

KA9333806

IAEA/UNDP-RAS/89/044-08  
Technical Report 8

**FOOD IRRADIATION PROCESS CONTROL AND ACCEPTANCE**

**REGIONAL UNDP PROJECT FOR  
ASIA AND THE PACIFIC**

**MISSION UNDERTAKEN IN VIETNAM**

**FOOD IRRADIATION PROGRAMME PLANNING  
FACILITY OPERATION AND PILOT SCALE STUDIES RPFI-PHASE III**



**UNITED NATIONS DEVELOPMENT PROGRAMME**



**INTERNATIONAL ATOMIC ENERGY AGENCY**

**VIENNA 1992**

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FACILITY OPERATION AND PILOT SCALE STUDIES RPF-III

Report prepared for the Governments of  
Bangladesh, China, India, Indonesia,  
Malaysia, Pakistan, Philippines, Republic of Korea,  
Sri Lanka, Thailand and Vietnam

by

the International Atomic Energy Agency  
acting as Executing Agency for  
the United Nations Development Programme

UNITED NATIONS DEVELOPMENT PROGRAMME  
INTERNATIONAL ATOMIC ENERGY AGENCY

VIENNA 1992

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Joint FAO/IAEA Division  
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26 April 1991

**ABSTRACT**

At the request of the Government of Vietnam, the FAO/IAEA expert undertook a one-week mission to Vietnam between 16 and 23 March 1991, to the Hanoi Irradiation Center of the Vietnam Atomic Energy Commission. This mission included the following:

The expert inspected the new Soviet automated, dry storage pilot plant gamma irradiator in the final stages of construction on the outskirts of Hanoi, and met with senior staff of the Hanoi Irradiation Center plus the Center specialized groups to hear and take note of their progress, problems and materials and manpower training expectations, etc.

A tour of a large rice and vegetable growing cooperative outside Hanoi was made, followed by a meeting with members of the Cooperative's governing body. This cooperative will participate in pilot scale food irradiation feasibility studies once the new irradiator is operational.

The expert provided a technical seminar to the Hanoi Irradiation Center staff, plus a general seminar to members of the Consumers Union of Vietnam plus invited guests, on radiation processing in general and food irradiation in particular, during the week.

The expert accompanied Irradiation Center staff to Haiphong to visit the National Institute for Marine Products Research plus two Government-run fishery products processing plants in connection with the marine products side of the national food irradiation programme.

He was accompanied to a meeting at the Ministry of Agriculture and Food Industry to meet with the Vice-Minister and staff plus food and allied industry representatives.

## I. INTRODUCTION

### A. Terms of Reference:

1. Evaluate current status of gamma irradiator and further needs.
2. Assist Irradiation Center staff in preparing for its use including pilot-scale food irradiation trials.
3. Evaluate staff preparedness and any further training/preparation needs.

### B. Background Information:

It was pointed out to the expert in Hanoi that very early food irradiation studies in Vietnam were conducted during the 1950's. However, the current food irradiation R&D program effectively began as the result of a 1982 FAO/IAEA expert mission to Vietnam by Dr. Mainuddin Ahmed, and follow-up actions including the planning of a semi-industrial scale pilot gamma irradiator for the country, to be provided by the FAO/IAEA. Since then, three additional FAO/IAEA food irradiation technical assistance missions were completed in the 1987-90 period. The subject mission is a continuation of this technical support, which has also included fellowships and workshop training for several Vietnamese professionals at the IFFIT-Wageningen, the CIC-Canada and elsewhere, plus FAO/IAEA sponsored participation at technical meetings. During the mid-to late 1980's, and continuing, food irradiation R&D has been and is underway at the VINATOM Irradiation Center at Hanoi, as well as at the Nuclear Research Institute at Dalat. In Nov. 1989 the Ministry of Health approved potatoes, onions, garlic (provisional, sprout inhibition) and dry green beans, maize, paprika powder; also dried fish (insect disinfestation, experimental batches). Construction of the building to house the new semi-industrial pilot gamma irradiator began in 1988, and Soviet-made hardware (conveyer system, source rack-and-hoist mechanism, control console and associated electro-mechanical control components, etc.) were installed by Soviet technicians during 1990 under Contract No. 54-90011 of June 1988. Laboratory instrumentation and materials, including dosimetry equipment has also been provided by the FAO/IAEA. Apart from some additional laboratory needs, including replacement of some nonfunctional components, plus the completion of the new irradiation center laboratory building, the outstanding need at the time of the subject mission was the delivery and installation of the first installment of cobalt-60 sources by the Soviet supplier, plus the up-grading and replacement of certain critical system components. This is expected to be completed by mid-1991, whereupon pilot scale irradiation of a variety of food commodities, and associated technoeconomic feasibility studies can commence. In anticipation of this, a National Seminar on Radiation Technology, attended by over 100 persons, was held at Hanoi on 30 May 1990.

