean	7.51

T-RATION

Entrees	Hedonic Mean
Desserts	
N *	
(19) Apples (Cold)	7.76
(28) Cherry Nut Cake	7.07
(46) Blueberry Compote	6.94
(38) Cherries in Sauce	6.53
(38) Orange Nut Cake	5.29
Overall Mean	7.08

The following were also served in the tray pack menu although they were in #10 cans.

Desserts N *	Hedonic Mean
(15) Butterscotch Pudding	7.60
(22) Canned Pears	7.59
(35) Chocolate Pudding	7.46
(12) Sliced Peaches	7.42
(38) Lemon Pudding	7.29
(33) Vanilla Pudding	7.29
Overall Mean	7.44

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

*Number of subjects sampled

Further, one cannot be certain that food acceptance ratings given by officer candidates eating in a garrison dining facility in a relatively stressful setting such as that at Camp Upshur would be similar to ratings given by typical Marines eating in the field. Nevertheless, ratings in the 6 to 7 hedonic range are clearly acceptable. Incidentally, note that the desserts packed in #10 cans which were served with the Tray Pack meals were all rated above 7.

Even more relevant than the absolute hedonic ratings given the Tray Packs by the Camp Upshur candidates is the comparison of their Tray Pack ratings to their ratings of A-ration foods. As can be seen, with the exception of desserts, Tray Packs were rated about the same or higher than the A-ration, on the average. In other words, even though they were eating field food in a garrison dining facility, these Marine officer candidates perceived Tray Packs as being at least as good, and in some instances better than the A-ration food served.

FOOD SERVICE WORKER OPINIONS

Demographics. The 13 food service workers interviewed and surveyed (see Appendix B for survey and interview forms) included five E-2's, three E-3's, two E-4's, two E-5's and one E-6. With the exception of the two chief cooks and dining facility supervisor who had each participated in six or more field exercises, their field experience was quite limited. Five of the cooks (38%) had never cooked in a field kitchen before and the remaining five cooks (38%) had only cooked in one field kitchen. Their attitudes toward the military were fairly positive with three cooks (23%) saying they disliked military service, four (31%) reporting they were neutral about the military, and the remaining six (46%) saying they liked military service.

The Food Service System. Table 18 provides the mean food service worker ratings of the status of nine factors in the food service operation during the Camp Upshur test. The data in the table represent responses on seven-point survey scales by the cooks and can be summarized as follows. The cooks were quite positive about the leadership from the dining facility supervisor, support and cooperation among cooks, leadership from their shift leader, proper maintenance of equipment, and their own food preparation skills. Menu variety, both at a given meal and from day to day, was rated between "neither bad nor good" and "slightly good." Sanitary conditions received a mean rating of "neither bad nor good". The only negative rating, and then only slightly below neutral, was for customer satisfaction.

Specific Features and Equipment in the MCESS Galley. Table 19 shows the ratings of ten specific features of the ISO Galley again on a seven-point scale. The cooks were most positive about the lighting, how long the customer waits in line, the condition of equipment, how easy it was to clean up after a meal, and how easy it was to serve customers. The ease of preparing the food on the menu was rated only slightly above neutral, while the temperature in the ISO Galley was rated between "neither bad nor good" and "slightly bad." The three major complaints of the cooks according to these ratings were concerned with space in the galley. Kitchen size, amount of storage space, and bumping into other cooks while working were all rated some degree of "bad." The mean rating given the kitchen overall was 3.86, slightly below "neither bad nor good."

TABLE 18. MEAN FOOD SERVICE WORKER RATINGS OF THE STATUS OF NINE FACTORS IN THE CAMP UPSHUR TEST FOOD SERVICE SYSTEM

Factor	Mean Rating*
Leadership from dining hall supervisor	6.08
Support and cooperation among cooks	5.79
Leadership from shift leader	5.73
Proper maintenance of equipment	5.46
Food preparation skills of the cooks	5.21
Menu variety at a given mean	4.57
Menu variety from day to day	4.57
Sanitary conditions	4.00
Customer satisfaction	3.86

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

TABLE 19. MEAN FOOD SERVICE WORKER RATINGS OF TEN FEATURES OF THE MCESS GALLEY

	Mean Rating*
Lighting	5.79
How long customer waits in line	5.67
Condition of equipment	5.50
How easy to clean up	5.21
How easy to serve customers	4.86
How easy to prepare the food on the menu	4.14
Temperature	3.57
Bumping into other cooks while working	3.50
Amount of storage space	3.29
Size of the kitchen	2.79
OVERALL	3.86

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

The problem of workspace in the kitchen was followed up in a more detailed question. Worker response was quite negative with the kitchen workspace being rated a 2.0 or less by 69% of the food service workers (See Table 20). Five workers, including the dining facility supervisor and the two chief cooks, reported that the workspace was much too small/confining.

A general comment should probably be made at this point concerning the workers' perceptions of the MCESS galley as a field kitchen. In the interviews, cooks had to constantly be reminded that this was the case. This is not surprising since the cooks quite freely made use of the permanent galley they were situated next to for some of the food preparation. Further, some of their negative comments seem to be based on the difficulty they experienced attempting to extrapolate from cooking in the parking lot of a permanent dining facility to cooking in the field. Clearly, the best test of any field system should be seen in the field, away from permanent facilities.

