DoD Food RDT&ENG Program: An Evaluation (1981)

Pages
64

Size
8.5 x 10

ISBN
0309331099

Task Force of General Committee on DoD Food Program; General Committee on DoD Food Program; Advisory Board on Military Personnel Supplies; Commission on Sociotechnical Systems; National Research Council

951400 PB83-139337 81-01222 ✓

DoD Food RDT and ENG Program: An Evaluation

(Final rept)

National Research Council, Washington, DC. Advisory Board on Military Personnel Supplies.

Corp. Source Codes: 019026369

Sponsor: Army Natick Research and Development Labs., MA.

Report No.: ABMPS-118

1981 63p

Languages: English

NTIS Prices: PC A04/MF A01

Country of Publication: United States

Journal Announcement: GRAI8306

Contract No.: DAAK60-79-C-0015

The food and food service requirements of the armed services are diverse and, at times, extremely complex. There is an ongoing need for the creation of new food service systems and the adaptation of existing ones to new weapons systems and changing combat conditions. Advances and innovations made in the processing, packaging, and handling of foods are creating pressures of their own for the development and deployment of new food service systems that can provide better rations more economically to military personnel. This study consisted of an examination of (a) the handling of the food and food service requirements of the Army, Navy, Air Force, Marine Corps, and Defense Logistics Agency by the Army Natick Research and Development Laboratories.

Descriptors: *Food processing; *Food services; *Military rations; Evaluation; Food preparation; Food packaging; Nutrition; Requirements; Military facilities; Requirements; Human nutrition; Food habits; Recommendations; Cost engineering

Section Headings: 6H (Biological and Medical Sciences--Food); 15E (Military Sciences--Logistics); 98H (Agriculture and Food--Food Technology); 74E (Military Sciences--Logistics, Military Facilities, and Supplies)

ABMPS Report No. 118
DoD Food RDT&Eng Program--An Evaluation

Prepared by the
General Committee on DoD Food Program
Advisory Board on Military Personnel Supplies
Commission on Sociotechnical Systems
National Research Council

NATIONAL ACADEMY PRESS
Washington, D.C.
1981

NOTICE

The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Prepared for the
U.S. Army Natick Research and Development Laboratories
Natick, Massachusetts
under Contract No. DAAK60-79-C-0015.

The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purpose of furthering knowledge and of advising the federal government. The Council operates in accordance with general policies determined by the Academy under the authority of its Congressional charter of 1863, which establishes the Academy as a private, non-profit, self-governing membership corporation. The Council has become the principal operating agency of both the Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine. The National Academy of Engineering and the Institute of Medicine were established in 1964 and 1970, respectively, under the charter of the National Academy of Sciences.

PREFACE

Statement of Task

In October 1979, the General Committee on DoD Food Program* agreed to a request by the U.S. Army Natick Research and Development Laboratories (NLABS) for a study of the DoD Food RDT&Eng Program** at NLABS. This program had been initiated ten years before by the Assistant Secretary of Defense (Installation and Logistics), and it was thought that an objective appraisal would be of value.

The study was designed to provide the following:

- An evaluation of NLABS responses to military service requirements (MSRs) from case studies of a representative sample of MSRs.
- An assessment of the Technology Base activities of the Food RDT&Eng Program.
- An assessment of the nutritional aspects of the Food RDT&Eng Program.***
- An identification of methods for improving the Food RDT&Eng Program.

---

*A committee of the Advisory Board on Military Personnel Supplies (ABMPS) of the National Research Council. The Committee was established to review and coordinate the work of the ABMPS food and food-related committees and provide an overview of the U.S. Department of Defense (DoD) Food RDT&Eng Program at NLABS.

**Research, development, testing, and engineering program. NLABS has the responsibility for all but the nutritional aspects of the program, the latter being the responsibility of the Surgeon General of the Army. Three of the five NLABS operational units are involved in the DoD Food RDT&Eng Program: the Science and Advanced Technology Laboratory, Food Engineering Laboratory, and Operations Research and Systems Analysis Office (OR/SA). The other operational units are the Aero-Mechnical Engineering Laboratory and the Clothing, Equipment, and Materials Laboratory.

***Added at the request of the Office of the Under Secretary of Defense for Research and Engineering.

Organization of Study

Five panels with 3-5 members per panel were formed to study the handling of the food and food-related requirements of the Army, Navy, Air Force, Marine Corps, and Defense Logistics Agency. Two additional panels were formed to study the Technology Base activities of the DoD Food RDT&Eng Program and the nutritional aspects of the program. A task force comprised of the Chairman of the General Committee and the chairmen of the panels defined the tasks of the panels, selected 16 representative MSRs for case studies, and formulated study guidelines (see APPENDIX).

Meetings

The Task Force met at NLABS in Natick, Massachusetts, on February 28-29, and March 1, 1980. Each of the panels subsequently held several meetings, some of them with food RDT&Eng personnel at NLABS and representatives of various DoD components.

A meeting of the report preparation group in Chicago on November 7-9, 1980 was followed by a meeting of the General Committee in Washington, D.C., on January 15-16, 1981 for a discussion of the report. The report preparation group met again in Washington, D.C. on February 10 and March 20 for the completion of its task.

CONTENTS

SUMMARY

The food and food service requirements of the armed services are diverse and, at times, extremely complex. There is an ongoing need for the creation of new food service systems and the adaptation of existing ones to new weapons systems and changing combat conditions. There is also a need to improve the efficiency and management of garrison feeding systems.

Advances and innovations made in the processing, packaging, and handling of foods are creating pressures of their own for the development and deployment of new food service systems that can provide better rations more economically to military personnel in tanks, submarines, aircraft, ships, missile silos, isolated outposts, remote garrisons, or wherever they might be.

This study consisted of an examination of (a) the handling of the food and food service requirements of the Army, Navy, Air Force, Marine Corps, and Defense Logistics Agency by the Army Natick Research and Development Laboratories (NLABS), (b) the Technology Base activities associated with the DoD Food RDT&Eng Program,* and (c) the Department of Defense's nutrition research activities.

The conclusions reached are based not only on the findings of this study but also on the collective experience of the members of the General Committee and the panels with the work carried out over the years on the DoD Food RDT&Eng Program.

---

*Department of Defense Food Research, Development, Testing, and Engineering Program

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The following are the major conclusions reached in this study:

1. The DoD Food RDT&Eng Program at the Army Natick Research and Development Laboratories is generally fulfilling its mandate within the budgetary constraints imposed, making essential and highly important contributions to the food and food service programs of the armed services.

2. The Army, Navy, Air Force, Marine Corps, and Defense Logistics Agency are generally well satisfied with the response of NLABS to their food and food-service requirements and the results achieved, but the present operation could be improved if (a) NLABS instituted better management control of its projects, (b) the DoD Food RDT&Eng Program were given adequate, consistent, and timely funding, and (c) the representatives assigned by the armed services to the Joint Technical Staff were more technically qualified.

3. NLABS' generally well-equipped facilities and the wide range of knowledge, skill, and experience of its personnel make it possible for it to deal with the food problems of the armed services far better than the individual services could on their own. The services have neither the desire to operate their own individual food RDT&Eng programs nor the capability for doing so.

4. The DoD Food RDT&Eng Program at NLABS would be more effective and have fewer difficulties if NLABS were attached to an organizational element of DoD that provided greater visibility and support. Buried in the Army structure where there is little interest and knowledge of food R&D, the program is being adversely affected by management, morale, communication, and funding problems.

5. The effectiveness and productivity of the DoD Food RDT&Eng Program at NLABS would be further improved by placing it under a strong civilian director with the authority to plan, lead, organize, control, and allocate resources.

6. The potential of NLABS would be more fully realized if there were a greater degree of communication (a) within NLABS between managers, scientists, and technicians, and the Joint Technical Staff, (b) between NLABS and other DoD components via the Joint Technical Staff and NLABS tours, and (c) between NLABS, the universities, and private industry via NLABS tours, personal contacts, seminars, industry association meetings, peer-review journals, and trade publications.

7. The level of funding for Technology Base activities during the past five years (35-70 percent of that requested) has adversely

affected activities that provide vital conceptual and technological support to the DoD Food RDT&Eng Program. The FY 1981 level of funding is well below the FY 1977 level when measured in constant dollars.

8. Although Congress has transferred the nutrition research effort at the Letterman Army Institute of Research (LAIR)* to the U.S. Department of Agriculture (USDA), DoD still has the responsibility for identifying the mission-essential nutrition research needs of the armed services and coordinating its efforts in this direction with those of USDA and other contractors.

Recommendations

The General Committee recommends that:

1. The personnel and facilities at NLABS that are involved in the DoD Food RDT&Eng Program be transferred from the Army Materiel Development and Readiness Command (DARCOM) to an organizational element of DoD that can provide the attention, support, and visibility that the program requires to achieve its objectives; also that a study be made of the feasibility of transferring all the personnel and facilities of NLABS, not just those involved in the Food RDT&Eng Program, to keep the organization from being fragmented.

2. The Food RDT&Eng Program at NLABS** be placed under a strong civilian director with the authority to plan, lead, organize, control, and allocate resources, and that this be done regardless of where NLABS is located within DoD.

3. The Food RDT&Eng Program at NLABS be given adequate, consistent, and timely funding to prevent the type of disruption caused by the erratic funding practices of the past.

4. Technology Base activities be kept separate from direct work on MSRs. Also that steps be taken to prevent direct work on MSRs under the guise of Technology Base activities using funds that have been allocated for the latter.

5. DoD have a single nutrition component (supported by a budget line) that can (a) identify the mission-essential nutrition research

---

*A unit of the Office of the Army Surgeon General.

**Three of the five NLABS operational units are involved in the DoD Food RDT&Eng Program: the Science and Advanced Technology Laboratory, Food Engineering Laboratory, and Operations Research and Systems Analysis Office (OR/SA). The other operational units are the Aero-Mechanical Engineering Laboratory and the Clothing, Equipment, and Materials Laboratory.

required by DoD, (b) set priorities, and (c) determine budgetary requirements.

6. Representatives to the Joint Technical Staff be technically qualified and have the technical skills required to provide effective liaison and ensure proper utilization of the final product.

7. NLABS institute better management control of its projects.

8. Communications be improved within NLABS, between NLABS and other DoD components, and between NLABS, the universities, and the private sector using whatever means are available (i.e., personal contact, reports, NLABS tours, seminars, industry association meetings, peer-review journals, trade publications, etc.).

INTRODUCTION

The food program of the U.S. Department of Defense (DoD) is an enormous undertaking. The Army, Navy, Air Force, and Marine Corps together serve an average of 1.6 million meals a day to 750,000 service men and women stationed in the United States and abroad, maintaining a total of 2,400 dining facilities. The total cost of the program (food, equipment, labor, maintenance, etc.) exceeds $10 billion per year.

The management problems are complicated by the great diversity of conditions, environments, and geographic locations encountered during food service operations in the field, at sea, below the sea, and in the air, from the heat of the desert to the cold of the Arctic. The complications are compounded by long supply lines and the need to maintain reserves of food in long-term storage.

The responsibility for the overall policy and direction of the DoD Food Service Program lies with the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics), who is assisted in this task by the DoD Food Planning Board. The Secretary of the Army and the Natick Research and Development Laboratories (NLABS) are responsible for the formulation and execution of the DoD Food RDT&Eng Program, and work in coordination and cooperation with the Army, Navy, Air Force, Marine Corps, and Defense Logistics Agency (DLA). The program is subject to the review and approval of the Under Secretary of Defense for Research and Engineering.

A number of the food requirements of the armed services are uniquely different from those of the civilian sector. Food supplies for combat troops, naval vessels (particularly submarines), personnel in forward or isolated positions, and emergency situations must have special characteristics that are not essential in foods prepared for the commercial civilian market. The requirements vary with each operating environment but are generally combinations of some or all of the following: low weight, low volume, edibility with little or no preparation, long-term shelf stability, and durable packaging.

The food service equipment designed for military use may also differ markedly from that designed for civilian use. To function satisfactorily under the conditions met in the field, such equipment must be more rugged, mobile, compact, and reliable than equipment utilized in the civilian sector. It must also be compatible with weapons systems in use and function effectively in toxic and other extreme environments.