## II. WORK PROGRAMME

The expert arrived in Hanoi on Saturday, 16 March where he was met and taken to the downtown Hanoi lodging by Dr. Vo Hoang Quan and Mr. Pham Quang Vinh of the VINATOM Irradiation Center. At the hotel, we went over the proposed work plan for the week and discussed the general situation of the new irradiator and the food irradiation program. Sunday evening the expert was taken to dinner by Dr. Vo Hoang Quan and Irradiation Center Director, Dr. Nguyen Van Chau, who provided an additional overview of the Center's activities as they relate to the mission, and the status of the new irradiator.

The morning of Monday, the 18th, the expert was taken to the Irradiation Center on the outskirts of Hanoi for meetings and discussions with senior staff including Director Chau, Vice-Director, Dr. Vo Van Thuan and professional staff responsible for the different activities (dosimetry, operations, applications). The meetings were followed by a tour of the new gamma irradiation facility, at which the expert took photographs of key components. It is an automated, overhead monorail carrier, panoramic gamma irradiator, not unlike certain industrial irradiators currently in use in the U.S. and elsewhere, except that it is a circulating water-cooled dry storage unit rather than a wet-storage (water pool) one.

The source rack-to-product geometry is "product overlap" (maximum source utilization efficiency) with two product bins per each carrier, which shift positions vertically midway between each two-cycle processing operation. Each carrier automatically rotates 180° following each source rack pass (halfcycle) to optimize dose uniformity. Each product bin (two per carrier) has the dimensions, 1.2m long by 1.0m high by 0.8m wide (perpendicular to the plane of the source rack, representing maximum product/target depth of a completely full carrier bin). The Soviet cobalt 60 source pencil dimensions will (when they arrive and are installed) be 11mm diameter by 80 mm length, comparable to the standard Nordion International Inc. C-188 source pencil. The last major component, the irradiation cell air circulation-ventilation system was being installed by Center personnel at the time of the tour. Both component (eg. electromechanical sensor-activators) and functional (cycling; carrier rotation and bin vertical transfer) problems were pointed out during the tour, and this was further discussed back at the meeting room following the tour.

Following the latter discussions, and lunch, Drs. Chau and Quan, and Mr. Vinh joined the expert for a visit at an onion and vegetable production co-operative outside Hanoi in the Red River Valley. Until recently, the co-operative, like others in the district and elsewhere in the country, was a State-operated collective enterprise. Since the initiation of the policy of economic renewal ("Doi Moi"), however, it/they have been largely "privatized", as have numerous other non-strategic commercial activities. A meeting with local co-operative members was presided over by their Agricultural District Secretary, whose District encompasses over 6000 Ha of rice and vegetable growing area, and the

Director of the Co-operative, which consists of about 360 Ha of very fertile farmland, upon which cucumber, lettuce, kolirabi, onion, tomato and cabbage, etc. are grown on acreage divided among the participating families. They transport their produce, much of it by bicycle, to market in an around Hanoi for sale, plus provide some to the State, and for themselves.

