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MEDDH-MP

SUBJECT: February 1960 Proposal of the Interdepartmental Committee on Irradiated Food

TO: Chief of Research and Development
Office of the Chief of Staff
Department of the Army
Washington, D.C.

1. It is recommended that the Department of The Army concur in the February 1960 Proposal of the Interdepartmental Committee on Irradiated Food.

2. Recommendations numbers 4 and 5 might be better stated as follows:

"4. The Army complete its wholesomeness and safety program and that the Operating Agency initiate such complementary wholesomeness and safety work as may be required for the civilian radiation processed foods program."

"5. A wholesomeness and safety program working panel to the Interdepartmental Committee be established consisting of Army, AEC, FDA, USDA and consultants as required to coordinate this program."

3. It is urged that those agencies having representation on the Committee on Wholesomeness provide participants who have medical backgrounds.

4. It is reemphasized once again that any research emanating from this proposal should be oriented with the concept that food with any measurable induced radioactivity will not be used for human feeding. In this regard the low level treatment of food offers the best approach. Should problems of wholesomeness develop in this low level program, the proposed funding is probably inadequate.

LMH/Hm
1 March 60

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FEBRUARY 1960

AN INTERIM REPORT

to the

INTERDEPARTMENTAL COMMITTEE ON RADIATION PRESERVATION OF FOODS

on

A NATIONAL CIVILIAN RADIATION PROCESSED FOODS PROGRAM

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VIII. Initial Appropriation [illegible]

IX. Budget Estimates [illegible]

Attachment I Irradiation Facilities for a National Civilian Radiation Processed Foods Program [illegible]

Appendix "A"

Appendix "B" 33

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At a [illegible] 1959, the Interdepartmental Committee on Radiation Preservation [illegible] agreed to establish an ad hoc panel to formulate a [illegible] radiation processed foods program. This was prompted primarily by the Department of the Army decision to reorient its program more toward research and to concentrate on radiation sterilization of a few items of military interest. It was therefore deemed necessary to consider a complementary program to implement civilian interest in radiation processed foods.

In appointing members of the ad hoc panel, Mr. H. B. McCoy, then Chairman of the Interdepartmental Committee, defined its task as follows:

1. Make an assessment of the current "state of the art."
2. Review progress achieved in Government activities.
3. Consider what problems or issues now need to be dealt with to advance the radiation processing of food.
4. List specific areas of further research and development.
5. Recommend how and in what way the future program in the Government may be administered.
6. Make suggestions and recommendations regarding size of the research and development program.
7. Indicate what, if anything, the Federal Government might do to encourage research and development by private firms, institutions, etc.

The following report has been concurred in by all members of the ad hoc panel, with the exception of David H. Rest. They desire [illegible] that references in the report to cobalt 60 and x-ray machines be accompanied

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by mention of electron accelerators as alternate on additional radiation sources. This matter should be considered at the meeting of the Interdepartmental Committee.

This report does not spell out in detail the technical elements of the proposed program. This would be one of the first program activities. Furthermore, the report does not embody a comprehensive analysis of the current state of technology of radiation processed foods but rather [illegible] identifies [illegible] processed at sterilization and pasteurization [illegible] also that the program [illegible] developed without [illegible] knowledge of future Army plans.

This report [illegible] with conduct of research and development on radiation processing of foods. It does not attempt to define [illegible] Government agency responsibilities in such areas as regulation, health and safety, etc., and does not imply any commitment by any Government [illegible] with respect to any regulatory matter within its jurisdiction.

MEMBERSHIP

Paul C. Aebersold, Chairman	Atomic Energy Commission
John Holston	Department of the Interior
H. W. Koch	Department of Commerce
Jacob M. Schaffer	Department of Commerce
Samuel N. Klein	Small Business Administration
David H. Rest	Quartermaster Food and Container Institute for the Armed Forces

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Colonel [illegible]	Office of the [illegible]
Wilbur J. [illegible]	Department of [illegible]
Andrew [illegible]	Health, Education [illegible]
Shelbey Gra.	Health, Education [illegible]

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RECOMMENDATIONS

It is recommended that

1. The Interdepartmental Committee approve the national civilian radiation processed foods program as set forth in Part [illegible] of the report and refer it to Member Agencies for concurrence and implementation.

2. The Atomic Energy Commission be designated as the operating Agency for the national civilian radiation processed foods program.

3. The Interdepartmental Committee support the need for a complementary program by the Department of the Army on radiation preservation of foods and the requirement to pursue such a program aggressively.

*4. The Army complete its wholesomeness and safety program at sterilization doses to resolve biological anomilies that have arisen from long-term feeding studies and that AEC assist in this program as mutually agreed upon, as well as, initiate a wholesomeness program on selected foods at sub-sterilization doses.

