INTERNATIONAL ATOMIC ENERGY AGENCY

PROJECT DESK EVALUATION OF A MODEL PROJECT

CPR/5/009

INDUSTRIAL SCALE IRRADIATION OF RICE AND OTHER FOODSTUFFS

EVALUATION SECTION

DEPARTMENT OF TECHNICAL CO-OPERATION

IAEA-PDE-96/01
November 1996
Original: ENGLISH

TABLE OF CONTENTS

ABSTRACT

The project CPR/5/009 was approved in 1993 as a model project. The project objective was to build an industrial food irradiation facility for high quality rice and other foodstuffs, with a processing capacity of 5000-9000 tonnes per year. This capacity is large compared to many other facilities of the same type elsewhere. The success of the project was to be measured against the full utilization of the facility with an acceptable availability factor. Disbursements on Agency inputs up to the end of June 1996 were $294,716 and consisted of one 100 kCi Co-60 source, quality control equipment, bag heat sealers, one expert mission and 13.5 months of training abroad. The current budget is $323,870, following two programme changes. The total cost of the project was estimated at $1,331,300 with the Chinese Government providing the balance.

The major conclusions of this evaluation are as follows:

- The existence of solid national expertise in the design of similar projects was an important asset to the project. However, some delay and additional cost resulted from not using this available national expertise in designing and constructing similar plants to develop the detailed design, and to supervise the manufacture of equipment. However, this delay, which amounted to some nine months, does not pose a significant risk to achieving the overall objectives, if the appropriate measures are taken. The design improvements currently being implemented into the as-built irradiator will increase its availability by reducing unplanned downtime.

- Initially, the Agency overestimated the project and business management experience of the counterpart, and consequently underestimated the extent of support required. Providing support to counterparts in facing the key challenges of project management and business operation must be considered by the Agency in future projects of this type. The counterpart institution is also encouraged to emphasize these management issues in order to maximize sustainable and cost-effective utilization of such facilities.

- A new operational plan has been prepared by the counterpart for 1996 through 1998 which identifies seven customers requiring treatment of a total of 1000 tonnes per year of cereal grains and 1500 tonnes per year of other foodstuffs. This plan reflects a change in overall emphasis from supporting food supply security to ensuring the safety of foodstuffs. It is not clear whether this plan will support operation of the facility at full capacity. The team in place to operate the facility also needs further strengthening.

EXECUTIVE SUMMARY

Background

The project counterpart, the Institute for the Application of Atomic Energy of the Chinese Academy of Agricultural Sciences, is the national centre for the application of nuclear methods to agriculture. The immediate goal of the food irradiation programme in China was to build an industrial-scale food irradiation facility for high quality rice and other foodstuffs with a processing capacity of 5000-9000 tonnes per year, and to use it to increase the food supply to Beijing. The success of this project was to be measured against the full utilization of the facility with an acceptable availability factor.

The project CPR/5/009 was approved in 1993 as a model project. Disbursements on Agency inputs up to the end of June 1996 were $294,716. The current budget is $323,870, following two programme changes. The total cost of the project was estimated at $1,331,300, with the Chinese Government providing the balance.

The present evaluation was requested by the senior management of the Technical Co-operation Department to assess the progress made by the project towards its intended impact, versus its performance indicators so as to learn any lessons for similar projects in the future. The major conclusions of this evaluation are as follows.

Efficiency

(a) The assessment of project design rated as of "**Acceptable Satisfaction**" based on:
- The project design utilized an existing concept developed by national experts.
- However, the project and business management experience of the counterpart was overestimated by the Agency and the necessary support was thus not given.

(b) The assessment of project implementation rated as of "**Low Satisfaction**" based on:
- Some locally and Agency-supplied equipment was not fit-for-purpose and needed replacement or modification. Some weakness in overall project co-ordination are apparent.
- Expert assistance was not timely and the duration was insufficient.
- Design modifications are still being conducted.

(c) However, the following aspects rated as of "**Acceptable Satisfaction**":
- The implementation of the budget was adequate and in the main, the slippage to the established time schedule was out of the control of the counterpart.
- Adequate training was provided by the Agency.

Following an initial delay to the commencement of construction, due to the estimated building costs being higher than budgeted, further delays occurred to the commencement of commissioning due to the need to replace or modify locally supplied equipment that was inadequate or incorrect. The problem with this locally supplied equipment arose due to lack of co-ordination between designer and manufacturer. In addition, lack of fitness for purpose of the optical microscope and the laboratory heat sealer supplied by the Agency led to a need for re-purchasing.

Recommendation 1

Providing support to counterparts in facing the key challenges of project management and business operation must be considered by the Agency in future projects of this type. The Counterpart institution is urged to emphasize these management issues in order to maximize sustainable and cost-effective utilization of the facility.

In particular, most of the difficulties with the engineering design of projects of this nature may be overcome if, in future, consideration is given to the need for a design review at an early stage and regular follow up by an independent expert provided by the Agency.

Effectiveness

The project objectives had not been achieved at the time of the review.

While at the time of the review the facility was still not operating as expected at the outset of the project, there is, however, confidence that once commissioned the plant should be capable of operating to a good availability factor and in a safe manner. A small group of three technicians are available to operate the facility. In addition, a quality control plan has been outlined by the counterpart to ensure that the process performs in a consistent manner.

Recommendation 2

The team in place to operate the facility needs further strengthening, both in number and qualification, through training in national industries.

Progress Towards the Intended Impact

Very little treated rice has been made available for public consumption beyond that sold in two Beijing supermarkets as part of a public acceptance campaign held in February of this year.

A new operational plan has been prepared for 1996 through to 1998, which identifies seven customers requiring treatment of a total of 1000 tonnes/annum of cereal grains and 1500 tonnes/annum of other foodstuffs, indicating a slight change in emphasis of the project away from that of supporting food supply security to ensuring the safety of foodstuffs. However, the absence of a marketing function poses some concerns with regard to achieving the intended objectives.

Recommendation 3

The counterpart would be well advised to introduce a service marketing function to reach the end users of the facility and ensure cost-effective operation.

Risks and Opportunities on Sustainability

The positive factors for sustainability are the following:

(a) The outlined operational plan, although not yet clearly demonstrating full utilization of the irradiator, constitutes a positive step towards establishing sustainabilty.

(b) The existence of an annual operating budget, which should increase as sales commence, is a positive factor for sustainability.

(c) National availability of opportunities for training operators, in dose control, quality assurance and general operational matters.

The main concern regarding sustainability is the ability, or otherwise, of the Institution to run a commercial venture, when the input from management skilled in such matters is lacking.

1. INTRODUCTION

1.1. PROJECT BACKGROUND

The FAO estimates that up to 30% of the world's fresh food is lost after harvesting, due to insect infestation, mold growth and sprouting. Conventional methods of disinfestation involving the use of insecticides or chemical fumigation have detrimental effects on humans and the environment due to toxicity, and are being increasingly restricted. In China, considerable attention has therefore been given in recent years to the use of irradiation to disinfest grains, meat products, beans and seafood, and to increase the shelf-life of apples.