The survey questions about the MCESS Galley were expanded on by general interview questions asking the workers what they liked and disliked about it. The most frequent response concerning what they liked about the galley, that it was better than a tent, reflected the ability of at least some of the cooks to see the MCESS Galley as a field kitchen. Another frequent comment (from the same set of cooks) was that they preferred the electric cooking equipment in the galley to the liquid fuel fired M-2 burners typically used in the field. The three other positive comments made by more than two cooks concerned the equipment, ease of cleaning, and compactness of the galley.

Frequent answers to the question asking what they disliked about the MCESS Galley were that it was too small, that there were too many people to feed in too short a time, that the water on the floor was difficult to remove, that the screens on the doorways were inadequate, that more steam table wells were needed, and that the drains on the steam line were unsafe.

A series of follow up interview questions asked about the serving line, ovens, pressure steamers, counters, and tables, and space to heat the Tray Packs. When asked if extra steam table wells were needed, only one cook said no. Approximately 1/3 of the cooks said one more was needed while nearly 1/2 (46%) felt that two extra wells were needed. Another question asked how many more ovens, if any, were needed. Only one cook said the present number was adequate and over 2/3 of the cooks (69%) felt that two additional ovens were desirable.

The 11 cooks who had either used the pressure steamers or who as supervisors had observed them being used were all in agreement that they worked very well. They were also all in agreement that they should be larger; specifically, large enough to take a full-size steam table insert. All of the cooks agreed that there were enough counters and tables in the ISO Galley. As a matter of fact, four of the cooks (31%) felt that there was too much counter and table space.

TABLE 20. FOOD SERVICE WORKER RATINGS OF KITCHEN WORKSPACE (N=13)

1	Much too little	38%
2	Somewhat too little	31%
3	A bit too little	23%
4	Just about right	8%
5	A bit too much	0
6	Somewhat too much	0
7	Much too much	0

There was a little disagreement about whether there was enough space to heat tray packs. One cook ventured no opinion, ten felt the space was adequate, while two thought more heating space should be provided.

The workers were also asked if they felt that any equipment should be added to the ISO Galley to make their job easier or the food better. As might be expected with such an open ended question quite a variety of answers were given. Nevertheless, there was some agreement on two items of equipment with five cooks (38%) recommending the addition of a steam-jacketed kettle (a "copper"). Their rationale was that they could not cook and serve at the same time with the serving line performing both functions as it does in the ISO Galley. Four cooks (31%) also recommended that one more tilt fry pan be added.

Probing more specifically, questions were also asked about the addition of holding cabinets and refrigerators to the inside of the MCESS Galley. Eleven of the twelve cooks who answered the question (92%) felt that holding cabinets would be very useful in maintaining temperature of both the Tray Packs and A-ration food after it was cooked. There was more of a split on the question of refrigeration. The majority of cooks (75%) felt that the outside refrigeration units used at Camp Upshur were adequate. The other quarter of the cooks thought a small refrigerator should be installed under the counter in the MCESS Galley.

A question asking what equipment could be eliminated from the galley elicited only the response of some of the tables or counters.

Tray Packs. The cooks were asked what they thought of the idea of using Tray Packs in general. Seven cooks (54%) were positive about their potential use in field feeding, five (38%) were neutral seeing both advantages and disadvantages, while only one cook (8%) was negative about them. Positive aspects of the Tray Packs mentioned included that they could be ready at any time and that they would be very easy to store in the field. Negative aspects mentioned were that they were too much trouble to open and that a single Tray Pack held too few portions.

The cooks were also asked whether the A or T-ration was easier to prepare and which was easier to clean up after. Two thirds (67%) of the twelve cooks answering the question felt that the T-ration was easier to prepare, three (25%) perceived the A-ration as being easier, and one (8%) thought they were equally easy to prepare. More than 3/4 of the cooks (83%) felt that the T-ration was easier to clean up after. One thought cleanup was easier after an A-ration meal, and one felt that they were about the same.

Temperature. The cooks were also asked about the heat in the ISO Galley. Three cooks (23%) perceived it as being too hot. Five cooks (38%) also said that the ISO Galley was hot, but that you had to expect a kitchen to be hot and the ISO Galley was not particularly bad in that respect. The remaining five cooks (38%) said that the temperature was all right.

Safety. Cooks were also asked to list any safety hazards they had observed in the ISO Galley. In order of the frequency with which they were volunteered, by at least two cooks, there were burns received from the drain on the steam line, hitting their heads on the low portion of the ceiling, bumping into other cooks while working, and being burned from the steam that escapes through the rounded corners of the Tray Packs on the serving line.

The Test. As a final interview question, the cooks were asked whether they thought Camp Upshur test was a good test of the MCESS Galley. Five (38%) thought that it was a good test; eight (62%) felt that it was not. Those who felt that it was a good test gave as reasons that there were lots of people to feed and that the MCESS Galley was located next to the regular dining hall if something went wrong.

The cooks who thought it was a bad test said that it should have been conducted in the field, that it was too close to the permanent galley which was often used, and that there was too much pressure to feed too many candidates in too short a time period.

When asked how the test could have been better, the cooks' answer was unanimous. The ISO Galley should have been tested in the field.

