IAEA-PDE-94/05
9 December 1994
Original: ENGLISH

PROJECT DESK EVALUATION

A DESK EVALUATION REVIEW OF PROJECT

VIE/4/009

DESIGN AND PRODUCTION OF NUCLEAR

INSTRUMENTS

DEPARTMENT OF TECHNICAL CO-OPERATION

IAEA-PDE-94/05
9 December 1994
Original: ENGLISH

PROJECT DESK EVALUATION

A DESK EVALUATION REVIEW OF PROJECT

VIE/4/009

DESIGN AND PRODUCTION OF NUCLEAR

INSTRUMENTS

EVALUATION SECTION

DEPARTMENT OF TECHNICAL CO-OPERATION

PROJECT DESK EVALUATIONS

A Project Desk Evaluation (PDE) is an intensive review process, using agreed guidelines, of the design, implementation, and the outputs of a project. Its purpose is to convey concisely as comprehensive a picture of a project's performance as can be obtained without a special evaluation mission to the project site. It also seeks, where possible, to draw generalizable lessons that go beyond the specific project under review. Frequently, Project Desk Evaluations are conducted on a set of similar projects, e.g. radiation protection projects or projects in nuclear medicine, in various countries and reported on together. In this way a wide range of approaches, strategies, problems and trends relating to a common type of undertaking can be examined and conclusions confidentially drawn.

Project Desk Evaluations are carried out by the staff of the Evaluation Section, Department of Technical Co-operation, with the assistance of the relevant staff in the Agency concerned with the specific projects. Upon completion, each Project Desk Evaluation is submitted to the Deputy Director General of the Department of Technical Co-operation.

DESK EVALUATION REVIEW OF PROJECT

VIE/4/009

DESIGN AND PRODUCTION OF NUCLEAR INSTRUMENTS

Table of Contents

		Page
Executive Summary		i - vi
I.	Introduction	1
II.	Project under Review	4
	Financial Summary	5
	Approved Project Objectives and Activities	6
	Project Summary	7
	Implementation	9
	Accomplishments	14
III.	Findings	18
IV.	Recommendations	22
	Annex I Low-cost Nuclear Instruments for Nuclear Medicine	25

EXECUTIVE SUMMARY

A technical co-operation programming mission in 1981, in collaboration with the national authorities, identified nuclear electronics as a high priority area for the IAEA support, as an essential prerequisite for the development of a nuclear science and technology programme in Viet Nam. The aim would be to develop a viable capability for maintenance and repair of the existing nuclear instruments at the Dalat Nuclear Research Institute (DNRI), the premier nuclear centre in the country, and also to design and manufacture low-cost simple nuclear electronic equipment to meet the steadily increasing needs of the DNRI, as well as of other national institutions, hospitals and universities engaged in the application of nuclear technologies, particularly in the southern part of the country. Consequently, the Agency had been assisting these activities from 1981 to 1991 through two TC projects, namely,

(i) VIE/4/002 - Nuclear Electronics Laboratory, and
(ii) VIE/4/003 - Nuclear Instrumentation.

The successful implementation of these two projects led to further Agency support under VIE/4/009 - Design and Production of Nuclear Instruments (under this review) which was approved in 1989 as a multiyear project with the aim of developing a further capability for the local manufacture of nuclear instruments both for hospitals and nuclear research laboratories in the southern part of Viet Nam. The project was completed and formally closed in May 1994. At the same time, a new request under the title "Production of Low-cost Nuclear Instruments" was received from Viet Nam for the Agency's consideration under its 1995-96 Regular Technical Co-operation Programme.

This desk evaluation review of project VIE/4/009 was undertaken at the expressed desire of the Deputy Director General and Head of the Department of Technical Co-operation to provide an assessment of project achievements with a view to whether or not the new request under RP 1995-96 as mentioned above could be developed as a key/model project. Also the review could help determine how the experience gained during the development of this project might be utilized in the management and implementation of similar projects in Asia and in other regions.