The Institute for the Application of Atomic Energy of the Chinese Academy of Agricultural Sciences is the national centre for the application of nuclear methods to agriculture. The Institute has engaged in research into applications of irradiation since its establishment in 1960, and also co-ordinates related research activities in 21 provinces nation-wide. It has experience in operating a 4000 Ci cobalt-60 irradiator. In 1993, the Institute turned to addressing the problem of increasing the supply of food commodities and initiated a major technology transfer programme on commercial-scale disinfestation of rice, since the production and sale of high-quality rice is stopped during the season in which infestation is greatest.

The immediate objective of the food irradiation programme was to build an industrial-scale food irradiation facility for high quality rice, with a processing capacity of 5000-9000 tonnes per year, to increase the food supply to Beijing. The facility was to be located near the Institute for the Application of Atomic Energy, which directed the programme under the sponsorship of the National Committee of Science and Technology.

With the facility in operation, attention was to turn to optimizing processing technology, including dose control and product quality. In addition, problems involving packaging, transport, public acceptance, economic benefits and export possibilities were to be studied. In the future, other agricultural products, such as chestnuts, spices and some industrial products, were also to be treated in the facility. As the programme progressed, the use of radiation in food preservation was to be promoted throughout the country and the technology transferred to other Chinese research facilities.

At the outset, it was understood that a partnership had been formed between the Institute and the Beijing Jinliang Cereal Products Company, a company already engaged in the production and marketing of rice and other cereals, who would be responsible for distribution of the irradiated products. The intended schedule was to treat and distribute 5000-9000 tonnes of rice and other grains per year by the end of 1996.

In 1994 the IAEA agreed to support the project and adopted it as a model project, as it was seen to have the potential to bring major benefits to end users in the short term. Further, it would clearly demonstrate the advantage and cost-effectiveness of nuclear techniques over other methods of treatment. The success of the project was to be measured against the full utilization of the facility with an acceptable availability factor.

1.2. REASONS FOR THE EVALUATION

Following the setting of performance indicators for all model projects in 1995, the management of the Technical Co-operation Department requested the evaluation of this project during 1996, to assess the progress made against said indicators and to learn any lessons for similar projects in the future.

The detailed Terms of Reference for the evaluation are attached in Annex A1.

1.3. THE EVALUATION PROCESS

This evaluation was based on the "Integrated Evaluation Framework" developed by TC Evaluation during the early part of 1996.

The evaluation consisted of a desk review of project activities since its inception in 1994, based on project documentation available within the Agency's files and interviews with Agency staff involved in the project. The data reviewed included both technical and financial data. This information was used to assess efficiency and effectiveness. Impact, continued relevance and sustainability were assessed using in addition the replies given by the counterpart in response to a questionnaire which he was asked to complete.

The report is divided into the following main sections. Section 2 presents in more detail the evaluation methodology as tailored to this project; Section 3 presents the results and major conclusions of the evaluation. Annexes A1, A2 and A3 contain the Terms of Reference for the evaluation; a summary of the project plan and the progress to date; and the questionnaire completed by the counterpart, respectively.

2. EVALUATION METHODOLOGY

2.1. AREAS OF ASSESSMENT

The evaluation framework applied in this exercise is based on the Logical Framework Approach (LFA)[1] for project design. The general definitions adopted and the relationships between the evaluation concerns and the elements of project design are represented in Figure 2.1.

Figure 2.1 – Evaluation Concerns

<table>
<tr><th>PROJECT DESIGN ELEMENTS</th><th>EFFICIENCY</th><th>EFFECTIVE-NESS</th><th>IMPACT</th><th>RELE-VANCE</th><th>SUSTAINA-BILITY</th></tr>
<tr><td>OVERALL GOAL</td><td></td><td></td><td rowspan="2">The positive and negative changes produced, directly or indirectly, as a result of the project or programme</td><td rowspan="3">The degree to which the objectives of a project are, or remain, pertinent, significant and worthwhile, in relation to the identified priority or needs and concerns</td><td rowspan="4">The extent to which partner country institutions will continue to pursue the objectives and goals after external assistance is terminated</td></tr>
<tr><td>PROJECT OBJECTIVE</td><td></td><td rowspan="2">A measure of the extent to which a project or programme is successful in achieving its purpose</td></tr>
<tr><td>OUTPUTS</td><td rowspan="2">A measure of "productivity" of the project process - how economically inputs are converted into outputs</td><td></td></tr>
<tr><td>ACTIVITIES + INPUTS</td><td></td><td></td><td></td></tr>
</table>

Efficiency is a measure of how economically inputs are converted into outputs. It is defined as the sum of the following factors: (a) *project design quality*, measured by the appropriateness and linkage of inputs and the activities that transform them into outputs; (b) *project implementation*, measured by adherence to schedule; timeliness and fitness-for-purpose of inputs, and budget utilization; and (c) *management performance*, measured by the ability to monitor progress and take corrective actions. Cost-effectiveness was assessed by comparing the approach adopted with other options.

[1]Adapted from "Evaluation, Based on the Project Cycle Management Method", March 1994, by K. Samset, Scanteam International, Oslo, Norway. Developed for the Foundation for Advanced Studies on International Development, Japan.

Effectiveness is a measure of the extent to which the project objective has been achieved or is likely to be achieved, qualitatively and quantitatively, as per the performance indicators.

Impact is a judgment on the extent to which the project has contributed (positively or negatively) to the overall goal.

Relevance is a judgement on the extent to which the project addressed a national priority, adopting a commensurate design approach.

Sustainability is a measure of the extent to which the achievements of the project can be expected to last after the project is terminated.

2.2. EVALUATION PROCESS

(a) The inputs from various sources and their links and relationships with the project activities, outputs and goals are discussed in Annex A2. The project was conceptualized as represented in Figure A2.1 of Annex A2.
(b) Compliance with the pre-established performance indicators was reviewed and analysed at the level of inputs, activities, outputs, objective and goal, as summarized in Table 2.1.
(c) The evaluation questions associated to the key determining factors in each of the areas of assessment are summarized in Table 2.2, together with the methods used to address them and the estimated reliability of the information obtained.
(d) Based on the answers to the evaluation questions, the evaluation matrix included in Section 3 was constructed and the ratings assigned.
(e) The evaluation findings and recommendations relate to the ratings assigned and aim at further enhancing the positive aspects, while reducing the risks.

2.3. RATING SYSTEM

Judgements were made against each evaluation question as to whether they were of High, Acceptable or Low Satisfaction or Not Achieved.

The assessment of efficiency was conducted as follows:

(a) The accomplishment of the key questions concerning efficiency identified in Table 2.2, i.e. quality of project design, performance and quality of Agency and counterpart inputs, achievement of project schedule, budget implementation and project management, are analysed and rated as indicated in Section 3.
(b) Cost-effectiveness was assessed against the market and operations plan, which will also ensure meeting the project objectives.