The meeting was followed by a walking tour of the village and adjacent growing area. Onions, much suffering advanced sprouting, and largely green tomatoes were in temporary storage within member family living quarters. The production plots appeared lush, and well cared-for, but with excessive pre-harvest field spoilage, due in part to the hot, humid climate (though rather cool at this early Spring time of the mission). In-field rotting (spoilage, including onion sprouting) is the No. 1 problem, especially with late growing-season plantings, which suffer most from high temperature-rainy climactic stress. There is relatively little post-harvest processing (canning, freezing) capacity in-and-around Hanoi; and the climate is not suitable for dehydration (eg. of onions). Pickling (e.g. of tomatoes, cucumbers) is not the custom.

The Irradiation Center is about 20 km. or one hour by road from this production area, so sprout inhibition of onions before (bulk) storage and marketing, for example, is logistically as well as technically feasible, provided they are harvested in prime condition. This would, of course, require obvious modification of the current system to incorporate irradiation, if the economic feasibility is sufficiently positive, an up-coming subject of Irradiation Center study. The tour was followed by further discussion at the Co-operative's meeting hall, and a banquet featuring locally grown food, and locally produced "spirits" (which was the object of endless "toasts"). After the very generous and enjoyable meal we returned to Hanoi to end the day.

The following (Tuesday) morning the expert was again taken to the Irradiation Center for a meeting with the Consultative Committee on Food Irradiation. In addition to Drs. Chau and Quan, in attendance were Dr. Hoang Manh Tuan, Deputy Director General of the Department for Standardization Metrology and Quality Control and Chairman of the recently formed Consumers' Union of Vietnam; Dr. Le Van Thieu, Secretary General of the Vietnamese Association for Standardization, Metrology and Quality Control and General Secretary of the Consumers' Union of Vietnam; Professor Tu Giay, Director of the National Institute of (applied) Nutrition, and, Dr. Bui Minh Duc, Head of the Department of Food Hygiene of the National Institute of Nutrition. A wide-ranging discussion of food irradiation technology, global industrial applications, regulation, labelling and public acceptance was held, with the expert responding to comments and questions following opening remarks. The Consumers' Union representatives invited the expert to present a seminar at their Hanoi headquarters the following afternoon, with the membership plus representatives of the press and local radio/television to be among the audience.

The afternoon was devoted to a technical seminar by the expert at the downtown Hanoi headquarters of VINATOM, before Irradiation Center professional staff and others of the Commission. A lengthy series of slides was employed by the expert, which stimulated a good deal of comment and questions from the enthusiastic group.

The next (Wednesday) morning, the expert was again driven to the Irradiation Centre where he met separately with (a) the operations group responsible for the operation and maintenance of the irradiator, headed by Mr. Ho Minh Duc, Chief Operator, (b) the applications or food irradiation group, headed by Dr. Quan, and the dosimetry group, headed by former Center Director, Dinh Ngoc Lan, a proponent of the ethanol-chlorobenzene dosimetry system developed used in Hungary. The activities, training and other expectations, and problems being encountered were discussed with each group in succession.

The expert made a second tour of the new irradiator with the operations group, during which shortcomings and problems of the system were pointed out in more detail as it was being operated ( in the absence of cobalt-60). Apart from the continuing lack of cobalt-60 sources, problems include:

- (a) the high deterioration rate of sensitive components such as sensors which control specific cycle operations.
- (b) repeatability and fidelity of carrier rotation during cycling.
- (c) unsatisfactory product bin vertical in-carrier transfer,
- (d) apparent difficulty with the source rack raising-and-lowering mechanism, and
- (e) non-delivery of the 8 KVA generator and radiation cell inercm and TV monitoring system.

It is, of course, too soon to evaluate the performance of the circulating- water cooling system in the absence of cobalt-60 sources installed in the rack. The control console appears to perform satisfactorily, but the group was bothered by the fact that it is an upright model rather than one that operators can comfortably sit at for long periods, as with comparable irradiators in Cuba and Portugal.