Accomplishments

By the time of its completion in May 1994, project VIE/4/009 had provided a total of 29 man-days of expert services, equipment and supplies worth $117 180, as well as two fellowships and one scientific visit for a total of 12.9 months of training abroad. In addition, some 12 months of training was provided through project-related fellowships for two persons under a group fellowship training programme. The project had thus completed all activities foreseen.

However, in reviewing the project accomplishments, one should remember that the project VIE/4/009 was initiated on the foundation already laid by the two other Agency assisted projects, VIE/4/002 and VIE/4/003, operational from 1981 to 1991 at the same laboratory. Therefore, all the achievements that one could currently see at the Nuclear Electronics Department of the Dalat Nuclear Research Institute are the results of the continuous Agency efforts through all the three TC projects during the last 13 years (1981-1993). As such, some of the project accomplishments that are listed below were due to the combined activities under the three projects. These are summarized as follows:

(a) Starting with a modest beginning, the Dalat Nuclear Research Institute (DNRI) has now a well organized Nuclear Electronics Department with a staff of over 20 trained electronics engineers and technicians (of which 16 were trained by the Agency), 150 m^2 spacious, reasonably well-equipped laboratories, including a Printed Circuit Board (PCB) Laboratory capable of producing double-sided PCB's, and a mechanical workshop. A dedicated team of engineers and technicians, with complete self-reliance, now provide maintenance and repair services for a wide range of nuclear electronic equipment from old to modern types at the DNRI, and also provide these services to other national institutions, mainly hospitals.

(b) The Department has developed a capability to design and construct some good quality but low-cost nuclear instruments, like charge-sensitive preamplifiers, amplifiers, spectroscopy amplifiers, single channel analysers, frequency counters, discriminators, linear gates, pulse generators, low- and high voltage power supplies, coincidence units, beta counters, survey meters, nano-second pulse delays, time-to-amplitude converters, ADC's, dosimeters, counter/timer, etc. in NIM module as well as in Eurocard standard, capable of withstanding the high humidity of the local climate.

(c) The microcomputers supplied by the Agency have helped the team to upgrade their activities and embark on modern approaches to the design and manufacture of computer interfacing as required in various types of nuclear experiments, such as in gamma spectrometry, ore analysis and environmental monitoring.

(d) The counterpart has also designed and fabricated a number of specialized equipment, such as computer-based 2-channel and 4-channel renographs for thyroid up-take measurement, a mini-assay instrument used for in-vitro counting in Radio-ImmunoAssay (RIA) studies, a portable iodine uptake measurement instrument for thyroid studies in remote areas, a surface contamination monitor and a radioactivity warning instrument, as needed in hospitals and nuclear medicine centres.

(e) Coupled with the capacity of the Dalat Nuclear Research Institute to supply suitable radioisotopes (I-131 and Tc-99m) for diagnosis. and the counterpart's ability to manufacture medical instruments for their studies, the project has stimulated five hospitals in South Viet Nam (Lam Dong, Khanh Hoa, Can Tho, Da Nang and Qui Nhon hospitals) to establish their own nuclear medicine laboratories.

(f) With the Agency-supplied equipment and spare parts, including electronic and other components as well as the Eurocard systems, the counterpart laboratory has already designed and fabricated some 300 units of about 50 different types of the nuclear and medical instruments as mentioned under (b), (c) and (d) above as per demands and requirements of the various research laboratories of DNRI as well as of other research institutes and hospitals, which were supplied to the end-users during the last ten years. One computer-based XRF spectrometer was also supplied to a gold processing company in Hanoi.

Findings

The project VIE/4/009, coupled with the related projects VIE/4/002 and VIE/4/003, has helped in the establishment of a well organized laboratory at the Nuclear Electronics Department of the Dalat Nuclear Research Institute, both in terms of building laboratory facilities as well as qualified manpower. The Department has now attained a capacity not

only to provide a good quality repair and maintenance service for the nuclear electronic equipment of the entire institute, but also for other national institutions in the country. In addition, the team have acquired sufficient expertise in the design and manufacture of a large number of nuclear instruments, from simple to sophisticated ones, including computer interfaced spectrometers and renographs for use in research laboratories and in hospitals, and have already supplied a number of them to the end-users. More importantly, the instruments have been designed to withstand the rough weather conditions of South Viet Nam, where high humidity is a menace to many of the equipment imported from abroad. The local manufacture is also cost-effective. It is estimated by the counterpart that the average cost of the instruments thus produced is less than half of the imported price, mainly due to cheap labour still available in Viet Nam, thus saving a considerable amount of foreign exchange which is now needed only to import electronic and other components not locally available and some specialized equipment, including detectors for specific purposes. However, the degree of cost-effectiveness needs to be established on the basis of a professional market study.