The assessment of effectiveness was measured versus the performance indicators adopted for the project, identified in Table 2.1.

Table 2.1 - Performance Indicator Matrix

Project Design	Verifiable Indicators	Means of Verification	Assumptions
Overall Goal:	• Quality rice and other foodstuffs available to Beijing market outlets, with reduced losses (10% reduced to 5%).	• Results of quality control programme.	Irradiation results in acceptable shelf life of 2 years.
Project Objective:	• 5,000-9,000 tonnes of rice and other foodstuffs treated per annum from 1995.	• Project progress reports.	Rice and other foodstuffs delivered to irradiator.
Outputs:	• Trained staff. • Facility operating to full capacity and with adequate availability factor.	• Project progress reports.	Construction proceeds according to schedule.
Inputs/Activities:	• Milestones in work plan. (time, quality, quantity).	• Project progress reports.	Design already completed in 1993 is acceptable.

Table 2.2 - Evaluation Questions and Instruments

AREA OF ASSESSMENT	EVALUATION QUESTIONS	METHODS	RELIABILITY
Efficiency:			
* Project design * Project implementation and management * Counterpart inputs	• Were the aspects requiring assistance adequately identified and supported. • Were Agency inputs fully connected to the project outputs and objectives. • Was the project completed within the budget and was the budget utilized efficiently. • Was 'fit-for-purpose' equipment ordered to time and within cost. • Were the IAEA inputs of expert advice, specialized equipment and training delivered to the necessary standard and in a timely manner. • Were the design of the facility, the construction, equipment fabrication and installation adequately conducted. • Were project milestones met in accordance with the project time schedule.	Desk Review and Questionnaire	Medium
Effectiveness:			
	• Are there sufficient trained staff to manage and operate the facility. • Has the treatment of other foodstuffs been demonstrated. • Is the facility operating at the planned utilization rate (hrs/day) and throughput (tonnes/day).	Questionnaire	Medium
Impact:			
	• Does an operational plan for the next 2-3 years exist which ensures cost-effective utilization of the facility. What foodstuffs, other than rice, are to be treated by the facility.	Questionnaire	Medium
Relevance:			
	• Has the shelf-life and reduced loss been demonstrated. • Are irradiated foodstuffs accepted by the Beijing public. • Are there plans in China to phase out the use of chemical treatment.	Questionnaire	Medium
Sustainability:			
	• Are plans in hand to train replacement personnel and to expand the technology. • Is a marketing plan available	Questionnaire	Medium

3. EVALUATION RESULTS

3.1. OVERALL ASSESSMENT

The assessments made of the different evaluation concerns are presented in Table 3.1.

Figure 3.1 - Overall Evaluation Matrix

PROJECT DESIGN	EFFICIENCY	EFFECTIVE-NESS	IMPACT	RELEVANCE	SUSTAINA-BILITY
OVERALL GOAL Quality rice and other foodstuffs available to Beijing market.			-Sufficient throughput of products is still to be ensured.		-A service marketing function not yet introduced.
PROJECT OBJECTIVES 5,000-9,000 tons of rice and other foodstuffs treated per annum from 1995.		**Objectives not yet achieved:** -Operational problems still prevent reasonable availability of the facility. -Number of operating staff is small.			
PROJECT OUTPUTS -Trained staff. -Facility operating to full capacity and with adequate availability factor.	**PROJECT DESIGN - Acceptable Satisfaction:** -Adequate original project concept. -Key support needed in project and business management neither requested nor provided.				
Inputs/Activities: Counterparts- -Design -Construction -Equipment -Manpower IAEA: -Experts -Special equipment -Training	**PROJECT IMPLEMENTATION - Acceptable Satisfaction:** -Adequate time schedule and budget management. -Adequate Agency-supported training; further local training for operation staff needed. **Low Satisfaction:** -Equipment input: some locally and Agency-supplied, not fit-for-purpose, needed replacement. -Expert assistance not timely and duration insufficient. -Design modifications still needed.				

3.2. EFFICIENCY

(a) The assessment of project design rated as of "**Acceptable Satisfaction**" based on:
- The project design utilized an existing concept developed by national experts.
- However, the project and business management experience of the counterpart was overestimated by the Agency and the necessary support was thus not given.

(b) The assessment of project implementation rated as of "**Low Satisfaction**" based on:
- Some locally and Agency-supplied equipment was not fit-for-purpose and needed replacement or modification. Some weakness in overall project co-ordination are apparent.
- Expert assistance was not timely and the duration was insufficient.
- Design modifications are still being conducted.

(c) However, the following aspects rated as of "**Acceptable Satisfaction**":
- The implementation of the budget was adequate and in the main, the slippage to the established time schedule was out of the control of the counterpart.
- Adequate training was provided by the Agency.

When the project was adopted by the Agency in 1994 the national decision to proceed with the project had already been taken and the design of the facility was nearing completion and a contract for construction was about to be placed. The design was being undertaken by the Beijing Institute for Nuclear Engineering. In addition the project was being carried out with an understanding that the Beijing Jinliang Limited Company, a company already engaged in the production and marketing of rice and other cereals, would be involved. The facility was scheduled to be in operation by the second quarter of 1995.

During implementation faults in the design, and in the local manufacture of equipment, by the Sichuan Tianyuan Machinery factory, delayed the completion of the facility. There was a lack of co-ordination between the designers and manufacturers. In particular, the design and manufacture of the source rack and automated conveyor system needed to be modified. The loading of the cobalt-60 source took place in October 1995, but commissioning was still being hampered because the re-manufactured food transportation system was still not running smoothly.

The initial project schedule was amended on a number of occasions due to an initial delay with the funding followed by the above mentioned problems. The ensuing delay has resulted in an overall slippage of some 9 months to commencement of operation.

The counterpart has outlined the previous experiences of the two main contractors for construction and equipment manufacture and concedes that, although both are well established industrial companies, the Tianyuan Machinery Factory at Sichuan lacked experience in manufacturing equipment to the required quality standard.

As regards the supply of equipment, the Agency supplied a 100 kCi cobalt-60 source, an incubator, a stereo-microscope, a UV/VIS spectrophotometer, an optical microscope, a laboratory heat sealer and a commercial-scale bag heat sealer. Lack of fitness for purpose of the optical microscope and the laboratory heat sealer led to a need for re-purchasing.

The IAEA input into the project consisted of the provision of expert advice on disinfestation, packaging, process control, dosimetry and source loading, some specialist equipment and the funding of fellowships and scientific visits. Only one expert mission has taken place to date. The counterpart, in answering the questionnaire, has expressed extreme satisfaction with the outcome of the expert visit that did take place and has commented that expert support would have been even more effective if it had been regular from the beginning of the project.

Recommendation 1

Providing support to counterparts in facing the key challenges of project management and business operation must be considered by the Agency in future projects of this type. The counterpart institution is urged to emphasize these management issues in order to maximize sustainable and cost-effective utilization of the facility.

