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ARMY FIELD KITCHEN WORKLOADS AND FUEL CONSUMPTION

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14. ABSTRACT
To improve the effectiveness and efficiency of overall field feeding operations, the U.S. Army in recent years fielded a new Container Kitchen, new Modern Burner Unit, and two new group rations to include Unitized Group Ration - A and Unitized Group Ration - Heat/Serve. In addition, these new fieldings were designed to improve the Army's capability to deliver frequent high quality hot meals to deployed Army units. This report details the results and findings of data collection during unit field training focused on collecting baseline data to quantify the kitchen workloads and fuel consumption levels associated with current field feeding operations, field kitchens, and group rations. This baseline data provides: a basis to identify the potential benefits or impacts of future research and development programs, quantifify any workload reduction benefits associated with the recently fielded Container Kitchen, Modern Burner Unit, and Unitized Group Rations; and the quantitative data to support future development of a field kitchen workload and staffing model as a function of key workload drivers such as type ration and number meals prepared, mix of on-site and remote site meals, etc. For a 900- soldier kitchen, results/findings indicate the new Unitized Group Rations and Modern Burner Unit have reduced kitchen daily workloads by about 61 work hours or almost 7 cook positions.

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Preface

This report details the results and findings of data collection efforts during various Army field training exercises focused on quantifying and understanding the kitchen workloads and fuel consumption levels generated by current field feeding operations. Data collection covered field training exercises at the following installations: Fort Bragg, Food Hood, Fort Stewart, Pohakuloa Training Area, National Training Center, and Joint Readiness Training Center. This work was conducted during the period October 2002 to September 2004 under the U.S. Army Natick Soldier Center Combat Feeding Research and Engineering Program (CFREP) AH99 project Field Feeding Kitchen Workloads.

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Executive Summary

This report details the results/finding of data collection efforts during field training exercises with representative Army units focused on quantifying the kitchen work loads and fuel consumption levels generated by current field feeding operations, field kitchens, and group field rations. The objectives for collecting this data were to:

- Quantify kitchen workload and fuel consumption impacts generated by current Army field feeding operations to provide a baseline to identify and evaluate potential benefits of future research and development initiatives.

- Quantify workload and fuel consumption reduction benefits generated by the recently fielded Container Kitchen, Modern Burner Unit, and Unitized Group Rations.

- Collect quantitative workload data to support follow on development of a kitchen workload and staffing model as a function of key workload drivers, such as: type ration, number of meals prepared, and mix of on-site to remote site meals.

Field data collection efforts covered 17 different field kitchens during 7 different field-training exercises. A time-based sampling methodology was utilized to estimate the kitchen workloads by task and equipment operating hours, and resulting fuel consumption levels for each kitchen by meal period. The work sampling data collection included 11 defined productive kitchen work tasks to include food preparation, serving, pot/pan sanitation, kitchen sanitation, burner maintenance, etc. Key results/findings include:

- Overall kitchen workloads can be highly variable between meal periods for the same kitchen due to different labor content menus and work efforts that occur during some, but not all, meal periods - for example receive supplies or dig soakage pit.

- Average overall kitchen workloads can be highly variable between similar type and size kitchens due to differences in cook team experience, training, and productivity; food preparation methods utilized, and general operating procedures.

- Based on 30 meal periods of Mobile Kitchen Trailer and 11 meal periods of Container Kitchen work sampling data, the Container Kitchen and Mobile Kitchen Trailer appear to be approximately equally efficient if utilized to support the same number of meals and feeding environment.

- Food preparation is the largest work activity and accounts for about 32% of overall kitchen workload. The 3 largest kitchen work activities (food

preparation, pot/pan sanitation, and serving) represent about 69% of overall kitchen workload.

- Total kitchen workload, food preparation, and pot and pan sanitation work hours increase with the number of meals prepared. Serving work hours increase with the number of on-site meals. Remote site feeding and perhaps pot and pan sanitation work hours increase with number of remote site meals.

- Worker productivity is higher with larger kitchens. Based on MKT kitchen data, worker productivity for kitchens preparing 150 to 200 meals averaged 8.0 meals per work hour, while productivity for kitchens preparing 700 to 850 meals averaged 12.2 meals per work hour or slightly more than 50% higher.

- The new Unitized Group Rations (A and Heat/Serve) significantly reduced kitchen food preparation work hours as compared to the former group A and B rations that they replaced. For the UGR rations, food preparation work hours averaged 2.5 work hours per 100 meals as compared to a much higher 4.6 work hours for the former A/B rations. For field kitchens supporting 400 and 900 soldiers, this savings equates to a workload reduction of 16.8 and 37.8 work hours per day, respectively, or an equivalent 1.9 and 4.2 cook positions.

- The new Modern Burner Unit significantly reduced kitchen workloads associated with starting, fueling, maintaining, and repairing kitchen burners as compared to the former M-2 burner. From historical data, M-2 burner work hours averaged 1.4 work hours per 100 meals while MBU work sampling data results indicated a very minimal 0.1 work hours per 100 meals. For field kitchens supporting 400 and 900 troops, the MBU workload savings equates to 10.4 and 23.4 work hours per day, respectively, or an equivalent 1.2 and 2.6 cook positions per kitchen.

- The Container Kitchen utilizes significantly more fuel than a Mobile Kitchen Trailer due to the kitchen's larger generator and associated higher fuel consumption rate and longer daily operating hours to power the kitchen's refrigerator. In terms of gallons per 100 meals, the Container Kitchen utilizes about 43% more fuel at 2.26 versus 1.58 for the Mobile Kitchen Trailer.

ARMY FIELD KITCHEN WORKLOADS AND FUEL CONSUMPTION

Introduction

Background

During the past several years, the Army has fielded a new field kitchen, a new burner unit, and 2 new group ration concepts designed to upgrade and improve the effectiveness and efficiency of overall field feeding operations.

The Army's current field system includes 3 types of kitchens to include the Mobile Kitchen Trailer (MKT), the Kitchen Company Level Field Feeding - Enhanced (KCLFF-E), and the recently fielded Container Kitchen (CK). The MKT was fielded in the 1975 timeframe and was designed to support company level feeding and provide group "A" or "B" type rations to up to 350 soldiers per meal. With company level feeding, an infantry or a tank battalion (e.g. 1 headquarters company and 4 line companies each) was authorized 5 MKTs and each MKT was operated as a separate company level kitchen. In the early 1980's, the Army implemented battalion level feeding operations for most divisional combat battalions. With the change to battalion level feeding, MKT authorizations were reduced to 3 for an Infantry Battalion and 2 for a Tank Battalion. With battalion feeding, the MKTs are collocated at the Headquarters Company and operated as one consolidated kitchen. With this feeding concept, group hot meals were prepared and transported in insulated food containers (IFCs) to remote line companies as needed. With the change to battalion level feeding, the Army fielded the KCLFF-E at company level to maintain a limited company level food preparation capability. The KCLFF-E provides a company level tray ration capability and a limited "A" ration capability to include hot beverages, hot soups, and select "A" ration items.

During the late 1970's and early 1980's, the Natick Soldier Center was involved in several technology demonstrations and field experiments to evaluate the effectiveness and work loads of alternative kitchen and ration concepts to support Army battalion level feeding and USMC field feeding operations. These evaluations included 3 complexed MKTs and Modular Tent Kitchens (MTKs) for battalion level feeding, 2 MKTs and a MTK for field hospital feeding, a new sanitation center to support field kitchen operations, and a new tray ration concept to supplement the standard group "A" and group "B" rations.

Since these field evaluations, the Army has fielded the new Container Kitchen, the new Modern Burner Unit (MBU), a sanitation center, and the new Unitized Group Ration - A (UGR-A), and new Unitized Group Ration - Heat/Serve (UGR-H/S). The focus of each of these was to upgrade, simplify, and improve field-feeding operations; reduce kitchen workloads, and increase the capability and flexibility to provide supported troops with frequent, highly acceptable group hot meals.

Objectives

The objectives of this report are to:

- Detail the methodology utilized to collect data to quantify kitchen level workloads and fuel consumption associated with current Army field feeding operations;

- Detail and discuss the resulting kitchen workload and fuel consumption data collected for representative Army units and field kitchen feeding operations;

- Quantify the kitchen workload and fuel consumption impacts generated by current field feeding operations to provide a baseline to evaluate the potential benefits of future high payoff research and development initiatives; and

- Quantify any workload and fuel consumption reduction benefits generated by the recently fielded new kitchen, burner unit, and group rations.

In addition, the work sampling data will be utilized to support a follow on effort to develop a kitchen workload and staffing model as a function of key work load drivers to include: number of troops supported, type group meals and number per day, and mix of on-site to off-site feeding.

Field Kitchen and Burner Descriptions

Army units are presently authorized a variety of field kitchens all with the same primary burner unit (MBU) to support their field feeding requirements. The kitchens include:

- Mobile Kitchen Trailer (MKT),
- Kitchen Company Level Field Feeding - Enhanced (KCLFF-E),
- Modular Tent Kitchen (MTK), and
- Container Kitchen (CK).

For this project, work sampling and fuel consumption data was collected for various Army units with MKT, KCLFF-E, and CK kitchens. While no project data was collected with the MTK kitchen, historical data for MTK type kitchens is available from prior field evaluations and presented in Appendix C. Based on prior historical data, MTK and MKT kitchen workloads are approximately the same when utilized to prepare the same type ration and number of meals.

Mobile Kitchen Trailer (MKT)

The MKT was fielded in the 1975 time frame and designed to support company level feeding operations and to prepare group "A" or "B" type rations for up to 350 soldiers per meal period. The MKT is mounted on a 1½ T trailer and towed by a Light

Medium Tactical Vehicle (LMTV). The MKT is designed to be setup and operational in about 30 minutes. Figure 1 depicts an opened set-up MKT. While the MKT was initially fielded with M-2 burners, the MKT and all Army kitchens currently utilize the new JP-8 fueled MBUs as their primary heat source for cooking and sanitation purposes. Major MKT cooking equipment components include: field ranges, cooking racks, pot cradles, serving line griddle, and steam table.

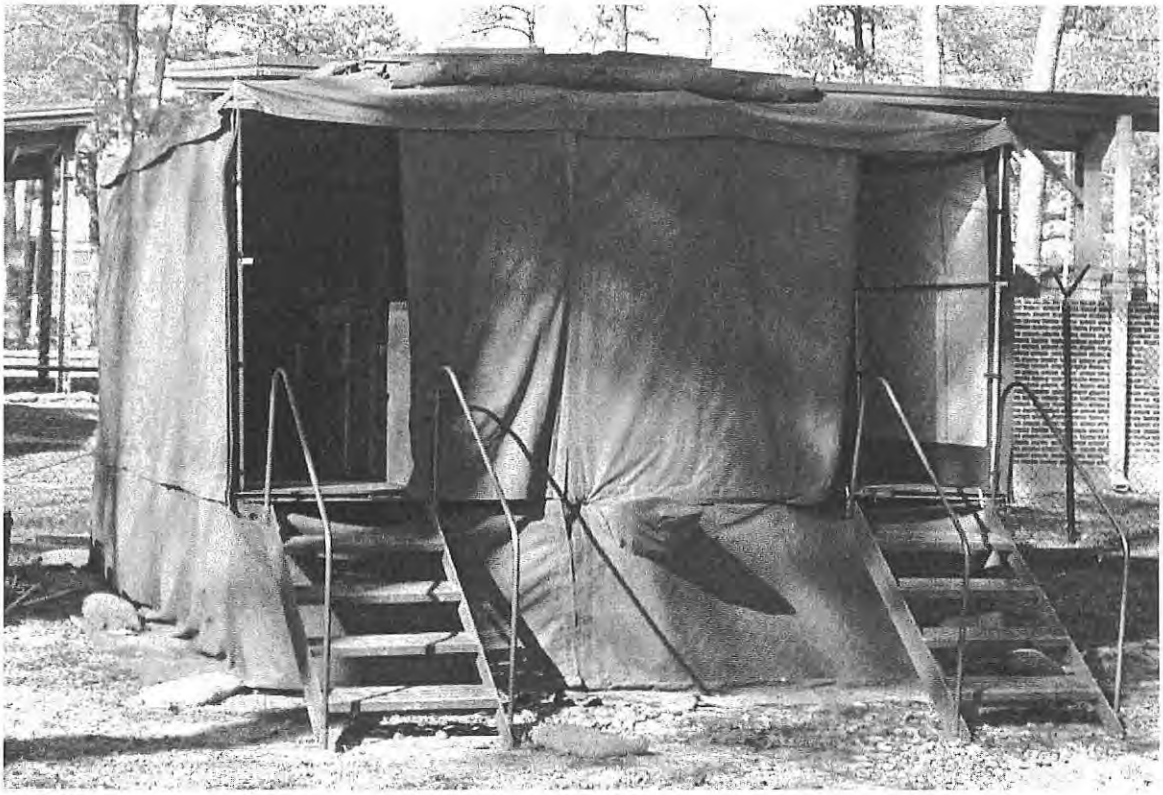

Figure 1. Mobile Kitchen Trailer - External View

With the switch to battalion level feeding operations, MKTs authorizations are based on total battalion feeding strength at the rate of 1 MKT per 350 soldiers or fraction thereof.

The MKT was designed for both group "A" and "B" type rations. These group rations required extensive food preparation activities to include assembling and measuring scratch bulk ingredients, mixing, stirring, cooking, etc. These rations have since been replaced by the more labor efficient Unitized Group Ration - A (UGR-A), and Unitized Group Ration - Heat/Serve (UGR-H/S). Each of these rations is described later.

Kitchen Company Level Field Feeding - Enhanced (KCLFF-E)

When the change to battalion level feeding operations was made, the KCLFF-E was introduced to maintain a limited company level food preparation capability. The KCLFF-E, depicted in Figure 2, is designed to provide a company level tray ration

Figure 2. Kitchen Company Level Field Feeding - Enhanced

(similar to current UGR-H/S ration) and only a limited "A" ration capability to include hot beverages, hot soups, and select "A" ration items. Primary KCLFF-E components include a field range, pot cradle, a tray ration heater, and 3 MBU burners. No generator or sanitation center is authorized with the KCLFF-E. The limited power required by the MBUs is provided by a battery pack, which is recharged as needed by another unit generator or vehicle. In addition, the tray ration heater cabinet is utilized for any limited sanitation requirements.

Modular Tent Kitchen (MTK)

The MTK is equipped with and utilizes cooking equipment similar to that of the MKT. The primary difference between these two kitchens is that the MKT is trailer-mounted while the MTK is set-up on the ground and housed in an extendable frame supported tent. With the extendable frame supported tent, the kitchen shelter can be sized in 8' increments to house all required cooking and food preparation equipment and one or multiple serving lines to support varying troop feeding levels.

Container Kitchen (CK)

The CK is housed in a trailer-mounted 3:1 expandable ISO 8′ x 8′ x 20′ container and is designed to be pulled by the Army 5T Medium Tactical Vehicle (MTV). The CK was designed for the new UGR-H/S and UGR-A group rations and has a rated capacity of

800 meals per meal period. CK equipment includes 7 MBUs to support food cooking/preparation activities, 2 commercial refrigerators, an environmental control unit, and a self-contained 10 KW generator for power. Other cooking items include an oven, tray ration heater, cook stands/pot cradles, griddle, and steam tables. Figures 3 and 4 depict an external view of the expanded CK and the kitchen's internal hot food serving line.

Modern Burner Unit (MBU)

Fielding of the JP-8 fueled MBU to replace the gas-fueled M-2 burners was initiated in FY01. The MBU is the primary heat source and is utilized by all Army kitchens to include: MKT, KCLFF-E, and new CK. The MBU requires limited electrical power that is provided by a battery pack for the KCLFF-E, and the kitchen generator for the MKT or CK. Benefits of the MBU, compared to the M-2, include push button starting, refueling in place, and significantly reduced workloads to start, maintain, and repair.

Group Ration Descriptions

Current and former rations utilized to provide group hot meals to Army units include:

- Current Group Rations
  - Unitized Group Ration - Heat/Serve (UGR-H/S),
  - Unitized Group Ration - A (UGR-A).

- Former Group Rations
  - B Ration,
  - A Ration.

Field data collection efforts under this project covered only the current UGR-H/S and UGR-A group rations. Relative to UGR-H/S ration, data collection was limited to KCLFF-E and CK operations, while for the UGR-A ration data collection covered all current kitchens to include KCLFF-E, MKT, and CKs. Historical workload and fuel consumption data for the prior "A" and "B" group rations with MKT and Modular Field Kitchens (MFKs) are available from prior Natick field evaluations and experiments. For comparative evaluations, the historical "A" and "B" ration data is adjusted and detailed in Appendix C. A brief description of each type ration follows.

Unitized Group Ration - Heat/Serve (UGR-H/S)

The UGR-H/S (Figure 5) is the first group ration utilized during operational deployments. This ration is shelf stable and requires no refrigeration. To insure complete meals and simplify distribution, all components and quantities for 50 group meals are pre-assembled at a continental United States (CONUS) depot and transported

Figure 3. Container Kitchen - External View

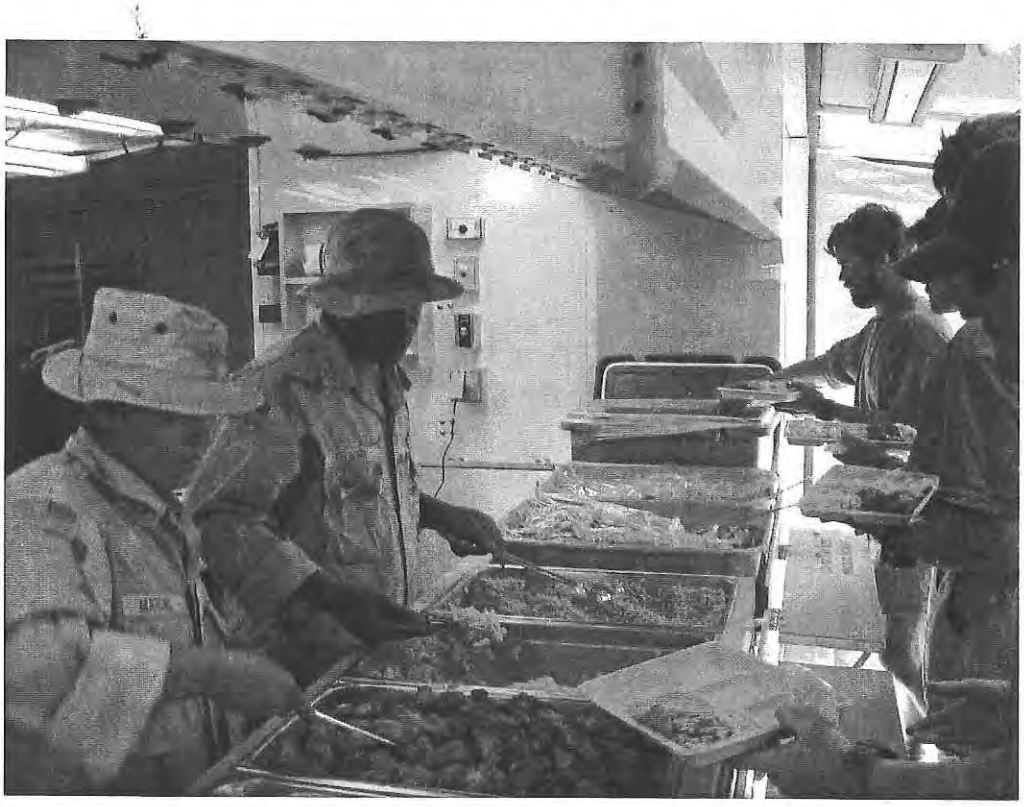

Figure 4. Container Kitchen - Serving Line

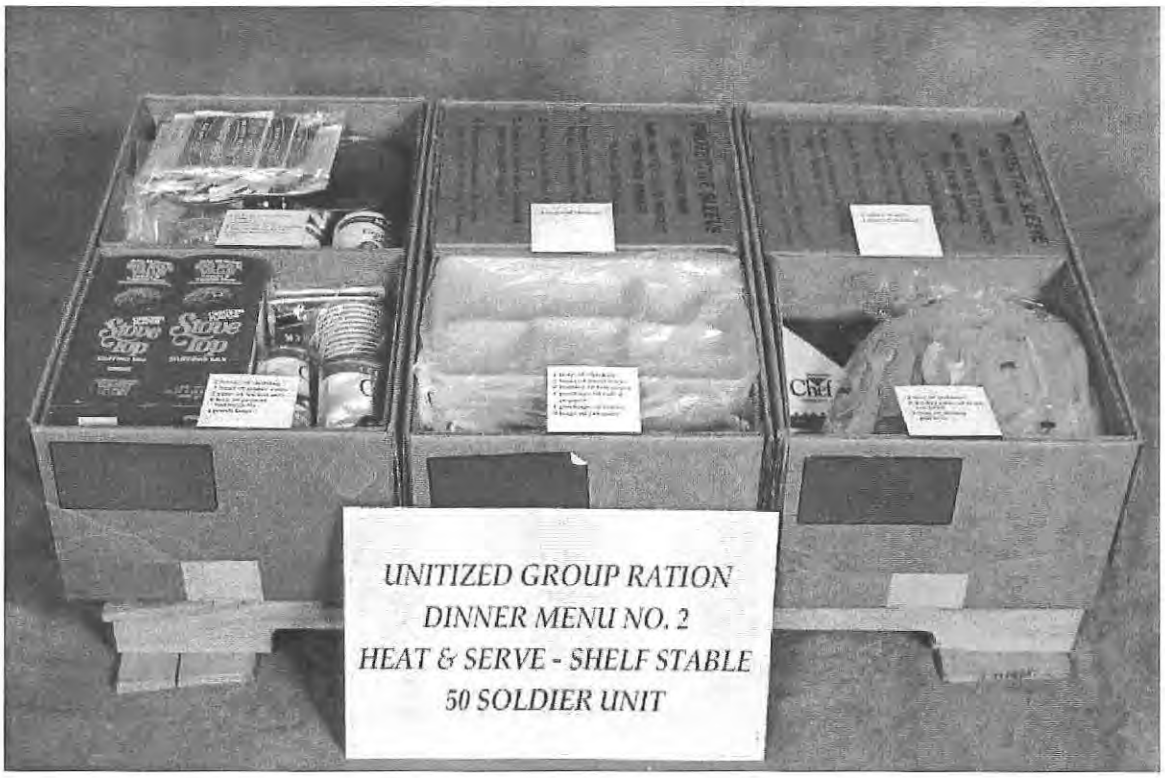

Figure 5. Unitized Group Ration - Heat/Serve (UGR-H/S)

together and provided in a set of 3 boxes. This ration is designed to reduce kitchen workloads and simplify overall field kitchen operations as compared to the group "B" ration which it replaced. This ration utilizes tray pack items for the entrée, starch, and some dessert meal components. Figure 6 depicts open tray pack components on a MKT serving line. These items thermally processed, pre-prepared, shelf-stable foods packaged in hermetically-sealed, half-size steam table pans and only require heating and/or simply opening prior to serving.