The limited potential of the military market does not usually justify the size of investment in R&D the civilian food industry would need to make if it were to attempt to provide food products and equipment for the armed forces. When the potential does justify an investment by a private company in the development of a new product, the procurement system works against that company since every other company

that wishes to bid on the procurement contract has free access to all the pertinent information it needs on the product through the written specifications. The set-aside provisions of the Small Business Act* place large companies at a particular disadvantage. As a result of the system and the limited potential of the military market, DoD generally finds it must do its own product development work through the Food RDT&Eng Program.

One must not conclude, however, that there is no mutuality of interests in the military and civilian sectors. The military food program has benefited from advances made in the civilian food industry and the civilian sector has benefited no less from advances made in the military sector. The DoD Food RDT&Eng Program has been of particular benefit and value to industries now engaged in the production of boxed beef, canned and fabricated meats, canned specialty foods, dehydrated and freeze-dry coffee, dehydrated eggs, dry soup mixes, dry beverage mixes, cake mixes, converted rice, and a variety of other processed foods. The program has also made important contributions to retort pouch technology, the thermal processing of food in steam-table tray pans, and the development and improvement of various types of food-service equipment (e.g., french-fry extruders, conveyor-belt broilers, and refrigeration components).

DoD Food RDT&Eng Program at NLABS

The DoD Food RDT&Eng Program at NLABS covers, but is not limited to, the following:

- Food chemistry, microbiology, nutritional evaluation, processing, preservation, packaging, stability, and consumer acceptance.
- Equipment for food preparation, holding, handling, delivery, serving, and sanitation.
- Food service systems and facilities for all environments and operating conditions.
- Food products, recipes, menus, operational rations, and food packets.
- Specifications for procurement of food and related packaging, equipment, and systems.

---

*Section 15, 15 USC 644. Small business preferences have also been established in Public Law 95507.

One of the major objectives of the program is the timely introduction of new and improved food items, feeding systems, and techniques for preservation and packaging.

The Food RDT&Eng Program, like other RDT&Eng programs carried out by the Army, is comprised of a variety of activities, including (a) research, (b) exploratory development, (c) advanced development, and (d) engineering development. These are defined as follows by Army Regulation 70-1 (1975):*

- Research (designated as 6.1 activity) includes scientific study and experimentation that is carried out to increase knowledge and understanding in the scientific fields that are related to national security needs. It includes research that is directed toward the acquiring of fundamental knowledge for the solution of identified military problems and, also, research that will provide part of the base for subsequent exploratory and advanced developments in the defense-related technologies of new or improved military capabilities.

- Exploratory development (designated as 6.2 activity) includes efforts toward the solution of specific military problems, efforts that can range from fairly fundamental applied research to the development of prototype hardware.

- Advanced development (designated as 6.3 activity) includes the development of generic techniques (6.3A) and hardware (6.3B) that can have a variety of military applications.

- Engineering development (designated as 6.4 activity) is the development work that is carried out in the engineering phase of a project. This phase is usually completed before a project has been approved for procurement and operation.

The activities that are designated as 6.1, 6.2, and 6.3A are categorized as Technology Base activities, but there is no 6.3A funding in the Food RDT&Eng Program.

Processing of Food RDT&Eng MSRs (Military Service Requirements)

The Army, Navy, Air Force, Marine Corps, Defense Logistics Agency (DLA), and various DoD components (e.g., Food Planning Board, Food Service Facility & Equipment Planning Board) submit their requirements for food RDT&Eng on an annual schedule to the Deputy Chief of Staff for Research, Development, and Acquisition (DCSRDA). Designated as MSRs

---

*These definitions apply to all RDT&Eng in the Army, not just that in the food program.

(military service requirements), they may call for research, development, testing, and engineering (the 6.2-6.4 activities described above) on a wide variety of food and food-related problems, ranging from the preparation, nutrition, preservation, packaging, and acceptance of individual food items to the development of food service systems and facilities for all environments, operating conditions, and weapon systems.

DCSRDA passes the MSRs on to NLABS for study and the development of a technical plan for achieving the specified objectives, and the MSRs then proceed through a series of steps to the execution of the required RDT&Eng and the implementation of the final results (Figure 1).

Organization and Mission of Food RDT&Eng Program Elements at NLABS

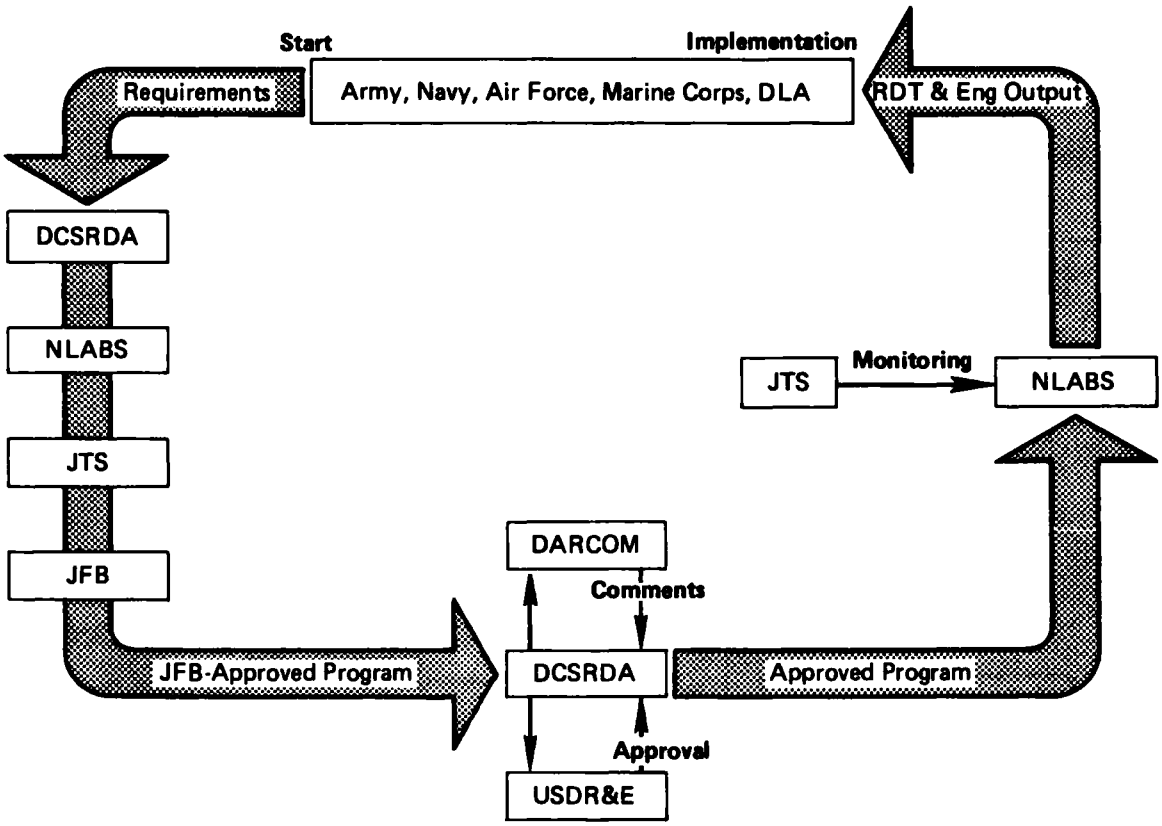
The NLABS elements involved in the DoD Food RDT&Eng Program are the following: the Science and Advanced Technology Laboratory, Food Engineering Laboratory, and the Operational Research and Systems Analysis Office (see Figure 2). The mission, responsibilities, and organization of each of these elements are described below.

Science and Advanced Technology Laboratory

The mission of the Science and Advanced Technology Laboratory includes:

- Basic and applied food science research and development.
- Collection of background data and development of principles for new and improved feeding systems.
- Basic and applied engineering on methods and systems for reducing environmental pollution from military activities.
- Research on prevention of microbiological deterioration of materials.
- Technical support to standardization, logistics, and operations.

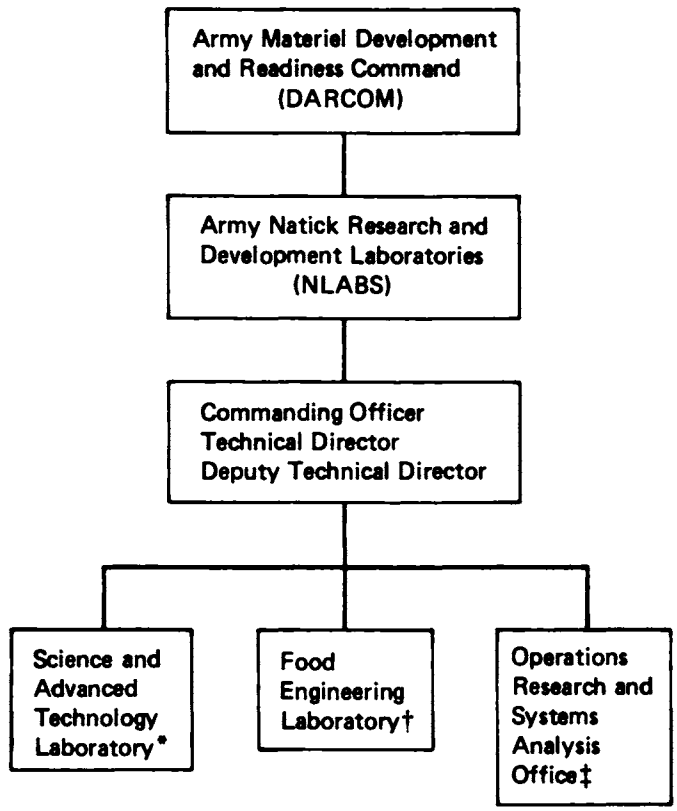
Figure 3 shows the groups in the laboratory engaged in food RDT&Eng.



Acronyms:

DARCOM	Army Materiel Development and Readiness Command
DCSRDA	Army Deputy Chief of Staff for Research, Development, and Acquisition
DLA	Defense Logistics Agency
JFB	Joint Formulation Board
JTS	Joint Technical Staff
NLABS	Natick Army Research and Development Laboratories
USDR&E	Under Secretary of Defense for Research and Engineering

Figure 1. Flow Diagram for Military Service Requirements (MSRs)



*For organizational subdivisions, see Figure 3.
†For organizational subdivisions, see Figure 4.
‡No organizational subdivisions.

Figure 2. Elements of NLABS Involved in DoD Food RDT&Eng Program

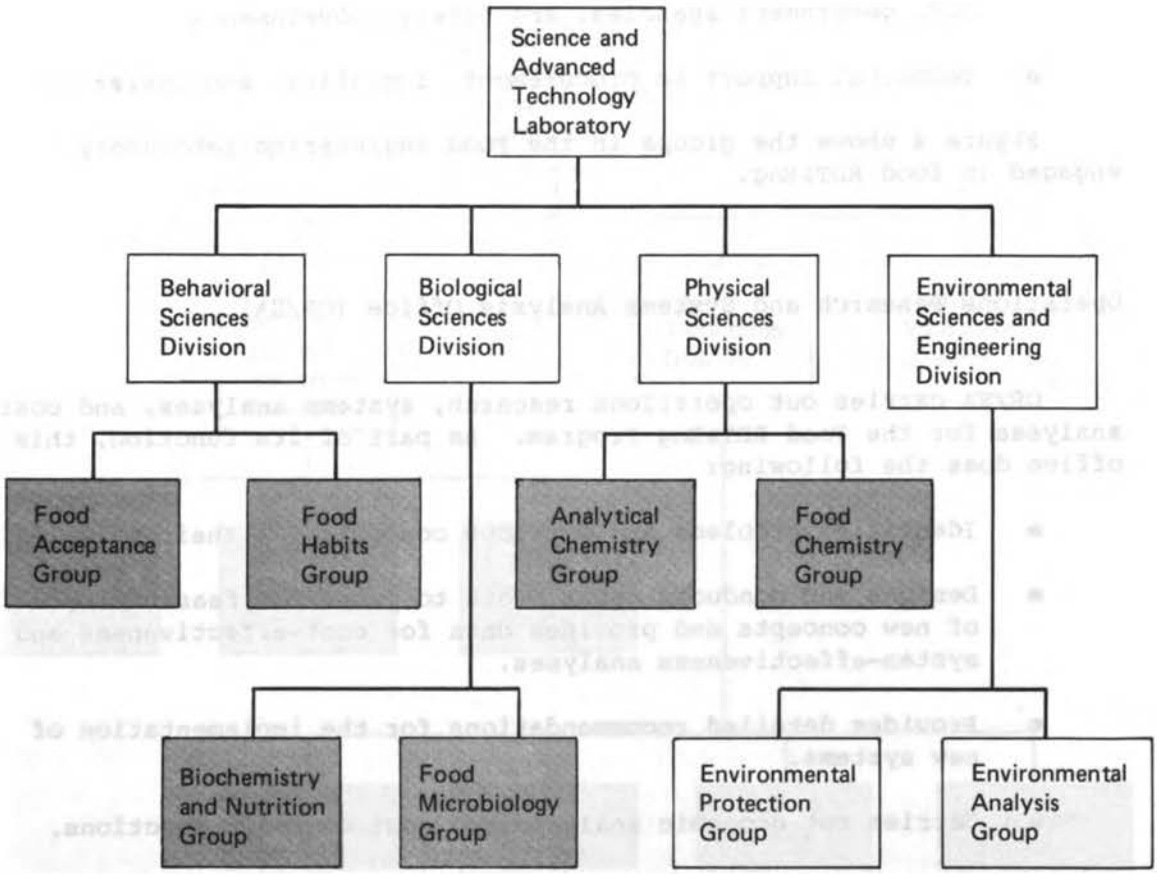


Figure 3. Organization of Science and Advanced Technology Laboratory

Food Engineering Laboratory

The mission of the Food Engineering Laboratory includes:

- Research and development, product engineering, and standardization work on the design, development, and evaluation of military rations, food products, food processes, packaging, food service equipment, and feeding systems for DoD, other U.S. government agencies, and foreign governments.