Conclusions. Worker opinion data must be tempered by the facts that most of the cooks had little or no field experience and that the MCESS Galley was not tested in the field. The major complaint about the galley centered around lack of workspace. Some complaints were also made about the heat in the galley. Those cooks with field experience favored the MCESS Galley over a tent and electrical cooking over M-2 burners. Some suggestions were made for adding equipment; the general consensus seemed to be to add two extra wells to the serving line, two ovens, holding cabinets, a steam jacketed kettle, and an extra tilt fry pan. Most felt that the pressure steamers should be enlarged. A slight majority of cooks were favorable about Tray Packs; in general, 2/3 felt they were easier to prepare than the A-ration, and over 3/4 felt clean up was easier with them. In general, then, the cooks found both the ISO Galley and the Tray Packs to be acceptable overall, but with some limitations.

HUMAN FACTORS

ISO Galley Temperatures. Table 21 presents temperatures measured at various locations in the MCESS Galley in Effective Temperature (ET) ^{o}F. Effective temperature is an empirical thermal index based on dry bulb and wet bulb temperatures and air movement in terms of subjective feelings of warmth. In 100% humidity dry bulb and wet bulb temperatures are equal; with less than 100% humidity wet bulb temperature is lower than dry bulb. At 100% humidity, 80^{o}F, feels hotter than 80^{o}F at lower humidity. Further, human performance is correlated with feelings of warmth. Effective temperature, then, takes humidity and dry bulb temperature into consideration. For example, the 79^{o}F (ET) ambient temperature taken on 25 July at 1432 hrs resulted from an 84.5^{o} dry bulb and a 73.5^{o} wet bulb reading. On 30 July at 1545 hrs, the dry bulb temperature was higher, 86^{o}; but the lower humidity on that day led to a wet bulb reading of 72.5^{o} and a resultant 79^{o} (ET). It was hotter on 30 July, but less humid so that in terms of subjective feeling of warmth and potential effect on human performance, the two days' readings are identical.

TABLE 21. USMC MCESS GALLEY TEST EFFECTIVE TEMPERATURE IN F°

Date, Ration Type, and Time	Ambient	Griddle #1	Steam Kettle #2	Tilt Fry Pan	Oven #5	Steam Kettle #6
25 Jul T 1432	79	81.5	82.5	82.5	80.5	81.5
26 Jul A 1000	74	78	78.5	79.5	78	78
26 Jul A 1215	77	78.5	82	80.5	79.5	80.5
26 Jul A 1322	79	81	81.5	81.5	82.5	84
26 Jul A 1400	81	82.5	83	82	82.5	83.5
28 Jul A 1000	71.5	73	76	75	74	76
28 Jul A 1212	73	75	77	75	77	77
28 Jul A 1400	78.5	81	81	83	84.5	82
28 Jul A 1540	78	81	81.5	80.5	80	81
29 Jul A 0955	74	78	78	77.5	81	78
29 Jul A 1200	75.5	78.5	78.5	78	78	78.5
29 Jul A 1418	77.5	79.5	80	79.5	83.5	81
29 Jul A 1550	77	80	80	79	84.5	70.5
30 Jul T 0952	72.5	76	77	76	79	78
30 Jul T 1203	77	78	78	79.5	79.5	79
30 Jul T 1400	79.5	82	82.5	82.5	82	82.5
30 Jul T 1545	79	83	83.5	84	84	83
31 Jul T 1000	75.5	78	80	78	78	78
31 Jul T 1149	78	80.5	81	82	80	80
	T ration	+2.6	+3.4	+3.4	-3.2	+3.1
	A ration	+2.5	+3.4	+2.9	-4.0	+3.7
	All	+2.6	+3.4	+3.1	3.7	+3.4

Mean	from ambient overall	T ration	+3.2
		A ration	+3.3
		All	+3.3

Temperatures measured in the MCESS Galley were, on the average, only 3.3°F higher than ambient temperatures and never exceeded the 85°F (ET) maximum for prolonged exposure set by MIL STD 1472. However, since ambient in this test never exceeded 81°F (ET) it is not certain how the MCESS Galley would fare in higher ambients.

By its very nature a human factors evaluation report tends to focus on problems. In general, the human factors aspects of the ISO Galley were quite good. A few areas to be noted are:

- The screens on the doors were very difficult to fasten from the inside, impossible to fasten from the outside, and impossible to open when carrying things.

- There was very little storage space in the MCESS Galley.

- The top of doorway openings, ISO separaters, and hoods over the grills were too low.

- There was no kick-space under the serving line.

- The small gap between the steam line and the tray rest should be covered to preclude the potential sanitation problem caused by food dropping between the two.

- The step into the shelter is a potential tripping hazard.

- The power supply is located directly over the sink. If there is any possibility of separating these two the galley would be safer.

It can be concluded that from the human factors point of view the MCESS Galley is generally adequate with some noted exceptions. To be certain about the temperature aspects of the galley, it should be tested in higher ambient temperatures.

RECOMMENDATIONS

This section presents the recommendations resulting from the analysis of the data and from direct observations of everyday operations. These recommendations are separated into two parts: (1) Equipment Changes, and (2) Other Recommendations.

EQUIPMENT CHANGES

The following ISO galley reconfiguration reflects only those changes that observation and data indicated were needed for the 1000-man A-ration operation of the ISO galley complex. It is not suggested tha. these changes be implemented immediately, but that they be reviewed in conjunction with evaluating the ISO galley Marine Corps mission and costs associated with the changes.