The value of the expertise that has been achieved can not be counted in monetary terms. It has given the team of engineers and technicians the self-confidence and self-reliance needed for designing and manufacturing reliable and dependable instruments according to the local demands for laboratory and medical uses in addition to performing their routine job of repair and maintenance. The staff are now capable of designing and fabricating sophisticated nuclear instruments in greater numbers for meeting growing national demands.

In recognition of his expertise in the field, the project counterpart was selected to serve as an expert on Agency TC projects in the Asia and Pacific region.

It has been reported that a part of the money earned from the supply of equipment to other institutions, including hospitals, as well as for the repair services rendered to them, goes to the staff of the Nuclear Electronics Department. This practice is a good incentive and should continue in order to keep the staff who may otherwise be attracted by better prospects and remuneration in industries (which are now beginning to grow fast in Viet Nam) where there is always a large demand for experienced electronics engineers and technicians.

The implementation of project VIE/4/009 went very smoothly. None of the problems encountered in executing the two previous projects VIE/4/002 and VIE/4/003, such as delay in expert clearance, delay in communication by the counterpart on the receipt of equipment,

etc. were noticeable throughout the time of execution of this project. This may be due to the longtime association of the counterpart with the Agency staff, its procedures and requirements. A visit of the counterpart to the Agency Headquarters in connection with an Advisory Group Meeting on Spare Parts Supply was also helpful to sort out implementation issues.

The Government's commitment to the development of nuclear science and technology as a national priority, with due emphasis on nuclear instrumentation; skill, dedication and leadership of the counterpart staff; and good planning and management of the project by the Agency as well as by the counterpart; are some of the factors contributing to the success of the project.

It is understood that a new request from the counterpart of project VIE/4/009 has already been included under RP 1995-96 under the title "Local Production of Nuclear Medical Instruments (VIE/4/013)", which aims at quality control of the equipment already developed, in addition to further enhancement of laboratory facilities, so as to enable the counterpart to undertake the design and manufacture of more sophisticated nuclear equipment for research and medical uses for which there is a growing demand within the country. The request also stipulates that the project activities will be sustained by the national authorities (after cessation of Agency assistance) on the basis of market supply/demand and cost/profit principles, with emphasis on humanitarian and social needs. It is also understood that there are national plans to establish a nuclear medicine centre in each of the 40 or so provinces/cities in Viet Nam, which also highlights the future demands for nuclear medicine equipment in the country.

Considering the success of the previous projects and the expertise that the counterpart has already achieved, this review supports the approval of the above project under RP 1995-96. This could also be developed as a key/model project. However, since the current status of nuclear instrumentation at the Dalat Nuclear Research Institute is based mainly on the Agency support for equipment, electronic components and other supplies, as well as for manpower training, this review feels that it would be necessary to seek further clarification from the counterpart and the national authorities (VINATOM) on the following points:

(i) Whether there is any national plan to expand the production capability based on the prototypes developed by the counterpart.

(ii) Local demands for each piece of equipment - current, short term (2 years) and medium term (5 years), both for nuclear and non-nuclear instruments, along with the number of existing nuclear medicine centres in the country and those

likely to be created in the near future, which will be interested in the nuclear medicine equipment developed by the counterpart. (Determining the dimension of the potential market).

(iii) Cost effectiveness - cost of locally produced equipment vs. imported ones. This should be done for each and every type of equipment. And of course, savings of foreign exchange on each of them.

Recommendations

1. Recognizing the considerable achievements in nuclear instrumentation at the Dalat Nuclear Research Institute, but mindful of the need for their quality assurance and quality control in order to ensure their good performance and reliability, this review supports the inclusion of the new request of the counterpart under RP 1995-96 (VIE/4/013).