Unitized Group Ration - A (UGR-A)

The UGR-A ration includes frozen meal components and is introduced later once the supply system matures and permits distribution of refrigerated/frozen foods. With this ration, all components to prepare 50 group meals are also provided in 1 set of 3 boxes to include 1 frozen and 2 non-refrigerated boxes. The UGR-A makes maximum use of commercial items and is also designed to simplify overall field kitchen operations. To simplify kitchen operations, this ration makes extensive use of pre-cooked frozen boil in bag foods (e.g. scrambled eggs, individual cooked eggs, chicken breasts, BBQ pork ribs, etc) that only require heating prior to serving; pre-portioned prepared foods; and shelf stable packaged desserts like cakes and cookies that only require opening. This ration replaced the former bulk "A" ration.

Figure 6. Open Tray Pack Items from UGR-H/S Ration

B-ration

The "B" ration was the Army's former non-perishable group ration and was replaced by the UGR-H/S. The "B" ration is still utilized as a field ration by the U. S. Marine Corp (USMC) and Air Force. The "B" ration required extensive food preparation activities as menu items are made from scratch, involve detailed menus and several bulk ingredients, and require measuring, mixing, and stirring of ingredients, monitoring of the cooking process, etc. For example, with the UGR-H/S ration, beef stew and cakes are provided as tray pack items that only require heating and/or opening prior to serving directly from the tray container. With the "B" ration, these menu items are provided as a collection of ingredients that require measuring, mixing, stirring, and cooking to yield the ready-to-serve menu items.

A-ration

The "A" ration was the Army's prior perishable group ration. Like the "B" ration, this ration requires extensive food preparation activities as menu items are made from scratch, can involve detailed menus and several bulk ingredients, and require measuring, mixing, cooking, etc. This ration was replaced by the UGR-A, which simplified field kitchen food preparation operations.

Methodology

Approach

Field kitchen workloads and fuel consumption levels are dependent on several potential factors to include: type field kitchen, type group ration prepared, actual menu prepared, total number of meals prepared, mix of on-site and remote site feeding; and assigned food service personnel quality, training and experience.

The general approach for project data collection was to observe and collect requisite workload and equipment operating hour data for a variety of different units and feeding situations during realistic field training exercises (FTXs). To the extent possible, FTXs were identified and kitchens selected to facilitate data collection for different type units, different size units, different on-site versus remote site feeding mixes, etc.

Table 1 summarizes the project field data collection for 17 unit kitchens. The data was collected during 7 separate FTXs. Data collection for each field kitchen ranged from 1 to 4 complete meal periods and covered six CK, nine MKT, and two small KCLFF-E operations. Of these, 14 of the kitchens prepared UGR-A rations only, and only 3 prepared UGR-H/S or a combination of UGR-A and UGR-H/S rations. During the data collection period, opportunities to collect data relative to the UGR-H/S ration were limited as available quantities were primarily reserved for the on-going Operation Iraqi Freedom deployment. Overall project data collection covered 45 complete meal cycles to include 41 UGR-A meals and only 4 UGR-H/S meal periods.

Each unit planned and conducted their own FTX feeding operations. No changes or adjustments were requested to support Natick data collection goals. Most kitchens prepared 2 group meals per day, and on occasion a few prepared only one. When kitchens prepared 2 meals per day, data collection sometimes covered both meal periods and sometimes only a single meal period. When data collection involved both meal periods, the data collection period covered the entire workday from the start of initial breakfast work activities to the completion of all after dinner meal cleanup activities. When data collection covered 2 meal periods, the data collection period was typically from about 0300 to 2100 or 18 hours. For these days a break time was selected and all observed work prior to this time were allocated to the breakfast meal and all work after this time were allocated to the dinner meal. When data collection covered only a single meal, the data collection period was typically from about 0300 to about 1130 for a breakfast meal, and 1130 to 2100 for a dinner meal.

Table 1. Field Data Collection Location and Kitchen Summary

No.	Location/ FTX	Ave Meals/Meal Period			Type Kitchen*	Type UGR
		Onsite	Remote	Total		
1	Ft Bragg	50	650	700	MKT+	A
2	Ft Bragg	325	75	400	MKT	A
3	Ft Bragg	90	760	850	MKT+	A
4	Ft. Hood	140	60	200	MKT	A
5	Ft Hood	0	150	150	MKT	A
6	Ft Stewart	185	815	1,000	2 MKT	A
7	Pohakuloa	100	100	200	MKT	A
8	Pohakuloa	100	0	100	KCLFF-E	A
9	Pohakuloa	100	0	100	KCLFF-E	H&S
10	NTC-1	700	0	700	CK	A and H&S
11	NTC-1	175	375	550	CK	A
12	NTC-1	450	250	700	CK	A and H&S
13	NTC-2	350	0	350	MKT	A
14	NTC-2	400	0	400	MKT	A
15	JRTC	650	0	650	CK	A
16	JRTC	850	0	850	CK	A
17	JRTC	1,700	0	1,700	2 CK	A

* Also utilized extra equipment from KCLFF-E like tray heater(s) and pot cradle(s).

Data Collection

Three types of data were collected relative to each observed unit kitchen to include:

- Descriptive kitchen data
- Kitchen work load data
- MBU/Generator utilization data.

A description of each type data to include associated methodology follows:

Descriptive Kitchen Data

Kitchen workload and fuel consumption can be potentially impacted by several factors such as type kitchen, type group ration prepared, actual menu prepared, and number of meals prepared. Therefore a set of descriptive kitchen data was recorded for each kitchen and meal period for which kitchen work load and equipment utilization data were collected. This descriptive data facilitates analysis, evaluation, and interpretation of the collected quantitative kitchen work sampling and equipment utilization data.

Types of descriptive data recorded for each kitchen and meal period include:

- Quantity and type field kitchen,
- Extra equipment utilized,
- Sanitation Center equipment,
- Quantity and size generators utilized,
- Number MBUs,
- Feeding plan - number and type group meals per day,
- Re-supply/logistical support for rations, water, fuel, and waste disposal,
- Type ration and menu prepared by meal period,
- Total meals prepared by meal period,
- Remote site feeding - number of sites and number of meals by site, and
- Miscellaneous - other data to facilitate the analysis/interpretation of resulting work load and equipment operating hour data.

The resulting kitchen level descriptive data is presented in Appendix A for each kitchen, while the by meal period data (e.g. type ration/menu prepared, total meals prepared, number remote sites, etc.) is provided in the detailed by meal period workload data tables in Appendix B.

Kitchen Work Load Data

The work sampling method of data collection was utilized to collect quantitative data to characterize direct kitchen workloads associated the observed unit field kitchens by meal period. With this data collection method, a set of field kitchen tasks that cover major kitchen work activities and other specific work activities of interest, are first defined. Clear task definitions are essential to insure consistency and minimize variations between data collectors so to facilitate valid assessments, comparisons, and interpretation of the resulting by kitchen by meal period by task workload data sets. Examples of major kitchen work activities include Food Preparation, Serving, and Pot/Pan Sanitation. Table B-1 lists the kitchen work tasks and associated task definitions utilized for the work sampling data collection. The list of kitchen tasks includes:

- Food preparation
- Serving
- Supervision
- Other Food Service
- Other Non Food Service
- Remote Feeding
- Kitchen Sanitation
- Pot/Pan Sanitation
- Supply
- Burner Maintenance
- Generator/Other Maintenance

The two general work tasks, Other Food Service and Other Non Food Service, are designed to capture all productive work efforts by cooks or Kitchen Police (KP) that are not covered by the other specific work tasks. Examples of work activities for the 2 general work tasks include:

-Other food service tasks: cooks receiving supervision, food service team meetings, general planning, etc.

-Other non - food service tasks: digging soakage pit, erecting/tightening camouflage nets, KPs receiving supervision, maintaining hand washing units, etc.

With work sampling data collection, observations are taken at set times and a set time interval. For kitchen workload data, the observation interval was 15 minutes to include on the hour, quarter-hour, and half-hour. At each time point, cooks and KPs in or around the kitchen or sanitation center area are observed and categorized as being productive (working) or not working (non productive). For those determined to be productive, each is then classified as performing the work task that best fit their observed work effort. The clock time and resulting number of total cooks and KPS performing each productive work activity is then recorded on the data collection sheet (Figure B-1).

The work sampling data collected covered only those work activities observed and performed by cooks and KPs in and around the direct kitchen, sanitation center, and ration storage areas. Work efforts expended by cooks or KPs in other areas away from the kitchen area are not covered by or reflected in the work sampling data. Examples of these other non covered productive work efforts include: time to pick up and deliver required supplies (rations, ice, fuel, water) from supply points, time to haul/dispose of kitchen rubbish; supervisor, cook, and KP meetings away from kitchen area (e.g. in living quarters tent); and off site kitchen supervisor efforts to include meetings with unit to coordinate feeding plans and remote site feeding requirements, complete required requisition and other paperwork, etc. For development of a total kitchen workload and staffing model, these additional off-site workloads will need be estimated and added to those covered by the work sampling data to insure proper and sufficient kitchen staffing.

Overall and by task, direct kitchen workloads are determined from the work sampling data as follows. For each meal period, the recorded observations for each work task are summed. The resulting task totals for each meal period are then multiplied by the observation time interval of ¼ hour to obtain work hours by task for the meal period. Overall kitchen workload for the meal cycle is finally determined by summing the task work hours across all work tasks.

See Appendix B for a more detailed description of kitchen work sampling data collection to include detailed task definitions, data collection form, and resulting detailed by kitchen, by meal period, and by task workloads (productive work hours).

MBU/Generator Utilization Data

Equipment sampling was utilized to collect fuel burning equipment operating hour data to estimate kitchen fuel consumption levels. The method used was essentially identical to that used to collect kitchen work sampling data with one exception - a longer 30-minute observation level to include observations on the hour and half hour.

The same data collector collected kitchen work sampling and equipment sampling data. For equipment sampling data collection, the types and locations of all field kitchen associated fuel burning equipment were first identified. At the set time points, each item was observed and determined to be on (operating) or off (not operating), and the total quantity of each item by area determined to be operating was recorded on the data sheet.

Types of kitchen fuel burning equipment included the MBU for all kitchens, one or two 2-KW generators for MKT field operations, and a 10-KW generator for CK operations. For KCLFF-E operations, the limited power required by the three MBUs is provided by a battery pack that is recharged as needed by the MKT or another unit generator.

For MKT operations, one 2 KW generator is authorized to provide all required power for all MBUs and any necessary kitchen or sanitation center lights. To reduce noise levels, this generator is normally shut off between the breakfast and dinner meals and after the completion of the dinner meal when not required to support kitchen operations. While MKTs are authorized a single 2 KW generator, three of the observed MKT operations utilized two or separate generators to support MKT and sanitation center operations.

The CK includes a larger 10 KW generator to provide the additional power required by kitchen refrigeration, air conditioning, warming cabinets, lights, MBUs, etc. Because of the kitchen refrigeration, the CK generator normally operates continuously from the start of first kitchen work activities for breakfast to the completion of after dinner work activities with the exception of shut downs for refueling or maintenance. The CK generator is normally only turned off from the completion of after dinner work activities to the start of breakfast meal activities to reduce nighttime noise. When providing 2 group meals per day, the CK generator would typically operate continuously from about 0300 to 2100 daily or 18 hours per day or 9 hours per meal period.

Equipment sampling operating data was limited to the MBU for the KCLFF-E, MKT, CK, and sanitation centers; and the 2-KW generator for MKT operations. For CK kitchen operations, the 10 KW generator was assumed to operate an average 9 hours per meal period.

Fuel burning equipment operating hours by meal period were calculated from the equipment sampling data as follows. For each meal period, the recorded observations for kitchen MBUs, sanitation center MBUs, and 2-KW generators were summed. The resulting totals by type item and area for each meal period were multiplied by the

observation time interval (½ hour) to obtain operating hours, and then by the items fuel consumption rate to obtain item fuel consumption by meal period. Total kitchen fuel consumption was then determined by summing the resulting fuel consumptions across all type items.

For more details relative to the equipment sampling data collection, to include data collection forms and resulting equipment operating hour data, by type kitchen and by meal period - see Appendix B.

Results and Discussions

Project work sampling and equipment operating hour data collection covered a total of 17 different unit kitchens to include 2 KCLFF-E, 9 MKT kitchens, and 6 CK kitchens. Of these, kitchens 1 to 14 operated as regular mobile field kitchens in a regular field environment. Each of these kitchens was prepared to move as needed during the FTX. For these 14 field kitchens, the two KCLFF kitchens (8,9) used a single serving line for both hot and cold meal components, while each MKT and CK kitchen used their internal kitchen serving line for hot food components and a separate outside serving line for all other meal components to include: hot and cold beverages, deserts, salads, fruit, breads, condiments, etc. The outside serving lines were often totally self-serve and sometimes staffed with 1-2 servers for select items like salad or canned fruit or pudding. With these kitchens, soldiers simply sat on the ground or returned to their tents to consume their meals.

Kitchens 15 to 17, all CK kitchens, were set-up and operated in a stationary permanent base camp environment similar to that expected for the unit's planned Iraq deployment. There were no plans to move any of these kitchens. These kitchens also had very large commercial tent with tables, chairs, and floor mats for troop dining, large commercial ISO container freezers and refrigerators, and trailer mounted grease traps and large wastewater holding tanks, etc. In addition, the dining tents included double inside cold serving lines for all non-hot menu components and all beverages.

With kitchens 1 to 14, work efforts related to hand washing units were performed by cooks/kitchen police and were covered by the work sampling data. For kitchens 15 to 17, hand washing units and wastewater holding tanks were serviced by contractor support personnel and are not reflected in the work sampling data.

In terms of menu supplements, kitchens 1 to 14 provided the normal field supplements like fresh fruits and pre-made bagged mixed salads while kitchens 15 to 17 provided a comprehensive selection of assorted fruit and vegetable salads. In addition, instead of utilizing pre-made bagged mixed salads, these 3 kitchens prepared hand made salads from scratch which involved considerable labor to wash, cut/chop, and mix the salad ingredients.

Tables 2 and 3 detail kitchen specific feeding level data and the resulting average work hours per meal period and per 100 meals by type ration and work task for each observed kitchen. The data in these tables is organized/sorted by type kitchen, by total meals per meal period, and by type ration. Appendix B provides the more detailed by meal period data for each kitchen.

The remote site and meal count data in Tables 2 and 3 for each kitchen is the average for all meal periods. For each meal period, the total prepared meal count was determined by multiplying the number of modules opened by 50 even though sometimes

Table 2. Average Work Hours Per Meal Period

Kitchen Data								Productive Work Hours by Task												
No.	Type	Type Ration	No. Meal Periods	Remote Sites	On-site	Total Remote Meals	Total Meals	Food Prep	Serving	Supervision	Other Food Service	Other Non Food Service	Remote Feeding	Kitchen Sanitation	Pot/Pan Sanitation	Rubbish Removal	Supply	Burner Maint/Repair	Gen/Other Maint.	Total Prod. Hours
9	KCL	UGR-H/S	2	0	100	0	100	2.4	1.8	0.1	0.6	0.3	0.0	0.0	0.9	0.3	0.1	0.0	0.0	6.4
8	KCL	UGR-A	2	0	100	0	100	3.5	1.9	0.0	0.5	0.5	0.0	0.8	1.3	0.3	0.4	0.5	0.0	9.5
5	MKT	UGR-A	4	4	0	150	150	6.1	0.0	1.9	2.5	1.3	1.8	1.1	5.2	0.3	1.8	0.5	0.6	23.0
4	MKT	UGR-A	4	1	140	60	200	6.3	2.9	1.9	2.4	1.2	1.3	1.5	3.3	0.3	1.8	0.5	0.6	23.9
7	MKT	UGR-A	2	3	108	92	200	6.1	1.5	1.1	0.6	0.6	0.8	2.0	3.8	0.5	0.6	0.3	0.0	17.9
13	MKT	UGR-A	4	0	350	0	350	10.1	6.8	4.4	1.3	2.3	0.0	1.8	7.6	0.7	1.2	0.7	0.3	36.9
14	MKT	UGR-A	4	0	400	0	400	13.8	10.1	0.6	0.4	1.3	0.0	3.9	8.8	1.8	4.5	0.9	0.0	46.1
2	MKT	UGR-A	2	2	325	75	400	7.0	3.4	1.0	1.8	1.1	0.8	2.3	9.0	0.8	1.5	0.5	0.1	29.1
1	MKT	UGR-A	4	7	119	581	700	16.4	1.5	0.6	0.6	0.9	3.4	1.6	14.5	1.2	1.4	0.8	0.3	43.3
3	MKT	UGR-A	2	8	137	713	850	15.4	0.9	0.1	0.9	1.0	2.9	1.9	17.6	1.1	2.1	0.1	0.0	44.0
6	MKT	UGR-A	4	10	185	815	1,000	17.4	1.1	2.5	1.9	2.0	4.8	3.3	20.0	1.4	2.1	1.1	0.6	58.2
11	CK	UGR-A	1	4	205	345	550	15.5	5.0	5.0	6.5	0.0	2.3	2.3	15.0	0.8	2.3	0.8	0.0	55.3
15	CK	UGR-A	2	0	650	0	650	18.9	13.5	3.3	1.5	0.9	0.0	1.6	8.6	3.0	5.4	0.3	0.0	56.9
10	CK	UGR-H/S	1	0	700	0	700	14.0	5.8	2.5	1.3	3.8	0.0	1.5	16.5	1.0	3.0	0.3	0.5	50.0
10	CK	UGR-A	1	0	700	0	700	17.3	6.5	2.5	2.0	6.0	0.0	10.5	16.8	0.8	3.0	0.5	0.0	65.8
12	CK	UGR-H/S	1	4	425	275	700	14.5	5.5	0.0	0.0	0.0	1.0	1.5	16.3	0.5	0.0	0.3	0.0	39.5
12	CK	UGR-A	1	4	425	275	700	11.8	7.0	0.0	2.8	0.0	1.0	4.0	14.8	2.8	0.0	0.0	0.0	44.0
16	CK	UGR-A	2	0	850	0	850	30.6	10.3	4.8	1.9	3.0	0.0	5.3	14.9	5.4	5.0	0.4	0.0	81.4
17	CK	UGR-A	2	0	1,700	0	1,700	39.5	25.1	1.3	2.6	0.5	0.0	6.5	19.6	8.0	7.9	0.3	0.0	111.3

Table 3. Average Work Hours Per 100 Meals

Kitchen Data								Productive Work Hours Per 100 Meals by Task											
No.	Type	Type Ration	No. Meal Periods	Remote Sites	On-site	Total Remote Meals	Total Meals	Food Prep	Serving	Supervision	Other Food Service	Other Non Food Service	Remote Feeding	Kitchen Sanitation	Pot/Pan Sanitation	Rubbish Removal	Supply	Burner Maint/Repair	Gen/Other Maint.	Total Prod. Hours
9	KCL	UGR-H/S	2	0	100	0	100	2.4	1.8	0.1	0.6	0.3	0.0	0.0	0.9	0.3	0.1	0.0	0.0	6.4
8	KCL	UGR-A	2	0	100	0	100	3.5	1.9	0.0	0.5	0.5	0.0	0.8	1.3	0.3	0.4	0.5	0.0	9.5
5	MKT	UGR-A	4	4	0	150	150	4.1	0.0	1.3	1.7	0.8	1.2	0.7	3.5	0.2	1.2	0.3	0.4	15.3
4	MKT	UGR-A	4	1	140	60	200	3.2	2.1	0.9	1.2	0.6	2.2	0.8	1.6	0.1	0.9	0.3	0.3	12.0
7	MKT	UGR-A	2	3	108	92	200	3.1	1.4	0.6	0.3	0.3	0.8	1.0	1.9	0.3	0.3	0.1	0.0	8.9
13	MKT	UGR-A	4	0	350	0	350	2.9	1.9	1.3	0.4	0.6	0.0	0.5	2.2	0.2	0.3	0.2	0.1	10.6
14	MKT	UGR-A	4	0	400	0	400	3.5	2.5	0.2	0.1	0.3	0.0	1.0	2.2	0.5	1.1	0.2	0.0	11.5
2	MKT	UGR-A	2	2	325	75	400	1.8	1.0	0.3	0.4	0.3	1.0	0.6	2.3	0.2	0.4	0.1	0.0	7.3
1	MKT	UGR-A	4	7	119	581	700	2.3	1.3	0.1	0.1	0.1	0.6	0.2	2.1	0.2	0.2	0.1	0.0	6.2
3	MKT	UGR-A	2	8	137	713	850	1.8	0.6	0.0	0.1	0.1	0.4	0.2	2.1	0.1	0.3	0.0	0.0	5.2
6	MKT	UGR-A	4	10	185	815	1,000	1.7	0.6	0.3	0.2	0.2	0.6	0.3	2.0	0.1	0.2	0.1	0.1	5.8
11	CK	UGR-A	1	4	205	345	550	2.8	2.4	0.9	1.2	0.0	0.7	0.4	2.7	0.1	0.4	0.1	0.0	10.0
15	CK	UGR-A	2	0	650	0	650	2.9	2.1	0.5	0.2	0.1	0.0	0.3	1.3	0.5	0.8	0.0	0.0	8.8
10	CK	UGR-H/S	1	0	700	0	700	2.0	0.8	0.4	0.2	0.5	0.0	0.2	2.4	0.1	0.4	0.0	0.1	7.1
10	CK	UGR-A	1	0	700	0	700	2.5	0.9	0.4	0.3	0.9	0.0	1.5	2.4	0.1	0.4	0.1	0.0	9.4
12	CK	UGR-H/S	1	4	425	275	700	2.1	1.3	0.0	0.0	0.0	0.4	0.2	2.3	0.1	0.0	0.0	0.0	5.6
12	CK	UGR-A	1	4	425	275	700	1.7	1.6	0.0	0.4	0.0	0.4	0.6	2.1	0.4	0.0	0.0	0.0	6.3
16	CK	UGR-A	2	0	850	0	850	3.6	1.2	0.6	0.2	0.4	0.0	0.6	1.8	0.6	0.6	0.0	0.0	9.6
17	CK	UGR-A	2	0	1700	0	1,700	2.3	1.5	0.1	0.2	0.0	0.0	0.4	1.2	0.5	0.5	0.0	0.0	6.5

* Productive work-hours per 100 meals calculated by dividing the Table 2 average task work hours per meal period as follows: Serving - divide by Onsite Meals/100; Remote Feeding - divided by Total Remote Meals/100; and for all other tasks and total productive hours -divide by Total Meals/100.

not all main components were completely utilized. The total remote site meal count per meal period was determined by summing the meal orders across all remote sites. The on-site prepared meal count was determined by subtracting the remote meal count from the total prepared meal count. The on-site meal count represents the number of meals available to serve, not the number of meals actually served. Based on physical meal headcounts at some kitchens and observations at others, the number of on-site meals served was sometimes significantly less than the quantity prepared and available.