The food irradiation applications group has been employing a (now 2.5 Kci) small cobalt-60 unit at the Hanoi Cancer Hospital for local product sample irradiation, plus collaborative work with counterparts at the Dalat Nuclear Research Center which has a larger, Soviet made ("Isledovatel") cobalt-60 unit. A progress report on the preservation of salt-dried fish with irradiation project being conducted in cooperation with Dalat was specifically discussed with Dr. Quan, chief scientific investigator. He and others have received recent FAO/IAEA sponsored training, including Mr. Pham Quang Vinh, who will spend six months at BARC, Bombay beginning in May 1991. Dr. Quan is scheduled to attend the workshop at Dhaka, Bangladesh in July, followed by the Regional RCM at Jakarta. While the expert was in Hanoi, confirmation of the renewal of the food irradiation research contract with the FAO/IAEA (RPMI-Phase III) was received.

The dosimetry group presented a list of laboratory equipment and materials received thus far, plus additional needs, for the expert to bring back to the FAO/IAEA. Included in the list is equipment and materials received for the irradiator facility. Also provided was a list of fellowship training, scientific visit and research contract expectations for 1991-92, which were passed along to the appropriate FAO/IAEA staff upon returning. To this the expert would add the need for a Radiochromic dosimetry system (eg. Far West Technology Inc., California) of the type now in use at OAEP, Bangkok, the Jakarta Center for Application of Isotopes and Radiation (CAIR) and elsewhere for low-dose applications (eg. sprout inhibition, insect disinfection).

Wednesday afternoon the expert provided the seminar requested by the Consumer Union of Vietnam at their downtown Hanoi headquarters. In addition to Union membership, members of the Hanoi press and broadcast media were in attendance, as was Mr. Guram Muchaidze, UNDP Chief Technical Advisor stationed in Hanoi. Mr. Muchaidze is from Tbilisi, Georgia, USSR. The meeting was presided over by Dr. Hoang Manh Tuan, Chairman of the Consumers' Union, and Dinh Ngoc Lan, former Irradiation Center Director and current Chief of Dosimetry provided the two-way translation. In recognition of the 'language gap', and in anticipation of many comments and questions from the large audience, the expert kept the formal presentation relatively brief.

Noticing a stack of International Organization of Consumer Unions (IOCU) Asia and Pacific Regional Headquarters, Penang, Malaysia literature on a table upon arriving, the expert specifically addressed the international anti-food irradiation network's efforts to perpetuate a socio-political controversy on the subject, and in particular the central efforts of the Penang IOCU group's efforts in this regard. This was followed by a summary of the economic, food availability/security and public health benefits offered by food irradiation, plus its limitations. These remarks were in-turn followed by a lengthy comment plus question-and-answer session during which it became evident that the IOCU Penang literature, containing some dated or otherwise inaccurate and misleading misinformation about food irradiation was having a negative influence in Hanoi, as elsewhere in the Asia-Pacific Region. The session afforded the expert a good opportunity to clarify and set-the-record-straight on much of this all-too-familiar misinformation before a most interested group.

Consumers' Union Chairman, Huang Manh Tuan, was to represent Vietnam at the UNDP/IAEA/FAO Regional (RCA) Workshop on Public Information of Food Irradiation at Bangkok in late-May, ended the session with a general statement on the operating philosophy of the Consumers' Union plus an open-minded, if somewhat guarded current viewpoint towards the food irradiation issue.

Mr. Muchaidze, UNDP, had earlier correctly expressed the point that in a country with all of the current economic and infrastructural problems that Vietnam faces one must be very cautious in introducing new and unfamiliar technologies. The expert

expressed his agreement, pointing out that the FAO/IAEA strategy has been, and continues to be one of very cautiously and prudently introducing irradiation technology into developing countries, first in a small-scale R&D manner, followed by scaling up to pilot plant level to determine overall industrial feasibility of promising technically feasible applications before supporting any move to full industrial scale whenever possible, as in the Vietnam case. The expert further pointed out that such preliminary phases receive much financial and other FAO/IAEA support, including training, and regional coordination meetings to foster communication and other interaction among various national groups, to minimize the pre-industrial phase costs and risks to participating member countries. This theme was taken up by Dr. Tuan as part of his closing comments. The session was video-taped, and segments were shown on television that evening and the next.