2. The project counterpart should be advised to develop the nuclear medicine instruments so far designed and manufactured, with appropriate quality assurance/quality control, as a package for different nuclear medicine centres/hospitals in Viet Nam. The Agency may also help in creating interest in other developing Member States through the supply of some of these instruments under TC projects.

3. The Agency should encourage the counterpart and the national authorities (VINATOM) to explore the possibility of expanding the production capability for nuclear, medical as well as non-nuclear instruments, in order to transfer the technology and expertise achieved through the Agency-supported projects to the national economy. For this, a professional market study, covering the demand/supply targets, further training requirements, cost of production and benefits, etc. should be conducted to ensure sustainability of the project achievements. Otherwise, it is very likely that the trained manpower in this field may be lost in the stream of up-coming foreign industries/companies planning to set up their own industries in Viet Nam.

1

INTRODUCTION

Viet Nam is a country stretched along the South China Sea with a varied climate. The north is cool, sometimes cold, from October to March, while the south is warm to hot with high humidity throughout the year. Following a number of political setbacks since the second World War, the country was reunited in 1975, when the Government put high priority to the revitalization of its nuclear science and technology activities as part of the national economic and social development programme, beginning with the strengthening of the National Nuclear Research Institute at Dalat (including refurbishing of the research reactor) in South Viet Nam. The Dalat Nuclear Research Institute (DNRI), the premier nuclear institute in the country, now has a 500 kW research reactor as its central facility with a number of scientific departments engaged in research and development activities, covering the areas of isotope production, nuclear physics, reactor engineering, nuclear instrumentation, analytical techniques, radiation protection and environmental monitoring, agriculture and biology. However, a trade embargo by certain countries, coupled with the shortage of foreign exchange, hindered the acquisition of appropriate nuclear technologies, including the import of certain nuclear equipment and components into the country. An IAEA programming mission in 1981 identified nuclear instrumentation as one of the priority areas for technical co-operation. The aim would be to develop a viable capability for maintenance and repair, and also for design and production of low-cost simple nuclear electronic equipment to meet the steadily increasing needs of the DNRI, as well as of other national institutions, hospitals and universities engaged in the application of nuclear technologies, particularly in the southern part of the country.

Consequently, the Agency had been assisting the Nuclear Electronics Department of the DNRI in the above lines through two TC projects since 1981, namely:

(i) VIE/4/002 - Nuclear Electronics Laboratory, and
(ii) VIE/4/003 - Nuclear Instrumentation

The project VIE/4/002 was initiated in 1981 and completed in 1983 with a total Agency provision of $88 303, which included 6.3 man-months of expert services and $54 334 for equipment and supplies. In addition, two fellows were trained on long-term fellowships supported under the general fellowship fund. The follow-up project VIE/4/003 was initiated in 1983 and completed in 1991 with a total Agency input of $153 336, which included one

man-month of expert services, $121 595 for equipment and supplies, and $24 605 for one fellowship. In addition, seven other fellows were trained on long-term fellowships and one was offered a scientific visit, the costs of which were covered from general and regional fellowship funds.

The successful implementation of the above two TC projects enabled the counterpart to upgrade the laboratory facilities in terms of equipment, including laboratory and diagnostic tools and kits, spare parts, electronic components and other laboratory supplies, and set up a core of trained manpower at the Nuclear Electronics Department of the Dalat Nuclear Research Institute. A basic capability for the repair and maintenance (including preventive and corrective maintenance services) of nuclear and electronic equipment was set-up and the counterpart staff were able to design and manufacture simple nuclear instruments, both modular and stand alone, commonly required in research laboratories, such as counting and monitoring equipment, spectrometer systems, survey meters, etc. to meet the steadily increasing demands of the DNRI as well as of the neighbouring hospitals in the southern part of Viet Nam.