A major constraint established at the start of this effort was that each of the three center shelters of the ISO galley, the main food preparation areas, use less than 60 kW of power. Although the incorporation of a 200-kW generator has been discussed in this report, the utilization of three 60-kW generators for providing power to the ISO galley, as discussed in the concept design, will be the basis for recommending the following equipment changes. Table 22 presents the expected maximum power usage of each of the three galley containers as they were electrically wired for the test at Camp Upshur. All 115-volt equipment is added to the grand total power usage at nameplate, that is, at the manufacturer's rating, while all 208-volt equipment is added at 70% of the manufacturer's rating. This is a standard electrical engineering procedure to allow for the cyclic demand for power by equipment requiring 208 volts by way of temperature sensitivity.

An oven set at 300°F would draw 11 kilowatts of power until its internal temperature attained 300°F, then its demand for power would drop to 0 until the oven temperature fell below some predetermined level, at which point the oven would again draw 11 kilowatts until the temperature reached 300°F. Since it can be expected that all 208 volt equipment would not be drawing power at the same time due to temperature sensitivity, a cyclic demand for power is established. Table 22 shows that when all equipment items are on, the demand for power in galleys 1 and 3 is very close to the pre-established constraint of 60 kilowatts, while galley 2 has a considerable amount of power remaining.

Table 23 depicts the recommended changes to the ISO galley configuration and the effects on power when implementing these changes. The following is a discussion of each change and their effects on the galley's operation:

1. Change #2 removes the reefer from galley #1, the M-80 hot water heater and water pump from galley #3 and relocates them onto the electrical lines to galley #2. This reduces the power demand of galley 1 and 3, and makes more efficient use of the available power in galley #2.

TABLE 22. MAXIMUM POWER USAGE

EQUIPMENT	Galley 1	Galley 2	Galley 3
Exhaust Fan	1.5 kW	1.5 kW	1.5 kW
Lights	1.5	1.5	1.5
Air Curtains	.6	-	.6
Fan (Stand Ups)	.3	-	.3
Water Pump	-	-	.3
M-77 Heater	-	-	1.2
Slicer	-	0.3	-
Vegetable Cutter	-	0.3	-
Total 115V Equipment	3.9 kW	3.6 kW	5.4 kW
3 Well Steam Kettles	32.4 kW	-	32.4 kW
Grill	16.0	-	16.0
Oven	11.0	-	11.0
Steam Cooker (2)	-	21.6	-
Tilt Fry Pan	-	15.0	-
Reefers	3.0	3.0	-
Total 208V Equipment	62.4	39.6	59.4
	x.7	x.7	x.7
	43.7	27.7	41.6
Total 115V + 208V	47.6	31.3	47.0

TABLE 22

(Cont'd)

Equipment	Galley 1	Galley 2	Galley 3
Present Coffee Urn	12.0		12.0
Toaster	5.0 17.0 x.7 11.9		5.0 17.0 x.7 11.9
Grand Total	59.5	31.3	58.9

TABLE 23. PROPOSED CHANGES, FOR 1000-MAN OPERATION, EFFECT ON POWER

CHANGE	Galley 1	Galley 2	Galley 3
1. NO CHANGE	59.5 kW	31.3 kW	58.9 kW
2. Reefers, M77 Heater + Water Pump to Galley 2	- 2.1 kW	+3.6 kW	-1.5 kW
SUBTOTAL	57.4 kW	34.9 kW	57.4 kW
3. a) Remove current Coffee Urn	-12.0 kW	-	-12.0 kW
	x.7		x.7
	-8.4 kW		-8.4 kW
SUBTOTAL	49.0 kW	34.9 kW	49.0 kW
b) Add Bunn-O-Matic RL 35	+4.6 kW	-	+4.6 kW
	x.7		x.7
	+3.2 kW		+3.2 kW
SUBTOTAL	52.2 kW	34.9 kW	52.2 kW
4. Add one well to Steam Kettles	+10.8 kW		+10.8 kW
	x.7		x.7
	+ 7.6 kW		+ 7.6 kW
SUBTOTAL	59.8 kW	34.9 kW	59.8 kW
5. Remove Steam Cookers		-21.6 kW	
		x.7	
		-15.1 kW	
SUBTOTAL	59.8 kW	19.8 kW	59.8 kW
6. Add Holding Cabinet (H138CDD 1834 Crestcore)		+ 1.5 kW	
SUBTOTAL	59.8 kW	21.3 kW	59.8 kW
7. Add 2 Ovens to Galley 2		+22.0 kW	
		x.7	
		15.4 kW	
SUBTOTAL	59.8 kW	36.7 kW	59.8 kW

TABLE 23

(Cont'd)

CHANGE	Galley 1	Galley 2	Galley 3
8. Add 2 Under-Counter Refrigerators (Hobart J-1)		+1.7 kW	
SUBTOTAL	59.8 kW	38.4 kW	59.8 kW
9. Add 60 Quart Mixer (Hobart H-600)		+1.2 kW	
TOTAL	59.8 kW	39.6 kW	59.8 kW

2. Change #3 replaces the current coffee urns in galley 1 and 3 with one that draws considerably less power, the Bunn-O-Matic RL35, thus making more power available to galley 1 and 3 for additional equipment changes. The Bunn-O-Matic RL35 coffee maker is a 5 pot (10 cups per pot) system that can provide a pot of coffee every 3 minutes.

3. By adding one more well to the three-well steam kettles, as presented in change #4, two benefits result. First, during A-ration meals, the menu sometimes consisted of one entree, two vegetables, and a starch, or one entree, gravy, a vegetable, and a starch. A four-well kettle on each line will aid in maintaining the temperatures of these items which will then appear more appetizing to the customer. Second, a fourth well will provide some of the additional capacity required for preparing a meal for 1000 men.