Thursday (3/21) Drs Chau and Quan, and Mr. Vinh accompanied the expert to Haiphong to visit the National Institute for Marine Products Research plus two State operated fishery products processing plants. The first stop was the Institute, where we visited with Prof. Dr. Bui Dinh Chung, Director; Deputy Director Nguyen Van Ngoan, marine products processing engineer, and, Dr. Do Van Khuong, Director of the Soviet-Vietnamese Seaweed Research and Technology Transfer Center at the Institute. The latter is very much involved in exploiting Vietnam's gracilaria resource for the production of agar-agar, said to be among the best in the world because of the quality of Vietnam's gracilaria. The expert was given samples of agar-agar to take back to Vienna for possible laboratory evaluation. The Institute, which has branches in several coastal locations, cooperates with VINATOM in marine product irradiation studies.

Following a discussion of Institute activities, comments by the expert on fishery product irradiation, and a tour of the facilities, Deputy Director Ngoan accompanied us to nearby Ha Long Fishcom for a visit with its' Vice-Director and General Manager, Mr. Do Ngoc Quy and his plant manager. Mr Quy explained that the firm's products include canned fish (e.g. sardines and tuna in soybean oil), canned meat, canned fruit (eg. pineapple), canned vegetables, frozen shrimp, fish and cuttle fish, animal feed (fish meal), agar-agar, and Vitamin A from fish livers. Export markets include Australia, Hong Kong, Japan, Europe and the USSR. This was followed by a tour of the processing plant which contained two Norwegian plate-contact freezers plus three Sabroe (Denmark) compressors, and, five Soviet-built retorts plus a steam boiler. The freezers were said to have a capacity of 2.4 mT/day each, taking product down to -18°C. A large walk-in freezer (-20°C) is also on-site. The plant employs between 650 and 1000 people depending on the level of activity, which fluctuates over each annual cycle. A large ice-making machine provides ample ice to maintain product in a well-iced condition prior to canning or freezing. At the time of the visit a large number of local women were preparing shrimp blocks for freezing under quite hygienic conditions, employing considerable ice at each work station (good GMP!).

In the afternoon, we visited a second State-run processing plant, the Haiphong Export Sea Products Processing Enterprise. Following an orientation meeting with Vice-Director Nguyen Thom and Hai Duong, a young lady food technologist in charge of quality control, we toured this newer and more modern plant of the two. It does strictly freezing preservation of fishery products (ie. no canning), plus agar-agar manufacture. About U.S. \$1.3 million worth of Japanese freezing and frozen storage equipment had been installed over the past five years. It is said to produce US \$2 million worth of product annually, much of it now exported to Australia, Japan, Hong-Kong, the USSR and elsewhere. The modest QC laboratory does basic chemical and microbiological analyses plus sensory testing to assure quality according to Vietnam National Standards Authority procedures. Smaller than the first plant, and at least as hygienic, this plant employs 250 people on average. One 40 mT/day ice making machine provides ample ice for product in temporary iced holding or undergoing preparation for freezing, including several shrimp/prawn varieties (white, yellow, brown, black tiger, etc.; wild-harvest and pond-raised). It exports 300 mT of frozen shrimp annually, much of it to Japan. A special Japanese (Nippon Suisan) label that they are permitted to use under Japanese inspection allows a 10% premium in the price. The excellent quality agar-agar is sold for 10,000 dong/Kg (about US \$1.35/Kg) in Vietnam, and much of it is exported (eg. to Japan). Following the tour the discussion session was continued, after which we departed for Hanoi to end the day.

The next (Friday) morning Drs. Chau and Quan and the expert went to the Ministry of Agriculture and Food Industry to meet with Vice Minister, Nguyen Thien Luan, International Cooperation Department Director, Nguyen Van Phuoc, and several food industry representatives. Assisted by an interpreter, the expert gave a broad overview of the current global and regional food irradiation status including the regulatory, industrial implementation, international trade aspects, and, public awareness/acceptance and the political controversy. There were a number of comments and questions by the group, which showed a particular interest in how and when irradiation might foster food exports. Drs. Chau and Quan provided the hosts with a description of the internal situation, including the activities and plans of the Irradiation Center, and its' new irradiator. The meeting continued until noon, whereupon it was adjourned.