Total Kitchen Workloads

A review of Tables 2 and 3 reveals that while there can be considerable variation in total workload for similar type size and size kitchens, that overall kitchen workloads increase with the number of meals prepared. This is seen in Figure 7 which plots the total work hour data per meal period (from Table B-2) for MKT and CK kitchens preparing up to 1,000 meals, and in Figure 8 which depicts the average total work hours per meal period for each kitchen (from Table 2). While there is often considerable variability in total kitchen workloads, the work sampling data results indicate that larger kitchens tend to be more productive then smaller kitchens. This is depicted in Figure 9, which shows that the average total work hours per 100 prepared meals decreases as the total number of prepared meals increases.

Figures 7 to 9 clearly depict the extensive variation in the average total workloads per meal period for same type/size kitchens, and even between meal periods for a specific kitchen. These variations are attributable to several potential factors to include: different menus with high to low labor content being prepared, differences in cook team training, experience, and worker productivity; differences in selected food preparation methods, or non regular meal period workloads that occur during some but not all meal periods - for example dig a soakage pit. As a result some smaller kitchens expended more total labor hours than larger kitchens, and sometimes kitchen of considerable different sizes utilized about the same amount of labor.

Examples of variations in average total work hours per meal period between same size kitchens include:

- Kitchen 4 and 7 (MKT-200 meals) - 17.9 to 23.9 work hours or 34%
- Kitchen 2 and 14 (MKT-400 meals) - 29.1 to 46.1 work hours or 58%
- Kitchen 10 and 12 (CK-700 meals) - 41.7 to 57.9 work hours or 39%

Examples of variations in total workloads between meal periods (see Appendix B) for a specific kitchen include:

- Kitchen 5 (MKT) - 19.0 to 27.0 total work hours or 42%
- Kitchen 2 (MKT) - 25.0 to 33.3 total work hours or 33%
- Kitchen 6 (MKT) - 50.3 to 63.3 total work hours or 26%

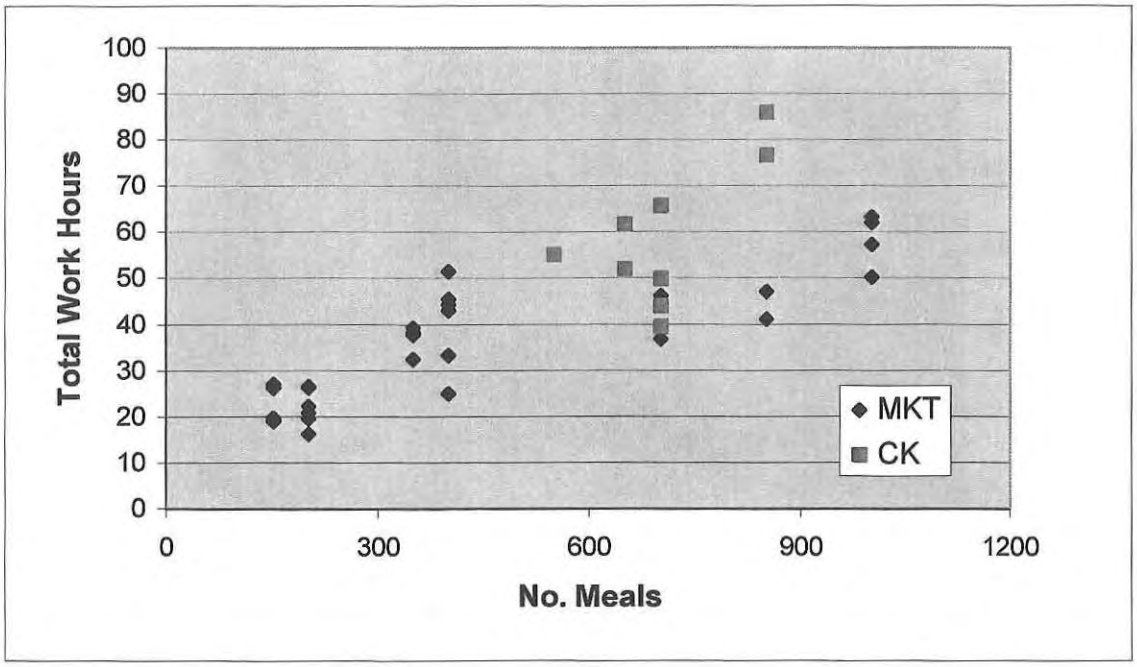

Figure 7. Total Work Hours by Meal Period

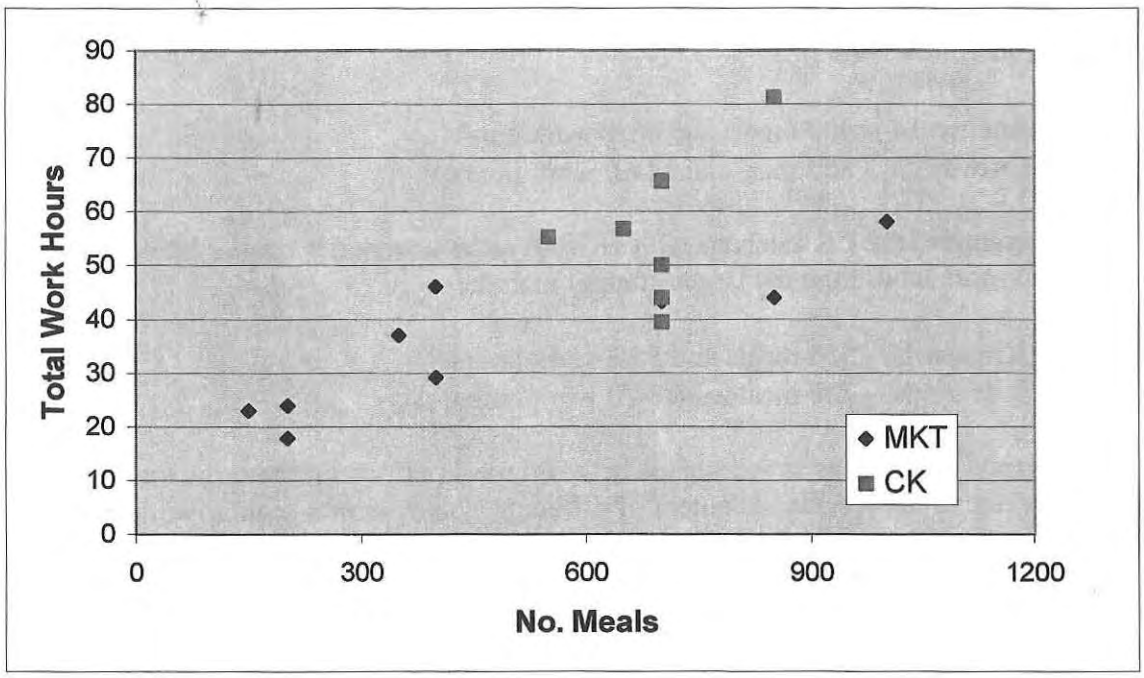

Figure 8. Average Total Work Hours Per Meal Period by Kitchen

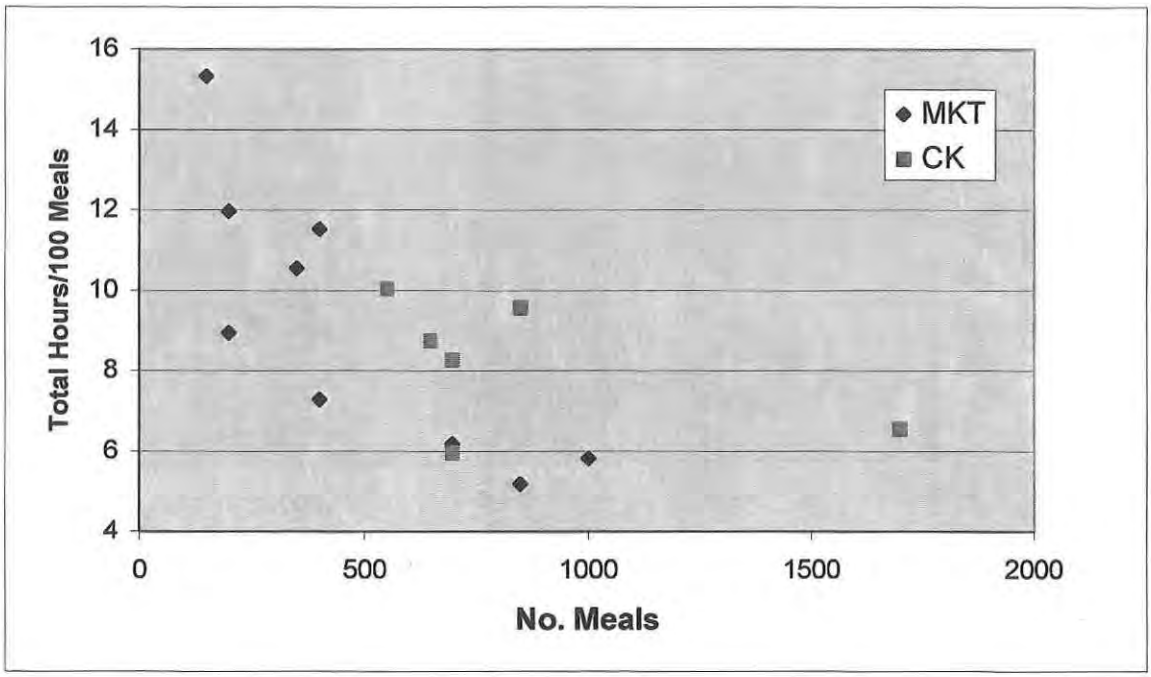

Figure 9. Average Total Work Hours Per 100 Meals by Kitchen

An example of 2 MKT kitchens of different size utilizing about the same total work hours include:

- Kitchen 14 - 400 meals and 46.1 work hours.
- Kitchen 3 - 850 meals and 44.0 work hours.

An example of 2 CK kitchens with UGR-A rations were the smaller kitchen expended more labor than the larger kitchen include:

- Kitchen 11 - 550 meals and 55.3 work hours.
- Kitchen 12 - 700 meals and 44.0 work hours.

The observed differences in workloads between meal periods for the same kitchen are primarily due to the workload content of different menus, or non-regular workloads that only occur during some but not all meal periods - for example the receiving of supplies for multiple meal periods. In addition to the above factors, the observed variability in average total workload per meal period between similar type/size kitchens may be due to differences in cook team training/experience, general operational procedures, and other factors. The differences in average workloads between similar type/size kitchens would likely be significantly reduced if data collection covered more meal periods, and each kitchen prepared the same menus with the same cook team.

Table 4. Average Work Hours Per Meal Period by Type Kitchen

	Type Field Kitchen			
Kitchen Data	**KCLFF**	**MKT**	**CK**	**All**
No. Meal Periods	4	30	11	45
Total Meals	400	14,100	9,750	24,250
Total Work Hours	32	1,108	753	1,893
Average Total Meals	100	470	886	539
On site	100	191	805	324
Remote	0	279	81	215
Work Task	**Hours**	**Hours**	**Hours**	**Hours**
Food Preparation	2.9	11.3	22.8	13.3
Serving	1.8	3.4	11.6	5.2
Supervision	0.1	1.7	2.6	1.8
Other Food Service	0.6	1.4	2.2	1.5
Other Non Food Service	0.4	1.4	1.7	1.4
Remote Feeding	0.0	1.8	0.4	1.3
Kitchen Sanitation	0.4	2.1	4.2	2.5
Pot/Pan Sanitation	1.1	9.9	15.0	10.4
Rubbish Removal	0.3	0.9	3.5	1.5
Supply	0.3	2.0	4.1	2.4
Burner Maintenance/Repair	0.3	0.7	0.3	0.5
Gen/Other Maintenance	0.0	0.3	0.0	0.2
Total Productive Work Hours	7.9	36.9	68.5	42.1

From Table 2 and Figures 7 to 9, for 850 meals, it seems the CK kitchen (#16) required a lot more total work hours than the MKT kitchen (#3). A review of the by task word load data reveals the much higher CK workload is primarily due to higher food preparation and serving hours. The higher CK food preparation hours (30.6 vs. 15.4) is likely mostly due to the high labor extensive from scratch salad selection provided by the CK kitchen, as compared to the MKT kitchens selection of pre-made bagged salads. The much higher CK serving work hours are due to the fact that all 850 CK meals were fed on-site, while only 137 of the MKT meals were fed on-site. These 2 factors account for the majority of the difference in CK and MKT total work hours. Any remaining difference likely represents normal workload variations due to differences in menus prepared, preparation methods, or variations in cook team experience and methods.

Workload Summary by Type Kitchen

Table 4 rolls up and summarizes all of the work sampling data in terms of average productive work hours per meal period by work task for each type kitchen. In total, data

collection covered 45 meal periods, 24,250 total meals, and 1,893 total productive work hours. Data collection relative to MKT operations represented 67% of the covered meal periods and 58% of the total prepared meals. Data collection for KCLFF-E operations was limited to only 4 meal periods. The average number of meals per meal period was 100, 470, and 886 for KCLFF, MKT, and CK operations, respectively. Also the average mix of on-site and remote meals varied considerably by type kitchens at 100%, 42%, and 91% on-site meals for KCLFF-E, MKT, and CK operations, respectively.

Food preparation was the largest work activity for each type kitchen. For CK and MKT the top five work activities were the same. From largest they were: food preparation, pot/pan sanitation, serving, kitchen sanitation, and supply. Interestingly the average total workload per meal period for each type kitchen appears to be closely related to the average total meals prepared.

Table 5. Average Work Hours Per 100 Prepared Meals by Type Kitchen

	Type Field Kitchen							
Meal Mix	**KCLFF**		**MKT**		**CK**		**All**	
On Site Meals	100%		41%		91%		60%	
Remote Site Meals	0%		59%		9%		40%	
Work Task	**Hours**	**%**	**Hours**	**%**	**Hours**	**%**	**Hours**	**%**
Food Prep	2.9	37%	2.4	30%	2.6	33%	2.5	32%
Serving	1.8	23%	0.7	9%	1.3	17%	1.0	12%
Supervision	0.1	1%	0.4	5%	0.3	4%	0.3	4%
Other Food Service	0.6	7%	0.3	4%	0.3	3%	0.3	4%
Other Non Food Svc	0.4	5%	0.3	4%	0.2	2%	0.3	3%
Remote Feeding	0.0	0%	0.4	5%	0.0	1%	0.2	3%
Kitchen Sanitation	0.4	5%	0.5	6%	0.5	6%	0.5	6%
Pot/Pan Sanitation	1.1	13%	2.1	27%	1.7	22%	1.9	25%
Rubbish Removal	0.3	3%	0.2	2%	0.4	5%	0.3	4%
Supply	0.3	3%	0.4	5%	0.5	6%	0.4	6%
Burner Maintenance	0.3	3%	0.1	2%	0.0	0%	0.1	1%
Other Maintenance	0.0	0%	0.1	1%	0.0	0%	0.0	1%
Total Work Hours	7.9	100%	7.9	100%	7.7	100%	7.8	100%

Table 5 summarizes the same work sampling data in terms of work hours by task per 100 meals and percent of total kitchen workload. Even though the average number of meals per meal period varied considerably from 100 for the small KCLFF to 886 for the CK kitchens, the overall workload per 100 meals was relatively constant for each kitchen at 7.9, 7.9, and 7.7 for KCLFF, MKT, and CK kitchens. Food preparation was the top work activity for each type kitchen and represented 30-37% of total workloads. The top

3 work activities for each type kitchen were food preparation, pot/pan sanitation, and serving. Together these represented 66-73% of each type kitchens total workload.

Overall Kitchen Workloads and Number of Meals Prepared

Work sampling data collection relative to MKT operations covered more kitchens, more meal periods, and several feeding levels over a larger 150 to 1,000 meal range than that for the CK. CK data collection was limited to a narrower 550-850 meal range with the exception of one kitchen of 2 CKs to prepare 1,700 meals. Therefore the MKT data was utilized to analyze kitchen workloads as a function of total meals prepared. To reduce the variability due to differences in menus prepared or cook team experience/productivity, the MKT data was grouped and analyzed as 4 meal count ranges to include Group A 150-200 total meals, Group B 350-400 total meals, Group C 700-850 total meals, and Group D 1,000 total meals. Table 6 summarizes the resulting workload data for these 4 MKT groups. With grouping, the number of kitchens and meal periods in each group are: Group A -3 kitchens and 10 meal periods, Group B - 3 kitchens and 10 meal periods, Group C - 2 kitchens and 6 meal periods, and Group D - 1 kitchen and 4 meal periods. This compares to the lower 1 to 4 meal periods for kitchen level data. The inclusion of multiple kitchens in a group and the resulting larger number of meal periods per group reduces observed variability and as a result data trends are clearer. The top part of Table 6 details the average number of total meals per meal period and the mix of on-site to off-site meals for each group. The bottom half of the table details the average work load per meal period and per 100 meals for each group.

From Table 6, Group A or the smallest size MKT kitchens averaged 180 meals and 22.4 total work hours meal period while the next size (Group B) averaged 380 meals and 39.0 total work hours. In comparing these groups, the Group B kitchens are somewhat more productive as they prepared 110% more meals (380 vs. 180) but expended only 74% more productive work hours than Group A. The higher productivity of the Group B kitchens is reflected in the resulting fewer work hours per 100 meals for the Group B kitchens, 10.3 versus 12.4 for Group A.

In comparing the Group B and to the still larger Group C kitchens, the larger Group C kitchens were much more productive than the Group B kitchens. On average, each Group C kitchens prepared 97% more meals (750 vs. 380) but utilized only 12% more total work hours. The much higher productivity for the Group C kitchens results in a much lower 5.8 work hours per 100 meals for the group C kitchens, compared to 10.3 for the Group B kitchens. A major part of the higher productivity for the Group C kitchens is due to the lower mix of higher labor on-site meals and the higher mix of lower labor content off-site meals, as compared to the Group B meal mix. In general, the serving hours expended to provide a set number of on-site meals is higher than that to assemble the same number of meals for remote site feeding. If the Group C mix of on-site and off-site meals was the same as group B, then the Group C serving hours would have been about 2 times as high as Group B, rather than lower. With the same Group B on-site to remote mix, the Group C work hours per 100 meals is estimated to be a higher

Table 6. Grouped MKT Workload Data

Summary Kitchen Data	Meals Prepared Per Meal Period							
	A: 150-200		B: 350-400		C: 700-850		D: 1,000	
No. Meal Periods	10		10		6		4	
Ave Remote Meals	102	57%	15	4%	625	83%	865	86%
Ave On-Site Meals	78	43%	365	96%	125	17%	135	14%
Ave Total Meals	180	100%	380	100%	750	100%	1,000	100%
	Work Hours		Work Hours		Work Hours		Work Hours	
Work Hours Per	Meal Period	100 Meals	Meal Period	100 Meals	Meal Period	100 Meals	Meal Period	100 Meals
Food Preparation	6.2	3.4	11.0	2.9	16.1	2.1	17.4	1.7
Serving	1.5	0.8	7.4	1.9	1.3	0.2	1.1	0.1
Supervision	1.7	1.0	2.2	0.6	0.5	0.1	2.5	0.3
Other Food Service	2.1	1.2	1.0	0.3	0.7	0.1	1.9	0.2
Other Non Food Service	1.1	0.6	1.6	0.4	1.0	0.1	2.0	0.2
Remote Feeding	1.4	0.8	0.2	0.0	3.2	0.4	4.8	0.5
Kitchen Sanitation	1.4	0.8	2.7	0.7	1.7	0.2	3.3	0.3
Pot/Pan Sanitation	4.1	2.3	8.4	2.2	15.5	2.1	20.0	2.0
Rubbish Removal	0.3	0.2	1.2	0.3	1.2	0.2	1.4	0.1
Supply	1.6	0.9	2.6	0.7	1.7	0.2	2.1	0.2
Burner Maintenance	0.5	0.3	0.8	0.2	0.6	0.1	1.1	0.1
Other Maintenance	0.5	0.3	0.1	0.0	0.2	0.0	0.6	0.1
Total Productive Hours	22.4	12.4	39.0	10.3	43.5	5.8	58.2	5.8

7.1, versus the prior calculated 5.8 based on Groups C actual mix. Removing the effects of differences in onsite to remote site mix, this indicates that the larger Group C kitchens are still significantly more productive than the smaller Group B kitchens.

