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TECHNICAL REPORT
NATICK/TR-79/027

**ANALYSES OF SCIENTIFIC, TECHNOLOGICAL,
AND ENGINEERING PARAMETERS OF CFPS
OPERATION METHODOLOGY AND PRACTICES**

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21. ABSTRACT (Continue on reverse side if necessary and identify by block number) The concept of the Central Food Preparation System (CFPS) is to concentrate the preparation of food items in a production mode and to regulate the heat and serve function in the dining hall kitchen. An analysis of scientific, technological, and engineering parameters of CFPS operation methodology and practices revealed that the CFPS was not operating in its intended design in the areas of Production, Quality Assurance, Quality Control, and Staffing.			

PREFACE

In a study of Army garrison feeding systems which included a field test at Fort Lewis, WA, the US Army Natick Research and Development Laboratories (NLABS) recommended that a system using a Central Food Preparation Facility (CFPF) be adopted for the larger Army garrisons. This Central Food Preparation System (CFPS) would use a cook/freeze systems and would include such things as central management of the dining halls. The Army concurred in the report and to further investigate CFPS, developed an interim facility at Fort Lee, VA and set up an overall control and a Directorate of Food Management (DFM). The US Army Troop Support Agency (TSA) planned and directed the test while Fort Lee was the operator.

The evaluation of the Central Food Preparation System (CFPS) at Fort Lee, including the part to be performed by FEL, was delineated by a directive from TSA entitled "Evaluation Plan Central Food Preparation System, Fort Lee, VA", dated 27 February 1978. The total evaluation was to include DA ODCSLOG, TSA, TRADOC, NLABS, and Fort Lee and to be performed in the period March through August 1978.

The overall evaluation of the CFPS was directed by TSA. The format of this report is essentially the same as directed by TSA for all feeder reports to their overall evaluation report. This report covers the part of the evaluation performed by the Food Engineering Laboratory, NLABS. The following personnel contributed in a major way to the evaluation.

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INTRODUCTION

In the past ten years, Armed Services interest in various cook/store feeding systems for use in other than operational rations has increased tremendously. The prime mover has been the necessity for conserving personnel and dollar resources. One way this can be done in food service is by concentrating the preparation of food items in a production mode while relegating the dining hall kitchen primarily to a heat-and-serve function.

One of the principal drawbacks to the introduction of cook/store systems has been the perception of the products as being of lower quality than freshly prepared foods. However, improved technology as well as increased consumer acceptance of the products have made their introduction in a large scale feasible. This is particularly true of cook/freeze products.

In a study of Army Garrison Feeding systems which included a field test at Fort Lewis, WA, the US Army Natick Research and Development Laboratories (NLABS) recommended that a system using a Central Food Preparation Facility (CFPF) be adopted for the larger Army garrisons. This Central Food Preparation System (CFPS) would use a cook/freeze system and would include such things as central management of the dining halls. The Army concurred in the report and to further investigate CFPS, developed an interim facility at Fort Lee, VA and set up an overall control and a Directorate of Food Management (DFM). The US Army Troop Support Agency (TSA) planned and directed the test while Fort Lee was the operator.

The CFPF at Fort Lee consisted of an Ingredient Preparation, a Central Kitchen and a Laboratory. The first two were located in separate buildings, about 50 yards from each other and the third was located across post. The Ingredient Preparation had been in operation for a considerable period of time before the evaluation, while the Central Kitchen came on line in January 1978. CFPF was designed to support at least 9000 meals per day, but Fort Lee consumption amounted to around half of that figure during the period of the evaluation.

The format of this report is essentially the same as directed by TSA for all feeder reports to their overall evaluation report.

EXECUTIVE SUMMARY

Professionals of various food disciplines and from the Food Engineering Laboratory, US Army Natick Research & Development Laboratories evaluated technical operations of the Central Food Preparation System (CFPS) at Ft. Lee, VA in the period March through August 1978. The evaluation was conducted by direct observations and by analyzing reports produced in the course of CFPS operations.

At no time during the evaluation was the CFPF in a production mode, but rather always in a kitchen mode. From this it followed that the personnel savings, material savings, and product quality benefits envisioned in developing CFPS could not be realized to anywhere near the extent deemed possible in the original development work. As a corollary and probably a part of the "kitchen syndrome", quality control as opposed to quality assurance was practically nonexistent.

Serious problems existed in the dining halls that appeared to occur because of a lack of training and motivation in the new system. These problems tended to be overcome as operating personnel gained experience with the system. However, the dining halls were being operated without the level of technical help, quality control, and central direction originally envisioned under the CFPS concept. Indirect evidence, such as nonuse of CFPF products, unbalanced menu, etc., suggested that dining hall staffing might be excessive.

It was concluded that from a technical standpoint, the CFPS as operated during the evaluation period was not representative of CFPS as originally conceived, nor was it at any time in a steady state. Therefore, any evaluation results refer only to a transient, nonrepresentative system.

CONDUCT OF EVALUATION

A. Purpose

The evaluation was to be based on the overall cost of and the quality of food served in CFPS in comparison with the standard dining hall system. However, CFPS is exceedingly complex and made up of so many diversified components that the basic evaluation could be made only of a system which might be entirely different from original design. In order to evaluate the system from technical and engineering standpoints, FEL undertook to analyze the operations using professionals in the various food areas. This analysis was designed to:

1. Determine the operating characteristic of the Interim CFPS as they existed during the evaluation period and where they varied from original design and/or accepted good practice.
2. Supply data for the economic analysis.
3. Supply information to permit adjustment of other evaluation efforts.

B. Discussion

There are several ways by which the internal workings of an operation can be examined and evaluated. The two methods chosen in this case were examination of records produced by the operation itself and direct observations by experts in various areas. The information from each method can be broken down into hard data and soft data. Generally speaking, hard data can be considered as facts and figures and soft data as deductions from a set of circumstances or opinions.

Hard data are specific, objective, and quantified, although wrong conclusions can be drawn unless proper precautions are taken. Soft data are subjective and thus value depends mostly on the qualifications of the persons generating them. Both types of data are necessary for the evaluation of CFPS. A large amount of data has been generated by FEL, particularly of soft data and has to be meshed with each other.