A desk evaluation review of the two projects was conducted in late 1985 (IAEA-DER-86/01 dated 13 January 1986) which concluded that "The success of the projects was largely due to the hard work and skill of the Nuclear Research Centre's staff. The nuclear electronics laboratory was well equipped by the Agency, and most importantly, all the equipment has been kept in working condition and is being extensively used. The centre has carried out successfully the activities planned within the context of project VIE/4/003, developed the local skill to manufacture and design nuclear instruments which can now be supplied to other institutions, and provided maintenance and repair services". The review also identified a number of problems in implementing the two projects, mainly relating to communication and local constraints, such as delay in expert clearance, lengthy customs clearance procedure for equipment, and delay in reporting their receipt or otherwise to the Agency.

The projects VIE/4/002 and VIE/4/003 together may be regarded as Phase-I of nuclear instrumentation in Dalat, laying the foundation for further Agency support under VIE/4/009, Design and Production of Nuclear Instruments (under this review), which was approved in 1989 as a multiyear project with the aim of developing a further capability for the local manufacture of nuclear instruments both for hospitals and nuclear research laboratories in the southern part of Viet Nam. The project was completed and formally closed in May 1994. At the same time, a new request under the title "Production of Low-cost Nuclear Instruments" was

received from Viet Nam for the Agency's consideration under its 1995-96 Regular Technical Co-operation Programme.

This desk evaluation review of project VIE/4/009 was undertaken at the expressed desire of the Deputy Director General and Head of the Department of Technical Co-operation to provide an assessment of project achievements with a view to whether or not the new request under RP 1995-96 as mentioned above could be developed as a key/model project. Also the review could help determine how the experience gained during the development of this project might be utilized in the management and implementation of similar projects in Asia and in other regions.

This report is the result of a thorough study of the files and documents available in the IAEA Headquarters, including expert field reports on project VIE/4/009, and extensive discussions with IAEA personnel involved in the project execution. The facts contained in this report were compiled, therefore, from all sources available at IAEA Headquarters to provide a comprehensive chronicle of project accomplishments, which forms the basis for the findings and recommendations provided.

II

PROJECT UNDER REVIEW

The following section contains a Project Desk Evaluation (PDE) of the Agency's multi-year project VIE/4/009 - "Design and Production of Nuclear Instruments", approved for Viet Nam in 1989.

The review was undertaken to assess the project's achievements at its conclusion and to determine any future needs and possible Agency assistance for further development of the counterpart laboratory in Dalat for nuclear electronics. It must be borne in mind, however, that a project desk evaluation is but one element of a critical examination and therefore there must be a tentativeness to and continual testing of its conclusions. As the Joint Inspection Unit concluded:

> "One of the most difficult problems which internal evaluation systems face is the tendency to regard them as a self-contained management technique which merely needs to be introduced into an organization to swiftly improve operations. In fact, evaluation in only one phase -- although an important one -- in the basic management cycle. It cannot have its full impact until it becomes part of a continuing commitment to development and improvement of the overall management system." (Second Report on Evaluation in the United Nations System, para. 28, Joint Inspection Unit, JIU rep.6)

Findings and recommendations are in Sections III and IV of this report.

FINANCIAL SUMMARY

VIE/4/009 - Design and Production of Nuclear Instruments

Recipient Institution: Nuclear Electronics Department
Nuclear Research Institute
Viet Nam Atomic Energy Commission
Dalat. Viet Nam

Counterpart: Ton That Con

Current Budget ($)	1989	1990	1991	1992	1993	1994	Total
Experts: Regular CC			8 850				8 850
Equipment: Regular CC	34 860	27 000	25 000	24 600	6 300		117 760
Fellowships: Regular CC Regular NCC		7 650 3 194		8 178			15 828 3 194
Total	34 860	37 844	33 850	32 778	6 300		145 632
Disbursements ($)	1989	1990	1991	1992	1993	1994	**Total**
Experts: Regular CC			8 892				
Equipment: Regular CC	34 929	25 738	20 620	1 522	9 736	24 633	117 180
Fellowships: Regular CC Regular NCC		3 279 3 194	3 124	6 640	2 785		15 828 3 194
Total	34 929	32 211	32 636	8 162	12 521	24 633	145 094

APPROVED PROJECT OBJECTIVES AND ACTIVITIES

The objectives of this multi-year project were:

(i) To establish a modern electronics laboratory where sophisticated instruments with double-sided plated hole printed circuit boards (PCBs) could be designed and fabricated,

(ii) To design and fabricate different types of nuclear and electronic equipment of good quality and reliability,

(iii) To provide enhanced maintenance and repair services and computer management for nuclear electronic instruments, and

(iv) To enhance the teaching and training functions of the laboratory.