In comparing Group C and the largest Group D kitchens, there appears to be no improvements in kitchen productivity for the larger kitchens. This may be due to chance as Group D includes only a single kitchen and 4 total meal periods, or it might indicate kitchen productivity improvements level off at or above certain feeding levels. On average, the Group D kitchens prepared 33% more meals (1,000 to 750) but also utilized 33% more work hours (58.2 to 43.5). In addition, the mix of on-site to off-site meals was similar for both groups. As a result the work hours per 100 meals for was the same for both Groups at 5.8.

Based on the Table 6 data, Figure 10 depicts the average total work hours and food preparation work hours per meal period for the 4 MKT groups while Figure 11 depicts the same in terms of per 100 meals. Figure 10 clearly shows that both total kitchen work hours and food preparation work hours tend to increase with kitchen size. Figure 11 shows that overall kitchen productivity improved with the number of meals prepared and appears to perhaps level off at about 750 meals. Relative to the largest work activity food preparation, productivity appears to continue to improve though at slower rates at higher levels. A standard measure of productivity is units per hour or meals per worker hour. Relative to total kitchen work hours, the productivity of the Group A, B, C, and D kitchens were 8.0, 9.7, 12.2, and 12.2 meals per productive work hour; while relative to food preparation work hours only productivity rates were 29, 35, 47, and 57 meals per work hour.

Kitchen Workload Review by Task

For each kitchen, the top 3 activities - food preparation, serving, and pot/pan sanitation on average accounted for 69% of overall kitchen workload. The total workload for a larger kitchens is higher than that for similar smaller kitchen due to the larger quantities of food to be prepared, the more pots/pans to be used and sanitized, etc. However other factors like specific menus prepared or mix of on-site/off-site meals also impact specific work activities and in turn total kitchen workloads. This section reviews kitchen level Table 2 data and trends in terms of the key factors that drive the work hours of each work activity.

Food Preparation

Food preparation work hours are impacted by several factors to include specific menu being prepared, cook team experience and productivity, etc. Figure 12 depicts the food preparation work hours per meal period for MKT and CK kitchens preparing up to 1,000 meals. Together Figures 10 and 12 reveal that food preparation hours increase with the number of total meals prepared though at a slower rate due to increased productivity at higher feeding levels.

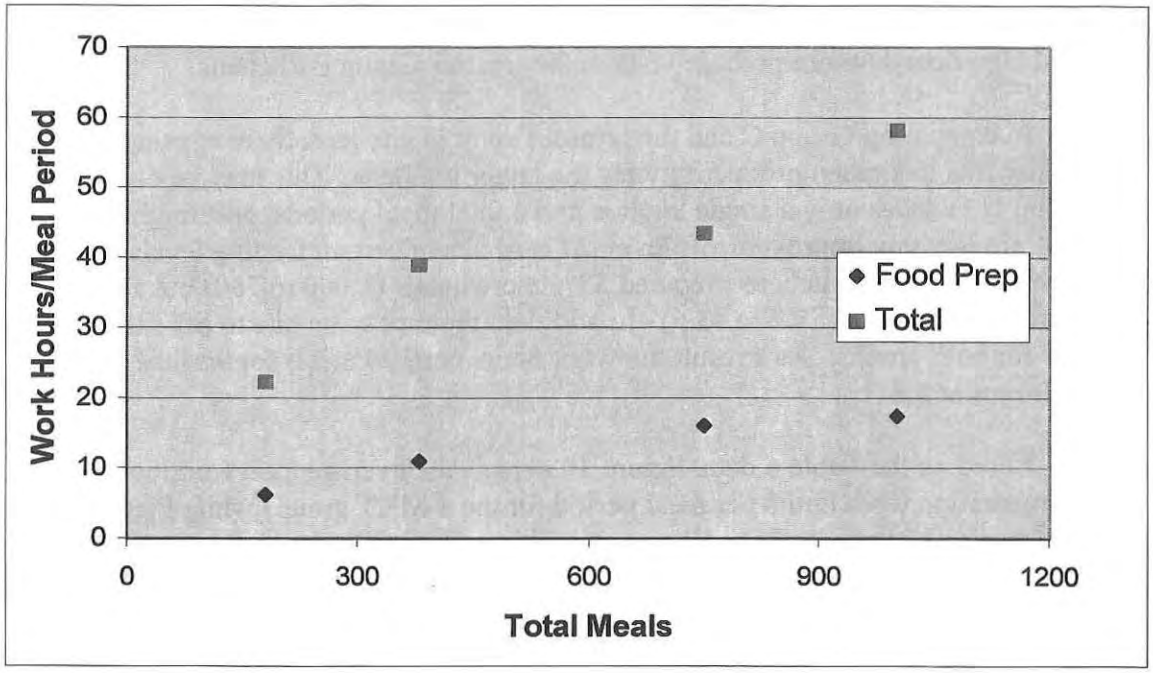

Figure 10. Grouped MKT Date - Average Total Work Hours Per Meal Period

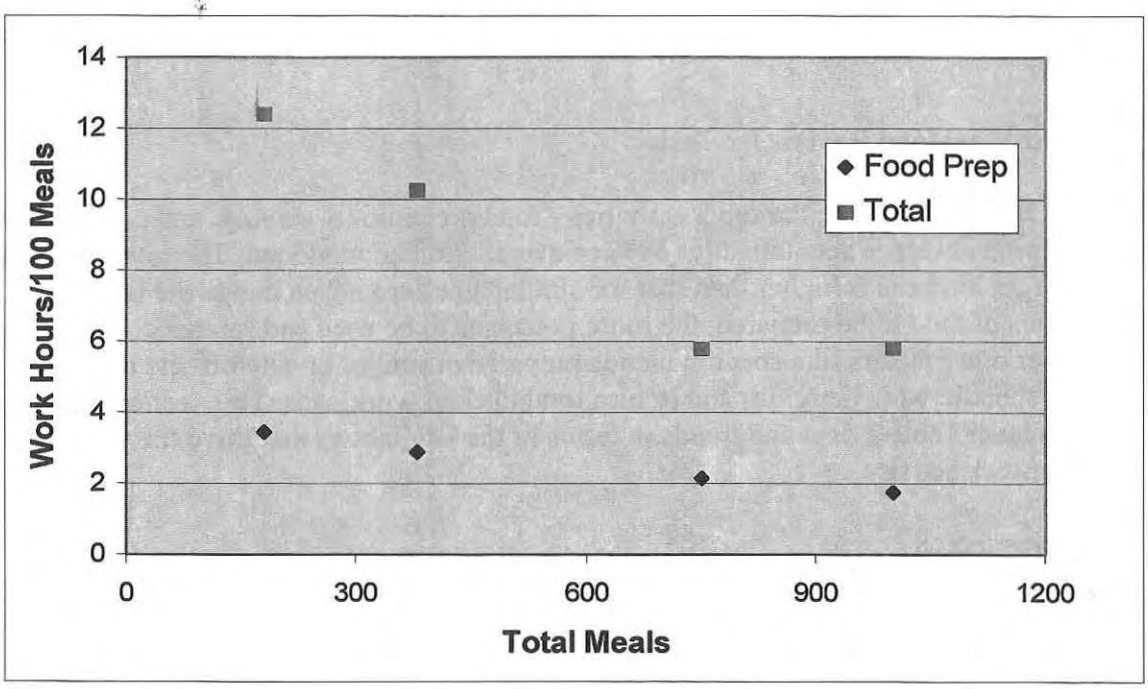

Figure 11. Grouped MKT Data - Average Total Work Hours Per 100 Meals

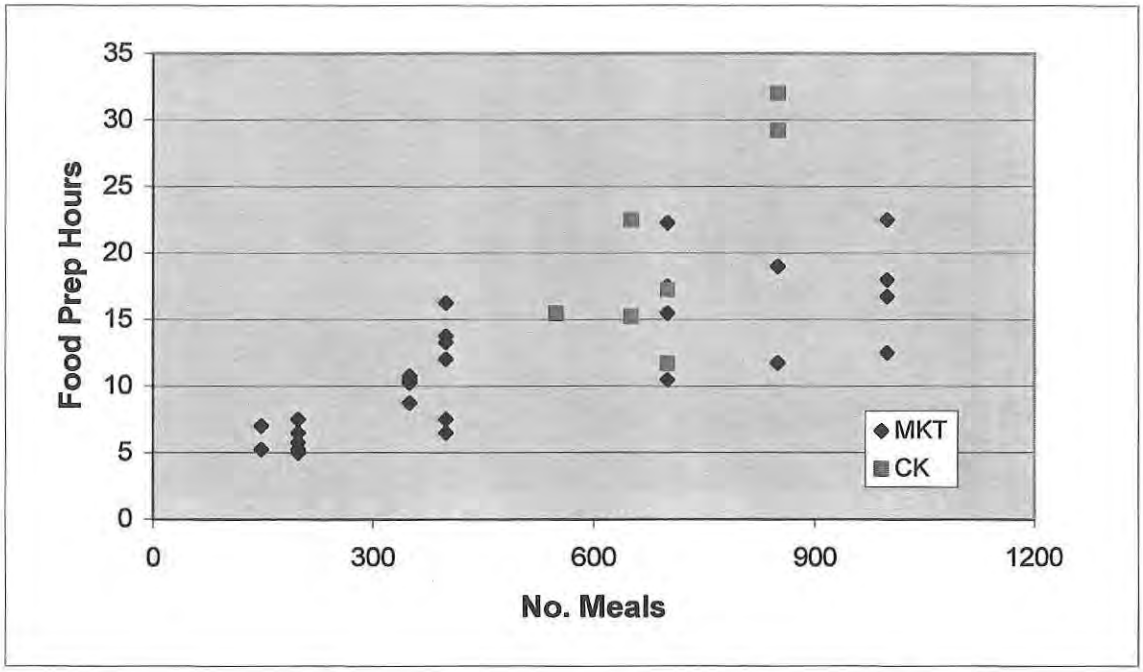

Figure 12. Food Preparation Hours Per Meal Period

Serving

This work task covered several activities to include: setting up serving line, manning a serving line whether actively serving or not, monitoring a serving line for replenishment requirements, restocking serving lines, etc. A review of the kitchen level data indicates that serving work hours increase with the number of on-site meals but can be highly variable for kitchens providing similar quantities of on-site meals. Based on field observations, factors impacting this variability include: number of assigned servers during busy periods and slow periods, number cooks or KP actively monitoring the external serving line with non hot food item items, and length of serving period. Figure 13 depicts the average serving hours per 100 available on-site meals for the 16 kitchens with on-site meals. This figure depicts the variability in serving hours for kitchens providing similar amounts of on-site meals. The resulting serving hours per 100 available on-site meals varied from less than 1 to about 2.5 and averaged about 1.6. From Figure 13 it appears the average serving work hours per 100 meals appears to remain the same at about 1.6 for all size kitchens.

Some of the observed variability is likely due to the percent of each kitchen's available meals actually served. Some kitchens served essentially 100% of the available meals while others had significant excess quantities. For kitchens with significant excess meals, the calculated work hours per 100 available meals understates the actual workload expended per 100 served meals. A better kitchen serving workload

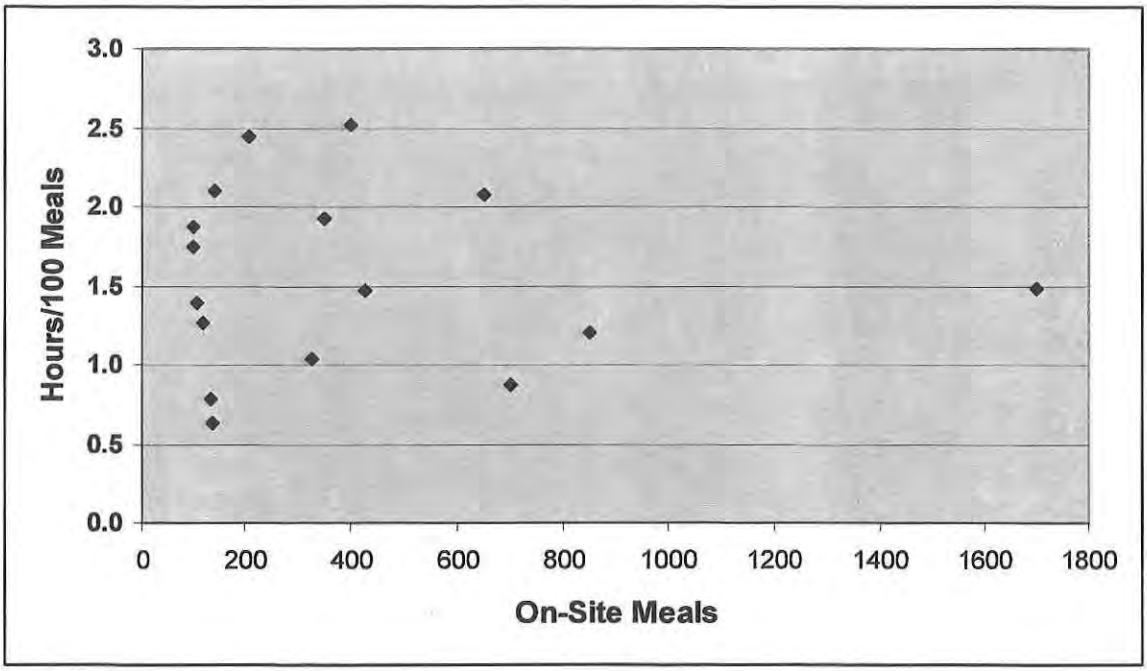

Figure 13. Serving Work Hours Per 100 On-Site Meals

metric is work hours per 100 meals actually served. However several kitchens did not collect physical headcount data for on-site meals served.

Based on field observations, a kitchen's hot serving line is typically staffed with 2 to 3 cooks and can maintain an extended sustainable serving rate of about 4.0 to 4.5 customers per minute. Based on a serving line with 2.5 cooks and a serving rate of 4.25 customers per minute, this equates to a minimum 1.0 serving hours per 100 meals served for manning the hot serving line only. To this need be added additional work hours for setting up the serving line, manning the serving line when no lines, monitoring and replenishing the external non hot food serving line, etc.

Supervision

Each field kitchen is staffed with one senior food service specialist or dining facility manager. This work task covered observed supervision activities of the dining facility manager in and around the direct kitchen area. The average level of supervision per meal period varied greatly between kitchens from a low of 0.0 work hours to a peak of 5.0 work hours, and averaged about 2.0 work hours per meal period across all kitchens. At some field kitchens, the dining facility manager was on-site a significant part of each workday, while at others the dining facility manager was seldom seen. A review of supervision hours across kitchens reveals no linkage between supervision work hours and number of meals prepared. For example MKT kitchen 13 preparing 350 meals averaged 4.4 supervision hours while MKT kitchens 1 and 3 preparing slightly more 400 meals utilized only 0.6 and 1.0 each. Similarly CK kitchen 11 preparing 550 meals

utilized the max 5.0 supervision hours while CK kitchen 17 preparing a much higher 1,700 meals utilized only 1.3 hours. Kitchen supervision hours per meal period appear to be dependent on the kitchens dining facility manager, and independent of type kitchen, total meals prepared, or mix of remote/on-site meals.

Other Food Service

Examples of work included under this task include: cooks receiving supervision, food service related team meetings, and general planning. Most of these work hours reflect cook work hours and not KP work hours. Except for one kitchen, average other food service work hours per meal period varied from 0.0 to only 2.8 work hours between kitchens. For kitchen 11 for which data collection covered only one meal period, the other food service work hours were a higher 6.5. This was primarily due to an extended on-site cook team meeting. The average across all kitchens was about 1.5 hours per meal period. This task represent a small 4 % of total kitchen work load and appear to be independent of type kitchen, total meals prepared, or mix of on-site to offsite meals.

Other Non Food Service

Work efforts included under this task are primarily KP work activities like digging a soakage pit, servicing field hand washing units, tighten camouflage netting, etc. Most of these activities occur on a non-regular basis - for example dig soakage pit. As a result work hours per meal period varied from 0.0 to 4.9 between kitchens and average only 1.3 work hours across all meal periods. This task represented a low 3% of overall kitchen workload and appears to be independent of type kitchen, total meals prepared, or mix of on-site to offsite meals.

Remote Feeding

Remote feeding was supported by 7 of the observed MKT kitchens and only 2 of the CK kitchens. For this activity average work hours increase with the number of remote meals provided. For this task, work hours for the 4 MKTs providing 60 to 150 remote meals per meal period averaged 1.2 hours per meal period or 1.3 hours per 100 remote meals, while work hours for the 3 MKTs providing 581 to 860 meals per meal period averaged a higher 3.7 hours per meal period but a lower 0.5 hours per 100 remote meals. Together, this data indicates the average workload for this task increases with the number of remote meals though at a slower rate.

Kitchen Sanitation

The level of kitchen sanitation varied considerably from kitchen to kitchen. At some kitchens, all cooking equipment to include burner stands and pot cradles were thoroughly scrubbed and cleaned and floors were washed after each meal periods. At others, kitchen sanitation was less intensive after each meal period. Between the MKT kitchens, average work hours for kitchen sanitation varied from 1.1 to 3.9 hours per meal period. For the CKs, kitchen sanitation work hours for one kitchen was a high 10.5 hours

for 1 meal period, while the others ranged between 1.5 to 6.5 work hours per meal period. Based on the more extensive MKT data, kitchen sanitation workload appears to remain about the same as the number of meals prepared increases. For this activity, the MKTs averaged 2.0 work hours and the CKs a higher 4.0 work hours per meal period. However the CKs also prepared about 2 times as many meals per meal period, 886 versus 470. As a result the sanitation workload per 100 meals was the same for both kitchens at 0.5 hours per meal period.

Pot/Pan Sanitation

This task was the second largest work activity after food preparation and is performed entirely by KPs. Based on the more extensive MKT data, as expected, it appears that the pot/pan workload increases with the number of meals prepared at the rate of about 2.1 work hours per 100 meals. Another factor, which likely impacts overall pot/pan sanitation workload, is the mix of on-site and remote site meals. Due to increased use of insulated containers and inserts for remote site meals, an equivalent number of remote site meals are likely to generate a higher pot/pan sanitation workload than the same number of on-site meals.

Rubbish Removal

This task was performed by KPs and averaged 4% of overall kitchen workload. Based on the MKT data, workload for this activity seems to increase with the number of meals prepared. For this task, the 3 smallest MKTs that prepared 150 to 200 meals averaged 0.3 work hours per meal period, the 3 MKTS that prepared 350-400 meals averaged 1.1 work hours, and the largest 3 MKTs that prepared 700-1,000 meals averaged 1.3 work hours. Based on the MKT data, kitchen rubbish removal workload is estimated at about a constant 0.2 work hours per 100 meals.

The rubbish removal work load for CK kitchens 15, 16, and 17 were relatively higher than that observed for other kitchens. This is because these 3 kitchens included large tents for troop dining and 100% of all meals were fed on-site. As a result these kitchens generated relatively larger amounts of rubbish in and around the dining shelter requiring disposals as all disposable dinner wear and meal waste was deposited in the kitchen area. For the other kitchens, disposable dinner wear and plate waste was often disposed in other areas away from the kitchen to include living shelter, work area, or remote site.

Supply

This activity covered supply related workload at the kitchen site only and excluded any worker hours expended away from the kitchen to pick up ration, water, or fuel supplies. Most of these hours were associated with off-loading, handling, and storing received Class I supplies. A few of the kitchens had an assigned storeroom person to also manage and issue stocks as needed. During the exercises, kitchens receive their Class I stocks either once a day or every 2-3 days. As a result, a Class I receipt

would represent a 2 to 6 meal period supply and would occur during some, but not all, meal periods. As a result the observed average work hours for this task was highly variable between kitchens and ranged from 0.0 to 7.9 work hours per meal period. The high 7.9 work hours was for the CK kitchen that was preparing 1,700 meals per meal period. These high hours included the work effort to off load and store a full flatbed trailer of Class I stocks by hand. The average work effort for this task should be related to and proportional to the quantity of stocks or number of complete meals received. Therefore the best metric for this work activity is work hours per 100 meals with the assumption that on average the number of meals received is the same as the number prepared. Based on the work sampling results for all 17 kitchens the average kitchen supply workload is estimated at 0.5 work hours per 100 meals.

Burner Maintenance

Observed MBU burner maintenance hours were minimal and between kitchens averaged from 0.0 to 1.1 work hours per meal period. For all 17 kitchens, burner maintenance hours represented 1% of overall kitchen workload and averaged 0.5 hours per meal period. The work sampling data collection covered 24,250 total meals and included only 24.25 total burner maintenance hours. This equates to 0.1 work hours per 100 meals.

Generator/Other Maintenance

Work hours associated with this task were even less than that for burner maintenance and averaged less than 1% of overall kitchen workloads. For more than half of the kitchens, no activity for this task was observed.

Comparison of Container Kitchen and Mobile Kitchen Trailer Workloads

In comparing CK and MKT workloads for similar feeding situations, potential workload differences were expected for only 2 tasks - food preparation and kitchen sanitation. For example no differences were expected for burner maintenance or pot/pan sanitation hours as each kitchen utilized the same MBU burners, same type pots/pans and food containers, and same sanitation center to sanitize pots, pans, etc. Due to the CKs larger work area and extra food preparation equipment, CK food preparation hours were expected to be possibly lower, and kitchen sanitation hours possibly higher than that for the MKT.

As previously discussed, food preparation work hours can be highly variable between meal periods for the same kitchen or between similar type and size kitchens. As a result, the ability to utilize the collected data to directly assess/evaluate food preparation work hours for same size MKT and CK kitchens is limited. For 700 meals and UGR-A rations, collected workload data included 1 MKT over 4 meal periods, and 2 CKs for 1 meal each. For these kitchens, food preparation hours averaged 16.4 for the MKT and a slightly lower 14.6 for the CK. For 850 meals and UGR-A rations, collected data

includes 1 MKT and 1 CK kitchen each for 2 meal periods. For these kitchens, food preparation hours for the CK averaged were much higher at 30.8 as compared to the MKTs 15.4. As previously mentioned, the much higher CK food preparation hours is primarily due to it's extensive high labor from scratch vegetable and fruit salad selection as compared to that provided by the MKT kitchen. Across all observed kitchens, MKT and CK food preparation hours averaged a similar 2.4 and 2.6 hours per 100 meals. Given the inherent variability in food prep hours due to several factors, there is no evidence that the CK is either more or less efficient in terms of food preparation hours than the MKT.