C. Methodology

Production reports available for FEL evaluation were dining hall head counts, weights of various entree items shipped by Troop Issue Subsistence Activity (TISA) to the dining halls, production yield reports, and 42-day cyclic menus. These reports were compared and analyzed to develop a picture of the operations.

A total of 38 individual direct evaluations were made of the CFPS in operation by various professional members of the FEL staff. Instructions to these persons were that they were to examine thoroughly the areas of their particular expertise, to examine other areas of the operation as time permitted, and to write extremely detailed MFR's. In some cases, technologists were requested to give technical assistance on a particular problem and this was not considered part of the evaluation. In cases where the evaluation uncovered problems and deficiencies for which help was requested in correction efforts, before and after conditions are reported as part of the evaluation.

Information from all sources was collected, collated, and analyzed. From this, the overall FEL Evaluation Report was developed. Where possible, the validity of the data was checked through other sources of similar data.

A separate study was made to compare energy usage of the CFPS against the standard dining hall system. Specific methodology for this study follows.

OBSERVATIONS AND FINDINGS

A. General Operating Characteristics, CFPF

1. Purpose: To compare the general operating characteristics of the CFPF.
2. Discussion: The CFPF concept departs from traditional Army food service practice in that it is designed to be in a food production mode rather than the kitchen mode of a standard dining hall. In both modes, food is prepared for serving with formulations or recipes being very similar. Where the two modes

differ is in the philosophy and practice of operations. The differences seem small to the uninitiated, but spell success or failure of the operation.

In the kitchen mode one man (the cook) starts out with raw materials and personally goes through or personally supervises all preparation steps to the final product ready for serving. In many cases he acutally helps with the serving and is in quite close contact with his customers. He is directly responsible under the dining hall steward to make sure all customers are fed with one product or an equivalent, that the food quality is at the desired level, and that health and safety of the customers are protected through proper sanitation and adherence to standard safe practices. His work is almost entirely driven by menu and meal time.

In the production mode, no one cook or production worker of any kind is charged with complete responsibility from raw material to consumer's plate. Instead, each worker is charged with only a small segment of the overall effort. It is extremely difficult for him to develop any great interest, or pride in any other part of the operation, and he probably will do things like accepting material from another section without questioning its quality or quantity, etc. Because of this difference, staff and line control operations become entirely different in a production mode. If they are not performed correctly in the CFPF, the operation will at the very least fail to perform up to expectations and probably will be inferior to the traditional kitchen in both costs and food quality. This work is divorced from menu and meal time. It is driven by efficiency of operations.

One of the fallacies commonly encountered with food service is that it is so simple anyone can do it. Actually a food service system is as complicated as a weapons system and will not function properly without personnel training. If major expansion is to be done without training and experienced management, it is doomed to failure. A refusal to recognize the critical difference between dining hall and production modes and a refusal to supply management trained in production techniques will make operation of a CFPS uneconomic and slanted toward poor food quality.

3. Evaluation Results: Almost no one in the CFPS understood the difference between the kitchen mode and the production mode. Their total experience was in the kitchen mode. Therefore, CFPF was being operated as though it was in the kitchen mode even though the food was prepared either frozen or chilled for serving at a later time. Evidence of this is as follows:

- Small lot sizes
- Widely varying yields which indicates an inattention to yields
- Short time between runs of the same product (Fig 1) (see, para B2 (p 10))
- Lack of floor quality control indicating complete dependence upon individual workers (cooks) for quality control
- Subjective evaluations by experienced technologists

4. Conclusions:

a. Since the CFPF has been operating in the kitchen mode, any evaluation of the operation is suspect as a true picture of how CFPF could operate.

b. Operation of the Interim CFPF confirms that without professional production management CFPS cannot be expected to reach its objectives of low costs and high food quality.

c. Unless the decision is made to supply professional production management and personnel training in the expansion of CFPF's, the systems will fail in their objectives.

B. Internal Operations, CFPF

1. Purpose: To determine if the CFPF was operating according to good practices to optimize costs and quality, considering available resources.

2. Discussion: It has been pointed out under General Operating Characteristics, CFPF that the CFPF should be operating in a production mode rather than a kitchen mode. This is a "way of life" or "way of thinking", that the operators and managers must have. In essence, it calls for making a product

a. with the desired or mandated quality,

b. as fast as possible, and

c. at the least possible cost.

Of course, these points are true to a degree when in the kitchen mode, but they are vitally essential in the production mode. This part of the evaluation is concerned with them as the day-to-day operations of the CFPF infringe on their optimization.

To a large extent, this part of the overall evaluation results from observations by the various technical experts from NLABS. While much of the data presented may be considered "soft" and "opinion", it has been developed by technical personnel with many years of experience in the field. Furthermore, any condition reported only once by only one person is considered an isolated aberration.

It must be recognized that working under the stipulation that the 42-day cyclic menu must be served in the CFPS, the CFPF is forced into being a job shop rather than a continuous production operation. However, great economies as well as better possibilities for stabilization of quality can result from increasing batch and run sizes to the maximum extent possible. For design purposes it was assumed that any item to be frozen in the CFPS would be made only once for one menu cycle. This increases run sizes, but because of the very large number of items served in the 42-day menu, some items are served only once and only one or two are served frequently enough to permit true continuous production even with the largest size CFPF ever contemplated.