- Technical support to procurement, logistics, and operations.

Figure 4 shows the groups in the Food Engineering Laboratory engaged in food RDT&Eng.

Operations Research and Systems Analysis Office (OR/SA)

OR/SA carries out operations research, systems analyses, and cost analyses for the Food RDT&Eng Program. As part of its function, this office does the following:

- Identifies problems and develops concepts for their solution.

- Designs and conducts experiments to prove the feasibility of new concepts and provides data for cost-effectiveness and system-effectiveness analyses.

- Provides detailed recommendations for the implementation of new systems.

- Carries out economic analysis and cost analysis functions.

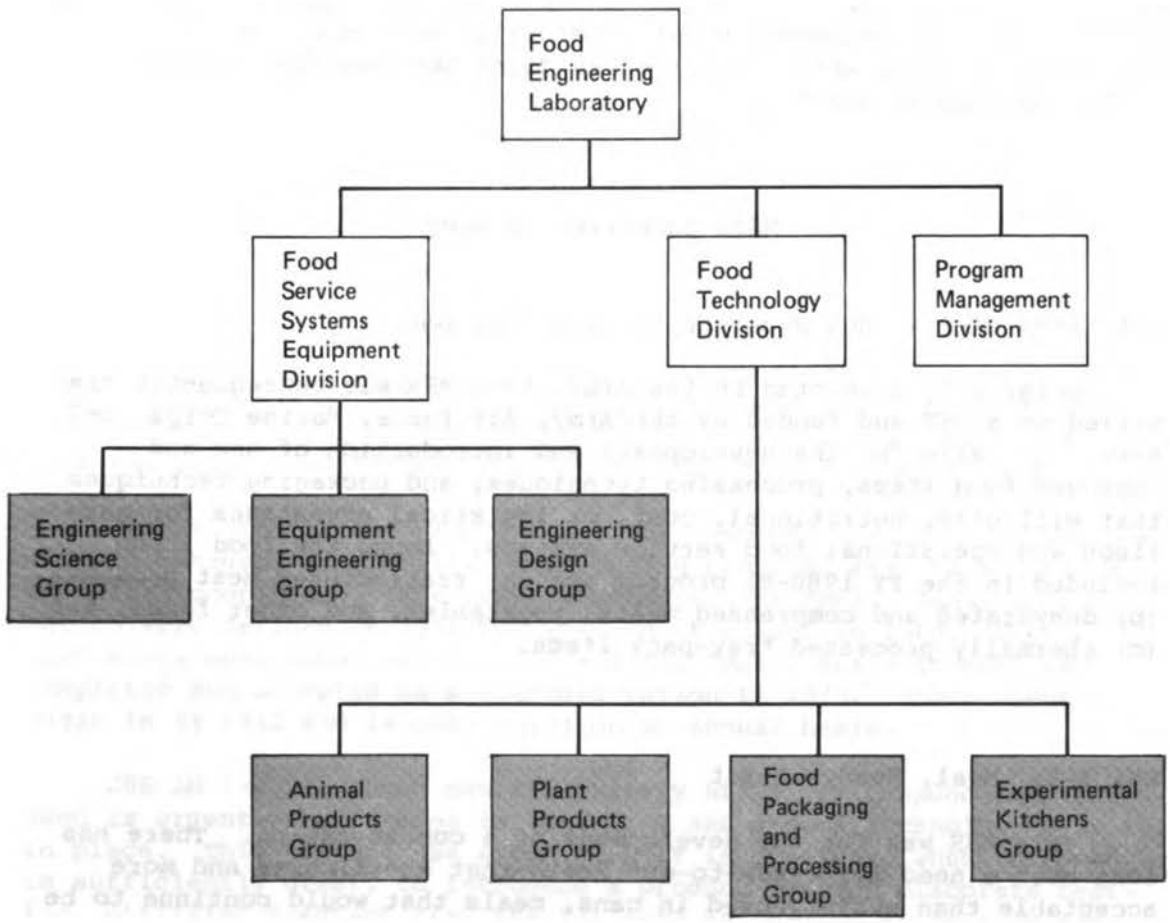


Figure 4. Organization of Food Engineering Laboratory

ASSESSMENT OF MSR ACTIVITIES AT NLABS

To assess the handling of military service requirements (MSRs) by the Army Natick Research and Development Laboratories (NLABS)*, the Task Force selected 16 representative MSRs for examination by the panels set up for this part of the study. Four of the 16 had been submitted by the Army, two by the Navy, four by the Air Force, three by the Marine Corps, and three by the Defense Logistics Agency. Four of the MSRs that proved to be of interest to more than one branch of the armed services were classified as Joint Service Requirements (JSRs) and funded jointly.

MSRs Submitted by Army

JSR AAFMN 81-25: New Subsistence Items for DoD

Originally submitted by the Army, this MSR was subsequently classified as a JSR and funded by the Army, Air Force, Marine Corps, and Navy. It calls for the development and introduction of new and improved food items, processing techniques, and packaging techniques that will offer nutritional, cost, or logistical advantages for garrison and operational food service systems. Among the food items included in the FY 1980-81 program are (a) restructured meat products, (b) dehydrated and compressed meats, vegetables, and other foods, and (c) thermally processed tray-pack items.

USA 3-3: Meal, Ready-to-Eat

This MSR was for the development of a combat ration. There has long been a need for ready-to-eat meals that are lighter and more acceptable than meals packed in cans, meals that would continue to be acceptable to service personnel if they were the only ration available for a period of up to seven days. Quick-serve, thermoprocessed, and irradiated foods in flexible pouches were evaluated for use in this MSR.

JSR AM 7-4: Long-Range Patrol Food Packet

This JSR, funded by the Army and Marine Corps, was for the development of a food packet for special forces in remote areas where the maintenance of supplies might be uncertain for periods of 3 to 10 days.

---

*References to NLABS in this report are exclusively to elements and personnel involved in the DoD Food RDT&Eng Program. This program, one of the many at NLABS, was the only activity examined in this study.

The objective was a lightweight packet that would make hot food available to personnel engaged in tactical operations if they had sufficient time, the only requirement other than the packet being a supply of potable water.

USA 8-4: Systems Analysis of Army Hospital Food Service Operation

This MSR was for the examination of Army hospital food service operations. The objective was a cost-effective system for serving highly acceptable, nutritious meals to patients and authorized duty personnel. The sizable and costly new hospital construction program of the Army made this MSR particularly important.

Assessment of Handling of Army MSR/JSRs.

The new and improved food items, processing techniques, and packaging methods being developed under JSR AAFMN 81-25 are essential to the food programs of all the services. The production testing for this effort, contracted out to private industry, is an example of the role the private sector can play in the DoD Food RDT&Eng Program.

The length of time required for the completion of USA 3-3 was due more to management, priority, and funding problems than to a lack of technical competence. The requirements for the "Meal, Ready-to-Eat" ration were defined in 1961 but work on it ceased in 1967. The requirements were redefined in 1973 and the "Meal, Ready-to-Eat" was completed and accepted as a standard ration in 1975. Procurement began in FY 1980 and is continuing on an annual basis.

JSR AM 7-4 has shown how effectively NLABS can respond when the need is urgent, the funding is adequate, and a good Technology Base is in place. This project has shown that it is possible, when the need is sufficiently great, to introduce a product without elaborate testing, utilizing feedback from the "client" to correct minor problems as the product is put into use.

The effort on USA 8-4 was well planned and orderly but the project was not without problems. The selection of a frozen food system over a chilled food system was based on an analysis utilizing weighting factors that were determined subjectively by one individual when they could have been determined more objectively or, at least, have been arrived at after consultation with other experts. In addition, some of the reports written on this project proved to be too technical to be understood by the individual who replaced the original project officer.

The study of these MSRs and JSRs revealed the importance of preventing erratic changes in funding and priorities. Three of the

four service requirements examined were delayed by changes in funding and shifts in priorities by the clients. Discussions with those in the Office of the Army Deputy Chief of Staff for Logistics indicated the Army was well satisfied with the manner in which its MSRs were being handled, however, despite the problems. In their view, NLABS was carrying out its tasks capably within the organizational and funding constraints imposed.

NLABS can improve the handling of MSR/JSRs by (a) instituting better management control of projects, (b) establishing objectives, goals and strict timetables for each project, (c) making certain project officers are technically qualified, (d) having more highly qualified technical representatives on the Joint Technical Staff, and (e) writing project reports at a technical level that can readily be understood by the client. DoD, on the other hand, might establish shorter term (e.g., one year) goals, put an end to erratic funding, and minimize shifts in priorities. The Army, in turn, might establish a long-range program for the development of competent technical and managerial personnel that can be brought together under one command and given the responsibility for the Army's food service systems.

MSRs Submitted by Navy

USN 2-1: Uniform Ration Cost System

In this MSR, the Navy requested that NLABS "develop and recommend a concept for a uniform ration cost system that is related to changing consumer requirements, including the derivation of a supporting method for the computation of a basic daily food allowance." The Navy wished to replace the existing law and a variety of regulations, some of them no longer suited to the times, with a system that could accommodate changing requirements, innovations, and new technologies that were related to foods and food services.

The MSR was assigned to the Operations Research and Systems Analysis Office (OR/SA) where a program was developed that would (a) enable the preparation of nutritionally sound meals that are highly acceptable and (b) result in a ration cost-accounting system that would enable the determination of system as well as raw food costs, provide cost limits for military systems, and also provide a built-in procedure for review and updating. The program was designed to be adaptable to the food supply and food service systems of all the armed forces.

The program has been approved by DoD and the four services, and enabling legislation has been drafted and referred to the House Committee on Armed Services.

USN 7-1: Food Service Systems Afloat Analysis

This MSR, assigned to OR/SA, was for the development of shipboard food service systems that would (a) improve the acceptance of foods and food service without compromising nutrition, (b) provide more rapid and efficient service, (c) reduce costs, (d) reduce manpower requirements, and (e) improve the design and decor of eating areas. The food service systems on many of the older ships, particularly the aircraft carriers, required immediate attention.

OR/SA produced a fast-food menu, prepared the recipes, assembled the equipment, designed the layout and decor, and developed the management and operational plans for a system that was installed on the USS Saratoga. The success of the project convinced the Navy it should install similar systems on all the other carriers and adapt the system or parts of it to other ships as well. The Navy subsequently asked NLABS to develop a program for the in-port feeding of shipboard personnel.

Assessment of Handling of Navy MSRs

The results achieved with USN 2-1 were very impressive and have made a basic and important contribution to the feeding systems of the armed services. OR/SA handled this extensive and complex MSR in a thorough and efficient manner.

USN 7-1, handled by OR/SA, became a team effort in which the Letterman Army Institute of Research and the Committee on Food Service Systems* worked with various groups within NLABS. The resulting improvement in the food service systems on the aircraft carriers involved was so marked, the Navy began to modify the food service systems on other ships along similar lines.