Relative to kitchen sanitation, the MKTs and CKs averaged 2.0 and 4.0 hours per meal period respectively across all meal periods. On average, CK kitchens prepared about twice as many meals per meal period. As a result the workload per 100 meals for each type kitchen was the same at 0.5 hours. Based on this, CK kitchen sanitation workloads might be higher or perhaps the same as MKT sanitation workloads.

For the other tasks, a review of the Table 5 workloads per 100 meal data indicates the workload associated with each task is about the same for both MKT and CK kitchens. The work hours per 100 meals for supervision, other food service, other non food service, rubbish removal, supply, burner maintenance, and other maintenance were essentially the same for both kitchens. In terms of serving hours, MKT hours were lower because 59% of its meals were served off-site as compared to 9% for the CK. For remote feeding, MKT hours were higher due to the higher mix of remote feeding. Relative to pot/pan sanitation, MKT hours were slightly higher and likely attributable to larger quantities of insulated containers and inserts from remote feeding requiring sanitation.

Comparison of UGR-A and UGR-H/S Work Hours

UGR-H/S food preparation and pot/pan sanitation work hours were expected to be potentially lower than those for the UGR-A. No differences in workloads between rations were expected for the other work tasks. UGR-H/S workload data collection covered only 4 total meals to include 1 KCLFF for 2 meal periods and 2 CKs for 1 meal period each. Given the observed variations in kitchen workloads, the available data is insufficient to assess any differences in UGR-A and UGR-H/S workloads.

Comparison of Kitchen Fuel Consumption Levels

For each field kitchen, Table 7 presents the average operating hours per meal period and per 100 meals for kitchen MBUs, sanitation center MBUs, and kitchen generators. Each MKT kitchen is authorized one 2 KW but three of these kitchens utilized two - one for the MKT and a separate one for the sanitation center. Each CK includes a built in 10 KW generator. Based on the MKT data, kitchen MBU hours tend to increase with the number of meals prepared but at a lower rate. Sanitation MBU operating hours also tend to increase with the number of meals prepared but the results

Table 7. Average Equipment Operating Hours Per Meal Period and Per 100 Meals

Kitchen Data					Hours/Meal Period				Hours/100 Meals			
					MBUs				MBUs			
No.	Type	Ration*	Meal Periods	Meals/ Meal Period	Kitchen	Sanitation	Total	Generators**	Kitchen	Sanitation	Total	Generators**
9	KCL	H/S	2	100	2.5	0.0	2.5	0.0	2.5	0.0	2.5	0.0
8	KCL	A	2	100	3.3	0.0	3.3	0.0	3.3	0.0	3.3	0.0
5	MKT	A	4	150	5.8	3.5	9.3	6.3	3.8	2.3	6.2	4.2
4	MKT	A	4	200	6.5	2.6	9.1	7.8	3.3	1.3	4.6	3.9
7	MKT	A	2	200	7.5	1.3	8.8	6.3	3.8	0.6	4.4	3.1
13	MKT	A	4	350	10.3	1.4	11.6	5.9	2.9	0.4	3.3	1.7
14	MKT	A	4	400	15.0	4.0	19.0	7.5	3.8	1.0	4.8	1.9
2	MKT	A	2	400	9.0	0.5	9.5	6.5	2.3	0.1	2.4	1.6
1	MKT	A	4	700	15.8	11.0	26.8	15.6	2.3	1.6	3.8	2.2
3	MKT	A	2	850	18.5	5.5	24.0	7.0	2.2	0.6	2.8	0.8
6	MKT	A	4	1,000	13.5	6.8	20.3	9.5	1.4	0.7	2.0	1.0
11	CK	A	1	550	14.0	1.0	15.0	10.0	2.5	0.2	2.7	1.8
15	CK	A	2	650	17.0	4.8	21.8	10.0	2.6	0.7	3.3	1.5
10	CK	H/S	1	700	14.0	4.5	18.5	10.0	2.0	0.6	2.6	1.4
10	CK	A	1	700	16.5	4.5	21.0	10.0	2.4	0.6	3.0	1.4
12	CK	H/S	1	700	15.0	6.0	21.0	10.0	2.1	0.9	3.0	1.4
12	CK	A	1	700	11.5	9.0	20.5	10.0	1.6	1.3	2.9	1.4
16	CK	A	2	850	31.0	4.0	35.0	10.0	3.6	0.5	4.1	1.2
17	CK	A	2	1,700	41.0	4.8	45.8	20.0	2.4	0.3	2.7	0.6

* A=UGR-A ration, H/S=UGR-H/S ration.

** KCL - no generator, MKT - 2 KW generator, and CK - 10 KW generator.

are more variable due to differences in sanitation center operations between kitchens. At some kitchens, the sanitation center consistently operated 2 burners under the sinks when doing pot/pan sanitation, while others utilized only one MBU and often had it shut off even while doing pot/pan sanitation. As shown in Table 7, one MKT preparing 400 meals averaged only 0.5 MBU sanitation hours while another MKT preparing the same 400 meals averaged 4.0 MBU hours per meal period. However, the observed pot/pan

sanitation work hours for the two kitchens were similar at 8.8 to 9.0 hours per meal period. Generator operating hours for the MKT kitchens appeared to remain fairly level and not dependent on the number of meals prepared. For MKT operations, the 3 kitchens with 2 generators (1,3, and 6) averaged 10.7 generator hours per meal period while those with one averaged a lower 6.7. A key factor affecting MKT kitchen generator hours was whether they were shut off or not between meal periods when not required to support MBU operations. Because of the CK refrigerator, the CK generators were operated continuously from the start of initial breakfast work activities to the completion of after dinner work activities. These generators were only shut down during the day for re-fueling purposes and between the completion of after dinner work activities to the start of breakfast work activities. For fuel consumption calculations, the CK generators were assumed to operate 18 hours per day or 9 hours per meal period.

Table 8 details the calculated average fuel consumption per meal period and per 100 meals across all observed MKT and CK operations. These are based on the following assumed average fuel consumption rates per hour: MBU burner - 0.30 gallons, 2 KW generator - 0.33 gallons, and 10 KW generator - 1.00 gallons. On average CKs prepared about twice the meals per meal period at 886 versus 470 for the MKTs. This difference need be considered in comparing CK and MKT fuel consumption levels. As shown by Table 8, the CK kitchen and sanitation center MBU hours per meal period were about 100% and 10% higher than those for the MKT. While the CK prepared about 100% more meals, it's sanitation center MBU hours were only about 10% than those for the MKT. A likely explanation for the small increase is the much higher mix of remote meals for the MKT kitchens and the associated higher workloads to sanitize the larger quantity of containers and inserts to support remote feeding operations as compared to on-site feeding operations. MKT generator hours were simply lower because they were often shut down between the breakfast and dinner meal periods while the CK generators continued to operate during this period. Overall CK fuel consumption averaged 20.03 gallons versus only 7.43 per meal period for the MKT. This increase is entirely attributable to the larger CK generator, which operated longer and at 3 times the fuel consumption rate, as compared to the MKT generator. In terms of total fuel consumption per 100 meals, the CK was about 43% higher at 2.26 gallons versus 1.58 for the MKT.

Workload Comparisons with Historical "A" and "B" Ration Data

The Army's new UGR-A and UGR-H/S group rations and MBU burners were designed to simplify field kitchen operations and reduce kitchen workloads as compared to the former Group "A" and "B" rations and M-2 burners which they replaced. While the old "A" and "B" rations required extensive food preparation activities as most menu items were prepared from scratch from bulk ingredients, the UGR-A and UGR-H/S rations include extensive use of pre-cooked or pre-prepared food requiring only heating prior to serving (e.g. boil in bag scrambled eggs or tray pack chicken breasts) or simply opening (e.g. cookies and cakes) prior to serving. In addition, compared to the M-2 burner, the new MBU significantly decreased the work hours required to start, pre-heat, maintain, and repair kitchen burners.

Table 8. Average Fuel Consumption by Type Kitchen

Kitchen Data	MKTs	CKs
Number Meal Periods	30	11
Total Meals	14,100	9,750
Aver Meals/Meal Period	470	886
Total Operating Hours		
Kitchen MBUs	337.00	249.00
Sanitation MBUs	131.50	52.00
Generators	249.50	130.00
Hours/Meal Period		
Kitchen MBUs	11.23	22.64
Sanitation MBUs	4.38	4.73
Generators	8.32	11.82
Hours/100 Meals		
Kitchen MBUs	2.39	2.55
Sanitation MBUs	0.93	0.53
Generators	1.77	1.33
Fuel/Meal Period		
Kitchen MBUs	3.37	6.79
Sanitation Center MBUs	1.32	1.42
Generators	2.74	11.82
Total	7.43	20.03
Fuel/100 Meals		
Kitchen MBUs	0.72	0.77
Sanitation MBUs	0.28	0.16
Generators	0.58	1.33
Total	1.58	2.26

Historical field kitchen workload data for field kitchens with bulk "A" and "B" rations and M-2 burners include the Natick Soldier Center-conducted Camp Pendleton, Fort Sam Houston, and Norway field experiments and evaluations from the 1976-1984 timeframe. The data from these evaluations is detailed and discussed in Appendix C. Based on these evaluations, it was demonstrated that kitchen workloads for "A" and "B" rations are approximately the same.

Table 9 summarizes the historical work sampling results for field kitchens with A/B rations and M-2 burners and also the current data for field kitchens with UGR-A and

Table 9. Comparison of Historical and Current Food Preparation and Burner Work Hour Data

Data	Source	Ave. Meals/ Meal Period	Work Hours/100 Meals	
			Food Prep Hours	Burner Hours
Historical	Camp Pendleton	900	4.4	1.1
- A/B Rations	Fort Sam Houston	337	4.7	1.4
- M-2 Burners	Norway	338	4.8	1.6
	Average	525	4.6	1.4
Current	19 Field Kitchens	540	2.5	0.1
- UGR Rations				
- MBU Burners				
Net Savings	Historical - Current		2.1 (46%)	1.3 (93%)

UGR-H/S rations and MBUs. The work hour results for A/B food preparation and M-2 burners were fairly consistent across the three historical data sets. As shown in Table 9, food preparation and burner work hours averaged 4.6 and 1.4 hours per 100 meals respectively for A/B rations and M-2 burners, and a much lower 2.5 and 0.1 work hours per 100 meals for the newer UGR-A and UGR-H/S rations and MBU burners. Together, the UGR rations and MBU burners reduced combined kitchen food prep and burner workloads by about 57% or 3.4 work hours per 100 meals.

Army kitchen food service staffing levels are based on providing 2 hot group meals per day, and a 12-hour workday with 75% productive work time or 9 work hours. For a kitchen supporting 400 soldiers, UGRs and MBUs have reduced food preparation and burner work hours by an estimated 16.8 and 10.4 hours per day or a combined 27.2 total work hours per day. This equates to a savings of 3 cook positions. For a kitchen supporting 900 soldiers, the estimated workload reduction is a higher 37.8 food preparation hours and 23.4 burner hours or 61.2 total work hours per day. This equates to estimated 6.8 total cook positions for food preparation and burner operations.

Conclusions and Findings

Primary results and findings include:

- Overall kitchen workloads can be highly variable between meal periods for the same kitchen due to different labor content menus and work efforts that occur during some, but not all, meal periods - for example receiving supplies or digging soakage pit.

- Average overall kitchen workloads can be highly variable between similar type and size kitchens due to differences in cook team experience, training, and productivity; food preparation methods utilized, and general operating procedures.

- Based on 30 meal periods of Mobile Kitchen Trailer and 11 meal periods of Container Kitchen work sampling data, the Container Kitchen and Mobile Kitchen Trailer appear to be approximately equally efficient if utilized to support the same number of meals and feeding environment.

- Food preparation is the largest work activity and accounts for about 32% of overall kitchen workload. The 3 largest work tasks (food preparation pot/pan sanitation, and serving) represent about 69% of overall kitchen workload.

- Total kitchen workload, food preparation, and pot and pan sanitation work hours increase with the number of meals prepared. Serving work hours increase with the number of on-site meals. Remote site feeding and perhaps pot and pan sanitation workload increase with the number of remote site meals.

- Larger kitchens are more efficient or productive than smaller kitchens. Based on MKT kitchen data, productivity for kitchens preparing 150 to 200 meals averaged 8.0 meals per work hour, while productivity for kitchens preparing 700 to 850 meals averaged 12.2 meals per work hour or about 50% higher.

- The new Unitized Group Rations (A and Heat/Serve) significantly reduce kitchen food preparation work hours as compared to the former group A and B rations that they replaced. For the UGR rations, food preparation work hours averaged 2.5 work hours per 100 meals as compared to a much higher 4.6 work hours for the former A/B rations. For field kitchens supporting 400 and 900 soldiers, this savings equates to a workload reduction of 16.8 and 37.8 work hours per day, respectively, or an equivalent 1.9 and 4.2 cook positions.

- The new Modern Burner Unit significantly reduces kitchen workloads associated with starting, fueling, maintaining, and repairing kitchen burners as

compared to the former M-2 burner. From historical data, M-2 burner work hours average 1.4 work hours per 100 meals while MBU work sampling data results indicated a very minimal 0.1 work hours per 100 meals. For field kitchens supporting 400 and 900 troops, the MBU workload savings equates to 10.4 and 23.4 work hours per day, or an equivalent 1.2 and 2.6 cook positions per kitchen.

- The Container Kitchen utilizes significantly more fuel than a Mobile Kitchen Trailer due to the kitchens larger generator and associated higher fuel consumption rate and longer daily operating hours to power the kitchens refrigerator. In terms of gallons per 100 meals, the Container Kitchen utilizes about 43% more fuel at 2.26 versus 1.58 for the Mobile Kitchen Trailer.

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Appendix A

Detailed Field Kitchen Descriptions

This Appendix provides descriptive information of each of the 17 observed field kitchen operations for which work sampling and fuel burning equipment utilization data was collected.

In this Appendix, each of the observed kitchen operations is numbered. This number links the kitchen descriptions in this Appendix, the detailed by meal period work sampling and equipment utilization data in Appendix B, and summary or comparative data tables in the main report.

Four main categories of general information are provided for each field kitchen. The first category is kitchen identification data to include exercise location/dates and primary supported unit. The next 3 categories provide details for each kitchen operation to include: primary kitchen equipment utilized; feeding plan specifics (type group rations provided, number group meal periods daily, total meals prepared per meal period, and remote feeding - number groups and sizes); and re-supply/logistical support details to include ration, water, fuel re-supply and rubbish, garbage, waste water disposal.

Field kitchen workloads (and equipment utilization/fuel consumption) are impacted by several factors to include the kitchen equipment, feeding plan specifics, and re-supply/logistical support plans detailed in this Appendix, and other factors not detailed here (e.g. actual menu, cook experience/quality, selected preparation methods, etc. The information in this Appendix is provided to help the reader interpret and understand the detailed workload and equipment utilization data in Appendix B, to include variations between field kitchens, and variations between meal periods for specific kitchens.

Field Kitchen 1

Installation/Dates: Fort Bragg

Supported Unit(s): Parachute Infantry Battalion

Kitchen Location: setup in Brigade Support Area (BSA).

Field Feeding Equipment:

- Field Kitchen: 1 Mobile Kitchen Trailer (MKT) w MBUs.
- Extra Equipment: 1 Tray pack heater and 2 pot cradles with MBUs.
- Sanitation Center: 3 sinks with 3 MBUs.
- Generators: one 2 KW generator for MKT and extra equipment, plus one 2 KW for sanitation center.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Meals prepared per meal period (average): remote-581, onsite -119, total -700.
- Remote feeding sites/meal period: 7-8.
- Remote group sizes:
    - Breakfast 1: 20, 24, 27, 66, 70, 125, 130, 155. Total Remote 617.
    - Breakfast 2: 20, 24, 27, 66, 130, 150, 155. Total Remote 572.
    - Dinner 1: 20, 24, 27, 66, 125, 130, 155. Total Remote 547.
    - Dinner 2: 20, 24, 27, 81, 130, 150, 155. Total Remote 587.

Re-supply/Logistical Support:

- Kitchen personnel picked up rations, ice, water, and fuel from supply sources within the BSA. Rations picked up on Monday, Wednesday, Friday cycle. Other supplies picked up as required. Travel distance to BSA supply sources about ¼ mile or less.
- Kitchen Waste:
    - Packaging waste/disposable dinnerware - kitchen staff loaded onto back of kitchen truck and transported to central BSA waste data collection point for transfer to large military trailer.
    - Wet garbage/food waste - dumped in to large soakage pit outside sanitation center and buried at end of exercise.
    - Sanitation center water - gravity feed drain into soakage pit.

Other:

- Instead of a 2nd MKT to prepare 700 meals, the unit used an extra tray pack heater and 2 extra pot cradles. These were set up and operated on the ground outside the single MKT. The tray pack heater was used to heat boil in a bag UGR-A items, for example scrambled eggs, while the extra pot cradles were used to boil/make coffee.

Field Kitchen 2

Installation/Dates: Fort Bragg

Supported Unit(s): Forward Support Battalion, Parachute Infantry Regiment

Kitchen Location: setup in Brigade Support Area (BSA).

Field Feeding Equipment:

- Field Kitchen: Mobile Kitchen Trailer (MKT) w MBUs.
- Extra Equipment: 1 pot cradle with MBU.
- Sanitation Center: 2 sinks with 2 MBUs.
- Generators: one 3-KW generator for all kitchen/sanitation center equipment.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Meals prepared per meal period: remote-75, onsite -325, total -400.
- Remote feeding sites/meal period: 2.
- Remote group sizes: 25, 50.

Re-supply/Logistical Support:

- Kitchen personnel picked up rations, ice, water, and fuel from supply sources within the BSA. Rations picked up on Monday, Wednesday, Friday cycle. Other supplies picked up as required. Travel distance to BSA supply sources about ¼ mile or less.
- Kitchen Waste:
    - Packaging waste/rubbish disposable dinnerware - kitchen staff loaded onto back of kitchen truck and transported to central BSA waste data collection point for transfer to large military trailer.
    - Wet garbage/food waste - dumped in to large soakage pit outside sanitation center and buried at end of exercise.
    - Sanitation center water - gravity feed drain into soakage pit.

Other:

- The extra pot cradles was set and operated on the ground outside the MKT.

Field Kitchen 3

Installation/Dates: Fort Bragg

Supported Unit(s): Infantry Battalion

Kitchen Location: setup in Brigade Support Area (BSA).

Field Feeding Equipment:

- Field Kitchen: Mobile Kitchen Trailer (MKT) w MBUs.
- Extra Equipment: 3 tray pack heaters and 3 pot cradles with MBUs.
- Sanitation Center: 3 sinks with 3 MBUs.
- Generators: one 2 KW generator for MKT and extra equipment, plus one 2 KW for sanitation center.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Meals prepared per meal period (average): remote - 713, onsite - 137, total - 850.
- Remote feeding sites/meal period: 7-8.
- Remote group sizes:
    - Dinner 1 - 35, 50, 65, 80, 135, 135, 165. Total Remote 665.
    - Dinner 2 - 25, 35, 65, 80, 105, 135, 155, 160. Total Remote 760.

Re-supply/Logistical Support:

- Kitchen personnel picked up rations, ice, water, and fuel from local supply sources within the BSA. Rations picked up on Monday, Wednesday, Friday cycle. Other supplies picked up as required. Travel distance to BSA supply sources about ¼ mile or less.
- Kitchen Waste:
    - Packaging waste/disposable dinnerware - kitchen staff loaded onto back of kitchen truck and transported to central BSA waste data collection point for transfer to large military trailer.
    - Wet garbage/food waste - dumped in to large soakage pit outside sanitation center and buried at end of exercise.
    - Sanitation center water - gravity feed drain into soakage pit.

Other:

- Instead of bringing 2-3 MKTs to prepare 850 total meals, the unit opted to use a single MKT augmented with 3 extra tray pack heaters and 3 extra pot cradles set up on the ground outside the MKT. The extra tray pack heaters were used to heat vegetables in #10 cans and pre-cooked items in plastic bags requiring only heating prior to serving. The extra pot cradles were used to prepare gravy, coffee, etc.

Field Kitchens 4 and 5

Installation/Dates: Fort Hood

Supported Unit(s): Air Defense Artillery Battalion

Kitchen Location: single battalion level kitchen at Crittensburg Range.

Field Feeding Equipment:

- Field Kitchen 4: Mobile Kitchen Trailer (MKT) w MBUs.
- Field Kitchen 5: Mobile Kitchen Trailer (MKT) w MBUs.
- Extra Equipment: none.
- Sanitation Center: one with 3 sinks and 3 MBUs supported both kitchens.
- Generators: one 2 KW generator per MKT plus battery pack for the sanitation center.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Kitchen 4:
    - Meals prepared per meal period: remote-60, onsite-140, total-200.
    - Remote feeding sites/meal period: 1. Remote group size: 60.
- Kitchen 5:
    - Meals prepared/meal period: remote-150, on-site-0, total-150.
    - Remote sites/meal period: 4. Remote group sizes: 10, 15, 60, 65.

Re-supply/Logistical Support:

- Kitchen personnel picked up rations on a Monday, Wednesday, and Friday cycle and water daily as required. The ration and water supply points were about 15 miles from the kitchen site and close to each other. As needed, kitchen personnel picked up fuel in 5-gallon cans at a fuel point, which was about ¼ mile away.
- Kitchen Waste:
    - Packaging waste/disposable dinnerware - carried by kitchen staff to garbage bins about 100 yards away which were hauled away daily by a support element to Ft Hood about 15 miles away for disposal.
    - Wet garbage/food waste - dumped into the sanitation center soakage pit.
    - Sanitation center water - gravity feed drain into open soakage pit.

Other:

- These 2 kitchens were set near each other but essentially operated as 2 separate field kitchens with some shared work efforts - for example pot/pan sanitation, and re-supply. Each MKT prepared a different UGR-A menu. Kitchen 4 supported all on-site feeding plus 1 remote site and kitchen 5 supported only remote sites. For data collection, workloads and equipment utilization were tracked separately by kitchen and common activity data, for example pot/pan sanitation was allocated back to the 2 kitchens.