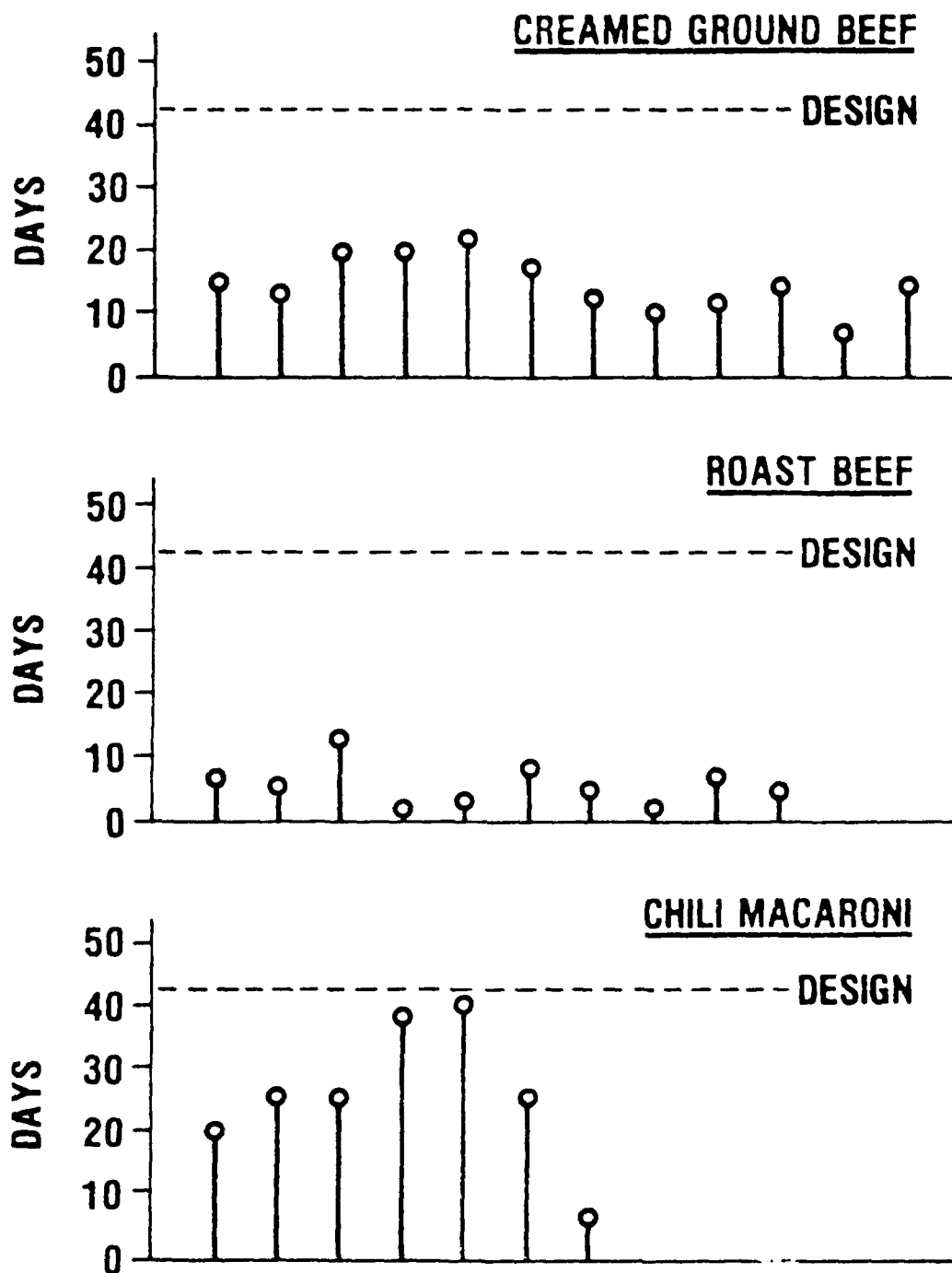


FIGURE 1. CFPF REPORTED PRODUCTION SCHEDULING IN DAYS BETWEEN RUNS

3. Evaluation Results: It was noted in many reports that run sizes of all products were small which negated the supposed advantages of CFPF. In order to determine if this was due to the small number of meals served at Fort Lee or to improper scheduling, production dates for the principal entree items were determined from DFM records. Results for three typical products are shown as days between runs in Fig 1. The dotted line labeled "Design" is 42 days. The vertical lines are days between successive runs and intervals on the horizontal axis have no significance. Chile Macaroni has the greatest time span between runs, but this is because it is served infrequently. Generally, entree items are made much too frequently, which results in lot sizes of 800 to 2500 portions or 400 to 1200 pounds. This is not a CFPF operation, but essentially a little over a large dining hall.

It follows from the above that hand labor was excessive as reported by many evaluators. Automatic equipment was not used since manhours of cleaning would be excessive for the results accomplished (para H,I). In some cases it seemed that automatic equipment suitable for the job at hand was not used more from habit than anything else.

The operation of CFPF seemed to be almost identical with a large kitchen rather than trending to the assembly line configuration of a pure production mode (para A). This extended to utilization of personnel with the crew floating through the whole process rather than individuals concentrating on one or two specialized tasks.

In addition, after a week investigating yields (para F) investigators found that the production personnel were not particularly concerned with quality and very often used materials they received without adjusting for discrepancies.

A month later this was turned around and production personnel were very conscious of their roles in maintaining quality. This did not solve the problem completely, but it was a big improvement.

4. Conclusions:

a. Small lot sizes were one of the principal manifestations of the CFPF being operated in the dining hall mode.

b. Improvements were made in operations, but the CFPF was still far from being an ideal production facility when the FEL evaluation was completed.

C. Internal Operations - Satellite Dining Halls

1. Purpose: To compare with recognized good practices the general operating characteristics of the satellite dining halls.

2. Discussion: Dining halls in a CFPS essentially are operated as they would be in their normal mode. Differences are found primarily in the way the food is handled, prepared, and served. This means that the kitchen personnel must be trained in new techniques. Furthermore, it is rare that frozen foods are or can be garnished before freezing. This should be done in the kitchen if the foods are to have their true customer appeal.

In planning stages of CFPS, it was recognized that the dining halls

would have to be under some kind of central control if the system was to operate properly. From this control would stem training in handling, reconstituting, display, and "merchandising" of food; standardization of practices; provision for strong quality control; binding the CFPF and dining halls together as a food service team.

While one of the parameters of CFPS has been that the 42-day cyclic menu would be used during the planning and test stages, it has been recognized that CFPS was not considered during planning of this menu. Therefore, no consideration was given to matching central-prepared with dining-hall-prepared foods to even out the workload in the dining halls from meal to meal. A casual examination of any of the 42-day cycles will show this. Therefore, if dining hall staffing is to be at a minimum, yet operate effectively, the menu must be adjusted. For example, considering only entree items at lunch and dinner, taking at random a two-week period, the mix is shown in Table 1.