In particular, most of the difficulties with the engineering design of projects of this nature may be overcome if, in future, consideration is given to the need for a design review at an early stage and regular follow up by an independent expert provided by the Agency.

3.3. EFFECTIVENESS

The project objectives had not been achieved at the time of the review.

However, there is confidence that, once fully commissioned and rice and other foodstuffs become available for treatment at the anticipated rate, the plant should be capable of operating with good availability factor and in a safe manner. A small group of technicians are available to operate the facility but this aspect needs to be enhanced.

From the information supplied in the answers to the questionnaire, it would appear that when in commercial scale operation the number of support staff required to load and unload the products being irradiated has been underestimated by the counterpart.

Recommendation 2

The team in place to operate the facility appears to need further strengthening, both in number and qualification, through training in national industries.

3.4. PROGRESS TOWARDS THE INTENDED IMPACT

Very little treated rice has been made available for public consumption beyond that sold in two Beijing supermarkets as part of a public acceptance campaign held in February of this year.

A new operational plan has been prepared for 1996 through to 1998, which shows a gradual annual increase in throughput from 1300 tonnes in 1996 to 3500 tonnes in 1998 and which identifies seven customers requiring treatment of a total of 1000 tonnes per year of cereal grains and 1500 tonnes per year of other foodstuffs. This plan indicates an apparent slight change in emphasis of the project away from that of supporting food supply security to ensuring the safety of foodstuffs. Whether this is an expediency, due to lack of supply of rice and other grains for irradiation, is not clear to this review. A quality control plan has been outlined by the counterpart to ensure that the process performs in a consistent manner. Both the operational plan and the quality plan need to be adhered to and continuously refined.

An important aspect of this project, if continuous operation as an industrial-scale business is to be achieved, are the roles of the operations manager and marketing manager. They need to be experienced in business management, a quality not always appreciated by the scientific community. These roles and responsibilities need to be addressed if impact is to be achieved.

Recommendation 3

The counterpart should introduce a service marketing function to reach the end users of the facility and ensure cost-effective operation.

3.5. RISKS AND OPPORTUNITIES ON SUSTAINABILITY

The outlined operational plan, identifying a number of customers for the years 1996 to 1998, although not yet clearly demonstrating full utilization of the irradiator, constitutes a positive step towards establishing sustainabilty.

The core key staff required to operate the facility are in place, consisting of two scientists, four technicians and support staff. Taking into account the level of manual operation of the facility, such a team needs strengthening to ensure sustainability. The existence of an annual operating budget, quoted as being 6.7% of the total investments, of which about 20% is for maintenance or upgrading of the facility, is a positive factor for sustainability. As income from sales commences, the funds available for operation should increase in parallel, thus ensuring sustainability. Training of operators in dose control, quality assurance and general operational matters is available nationally, thus also contributing to sustainability.

The main concern regarding sustainability is the ability, or otherwise, of the Institution to run a commercial venture, when the input from management skilled in such matters is lacking.

ANNEX A1.

TERMS OF REFERENCE

I. Background

In 1993 the Institute for the Application of Atomic Energy of the Chinese Academy of Agricultural Sciences began to address the problem of increasing the supply of food commodities to Beijing. In particular, a research programme on the commercial-scale disinfection of rice was initiated. The immediate goal was to build an industrial-scale food irradiator having a capacity to treat 5,000 - 9,000 tons of rice per year.

A request was made for Agency support, through the provision of expert services, training and specialized equipment. The project was approved and adopted as a model project in 1994. The current budget for Agency input in 1994 and 1995 was $323,870 and disbursements up to May1996 were $294,716.

II. Scope of Objectives of this Review

In 1995 performance indicators were defined for this project, namely, the full utilization and availability of the irradiation facility and the demonstration of fewer food losses. This evaluation is envisaged to determine:

- the adequacy and quality of the project design;
- the progress made with demonstrating the performance indicators/success criteria;
- the progress achieved towards the overall goals and its objectives, in particular the intended impact;
- the adequacy and relevance of the Agency's inputs;
- the relevance of the project's outputs versus the overall goal;
- the steps being taken to ensure sustainability.

III. Evaluation Methodology and Procedures

Project background material will be desk reviewed and internal interviews held to assess efficiency and effectiveness. Impact, relevance and sustainability issues will also be addressed by desk review and by feed-back from a questionnaire completed by the counterpart as follows:

- Project Efficiency:

  - The adequacy and quality of the project design - activities and inputs - and their link with the project's outputs and objectives;
  - The project work plan and budget implementation;
  - The relevance of the project's outputs versus its objectives.

- Project Effectiveness:

  - The progress achieved to date towards the intended objectives;
  - The cost-effectiveness of the equipment delivered in the framework of the use foreseen within the present project and in future activities;
  - The effectiveness of other IAEA inputs (training, fellowships, experts and visits) in meeting their intended objective.

- Project Impact:

- The quantity of rice and other food stuffs to be treated annually by the facility.
- The progress made in developing outlets for the product
- The reduction in food loss directly attributable to the facility.

- Continued Project Relevance

- The role played by this facility in further promoting this nuclear technique;
- The public acceptance of this process;
- Demonstration of the reduced losses of foodstuffs and the increase in shelf life.

- Project Sustainability

- The demand for the services of the facility for 1997 and beyond;
- The training programmes for training future operations staff;
- The development programmes for investigating the use of this technique for reducing losses of other fresh foods;
- The steps taken to ensure continued operation of the facility.

IV. Evaluation time-table

Desk review of background material .... 31 March 1996
Distribute questionnaire to counterpart .... 1 July 1996
Draft report .... 31 July 1996
Final report completed 1September 1996

V. Resources

The cost of the evaluation is charged to IAEA administrative funds.

ANNEX A2.

PROJECT SUMMARY

PROJECT SUMMARY

A2.1. PROJECT DATA

PROJECT NUMBER: CPR/5/009.

PROJECT TITLE: Industrial Scale Irradiation of Rice and other Foodstuffs.

SECTORS: 5H, Food preservation

PROJECT TIME-SPAN: 1994-1995

The project counterpart was Professor Shi Peixin of the Chinese Academy of Agricultural Sciences.

The approved budget for Agency support was $248,850. Two subsequent programme changes have resulted in a current budget of $323,870, distributed as shown in Table A2.1. Also shown in this figure are the disbursements up to June 1996.

Table A2.1 - Current Budget and Disbursements ($)

Year	Experts	Equipment	Fellowships	Total
Current Budget				
1994	10,800	200,000	22,050	232,850
1995	20,520	54,000	16,500	91,020
Total	31,320	254,000	38,550	323,870
Disbursements				
1994	1,697	23,694	-	25,392
1995	21,706	191,494	26,487	239,688
1996	-	29,635	-	29,635
Total	23,403	244,825	26,487	294,716

The total cost of the project was estimated at $1,331,300. The Chinese Government, through an annual loan, has supplied the remaining funds.