Field Kitchen 6

Installation/Dates: Fort Stewart

Supported Unit(s): Infantry Brigade

Kitchen Locations: Two different locations about 15 and 5 miles from the main base.

Field Feeding Equipment (Site 1):

- Field Kitchen: 2 Mobile Kitchen Trailer (MKT) w MBUs.
- Extra Equipment: 2 tray pack heaters and 1 pot cradle with MBUs.
- Sanitation Center: 3 sinks with 3 MBUs.
- Generators: one 2 KW generator for MKTs and extra equipment, plus one 2 KW for sanitation center.

Field Feeding Equipment (Site 2):

- Field Kitchen: 1 Mobile Kitchen Trailer (MKT) w MBUs.
- Extra Equipment: 3 tray pack heaters and 2 pot cradles with MBUs.
- Sanitation Center and Generators: same as Site 1.

Feeding Plan:

- One UGR-A meal per day (dinner) plus 2 MREs.
- Meals prepared per meal period (average): remote-865, onsite -135, total -1000.
- Remote feeding sites/meal period: 9-10
- Remote group sizes
    - Dinner 1 & 2 -15, 15, 25, 60, 85, 88, 90, 120, 131, 136. Total remote 765.
    - Dinner 3 - 25, 30, 88, 90, 105, 105, 115, 145, 150. Total remote 853.
    - Dinner 4 - 25, 30, 88, 90, 105, 115, 130, 145, 150. Total remote 878.

Re-supply/Logistical Support:

- Kitchen personnel picked up rations at the installation Troop Issue Supply Activity (TISA) on a Monday, Wednesday, and Friday schedule. Ration re-supply required 1-2 Light Medium Tactical Vehicles (LMTV) and 1 flatbed trailer. Kitchen personnel refilled the kitchens two 400-gallon water trailers on the main base each day. The fuel re-supply point was close by and within walking distance of the field kitchen site.
- Kitchen Waste
    - Packaging waste/disposable dinnerware - carried about 300 yards by kitchen staff and thrown into dumpster.
    - Wet garbage/food waste - dumped into sanitation center soakage pit.
    - Sanitation center water - gravity feed drain into open soakage pit.

Other:

- In moving from location 1 to location 2, the unit opted to replace 1 MKT with an extra tray pack heater and an extra pot cradle.

Field Kitchen 7

Installation/Dates: Pohakuloa Training Area

Supported Unit(s): Headquarters Battery, Field Artillery Battalion.

Field Feeding Equipment:

- Field Kitchen: Mobile Kitchen Trailer (MKT) w MBUs.
- Extra Equipment: none.
- Sanitation Center: 3 sinks with 3 MBUs.
- Generators: one 2-KW generator for MKT and sanitation center.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Meals prepared/meal period: remote - 92, onsite - 108, total - 200.
- Remote feeding sites/meal period: 3.
- Remote group sizes - 10, 22, 60. Total Remote 92.

Re-supply/Logistical Support:

- Kitchen personnel picked up rations daily with one LMTV during weekdays from the TISA about 2 miles away.
- The unit utilized one 400-gallon water trailer to support all unit water requirements to include field feeding. Unit cooks refilled the trailer about once daily at a water supply point about ½ mile away.
- Kitchen Waste:
    - Packaging waste/disposable dinnerware - piled up by kitchen staff and hauled away by support element at end of day.
    - Wet garbage/food waste - carried by kitchen staff about 100 yards and dumped in open pit for wild pigs to eat.
    - Sanitation center water - gravity feed into open soakage pit.

Field Kitchen 8 and 9

Installation/Dates: Pohakuloa Training Area, Hawaii

Supported Unit(s):

- Field Kitchen 8: Bravo Gun Battery, Field Artillery Battalion.
- Field Kitchen 9: Alpha Gun Battery, Field Artillery Battalion.

Field Feeding Equipment (Each Kitchen):

- Field Kitchen: one Kitchen Company Level Field Feeding (KCLFF) with 3 MBUs.
- Extra Equipment: none.
- Sanitation Center: Used the KCLFF tray ration heater for sanitation.
- Generators: None. As needed, the MBU battery pack is recharged by another unit generator or by HMMWV power takeoff.

Feeding Plan:

- Kitchen 8: Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Kitchen 9: Two UGR-H/S meals per day (breakfast and dinner) plus 1 MRE.
- Each kitchen:
    - Meals prepared per meal period: remote- 0, onsite - 75, total - 75.
    - Remote feeding sites/meal period: 0.
    - Remote group sizes: N/A.

Re-supply/Logistical Support (each kitchen):

- Battery cooks used a HMMWV to pick up rations daily at the TISA about 5-10 miles away. Upon return, the rations were kept in the HMMWV which was parked next to the kitchen until needed. For actual deployments, the Headquarters Battery would normally pick up rations for the entire battalion and deliver them to the Gun Batteries.
- Each battery used a single 400-gallon water trailer to support all unit water requirements, to include field feeding. The battery supply sergeant did water re-supply. As needed the water trailer was refilled at a supply point about 5-10 miles away.
- Fuel re-supply - provided by unit supply sergeant.
- Kitchen Waste:
    - Packaging waste/disposable dinnerware - piled up by kitchen staff and battery supply sergeant hauled back to main base (5-10 miles) for disposal.
    - Wet garbage/food waste - placed in plastic bags and supply sergeant hauled back to main base for disposal.
    - Sanitation center water -Used the KCLFF tray heater for sanitation. Water simply drained onto ground at the completion of sanitation activities.

Field Kitchen 10

Installation/Dates: National Training Center, Fort Irwin, CA

Supported Unit(s): Field Artillery Battalion

Kitchen Location: separate location away from the Brigade BSA.

Field Feeding Equipment:

- Field Kitchen: 1 Containerized Kitchen (CK) w MBUs
- Extra Equipment: N/A.
- Sanitation Center: 3 sinks with 3 MBUs.
- Generators: CK generator only (10 KW).

Feeding Plan:

- One UGR-A or one UGR-H/S meal (breakfast or dinner) per day plus 2 MREs.
- Meals prepared per meal period: remote-0, onsite -700, total -700.
- Remote feeding sites/meal period: 0.
- Remote group sizes: N/A.

Re-supply/Logistical Support:

- Rations delivered to the unit every 2 days from the Brigade Support Area (BSA) a distance of 3-5 miles of open desert terrain.
- Water - kitchen staff refilled water trailer as needed at nearby water supply point.
- Fuel - as needed, kitchen staff carried and refilled 5-gallon fuel cans at nearby supply point.
- Kitchen Waste
    - Packaging waste/disposable dinnerware - carried by kitchen staff about 50 yards and loaded onto large military trailer with side rails. As needed, trailer hauled away by support personnel to the main bases for disposal.
    - Wet garbage/food waste - double plastic bag and loaded by kitchen staff onto same trailer used for packaging waste.
    - Sanitation center water - gravity feed drain into open soakage pit.

Other:

- Unit was part of the 1st Brigade, 25the Division NTC training exercise.

Field Kitchen 11

Installation/Dates: National Training Center, Fort Irwin, CA

Supported Unit(s): Cavalry Battalion

Kitchen Location: separate location away from the Brigade BSA.

Field Feeding Equipment:

- Field Kitchen: 1 Containerized Kitchen (CK) with MBUs.
- Extra Equipment: N/A.
- Sanitation Center: 3 sinks with 3 MBUs.
- Generators: CK generator only.

Feeding Plan:

- One UGR-A meal per day plus 2 MREs.
- Meals prepared per meal period: remote-345, onsite -205, total -550
- Remote feeding sites/meal period: 4
- Remote group sizes - 45, 100, 100, 100. Total Remote 345.

Re-supply/Logistical Support:

- Rations delivered to the unit every 2 days from the Brigade Support Area (BSA) a distance of 3-5 miles of open desert terrain.
- Water - kitchen staff refilled water trailer as needed at nearby water supply point.
- Fuel - as needed, kitchen staff carried and refilled 5-gallon fuel cans at nearby supply point.
- Kitchen Waste
    - Packaging waste/disposable dinnerware - carried by kitchen staff about 50 yards and loaded onto large military trailer with side rails. As needed, trailer hauled away by support personnel to the main bases for disposal.
    - Wet garbage/food waste - double plastic bag and loaded by kitchen staff onto same trailer used for packaging waste.
    - Sanitation center water - gravity feed drain into open soakage pit.

Other:

- Unit was part of the 1st Brigade, 25the Division NTC training exercise.

Field Kitchen 12

Installation/Dates: National Training Center, Fort Irwin, CA

Supported Unit(s): Brigade Support Battalion

Kitchen Locations: Brigade Support Area (BSA).

Field Feeding Equipment:

- Field Kitchen: 1 Containerized Kitchen (CK) with MBUs.
- Extra Equipment: N/A.
- Sanitation Center: 3 sinks with 3 MBUs.
- Generators: CK generator only.

Feeding Plan:

- One group UGR-A or UGR-H/S meal per day plus 2 MREs.
- Meals prepared per meal period: remote-275, onsite -425, total -700
- Remote feeding sites/meal period: 4.
- Remote group sizes - 45, 65, 65, 100. Total Remote 275.

Re-supply/Logistical Support:

- This kitchen was located within the BSA and picked up rations, ice, fuel, and water from nearby BSA supply points as needed.
- Kitchen Waste
    - Packaging waste/disposable dinnerware - carried and loaded by kitchen staff onto large open military trailer with side rails. Trailer parked about 40-50 yards from kitchen and hauled away by support elements as needed.
    - Wet garbage/food waste - double plastic bag and loaded by kitchen staff onto same trailer used for packaging waste.
    - Sanitation center water - gravity feed drain into soakage pit.

Other:

- Unit was part of the 1st Brigade, 25the Division NTC training exercise.

Field Kitchen 13

Installation/Dates: National Training Center, Fort Irwin, CA

Supported Unit(s): Field Artillery Battalion.

Kitchen Location: remote separate location

Field Feeding Equipment:

- Field Kitchen: 1 Mobile Kitchen Trailer (MKT) w MBUs.
- Extra Equipment: Commercial refrigerated van.
- Sanitation Center: 3 sinks with 1 MBU.
- Generators: None used as commercial plug-in power was available and utilized. To estimate generator operating hours (without commercial power), assumed 2 operating if MBUs were on in both the kitchen and sanitation center, 1 operating if MBUs were on in only a single location, and 0 operating if all MBUs were off.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Meals prepared per meal period: remote-0, onsite -350, total -350
- Remote feeding sites/meal period: none
- Remote group sizes: N/A.

Re-supply/Logistical Support:

- Rations/ice were delivered to the kitchen site by a commercial truck. At kitchen site, rations were transferred to contract commercial trucks/reefers for storage until needed.
- Water - no water trailer re-supply as required water was available from on-site faucet.
- Fuel - picked up by cooks in 5 gallon cans at nearby fuel re-supply point
- Kitchen Waste
    - Packaging waste/disposable dinnerware - carried and loaded by kitchen staff onto large open military trailer with side rails. Trailer parked about 40-50 yards from kitchen and hauled away by support elements as needed.
    - Wet garbage/food waste - double plastic bag and loaded by kitchen staff onto same trailer used for packaging waste.
    - Sanitation center water - gravity feed drain into soakage pit.

Other:

- Kitchen was set-up near railhead to support personnel receiving/offloading unit equipment for the NTC brigade exercise.

Field Kitchen 14

Installation/Dates: National Training Center, Fort Irwin, CA, Oct 27-29, 2003.

Supported Unit(s): Aviation Battalion and attached task force elements

Kitchen Location: separate remote location away from rest of brigade.

Field Feeding Equipment:

- Field Kitchen: 1 Mobile Kitchen Trailer (MKT) w MBUs.
- Extra Equipment: None.
- Sanitation Center: 3 sinks with 1 MBU.
- Generators: one 3-KW (?) to support the MKT, plus power takeoff from military vehicle to support the sanitation center MBU.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Meals prepared per meal period: remote-0, onsite -400, total -400
- Remote feeding sites/meal period: 0
- Remote group sizes: N/A.

Re-supply/Logistical Support:

- Rations and ice were delivered to the kitchen site by a commercial truck. At kitchen site, rations were trans loaded by kitchen personnel for storage in commercial trucks/reefers.
- As needed, water trailers were hauled/filled by other support personnel at nearby water supply point (< ¼ mile).
- Fuel - picked up in 5 gallon gals at nearby supply point by kitchen personnel.
- Kitchen Waste
    - Packaging waste/disposable dinnerware - carried and loaded by kitchen staff onto large open trailer with side rails. Trailer parked about 40-50 yards from kitchen and hauled away by support personnel as needed.
    - Wet garbage/food waste - double plastic bag and loaded by kitchen staff onto same trailer used for packaging waste.
    - Sanitation center water - gravity feed drain into soakage pit.

Other:

- At completion of regular meal serving period, remaining hot meal components were placed in insulated containers for self-serving between meal or after regular serving hours.

Field Kitchens 15

Installation/Dates: JRTC, Fort Polk, LA

Supported Unit(s): Cavalry Battalion

Kitchen Location: Stationary permanent base camp environment.

Field Feeding Equipment:

- Field Kitchen: 1 Containerized kitchen (CK) with MBUs.
- Extra Equipment: ?????.
- Sanitation Center: 3 sinks with 1 MBU.
- Generators: CK generator (10 KW).
- Large self powered commercial freezers/refrigerators.
- Large commercial tent dining shelter with tables, chairs, and 2 inside serving lines for beverages, salads, condiments, desserts, etc.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Meals prepared per meal period: remote-0, onsite -650, total -650.
- Remote feeding sites/meal period: 0.
- Remote group sizes: NA.

Re-supply/Logistical Support:

- Rations/ice delivered to the kitchen site by military truck. At kitchen, supplies offloaded by kitchen staff and placed into tents, refrigerators, or freezers.
- Two water trailers - one for CK operations and one for sanitation center. As needed, kitchen staff refilled water trailers at water supply point 5-10 minute drive from kitchen.
- Kitchen Waste
    - Packaging waste/disposable dinnerware - carried and loaded by kitchen staff onto large open military trailer with side rails. Trailer parked about 75 yards from kitchen and hauled away by support personnel as needed.
    - Wet garbage/food waste - double plastic bagged and loaded by kitchen staff into same dumpster used for packaging waste.
    - Sanitation center gray water - drained thru grease trap/filter and stored in large plastic holding tank until pumped/removed by support contractor.

Other:

- Hand washers - 100% maintained by support contractor who filled with clean water, drained dirty water, etc.

Field Kitchen 16

Installation/Dates: JRTC, Fort Polk, LA

Supported Unit(s): Light Infantry Battalion

Kitchen Location: Stationary permanent base camp environment.

Field Feeding Equipment:

- Field Kitchen: 1 Containerized kitchen (CK) with MBUs.
- Extra Equipment: 2 pot cradles.
- Sanitation Center: 3 sinks with 1 MBU.
- Generators: CK generator (10 KW).
- Large self powered commercial freezers/refrigerators.
- Large commercial tent dining shelter with tables, chairs, and 2 inside serving lines for beverages, salads, condiments, desserts, etc.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Meals prepared per meal period: remote-0, onsite -850, total -850.
- Remote feeding sites/meal period: 0.
- Remote group sizes: NA.

Re-supply/Logistical Support:

- Rations/ice delivered to the kitchen site by military truck. At kitchen, supplies offloaded by kitchen staff and placed into tents, refrigerators, or freezers.
- Two water trailers - one for CK operations and one for sanitation center. As needed, kitchen staff refilled water trailers at water supply point 5-10 minute drive from kitchen.
- Kitchen Waste
    - Packaging waste/disposable dinnerware - carried by kitchen staff about 75 yards and dumped into open large dumpster which was hauled away by support contractor for disposal.
    - Wet garbage/food waste - double plastic bagged and loaded by kitchen staff into same dumpster used for packaging waste.
    - Sanitation center gray water - drained thru grease trap/filter and stored in large plastic holding tank until pumped/removed by support contractor.

Other:

- Hand washers - 100% maintained by support contractor who filled with clean water, drained dirty water, etc.

Field Kitchen 17

Installation/Dates: JRTC, Fort Polk, LA

Supported Unit(s): Brigade Support Battalion plus attachments

Kitchen Locations: Brigade Support Area (BSA) set-up as permanent base camp.

Field Feeding Equipment:

- Field Kitchen: 2 Containerized Kitchens (CKs) with MBUs.
- Extra Equipment: None.
- Sanitation Center: 3 sinks with 3 MBUs.
- Generators: Two 10KW generators - 1 per CK.
- Large self powered commercial freezers/refrigerators.
- Large commercial tent dining shelter with tables, chairs, and 2 inside self serve lines for beverages, salads, condiments, desserts, etc.

Feeding Plan:

- Two UGR-A meals per day (breakfast and dinner) plus 1 MRE.
- Meals prepared/meal period: remote-0, onsite -1,700, total -1,700.
- Remote feeding sites per meal period: 0
- Remote group sizes: NA.

Re-supply/Logistical Support:

- Rations/ice delivered to the kitchen site by military truck. At kitchen, supplies were offloaded by kitchen staff and placed into tents, refrigerators, or freezers.
- Three water trailers - one per each CK operation and one for sanitation center. As needed, kitchen staff filled water trailers at water supply point 5-10 minute drive from kitchen.
- Kitchen Waste
    - Packaging waste/disposable dinnerware - carried by kitchen staff about 30-40 yards and dumped into open large dumpster which was hauled away by support contractor for disposal.
    - Wet garbage/food waste - double plastic bagged and loaded by kitchen staff into the dumpster used for packaging waste.
    - Sanitation center gray water - drained thru grease trap/filter and stored in large plastic holding tank until pumped/removed by support contractor.

Other

The 2 CKs set up next to each other. Each had its own cooks and prepared all menu items, with slight variations between kitchens. The 2 kitchens shared one sanitation center, common ration storage areas, rubbish dumpsters, and one large dining shelter with two self serve lines for non hot meal components, beverages, etc. For data collection, all workloads were aggregated together and the 2 CKs were treated as one combined kitchen preparing 1,700 meals.

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Appendix B

Detailed Kitchen Workload and Equipment Utilization Data

This Appendix includes copies of the data sheets to collect work sampling and fuel burning equipment utilization data, and the resulting estimated direct kitchen workloads by task and fuel burning equipment operating hours for each observed field kitchen by meal period.

The kitchen workload and fuel burning equipment data collection sheets are provided as Figures B-1 and B-2, respectively.

The Army's field feeding standard is 3 quality meals per day to include 2 group hot meals when the situation permits. The number of group meals actually provided per day may be less depending on a host factors to include: deployment phase, supply system maturity, tactical environment, unit missions, etc.

Army field kitchen's are equipped and staffed to provide 2 group hot meals per day, typically breakfast and dinner, to all supported elements. Kitchen workload and equipment utilization data detailed in this Appendix was collected during 7 different training exercises (FTXs) and included 17 different unit kitchens. During these exercises, some of the observed kitchens provided 1 group hot meal per day while most were used to provide supported elements 2 group hot meals per day. For observed kitchens providing 2 group hot meals per day, some times data collection covered the entire workday and both meal periods, and other times data collection covered only a single meal period. For these kitchens, the main reasons for limiting data collection to a single meal periods were transportation constraints (e.g. inability to get to the kitchen site for the start of breakfast work activities, etc.) and/or lack of data collectors to cover the long workday and both meal periods (16 plus hours).

For field kitchens providing 2 group hot meals per day (breakfast and dinner) there is normally a 3-4 hour period between meal periods where there is very limited to no work activity. During this period, most/all cooks and kitchen police (KPs) typically return to their tents to rest. The start of work activities for the breakfast meal is typically 3-4 hours prior to the start of the on-site serving period or first pickup of food for remote feeding. For the dinner meal period, first work activities typically start somewhat earlier or about 4-5 hours prior to the start of on-site feeding or first remote site pickup. Following the completion of each on-site serving period, cook work activities were primarily on kitchen sanitation and then kitchen re-supply with the next meals stocks. This typically took 1-2 hours. Following on-site serving, main KP work activities were pot/pan sanitation, rubbish removal, and general cleanup. These activities typically extended longer due to the more extensive pot/pan sanitation workload.

When data collection covered 2 meal periods for a kitchen, the data collection period covered the entire workday from the start of first breakfast work activities, the slow between meal period, to the completion of all after dinner meal activities. In this situation, a typical data collection period was 0300 to 2100 or 18 hours. On these days, based on actual work activities, a break time was selected and all observed workloads prior to this time were allocated to the breakfast meal and all workload after this time

Date: _____ **Data Collector:** _____

	Food Prep/Serving				General				Remote Feed			Sanitation			Supply/Maintenance		
Clock Time		Food Preparation	Serving		Supervision	Misc. Food Service	Misc. Non-Food Service		Remote Feeding		Kitchen	Pots, Pans, Containers	Rubbish Removal		Supply Rations/Ice	Burner Maintenance	Generator Maintenance

Figure B-1. Kitchen Workload Data Collection Sheet

Date: ______________ **Data Collector:** ______________

		Kitchen			Sanitation			Generators		
Clock Time		Burner Type 1	Burner Type 2		Burner Type 1	Burner Type 2		Generator Type 1	Generator Type 2	

Figure B-2. Fuel-Burning Equipment Utilization Data Sheet

were allocated to the dinner meal. For days were data collection covered only a single meal, typical data collection periods were 0300 to about 1130 for a breakfast meal and 1120 to 2100 for a dinner meal.

The work sampling data collection methodology was utilized to collect data to estimate direct kitchen workloads associated with the various observed field kitchen operations. With this methodology, a set of kitchen tasks that cover the primary or major work activities one would expect to observe daily need be clearly defined. This is essential to insure agreement and consistently between data collectors and later valid comparisons between resulting kitchen data sets. Examples of major kitchen work activities include Food Preparation, Serving, and Pot/Pan Sanitation. A complete list of the resulting kitchen task categories to include definitions is provided in Table B-1. In addition to the major work tasks, the list includes 2 additional tasks, miscellaneous food service work and miscellaneous non-food service work to cover all other observed productive kitchen work efforts that do not properly fit into any of the other defined work task categories.