TABLE 1
Basic Preparation of Menu Items
42-Day Cyclic Menu

	Lunch		Dinner	
	CFPF	DH	CFPF	DH
16 July	0	2	2	0
17 July	0	2	0	1
18 July	0	2	2	0
19 July	0	2	1	1
20 July	2	0	1	1
21 July	1	1	1	1
22 July	1	1	1	1
23 July	1	1	1	1
24 July	2	0	1	1
25 July	1	1	0	1
26 July	1	1	1	1
27 July	2	0	0	2
28 July	1	1	2	0
29 July	1	1	2	0

Dining hall staffing will have to be such that the heaviest workload can be handled. Examination of the menu indicates that it could be adjusted by shuffling products with little effort to even out the workload without affecting the acceptability.

3. Evaluation Results: Consistently, reports from technologists and dieticians on the dining halls, indicated that there were serious negative attitude and morale problems with the operating personnel that seriously affected their performances. These reports were based on informal conversations with key personnel in the dining halls. Formal surveys should confirm the attitudes shown. Very definite improvements were noted during the course of the evaluation period, but there was no question in observers' minds that these problems had serious adverse effects on the quality of food and food service from a technical standpoint and which should show up in other evaluation studies.

Early in the evaluation period reports indicated serious problems in SOPs and operating guides not being followed so that food quality was very poor in many cases, the variety limited, leftovers excessive, etc. While there were problems in all dining halls, some facilities were much worse than others. Later reports began to indicate very definite improvements, although many problems still existed.

As far as could be determined, the menu was not completely adjusted to minimize workload, although it was stated that the Menu Board was making efforts in this direction. However, the issue was confused in actual dining hall situations by the leftovers being served most of the time.

A study of the frozen entree shipments to the individual dining halls, the menus, and the reported headcounts indicated the dining halls were not ordering enough product to meet their headcounts. The statistic used was called "missing meal factor" or MMF where

$$\text{MMF} = 100 \times \frac{\text{Portions Shipped} - (\text{Menu requirements} \times \text{adjusted headcounts})}{\text{Adjusted Headcount}}$$

The adjusted headcount took into account short order and such factors. MMF for April was 18.3 percent, for May 15.7 percent, for June 1.0 percent. These figures indicated that for April and May, the dining halls were not using as much CFPF products as they should have been. Where they found the labor and raw materials to prepare this additional food is not shown on records available to FEL. However, the June figure of 1.0 percent (which is really the equivalent of 0 percent) shows what can be done when a problem is called to the attention of management and a determined effort is made to solve it.

4. Conclusions:

- a. Morale and attitude problems with operating personnel caused severe food quality problems during the evaluation period.
- b. The dining halls were being operated without the level of technical help, quality control, and central direction originally envisioned under the CFPS concept.
- c. Improvements in operations indicate that the evaluation was being conducted too early and before the operation was in a steady condition.
- d. More thought and planning must be given to the menu so that the dining hall workload is evened out while maintaining the product mix directed by management.
- e. Any evaluations made on costs and quality during the period of the evaluation must be highly suspect unless meaningful factoring out of improper operations can be accomplished.

D. Personnel

1. Purpose: To determine if management and operating personnel had

the training and experience to operate the CFPS properly.

2. Discussion: One of the most difficult concepts to explain to persons who have not had first hand, hands-on experience in food processing operations is that it is a different world from running a dining hall. The difficulty lies in that the differences are a "thousand" little things, seemingly insignificant in themselves, that add up to success or failure of the operation. Production supervision is a skill which can be learned only by doing for the most part. Very seldom can it be learned by just observing, and some people never can get the hang of it. It is practically unheard of in industry for a person to step directly into a key production position without prior relevant experience no matter how many degrees he has after his name or how many times he had walked through the plant. Management, on the other hand, does not have to have the direct hands-on experience, although such experiences cannot but help, and most firms have management training programs which include production duties.

In contrast to supervision, the CFPF workers including cooks should be quite adaptable to processing operations although they will need some instruction, on-the-job training, and motivation. The new things they will have to face are basically much larger run sizes, more use of automatic equipment, more teamwork, stricter controls, and freedom from three-meals-a-day constraints.

Most dining hall workers under CFPS do not need quite the same skill levels as would be needed under the standard system since much of the cooking will be done for them. However, the management and key cooks must be skilled. In addition, all personnel must be indoctrinated and trained to handle the new system since the prepared foods can be ruined by improper handling. On the other hand, they can be made much more appetizing by proper handling, garnishing, etc.

3. Evaluation Results: One comment overheard and reported several times was to the effect that no training was conducted with dining hall personnel since this is the way it would be "thrown" at the operators in any expansion program. The disastrous effect that this lack of training combined with poor morale and motivation had on operations showed up in every evaluation report for at least the first two months of operations and continued on to some degree throughout the entire evaluation period.

They were few, if any, adverse comments on the workers in CFPF. They seemed to have whatever skills that were necessary and doing their jobs as directed.

Comments made by senior FEL staff members on management and supervision of CPFS production operations were to the effect that there was no one in the organization with the requisite production type experience to insure a smoothly run, successful production operation. The operation was run in the dining hall mode because this was the background of the personnel concerned. FEL evaluation personnel invariably reported that the CFPS personnel with whom they had contact were courteous, extremely helpful, and almost certain to be very capable in their own specialties.

4. Conclusions:

- a. Training of personnel was inadequate.
- b. Management and supervisory personnel were not experienced or

trained in production mode operations.

c. Selection of key personnel and training must be improved drastically for success of any proliferation.

E. Control of Product Quality

1. Purpose: To determine if product quality is being controlled from raw material to consumer's plate at a high a level as feasible with generally recognized good quality control and quality assurance practices.

2. Discussion: R&D conducted by NLABS on cook-freeze systems, current literature, and generally accepted practice all indicate that CFPS provides an excellent opportunity to maintain food quality at a uniformly high level. It will not be a "gourmet level", but neither does it have to be mediocre. Many tests indicate that frozen food properly designed and produced can be of excellent quality. CFPS provides the opportunity to have the most skilled cooks doing the critical cooking operations. It also provides the opportunity to have an industrial type quality control operation.