At this point, both galley 1 and galley 3's demand for power is very close to the constraints established at the outset of this effort. Very little additional electrical equipment changes in these two containers are envisioned as practical.

4. The equipment sampling data, and the cook's comments on the steam cooker, (for example, "its too small") forces us to recommend their removal from the equipment list of the ISO galley complex. This will provide an even greater availability of power for galley 2 as shown in change #5.

5. Throughout the test, a holding cabinet from the dining facility was utilized in the ISO galley. Clearly, one is needed that would maintain temperatures of menu items prepared in the galley. A hot holding cabinet as depicted in change #6 would provide this capability while requiring very little power. This unit would be movable in the galley, on wheels, to provide greater flexibility.

6. The maximum number of patrons fed at any one A-ration meal during the test was 690. During the preparation for this meal, all major items of cooking equipment were sorely taxed. It is envisioned that the galley could not prepare an A ration meal for 1000 men without considerable menu modification. This is especially true for the breakfast meal. Therefore, it is recommended that two ovens be added to galley 2 and to expand the production capabilities of the ISO galley. The effects of these two ovens on power is shown in change #7. One table can be eliminated from the inventory and the two ovens put in its place.

7. To reduce the amount of time spent going to and coming from the ISO reefers placed outside the galley complex, it is recommended that two under-the-counter-reefers be put inside the galley for storing those food items needed at the next meal. This will reduce the labor and time required to obtain stores from the reefers. The power required for these reefers is shown in change #8.

8. A 60-quart mixer, such as a Hobart H-600, can be placed in galley 2 to provide for a minimal bakery capability. This item would allow cooks to prepare enough bread for 1000 men for two meals. The effects on power are shown in change #9.

9. The layout of the proposed equipment change to the ISO galley is presented in Figure 13.

OTHER RECOMMENDATIONS

1. A safer drain nozzle should be designed for releasing the hot water from the wells of the two steam kettles. Initially, the cooks released the water from the wells by turning a drain which was located beneath the kettles. As the drain was turned, hot water began to pour out and came in contact with the cooks' hands — a very painful experience. To avoid this situation, the cooks had to resort to ladling the water out of each well incurring considerable labor and time.

2. Currently, the possibility of water from the sink splashing onto the electrical panel in galley #2, especially when operating on shipboard, presents a potentially hazardous condition. This electrical panel should be made water-tight or be relocated in order to prevent this hazard.

3. If, as planned, the ISO galley complex is designated for shipboard use, and must conform to Navy regulations, then the following five changes may be required: a) all equipment, tables, and counters require marine edges, b) all floor shelving should be raised to 8 inches off the floor for cleaning, otherwise the spaces under the equipment should be closed by a corrosion-resistant steel coaming, watertight at both top and bottom, c)battens are required for all open shelving in the ISO galley for securing loose shelf items, d) safety rails are required, and e) all equipment, tables, and counters should be firmly secured to minimize movement.

4. In the next phase, both the ISO galley complex and the sanitation center must be tested in an area significantly distant from permanent facilities, such as dining facilities, to preclude food service personnel from using these facilities to augment ISO galley operations.

5. The flooring of the ISO galley is constructed of plywood which was scored from the beginning of the test. Since plywood scores easily, its surface is very difficult to keep clean and sanitary. From this point of view, it is recommended that other types of flooring or floor coverings, such as rubber mats, be investigated for inclusion in future procurement packages.