To achieve these objectives, the Agency was to assist through:

- Provision of specialized equipment and electronic components.
- Provision of expert services for the organization of a national training course on interfacing in nuclear experiments.
- Fellowship training of counterpart staff.

The intended target groups and beneficiaries were, on the one hand, the various scientific research departments of the parent Dalat Nuclear Research Institute, and other national research institutes engaged in the application of nuclear science and technology, and on the other hand, the entire population of relevant patients in the southern part of Viet Nam, who would receive better medical care through the application of nuclear medicine practices.

PROJECT SUMMARY

In December 1987, the Vietnamese authorities submitted a request under the title "Nuclear Electronics Laboratory Development" for consideration under the Agency's 1989-90 Regular TC Programme. The request was in accordance with the Government-approved plan for experimental design and production of nuclear electronic instrumentation, within the framework of the National Five-year Plan 1986-90 for Peaceful Uses of Atomic Energy, and would constitute an extension of the Agency-supported projects VIE/4/002 and VIE/4/003 through which the counterpart had already acquired sufficient expertise in the design and development of simple nuclear instruments along with upgrading of laboratory facilities.

The assistance requested from the Agency included an estimated $180 000 of equipment, comprising printed circuit board (PCB) facilities, personal computers, testing equipment such as oscilloscopes, etc., equipment for mechanical workshop and technical documentation, as well as electronic components and materials. Three man-months of expert services and 54 man-months of fellowship training for five fellows as well as two scientific visits were also requested.

The project proposal was fully endorsed by the reviewing technical officer, Mr. Joze Dolnicar (RIPC), who was also the technical officer for the two previous projects VIE/4/002 and VIE/4/003. However, based on his experience with the activities of these two projects and the infrastructure already established, Mr. Dolnicar modified the project requirements to include two man-months of expert services, $77 000 for equipment and 12 months of fellowship training for two persons during a two-year period, 1989-90. While recommending the project for approval, Mr. Dolnicar made the following remarks:

> "The evaluation of projects VIE/4/002 and VIE/4/003 demonstrated that the investment in nuclear instrumentation projects in Viet Nam is bringing rich dividends. The local organization is excellent, the staff is competent and can perform remarkably with the adequate external support. It makes very good sense to build the second stage of an ambitious project where the first stage was successfully completed (through VIE/4/002 and VIE/4/003)".

The project was approved for a three-year period, 1989-91, including one man-month of expert services (in 1991), $85 000 for equipment and only three months of fellowships.

Between December 1989 and October 1993, nine programme changes were effected, adding $44 132 to this project, $32 760 for equipment and $11 372 for fellowship training.

The project was closed on 25 May 1994, having provided the services of one expert for a 29 man-day assignment, $117 760 worth of equipment and supplies, and $19 022 for two fellowships and one scientific visit, with a total Agency input of $145 094 (see detailed Financial Summary, page 5).

IMPLEMENTATION

Expert

As per expert provision available under the project, a job description was prepared in July 1991 for a one man-month mission in late 1991. The duties included:

- To arrange and guide a local training course for electronic engineers, in the field of interfacing in nuclear instrumentation.

Mr. Lauwers from Belgium carried out the assignment from 23 November to 21 December 1991. On his arrival, the expert held detailed discussions with the counterpart and visited several laboratories at the Nuclear Research Institute. It became immediately clear to him that the counterpart laboratory, the Nuclear Electronics Department of the DNRI, had already acquired considerable experience in the design and construction of electronic instruments, for research projects within DNRI as well as for medical applications throughout the country. The expert was quite impressed by the achievements of the counterparts in this field in general, and more particularly, by the hardware and software they had developed in order to interface commercially available nuclear ADCs with microcomputers. Several of their MCA systems had been delivered and were working in the Institute, and their own design for a new ADC (successive approximation with sliding scale correction) and associated microcomputer interface (MCD) looked very promising. However, the expert observed that most of the knowledge on hardware and software interfacing had been acquired by the staff members on a rather fragmentary basis. Accordingly, a training course on "Hardware and Software Interfacing of Nuclear Experiments with Microcomputers" was organized for 17 working days which also included some practical exercises. Ten participants from the Nuclear Electronics Department and 12 more from other Departments of the DNRI took part in the training course.