The control of product quality in any manufacturing operation must be the responsibility of the production personnel since they are doing the work and must not be freed from responsibility for the results of that work. However, since quality and control of quality are so important, there must be a formal staff organization whose responsibility it is to help production in the control of product quality. In CFPS this is the Technical Support Office.

Control of quality is divided into two main functions: Quality Control (QC) and Quality Assurance (QA). QC is the minute-by-minute, hour-by-hour, day-by-day checking of all things that might affect quality from the raw materials through sanitation and adherence to specifications, to a final look as the finished product goes out the door or, in the case of CFPS, goes on the consumer's plate. Statistical Quality Control (SQC) has been shown to be a useful tool in controlling quality. However, it would be applicable only in a very limited way to the Fort Lee CFPS because it is a job shop too small for SQC to be effective. Therefore, QC in this operation should be one or more intelligent and knowledgeable persons whose continuous and sole job is to check conditions and practices in the operations against specifications, SOPs, general instructions, operation guides, and good practice standards.

QA is the checking of the final product as it goes out the door or as it is received by the customer to make sure the quality is at designated level. In an internal operation, it is also testing to make sure that SOPs etc., such as for cleaning procedures, are producing the desired results. It is almost always done on a statistically chosen sample, rather than by 100 percent inspection. One of the best examples of QA is in the statistically chosen samples from meats offered under contract to the Armed Services and inspected on the basis of end-product criteria.

3. Evaluation Results: All of the evidence gathered indicated that QC was not being performed in such a way as to be effective. QA, on the other hand, was being pursued in most areas with some effectiveness.

Several reports and in particular those by the most senior technologists, stated flatly that no floor QC was observed. Examination of product yield figures (para 13) showed that there were wide fluctuations in yields of entree items which indicates that the QC job was not being done in controlling quality. Individual reports of instances of poor quality, extremely variable quality, nonconformance with SOPs and production guides, poor operational practices, etc. were so numerous that there could be no other answer but that product quality was not being controlled.

QA was being performed very well in sanitation and product safety areas (microbiology). A formal taste panel was in operation. However, it was apparent that any results it reported were not being translated into effective QC action.

4. Conclusions:

Control of product quality was being performed very poorly, particularly in the QC area.

F. Product Yields, CFPF

1. Purpose: To determine the consistency of yields, how they compare with standard and theoretical yields, and to relate yields to operational quality and efficiency.

2. Discussion: One of the most important indicators of an operation's quality and efficiency is product yields. With food products, it is generally accepted that yields will be increased around 15 percent when the operation is changed from a small kitchen-type to a large commercial-type. Thus, the yield becomes a big factor in relative food costs. Furthermore, variation of yields from run to run is a very good indication of how well the operation is controlled. It is an important indicator as to the efficiency of the quality control operation both in maintaining the desired quality level and the cost levels. For purposes of this study only entree item yields were investigated rather than trying to look at all yields.

3. Evaluation Results: Generally, all yields looked at displayed the same characteristics. In Fig 2, percent variation from theoretical yields are shown for three products. These products are fairly typical of all entrees and had been made enough times to provide valid comparisons. The yields are in time sequence on the horizontal axis which has no dimensions. Excluded are yields against which there were notations that indicated yields probably were not typical. Disregarding the one anomaly in Creamed Ground Beef and the one in Roast Beef the variations in the three products are shown in Table 2.

TABLE 2

Variation in Yields From Theoretical

	Total Spread (%)	Midpoint (%)
Creamed Ground Beef	20	-21
Roast Beef	37	+8.5
Chili Macaroni	31	-18

It is obvious from these figures that the operation was not under very good control. Furthermore, two questions can be asked. If the yields are so variable, how accurate are costs? If the yields are truly variable, how can product quality be anything but variable?

Because of variation in yields detailed investigation of yields was undertaken 16-21 July 1978 on-site by Mr. Robert Scott and SFC John Lyons of the Animal Products Group. Their findings indicated that yield variations were due to a large number of small factors in raw materials, issue, ingredient preparation, and production, most of which should have been caught and corrections forced by Quality Control and first line supervision. Both Scott and Lyons noted that in their opinion, the operation was being run in a kitchen mode rather than a production mode and, with a lack of floor Quality Control, this indirectly resulted in the yield variations.

In order to develop more reliable information on the yields which can be expected if the operational guides are followed exactly and tight control is exercised over production, Mr. Scott and SFC Lyons spent two weeks (20 Aug - 1 Sep 1978) with Mr. R. Helmer, TSA, following entree items from raw material to frozen product. Their report shows a complete turn around on the part of production personnel and excellent results being obtained. However, the quality control function was not being performed and some changes were pointed out as necessary in the methods of keeping records.

4. Conclusions:

a. Yields reported until the time of the Scott & Lyons evaluations indicate the system was not under control. Therefore, costs, quality, and personnel usage during the period up to that time (21 Jul 78) are highly suspect, and any evaluation studies on these parameters also must be highly suspect unless a meaningful factoring out of this lack of control can be accomplished.

b. Control of the operation after the Scott & Lyon evaluations will depend upon continued management attention.

c. Quality Control has not functioned properly (para E).

G. Product Mix, CFPS

1. Purpose: To investigate the theoretical CFPS product mix to determine the optimum make centrally, make dining hall, or buy commercial combination.