The afternoon was devoted to a wrap-up meeting at the downtown Hanoi headquarters of VINATOM with the entire Irradiation Center group, plus VINATOM Head and Dept. of International Relations and Planning Director, Dr. Nguyen Tien Nguyen. Dr. Nguyen also attended a farewell dinner for senior staff and wives Friday evening, hosted by the expert to reciprocate for the generous hospitality afforded him all week long.

Saturday morning, before leaving for the airport several Irradiation Center professionals including Dr. Chau came to leave documents, including a "Protocol" of the weeks mission to be signed, plus mail, etc., for the expert to take back to Vienna. In the forenoon, Dr. Quan and Mr. Vinh accompanied the expert to the airport to assist with departure formalities. The expert departed for Vienna via Bangkok and Frankfurt, arriving Sunday (24th).

### III. CONCLUSIONS AND RECOMMENDATIONS

The expert was impressed with the size, quality and enthusiasm of the Irradiation Center professional staff, which also included several junior staff members (eg. Hoang Hoa Mai, physicist/dosimetrist; Ms. Dinh Phuong Thao, Nguyen Anh Tuan, Ho Minh Duc, Tran Man Hung, Luu Quang Hoa, Le Quang Hoa, Nguyen Dinh Duong, whom the expert met at the 1990 FIPCOS, and, Dr. Jung W. Nam. Though quite well trained and prepared, the group lacks pilot-scale irradiation experience and needs all the continuing support in terms of training and equipment/materials, etc., that the FAO/IAEA can provide.

A) **Government of Vietnam:** Continue the good support of the Irradiation Center and its collaboration with other State entities, and, with additional enabling food irradiation approvals as appropriate.

**FAO/IAEA:** Support all fellowships, other training, meeting travel and equipment/materials requests to the extent possible for this most deserving group. Specifically,

- It is recommended that payment not be made to the irradiator supplier, nor that the irradiator be formally accepted and turned over to VINATOM until the full terms and conditions of the contract are met including that the irradiator is demonstrated to be complete and in proper working order in every respect, including adequate spare parts, to the full satisfaction of VINATOM.
- Dr. A. Kovács of Hungary need not go to Hanoi as planned until the above recommendation is satisfactorily met and formal commissioning takes place. His questions per his telefax of 27 February 1991 to P. Loaharanu are addressed in this report plus the documents carried back to the FAO/IAEA and distributed by the expert (e.g. some necessary items of equipment and materials have yet to be provided to the Irradiation Center).
- This expert deems it desirable to make a second mission to Hanoi after the irradiator commissioning and Dr. Kovács's mission, when pilot scale irradiation is getting underway to assist this group with feasibility studies of promising applications.

IV. PERSONS CONTACTED

Mr. Nguyen Tien Nguyen	Director, Department of International Relations and Planning, VAEC
Dr. Nguyen van Chau	Director, Hanoi Irradiation Center (HIC)
Dr. Vo Van Thuan	Vice-Director, Hanoi Irradiation Center (HIC)
Dr. Vo Hoang Quan	Head, Food Irradiation Laboratory, (HIC)
Dr. Hoang Hoa Mai	Head, Dosimetry and Radiation Chemistry Laboratory, (HIC)
Mr. Dinh Ngoc Lan	Dosimetry Laboratory, (HIC)
Mr. Pham Quang Vinh	Food Irradiation Laboratory, (HIC)
Mr. Ho Minh Duc	Chief Operator, (HIC)  (other HIC staff)
Mr. Nguyen Thien Luan	Vice Minister, Agriculture and Food Industry
Mr. Nguyen Van Phuoc	Director International Cooperation Department, Ministry of Agriculture and Food Industry  plus food industry representatives
Mr. Le Van Thien	Secretary General, Association for Standardization Metrology and Quality Control, and Director of Vietnam Consumers Association
Mr. Huang Manh Tuan	Deputy Director General, Department of Standardization and Metrology and Quality Control and Chairman, National Standards Association

Prof. Tu Giay

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Dr. Bui Minh Duc

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