*5. A Wholesomeness Program Working Panel to the Interdepartmental Committee be established consisting of the Army, AEC, FDA, Department of Agriculture and consultants as required to coordinate this program.

6. The Interdepartmental Committee support the requirement by the Department of the Army for adequate food preparation and radiation facilities to carry out effectively its research and development program.

7. Radiation research facilities established for either the Department of the Army program or the civilian radiation processed foods program be mutually accessible.

8. Close liaison be established between the Department of the Army and the operating Agency for the civilian radiation processed foods program on technical and administrative matters including budgets and scope of program activities.

* These recommendations were added at the meeting of the Interdepartmental Committee held on February 12, 1960, and were not a part of the report to the Committee by the Ad Hoc Panel.

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INTRODUCTION

To understand the [illegible] and problems of food preservation by radiation, it is necessary to appreciate what causes food to deteriorate. Food deteriorates in many ways. Through physical, chemical, and enzymatic changes, and by the activity of microorganisms and insects. Chemical and enzyme deterioration are only minutely affected by low doses of radiation contemplated for food processing, and physical changes, such as softening, may be promoted. The most promising areas for applications of low dose radiation are in control of insects and of microbiological damage.

Chemical spoilage of foods results from food components reacting with their environment or with other food components; for example, the reaction of fats with oxygen in air to cause rancidity. Radiation does no more or less to retard these reactions than does any other method of food preservation. These reactions are controlled to various degrees, however, with appropriate food technology.

Enzymatic spoilage results from enzymes in foods reacting with the food itself, i.e., "self digestion." Neither freezing nor irradiating stops this reaction although these processes may retard the reaction. Heat inactivates enzymes; hence, thermal processing does stop this reaction. In freezing, drying, or radiation preservation, a blanching or low heat treatment can be used to inactivate the enzymes during preservation.

Spoilage may result from the action of both insects and microorganisms. Ionizing radiation can destroy or inhibit these agents. This is the purpose of radiation processing.

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Fresh untreated foods are generally subject to spoilage by all the mechanisms mentioned. Physical, chemical and enzymatic changes are of major concern in longer term storage, and they can be retarded by refrigeration. The slowing of these mechanisms is generally not important during storage periods less than a month or two especially if adequate refrigeration is used. On the other hand, spoilage by microorganisms is often the prime cause of the rapid deterioration of perishable foods, and while refrigeration is helpful, it often will not do the job alone. Thus, the use of radiation to control microbiological spoilage and extend refrigerated shelf life of fresh-like products becomes a most important goal. Radiation is also a potent means of killing insects that damage foods.

Microorganisms and insects can be destroyed or their destructive action reduced by the use of irradiation, often with fewer deleterious effects on the product than caused by other methods. That is, a fresh or fresh-like product can, in some instances, be stored considerably longer than is now possible. For example, some fish and shell fish can be treated with ionizing radiation so that the fresh product can be stored under refrigeration (not frozen) for weeks instead of days.

With regard to shell fish, it is worth noting that prepared, cooked, shrimp sterilized by irradiation can be stored at room temperature for many months and then be essentially undistinguishable from prepared, cooked, fresh shrimp. Other types of commodities can be so treated. In addition, successful results have been experienced in extending the refrigerated shelf life of chicken, fish, pork, beef, grapes, strawberries and citrus fruit irradiated at sub-sterilization doses.

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Much need [illegible] preservation to make wi[illegible] bution from p[illegible] and [illegible] The recent Inter[illegible] Conference on Preser[illegible] Ionizing Radiations held at [illegible] Massachusetts Institute [illegible] clearly demonstrates the world wide interest in radiation processing of food and the faith that the United States will continue to be a leader in this development.

Domestically, any method that can increase the storage, distribution, and utility of our food resources will be of great economic advantage. For example, wide distribution of fresh ocean products in the mid-west can mean added prosperity to the fish industry. The same is true about supplying strawberries, peaches, and tropical and citrus fruits to distant markets.

In the last five years, the U. S. Department of the Army has carried on an extensive program to develop radiation preservation of food mainly for military purposes. Military food needs, however, are not the same as the food needs for civilian distribution. The need to store food for extended periods under adverse conditions, to distribute food to widely dispersed fighting units, to feed under conditions of great stress, all give rise to a military feeding system that has no parallel in the civilian population. Military requirements for irradiated foods will thus not necessarily be compatible with the needs of irradiated foods in the civilian feeding system.

The military requires a sterile, ready-to-eat food of high nutritional density that will be acceptable and morale building to the fighting man even after repetitive feedings. This resolves itself in the irradiated

*Report available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

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of the Cl[illegible] organism, requiring very high [illegible] diseases. [illegible] strawberries depend [illegible] ference with [illegible] quiring much lower do[illegible]. Also, the packaging of [illegible] ed hermetically, whereas for pasteurized fr[illegible] for respiration.