2. Discussion: All of the planning, experimentation, and evaluation of CFPS based products to be produced in CFPP on three basic criteria. These were:

a. The regular 42-day cyclic menu would be used with no substitutions dictated by CFPS.

b. Only products in the Federal Stock Catalog Supply List and authorized for issue in the standard feeding system would be used except for certain special products such as modified starch dictated by the cook-freeze system and larger size containers.

c. Decisions as to which products should be made in CFPP would be based, first, on quality of the finished product (essentially as good as or

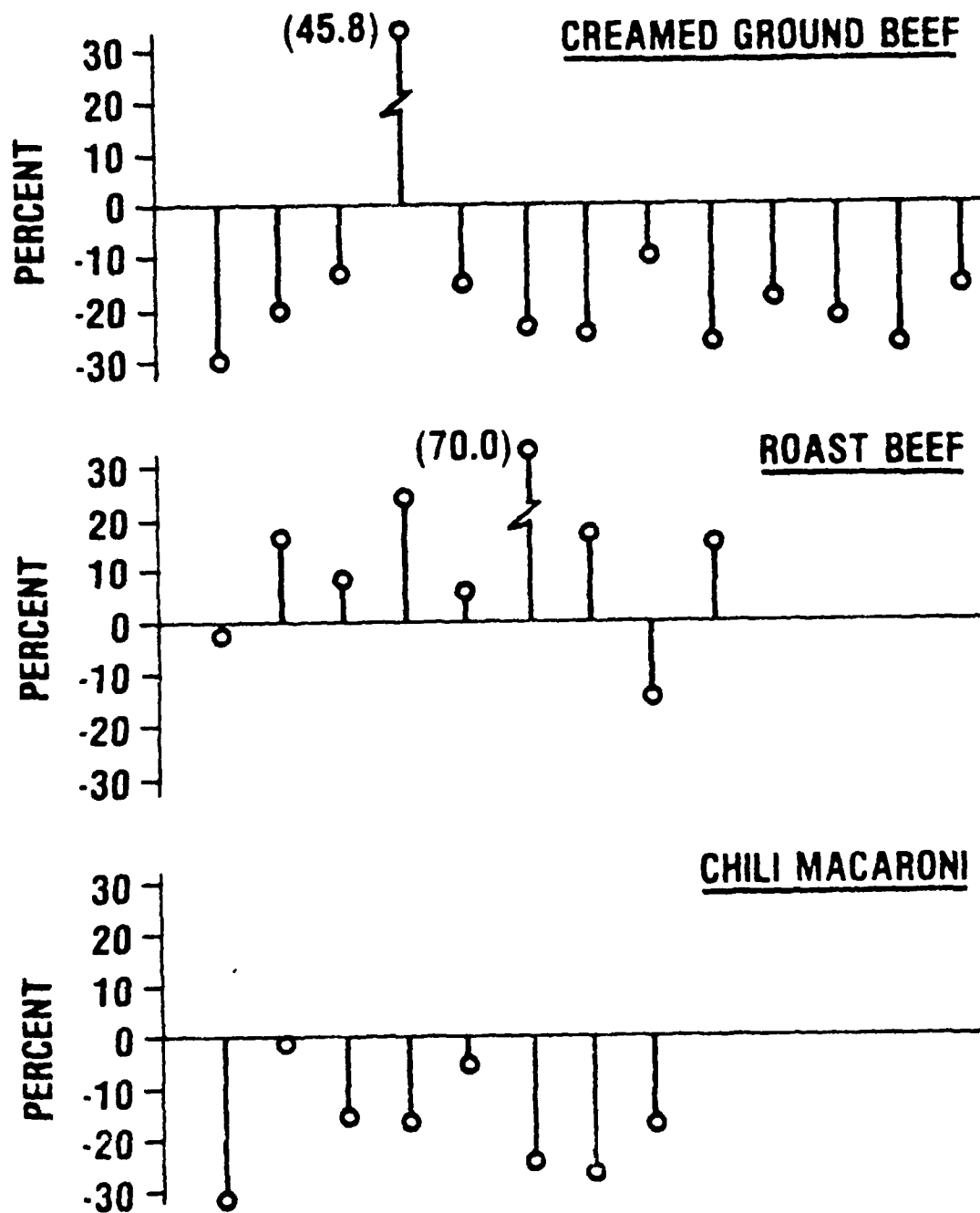


FIGURE 2. CFPF VARIANCE OF REPORTED PRODUCTION YIELDS FROM THEORETICAL (SEQUENTIAL)

better than the average dining hall prepared) and, second, on cost (considering both raw materials and labor).

Using these three criteria, the product mix for CFPS was established almost automatically. Any one of the 42-day cyclic menus will work out to be about 60 percent fully or partially prepared centrally.

The TSA Evaluation Plan¹, Central Food Preparation System, Fort Lee, VA dated 28 February 1978, contained a task listed as the joint responsibility of FEL and TSA to assess the impact of the 42-day cyclic menu in CFPS. This was later construed to include a make or buy study.

The initial FEL effort in this study was to develop possible menus containing 80 to 100 percent CFPF prepared or other convenience items, with the dining hall work on these items being limited to heating if required, garnishing, and serving. The task was assigned to the Experimental Kitchen Branch. Expansion of the task to determine a theoretical CFPS product mix based only on quality and cost was assigned to two food technologists. Unfortunately, time restraints limited the overall study to a survey of representative products and quality could not be examined in detail.

It should be pointed out that in the past, the introduction of convenience items into the Army garrison feeding system has been piecemeal and tended to follow the proverbial Parkinson's Law (work expands to fill the time available) so that the end result has been no labor saved. Therefore, as a practical matter, the introduction of Tray Pack, for example, into the present system as a piecemeal basis would result in no personnel savings. Based on the experience with the present CFPF at Fort Lee, the personnel savings if Tray Pack were introduced as a complete system would exist, but would probably be minimal. However, for the purposes of this study, it is assumed that Tray Pack is introduced as a system and that the cost of handling, reconstituting, and serving in the dining hall would be the same as for CFPF foods.

The product mix study covered only 10 individual representative items produced in CFPF. For this reason, and because costs were based on theoretical optimum staffing, they cannot be related directly to the economic study included in this overall evaluation report by OR/SA. Furthermore, since it was necessary to make so many assumptions due to the lack of time to obtain hard data, results should be considered approximate and the study a dry run for a larger effort.

The study was restricted to CFPS and regular feeding system as now constituted. This eliminated such things as an overall evaluation of convenience items now in the system, ingredients more in line with current production practices rather than in dining halls, etc. The basic economic factors were adapted from a report by Mark Davis and John Rogozenski of OR/SA dated 26 September 1972, entitled "Economic Analysis for the Proposed CFPF System at Fort Lee, VA"², adjusted for inflation. Values used are theoretical.