A2.2. PROJECT OBJECTIVES

The immediate objective of the project was to support the construction of an industria- scale food irradiation facility by the Academy of Agricultural Sciences, capable of processing 5000-9000 tonnes annually of rice and other agricultural products, to meet the market demand in the Beijing area.

Once the safe operation of the facility was successfully demonstrated, the intention was to spread the technology and experience in the treatment of rice and other foodstuffs as part of the national programme on the commercialization of food irradiation.

The IAEA contribution included the supply of expert advice on nuclear techniques and good practice, the delivery of defined specialist equipment (including a 100 kCi cobalt source), and training of scientists and technicians. This was to ensure that there was a trained team capable of operating the facility in a safe and efficient manner.

A2.3. PROJECT ACTIVITIES AND WORK PLAN

In 1993. China put forward a request for Agency support, and this was approved as a model project for funding in 1994-1995. The national decision to proceed with the project had already been taken before Agency approval was received. Thus, by 1994 the design of the facility was nearing completion and a contract for construction was about to be placed. The design was being undertaken by the Beijing Institute for Nuclear Engineering. In addition it was understood that the project was being carried out in co-operation with the Beijing Jinliang Limited Company, a company already engaged in the production and marketing of rice and other cereals.

At the outset, a work plan was agreed which outlined key dates as follows:

Civil engineering construction .... complete 31 Oct. 1994
Training of operating personnel .... complete 31 Dec. 1994
Cobalt source and assoc. equipment ....delivered 1 Feb. 1995
Installation of equipment .... start 1 Feb. 1995
....completed 15 March 1995
Commissioning and test run.. start 15 Feb. 1995
....completed 30 April 1995
Normal operation .... start April 1995

Due to delays, first with national funding caused by an unexpectedly high inflation rate of more than 10%, followed by equipment manufacture difficulties, this work plan was amended on a number of occasions, resulting in an overall slippage of commencement of operation to January 1996, that is an overall delay of some 9 months. The original work plan and the eventual outcome is as shown in Table A2.2.

A schematic of the inputs, activities and outputs for the project is given in Figure A2.1. This figure outlines the relationship between the IAEA and the other organizations involved in the project, as well as their interdependence.

A2.4. IAEA INPUTS

A2.4.1. Experts

Two expert missions were planned, the first to advise on disinfestation and packaging and the second to provide advice on process control, dosimetry and source loading.

The first expert mission has been postponed three times and has recently been scheduled for October 1996. The delays occurred due to unexpected delays in loading the Co-60 source into the facility, following the need to replace or modify some of the locally made equipment. The planned duties for this two week mission are:

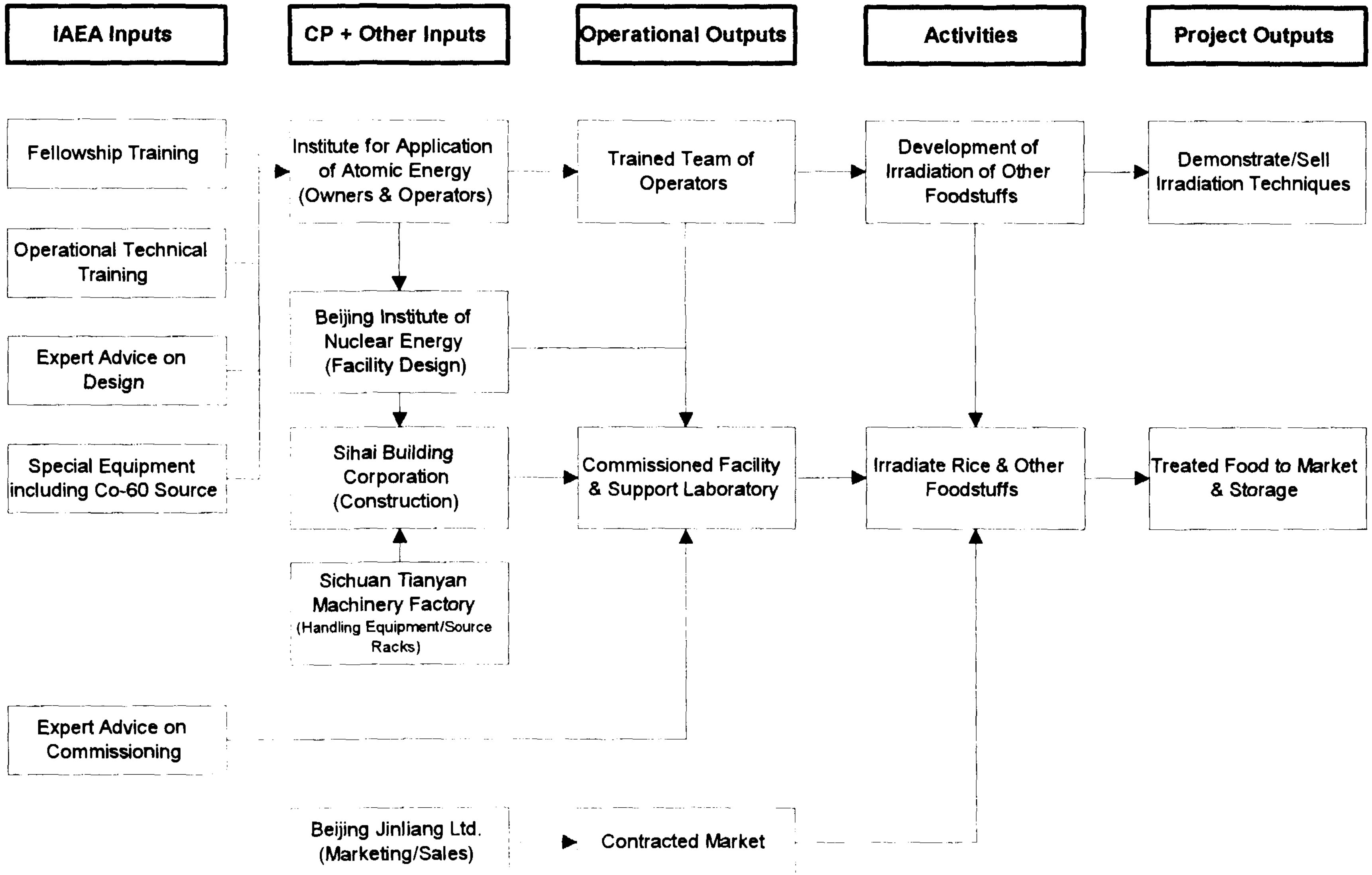
(a) The establishment and application of the National Codex Standard for food irradiation during processing, storage and fresh-keeping.