With the work sampling data collection, observations are taken at set time intervals. For the kitchen workload data collection, the observation interval was 15 minutes to include on the hour, quarter hour, and half hour. At each observation point, each cook and KP in or around the kitchen or sanitation center was observed and judged as being productive or non-productive. For those determined to be productive, each was then classified as performing the work task that best fit their observed work effort. The clock time and resulting number of observed workers' performing each work activity was then recorded on the data collection sheet (Figure B-1).

Kitchen workloads and equipment utilization are dependent on and impacted by several factors, such as - type field kitchen utilized, type group ration prepared, total number meals prepared, mix of on-site and remote site meals, and number remote sites. Therefore this additional data were also collected/noted for each kitchen and meal period for which work sampling and equipment utilization data was collected.

Kitchen workloads by meal period were estimated as follows. For each meal period, the recorded observations for each defined work task were first summed. The task totals were then multiplied by the observation interval or ¼ hour. The result is the estimated total expended work hours by task. Total kitchen workload is estimated by summing the estimated work hours across all work tasks.

The resulting kitchen data and associated workload data by kitchen and meal period and work task is detailed in Table B-2. Each of the 17 observed kitchens is numbered. This number links or connects the detailed by meal data in this Appendix with the Appendix A kitchen descriptions and various summary data tables in the main report. The detailed by meal Table B-2 table is sorted or arranged first by type kitchen, then number total meals prepared, and then by type group ration.

Table B-1. Kitchen Task List and Definitions

Task	Definition
Food Preparation	All direct work activities associated with the preparation or cooking of menu items to include: breakout/assembly of menu items/ingredients to prepare, stirring/mixing ingredients, actual cooking, monitoring cooking process, beverage preparation, obtaining cooking water, salad preparation, transferring cooked foods items to insulated containers for on-site or remote feeding.
Serving	Setting up and tearing down the hot and cold serving lines, manning the serving line whether actively serving or not, monitoring serving lines for status, replenishment of serving lines, arranging serving line items, etc.
Supervision	Dining facility manager or lead shift cook activities to include: direct supervision of staff, active monitoring of kitchen operations, preparation of kitchen records. Etc
Other Food Service	Any productive food service work activities not covered by other defined tasks. Examples include: obtaining and putting away pots/pans/utensils at the kitchen, receiving supervision, discussions/meetings related to feeding operations, etc.
Other Non Food Service	All productive non-food service tasks. Examples include: tent maintenance, re-staking tents/ camouflage systems, digging soakage pits for sanitation center water, cleaning grounds around the kitchen, truck maintenance, etc.
Remote Feeding	Label insulated containers for remote feeding, portion/count items for remote site groups; assemble remote site piles (insulated containers, beverage containers, boxes of other items) by unit for unit pickup, load items onto unit trucks, unload returned containers/items.
Kitchen Sanitation	All work activities to clean kitchen equipment to include floors, counters/cabinets, cooking equipment, burners, obtain required kitchen sanitation water from water trailer, etc. Equipment examples include: griddles, steam tables, MBU cook stands, pot cradles, field ranges, tray ration heater, etc.
Pot/Pan Sanitation	All work activities associated with the sanitation of pots, pans, insulated food and beverage containers, and utensils utilized during food preparation/serving process or to support on-site or remote site feeding. Work activities include: transport of items to the sanitation center, washing/rinsing/sanitizing of items, placement on racks for drying or next use, filling and transport of 5 gallon water cans to fill sinks, and cleaning of sanitation center sinks and tables.
Rubbish removal	Collection, removal, and transport of all waste materials from the kitchen, dining, and sanitation center to the waste collection point(s). Types of waste include: all ration packaging materials, wet food waste/garbage, and disposable dinnerware.

Table B-1 (cont'd). Kitchen Task List and Definitions

Task	Definition
Supply-Rations/Ice	On site supply activities only to include: receive/unload rations or ice and transfer to storage location, as needed obtain/transfer required meal components/ice to kitchen or serving line, as needed transfer excess item quantities back into storage.
Burner Maintenance	Refuel burners, stat/stop burners, and perform maintenance on burners.
Generator Maintenance	Refuel generators, start/stop generators, and perform maintenance on kitchen generators.

The methodology utilized to collect fuel burning equipment utilization data and estimate equipment operating hours was exactly the same as that utilized to collect work sampling data with the exception that the observation interval was 30 minutes to include on the hour and half hour.

Types of equipment for which operating data was collected included the MBU to support both kitchen and sanitation center operations, and generators to support Mobile Kitchen Trailer (MKT) field operations. MKT field kitchens are authorized one 2-KW generator to support all power requirements to include kitchen and sanitation center MBUs and any lighting. For most observed MKT operations, most used a single generator, but some used two or separate generators to support MKT and sanitation center operations.

The Container Kitchen (CK) includes a 10 KW generator to provide power for kitchen refrigeration, air conditioning, lighting, MBUs, etc. With the kitchen refrigeration, the CK generator is generally operated continuously from the start of first kitchen work activities for breakfast to the completion of after dinner work activities or about 18 hours per day, with the exception of short shut downs for refueling or maintenance. At the completion of after dinner work activities, the CK generator is generally shut down and then not restarted until the start of breakfast work activities. Therefore for CK operations, the kitchen generator is assumed to operate 18 hours per day if providing 2 group meals or 9 hours per group meal period.

With Kitchen Company Level Field Feeding (KCLFF) operations, the limited power required for MBUs is provided by a battery power pack. As needed, this power pack is recharged with the MKT generator or another unit generator. Therefore KCLFF operations include only MBUs as fuel burning equipment.

With the 30-minute or ½ hour observation interval for operating MBUs and 2 KW generator, the resulting total observations by type equipment were multiplied by ½ to estimate total operating hours. The fuel burning equipment operating hour date is detailed in Table B-3 by kitchen by meal period and per 100 meals.

Table B2. Detailed Kitchen Workloads by Meal Period

Kitchen Data							Productive Work Hours by Task												
No.	Type	Type Ration	Meal/Menu	Remote Sites	Total Remote Meals	Total Meals	Food Prep	Serving	Supervision	Other Food Service	Other Non Food Service	Remote Feeding	Kitchen Sanitation	Pot/Pan Sanitation	Rubbish Removal	Supply	Burner Maint/Repair	Gen/Other Maint.	Total Prod. Hours
9	KCL	UGR-H/S	D	0	0	100	2.8	1.5	0.3	0.5	0.5	0.0	0.0	1.3	0.3	0.3	0.0	0.0	7.3
9	KCL	UGR-H/S	D	0	0	100	2.0	2.0	0.0	0.8	0.0	0.0	0.0	0.5	0.3	0.0	0.0	0.0	5.5
9	KCL	UGR-H/S	Ave	0	0	100	2.4	1.8	0.1	0.6	0.3	0.0	0.0	0.9	0.3	0.1	0.0	0.0	6.4
8	KCL	UGR-A	D	0	0	100	4.0	1.8	0.0	0.0	1.0	0.0	0.8	1.3	0.3	0.3	0.3	0.0	9.5
8	KCL	UGR-A	D	0	0	100	3.0	2.0	0.0	1.0	0.0	0.0	0.8	1.3	0.3	0.5	0.8	0.0	9.5
8	KCL	UGR-A	Ave	0	0	100	3.5	1.9	0.0	0.5	0.5	0.0	0.8	1.3	0.3	0.4	0.5	0.0	9.5
5	MKT	UGR-A	B9	4	150	150	7.0	0.0	1.5	2.3	1.0	1.3	1.5	3.3	0.3	1.3	0.3	0.3	19.8
5	MKT	UGR-A	B10	4	150	150	5.3	0.0	0.8	2.3	0.5	2.3	1.0	4.5	0.0	2.0	0.3	0.3	19.0
5	MKT	UGR-A	D10	4	150	150	7.0	0.0	3.0	2.0	1.0	1.8	0.5	6.8	0.5	2.0	0.8	1.0	26.3
5	MKT	UGR-A	D12	4	150	150	5.3	0.0	2.3	3.5	2.5	2.0	1.3	6.3	0.3	2.0	0.8	1.0	27.0
5	MKT	UGR-A	Ave	4	150	150	6.1	0.0	1.9	2.5	1.3	1.8	1.1	5.2	0.3	1.8	0.5	0.6	23.0
4	MKT	UGR-A	B2	1	60	200	7.5	2.0	1.5	2.5	1.0	1.0	2.5	2.0	0.3	1.3	0.3	0.5	22.3
4	MKT	UGR-A	B4	1	60	200	5.3	3.5	0.8	1.5	0.8	1.8	2.0	2.8	0.0	2.0	0.3	0.3	20.8
4	MKT	UGR-A	D3	1	60	200	7.5	3.5	3.0	2.5	1.0	1.0	0.0	4.0	0.5	2.0	0.5	0.8	26.3
4	MKT	UGR-A	D5	1	60	200	5.0	2.8	2.3	3.0	2.0	1.5	1.5	4.3	0.3	2.0	1.0	1.0	26.5
4	MKT	UGR-A	Ave	1	60	200	6.3	2.9	1.9	2.4	1.2	1.3	1.5	3.3	0.3	1.8	0.5	0.6	23.9
7	MKT	UGR-A	B4	3	92	200	5.8	1.0	1.5	1.3	0.8	1.0	3.3	4.0	0.8	0.3	0.0	0.0	19.5
7	MKT	UGR-A	D5	3	92	200	6.5	2.0	0.8	0.0	0.5	0.5	0.8	3.5	0.3	1.0	0.5	0.0	16.3
7	MKT	UGR-A	Ave	3	92	200	6.1	1.5	1.1	0.6	0.6	0.8	2.0	3.8	0.5	0.6	0.3	0.0	17.9

Table B2 (cont'd). Detailed Kitchen Workloads by Meal Period

Kitchen Data							Productive Work Hours by Task												
No.	Type	Type Ration	Meal/Menu	Remote Sites	Total Remote Meals	Total Meals	Food Prep	Serving	Supervision	Other Food Service	Other Non Food Service	Remote Feeding	Kitchen Sanitation	Pot/Pan Sanitation	Rubbish Removal	Supply	Burner Maint/Repair	Gen/Other Maint.	Total Prod. Hours
13	MKT	UGR-A	D	0	0	350	10.5	5.8	5.0	1.0	3.0	0.0	1.5	8.5	0.5	1.5	0.8	0.3	38.3
13	MKT	UGR-A	B4	0	0	350	8.8	5.8	5.0	1.3	1.8	0.0	2.0	5.8	1.0	0.5	0.5	0.3	32.5
13	MKT	UGR-A	D9	0	0	350	10.8	9.3	4.5	1.3	2.5	0.0	1.0	6.5	0.8	1.8	0.8	0.3	39.3
13	MKT	UGR-A	B5	0	0	350	10.3	6.3	3.3	1.5	1.8	0.0	2.5	9.8	0.5	1.0	0.8	0.3	37.8
14	MKT	UGR-A	Ave	0	0	350	10.1	6.8	4.4	1.3	2.3	0.0	1.8	7.6	0.7	1.2	0.7	0.3	36.9
14	MKT	UGR-A	D	0	0	400	12.0	9.3	0.8	0.0	2.8	0.0	2.0	8.8	1.3	6.3	2.5	0.0	45.5
14	MKT	UGR-A	B4	0	0	400	13.8	9.0	1.5	0.5	1.3	0.0	4.5	8.8	2.3	1.0	0.5	0.0	43.0
14	MKT	UGR-A	D9	0	0	400	16.3	10.5	0.3	1.0	0.5	0.0	4.3	9.0	1.8	8.0	0.0	0.0	51.5
14	MKT	UGR-A	D5	0	0	400	13.3	11.5	0.0	0.3	0.5	0.0	4.8	8.5	2.0	2.8	0.8	0.0	44.3
15	MKT	UGR-A	Ave	0	0	400	13.8	10.1	0.6	0.4	1.3	0.0	3.9	8.8	1.8	4.5	0.9	0.0	46.1
2	MKT	UGR-A	D6	2	75	400	7.5	3.5	2.0	2.0	2.3	1.0	3.3	9.5	0.0	1.8	0.5	0.0	33.3
2	MKT	UGR-A	D	2	75	400	6.5	3.3	0.0	1.5	0.0	0.5	1.3	8.5	1.5	1.3	0.5	0.3	25.0
2	MKT	UGR-A	Ave	2	75	400	7.0	3.4	1.0	1.8	1.1	0.8	2.3	9.0	0.8	1.5	0.5	0.1	29.1
1	MKT	UGR-A	B	8	617	700	22.3	0.5	0.0	0.0	0.0	2.8	1.8	15.3	2.3	1.5	0.0	0.0	46.3
1	MKT	UGR-A	B7	7	572	700	17.5	2.3	0.0	0.0	0.0	4.8	0.0	16.8	1.3	1.8	0.5	0.0	44.8
1	MKT	UGR-A	D3	7	547	700	15.5	1.3	1.8	0.8	2.0	2.5	2.3	16.3	0.0	1.3	1.5	0.3	45.3
1	MKT	UGR-A	D6	7	587	700	10.5	2.0	0.8	1.5	1.8	3.5	2.3	9.8	1.3	1.3	1.3	1.0	36.8
1	MKT	UGR-A	Ave	7	581	700	16.4	1.5	0.6	0.6	0.9	3.4	1.6	14.5	1.2	1.4	0.8	0.3	43.3
3	MKT	UGR-A	D	8	665	850	19.0	0.5	0.0	0.0	0.0	3.0	1.8	16.8	1.5	4.3	0.3	0.0	47.0
3	MKT	UGR-A	D10	8	760	850	11.8	1.3	0.3	1.8	2.0	2.8	2.0	18.5	0.8	0.0	0.0	0.0	41.0
3	MKT	UGR-A	Ave	8	713	850	15.4	0.9	0.1	0.9	1.0	2.9	1.9	17.6	1.1	2.1	0.1	0.0	44.0

Table B2 (cont'd). Detailed Kitchen Workloads by Meal Period

							Productive Work Hours by Task												
No.	Type	Type Ration	Meal/Menu	Remote Sites	Total Remote Meals	Total Meals	Food Prep	Serving	Supervision	Other Food Service	Other Non Food Service	Remote Feeding	Kitchen Sanitation	Pot/Pan Sanitation	Rubbish Removal	Supply	Burner Maint/Repair	Gen/Other Maint.	Total Prod. Hours
6	MKT	UGR-A	D2	10	765	1000	16.8	2.3	1.8	2.8	2.5	4.8	3.8	21.3	1.3	5.3	0.3	0.8	63.3
6	MKT	UGR-A	D4	10	765	1000	22.5	1.8	1.8	2.0	1.0	5.5	2.8	17.5	0.5	0.5	1.0	0.5	57.3
6	MKT	UGR-A	D5	9	853	1000	12.5	0.0	4.5	2.5	2.5	5.3	5.0	21.3	2.8	2.8	2.5	0.5	62.0
6	MKT	UGR-A	D6	9	878	1000	18.0	0.3	2.0	0.5	2.0	3.8	1.5	20.0	1.3	0.0	0.5	0.5	50.3
6	MKT	UGR-A	Ave	10	815	1000	17.4	1.1	2.5	1.9	2.0	4.8	3.3	20.0	1.4	2.1	1.1	0.6	58.2
11	CK	UGR-A	D14	4	345	550	15.5	5.0	5.0	6.5	0.0	2.3	2.3	15.0	0.8	2.3	0.8	0.0	55.3
15	CK	UGR-A	D6	0	0	650	22.5	12.3	1.5	1.5	1.8	0.0	2.8	10.8	4.3	4.0	0.5	0.0	61.8
15	CK	UGR-A	D	0	0	650	15.3	14.8	5.0	1.5	0.0	0.0	0.5	6.5	1.8	6.8	0.0	0.0	52.0
15	CK	UGR-A	Ave	0	0	650	18.9	13.5	3.3	1.5	0.9	0.0	1.6	8.6	3.0	5.4	0.3	0.0	56.9
10	CK	UGR-H/S	D2	0	0	700	14.0	5.8	2.5	1.3	3.8	0.0	1.5	16.5	1.0	3.0	0.3	0.5	50.0
10	CK	UGR-A	B4	0	0	700	17.3	6.5	2.5	2.0	6.0	0.0	10.5	16.8	0.8	3.0	0.5	0.0	65.8
12	CK	UGR-H/S	D		275	700	14.5	5.5	0.0	0.0	0.0	1.0	1.5	16.3	0.5	0.0	0.3	0.0	39.5
12	CK	UGR-A	B		275	700	11.8	7.0	0.0	2.8	0.0	1.0	4.0	14.8	2.8	0.0	0.0	0.0	44.0
16	CK	UGR-A	D8	0	0	850	29.3	10.0	8.0	0.0	2.8	0.0	7.8	18.8	7.0	2.3	0.3	0.0	86.0
16	CK	UGR-A	D7	0	0	850	32.0	10.5	1.5	3.8	3.3	0.0	2.8	11.0	3.8	7.8	0.5	0.0	76.8
16	CK	UGR-A	Ave	0	0	850	30.6	10.3	4.8	1.9	3.0	0.0	5.3	14.9	5.4	5.0	0.4	0.0	81.4
17	CK	UGR-A	D9	0	0	1700	40.3	28.5	0.0	0.0	0.0	0.0	5.3	14.8	10.0	12.5	0.0	0.0	111.3
17	CK	UGR-A	D	0	0	1700	38.8	21.8	2.5	5.3	1.0	0.0	7.8	24.5	6.0	3.3	0.5	0.0	111.3
17	CK	UGR-A	Ave	0	0	1700	39.5	25.1	1.3	2.6	0.5	0.0	6.5	19.6	8.0	7.9	0.3	0.0	111.3

Table B3. Detailed Fuel-Burning Equipment Operating Hours by Meal Period

Kitchen Data						Hours/Meal Period				Hours/100 Meals			
No.	Type	Type Ration	Meal/Menu	Remote Meals	Total Meals	MBU-Kitchen	MBU-Sanit	MBU-Total	Generators*	MBU-Kitchen	MBU-Sanit	MBU-Total	Generators*
9	KCL	UGR-H/S	D	0	100	3.0	0.0	3.0	2.0	3.0	0.0	3.0	2.0
9	KCL	UGR-H/S	D	0	100	2.0	0.0	2.0	1.0	2.0	0.0	2.0	1.0
9	KCL	UGR-H/S	Ave	0	100	2.5	0.0	2.5	1.5	2.5	0.0	2.5	1.5
8	KCL	UGR-A	D	0	100	3.0	0.0	3.0	2.5	3.0	0.0	3.0	2.5
8	KCL	UGR-A	D	0	100	3.5	0.0	3.5	2.5	3.5	0.0	3.5	2.5
8	KCL	UGR-A	Ave	0	100	3.3	0.0	3.3	2.5	3.3	0.0	3.3	2.5
5	MKT	UGR-A	B9	150	150	7.5	2.5	10.0	7.5	5.0	1.7	6.7	5.0
5	MKT	UGR-A	B10	150	150	7.5	3.0	10.5	6.5	5.0	2.0	7.0	4.3
5	MKT	UGR-A	D10	150	150	6.5	4.5	11.0	9.0	4.3	3.0	7.3	6.0
5	MKT	UGR-A	D12	150	150	1.5	4.0	5.5	2.0	1.0	2.7	3.7	1.3
5	MKT	UGR-A	Ave	150	150	5.8	3.5	9.3	6.3	3.8	2.3	6.2	4.2
4	MKT	UGR-A	B2	60	200	8.0	2.0	10.0	7.5	4.0	1.0	5.0	3.8
4	MKT	UGR-A	B4	60	200	8.0	2.5	10.5	7.0	4.0	1.3	5.3	3.5
4	MKT	UGR-A	D3	60	200	5.5	3.0	8.5	9.5	2.8	1.5	4.3	4.8
4	MKT	UGR-A	D5	60	200	4.5	3.0	7.5	7.0	2.3	1.5	3.8	3.5
4	MKT	UGR-A	Ave	60	200	6.5	2.6	9.1	7.8	3.3	1.3	4.6	3.9
7	MKT	UGR-A	B4	92	200	8.5	1.5	10.0	7.5	4.3	0.8	5.0	3.8
7	MKT	UGR-A	D5	92	200	6.5	1.0	7.5	5.0	3.3	0.5	3.8	2.5
7	MKT	UGR-A	Ave	92	200	7.5	1.3	8.8	6.3	3.8	0.6	4.4	3.1
13	MKT	UGR-A	D	0	350	10.0	1.0	11.0	6.5	2.9	0.3	3.1	1.9
13	MKT	UGR-A	B4	0	350	12.0	1.0	13.0	4.5	3.4	0.3	3.7	1.3
13	MKT	UGR-A	D9	0	350	8.0	1.0	9.0	6.0	2.3	0.3	2.6	1.7
13	MKT	UGR-A	B5	0	350	11.0	2.5	13.5	6.5	3.1	0.7	3.9	1.9
13	MKT	UGR-A	Ave	0	350	10.3	1.4	11.6	5.9	2.9	0.4	3.3	1.7
14	MKT	UGR-A	D	0	400	13.5	6.0	19.5	8.5	3.4	1.5	4.9	2.1
14	MKT	UGR-A	B4	0	400	15.5	2.5	18.0	6.0	3.9	0.6	4.5	1.5
14	MKT	UGR-A	D9	0	400	17.0	2.0	19.0	7.0	4.3	0.5	4.8	1.8
14	MKT	UGR-A	B5	0	400	14.0	5.5	19.5	8.5	3.5	1.4	4.9	2.1
14	MKT	UGR-A	Ave	0	400	15.0	4.0	19.0	7.5	3.8	1.0	4.8	1.9
2	MKT	UGR-A	D6	75	400	7.0	0.0	7.0	8.5	1.8	0.0	1.8	2.1
2	MKT	UGR-A	D	75	400	11.0	1.0	12.0	4.5	2.8	0.3	3.0	1.1
2	MKT	UGR-A	Ave	75	400	9.0	0.5	9.5	6.5	2.3	0.1	2.4	1.6

* KCL - no generator; MKT - 2 KW generator; CK - 10KW generator.