¹ TSA Evaluation Plan, Central Food Preparation System, Ft. Lee, VA, 28 February 1978.

² M. Davis and J. Rogozenski, Economic Analysis for the Proposed CFPF System at Ft. Lee, VA, 26 September 1972.

3. Evaluation Results: It is very evident that the 42-day menu as it now exists, is not designed with CFPS in mind. Furthermore, the products listed in the Federal Supply Catalog to support this menu have been set up for dining hall use and dining hall operation mode rather than for a CFPF in a production mode. In addition to these points, the basic operating parameters for the CFPS such as container type for the product, make or buy mix, etc., could be changed in accord with newer state of the art to the advantage of CFPS.

The basic factors about the 42-day menu and the Federal Stock Catalog that affect the efficiency of CFPS are:

- a. Items prepared centrally are not necessarily set up in combination with dining hall prepared to equalize the dining hall workload.
- b. Container sizes are designed for small batch sizes.
- c. Mixes, partially prepared items etc., are used, although as far as is known, no study was made as to making these products in CFPF.
- d. The menu as a whole contains so many items that any one item can only be made in comparatively small lots even though it is served a number of times. A number of items will only be served once in the cycle.
- e. The menu was not made up to maximize CFPF production volume by increasing the number of centrally prepared items.

The results of the product mix study are shown in Table 3. Dining hall costs were allocated to specific food classifications and this figure added to material cost into the dining hall. Storage costs were not considered. The figure used for the commercial products was the same as for the CFPF products since it could be considered that they required the same amount of preparation effort.

Tray Pack products cost more than CFPF, but less than commercial frozen or dining facility. No. 10 can products are the cheapest, but generally speaking, their quality is distinctly lower than the other products. However, no quality distinctions are made in this part of the report.

4. Conclusions:

- a. Efficiency and product costs in CFPS can be improved greatly by adjustments in the menu used.
- b. The work on product mix in the A-ration should be continued and expanded independently of CFPS. The end result should be a clear picture of the impact on the system of convenience items, the possibilities of including partial or complete systems incorporating new state-of-the-art products such as thermally processed tray packs, and where further research can pay off in both the near and far terms.

H. Equipment

- 1. Purpose: To determine suitability, usability, and usage of equipment in the CFPF and dining halls.

TABLE 3

Comparison of Individual Portion Cost Estimates for Prepared Selected Master Menu Components in the DF and CFPF Versus Cost of Commercially Prepared Counterparts

Menu Components	Total Cost per Portion				No. 10 Can
	Dining Facility	Central Food Preparation	Commercial Counterpart 1/ Tray-Heat Processed Tray-Frozen		
<u>Entrees</u>					
Beef Stew	0.982	0.727	0.822	0.902	0.538
Sliced Roast Pork w/Gravy	1.322	1.025	1.292	1.392	0.727
Oven Fried Chicken	1.039	0.779	2/	0.781	2/
Meat Loaf	1.006	0.740	2/	0.902	2/
<u>Vegetables</u>					
Cauliflower Au Gratin	0.368	0.266	0.352 4/	0.383	2/
Potato Au Gratin	0.337	0.250	0.314 4/	0.342	2/
<u>Desserts</u>					
Yellow Cake Plain	0.375	0.263	2/	0.256	2/
Apple Pie	0.485	0.322	2/	0.269	2/
Chocolate Chip Cookies	0.394	0.262	2/	0.197 3/	2/
Sugar Cookies	0.371	0.260	2/	0.167 3/	2/

1/ Counterpart menu components include appropriate allocated Satellite Dining Facility operation costs.

2/ Not commercially available

3/ Fresh

4/ Estimate

2. Discussion: Dining halls are designed to prepare food from raw materials. This is true even though more and more so-called convenience foods have been added to the authorized raw materials. With a CFPS, some of the basic equipment is no longer needed in the dining halls, while additional equipment such as freezers and means for reconstitution must be added. The CFPF is, or should be, designed and equipped to prepare foods in a production mode using production type equipment and methods as far as possible.

In the original design work, the CFPF at Fort Lee was set up with equipment larger in size than would be needed for the expected production volume. This was done to operate equipment which would be used in the larger facilities and to provide for training.

This part of the evaluation is to determine how far the equipment and its operation deviate from what would be considered optimum.

3. Evaluation Results: Table 4 gives observed equipment usage time for two separate weeks. It is very evident that the equipment was underutilized to such a degree that the facility was running at a small fraction of its true capacity, if freezing capacity is excepted. Part of this is due to the original design calling for oversized equipment to be used for training purposes. However, the pattern of usage could have been improved if the facility had been in a production mode where there would be much longer times between runs.

The blast freezer is the controlling factor in determining total CFPF capacity in the Fort Lee facility. It was designed to reduce the temperature of 1000 pounds of typical entree items from 180°F to 0°F in 1½ hours. This has never been checked out. It would have to be and the whole freezing operation evaluated from scheduling to the actual temperature drop needed if the true capacity of the facility were to be determined.

Generally speaking, the equipment seemed to be adequate and to be operating properly with exception of the breeder and the roll-in ovens (Dispatch). The breeder was the wrong type to do a complete breeding job so that breeding had to be done by hand. A new breeder was on order, but not yet received. The roll-in ovens gave continual trouble in not providing uniform heating even though a factory representative was called in to adjust them and to install new perforated heat flow panels. From a products quality standpoint they are not as satisfactory as the rotary ovens although their usability and capacity are better.

Maintenance of equipment appeared to be very good. Problems encountered were mainly the type that could be expected in any new operation.

Complaints were voiced that there was insufficient equipment in the dining halls to reconstitute the volume of frozen products needed for the meals. (Some of this was noted by FEL personnel). However, it would require an indepth study to analyze the situation properly since it was made very complex by the menu set-up, product scheduling, etc. Theoretically, the equipment available was adequate. The way the system was operating, it was not.

Automatic and semiautomatic equipment was, to a large extent, not used in favor of hand labor, even though it was at hand and in operating condition.

The common excuse offered was that the lot sizes were too small and would not justify the labor and cleanup involved with equipment. In many cases, this was a valid excuse if the small lot sizes could be accepted as valid in the first place (Section F). In other cases, however, the excuse was considered invalid and the nonuse of equipment due more to the prevailing dining hall operational mode.