Much evid[illegible] mulated to show that a need exists to develop mode[illegible] dose radiation processing of foods to the point of commercial [illegible]

The fore[illegible] that there is justification for both military and civilian programs for radiation processing of foods. The Army program would continue to [illegible]ntrate on development of combat ration components for long term storage and the national civilian program should seek moderate shelf life extensions to produce foods of greater commercial utility.

These programs can be complementary and mutually beneficial in some areas but would be widely divergent in others. Fundamental research, dosimetry studies, wholesomeness, and radiation source technology are among those items which can be shared by both the military and civilian programs. Requirements of the two programs in such matters as microbiology, product development, process engineering, and packaging will be vastly different.

An important example where the two program requirements could overlap would be in the use of a national radiation processing of foods center. The requirements and plans for a national center are detailed in Attachment I to Part "B" of this report.

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for [illegible] report, and a recommended n[illegible]

[illegible] contained in Part "B".

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PART "A"

CURRENT STATUS OF THE TECHNOLOGY OF RADIATION PROCESSING OF FOODS

I. Introduction:

Research on the radiation processing of foods commenced over ten years ago. Within the past six years a full-scale development program has been concentrated in the United States on this new concept in food technology. Work on radiation processed foods in other countries has also been initiated and is being pursued actively. Major effort in the United States has been supported by the Government, primarily the Department of Defense, through contractual research projects at universities, research institutes, and private companies. Current selected information on radiation processed foods technology can be found in the previously mentioned report on the MIT International Conference on the Preservation of Foods by Ionizing Radiation. A comprehensive survey of the field through 1957 is contained in the U. S. Army Quartermaster Corps publication entitled, "Radiation Preservation of Food".* However, the rate of accumulation of information in this subject area has increased sharply since the latter book was published. Therefore it is necessary to consult the recent scientific journals for the most important new information.

II. Results from Experimental Investigations:

The comprehensive research and development program on radiation processing of food has revealed some products having potential for commercialization. Radiation sterilization of some meats, such as beef, still poses major problems but other items, such as chicken, fish and pork products, show

* Available as Report No. PB 131 493 from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Price $5.00

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[illegible] generally, however, [illegible] offers [illegible] effects on quality (flavor, [illegible] and [illegible] more nearly approach conventional [illegible] sub-sterilization of meat, [illegible] chicken and some [illegible] products, such as strawberries, to extend shelf life appears promising.

III. Present Problems

A. Meats:

1. Beef:

Radiation sterilized beef frequently has an off-flavor. The United States Army is intensively investigating the formation of off-flavor in beef and methods to overcome it as sterilized beef is a prime objective of the Army. Modest doses of radiation can be used to delay microbial spoilage of cuts of beef stored at 35°F. thus extending shelf life from about 5 days to perhaps 6 weeks.

2. Chicken:

Sterilizing doses produced minimal changes in taste and odor. Radiation sterilized chicken is slightly more pink in appearance than unirradiated chicken. Chicken irradiated with sub-sterilization doses and held at 35°F. has its shelf life extended to 30 days or more compared with 10 days for untreated chicken and retains acceptable taste and odor.

3. Pork:

a. Roast Pork - Experiments conducted by the Army demonstrated that pre-heated or roasted pork that is subsequently radiation sterilized is better in quality than heat-processed canned pork. The texture and flavor of radiation processed brown-an-serve pork is highly acceptable.

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b. Sausage [illegible] formulations of pork sausage [illegible] little affected by [illegible] processing. Shelf life of sausage [illegible] given [illegible] at 70°F. is more than six weeks compared with [illegible] control sausages.

[illegible] good results on bacon with [illegible] part to [illegible] at sterilization doses.

B. Marine Products:

Fishery products are promising for commercial radiation processing. Four-fold increases in refrigerated shelf life after sub-sterilization doses are found. The radiation processing of fish and shell fish, such as halibut, ocean perch, cod, shrimp, crab meat and lobster are perhaps the most promising for commercialization, since the flavor, odor, color and texture of these radiation processed products are likely to meet with consumer acceptance. Many fishery products are quite perishable and a four-fold increase in shelf life under refrigeration would be of significant benefit to the consumer and to the fishing industry.

C. Vegetables:

Sterilization of fresh vegetables has not been developed. Fair results have been obtained with sub-sterilization treatment of several vegetables, such as carrots and asparagus. The spoilage of vegetables, such as asparagus, due to rot and fungi may be controlled with sub-sterilization doses.

D. Fruits:

Sub-sterilization processing of fruits, such as strawberries, citrus fruits, grapes and peaches, may offer promise for commercialization. The low dose treatment of these fruit items can control

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spoilage [illegible] and brown rot, respectively. Shelf life extension for transcontinental shipment of a high spoilage item, such as strawberries, could be highly beneficial to the consumer and the grower. With respect to tropical fruits, such as papayas and mangoes, most serious problem of marketing is disinfestation of various fruit flies. It appears that low dose treatment of fruits can solve this problem.