Table B3 (cont'd). Detailed Fuel-Burning Equipment Operating Hours by Meal Period

Kitchen Data						Hours/Meal Period				Hours/100 Meals			
No.	Type	Type Ration	Main Entrée	Remote Meals	Total Meals	MBU-Kitchen	MBU-Sanit	MBU-Total	Generators*	MBU-Kitchen	MBU-Sanit	MBU-Total	Generators*
1	MKT	UGR-A	B	617	700	28.0	15.0	43.0	18.0	4.0	2.1	6.1	2.6
1	MKT	UGR-A	B7	572	700	15.5	14.5	30.0	18.5	2.2	2.1	4.3	2.6
1	MKT	UGR-A	D3	547	700	13.0	9.0	22.0	12.5	1.9	1.3	3.1	1.8
1	MKT	UGR-A	D6	587	700	6.5	5.5	12.0	13.5	0.9	0.8	1.7	1.9
1	MKT	UGR-A	Ave	581	700	15.8	11.0	26.8	15.6	2.3	1.6	3.8	2.2
3	MKT	UGR-A	D	665	850	20.5	9.5	30.0	8.5	2.4	1.1	3.5	1.0
3	MKT	UGR-A	D10	760	850	16.5	1.5	18.0	5.5	1.9	0.2	2.1	0.6
3	MKT	UGR-A	Ave	713	850	18.5	5.5	24.0	7.0	2.2	0.6	2.8	0.8
6	MKT	UGR-A	D2	765	1,000	11.0	6.0	17.0	14.0	1.1	0.6	1.7	1.4
6	MKT	UGR-A	D4	765	1,000	18.5	4.0	22.5	10.5	1.9	0.4	2.3	1.1
6	MKT	UGR-A	D5	853	1,000	11.0	10.0	21.0	7.0	1.1	1.0	2.1	0.7
6	MKT	UGR-A	D6	878	1,000	13.5	7.0	20.5	6.5	1.4	0.7	2.1	0.7
6	MKT	UGR-A	Ave	815	1,000	13.5	6.8	20.3	9.5	1.4	0.7	2.0	1.0
11	CK	UGR-A	D14	345	550	14.0	1.0	15.0	10.0	2.5	0.2	2.7	1.8
15	CK	UGR-A	D6	0	650	16.0	6.0	22.0	10.0	2.5	0.9	3.4	1.5
15	CK	UGR-A	D	0	650	18.0	3.5	21.5	10.0	2.8	0.5	3.3	1.5
15	CK	UGR-A	Ave	0	650	17.0	4.8	21.8	10.0	2.6	0.7	3.3	1.5
10	CK	UGR-H/S	D2	0	700	14.0	4.5	18.5	10.0	2.0	0.6	2.6	1.4
10	CK	UGR-A	B4	0	700	16.5	4.5	21.0	10.0	2.4	0.6	3.0	1.4
12	CK	UGR-H/S	D	275	700	15.0	6.0	21.0	10.0	2.1	0.9	3.0	1.4
12	CK	UGR-A	B	275	700	11.5	9.0	20.5	10.0	1.6	1.3	2.9	1.4
16	CK	UGR-A	D8	0	850	33.5	4.0	37.5	10.0	3.9	0.5	4.4	1.2
16	CK	UGR-A	D7	0	850	28.5	4.0	32.5	10.0	3.4	0.5	3.8	1.2
16	CK	UGR-A	Ave	0	850	31.0	4.0	35.0	10.0	3.6	0.5	4.1	1.2
17	CK	UGR-A	D9	0	1,700	40.0	8.0	48.0	10.0	2.4	0.5	2.8	0.6
17	CK	UGR-A	D	0	1,700	42.0	1.5	43.5	10.0	2.5	0.1	2.6	0.6
17	CK	UGR-A	Ave	0	1,700	41.0	4.8	45.8	10.0	2.4	0.3	2.7	0.6

* KCL - no generator; MKT - 2 KW generator; CK - 10KW generator.

Appendix C

Historical Kitchen Workload Data

To upgrade and improve overall field feeding operations, the Army over the past several years has fielded new group ration concepts, a new Containerized Kitchen, and new MBU burners. The primary focus for these fieldings was to simplify and improve field kitchen operations and reduce resulting kitchen workloads to produce and provide highly acceptable hot group meals.

To provide a baseline to evaluate any labor reduction benefits generated by these changes, this Appendix consolidates and present adjusted historical workload data from three prior field evaluations conducted by the Natick Soldier Center with MKTs or other field kitchens with M-2 burners and more labor-intensive A and B type group rations. These prior evaluations included the Camp Pendleton experiments, the Fort Sam Houston evaluations, and the Norway evaluations. Due to differences in data collection procedures, the historical workload data sets required adjustment to facilitate direct comparison with the more recent Appendix B workload data sets collected under this project. Each of these three prior field evaluations to include any workload adjustments to facilitate direct comparison with the Appendix B data sets is described below.

Camp Pendleton Data -1976

Table C-1 presents the adjusted historical workload data for two alternative field kitchens evaluated for the USMC during the Camp Pendleton field feeding experiments in 1976. These include a Modular Field Kitchen and 3 consolidated Mobile Kitchen Trailers (MKTs). This table was developed based on source data from Table B-1 in Technical Report 7T-4-OR/SA "The Camp Pendleton Experiment in Battalion Level Field Feeding," July 1976.

During these experiments, each kitchen was evaluated as a potential replacement to the then current USMC field kitchen. Each kitchen was utilized to support 900 Marines with 2 hot group meals per day. Each kitchen used similar equipment to include field ranges, M-2 burners, and serving lines with griddles and steam tables. The heat source for all cooking equipment and sanitation center sinks was M-2 burners. The main difference between the kitchens was that the Modular Tent kitchen operated on the ground and all equipment was housed in one 40' frame supported tent (TEMPER), while the 3 MKT kitchen consisted of 3 separate trailer kitchens. To function as a single kitchen, the 3 MKTs were backed up to each other in a T-configuration and connected by a central modular aluminum platform (12' x 12'). For these experiments, each kitchen was operated during a separate time period and was supported by the same sanitation center with 4 sinks and same ration storage tent.

The Table C-1 workload data for each kitchen is based on 4 days of work sampling data covering 8 meal periods for each kitchen. For each kitchen, work sampling data was collected 24 hours per day from 12:00 noon on Monday to 12:00 noon on Friday. During this time, each kitchen utilized the same menu cycle and prepared 2 group A ration meals per day (breakfast and dinner) for 900 Marines, to include 300 on-site and 600 remote-site meals per meal period. In addition, bakery type items for the

Table C-1. Historical Camp Pendleton Field Kitchen Workload Data (1976)

Type Kitchen	Modular Tent Kitchen		3 MKTs	
Type Ration	A/B		A/B	
No Meal Periods	8		8	
Meals Prepared/Meal Period	900-900		900-900	
Ave Onsite Meals/Meal Period	300		300	
Ave Remote Meals/Meal Period	600		600	
Ave Total Meals/Meal Period	900		900	
Total Meals	7200		7200	
	Ave Prod Workhours/		Ave Prod Workhours/	
Task/Activity	Period	100 Meals	Period	100 Meals
Food Prep	33.85	4.56	31.85	4.33
Serving	10.00	1.11	8.30	0.92
M-2 Burners	10.00	1.11	8.90	0.99
Supply	3.40	0.38	4.40	0.49
Kichen Sanitation	13.65	1.52	17.10	1.90
Pot/Pan Sanitation	16.20	1.80	15.20	1.69
Other Productive	16.20	1.80	16.20	1.80
Total Productive	103.30	11.48	101.95	11.33

next day were made during a night shift. By collecting work-sampling data 24 hours per day, all on-site productive work efforts are accounted for and reflected in the resulting work-hour estimates.

Table C-1 summarizes the average workload by work task for each kitchen per meal period and per 100 meals. Work hours per meal period for each kitchen was determined by summing all observations for the entire 96 hour data collection period, converting to work hours, and dividing by 8 or the number of meal periods. Productive work hours per 100 meals were determined by dividing the work hours per meal period estimate by 9 to reflect the 900 meals prepared per meal period.

There were some differences between the Camp Pendleton work task definitions and those used for the more recent Appendix B workload data sets. A description of the differences and the resulting Camp Pendleton data adjustments follow.

For the Camp Pendleton data, 3 separate defined work tasks covered food preparation type activities to include food preparation, baking, and pack food for remote feeding. For the recent Appendix B data sets all of these work activities were covered under a single task Food Preparation. To facilitate direct comparisons with the Appendix B workload data, the workloads for the 3 separate Camp Pendleton tasks were simply rolled up and are reported under the single task Food Preparation in Table C-1.

Another difference in data sets is for the task Supervision. For the Camp Pendleton data, supervision activities were recorded under the task Other Productive, while for the more recent Appendix B data sets Supervision was tracked as a separate work task. This will remain a difference in the data sets due to the inability to separate supervision activities out of the Camp Pendleton task Other Productive.

The kitchen workload data in Table C-1 is for each kitchen and group "A" rations. As shown, the total workloads for each kitchen with "A" rations are essentially the same at 103.30 work hours for the Modular Tent Kitchen and 101.95 work hours for the 3-MKT kitchen. During the last week of the experiment, each kitchen was also utilized to prepare 5 different B-ration menus to assess workload differences between "A" rations and "B" rations. This data indicated that overall "A" and "B" ration workloads are essentially the same.

Fort Sam Houston Workload Data

Table C-2 presents the adjusted workload data for the two alternative kitchens for field medical units evaluated at Fort Sam Houston in 1978. The kitchens included a Modular Field Tent Kitchen and a 2-MKT kitchen. This table was developed based on source data and information from Technical Report Natick/TR/79/040 "Evaluation of Alternative Field Feeding Systems For Army Field Medical Units," July 1978.

Each kitchen was evaluated as potential replacement to the standard M48 tent kitchen for field hospital unit. The kitchens were designed to permit near term fielding without a need for any major research and development program. Each kitchen used similar equipment to include field ranges, M-2 burners, and serving lines with griddles and steam tables. The heat source for all cooking equipment and sanitation center sinks was M-2 burners. These kitchens were smaller but similar to the 2 kitchens evaluated during the Camp Pendleton experiments and detailed earlier due to the lower feeding levels. In addition these kitchens were augmented with some special equipment to support patient feeding requirements.

The Camp Pendleton and Fort Sam Houston Modular Tent Kitchens both used the same frame supported shelter and similar primary cooking, serving, and sanitation equipment. For the Camp Pendleton evaluations, the Modular Tent Kitchen and ration storage used separate 40' and 16' tent shelters. Due to lower feeding levels and total equipment requirements, for the Fort Sam evaluations the Modular Field Kitchen and ration storage were both housed in one 40' shelter (32' for kitchen and 8' for storage).

Table C-2. Historical Fort Sam Houston Field Kitchen Workload Data (1978)

Type Kitchen	Modular Tent Kitchen		2 MKTs	
Type Ration	A/B		A/B	
No Meal Periods	9		12	
Meals Prepared/Meal Period	273-408		227-358	
Ave Onsite Meals/Meal Period	301		259	
Ave Remote Meals/Meal Period	36		37	
Ave Total Meals/Meal Period	337		296	
Total Meals	3031		3545	
	Ave Prod Workhours/		Ave Prod Workhours/	
Task/Activity	Period	100 Meals	Period	100 Meals
Food Preperation	14.11	4.19	15.46	5.22
Serving	5.96	1.77	5.67	1.91
Burners (M-2)	4.07	1.21	4.86	1.64
Kitchen Sanitation	3.68	1.09	3.43	1.16
Pot/Pan Sanitation	4.46	1.32	3.93	1.33
Other Productive	6.72	2.00	6.72	2.27
Total Productive	39.00	11.57	40.06	13.53

For this evaluation, each kitchen was also operated during a different time period and each was supported by the same sanitation center. The sanitation center was essentially the same as that utilized at Camp Pendleton experiments detailed previously. Compared to the Camp Pendleton kitchens, the Fort Sam Modular Field Kitchens and 2-MKT kitchen were both augmented with additional electrical kitchen equipment like meat slicer, vegetable cutter, and blender to support hospital patient feeding.

During these evaluations, each kitchen prepared 3 group meals per day to include both "A" and "B" ration meals. As shown in Table C-2, work sampling data for the Modular Tent Kitchen covered 3 days or 9 meal periods and the number of meals prepared per meal period varied from 273 to 406 and averaged 337 to include 36 ward patient meals. For the 2 MKT kitchen, work sampling data collection covered 4 days or 12 meal periods and the number of meals prepared per meal period varied from 227 to 358 and average 296 per meal period to include 37 ward patient meals. Each day, work sampling data collection covered the time period from the start of breakfast work activities to the completion of after dinner meal cleaning activities or from about 0400 to about 1900 daily. Not observed or covered by work sampling data collection were the night shift work efforts to bake the next day menu items. Therefore night shift workloads

need be estimated and added to those observed and estimated based on work sampling observations.

Total work hours per meal period for each kitchen by task were calculated and estimated as follows. First, all work sampling data for each kitchen were summed by task and converted to total work hours by task. For each kitchen, the resulting total work hours by task was divided by 9 for the Modular Field Kitchen and 12 for the 2-MKT kitchen to calculate an average workload by task per meal period. This calculated workload excludes any efforts expended by the night shift to prepare/bake the next days menu items but not covered by work sampling data. Night shift productive work efforts were estimated as follows and added to those calculated based on the work sampling data. The night shift consisted of 3 workers - 2 cooks and 1 KP and was assumed to average 8 hours (between the hours of 1900 and 0400). Based on the Army manpower planning factors, productive night shift work time was assumed to be 75% of shift time. Therefore total productive work effort provided by the night shift was calculated to be 18 work hours (3 workers x 8 hour shift x 75% productive time). Since each kitchen provided 3 group meals daily, the 18 hours equated to an incremental 6 productive work hours per meal period. Night shift work tasks included M-2 burners, Food preparation, Other, and Equipment Sanitation. Pots, pans, and utensils requiring sanitation were simply placed in the sanitation center for cleaning by the day shift. Based on observed day time work levels for these 4 tasks, the incremental 6 productive hours per meal period was sub-allocated as follows: M-2 burners - 0.9 hours, Food Prep 3.0 hours, Other - 1.4 hours, and Equipment Sanitation - 0.7 hours. These night shift estimates by task were added to those estimated based on the work sampling observations to yield total estimated kitchen workloads.

For the Fort Sam work sampling data, supervision activities were recorded under the task Other Productive, while for the more recent Appendix B data sets Supervision was tracked as a separate work task. This will remain a difference in the data sets due to the inability to separate supervision activities out of the Fort Sam task Other Productive.

The summary kitchen workload data in Table C-2 is for each kitchen covers both "A" and "B" ration preparation. The Modular Tent Kitchen workload data is based on 2 days or 6 meals of "A" rations and 1 day or 3 meals of B-rations. The 3-MKT kitchen data is based on 3 days or 9 meals of "A" rations and 1 day or 3 meals of "B" rations. As also shown by the Camp Pendleton data, the total average workloads for each kitchen with "A" or "B" rations are essentially the same at 39.00 work hours for the Modular Tent Kitchen and 40.06 for the 2 MKT kitchen. In addition, a comparison of "A" ration and "B" ration work sampling data also indicate the workloads for each type ration are essentially the same.

Norway Workload Data

Table C-3 presents the adjusted workload data for the Modular Tent Kitchen evaluated with the USMC during a NATO cold weather exercise in Norway in 1984.

Table C-3. Historical Norway Field Kitchen Workload Data (1984)

Type Kitchen	Modular Tent Kitchen		Modular Tent Kitchen	
Type Ration	B- Ration		Tray Pack	
No Meal Periods	16		11	
Meals Prepared/Meal Period	213-499		230-927	
Ave Onsite Meals/Meal Period	338		322	
Ave Remote Meals/Meal Period	0		164	
Ave Total Meals/Meal Period	338		486	
Total Meals	5404		5345	
	Ave Prod Workhours/		Ave Prod Workhours/	
Task/Activity	Period	100 Meals	Period	100 Meals
Food Prep	16.06	4.75	4.50	0.93
Serving	11.06	3.27	8.11	2.52
Supervision	1.20	0.36	0.07	0.01
M-2 Burners	5.34	1.58	0.98	0.20
Gen Clean-up	2.00	0.59	1.02	0.21
Equip Sanitation	2.52	0.74	0.66	0.14
Pots and Pans	6.17	1.83	1.27	0.26
Resupply	0.69	0.20	0.30	0.06
Other	0.34	0.10	0.05	0.01
Night Shift	0.00	0.00	0.00	0.00
Total Productive	45.39	13.43	16.95	3.49

This table was developed based on source data and information from Technical Report Natick/TR-85/054 "Technology Demonstration of the Proposed USMC Field Feeding System for the 1990s," June 1985.

Unlike the prior Camp Pendleton and Fort Sam Houston evaluations, the Norway evaluations covered only one kitchen - the Modular Tent Kitchen, and a new group "tray pack" ration. The Modular Tent Kitchen was evaluated as a potential replacement to the then standard USMC field kitchen, while the "tray ration" was evaluated as a new group ration to support USMC deployments.

The Norway Modular Tent Kitchen used the same type frame supported shelter as used by the Camp Pendleton and Fort Sam Modular Tent Kitchens. Main kitchen equipment items were similar and included those from Camp Pendleton and Fort Sam kitchens (field ranges, serving lines with griddles and steam tables, M-2 burners, etc) and

in addition included 2 new items - pot cradles and tray ration heaters. The heat source for all kitchen equipment (except for the tray ration heater) and the sanitation center was M-2 burners. The tray ration heaters included a push button start diesel fuel burner to heat the water to heat the tray pack items.

For this evaluation, the Modular Tent Kitchen and ration storage were in one 48' shelter (40' for kitchen and 8' for storage). This compares to a separate 40' kitchen shelter and 16' ration storage shelter fort he Camp Pendleton evaluations, and one 40' shelter (32' for kitchen and 8' for storage) for the Fort Sam evaluations. As for the Camp Pendleton and Fort Sam evaluations, this Modular Tent Kitchen was supported by a similar sanitation center housed in a separate 16' frame supported tent.

For this evaluation, the kitchen was used to prepare and provide "B" rations and "tray rations" on different days. Table C-3 summarizes the work sampling data for the kitchen with each type ration. Kitchen work sampling data collection covered 6 days and 16 meal periods for the "B" ration, and 4 days and 11 meal periods for the "tray ration." The number group meal periods per day varied from 2 to 3. As shown in Table C-3, there was a difference in the mix of on-site and remote site meals between type rations, and there was a significant variation in the number of meals prepared per meal period for each type ration. With the "B" ration, all meals were fed on site, while for the "tray ration on average about 2/3 were fed on-site and 1/3 at remote sites. For B- ration operations, the total meals prepared per meal period ranged from 213 to 499 and averaged 338 meals, while for the tray ration total meals ranged from 230 to 927 and averaged 486 meals. With the "tray-ration," the actual remote site meals per meal period varied from 0 to 500 and averaged 164 meals.

For each ration, work sampling data collection covered the time period from 0400 to 2000 daily. This covered the start of breakfast meal work activities to the completion of after dinner cleaning activities. With the "tray ration" there was no night baking shift as all menu desert items (e.g. assorted cakes and fruit desserts) were provided as tray items that only required heating and/or opening for serving. As a result, the work sampling data collection for "tray ration" operations covered and included all productive work efforts. With the B-ration, a separate night shift from 2000 to 0400 prepared baked type items on the next days menu to include cakes, cookies, biscuits, etc. For the B-rations, this work effort was not covered by work sampling and need be estimated and added to the workload calculated based on observed work sampling data.

Total work hours per meal period for the Modular Tent Kitchen for B rations and for "tray rations" were calculated and estimated as follows. First, all work sampling data for each ration were summed by task and converted to total work hours by task. For "tray rations" the resulting total work hours by task was divided by 11 to estimate average work hours by task per meal period. For the "tray ration, " no further calculations or adjustments were required since work sampling observation covered all "tray ration" productive activities.

For the B-ration, the resulting total work hours by task (based on work sampling observations) was divided by 16 to calculate an initial average workload by task per meal period. However this workload estimate excluded night shift productive activities that need be estimated and added to those based on work sampling data. Night shift productive work efforts per meal period were estimated as follows. The night baking shift consisted of 3 workers to include 2 cooks and 1 KP and an 8-hour work shift (2000 to 0400). As for the Fort Sam data, based on Army manpower planning factors, productive work time was assumed to be 75% of shift time. Therefore total productive work effort per night shift was calculated at 18 work hours (3 workers x 8 hour shift x 75% productive time). The "B" ration work sampling data covered 6 days and 16 meal periods. Therefore the incremental night shift productive effort is estimated at 108 total work hours (6 shifts x 18 hours/shift) or 6.75 average work hours per meal period. Night shift productive work activities were assumed to only include the following tasks: M-2 burners, food preparation, general clean up, and equipment Sanitation. Ant pots, pans, and utensils requiring sanitation were simply moved to sanitation center for cleaning by the day shift. Based on observed day time work levels for these 4 tasks, the incremental 6.75 productive hours per meal period was reallocated as follows: M-2 burners - 1.47 hours, food preparation - 4.05 hours, general clean-up - 0.55 hours, and equipment sanitation - 0.69 hours. These night shift estimates by task were added to those estimated based on the work sampling observations to yield total estimated kitchen workloads.

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List of Acronyms

BSA	Brigade Support Area
CK	Containerized Kitchen
CFREP	Combat Feeding Research and Engineering Program
CONUS	CONtinental United States
FTX	Field Training eXercise
HMMWV	High Mobility Multi-purpose Wheeled Vehicle
IFC	Insulated Food Container
JRTC	Joint Readiness Training Center
KCLFF	Kitchen Company Level Field Feeding
KPs	Kitchen Police
LMTV	Light Medium Tactical Vehicle
MBUs	Modern Burner Unit
MKT	Mobile Kitchen Trailer
MRE	Meal, Ready-to-Eat
MTK	Modular Tent Kitchen
MTV	Medium Tactical Vehicle
NTC	National Training Center
UGR-A	Unitized Group Ration - A
UGR-H/S	Unitized Group Ration - Heat/Serve
USMC	United States Marine Corps

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