USN 2-1 and USN 7-1 illustrate the value and effectiveness of the NLABS elements that are involved in the DoD Food RDT&Eng Program. The facilities and equipment at NLABS and the knowledge, skill, and experience of the scientists and technicians make it possible for NLABS to deal with the food RDT&Eng problems of the services far better than the services would be able to on their own.

The efficiency and output of the NLABS elements involved in the DoD Food RDT&Eng Program could be improved, however, if steps were taken to:

---

*A committee of the Advisory Board on Military Personnel Supplies, National Research Council.

- Simplify the unnecessarily complex time-consuming procedures that have evolved over the years for the processing of MSRs. The movement of MSRs up and down the chain of command during the planning, formulating, prioritizing, and funding stages takes far too much time. The process should be simplified.

- Improve communications. The Navy's food management personnel should take advantage of the information and training activities and programs at NLABS, and NLABS should react to the changing food and food service needs of the armed services by organizing seminars, presentations, and other forms of communication on a regular and continuing basis. NLABS should, in addition, expand its communication with the civilian sector (i.e., private industry and the universities) by (a) allowing its personnel to make more frequent visits to factories, laboratories, and meetings and (b) inviting personnel from the civilian sector to Natick for seminars, consultations, and meetings organized to familiarize them with military problems and programs.

- Improve the level of funding and its administration. The Food RDT&Eng Program requires budgetary support that is not threatened by the competitive struggles that occur when funds are not adequate.

The Joint Technical Staff would be more effective if all the DoD and service representatives appointed to this important body had a professional or near-professional knowledge and understanding of foods and food-service systems. This is unfortunately not the case at the present time.

The role that the civilian sector can play in the DoD Food RDT&Eng Program needs to constantly be considered, with the knowledge and experience of private industry and the universities put to use where applicable. The civilian sector should not be expected to play a major role in the DoD Food RDT&Eng Program, however, since the foods and food-service systems of the military sector differ markedly from the food and food-service requirements of the civilian sector.

As effective as NLABS is in the handling of MSRs, it appears from this study of Navy MSRs that NLABS might function more effectively if it were transferred from its present position in the Army organizational structure to a part of DoD that is not associated with a particular branch of the armed forces. Such a move would make NLABS appear less partial to the needs, requirements, and biases of the Army.

MSRs Submitted by Air Force

AF 3-16: Dehydrated Whole Milk

This MSR was for the development of a process for the production of dehydrated whole milk (or a chemically equivalent dehydrated filled milk product) that, when reconstituted, would have the quality and acceptance of whole milk. The Air Force was interested in such a product for use on high-altitude aircraft, in aeromedical evacuation operations, and in air-transportable hospitals. The Navy is studying its use on board ships and submarines.

AF 3-20: Thermostabilized Foods

This MSR was for the establishment of specifications for the purchase of thermostabilized foods packed in individual-sized servings in pull-tab aluminum cans. Less than one year was allowed for the completion of the project because the results were required for the feeding of personnel on the high-priority B-1 bomber being developed at the time. The target date was January 1, 1974. NLABS developed 26 meat, vegetable, and fruit items and, after sensory and storage tests, had production guides for 12 items ready by February 1, 1974. A contract for a sample run on 10 of these items was given to a commercial food company, and delivery was taken on July 1, 1975. During acceptability evaluations by the Air Force, all of the samples were given high ratings.

With the subsequent cancellation of the B-1 bomber, the Air Force terminated work on the MSR. Efforts to find other uses for these food items proved unsuccessful but NLABS did proceed with five-year storage studies that are scheduled for completion in February 1981.

AF 8-1: Automated System for Food Service Operations

Work is still in progress on this MSR. The objective is an automated system for food planning and control that will replace the manual system now in use. The present system needs to be replaced because it is slow and cumbersome and lacks the controls and proper administrative procedures necessary to prevent abuses. The Air Force estimates it might cost $3.4 million to install a new automated system throughout the Air Force but sees the potential for saving about $1 million per year after the system becomes fully operational.

There are plans for adapting this system for use in the Navy Ashore Food Service System after the completion of this project for the Air Force.

AF 9-1: Air Force Mobility and Augmentation Feeding System

This MSR was for an operational food system that can function well in any geographical environment. The specifications called for a system that would be capable of serving hot meals within 48 hours of deployment, be fully operational within 5 days, be capable of operating around the clock, not require fresh foods, and require fewer, less highly-trained operating personnel. The Air Force was looking for a state-of-the-art solution, not a long-term development of an entirely new feeding system.

Assessment of Handling of Air Force MSRs

The effort on AF 3-16 was well planned and executed and was completed on time. The product was developed under contract with a private company. The development of specifications for procurement, started in 1976, was not completed until 1979 for a variety of internal and external reasons; the delay was unnecessarily long and might have been shortened by better management of the project. The Navy became interested in the product for afloat feeding and tested it on board several ships and submarines during 1975-76. The Air Force, meanwhile, lost interest and terminated its participation in the project in 1976. At the time of this study, preparations were being made to solicit bids for 100,000 lbs of the product for the Navy. Delays in this procurement could have been prevented by better coordination between NLABS, the procurement agency, and industry. In view of the technological developments in this area since 1976, this project should be repeated to improve the overall quality of the product. All of the services can benefit because of the popularity of milk in the armed services and the need for a non-perishable substitute for afloat, in-flight, isolated site, combat, and other special feeding systems.

AF 3-20 was carried out successfully by NLABS and shows how well the Food RDT&Eng Program can deal with an urgent problem. It would have been difficult, if not impossible, for private industry to have responded as rapidly. There is still room for improvement, however. The eight months it took to obtain the needed food items was far too long. A better procurement system is needed at NLABS to speed up the purchase of such items.

While the project was in process, there was a communication gap that could have been very costly if the B-1 bomber had not been cancelled. As the product was being developed, changes were made in the configuration of the bomber without NLABS or the Air Force representative on the Joint Technical Staff being informed. If the project had gone to completion, the product could not have been utilized. This episode underlines the need to integrate the development of food and food service systems with the development of weapon and combat systems.

A few other comments are in order on the handling of MSRs:

First, if some aspect of an MSR is going to be costly or cause procurement problems, NLABS should alert the service involved and try to have that aspect changed. In this project, for example, the MSR specified a relatively expensive pull-tab aluminum can when a cheaper steel can would do the job. A steel can was ultimately chosen.

Second, AF 3-20 would not have been considered "urgent" if work on the food service system had been started when the development of the weapons system was initiated, instead of being an afterthought.

Third, it is regrettable that NLABS has not yet written a technical report on AF 3-20. Such reports are an important part of a project, disseminating new information to others and providing visibility for the authors as well as the food program. They should be written as soon as possible. In those instances where an extended period of time is required for the completion of some parts of a project (e.g., shelf-life tests), a report on the parts that have been completed should not be delayed.

AF 8-1 has been well-managed so far and is on schedule. The Air Force is pleased with the progress to date. Although some problems have been encountered, this is a new area of activity for NLABS and the Air Force and some difficulties are to be expected. This project might have been contracted out to a computer consulting firm, but the Air Force and NLABS preferred that it be carried out in-house. An outside firm could not be expected to acquire an adequate knowledge and understanding of military food service systems without a considerable expenditure of time and effort that would ultimately show up in higher costs for the project.

The Air Force and NLABS are commended for using the Food RDT&Eng Program to deal with the management aspects of military food service systems. The program should not be limited to food and equipment.

AF 9-1 has been handled very well and the Air Force is very satisfied with the progress made to date. An outside contractor probably would not have carried it out as well, even if one could have been found with the breadth of expertise required for a project of this size and complexity, although NLABS did use a private organization to supplement its efforts on this project. The experience of NLABS personnel with military food service systems and military exercises makes them uniquely qualified for this type of effort.

The time required for this and similar projects appears inordinately long, however. While this project deals with all aspects of a field feeding system, it should have been possible to complete it in less than the four years spent so far, particularly by personnel as experienced as those at NLABS. It should not have taken 10 months to award a subcontract to a private firm, for example. NLABS should make an effort to reduce the amount of time spent on MSRs.

The study of these four Air Force MSRs showed that the DoD Food RDT&Eng Program is effective in dealing with the food and food service requirements of DoD components. DoD cannot rely on the commercial food industry for its RDT&Eng; private industry may assist with specific problems, but its interests and concerns are different from those of the armed services.

The Air Force representative on the Joint Technical Staff is the key to good liaison and coordination between the Air Force and NLABS. This individual and the Air Force representative on the Joint Formulation Board might do more toward effecting a more rapid and more effective implementation of the results obtained. NLABS, on the other hand, should do more to make the results of MSR projects known to all the DoD components concerned with food and food service, since these results are often applicable to the problems of components other than the ones that submit the MSRs.

The largest problem at NLABS is the turmoil caused by budget and personnel cuts and the inevitable reorganization that ensues. The Food RDT&Eng Program is being adversely affected by cuts in funding that are exacerbated by the effects of inflation, resulting in crises that lower efficiency and morale. The Army needs to provide more support to NLABS and the Food RDT&Eng Program and to be more consistent in its support. More support should also be garnered from the other branches of the armed forces and the Congress. To obtain more support from other branches, however, the Army will have to dispel the notion that exists, rightly or wrongly, that Army MSRs are given preferential treatment by NLABS.

NLABS units do a good job with the MSRs assigned to them, considering their funding, staffing, and workload, but there is always room for improvement, as is the case in the best of organizations. Improvements can be made at NLABS in the management information system, the implementation of project results, the publication of reports, and the reviews of the effectiveness and cost/benefit ratios of projects.

Communications within NLABS should be improved, particularly when dealing with budget constraints and personnel actions. The projects themselves would also benefit from a greater degree of communication between the managers, the personnel doing the work, and the Joint Technical Staff.

Communications between NLABS and the branches of the armed forces, depending primarily on the representatives of the branches who sit on the Joint Technical Staff, should be improved by providing these representatives with more information and data on active projects. NLABS might also consider including in the usual tours of Natick those who are only indirectly involved in the DoD Food Program.

Communications between NLABS and professionals in the universities and private industry are good as a result of organizational affiliations, seminars, and published reports and papers, but the contacts are

too limited at the working level, particularly on R&D and the development of specifications. It is essential that a continuous effort be made to improve the contacts between NLABS and the industrial and academic sectors. Travel funds should be increased to accomplish this end.

MSRs Submitted by Marine Corps

USMC 2-5: Emergency/Assault Packet

The objective of this MSR is a high-density lightweight food packet for personnel engaged in assault operations that might last for periods up to ten days. The packets are to contain "quick-energy" ready-to-eat foods, provide 1,000-1,500 calories, and meet the minimum nutritional requirements for operational effectiveness in hot or cold climates. In addition, they are to be packaged in flat flexible waterproof containers, weigh no more than 450 grams (about 1 lb) each, and be capable of storage without refrigeration for up to two years.

JSR AM 3-1: Food Service System for Army/Marine Corps in the Field

This JSR includes a Marine Corps requirement for a food service system that can feed a Marine air-ground task force in the field or in transit on merchant ships. The food service system is to be compatible with the Marine Corps Expeditionary Shelter System.

JSR AM 6-1: Automated Field Bakery System

This Army/Marines joint service requirement is for a mobile automated field bakery that provides greater output, more consistent quality products, and lower operating costs than the mobile field bakery now in use (developed in 1945). The new unit is designed to produce over 14,000 lbs of baked bread products in a 20-hour period (approximately 25 percent more than the present unit) and will reduce the number of operating personnel by 36 percent, saving $57,000 (FY 1975 dollars) per year in labor costs.

Assessment of Handling of Marine Corps MSR/JSRs

Although the work on USMC 2-5 is still in progress, it is apparent that NLABS is developing a food packet that should fully satisfy the requirements of the Marine Corps. Troops taking part in field tests of the packets rated them "good" to "excellent" and commented favorably

on the menu variety and palatability. Those who participated in a 5-day test at elevations of 6,000 to 9,500 feet, in snow and at temperature of 0° to 50°F, felt they could work and fight on such rations for longer periods of time.