The expert concluded that he found in the Nuclear Electronics Department a very motivated team of electronics engineers with a good knowledge of the hardware and software aspects needed to design modern nuclear instrumentation systems. However, due to the rather isolated position of the country and the fact that modern technology was not available locally, continuous support from the IAEA seemed to him absolutely necessary in order to keep improving the quality of the work that was being done.

According to the expert, the training course was obviously a success for two reasons:

- It gave a solid structured basis for the fragmentary knowledge that some of the participants had already acquired in the field of microcomputer interfacing by previous experience.

- It was a good introduction for those with little experience in interfacing due to their activities in other fields, such as fast linear electronics.

However, some important aspects of microcomputer interfacing (installable device drivers, DMA transfers, serial communications and the use of mixed assembly language/high level language programming) could not be treated in the framework of this course due to lack of time. The expert recommended that it would certainly be advisable that the IAEA would organize a follow-up training course that could deal with these advanced topics sometime next year.

The expert made a number of recommendations to the Agency, the main part of which was related to the supply of spare parts and accessories, and in particular, the following ones:

(a) If the counterparts were also to tackle microprocessor designs in the near future, they should receive an emulator system with associated software.

(b) If it is possible in view of the remaining budget, the IAEA should organize a followup training course in 1992 (covering the advanced topics as mentioned earlier).

(c) Further improvement of the present situation which is indeed very promising will require continuous technical support from the IAEA in the form of an extension of the project or the creation of a new one.

While immediate actions were initiated on the supply of spare parts and accessories as recommended by the expert, Mr. Dolnicar, the technical officer, after reviewing the report, made the following comments:

"As a general observation, we should note that the team of the counterparts is well trained, rather active and successful. We should also register the sad fact that their activities are almost entirely based on the input from the Agency's TC. This is a very interesting case. We would be justified to claim that after several years of TC assistance, the project should be in a state when it can be run without our help. This obviously applies to the electronics laboratory staff. No additional general training

is needed: whatever special knowledge is required, they should acquire it by self-study. The same does not apply for material support. The equipment of the laboratory is good, and no major new instruments are required. However, all the work on designing and producing the instruments on a small scale obviously still totally depend on the Agency's inputs. In view of the undisputable fact that the instruments manufactured in the electronics laboratory are being used in many institutions in Viet Nam, and have been produced at a fraction of the price for the same instruments ordered abroad, some future support might be very well justified. This is an open question."

As regards the expert's specific recommendations, Mr. Dolnicar observed as follows:

Item (a): I might agree with the expert, but the cost would be $20 000.
Note: This could not be supplied due to shortage of funds.

Item (b): With the remaining one man-day (under Expert component), we can do nothing. And in view of the good background of the staff, I would not recommend additional expert funds to the project.

Item (c): See general comments.

It may be noted here that all the three specific recommendations of the expert have since been taken care of in the context of the new request included under RP 1995-96- "Local Production of Nuclear Medical Instruments (VIE/4/013)."

The expert's final report in full was sent to the Government of Viet Nam as well as to the project counterpart on 22 January 1992, i.e. within a month of the expert assignment, which is remarkable.

EQUIPMENT

Equipment constituted the major part of the project expenditure. A total of $117 180 worth of equipment and supplies was provided, covering 81% of the total project fund. Almost two thirds of this amount was spent for the supply of electronic components, spare parts and accessories, the rest covered the cost of two micro-computers, one laser printer, three X-T plotters, four oscilloscopes (one was for the Centre for Nuclear Techniques, Ho Chi Minh City), three digital multimeters, a scintillation detector, one proportional counter, one pulse generator, two regulated power supplies and printed circuit board (PCB) facilities. All

items requested were ordered and dispatched in a timely manner, mostly within 3-4 months. The counterpart was also prompt in responding on their arrival and receipt.