The nonuse of equipment was particularly prevalent in the packaging operations. For example, a detailed report by a packaging technologist showed ten persons being used for hand functions in the bakery packaging operation. This could be reduced to three using the automatic Raque packaging line. The same was true of the entree packaging, where ten packers were used instead of three. The unloading operation of the freezer used ten persons, whereas this would be reduced to five persons if the automatic mode of the Baker-Perkins freezer was used.

Certain pieces of packaging related equipment were not available. A PurePak machine would automatically fill and seal milk cartons with soups, sauces, and gravies. It was not available and soups were observed being filled by hand dipping into aluminum half-size steam table disposable pans. This is extremely wasteful of materials and labor as well as providing a package awkward to handle. Equipment for the mold system for entrees which was displaced by the disposable aluminum pans (Section I) would not save any appreciable direct labor over the system for aluminum pans (which was not being used).

4. Conclusions:

- a. Underutilization of equipment was so pronounced that it was almost impossible to evaluate it.
- b. Available automatic equipment was used minimally.
- c. Dining hall equipment should be reevaluated if CFPS is proliferated.

I. Packaging

1. Purpose: To determine if the CFPS was using the most cost efficient packaging considering present state-of-the-art.

2. Discussion: If food products are prepared for use at a later date, they must be packaged in some way to protect them from outside contamination and to provide a means by which they may be stored, transported, and prepared for serving. The elaborateness and sturdiness of the container system will depend upon the conditions to which it will be subjected. Generally, cost of the containers and packaging materials will parallel the amount of protection needed, but convenience and operating factors will also effect it.

In the original design of CFPS, very careful consideration was given to packaging and packages as part of the total system. However, in development of the Interim CFPS at Fort Lee it was deemed necessary to make certain changes due to convenience and physical layout of the CFPS.

3. Evaluation Results: The original design for packaging entrees was

TABLE 4
CFPF Equipment Usage

Equipment	Number In Use	Weekly Hours of Operation			
		12-16 June 1978		28 Aug - 1 Sep 1978	
		Max/Day	Total	Max/Day	Total
Cutter, Cookie	1	---	---	0.75	1.5
Depositer, Cake	1	1.0	1.75	1.0	1.0
Depositer, Cookie	1	2.0	4.0	---	---
Doughnut Machine	1	4.0	4.0	4.0	8.0
Fryer, Continuous	1	1.1	2.3	3.5	11.7
Fryer, Tilt	2	1.25	2.67	---	---
Kettles		7.0	22.25	6.0	12.0
Mixer	1	1.0	3.75	1.0	5.0
Oven, Revolving	2	5.5	13.5	5.75	17.25
Oven, Roll-In	2	4.75	10.75	4.1	9.6
Pie Machine	1	2.0	2.0	---	---

freeze them in a flexible mold slightly smaller than a half-size steam table pan, remove the frozen block from the mold, and wrap it with a suitable film using an automatic bread wrapping machine. The frozen blocks would be placed in stainless steel pans for reconstitution. Currently, disposable aluminum pans are used. The main advantages of the disposable pans are convenience and no washing of used molds and reconstitution pans. The main disadvantages are considerable waste volume in shipping and storage and an increased direct cost of approximately three cents per serving.

The original design packaging of soups, gravies, and sauces was the PurePak (paper milk carton) type. However, instead of this system, these products were placed in aluminum half-size steam table pans. With single strength soups, the increased direct container cost is approximately two cents per serving.

The primary observation on packaging in the bakery area was that almost no automatic equipment was being used. In addition, the fiberboard boxes were oversized which resulted in crushing due to nonsupportive loading when the cartons were placed in freezer storage.

Since the ingredient preparation area is located apart from the main production area, it is necessary to protect products between the two areas. This protection, of course, involves additional packaging materials. However, there seemed to be no problems in this area and no detailed study was deemed necessary.

No problems were noted in the salad area.

4. Conclusions:

a. Packaging cost differentials between the original design and actual operations were large enough to cause significant per serving cost increases in the For Lee facility.

b. Packaging systems must be given serious consideration in any proliferation effort.

c. Boil-in-bag type operation could supply many advantages over the half-size steam table pan.

J. Energy

1. Purpose: To determine the energy consumption of CFPP in comparison with the standard food service system.

Data on this subject is presented in Technical Report NATICK/TR-79/032 K.H. Hu et al., Quantitative Analysis of Energy Usage in Central Food Preparation System at Fort Lee, VA.³

³K.H. Hu et al., Quantitative Analysis of Energy Usage in Central Food Preparation System at Fort Lee, VA, NATICK/TR-79/032.

CONCLUSIONS

A. The CFPPF was operating in a kitchen rather than a production mode during the entire evaluation period. Therefore:

1. Projected personnel savings of CFPPF were not even approached.
2. Projected material savings of CFPPF such as from increased yields were nonexistent.

B. Quality Assurance was operating, but its overall effect on food quality seemed minimal. Microbiological quality assurance of food safety was satisfactory.

C. Quality Control in CFPS was practically nonexistent. Therefore:

1. Quality of products leaving CFPPF varied widely even within individual lots.
2. Quality of products as affected by dining hall procedures varied widely.
3. Overall quality in consumers' plates was not as high as could be expected from a CFPS.
4. Adherence to SOP's, production guides, and similar controls was haphazard throughout CFPS.

D. Dining hall staffing was probably excessive as shown by indirect evidence (menu not adjusted for CFPPF, nonuse of CFPPF products, etc.)

E. The CFPS as operated during the evaluation period was not representative of what a CFPS could or should be. Therefore, it should not be considered a valid test of the concept.

RECOMMENDATIONS

In view of the resources that have been expended on this project and despite the initial unfavorable evaluation of the current CFPPF facility, it is recommended that the CFPS concept not be discarded at this point, but that the CFPPF be reorganized to run as originally designed. It is further recommended that the CFPPF and one or two dining halls be run to a steady-state condition so that both the theoretical and the practical minimum staffing levels of the system may be developed.