TABLE A2.2 - ORIGINAL WORK PLAN AND OUTCOME

INDUSTRIAL-SCALE IRRADIATION OF RICE AND OTHER FOODSTUFFS (CPR/5/009)													
		1994				1995				1996			
	ACTIVITIES	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
1	Project Approval	x■[1]											
2	Design Phase	xxxxxx■♦											
3	Civil Engineering Construction	xxxxxxxx	xxxxxxxx	xxxxxxxx	xx■-----♦								
4	Fellowship CPR/94005		xxx	xxxxxxxx	xxxxx■--	------- -	-------------	♦					
5	Equipt. manuf. (i.e. Source/Product Handling. Control panel etc.)		xxxxxxx■x	xxxxxxxx■	------------- -	♦							
6	Training Oper. staff		xxx	xxxxxxxx	xxxxxx♦								
7	Equipment (Item 2-5 RFP-1)				xxxxxxx■	-----------	♦						
8	Expert (-01) Irradiation/ disinfestation (1 month)				xxxxxxx■						xxxxxxxxx		
9	Equipment Co-60 source (RFP 1, Item #1)					xxx■♦							
10	Start Installation of Facilities				+	xxx■♦							
11	Fellowship CPR/96028						xxxxxxxxx	xxxxxxxx■			xxxxxxxxx		
12	Installation Completion					xxxx■	------------- -	------------- -	--------♦				
13	Expert (-02) Process Control						xxxxxx■♦						
14	S.V.'s (Two #)						xxxxxxxx	xxxxxxx♦					
15	Commissioning and Test Run					xxxxxxxx	xxxx■-----	------------- -	------------- -	------------- -			
16	Start Operation						xxxxx■----				xxxxxxxxx		

1 ■ Planned Completion Date
♦ Actual Completion Date

Figure A2.1 - Schematic of Inputs, Activities and Outputs



(b) The microbial analysis and the change of the food in colour, smell, and taste after irradiation processing.
(c) The commercialization and consumer acceptance of irradiation disinfestation, including market survey and economic benefits.

The second expert mission took place during May-June 1995. The planned duties for this 30-day mission were to:

(a) Provide training on food irradiation process control and dosimetry.
(b) Provide assistance during source loading and commissioning of the facility.

The expert helped to install the facility's process control programme, inspected the equipment rooms and the irradiation facility, measured the Institute's dosimeters and compared them with his own dosimeter. The instructive recommendations and proposals he put forward for the irradiation facility were accepted and provided for improvements to the facility. However, the major intent of this expert mission was to provide assistance during source loading and commissioning, including dose rate mapping and dosimetry evaluation during source loading. Since the source could not be loaded before his departure, the effectiveness of the mission was reduced. Before leaving, however, the expert achieved the following:

- Transferred the expertise to the counterpart staff on the steps to be taken during commissioning and on the dosimetry requirements.
- Provided training on dosimeters and calibration methods.
- Carried out rate and dose measurements and mapping using chemical dosimeters, physical rate meters, and computer modelling.
- Gave a lecture and consultations on gamma irradiation of food.
- Provided relevant literature on gamma irradiator and dose rate mapping computer programmes.

The expert concluded that the estimated plant capacity for rice is between two and three tonnes per hour when using the 100 kCi cobalt source. The annual throughput is thus a minimum of 9000 tonnes with one shift of eight hours per day over 300 days per year. The annual rice irradiation is planned to be 8000 tonnes and during the rest of the time other agricultural products can be irradiated. Advice on the preparation of various goods to be irradiated was also provided to the staff.

He further concluded that the irradiation unit, before commissioning, was in a safe condition and that completion of the dose rate distribution of the irradiation room, labyrinths, outside shielding walls could be finished by the operating staff.

His recommendations to the counterpart institution were that they should:

(a) Install a calibrated ECB chemical dosimeter system.

(b) Find a locally available semiconductor detector unit for regular dose rate control of the radiation technological process, and for the regular control of the exposure of materials to be irradiated.

(c) Introduce dose indicators for the materials to be irradiated.

(d) Provide a portable dose rate monitor for the operating staff to control the safe daily operation of the facility.

(e) Ensure a separate and well equipped chemical dosimetry laboratory.

(f) Since the operated irradiation units cannot provide high dose rate, the national secondary standardization institute, and the IDAS control should be called in.

(g) Ensure a fellowship of 3-4 months duration for one radiation chemist, or for one nuclear engineer.

(h) Participate in the IAEA regular operated IADS programme.

(i) Provide TLD dosimeters for low and medium dose ranges from 1 krad to 500 krad.

(j) Keep the pilot irradiator for sample irradiation, because a gamma cell type irradiation unit is missing.

(k) For the future, increase the source activity and geometry for high dose, fast sample irradiation.

(l) The new food demonstration facility needs increased activity in scientific and experimental capacity of irradiation.

His recommendations to the Agency were that it should:

(a) Support the Institute to purchase the ECB dosimeter system, including the computer controlled interface and 1000 pieces of ECB dosimeters for immediate use (approximately $3000).

(b) Support, in 1995-1996, scientific visits, fellowships, and training abroad in the field of high dose dosimetry.

(c) Support the Institute with one set of Alanine dosimeters, to be used to calibrate the field of the pilot irradiator by the IDAS (approximately $100).

(d) Consider to have the expert return to support source loading and dosimetry utilization.

In addition to the expert mission to China, the project funded visits by Chinese staff members of the Academy of Agricultural Sciences to the IAEA (L. Wang) and to a National Workshop in Sri Lanka (P. Shi). At both venues they imparted their views and experiences on irradiation of foodstuffs and the progress with this project, as well as other matters.

A2.4.2. Equipment

The initial request to the Agency was for a 100 kCi Co-60 source, chromatography system, gas chromatograph, and UV/VIS spectrophotometer. However, no technical specifications were given for this equipment and only the manufacturer and model number were provided. Upon Agency approval of the project the Technical Officer determined that the chromatography system and the gas chromatograph were for research purposes and did not meet the criteria of this model project, which was to establish a commercial-scale irradiation facility for high quality rice and other grains, for which food irradiation methodology has been well established. Once the initial requisitions were approved the counterpart continued to request additional equipment, including an additional 50 kCi Co-60 source, incubator, stereo microscope, bag sealer, forklift trucks, a colour projection training and education system, belt freezer, data management system, and room air-conditioning. Each request was considered on its merit. The list of equipment actually supplied is as shown in Table A2.3.

A2.4.3. Fellowships and Scientific Visits

Four project-funded fellowships and scientific visits were awarded to the local staff for a total of 13.5 months of training abroad, as shown in Table A2.4.