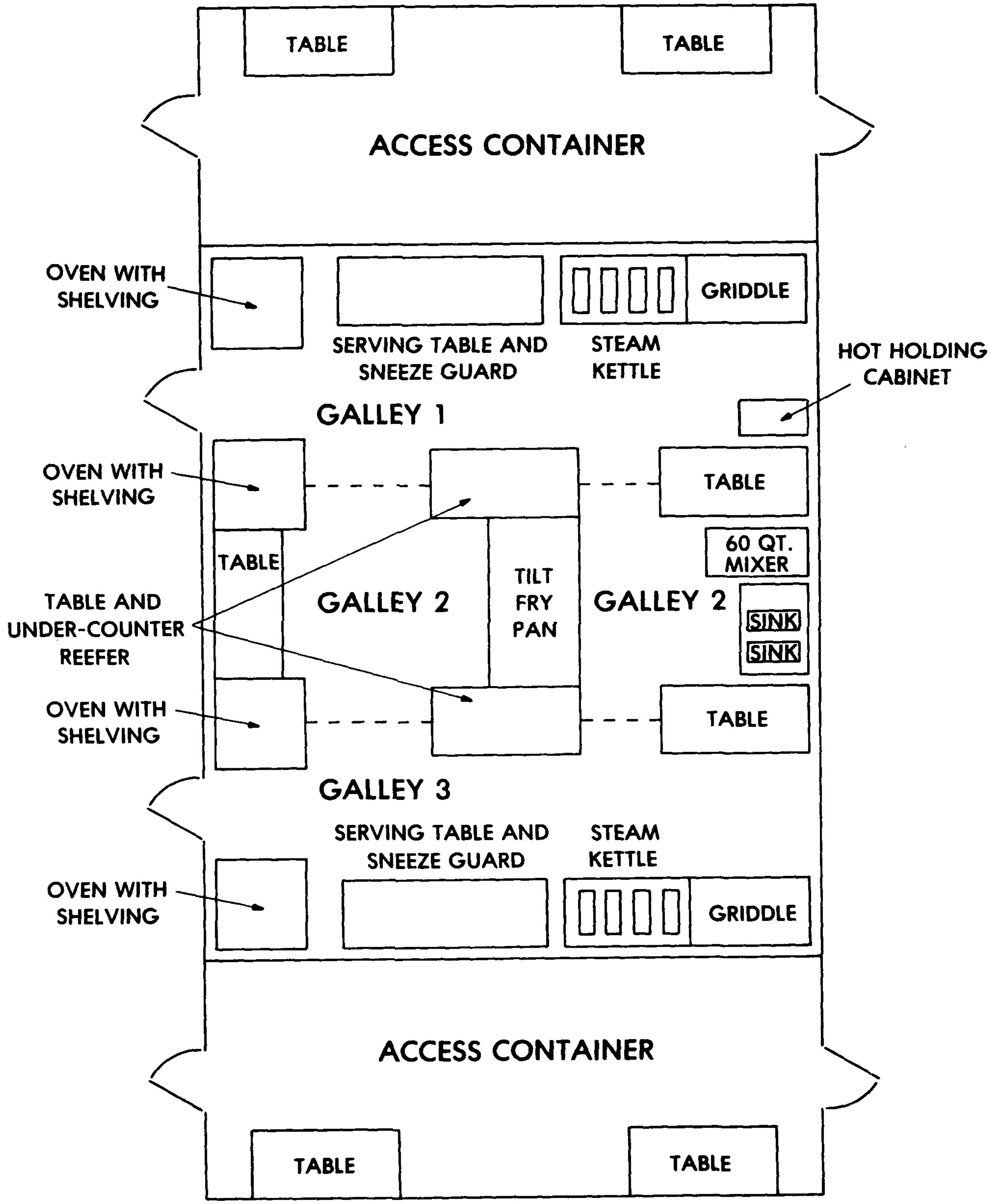

FIGURE 13: RECOMMENDED EQUIPMENT CHANGES

6. For the removal of water spilled on or used for cleaning the floor of the ISO containers, the placement of drains on the floor or the addition of water vacuums as part of the standard equipment list is suggested. The placement of drains may not be practical, since the location of the ISO galley complex on merchant ships, i.e., the first level, may not allow for the release of water through the flooring.

7. Two problems developed with the Velcro screening used at each of the openings to the ISO galley. First, the use of Velcro for securing the screen at the openings made it difficult for the cooks and messcooks to close once they were inside the galley. This problem could possibly be solved by adding zippers to secure the screens. Second, through daily use and the normal hectic pace of ISO galley operations, the screening was subjected to harsh treatment which caused small tears to develop in a short period of time. To alleviate both these problems, other types of screening, perhaps of a heavier mesh, and other methods for securing this screening should be investigated.

8. On the fourth day of the test, four air curtains were placed over the entrances and exits of the two access shelters to help reduce the number of flies entering the galley. Although they provided some protection, the air curtains created a downward draft of air that was strong enough to force certain loose items (such as bread) off the candidate's plates as they exited the access shelter. To alleviate this problem, the air curtains were then turned off during the serving periods which significantly reduced their effectiveness. It is therefore recommended that air curtains that produce a less forceful downward draft or that alternative forms of protection against flies be investigated, especially if the ISO galley is expected to operate in hot or humid climates.

9. A thermometer should become an integral part of each steam kettle well of the steam kettles so that the cooks can monitor well water temperatures. The addition of thermometers will aid the cooks in their operations, for example, heating of tray packs which can begin once water temperatures have reached 180^{o}F.

10. The wire baskets surrounding the lighting on the ceiling should be constructed of non-corrosive aluminum and not be painted.

11. The addition of a clock to the ISO galley will aid in the scheduling of production, especially for tray-pack meals.

12. The two tables with drawers, currently against the front wall of the center container of the ISO galley, tended to sag towards the center, when items of weight, such as tray packs, were placed on their surface. After a short period of time and repeated placement of heavy items on the surface of these tables, the drawers began to stick, requiring considerable force to open. These tables should therefore be replaced with heavier duty tables that inhibit this tendency to sag.

13. The addition of a sneeze guard on each serving line would provide the ISO Galley with two advantages. First, the sneeze guard would increase serving line capabilities by providing more service area. Secondly, this item would provide some protection from patrons spreading bacteria onto the food. This sneeze guard would be placed over the grill, steam kettle, and portions of the serving table.

14. Shelving should be placed over the ovens to provide additional serving line and work space capabilities. This shelving would have a two inch space between the top of the oven and the bottom of the shelf to allow for heated air from the ovens to dissipate.

This document reports research undertaken at the US Army Natick Research and Development Command and has been assigned No. NATICK/TR-82/029 in the series of reports approved for publication.