E. Grains:

Radiation treatment has been investigated for the disinfestation of grain. Questions which have not been well answered in this regard include comparison between cost of chemical and radiation disinfestation, prevention of reinfestation and the problem of multiple radiation treatment, if required. Radiation disinfestation of grain or grain products may find commercial applications.

F. Sprout Inhibition:

Prevention of sprouting in tubers particularly potatoes, as a result of radiation treatment has been amply demonstrated. Radiation treatment makes it possible to inhibit sprouting for long periods under commercial conditions. There are problems to be overcome in subsequent decay prevention.

IV. <u>Wholesomeness and Safety Clearance</u>

A most comprehensive program to test the nutritional and toxicological safety of irradiated food has been conducted by the Department of the Army (Office of The Surgeon General). This program exceeds any animal feeding program that has ever been conducted on processed foods. The plans for the tests have been developed in close liaison

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with the Food and Drug Administration. It is our understanding that three to five more years would be required to complete and analyze feeding studies. Research in this area is intended to determine whether irradiated foods are safe and wholesome.

Much concern developed recently on the problem of induced radioactivity when it was observed that short lived radioactive isotopes with low activity could be measured in foods treated with high energy electrons. Fortunately, however, experimental evidence indicates that low energy gamma sources such as cobalt-60 and cesium-137, or X-rays of comparable low energy, as would be expected, do not produce detectable activity in foods. The Food and Drug Administration will of course require documentary evidence on the safety of these sources for food processing.

V. **Packaging:**

Experimental studies to date have been directed largely at satisfactory packaging materials for sterilization processing. Considerable work remains to be done in studying satisfactory packaging materials for sub-sterilization processing. Such containers must not only be capable of preventing microbial recontamination, but also of permitting transmission of respiratory gasses. In addition, it must be determined what types of chemical by-products result from the packaging material since minute amounts of extractable substances produced during irradiation could result in undesirable effects in the food.

VI. **Radiation Facilities:**

Radiation sources currently used for the radiation processing of foods program are generally inadequate in size and characteristics, and are usually located at distances from both the source of food supply and the research laboratory. The principal existing gamma sources consist

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of [illegible] types used under dissimilar conditions of [illegible] removed from food processing laboratories. It [illegible] by the need for additional gamma irradiators or [illegible] machines to develop the best and most economic conditions for radiation processing of a wide variety of food products.

VII. Economics:

Economics of radiation processing are presently based on laboratory studies and calculations rather than on experience under pilot plant conditions. Cost estimates for sterilization treatment have been on the order of a few cents per pound whereas the estimated cost for sub-sterilization processing has generally been on the order of a few tenths of a cent per pound. Reliable cost information will not become available until quasi-commercial plants are built.

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PART "B"

RECOMMENDED NATIONAL CIVILIAN RADIATION PROCESSED FOODS PROGRAM

I. Program Description

To conduct research and development, economic, marketing, and consumer acceptance studies, and feasibility demonstrations during the next 5 years necessary to establish the commercial practicality of civilian applications of radiation processed foods that would accelerate their introduction into the economy. The immediate objective would be to concentrate on a small number of selected food products which appear to promise early technical feasibility and market acceptance.

II. Basic Assumptions

A. The most immediate civilian application of radiation to preserve foods, both from a technical and economic point of view, is low dose treatment to extend shelf life of perishable foods, including meat, fish, vegetables and fruits.

B. Establishing the wholesomeness and safety of radiation processed foods will for some years be largely a Government responsibility since industry would not undertake both high capital costs for radiation processing plants and expensive long term wholesomeness costs. Short term wholesomeness tests could be expected of industry on individual items, having particular commercial attractiveness.

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C. The Army wholesomeness and safety program at sterilizing and sub-sterilizing doses will be completed and will contribute information toward clearance for these foods as well as additional foods irradiated to lower sub-sterilization doses; however, a modest amount of supplemental work may be necessary to obtain clearance for foods of interest in the civilian program.

D. The provisions of Public Law 85-929, September 6, 1958, which amended the Federal Food, Drug, and Cosmetic Act, must be met as regards the use of radiation as a food additive. Since radioactivity under some circumstances is carcinogenic, radiation processing of food which will induce lasting measurable radioactivity in the food will not be permitted under the present law.

E. Public acceptance of radiation processed foods must be demonstrated. Even though a number of food items may have been given FDA clearance by high dose tests, animal and human volunteer feeding studies with specific low dose treated foods may be required for psychological reasons.

F. Establishment of the commercial success of a few radiation processed foods will prompt industry to extend independently the technology throughout the broad spectrum of food products.

G. Individual Federal Agencies will continue to conduct long range fundamental research programs on radiation effects on food. The Army program will continue and will supply much fundamental data of this kind which would otherwise have to be developed under the civilian program.