A close examination of the effort on JSR AM 3-1, including a visit to Camp Upshur to observe a field test of the system, showed that the work on this project has been competent, thoughtful, and well-planned. NLABS has done not only what was directly indicated by the JSR but has taken into account alternative conditions and scenarios. Additional field trips are scheduled.

The system being developed under JSR AM 6-1 will bring the baking practices of the armed forces abreast of the state of the art. The hardware for the system is being assembled as it becomes available but delays in shipments by some contractors are causing some slippage in the timetable.

The work on these MSR/JSRs has been carried forward effectively but a final assessment is not yet possible, the three projects still being in process. The working relationship between NLABS and the Marine Corps is excellent and the Corps is well satisfied with the overall performance on its MSRs. There is some concern about the time required for the completion of these projects, however; delays in funding are having a considerable effect on the rate of progress.

There is room for improvement, of course. If more care and thought were given to the original preparation of MSRs, NLABS could respond to the needs of the services more quickly and effectively. And, if communications between NLABS and the services were improved, problems that arise with food service programs in garrisons and in the field could be reduced. NLABS is an unusual and remarkable resource and should be properly utilized.

A better exchange of information between NLABS and other DoD components concerned with food and food service would result in a fuller realization of the potential of NLABS. Its activities and results should be published and circulated widely within DoD, since the work done for one DoD component can often benefit or produce spin-offs for other components. Greater communication would, at the very least, stimulate the thinking and planning of those involved in food programs. The representatives appointed by the various services to the Joint Technical Staff are important channels of communication and should be utilized for this purpose. They should be fully informed of past as well as current projects.

Better communication is also needed between NLABS and private industry. Only a small segment of the private sector has more than a passing acquaintance with NLABS and those who know its mission are few. The only impression some have of NLABS has come from reading the product specifications for bids, and these specifications have often left the impression that NLABS personnel have not kept up with the state-of-the-art. This state of affairs can be greatly improved by publishing

the results of NLABS' work in scientific peer-review and trade journals and presenting them at industry association meetings. When NLABS personnel participated in a recent meeting of the American Defense Preparedness Organization, many industry representatives at the meeting began to hear for the first time about the functions and capabilities of the laboratories at Natick.

Some suggest Army, Navy, Air Force, and Marine Corps might do their own food RDT&Eng, and some suggest that the armed services rely to a greater extent on private industry. An examination of the Marine Corps' capabilities in this area indicates it cannot carry out its own food RDT&Eng. If NLABS did not exist, the Marine Corps would pass on its requirements to the Navy, but the Navy does not have the type and quantity of talent necessary for this kind of effort either. It would be too costly and inefficient for each branch of the armed forces to have its own RDT&Eng capability. The present arrangement is optimal, providing the maximum benefit at the lowest total cost. The contracting of military food RDT&Eng projects to private industry would not be a viable arrangement, although some consulting firms can certainly be of assistance. The goals and objectives in the private food sector are quite different from those in the military sector. If NLABS did not exist, there would be a strong argument for creating it.

Requirements Submitted by Defense Logistics Agency (DLA)

DLA 6-1: Research on Food Infestation

DLA 6-1 was for basic research on the infestation of food by various insects, including studies of (a) the vulnerability of military food items to infestation, (b) factors that affect the attraction of rodents and insects to military food items, (c) insect secretion, and (d) new types of packaging. The longer storage periods for military food items make them more vulnerable than civilian food products to infestation.

DLA 6-3: Research on Causes and Measurement of Spoilage Losses of Perishable Subsistence

DLA 6-3 was originally for a study of the causes of spoilage of perishable items that cannot be frozen for storage (e.g., fresh fruits and vegetables), and the development of procedures and equipment that would make it possible to detect the onset of spoilage before it became evident by sight or smell. It represented a new and novel approach to the study of deterioration patterns in fresh produce, presuming as it did that a common spoilage mechanism existed for fresh fruits and vegetables and that a study of this kind would not only determine what it was but would lead to the development of a practical means for dealing with it.

As work on the project progressed, the objective changed, shifting from a study of spoilage to the development of a controlled-atmosphere system for extending the shelf life of fresh produce. The effort was concentrated on iceberg lettuce because this item was considered a morale-booster.

DLA 7-1: A Substitute for Trichloromelamine (TCM)

DLA 7-1 was for the development of a substitute for TCM that could be used on mess gear and food items, particularly fruits and vegetables, to protect service personnel from diseases commonly associated with foods (e.g., amoebic dysentery). It was considered essential that the substitute chemical be effective down to 5°C and that there be no adverse consequences (e.g., corrosion or toxicity) from its use. The use of TCM had to be discontinued because it was no longer registered as a safe disinfectant by the U.S. Environmental Protection Agency.

Assessment of Handling of DLA Requirements

Work on DLA 6-1 has not yet been completed. Started in 1976 and scheduled for completion by 1979 at a total cost of $700,000, various parts of the project were assigned to seven NLABS units. By the end of FY 1979, some parts of the project had been completed and some parts had been terminated, but the majority of the work had been realigned and redirected, and the total cost had risen to approximately $1 million. All the milestones set in 1976 are now obsolete, and only two of the NLABS units involved in the project are still at the original task. The work on one subproject (BC 014), though irregular, was technically successful but the results are not being utilized because the Veterinary Corps considers the existing technology adequate. The work on another subproject (BC 001) proceeded before any need had been established for the end result. The product developed during a third subproject (BC 013) was never evaluated because the contractor never delivered it to NLABS. Better management control would have prevented this waste of time and effort on subprojects that represented half of the work on this MSR.

The change made in the direction and goal of DLA 6-3 by NLABS is of some concern. The decision to concentrate on the extension of the shelf life of lettuce may have been a wise step but it is difficult to understand how such a change can be made in a specifically authorized project without appropriate written explanations and reports. There is also concern about the decision not to publish a report on the original part of the project, since negative results can be as useful as positive results. Failures need to be published to avoid the wasteful repetition of efforts that did not succeed.

There does not appear to be any set policy on the publishing of unclassified findings by NLABS personnel. Reports in in-house publications and peer-review journals should be encouraged to add to the available body of technical and scientific information, give the public a true picture of the role and value of NLABS, and enhance the standing of NLABS personnel among their peers.

The approach used on DLA 6-3 after the project was redirected appears to be satisfactory but the system developed does not seem to be ready as yet for the full-scale 1,000-case-per-month field test being proposed for lettuce. A more modest test at first would show the effects of scale without the risk of a disastrous setback.

The effort on DLA 7-1 appears to have been well planned and expeditiously executed. A carefully documented protocol detailing the testing of a large number of compounds and formulations produced very satisfactory results.

ASSESSMENT OF TECHNOLOGY BASE ACTIVITIES AT NLABS

The section of Army Regulation 70-1 (1975) that defines Technology Base activities for all Army R&D programs also defines the Technology Base activities of the DoD Food RDT&Eng Program. This section of the regulation states, in essence, that such programs must:

- Maintain a strong and progressive technology base by conducting a broad and continuing research and exploratory development program.
- Establish an adequate in-house capability for providing fundamental knowledge when needed, particularly in areas that are of particular importance and use to the Army.
- Encourage and ensure the investigation of new ideas and concepts that may contribute to the functioning of the Army.
- Encourage multiservice support of those facets of research and exploratory development that will have a bearing on the development programs of more than one of the military services.
- Conduct and support research and development in training and education to increase the effectiveness of training efforts, reduce the time required, and cut costs.
- Maintain effective contact between the Army and the scientists of this nation and, when appropriate, scientists elsewhere in the free world.

All of the 6.1, 6.2, and 6.3A activities described in Army Regulation 70-1* that are not in response to MSRs come under the heading of Technology Base activities. The scope of these activities was broadened in 1977** by the stipulation that long-term (2-20 year) fundamental and applied scientific engineering investigations be directed toward the advancement of the state of the art and the state of knowledge on techniques, products, and services of potential military significance.

Technology Base activities for the Food RDT&Eng Program are carried out by most of the groups in the Science and Advanced Technology Laboratory (SATL) and Food Engineering Laboratory (FEL) of the Army Natick Research and Development Laboratories (see Figures 3 and 4). There are no Technology Base activities in the Operations Research and Systems Analysis Office (OR/SA) at NLABS. SATL, FEL, and OR/SA can assign parts of the MSRs assigned to them to any of the Technology Base groups, cutting across organizational lines where necessary.

---

*See INTRODUCTION of this report.

**At September 1977 meeting of DoD Joint Formulation Board.

Methodology Used to Evaluate Technology Base Activities

In evaluating the Technology Base activities in the Food RDT&Eng Program, it was necessary to distinguish between activities funded for that purpose and activities funded for other aspects of the Food RDT&Eng Program and other programs. None of the groups within the Science and Advanced Technology Laboratory and Food Engineering Laboratory is involved exclusively in Technology Base activities. They are engaged in other activities, and it is often difficult to keep the separation in funding and function clearly defined.

The objective of this part of the study was an evaluation of the effectiveness of Technology Base* activities at NLABS** in general, rather than an evaluation of the effectiveness of Technology Base activities in meeting particular highly specific requirements, for the following reasons: (a) the contributions of Technology Base activities to the overall program are, by nature, indirect and (b) the Technology Base must be in place prior to the receipt of a military service requirement (MSR) since it usually requires more time to establish the Technology Base for the solution of a particular problem than that generally available when a MSR is assigned.

To facilitate this effort, the Technology Base activities in the Science and Advanced Technology Laboratory (SATL) and Food Engineering Laboratory (FEL) were grouped according to discipline and function as follows:

Science and Advanced Technology Laboratory (SATL)	Food Engineering Laboratory (FEL)
Food microbiology	Food processing
Biochemistry and nutrition	Food packing and packaging
Analytical and flavor chemistry	Food storage and distribution
Food structure and stability chemistry	Food service equipment
Food acceptance and food habits	

*When the term "Technology Base" is used in the remainder of this section, it should be understood to mean the "Technology Base of the Food RDT&Eng Program."

**References to NLABS in this report are exclusively to elements and personnel involved in the DoD Food RDT&Eng Program. This program, one of the many at NLABS, was the only activity examined in this study.

Individuals engaged in each type of activity were then interviewed to determine the following:

- The characteristics and scope of the activity in terms of personnel, organization, equipment, funding, buildings, etc.
- The quality of the activity, as it might be judged by scientists and engineers outside the military establishment.
- The relevance of the activity to the mission of NLABS and the Food RDT&Eng Program.
- The extent to which the activity contributes to MSRs in particular and the Technology Base in general.

Technology Base Activities

The examination made of the Technology Base activities in the DoD Food RDT&Eng Program indicates some serious problems: (a) while the budget for these activities has remained fairly constant over the past several years when measured in current dollars, inflation has seriously eroded the level of activity in this area and (b) additional erosion has resulted when direct work on MSRs has been done under the guise of Technology Base activities.

The various units engaged in Technology Base activities have been affected differently. Some have been affected only slightly but the effect of this erosion on others has been drastic. The overall impact on Technology Base personnel and programs has been telling, with a loss of initiative and morale becoming increasingly evident.

When budgets have eroded moderately, vacancies resulting from normal attrition have not been filled and, since these vacancies have occurred predominantly in lower-level positions held by younger persons, the mean age of various sections has increased, raising serious concerns about their balance, vigor, and continuity. When budgets have eroded drastically, there has been a tendency, particularly in the Science and Advanced Technology Laboratory, to save the senior positions and leave a section too understaffed and underequipped for productive results when it would have been preferable to terminate the section entirely.

Food Microbiology Activities

The food microbiology group of SATL has been able to maintain the level of its Technology Base activities despite budgetary constraints. The balance between Technology Base activities and direct work on MSRs

by this group does not appear to be changing, but strong leadership from the office of the SATL director will be required to maintain this balance.

Biochemistry and Nutrition Activities

The biochemistry and nutrition group of SATL, with a total of nine persons, devotes less than four SY* to Technology Base activities. Their facilities and equipment appear adequate for this level of activity, although increased funding (and the authorization to replace a technician lost by retirement) would accelerate the solution of Technology Base problems and, in addition, enable a more effective contribution to the work on MSRs. The quality of their research is very high; several members of the group are recognized as leaders in their fields.

The capability for biochemical studies is, without question, relevant and necessary to the Technology Base activities of the Food RDT&Eng Program. The two biochemists involved in this part of the program are spread too thinly over important areas of study, however.