APPENDIX A

Test Menu

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22 July

Lunch

Hot Sliced Beef Sandwich
Mashed Potatoes
Brown Gravy
Buttered Succotash
Buttered Green Beans
Carrot Strips
Corn Relish
Pickled Cherry
Bread
Butter
Chocolate Coconut Pudding
Assorted Beverages

Dinner

Creole Shrimp
Steamed Rice
Glazed Carrots
Buttered Wax Beans
Spring Salad
Assorted Dressings
Bread
Butter
Apple Crisp
Assorted Beverages

23 July

Lunch

Baked Beef and Noodles
Buttered Peas and Carrots
Stewed Tomatoes & Croutons
Tossed Vegetable Salad
Sweet Mixed Pickles
Bread & Butter
Spice Cake
Peanut Butter Cookies
Beverages

Dinner

Spaghetti with Meat Sauce
Grated Cheese
Buttered Green Beans
Buttered Mixed Vegetables
Cottage Cheese
Bread & Butter
Assorted Beverages

24 July
(Tray Pack Items Were Served)

Lunch

Salisbury Steak
Potatoes in Brine
Stewed Tomatoes
Bread & Butter
Tossed Green Salad
Peaches
Orange Nut Cake
Beverages

Dinner

Chicken Stew
Lima Beans
Corn
Bread & Butter
Tossed Green Salad
Vanilla Pudding
Cherries in Sauce
Beverages

25 July
(Tray Pack Items Were Served)

Lunch

Lasagna
Potatoes in Brine
Green Beans
Bread & Butter
Tossed Green Salad
Lemon Pudding
Orange Nut Cake
Assorted Beverages

Dinner

Sliced Turkey with Gravy
Potatoes in Brine
Peas
Bread & Butter
Tossed Green Salad
Cherries in Sauce
Chocolate Pudding
Assorted Beverages

26 July

Lunch

Fried Ham Steaks
Sweet Potatoes
Buttered Asparagus
Scalloped Corn
Bread & Butter
Confetti Salad
Chocolate Krinkle Cookies
Assorted Beverages

Dinner

Newport Fried Chicken
Baked Beans
Peas
Bread & Butter
Spring Salad
Marble Cake
Beverages

28 July

Lunch

Chicken Cacciatore
Buttered Noodles
Paprika Buttered Cauliflower
Buttered Lima Beans
Assorted Breads & Butter
Cottage Cheese & Peach Salad
Sugar Cookies
Assorted Beverages

Dinner

Meat Loaf
Rice Pilaf
Tomato Gravy
Buttered Peas
Sauteed Corn
Bread & Butter
Assorted Relish Tray
Fruit
Assorted Beverages

29 July

Breakfast

Scrambled Eggs
Bacon
Sausages
French Toast
Hash Browns
Bread & Butter
Syrup
Assorted Beverages

Lunch

Pork Chop Suey
Steamed Rice
Chow Mein Noodles
Buttered Green Beans
Buttered Wax Beans
Assorted Breads
Butter
Sliced Cucumber & Onion Salad
Brownies
Assorted Beverages

Dinner

Baked Ham
Pineapple Sauce
Buttered Sweet Potatoes
Simmered Blackeyed Peas
Buttered Mixed Vegetables
Dinner Rolls & Butter
Dinner Rolls & Butter
Tossed Green Salad
Tomatoes & Cucumbers
Refrigerator Cookies
Assorted Beverages

30 July
(Tray Pack Items Were Served)

Lunch

Stuffed Peppers
Potatoes in Brine
Peas
Bread & Butter
Tossed Green Salad
Butterscotch Pudding
Pears
Assorted Beverages

Dinner

Beef Stroganoff
Potatoes in Brine
Corn
Bread & Butter
Tossed Green Salad
Apples in Sauce
Cherry Nut Cake
Assorted Beverages

31 July
(Tray Pack Items Were Served)

Lunch

Chicken á la King
Potatoes in Brine
Peas
Bread & Butter
Tossed Green Salad
Blueberry Compote
Cherry Nut Cake
Assorted Beverages

Dinner

Sliced Roast Pork & Gravy
Potatoes in Brine
Corn
Bread & Butter
Tossed Green Salad
Apples in Sauce
Chocolate Pudding
Assorted Beverages

APPENDIX B

Food Service Worker Survey

USMC Field Feeding Worker Survey

The Natick R & D Command has been asked by the Marine Corps to study the field feeding system. This is your opportunity to have a say in this study. In the past we have implemented recommendations made by customers and workers in studies for the Air Force (Travis AFB), Navy (NAS Alameda), Army (Fort Lewis) and Marines (29 Palms). Please take this survey seriously; we take your opinions seriously, so please read every question carefully, and give your honest answers.

You will notice that we have not asked for your name or social security number. Therefore, the answers you give us are confidential.

It is fairly clear how to answer most of the questions in this survey; you simply write in the correct numbers or circle the appropriate letters or numbers. Below there are examples of the 3 most common types of questions with some answers written in so you can see how to do it.

Example 1. The question below asks for a write-in answer. If you were 5 ft. 8 in. tall, you would write these numbers in as we have done.

Indicate your height. __5__ ft. __8__ inches

Example 2. This question asks how satisfied you are with certain aspects of the Marines. If you were slightly satisfied with your supervisor, you would circle 5 next to supervisor. If you were very dissatisfied with your uniform, you would circle 1 next to uniform. If you were satisfied with your pay, you would circle 6 next to pay. Your questionnaire would look like this.

Tell us how satisfied or dissatisfied you are with these aspects of the Marines (circle one number for each aspect).

	Very Satisfied	Satisfied	Slightly Satisfied	Neither Satisfied Nor Dis-satisfied	Slightly Dis-satisfied	Dis-satisfied	Very Dis-satisfied
a. Supervisor	7	6	(5)	4	3	2	1
b. Uniform	7	6	5	4	3	2	(1)
c. Pay	7	(6)	5	4	3	2	1

Example 3. For this example, we've taken the same question as the second example and set it up a little differently. You still circle the number which best describes your feelings. Again, if you were slightly satisfied with your supervisor you would circle 5 next to supervisor. If you were very dissatisfied with your uniform, you would circle 1 next to uniform. If you were satisfied with your pay, you would circle 6 next to pay. Your questionnaire would look like this.