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III. Program Administration

A. The Interdepartmental Committee will provide over-all guidance and recommendations in program policy, direction and budget. It will function principally as a coordinating committee rather than an operating committee.

B. Program administration would be conducted by one designated Agency on behalf of the Interdepartmental Committee and its member Agencies. This is to include program budgeting, contracting, and reporting. It is proposed that AEC be the operating Agency because (1) much of the food process development work required involves radiation source technology and radiation engineering, and (2) the radiation processed foods program would be a principal facet of the Nations' Atoms-For-Peace program.

C. The Interdepartmental Committee would function by:

1. Reviewing and making recommendations concerning the over-all program as presented annually by the operating Agency, including the proposed budget request to Congress.

   NOTE: This would not preclude any Agency pursuing activities with its own funds independently of the Interdepartmental Committee, and does not imply Interdepartmental Committee control of Agency research and development program.

2. Receiving periodic reports and evaluations from the operating Agency on the status of the program.

3. Meeting at least semi-annually to consider policies, programs, and procedures and issue such public statements as may be considered desirable.

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4. Establishing a Program Coordination Committee of the most directly participating Agencies to meet as necessary at the call of the operating Agency to consider specific problems as they arise.

D. The operating Agency will function by:

1. Preparing the over-all program and budget for review and recommendation by the Interdepartmental Committee and making the budget request to Congress.
2. Consulting the member Agencies on proposed programs and projects including cost and justifications, for inclusion in the over-all program.
3. Receiving proposals from private organizations and reviewing them where necessary with an appropriate member Agency.
4. Making agreements and contracting with member Agencies and others for conduct of work.
5. Reviewing and evaluating reports, etc., from contractors and others with appropriate member Agencies and other experts in the field as well as assuring the availability of such reports and evaluations to member Agencies, industry, the public, and foreign countries as appropriate.
6. Establish and consult as necessary with a committee of the National Research Council on civilian radiation preservation of food regarding broad program policy and objectives.

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IV. Program Objectives

A. To further the national Atoms-For-Peace and War-On-Hunger programs, assume U. S. world leadership in the radiation processing of foods, and provide technical assistance in this field to developing countries.

B. To identify potential civilian applications of radiation processed foods which would have substantial technical, economic, or other significance in food production, processing, distribution, marketing, or consumption.

C. For selected food products conduct research and development work necessary to establish the technical and commercial feasibility of radiation processing.

D. To supplement Army wholesomeness and safety studies as necessary to obtain FDA clearance for the above referenced selected food products and to conduct continuing wholesomeness studies on radiation processed foods of interest in the civilian economy.

E. Through suitable Government and private facilities, and with adequate "promotions," to test market for these selected radiation processed food products.

F. To conduct studies of basic nutritional and organoleptic factors on the biochemical level to compare radiation processed foods with foods processed by other methods, specifically to compare fresh, frozen and irradiated foods after typical consumer storage and cooking procedures.

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V. Cooperation with Industry

A policy of maximum cooperation with industry will be followed. Extensive use should be made of "radiation study agreements" in which for a given phase of work the government supplies the service of irradiation of the food, and industry performs the remaining parts of the investigation. Results from the investigations are then made available to all those who are cooperating in the program.

In this way it is expected that industry will make most of its contributions in investigations in the areas of shelf life extension, packaging, consumer acceptability testing, and marketing analyses. The government would be expected to support the major work in the areas of fundamental research, microbiology, food chemistry, and causes of organoleptic changes, etc., provide irradiation services, develop economic and safe radiation process technology and conduct basic wholesomeness testing.

VI. Facility Requirements

In view of the combined needs of the military and civilian programs, a national radiation processed foods research and development center would materially accelerate progress. Certain specialized radiation facilities for food processing, e.g., research irradiators and mobile food irradiators also will be necessary to achieve the foregoing program objectives. Attachment 1 sets forth in detail proposed facilities for radiation processed foods research and their estimated

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construction costs, as well as, alternative facility recommendations depending upon action on the Army program.

VII. Problems Foreseen

A. Due to the budgeting cycle, it would not be expected adequate operating funds will be available for the civilian radiation processed foods program before FY 1962.

B. Assuming the Army arrives at a decision or other arrangements are made to proceed promptly with construction of a research and development radiation center for food processing, it would not be available for use before FY 1962. If the center must await the customary budgeting process, it would not be available for use until FY 1964. Thus two years can be saved if the center can be undertaken promptly.

VIII. Initial Activities

A. Survey all research and development work to date to analyze and collect data relevant to the civilian program.

B. Conduct studies described in IV B above.

C. In selected cases, identify scope and cost of research and development program needed and initiate preliminary experimental work.

D. Design mobile irradiators consisting of high intensity Cobalt 60 sources and/or x-ray sources of comparable energy.

E. Analyze status and timing of Army wholesomeness program and establish close and continuing liaison with this activity.