The senior research scientist and consultant engaged in Technology Base activities on nutrition are also thinly spread over important areas of study. The primary responsibility for nutrition research lies elsewhere (the Army Surgeon General and U.S. Department of Agriculture) but NLABS still needs to retain a capability for on-the-spot evaluations of biological and chemical aspects of nutrition.

Analytical and Flavor Chemistry Activities

The analytical chemistry group of SATL consists of two sections: a five-person research section and a six-person analytical services section.

The research section deals with basic methodology relating to special food and feeding problems of the armed services (e.g., microbial spoilage of fish, chicken, and beef, oxidation of dehydrated and freeze-dried eggs, and fat degradation in various foods during storage). Once a pacesetter in gas chromatography and mass spectroscopy (GC-MS), this section has made fundamental contributions to the GC-MS instrument industry with innovative designs, techniques, and applications. But the combined effect of limited funding and the manner in which the funds available have been allocated during the past several years has changed the picture radically. Because of the failure to allocate a sufficient amount to this unit for new equipment and

---

*Scientist-years per year.

specialized personnel, the unit is no longer able to keep up with the latest developments in its area of concern.

The analytical services section is responsible for (a) the analysis of foods and ingredients and (b) analytical methods by which other military units carry out food assays. This section's greatest need is funding for new semi-automatic or fully automatic equipment that would increase the productivity of its technicians.

The morale in both sections is good despite the problems with equipment obsolescence. When funding becomes available, priority should be given to the replacement of the present minicomputer; the likely improvement in productivity would pay for the cost of a new computer within 2-3 years.

The shortage of technical help is another problem. Visiting scientists have filled some of the gaps, but the shortage persists.

Food Structure and Stability Chemistry Activities

Research at NLABS on food structure and stability is directed toward (a) measurements of texture and consumer response to texture, and (b) studies of food deterioriation by oxidation and ways of reducing it. Technology Base activities in these areas, part of the responsibility of the food chemistry group of SATL (8 SY), contribute to projects dealing with flaked and formed meats, meat texture, compressed food bars, and glycerated celery. Members of the group have made important and fundamental contributions with published papers, book chapters, presentations at meetings, and innovative equipment designs and applications.

Budgetary retrenchments have reduced the productivity of the group, however, reducing the Technology Base output per dollar spent as well as the overall output. This will continue to be the case as long as new equipment purchases and technician positions are the first to go in a budget cut.

Food Acceptance and Food Habits Activities

The food acceptance group and food habits group of the Behavioral Sciences Division of SATL have made significant contributions to the study of (a) sensory effects (taste perception, olfaction, and flavor analysis), (b) techniques for taste testing and sensory evaluation, (c) appetite mechanisms, (d) food selection, and (e) food habits. They publish an average of 30 papers per year.

Twelve of the personnel engaged in these activities are staff and visiting scientists; the other ten are support personnel. Six SY are spent on direct work for MSRs (mostly for OR/SA) and approximately 2 SY are spent on work funded by government agencies outside DoD, leaving 4

SY for Technology Base activities for the DoD Food RDT&Eng Program. Their facilities are excellent and, with additional technicians, their productivity could be increased.

The extremely strong and productive Technology Base activities of the food acceptance and food habit groups are a major strength of the DoD Food RDT&Eng Program. Any reduction in the level or balance of these activities would be detrimental to the program.

Food Processing Activities

Activities that relate to food processing are carried on by three groups within the Food Engineering Laboratory (FEL) of NLABS: (a) the animal products group, (b) the plant products group, and (c) the food packaging and processing group (see Figure 2-4). Approximately 13 SY are devoted to direct work on MSRs assigned to FEL and OR/SA and 8.5 SY are allocated to Technology Base activities, a good balance.

Food processing activities demonstrate the need for a multidisciplinary approach and the value of a broad Technology Base. This can be seen in the work done on the reduction in the space required for the storage of specific foods, particularly for the Navy. The progress made would not have been possible without the combined knowledge and experience of NLABS scientists in such areas as vegetable processing, dehydration, compression, freeze-drying, dielectric and other properties of food materials, microwave heating, and protective packaging.

There is some concern about the quality of nutrient analyses by private laboratories. This problem might be dealt with by requiring adequate quality control practices at these laboratories, as is done by other government agencies.

Attention should also be given to the obsolete and redundant equipment in the pilot plant shared by the groups engaged in food processing activities. The units that are of little or no use should either be sold, traded in when new equipment is purchased, donated to universities, or stored.

The frequency with which long-term storage tests fall victim to recurring budget crises is particularly disturbing. Storage tests that have been in progress for periods of as much as several years are often heedlessly interrupted by erratic budget shifts that result in a total loss of the investment made in time, effort, and money.

Food Packing and Packaging Activities

Only one of the 13 scientists in the food packaging and processing group is involved in Technology Base activities on food packing and

packaging. The others are involved in direct work on MSRs and in Technology Base activities on food processing.

The food packing and packaging activities include (a) studies of physical and environmental requirements, packaging systems for dehydrated foods, and capabilities and shortcomings of currently available materials, and (b) the development of criteria for materials and packaging systems for the military.

The facilities for packaging R&D at NLABS are impressive, with the equipment for package fabrication and testing, food processing, controlled environmental storage, chemical analysis, and sensory analysis all under one roof. The packaging work done in recent years has been devoted primarily to procurement and MSRs, however. While it has contributed to the Technology Base to some extent, the contribution has not been as significant as it might have been, which is unfortunate. The need for packaging that can resist abuse over long periods of time poses a unique challenge.

Food Storage and Distribution Activities

The careful evaluation of the storage stability of newly developed subsistence items is an essential part of the DoD Food RDT&Eng Program. One of the principal objectives of Technology Base activities in this area is the definition of acceptable storage life from sensory and nutritional studies.

All of the groups in the Food Engineering Laboratory (FEL) have an active interest in food storage problems, but the Technology Base is suffering from the diversion of effort to direct work on MSRs. There is, as a result, a limited amount of basic knowledge available for the analysis of such interesting and relevant problems as the storage stability of dehydrated/compressed foods. Most of the storage studies on dehydrated/compressed foods have been postponed or cancelled entirely to serve more immediate needs. The problem is exacerbated by the long-range nature of such studies and the need to anticipate them months and even years in advance.

Food Service Equipment Activities

Because of the unique requirements of the military for feeding in the field, only a limited amount of the knowledge and effort on food service equipment in the private commercial sector is applicable to military problems and needs. The management and personnel in the Food Service Systems Division of FEL (see Figure 4), on the other hand, are expert in this area but the 32 scientists and support persons in the three groups of this division devote only 0.5 SY to Technology Base activities in this area. The development work in which they are engaged leaves little time for anything else.

The manpower, resources, and support of the Food Service Systems Division appear to be adequate for its present activities but there should be a reallocation of effort or an increase in personnel sufficient to enable the assignment of at least 4 SY to more basic and potentially innovative studies.

Overall Assessment

The Technology Base activities of the DoD Food RDT&Eng Program provide essential conceptual and scientific support to the mission-oriented MSR program. The dividends from these activities are far in excess of the funds invested in them. A study of these activities indicates a need to reexamine some aspects of their organization, direction, and administration, however.

The Technology Base activities are not organized in a way that gives them a specific identity. Their scope and objectives are not clearly defined, and there is no office or director with the overall responsibility for administration and budgetary control, as is the case with other organizational units in the program (e.g., SATL, FEL, and OR/SA).

Because of its organizational structure, the Food RDT&Eng Program fails to foster adequate two-way communication and, as a result, the coordination and integration of Technology Base activities with other elements of the program are not as good as they might be. The organizational structure of the program does not specifically prevent or prohibit communication, coordination, and integration; it simply fails to offer sufficient incentive for them to take place as they should.

An organizational identity for Technology Base activities would make them less vulnerable in the competition for diminishing dollars and reduce the pressures that arise at times for the diversion of Technology Base resources to direct work on MSRs. The ill-defined and generally diminishing support base for this part of the program is making it impossible to replace obsolete computers, instruments, and other types of equipment, reducing the effectiveness of the scientists and engineers involved.

This examination of the Technology Base activities of the Food RDT&Eng Program has shown the need to (a) ensure the allocation of adequate manpower and equipment to the research that needs to be carried out in support of the work on MSRs, (b) identify industry and university scientists who can assist in the solution of problems encountered in the procurement and protection of foods and the development of food services, (c) establish and maintain a national awareness of military feeding problems by means of periodic regional meetings, and (d) improve communications between scientists, program supervisors, and any others who might contribute to Technology Base activities.

DoD's responsibility for the well-being of military personnel (plus its responsibilities toward civilian populations during periods of occupation, emergency, and natural disaster) have led to extensive research in this area. Considerable work has been done on the preservation of the nutrient content of rations under every condition of storage and field use likely to be encountered during times of peace as well as times of war. During the last two decades attention has also been given to the nutritional and metabolic consequences of trauma, burns, and sepsis, as well as the newer modalities of parenteral and enteral support for persons so affected.

The support of nutritional research within DoD components has fluctuated widely in the past, resulting at times in its virtual disappearance from some programs. After World War I, for example, nutrition research in the U.S. Medical Department, the leader in such research at the time, was reduced to the point where it existed only on paper. The situation became quite the opposite during World War II when semi-starvation and deficiency diseases among civilian populations and prisoners of war, coupled with a realization of the importance of maintaining a peacetime corps of well-trained personnel and adequate support facilities, led to a blossoming of DoD and DoD-supported research in nutrition.

During the 1950s and 1960s, the nutrition research within DoD plus that funded by DoD outside the military establishment comprised the major part of such activity in the United States. Involved in nutrition research within DoD were the Food and Container Institute, Quartermaster Corps, Army Medical Research and Nutrition Laboratory, U.S Air Force School of Aerospace Medicine, and several Navy medical research units (NAMRU), including NAMRU-II in Taiwan and NAMRU-III in Egypt. The activities were broad-based and were coordinated by the Environmental Physiology Panel, a DoD component that included all the major military laboratories engaged in human-related environmental research.

Current Status

Nutrition research within DoD has declined drastically during recent years, partly because other federal and civilian agencies (e.g., U.S. Department of Agriculture and National Institutes of Health) have taken on activities for which DoD was responsible and partly because of the discontinuance of a number of programs (e.g., the study of nutrient requirements of personnel under various types of stress). Without an effective mechanism for identifying important mission-oriented nutrition needs within the armed services and establishing priorities for such research, funding for nutrition research has almost disappeared from DoD budgets.

The activities, personnel, employment ceilings, and equipment of the Human Nutrition Research Program at the Letterman Army Institute of Research (LAIR) were transferred to the Science and Education Administration (SEA) of the U.S. Department of Agriculture (USDA) in April 1980 by the U.S. Congress.

With the transfer of LAIR to SEA, nutrition research within DoD has been reduced to isolated, often minor, aspects of mission-related problems. The following are examples of the type of research now being carried out by DoD components:

- The Naval Health Research Center in San Diego, California, is studying short-term exercise-diet programs in which carbohydrate-loading is being used to increase muscle glycogen stores.

- The Naval Submarine Medical Research Laboratory in Groton, Connecticut, is evaluating (a) the effects of a lack of sunlight on Vitamin D metabolism and (b) the effects of diet, physical activity, fumes, distilled water, and other concomitants of submarine environments on mineral and bone metabolism, body composition, cardiovascular fitness, etc.

- The Food Engineering Laboratory of the Natick Army Research and Development Laboratories (NLABS) is developing compact lightweight rations for assault operations of short duration, and the Naval Submarine Medical Research Laboratory is helping to evaluate such rations.

- The Army Institute of Surgical Research is continuing its work on nutritional support for combat casualties.

- The Army Medical Research Institute of Infectious Diseases at Fort Detrick in Frederick, Maryland, is continuing its studies of the relationships between nutrition, immunity, and infection.

- At the Walter Reed Army Institute of Research, studies are underway on the effects of nutrients, diet, and other factors on circadian rhythms in an effort to reduce the effects of jet-lag on troops that are rapidly deployed to a distant operation.

There are, in addition, physiological, biochemical, and metabolic studies underway that have a significant bearing on nutrition.

Nutrition Research Needs of Armed Services

The food programs of the armed services appear to be oriented toward food service at the present time, with insufficient attention being given to nutrition. There is a general realization that

nutrition is important but the exact relationship between nutrition and performance does not appear to be well understood. Little effort is being made to learn more about the nutritional and other dietary factors that affect performance under conditions of physiological and psychological stress.