Table A2.4 - Fellowships and Scientific Visits

Name	Host Institute	Dates	Training Subject	Result
CPR/94005 - M. Gao	US Dept. of Agriculture Food Safety Laboratory, Philadelphia	March to Sept. 1995 (6 months)	Microbiological examination of irradiated foods	Completed successfully
CPR/96028 - J. Zhang	Iowa State University	Starting in Q2 1996 for 6 months	Packaging materials Eval. of effects of radiation on materials, compatibility of materials with food during irradiation	Course underway
CPR/94073 - P. Shi (Scientific visit)	Canadian Irradiation Centre	July 1995 (21 days)	Operation of irradiation facility and process control	
CPR/94074 - Y. Lin (Scientific visit)	Canadian Irradiation Centre	July 1995 (21 days)	Operation of irradiation facility and process control	

A2.5. IMPLEMENTATION

As mentioned in Section A2.3, faults in the design and manufacture of equipment delayed the completion of the facility. There was lack of co-ordination between the designers and manufacturers. In particular, the design and manufacture of the source rack and automated conveyor system was found to be flawed. The source rack could not meet the international regulations outlined in IAEA Safety Series No. 107 for an irradiation facility. Therefore the source rack and all the source modules had to be re-manufactured.

The loading and unloading system also had to be modified owing to deficiencies in the system design. This work was not completed until late 1995. Further, the food transportation system would not operate as required and had to be modified.

The loading of the cobalt-60 source took place in October 1995, but commissioning was still being hampered because the re-manufactured food transportation system was still not running smoothly as of late 1995

In the autumn of 1995 the Chinese regulatory authorities formally informed the counterpart that the commissioning test period must last at least six months before the Chinese Government would issue an operating license (this has now been granted). This has further delayed the commencement of normal operations. It is this delay that has resulted in the postponement of the expert mission on disinfestation and deterioration of irradiated food.

TABLE A2.3 - EQUIPMENT SUPPLIED BY THE AGENCY

EQUIPMENT ID	REQUEST RECEIVED	DESCRIPTION	ORDER DATE	RECEIPT DATE	TOTAL COST	VENDOR'S NAME
1A	94-01-27	Irradiator Gamma, Source (100 kCi Co-60 Source)	94-07-21	95-03-30	138,400	Reviss Services Limited, UK
1B	94-01-27	Incubator	94-07-08	94-10-17	4,309	Fischer Scientific Co., USA
1C	94-01-27	Microscope, Optical Research (Stereo Microscope)	94-07-08	94-10-17	See 1	Fischer Scientific Co., USA
1D	94-01-27	Spectrophotometer, UV-VIS	94-06-17	95-01-11	20,443	Biolab. G.m.b.H., AUSTRIA
1E	94-01-27	Sealer, Heat	94-07-08	94-10-17	See 1	Fischer Scientific Co., USA
2A	94-12-19	Spares (Spare Lamps for UV-VIS)	95-02-24	95-04-07	804	Biolab. G.m.b.H., AUSTRIA
2B	94-12-19	Sealer, Heat	95-03-28	95-08-31	40,727	Nissei Trading Co. Ltd., JPN
2C	94-12-19	Climatic chamber, Walk-In Cooling Chamber	95-03-28	95-12-30	29,570	Lab-Line Instruments Inc., USA
3A	94-12-21	Microscope,Optical Technical (Stereo Microscope)	95-03-28	95-08-31	10,504	Carl Zeiss Jena G.m.b.H - (Formerly Jenoptik Jena GMBH), GER

Some problems with the supply of certain items of equipment by the Agency have also been identified. Due to a misunderstanding by the Agency concerning the utilization of this equipment at the Institute and the absence of technical specifications by the Institute, the microscope and heat sealer initially purchased by the Agency did not meet the needs of the project and had to be replaced.

The microscope that was purchased was a student microscope and was not adequate for the technical requirements. The bag sealer was designed for sealing laboratory samples and was not designed for commercial use. It would appear that this situation arose because the counterpart requested specific equipment by named manufacturers and did not supply a technical specification of their use.

As required, the Agency requested bids for all the equipment and selected the lowest priced equipment considered as equivalent to that requested by the counterpart. Apart from the two items mentioned above, the counterpart notified the Agency that the spectrophotometer selected did not meet their needs. They also noted that the Agency did not consider the availability of servicing in the Beijing Area for the equipment supplied and that additional shipping expenses were incurred when the UV/VIS spectrophotometer, produced in Japan, was shipped to Vienna and then to China. Similarly, the stereo microscope was produced in China, shipped to the USA and then back again to China.

ANNEX A3.

COMPLETED SURVEY QUESTIONNAIRE

QUESTIONNAIRE FOR PROJECT CPR/5/009, INDUSTRIAL-SCALE IRRADIATION OF RICE AND OTHER FOODSTUFFS

- Experiences, positive and negative, during the construction and commissioning of the facility.

(1) Construction

This project was designed according to Construction Regulation and Design Rules for Safty consideration of Cobalt irradiation of China. The construction was generally carried out as the design. The irradiation center built basicly met the requirements in safty and practical use and was good for outward appearance. The main problems were as following: the building is too high that incost; the size of the entrance door was not very suitable for loading and unloading; and the storage room was a little too small.

(2) Commissioning of the facilities

The design of source lifting system and safty locking device was reasonable, and its installation met requirement, and could be operated normally. Safety control in some area of this facilty were in leading position in the country.

Design for transportation system was not at top level: e. g. the adopted irradiation way of products overlaping irradiation source was unsuitable for low dose irradiation of foodstuff; the too large gap of the carriors rendered the energy utilization efficiency low. There were also some problems in manufaction and installation. After three—month test operation, the problems in part manufacture and installation of the transportation system were found out, and that made this system unable to run normally.

- Suggestions on ways to improve Technical Co-operation Department coordination with its counterpart during project implementation.

The coordination of the TC in all aspects were appropriate.

- Views on the future use of the facility, its impact on end-users and its relevance for the future development in the treatment of fresh foods.

The equipments which agency provided were mainly for food irradiation. irradiation quality control and coordinating commercial application. Their end effect should meet quality control and dose guarantee of industrial scale irradiation foodstuff, and meet the application of GIP, production technology, and promote the development of irradiation of fresh foods.

POOR QUALITY ORIGINAL

1. Questions relating to input supplied by the Agency

1.1 Two expert missions took place as part of the project; please comment on the effectiveness of these.

	Excellent	Good	Satisfactory	Unsatisfactory
Expert 1 - Advice on Disinfestation and Packaging				
• Technical advice				
• Performance overall	Rescheduled to take place in September 1996			
• Length of visit				
Expert 2 - Training on Process Control, Dosimetry and Assistance during Source Loading				
• Technical advice	✓			
• Performance overall		✓		
• Length of visit/timeliness		✓		

Please indicate the deliverables produced by the expert:

1. To install calibrated ECB chemical dosimeter system.
2. To make research to find locally available semiconductor for regular rate control, of the radiation technological process, and for the regular ontrol of the exposure of materials to be irradiated.
3. To introduce dose indicators for the materials to be irradiated.
4. To provide a portable dose rate monitor for the operating staff to control the safe daily operation.
5. To ensure a separate and well equipped chemical Dosimetry Laboratory.
6. Since the operated irradiation units can't provide high dose rate, the national secondary standardizatuion institute, and the IDAS control should be called in.
7. To ensure fellowships for one radiation chemist, or for one nuclear eng. 3—emonth. Recommended Country: Hungary, Institute of Isotopes Co. Ltd. Budapest, for the year 1995, or 1996 under the supervisor Vilmos Stenger.
   :National Nuclear Research Center Denmark Riso, under the supervisor Dr. Arne Miller,
   : Ruder Boskovic Institute, Zagreb, Croatia, under the supervisor Dr. Dusan Razem.
8. To participate in the IAEA regular operated IDAS program.
9. To provide TLD dosimeters for low, medium dose ranges for 1 krad—500 krad.
10. To keep the Pilot Irradiator for sample irradiations because a Gamma Cell type irradiation unit is missing. Increase the source activity for the future and the source geometry for high dose fast sample irradiations. The new Food Demonstration Facility needs increased activity in scientific and experimental capacity of irradiation.