7	6	5	4	3	2	1
Very Satisfied	Satisfied	Slightly Satisfied	Neither Satisfied Nor Dis-satisfied	Slightly Dis-satisfied	Dis-satisfied	Very Dis-satisfied

Please tell us how you feel about each of the following aspects of Marine life by circling the appropriate number for each factor.

a. Supervisor	7	6	(5)	4	3	2	1
b. Uniform	7	6	5	4	3	2	(1)
c. Pay	7	(6)	5	4	3	2	1

1. Please write in the number of your present grade. E-____

2. How long have you been in Marine food service? ____________

3. How would you describe your job on this exercise. (Please circle one number)

    1. Dining Hall Supervisor
    2. Shift Leader
    3. Senior Cook
    4. Cook
    5. Cooks Apprentice
    6. Clerk
    7. Storeroom
    8. Supply
    9. Other (please specify) ______________

4. To how many field exercises (besides this one) have you been assigned/ attached in food service?

______________field exercises

5. What are your FEELINGS ABOUT THE MILITARY? (Circle the appropriate number).

Dislike Very Much	Dislike Moderately	Dislike a Little	Neutral	Like a Little	Like Moderately	Like Very Much
1	2	3	4	5	6	7

6. Overall, how would you rate your food service job in this field kitchen compared with your food service job when you are at your home base? (Please check one)

_____Much better than at home base

_____Somewhat better than at home base

_____Slightly better than at home base

_____About the same as home base

_____Slightly worse than at home base

_____Somewhat worse than at home base

_____Much worse than at home base

_____Not applicable, I don't work in food service at home base

7. We would like you to rate each factor below on HOW GOOD OR BAD each actually is in terms of the PRESENT FOOD SERVICE OPERATION on this exercise. Please use the following scale.

Very Bad	Moderately Bad	Slightly Bad	Neither Bad Nor Good	Slightly Good	Moderately Good	Very Good
1	2	3	4	5	6	7

a.	Sanitary conditions in the kitchen and dining area	1	2	3	4	5	6	7
b.	The food preparation skills of the cooks	1	2	3	4	5	6	7
c.	Leadership from your dining hall supervisor	1	2	3	4	5	6	7
d.	Leadership from your shift leader	1	2	3	4	5	6	7
e.	Support and cooperation among the cooks	1	2	3	4	5	6	7
f.	Customer satisfaction	1	2	3	4	5	6	7
g.	Proper maintenance of equipment	1	2	3	4	5	6	7
h.	Menu variety at a given meal	1	2	3	4	5	6	7
i.	Menu variety from day to day	1	2	3	4	5	6	7

8. In your opinion, how much workspace is there in this kitchen?

Much Too Much	Somewhat Too Much	A Bit Too Much	Just About Right	A Bit Too Little	Somewhat Too Little	Much Too Little
____	____	____	____	____	____	____

9. Using the same scale as before, please rate each factor below on HOW GOOD OR BAD you feel it is in your kitchen. As a reminder, this is the scale to use.

Very Bad	Moderately Bad	Slightly Bad	Neither Bad Nor Good	Slightly Good	Moderately Good	Very Good
1	2	3	4	5	6	7

a. Amount of storage space	1	2	3	4	5	6	7
b. How easy to get at supplies stored in kitchen	1	2	3	4	5	6	7
c. Size of the kitchen	1	2	3	4	5	6	7
d. Noise	1	2	3	4	5	6	7
e. Lighting	1	2	3	4	5	6	7
f. Bumping into other cooks while working	1	2	3	4	5	6	7
g. Temperature	1	2	3	4	5	6	7
h. How easy to serve customers in line	1	2	3	4	5	6	7
i. The condition of equipment in the kitchen	1	2	3	4	5	6	7
j. How easy to move the kitchen	1	2	3	4	5	6	7
k. How easy to set up the kitchen	1	2	3	4	5	6	7
l. How long the customer waits in line	1	2	3	4	5	6	7
m. How easy to prepare the food on the menu	1	2	3	4	5	6	7
n. How easy to clean up	1	2	3	4	5	6	7
o. The kitchen OVERALL	1	2	3	4	5	6	7

FOOD SERVICE WORKER INTERVIEW QUESTIONS

1. What is your rank?
2. How long have you been a Marine cook?
3. Have you ever worked in a field kitchen? How often?
4. What do you like about this field kitchen?
5. What do you dislike about this field kitchen?
6. Is the serving line adequate to do the job?
   6a. Are there enough wells?
7. Are the pressure steamers adequate to do the job?
8. Are the ovens adequate to do the job?
   8a. Are there enough?
   8b. Are they too low?
9. Could any piece of equipment be added to make your job easier or the food better?
10. Should any piece of equipment be eliminated or changed?
11. What do you think of the idea of tray packs in general?
12. What do you think of the tray packs used here?
13. Is the A ration or tray pack meal easier to prepare?
14. Is it easier to clean up after a tray pack of a ration meal?
15. Did you have any problems opening the tray packs?
16. Was there enough space to heat up all the tray packs needed?
17. Should there be refrigeration in the ISO galley itself?
18. Were there any safety hazards in the ISO galley?
19. How was the temperature in the ISO galley?
20. Did you have enough counters and tables to work on?
21. Was this a good test of the ISO galley?
    21a. Why (not?)
    21b. What would have made it a better test?

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