The nutrition requirements of the armed services and the problems involved in satisfying such requirements vary widely with location and activity. The nutrition needs of garrisoned personnel are similar to those of civilians and are no problem. They are easily met by the variety of foods available at garrison posts. The major problem with garrisoned personnel is caloric intake. Young recruits engaged in the vigorous physical activity of basic training may stay fit and trim on as much as 5,000 calories per day while personnel engaged in sedentary activities (e.g., instrument operators, clerks, and administrators) become obese on 2,000 calories per day when their leisure pursuits are also sedentary. The need to adjust food intake to the degree of activity does not seem to be adequately appreciated. Information on the relationship between diet and health should be disseminated throughout the armed services to help personnel keep their food intake consistent with their life style and psychological needs.

Greater attention needs to be given to the nutrition requirements of personnel in forward positions, however, where the supplies and varieties of foods are limited and nutrition can play an important role in minimizing physiological and psychological stress.

To assist in the identification of nutrition problems the DoD Food Program should include personnel with the expertise necessary to do so. There should also be a comprehensive educational program that is geared toward making the individual more aware of his nutritional and dietary needs.

Role of the Army and DoD in Nutrition Research for Armed Services

The Army's nutrition research activities have been severely restricted by the 1980 Defense Appropriations Act which states, in part: "The Army is to negotiate with USDA so that USDA can perform Army's mission-essential nutrition research program on a reimbursable basis." This was interpreted in some quarters as a prohibition against the identification of nutrition research by DoD in a budget line but the respective roles of DoD and USDA vis a vis nutrition research for the armed services were subsequently clarified by the Senate Appropriations Committee* and a memorandum from the Office of the Under Secretary of Defense for Research and Development which stated, in part,

*Report No. 96-1030 (p.38), a report that accompanied the Agricultural, Rural Development and Related Agencies Appropriation Bill (H.R. 7591, 96th Congress), November 24, 1980.

that it is "quite appropriate for DoD to include nutrition components in their mission-related research programs such as combat casualty treatment, military disease hazards, soldier effectiveness, and food technology."

While it is not recommended here that DoD be allowed to establish its own nutrition research laboratory, there are activities bearing on Dod's nutrition concerns that need to be identified and supported in a budget line. A single unit within DoD should be authorized and directed to:

- Identify the nutrition information the armed services need to fulfill their missions. USDA and other contractors cannot be expected to have sufficient knowledge of DoD's requirements to carry out this task.

- Establish priorities for the mission-essential nutrition research to be carried out by USDA, other contractors, and DoD (when such research is carried out by DoD in existing R&D facilities).

- Assume the responsibility for contracting out and monitoring mission-essential nutrition research that cannot be carried out by USDA or DoD and establish a budget line for such research.

- Carry out research programs that have a nutrition component when this component cannot readily be separated out and contracted to an organization outside DoD (e.g., research programs dealing with physiological or psychological stress, or field tests on military units in a simulated combat environment).

Although it is essential that DoD take the responsibility for the nutrition needs of the armed forces, the prerogatives listed above should be sufficient for its research requirements. It makes good fiscal sense to coordinate the nutrition research of DoD with that of USDA and other federal agencies to avoid duplication. This particularly applies to research related to the feeding and performance of garrisoned personnel and research related to support services. The key to an effective program is a clear understanding of USDA capabilities and good liaison.

At the start of any new food project, high priority should be given to a comprehensive review of the literature to prevent a duplication of research that has already been carried out. Capabilities for such reviews exist in the Life Sciences Research Office of the Federation of American Societies for Experimental Biology, in government agencies, and in universities.

ASSESSMENT OF ORGANIZATION AND FUNDING OF DOD FOOD RDT&ENG PROGRAM AT NLABS

As the DoD Food RDT&Eng Program has evolved over the last decade, NLABS has been asked to deal with increasingly complex food and food service problems for the military services. Many of its assignments have been high-priority tasks that have had a direct bearing on the efficiency and combat effectiveness of operating personnel for major weapons systems (e.g., the MX missile and ground-launch cruise missile) and combat personnel in a variety of extreme environments (e.g., nuclear, chemical, and biological environments).

All of the branches of the armed forces need to modernize their thinking and programming in the area of food and food services. Their personnel appear to be knowledgeable and intent on doing a first-class job but they seem to be operating within a framework of regulation, command, and precedent that make first-class performance extremely difficult, if not impossible. Many changes are indicated. The armed services, from the highest levels down, must pay greater attention to the importance of food to the physical well-being and morale of servicemen and women.

They must also recognize the importance of treating food-service systems as systems; the development of a good food-service system by professionals is of little use when command and supply personnel do not regard it as a system and begin to make ad hoc changes here and there.

Unfortunately, the Food RDT&Eng program has never had the level of funding required to handle all of the important food and food service requirements of the armed forces adequately. As a result, a number of projects have been under-funded, some have been deferred, and others have been rejected. During this study, the Army Panel reported that three of the four Army MSRs examined had been delayed by changes in funding and the resulting shifts in priorities. The Air Force Panel reported that the largest problem with the handling of Air Force MSRs had been the turmoil caused by budget and personnel cuts. The Marine Corps Panel found that delays in funding were having a considerable effect on the progress of the work being done on Marine Corps MSRs. The Technology Base Panel found that funding cuts were having significant effect on initiative and morale.

The funding difficulties of the Food RDT&Eng Program are apparently the result of the position of NLABS in the organizational structure of DoD. With NLABS attached to the materiel-oriented Army Materiel and Development Command (DARCOM)*, the program has not had the visibility and support it might have had if NLABS had been attached to a food-oriented element, such as the Office of Assistant Secretary

---

*NLABS was assigned to DARCOM in 1962, almost a decade before the inception of the Food RDT&Eng Program.

of Defense (Manpower, Reserve Affairs, and Logistics) or the Defense Logistics Agency. To make matters worse, NLABS has been such a small part of the overall responsibility of DARCOM the program has been buffeted about in a sea of larger and more immediate concerns, all but forgotten. The personnel and funding problems that have resulted should come as no surprise.

Table 1 shows the levels of funding requested for the Food RDT&Eng Program during the 1977-81 period and the levels of funding provided. The totals for direct work on MSRs and Technology Base activities are also listed.

Table 1 Funding for DoD Food RDT&Eng Program (current dollars, millions)

	Category*					Direct Work on MSRs	Tech Base Activity
	6.1	6.2	6.3	6.4	Total		
FY 1977							
Requested	1.656	9.393	2.221	0.273	13.543	8.475	5.068
Provided	1.200	6.633	0.688	0.161	8.682	6.172	2.510
%					64	73	50
FY 1978							
Requested	1.619	11.311	1.726	0.286	14.942	8.626	6.316
Provided	1.139	5.094	0.809	0.208	7.250	5.012	2.238
%					49	58	35
FY 1979							
Requested	1.923	6.607	1.713	0.350	10.593	6.927	3.666
Provided	1.323	4.400	0.473	0.350	6.546	4.120	2.426
%					62	59	66
FY 1980							
Requested	1.924	7.109	1.480	0.345	10.858	7.231	3.627
Provided	1.456	4.366	0.545	0.500	6.867	4.329	2.538
%					63	60	70
FY 1981							
Requested	2.171	8.961	2.353	0.450	13.935	9.243	4.692
Provided	1.309	6.598	1.274	0.410	9.591	6.827	2.764
%					69	74	59

*Categories described in INTRODUCTION. Figures exclude funding for radiation preservation activities that have now been transferred to the U.S. Department of Agriculture.

Source: U.S. Army Natick Research and Development Laboratories (NLABS).

The figures in these tables show that the funding provided during each of the last five years has fallen short of that requested. Funding for direct work on MSRs has ranged from 58 to 74 percent of that requested and funding for Technology Base activities has fared even worse, ranging from 35 to 70 percent of that requested. It is apparent that a significant number of MSRs were not being funded and that cutbacks were being made in the Technology Base activities required to support current and future MSRs. The levels of funding have recovered somewhat from the 1978-79 lows but the effect of inflation has left the FY 1981 level of funding well below that of FY 1977 in constant dollars.

To counter the erosion that has been taking place in the DoD Food RDT&Eng Program during the past several years, more people up and down the chain of command at DoD need to be made aware of its existence, accomplishments, and potential. A particular effort is needed to make the program more clearly visible to those who determine its budget in DoD and Congress. In its present form, it is hidden among the other programs at NLABS, undetectable to those who are not directly involved. If those responsible for DoD policies and budgets knew more about the program, the serious personnel and funding problems described in this report might have been avoided.

The past several years have been a period of particular uncertainty in the DoD Food RDT&Eng Program at NLABS. The apparent lack of clear-cut goals and directives, erratic and inadequate funding, shifts in personnel and, in the midst of all this, various attempts at reorganization have adversely affected the efficiency and morale of those involved in this program. Leadership in both the administrative and scientific echelons is not as dynamic as it should be and the situation is not being helped by the failure to fill several key positions that have been vacant for some time.

A number of attempts to deal with the problems plaguing the Food RDT&Eng Program by transferring NLABS elsewhere in the DoD organizational structure have been unsuccessful to date but should be considered once again. It is essential that a transfer be made as soon as possible and that it be done with the view to providing the Food RDT&Eng Program with the support and stability it requires to fulfill its mission. A transfer to DLA would give NLABS the appearance of being impartial, but the central problem is not the partiality or impartiality of NLABS; it is, rather, the lack of program visibility and the lack of adequate and consistent funding.

Whether or not a transfer is made, it is important that the DoD Food RDT&Eng Program be headed by a strong director with the authority, the ability, and the will to plan, organize, and control the program effectively, providing the kind of leadership needed to deal with the problems that are preventing the program from realizing its full potential. The director should also have the authority to determine how the funds available are divided between work on MSRs and Technology Base activities.

It is also important that the director of the DoD Food RDT&Eng Program continue to be a civilian. A military director on a regular tour of duty (three year maximum) would not be able to acquire the knowledge and experience required to carry out his duties and responsibilities effectively before moving on to his next tour. The lack of continuity that would result from constant changes in leadership would seriously handicap the program, even if a military director with the necessary qualifications could be found every three years, in itself a highly unlikely possibility.

The effectiveness of the Food RDT&Eng Program could also be increased by making some changes in the way it operates. Although NLABS functions creditably when one considers its workload and the limitations imposed by funding and personnel constraints, its output could be improved by (a) less complex procedures, particularly in the processing of MSRs, (b) better internal communication between the personnel and units of the Science and Advanced Technology Laboratory, Food Engineering Laboratory, and OR/SA, (c) better communication between NLABS and other DoD components, (d) better communication between NLABS and the civilian sector, (e) adequate, consistent, and timely funding, and (f) the prompt employment of qualified personnel when vacancies occur.

The results that can be achieved with coordinated well-planned efforts have been demonstrated by NLABS' Operations Research and Systems Analysis Office (OR/SA). The approach and methods developed by this group should be utilized by other NLABS elements.

NLABS should improve its procurement system to speed up the awarding of contracts and the purchase of materials and equipment. This step alone would move the completion dates of projects up by several months, sometimes by as much as a year.

NLABS should also encourage the timely publication of project results, where security permits, to increase the visibility and recognition of the Food RDT&Eng Program and the personnel at NLABS and, not least of all, to maximize the benefit to the nation's consumers from the tax dollars spent.

APPENDIX

ADVISORY BOARD ON MILITARY PERSONNEL SUPPLIES

Richard L. Hall, Chairman
Vice President, Science and Technology
McCormick and Company, Inc., Hunt Valley, Maryland

Vigen K. Babayan
Vice President, Science and Technology
Stokely Van Camp, Inc., Indianapolis, Indiana

Linda Bartoshuk
Associate Professor
Department of Epidemiology and Psychology
Yale School of Medicine, New Haven, Connecticut

G. Robert DiMarco
Director, Central Research
General Foods Corporation, White Plains, New York

Daniel F. Farkas
Professor and Chairperson
Department of Food Science and Human Nutrition
College of Human Resources
University of Delaware, Newark, Delaware

Dee McDonald Graham
Assistant Director, Scientific Research
Del Monte Corporation Research Center, Walnut Creek, California

Theodore P. Labuza
Professor of Food Science and Technology
University of Minnesota, St. Paul, Minnesota

Ludwig Rebenfeld
President
Textile Research Institute, Princeton, New Jersey

Frank R. Fisher
Executive Director
Advisory Board on Military Personnel Supplies
National Research Council, Washington, D.C.