NOTE: "B" and "C" above have already been done in the case of fish by MIT under contract with AEC. A full report will soon be available.

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IX. Budget Estimates

Assumptions:

1. Eight food items to be developed.
2. Man years charged at total cost of $25,000 each.
3. The estimates are made on the basis of Cobalt 60 as the radiation source. It might be desirable to use low-energy electron accelerators as the radiation source for some of the irradiators envisioned. In this event, the cost estimate will be comparable to the Cobalt 60 source estimate.

Operating Costs:

	FY '60	FY '61	FY '62	FY '63
Initial Activities	200,000			
Equipment				
Research Irradiators (4)	200,000			
Mobile Irradiators (2)		400,000		
Food Chemistry		50,000	200,000	200,000
Microbiology		100,000	400,000	400,000
Product Development		100,000	400,000	400,000
Nuclear Effects		25,000	25,000	25,000
Process Engineering			25,000	50,000
Packaging Development		25,000	50,000	75,000
National Center Operation			50,000	150,000
Commodity Procurement and shipping		10,000	35,000	50,000
Irradiation Services		180,000	200,000	250,000
Supplementary Wholesomeness		30,000	60,000	90,000
	400,000	920,000	1,445,000	1,690,000

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Construction*

	FY '60	FY '61	FY '62	FY '63
National Center			1,400,000**	
Marine Products Irradiator			500,000***	

* Alternative recommendations depending upon action on the Army program are set forth in Attachment 1.

** Not required if Army funds presently held by AEC for a gamma facility are available to build a center to which civilian program has access. Assumes Cobalt 60 at Army price.

*** Not required if National Center built in a suitable location either by Army as above, or by civilian program.

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ATTACHMENT 1

IRRADIATION FACILITIES FOR A NATIONAL CIVILIAN RADIATION PROCESSED FOOD PROGRAM

I. Introduction

Irradiation facilities for the conduct of research and process development for a national civilian radiation processed foods program are discussed. The construction of several specialized facilities is proposed. These facilities would also be available for use by the Department of Defense, other Government departments and industry and be operated under the legal guidance of the Interdepartmental Committee.

II. Need for Facilities

A. Existing radiation sources used to irradiate food are inadequate in size and characteristics, and are generally located at some distance both from the source of food supply and the laboratory which is supervising research and development efforts. To provide proper process control of the radiation processing experiments, the irradiation sources should be located close to the source of food supply and the research laboratory. Much of the food now being irradiated in the research program is frozen or refrigerated for extended periods prior to irradiation resulting in the introduction of undesirable conditions.

B. Irradiators are needed to develop and demonstrate the best and most economic methods of food radiation processing under a wide variety of product conditions. It is to be emphasized that the development work to be carried out is on both the techniques of radiation processing of foods and the quality of the resulting product.

C. Fixed facilities will meet some of the existing requirements. Certain food studies, however, must be carried out using fresh harvested or

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fresh processed local varieties of food. Mobile Food Irradiation Units with approximately 100,000 curies of cobalt 60 or the equivalent X-rays from a low energy electron accelerator will fulfill this need. The value of these units would be enhanced through their being shared by several users. This is feasible since peak demands and program requirements relative to various food items will vary throughout the year and from one area of the country to another. The cobalt 60 irradiation units could be mounted on special trucks or flat cars providing adequate shielding of the source during transport. These units would be staffed by trained personnel for effective and safe utilization. The Mobile Irradiators would be administered from a home base which would also provide the operational personnel for the units. Additionally, several small scale research irradiators with approximately 10,000 curies of cobalt 60 or the equivalent X-rays from a low energy electron accelerator each will be required to investigate fundamental research problems such as the biochemical effects in radiation processed foods and the origin and control of organoleptic factors (see Appendix "A").

D. These facilities would retain focus on the United States as a leader in the field of food irradiation. They would provide a visible and substantial contribution to technical assistance for less developed countries. This would be done by performing research and development processing in food preservation applicable to these less developed countries and by acting as the training centers for personnel from foreign countries.

III. <u>Types of Irradiation Facilities</u>

A. Research Irradiators

Four research irradiators are proposed for conduct of fundamental studies necessary for developing radiation processed foods. Interest

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has been proposed for two each of these irradiators for the Department of Agriculture and Department of Interior.

B. Mobile Irradiators

1. For fruits, vegetables, and grains

A mobile irradiator is proposed for use by the Department of Agriculture in the continental U. S. for studying shelf-life extension of fruits and vegetables and disinfestation of grain.

2. For tropical fruits

A mobile irradiator is proposed for use by the Department of Agriculture in Hawaii to study the disinfestation of tropical fruits.