POOR QUALITY ORIGINAL

1.2. How could these missions have been improved, please comment.

	Yes	No
Better defined job descriptions	✓	
Better definition of deliverables	✓	
Advice on other project activities	✓	
Other - Please describe		

1.3 What has been the value of the various methods to assimilate the technical "know-how" and the experiences of others?

	Very Useful	Useful	Of Little Use	Not Useful
• Fellowships		✓		
• Expert missions	✓			
• Practical demonstration/training				
• Scientific visits		✓		

1.4 Which of the four above methods was the most effective, please rank in order.

Most Effective	1.Expert missions 2.Fellowships 3.Scientific visits
Least Effective	4.

1.5 Please comment on why, on this occasion, this ranking was chosen.

Expert service missions should be the most important at the beginning of this project. The direction of the experts to practical questions could help improve the work, and facilitate the fulfillment of the project in time and with the guarantee of quality. If the first expert mission had been provided at the beginning of the project, the effects of service would have been better. Fellowship would facilitate the further development of the project, and that was the second most important. Scientific visit provided the management staff in this project a good opportunity to communicate and understand the international advanced techniques, and the techniques could be applied in future work.

The practical demonstration & training were arranged by our government.

POOR QUALITY ORIGINAL

1.6 The Agency supplied specific items of equipment, please comment on the performance of the Agency in supplying this equipment.

Description	Excellent			Good			Satisfactory			Unsatisfactory		
	1	2	3	1	2	3	1	2	3	1	2	3
• Quality of product	✓		✓		✓							
• Adequacy of the product	✓		✓		✓							
• Timeliness of delivery	✓		✓		✓							
• Other, please comment												

Item 1: Cobalt source
Item 2: Laboratory equipment
Item 3: Heat sealer

2. Project Activities

2.1 Please confirm the designers of the facility and their previous experience and references in designing similar plants.

The main designer, Beijing Institute of Nuclear Engineering, had designed several irradiation facilities of different types in our country, thus should be regarded as experienced designer. However they were not experienced enough for designing transportation system of industrials scale food irradiation facility. In addition, the designer and the manufacturer failed to cooperate well. That produce quality problems during construction and operation of the transportation system, and normal operation was influence.

2.2 Please confirm the major contractors and their previous experience/references.

1. The major construction contractor, China Sihai Technology Co., should be regarded as experienced. Since their main previous projects are large scale construction of pouring of concrete.

2. Equipment manufacturer was Tianyuan Manchine Factory of Sichuan; Its previous work was to manufacture transportation equipments for large automatic factories, such as Beijing National Color—TV Factor, Sijiazhuang Washing Machine Fatory. It was a medium—sized factory with more than 2000 workers, but it lacked experience of manufacture of irradiation equipment.

POOR QUALITY ORIGINAL

2.3 Please comment upon the reasons for the delay in commissioning of the facility.

	Yes	No
• Design	✓	
• Construction	✓	
• Equipment manufacture	✓	
• Equipment installation	✓	
• Testing	✓	

• Other, please provide details.

The reasons were:

① Waiting for government approval on environment evaluation and hygience evaluation.

② Delay of construction: due to inflation, more investment was needed for construction, but the funds could not arrival timely.

③ Quality probelm of equipment ,due to unproperly coordination between designer and manufactor, effected the installation and commissioning.

2.4 Would the project have benefitted further from Agency support at the major project stages?

	Yes*	No
• Design		✓
• Construction		✓
• Manufacture		✓
• Commissioning	✓	
• Operations		✓

*If yes, please explain:

Mr. Stenger, the expert from the agency, checked up the facility in detail on all aspects, and gave us very useful suggestions to existing problems, and facilitated our work.

POOR QUALITY ORIGINAL

3. Planned operation of the facility

3.1 What is the operational plan and committed market for the facility during the next 2-3 years?

Customer	Product	Quantities	Period (Year)
Beijing Heima Co. Beijing Jingliang Co. Beijing west—suburb farm	Cereal grains	800—1000 Tons/year	1997 1998
Kanerfu Co. Institute of Food and Resource CAAS Fuhai Biology Institute	Health Protection Food	1500 Tons/Year	1997, 1998

3.2 What steps or plans have been taken to re-train scientists and operators to ensure sustainable operation of the facility?

In order to run the center reliably, the staff of irradiation center were trained by the Protection Committee Against Irradiation in our institute. Operator could operate the control panel skillfully. It was up to the State Technology Administration Department to check up dose guarantee, quality technique and operation training. National bureau of technique inspection takes charge of dose control, quality assurance and training of operation and management.

3.3 Please describe your Quality Control plan.

Product	Sample Size withheld for Survey	Storage Conditions	Tests
1. Cereal grains 2. Dehydrated Vegetables 3. Spice 4. Health protection food 5. other	3—5 samples/batch or according to the requirment of customers	complex package at room temperature	dose monitor, microbiological detection

POOR QUALITY ORIGINAL

3.4 Please provide the following operations information.

• Number of scientific staff	2
• Number of technicians	3
• Number of other staff	1
• Annual maintenance/upgrading budget as percentage of investment	1—1.5%
• Annual operating budget as percentage of investment	6.7% (housing and machine depreciation inclusive) 3% (Housing and machine depreciation exclusive.

4. Operations feedback[1]

4.1 The IAEA kindly requests up to two years of commercial facility operations feedback.

Indicators of Project Success	Quantity Processed (Tons)		
	1996	1997	1998
Type of product:			
1 Cereal grains	800—1000	1000	1000
2 Dehydrated Vegetables		100	100
3 Spice		100	100
4 Health protection food	150—200	500	600
5 other	150—300	300—1300	1200—2200
Facility utilization:			
• Hours of operation	3000—3500	4000—5000	6000—7000
• Hours of planned outages	2000	1500—2000	500—1000
• Hours of unplanned outages.	1500	500	500
Reasons for unplanned outages	Machine unnormal runing		

with the market varying, the irradiation product quantity and variety were basis on evaluation, and maybe need practical adjustment every year.

[1] Please enter in column 1 the current situation. Could you then update the information each year and inform the Agency.

POOR QUALITY ORIGINAL