GENERAL COMMITTEE ON DoD FOOD PROGRAM

Vigen K. Babayan, Chairman
Vice President, Science and Technology
Stokely Van Camp, Inc., Indianapolis, Indiana

David H. Ashton
Laboratory Manager, Research and Development Department
Hunt-Wesson Foods, Inc., Fullerton, California

Malcolm C. Bourne*
Professor of Food Science and Technology
New York State Agricultural Experiment Station
Cornell University, Geneva, New York

Fergus M. Clydesdale**
Professor, Department of Food Science and Nutrition
University of Massachusetts, Amherst, Massachusetts

Frederick J. Francis**
Professor, Department of Food Science and Nutrition
University of Massachusetts, Amherst, Massachusetts

F. E. Horan*
Consultant
Hot Springs Village, Arkansas

Herman H. Kraybill
Scientific Coordinator for Environmental Cancer
National Cancer Institute, Bethesda, Maryland

Chester K. Litman
Consultant
Paradise Valley, Arizona

John D. McLaughlin
President, L. J. Minor Corp.
Colonial Heights, Virginia

Max Milner
Executive Officer, American Institute of Nutrition
Bethesda, Maryland

Robert O. Nesheim*
Vice President, Science and Technology
Quaker Oats Company, Chicago, Illinois

William M. Roberts
Vice President
Dairymen, Inc., Louisville, Kentucky

Arthur J. Siedler**
Department Head, Department of Food Science
University of Illinois, Urbana, Illinois

Frank R. Fisher
Study Director
Advisory Board on Military Personnel Supplies
National Research Council, Washington, D.C.

S. Edward Gamarekian
Editor, Advisory Board on Military Personnel Supplies
National Research Council, Washington, D.C.

---

*Term of appointment began July 1, 1980.
**Term of appointment ended June 30, 1980.

TASK FORCE OF GENERAL COMMITTEE

Vigen K. Babayan, Chairman
Vice President, Science and Technology
Stokely Van Camp, Inc., Indianapolis, Indiana

Elwood F. Caldwell
Chairman, Department of Food Science and Nutrition
University of Minnesota, St. Paul, Minnesota

Mary Elisabeth Crimmins
Vice President, School Services
ARA Services, Inc., Philadelphia, Pennsylvania

Wray E. Dudley
Consultant
Troy, Ohio

Chester K. Litman
Consultant
Paradise Valley, Arizona

Robert Nesheim
Vice President, Science and Technology
Quaker Oats Company, Chicago, Illinois

Oscar P. Snyder
Department of Food Science and Nutrition
University of Minnesota, St. Paul, Minnesota

Jerry L. Welbourn
Research Manager
McCormick & Company, Corporate R&D Laboratories Inc., Hunt Valley, Maryland

ARMY PANEL

Oscar P. Snyder, Jr., Chairman
Associate Professor, Department of Food Science and Nutrition
University of Minnesota, St. Paul, Minnesota

John P. Norback
Assistant Professor, Food Systems Management
Department of Food Science
University of Wisconsin, Madison, Wisconsin

David R. Thompson
Assistant Professor, Department of Agricultural Engineering
University of Minnesota, St. Paul, Minnesota

NAVY PANEL

Chester K. Litman, Chairman
Consultant
Paradise Valley, Arizona

F. Joseph Corcoran
Joe Corcoran Associates, Scottsdale, Arizona

Fergus M. Clydesdale
Professor, Department of Food Science and Nutrition
University of Massachusetts, Amherst, Massachusetts

Adrian W. Phillips
Foodservice Systems Design
Phoenix, Arizona

AIR FORCE PANEL

Jerry L. Welbourn, Chairman
Research Manager
McCormick & Company, Corporate R&D Laboratories Inc., Hunt Valley, Maryland

James A. Brooks
Manager, Contract Sales
General Foods Corporation, White Plains, New York

Nancy E. Fogg
Assistant Director of Food Science
Nabisco Research Center, Fair Lawn, New Jersey

Norman D. Heidlebaugh
Professor and Head, Department of Veterinary Public Health
College of Veterinary Medicine
Texas A&M University, College Station, Texas

Arthur Avery
Professor, Restaurant and Hotel Management
Purdue University, West Lafayette, Indiana

MARINE CORPS PANEL

Wray E. Dudley, Chairman
Consultant
Troy, Ohio

Roland Duning
Manager of Unit Equipment
Ponderosa Systems, Inc., Dayton, Ohio

Carroll Johnson
Vice President, Engineering and Construction Facilities
Friendly Ice Cream Corporation, Wilbraham, Massachusetts

LeRoy Dugan, Jr.
Professor, Food Science and Human Nutrition
Michigan State University, East Lansing, Michigan

James L. Brown
Managing Director, Customer Services
National Sanitation Foundation, Ann Arbor, Michigan

DEFENSE LOGISTICS AGENCY PANEL

Mary Elisabeth Crimmins, Chairman
Vice President, School Services
ARA Services, Inc., Philadelphia, Pennsylvania

Stanley Segall
Head, Department of Nutrition and Food Sciences
Drexel University, Philadelphia, Pennsylvania

Arthur J. Siedler
Head, Department of Food Science
University of Illinois, Urbana, Illinois

TECHNOLOGY BASE PANEL

Elwood F. Caldwell, Chairman
Chairman, Department of Food Science and Nutrition
University of Minnesota, St. Paul, Minnesota

Daniel F. Farkas
Professor and Chairman, Department of Food Science and Human Nutrition, College of Human Resources
University of Delaware, Newark, Delaware

Edmund W. Lusas
Director, Food Protein Research and Development Center
Texas A&M University, College Station, Texas

John A. Troller
Group Leader, Food Microbiology
Procter & Gamble, Winton Hill Technical Center
Cincinnati, Ohio

NUTRITION PANEL

Robert Nesheim, Chairman
Vice President, Science and Technology
Quaker Oats Company
Chicago, Illinois

Elsworth R. Buskirk
Director of Laboratory of Human Performance Research
Pennsylvania State University
University Park, Pennsylvania

Lloyd J. Filer
Department of Pediatrics
University of Iowa Hospitals & Clinics, Iowa City, Iowa

Allison A. Yates
Administrative Dean
State College, Johnson City, Tennessee

PANEL TASKS

Army Panel

The Army Panel was asked to assess the effectiveness of the DoD Food RDT&Eng Program in dealing with the military service requirements of the Army by examining the handling of four specific MSR/JSRs:

- JSR AAFMN 81-25: New Subsistence Items for DoD
- USA 3-3: Meal, Ready-to-Eat
- JSR AM 7-4: Long-Range Patrol Food Packet
- USA 8-4: Systems Analysis of Army Hospital Food Service Operation

Navy Panel

The Navy Panel was asked to assess the effectiveness of the DoD Food RDT&Eng Program in dealing with the MSRs of the Navy by examining the handling of two specific MSRs:

- USN 2-1: Uniform Ration Cost System
- USN 7-1: Food Service Systems Afloat Analysis

Air Force Panel

The Air Force Panel was asked to assess the effectiveness of the DoD Food RDT&Eng Program in dealing with the requirements of the Air Force by examining the handling of four specific MSRs:

- AF 3-16: Dehydrated Whole Milk
- AF 3-20: Thermostabilized Foods
- AF 8-1: Automated System for Food Service Operations
- AF 9-1: Air Force Mobility and Augmentation Feeding System

Marine Corps Panel

The Marine Corps Panel was asked to assess the effectiveness of the DoD Food RDT&Eng Program in dealing with the requirements of the Marine Corps by examining the handling of three specific MSR/JSRs:

- USMC 2-5: Emergency/Assault Packet
- JSR AM 3-1: Food Service System for Army/Marine Corps in the Field
- JSR AM 6-1: Automated Field Bakery System

Defense Logistics Agency (DLA) Panel

The DLA Panel was asked to assess the effectiveness of the DoD Food RDT&Eng Program in dealing with the requirements of the DLA by examining the handling of three specific requirements:

- DLA 6-1: Research on Food Infestation
- DLA 6-3: Research on Causes and Measurements of Spoilage Losses of Perishable Subsistence
- DLA 7-1: A Substitute for Trichloromelamine

Technology Base Panel

The Technology Base Panel was asked to examine the charateristics and scope of the technology base of the DoD Food RDT&Eng Program in terms of its personnel, buildings, equipment, funding, organization, etc. As part of its task, the Panel was to consider the following questions:

- How would the technology base of the DoD Food RDT&Eng Program be judged by professionals who are engaged in this type of effort outside DoD?
- How relevant is this technology base to military service requirements, past, present, and future?

Nutrition Panel

The Nutrition Panel was asked to review the nutrition research that has been carried out by DoD to date and make a case study of the work done on nutrition on the USS Saratoga. As part of its task, the Panel was to consider the following questions:

- Should DoD have its own nutrition research program and, if so, what specific areas of investigation should it include?
- Now that the U.S. Congress has given the U.S. Department of Agriculture (USDA) the responsibility for mission-related nutrition research for the armed services, what type of relationship between DoD and USDA would best serve the needs of the armed forces?

STUDY GUIDELINES

The General Committee drew up the following questions to guide the panel studies:

- Are the MSRs being submitted by DoD components (Army, Navy, Air Force, Marine Corps, and DLA) new or are the DoD components trying to revise or replace existing systems?

- How are the MSRs being handled by the DoD components to which they are assigned (the Science and Advanced Technology Laboratory, Food Engi- neering Laboratory, and the Operations Research and Systems Analysis Office)?

- What is the extent of the carryover from present and previous systems?

- What is the input from private industry, from the Tech Base, from other military systems or programs, and from NLABS?

- Are the results satisfactory?

- What conclusions can be drawn and recommendations made?

When the Panel reports were submitted to the General Committee, some gaps were noted and, as a result, the Panels were asked to answer a number of specific questions:

- How effective has the DoD food program at NLABS been in dealing with the food problems of the services?

- How do the services rate the DoD food program at NLABS? Would they prefer to do their own food RDT&Eng? Should they do their own food RDT&Eng?

- How do the Panels rate NLABS' handling of the specific projects examined by the Panels?

- How does each branch of the service monitor the RDT&Eng being done in its behalf by NLABS?

- What changes in the organization or operation of the DoD food program would make it more responsive, more efficient, or more effective?

- How can the various branches of the military establishment improve their food services and how can NLABS help?

- Is the DoD RDT&Eng program adequately funded?

- Should DoD and the branches of service rely to a greater extent on private industry for food RDT&Eng?

- What is the role of the representative of each service to the Joint Technical Staff? Do the services think this representative is necessary? What changes, if any, should be recommended?

- Has the Joint Formulation Board (JFB) been effective in controlling the RDT&Eng program and the services' requirements?

- Does the DoD food program at NLABS have adequate impact on and input to the various branches of the military?

- Can MSRs be dealt with more efficiently or more effectively? How?

- Can the relationship between the military services and NLABS be improved? How? If there are any problems at present, what are they?

- Can the lines of communication within NLABS be improved? How? What are the problems at present, if any?

- Can the lines of communication between NLABS and the various branches of the armed services be improved? How? What are the problems at present, if any?

- Can the lines of communication between NLABS and the private sector be improved? How? What are the problems at present, if any?

- Can the Joint Technical Staff be more responsive, more efficient, or more effective? How? Describe any problems or complaints there may be at present.

GLOSSARY

ABMPS	Advisory Board on Military Personnel Supplies
DARCOM	Army Materiel Development and Readiness Command
DCSRDA	Army Deputy Chief of Staff for Research, Development, and Acquisition
DoD	Department of Defense
DLA	Defense Logistics Agency
FEL	Food Engineering Laboratory
JFB	Joint Formulation Board
JTS	Joint Technical Staff
MSR	Miliary service requirement
NLABS	Army Natick Research and Development Laboratories
OR/SA	Operations Research and Systems Analysis Office
R&D	Research and development
RDT&Eng	Research, development, testing, and engineering
SATL	Science and Advanced Technology Laboratory
SY	Scientist-years per year
USDA	U.S. Department of Agriculture
USDR&E	Under Secretary of Defense for Research and Engineering