C. Fixed Irradiators

1. For marine products

A marine products processing irradiator is proposed for use by the Department of Interior and should be located near an important east coast fishing port. Note that need for this irradiator would be eliminated if the National Center were built in a suitable geographic area since it could be utilized in part for this purpose.

2. A National Center

Among the facilities should be one having sufficient flexibility to investigate those radiation process variables that the program thus far has demonstrated to be of importance. Such a National Center would:

a. Permit study of microbiological safety, depth dose uniformity, and dose rate effects.

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b. Permit study of civilian applications for low dose treatment of meat products.

c. provide adequate process control to assure reproducibility of end product.

d. Provide a supply of radiation processed foods for testing acceptance, palatability, and storage characteristics.

e. Promote interest and participation of industry in radiation processing of foods.

f. Develop process specifications and quality control factors.

g. Study radiation effects on containers.

h. Give indications of costs, to include capital, operating, and cost per pound for radiation processing of foods.

Cobalt 60 Complex - Cobalt 60 has been selected as the principal radiation source for the National Center because of its properties of being neutron-free, readily reproducible, and reliable. The proposed cobalt 60 irradiator is capable of processing in excess of 500 megarad pounds per hour of food. The uniquely flexible source is designed to solve process development problems relating to microbiological safety, depth dose uniformity, product quality control, variable dwell time and evaluation of products using variable source and conveyor configurations. This irradiator requires about one million curies of cobalt 60, a cave with a water pool storage facility, labyrinth entrance, and a simple flexible conveyor. The estimated total cost of the facility is $1.1 million including cobalt 60 and 10% over-all cost contingency. It will also be desirable to examine the suitability of low energy electron accelerators for the radiation processing of foods.

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Supporting Food Preparation, Laboratory and Office Building -- The building proposed to support food research and process development requirements contains approximately 10,000 square feet. Food preparation will be performed with institutional type equipment requiring manual operation. A suitable refrigeration area will be provided. The laboratory area will provide for chemical quality control tests, microbiological tests, dosimetry tests and taste acceptance tests. If the Army builds facilities which are adequate for a National Center, the Interdepartmental Committee and the operating Agency should seek an arrangement for access to it.

IV. Alternative Recommendations Depending Upon Action on Dept. of Army Program

In this report it has been assumed that the Army program will continue as proposed by the Quartermaster Corps and that it would require at least partial use of facilities comparable to the National Center. Should these assumptions prove incorrect, it is to be noted that

1. The food throughput of the National Center for low dose sub-sterilization treatment would be far in excess of the near term civilian program requirements,
2. The immediate civilian program requirements could be met by research and mobile irradiators and
3. The Atomic Energy Commission presently has under construction a radiation engineering facility at Brookhaven National Laboratory, which with some modification, could meet the product and process development objectives envisioned for the National Center relative to the civilian program, including the limited amount of product irradiations foreseen. (see Appendix "B")

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If the Army does not build an irradiation facility for its own use, and in addition cannot justify sharing the use of a National Center to furnish radiation services for its program, then it is recommended that construction of the Center be deferred. In addition to the mobile and research irradiators previously mentioned, it is recommended that a marine products irradiator be established as identified on page 24 of the report. In these circumstances, the operating budget estimates would require reconsideration.

V. Cost Estimate for Irradiation Process Research Facilities

		Plan Including National Center	Alternate Plan
Fixed Reseach Irradiators (4)		200,000	200,000
Mobile Irradiators (2)		400,000	400,000
Fruits, vegetables, grain	200,000		
Tropical fruits	200,000		
National Center*		1,400,000	
Marine Products Irradiator 550,000**			550,000
		2,000,000	1,150,000

* Assumes cobaly 60 could be provided at Army price. Not required if Army funds presently held by AEC for a gamma facility are available to build a center to which the civilian program has access.

** This irradiator would be needed only if the National Center were not built or was constructed in an unsuitable location.

VI. Schedule

It is estimated that approximately 18 to 24 months would be required to design, construct and test operate the fixed irradiators.

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APPENDIX "A"

IMPORTANCE OF BASIC RESEARCH STUDIES IN FOOD SCIENCE (CHEMISTRY AND MICROBIOLOGY) IN THE RADIATION PROCESSED FOODS PROGRAM

To evaluate the ultimate potential of irradiation in the processing of foods, basic chemical and microbiological research studies are needed to provide information not now available designed to circumvent off-flavor and odors that develop in foods such as beef. It may also be possible to decrease, through bacteriological studies, the dosage required to achieve specific preservation objectives. Significant advances cannot be made until such data are available for products of such great importance as meats with the use of sterilizing dosages. These research areas need significant attention, not only to assist in achieving the technological objectives described, but also as a part of the government's role in support of basic science in the over-all Atoms-for-Peace program. Scientists and other leaders in all countries have looked to the United States for leadership in basic science relating to the potential peace time use of atomic energy and it is essential that the United States continue to provide this leadership. Full evaluation of the potentials of irradiation in food processing cannot be made without the basic research studies in food science in the areas outlined above. Valid information cannot be obtained from these studies unless the research organizations have available adequate research facilities.

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APPENDIX "A"

HIGH INTENSITY RADIATION DEVELOPMENT LABORATORY

The HIRDL to be constructed at Brookhaven National Laboratory will serve for research and development on the use of high intensity radioisotope sources. This facility will be capable of safely handling 1,000,000 curies of cobalt 60 and much greater quantities of cesium 137. Initially the laboratory will be loaded with 500,000 curies of cobalt 60.

The building will contain small research laboratories and two large hot cells with remote handling equipment and a canal. One of these hot cells, the Experiment Preparation Cell, will receive radiation sources directly from either nuclear reactors or fission product separation plants. It will be used to handle, clad, weld and safety test source containers. The sources are then transferred via the canal to the second hot cell, the Experiment Irradiation Cell.

In the Experiment Irradiation Cell, detailed measurements will be made of the radiation fields created using various geometric arrangements of fabricated radioisotope sources. Experiments will include irradiation of different target materials representative of commercial items such as food, drugs and chemicals, that might be treated in a large irradiator.

The program with this new facility will include experimental studies of factors affecting the design of large irradiators, such as radiation dose delivered at different points within a target, source dimensions, target dimensions, optimum source and cladding dimensions, optimum design of high efficiency irradiators, heat generation and dissipation in high level sources and radiation damage to source materials.

Work of this facility will provide sufficient experimental and engineering data to permit private groups to design high level irradiators

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for particular commercial operations.

Additional facilities necessary at Brookhaven to meet requirements for a food program would be food preparation storage, handling and transportation facilities, and also laboratory space and equipment for evaluation of foods prior to and after irradiation. Throughput capacity would be several hundred pounds per hour at moderate dose treatment (0.5 megarad). The facility could handle packages approximately 16" x 20" x 6".

The HIRDL is expected to have undergone trial runs and be available for product irradiation about July, 1962.

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DRAFT (Read over telephone by Col. Oliver)
23 February 1960

DEPARTMENT OF COMMERCE
INTERDEPARTMENTAL COMMITTEE ON RADIATION PRESERVATION OF FOOD

17 February 1960

Honorable
Secretary of the Army
Washington 25, D.C.

Dear Mr. Secretary:

The Interdepartmental Committee on Radiation Preservation of Food met February 12, 1960, and approved in principle the attached report (2 copies attached). This report, entitled "A National Civilian Radiation Processed Foods Program", was prepared at the request of the Committee by an ad hoc working group of government officials closely associated with this new food processing development.

The Committee requested this report as essential to carrying out its primary objectives which are:

1. Provide motivation and broad guidance for the Government Research Program on the Radiation Preservation of Food.

2. Facilitate a transition of program responsibility from the Department of Defense to other government agencies and to the free economy as rapidly as possible.

The Committee agreed that the heads of the nine agencies represented on the Committee should study and comment on the report prior to the Committee's final review and development of an integrated national civilian program. The Atomic Energy Commission is the civilian agency recommended to operate a National Civilian Radiation Processed Food Program.

May I express, too, our appreciation of the services of Mr. Richard Morse of your agency as a member of the Committee, Dr. R.G.H. Siu as his alternate, and other representatives of your organization who have furnished their services to the Committee.

We would appreciate receiving your comments by March 10, 1960 if at all possible.

Thanks for your cooperation.

Sincerely yours,

H. Herbert Hughes
Chairman

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food field to completely sterilized meat products which comprise large tonnages of military subsistence such as, beef, pork, ham and chicken. It is then reasonable to expect that the Army concentrate its efforts on developing these items.

The civilian needs on the other hand stem from the problem of distributing and utilizing foods in as near fresh condition as possible. At one time dried and salted foods were the closest to fresh foods that could be preserved and distributed. Subsequently, pickling and curing processes replaced some but not all of the drying and salting operations. The situation has been similar following the development of thermal processing, freezing and improved dehydration processes. Each process has developed very useful roles. So it may be with radiation processing. Some food items will yield outstanding products by irradiation. But the process will not be universally applicable. The amounts of dried, smoked, pickled, canned and frozen food items will not be greatly affected.

Sterility may be obtained by combining other treatments such as heat or antibiotics with radiation. In this case the irradiation dose can be considerably reduced thus minimizing the development of off-flavor or other undesirable effects. At the same time, beneficial effects can be obtained such as flavor and texture improvement by reducing the amount of heat needed to sterilize canned meats by combining heat with irradiation. This can be of interest for both Army and civilian needs.

While the fundamental problems in the development of both a moderately treated food and a completely sterilized food with radiation are the same, there are specific differences that require separate investigations. For example, the microbiology of completely sterile foods involve the killing

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