TRAINING

Between 1990 and 1992, two project-funded fellowships and one scientific visit were awarded to the counterpart staff for a total duration of 12.9 man-months of training abroad in different aspects of nuclear electronics maintenance and development, including microcomputer interfacing. Two more fellows were trained under the Agency's Seibersdorf Laboratories' Group Fellowship Training Programme on Nuclear Spectroscopy Instrumentation Maintenance, the cost of which was borne by the regional fellowship fund. In addition, several fellows from the counterpart laboratory were trained earlier in the context of the two related projects VIE/4/002 and VIE/4/003. In order to have a comprehensive idea of the extent of the Agency's efforts to train counterpart staff in the design, development and maintenance of nuclear equipment, a list of all the fellows so far trained from the Nuclear Electronics Department of Dalat Nuclear Research Institute is given in **Table 1**. As could be seen, a total of 16 project funded (PF) and project-related (PR) fellowships and scientific visits were awarded to the local staff for a total duration of 151.6 man-months of training abroad.

Table 1

Persons Trained in Electronics Maintenance and Development

	Fellowship No.	Name	Host Country	Year	Duration mm/dd	TC Project	Status
1	VIE/8101 & VIE/8211	Dinh Thi Minh	Romania	1982/83	20/01	VIE/4/002	PR
2	VIE/8516	Luong Ba Hung	Hungary	1986/87	12/01	"	PR
3	VIE/8923	Pham Ngoc Tuan	Germany	1990/91	12/00	VIE/4/003	PF
4	VIE/8201	Nguyen Viet Zung	Hungary	1982/83	16/00	"	PR
5	VIE/8411	Ho Thai Ha	Hungary	1985/86	12/00	"	PR
6	VIE/8413	Vu Quoc Trong	Hungary	1984/85	12/01	"	PR
7	VIE/8508	Truong Van Minh	IAEA	1986/87	12/00	"	PR
8	VIE/8602	Dao Minh Tam	Hungary	1988/89	12/01	"	PR
9	VIE/8637	Ho Thai Ha	Hungary	1986	6/00	"	PR
10	VIE/8639	Chau Le Ha	Hungary	1987/88	12/00	"	PR
11	VIE/8632V	Ton That Con	Germany/ Hungary	1986	0/27	"	PR
12	VIE/9006	Hoang Y Nhi	India	1990/91	6/00	VIE/4/009	PF
13	VIE/9027	Tran Thien Huong	Hungary	1990/91	6/01	"	PF
14	VIE/92003V	Dinh Sy Hien	Germany/ Hungary	1992	0/26	"	PF
15	VIE/8901	Trinh Dinh Truong	IAEA	1990/91	5/20	"	PR
16	VIE/91007	Tguyen Chi	IAEA	1991/92	6/00	"	PR
				TOTAL	151		

Abbreviations: PF - Project-funded fellowship
PR - Project-related fellowship

ACCOMPLISHMENTS

By the time of its completion in May 1994, project VIE/4/009 had provided a total of 29 man-days of expert services, equipment and supplies worth $117 180, as well as two fellowships and one scientific visit for a total of 12.9 months of training abroad. In addition, some 12 months of training was provided through project-related fellowships for two persons under a group fellowship training programme. The project had thus completed all activities foreseen.

However, in reviewing the project accomplishments, one should remember that the project VIE/4/009 was initiated on the foundation already laid by the two other Agency assisted projects, VIE/4/002 and VIE/4/003, operational from 1981 to 1991 at the same laboratory. Therefore, all the achievements that one could currently see at the Nuclear Electronics Department of the Dalat Nuclear Research Institute are the results of the continuous Agency efforts through all the three TC projects during the last 13 years (1981-1993). As such, some of the project accomplishments that are listed below were due to the combined activities under the three projects. These are summarized as follows:

(a) Starting with a modest beginning, the Dalat Nuclear Research Institute (DNRI) has now a well organized Nuclear Electronics Department with a staff of over 20 trained electronics engineers and technicians (of which 16 were trained by the Agency), 150 m^2 spacious, reasonably well-equipped laboratories, including a Printed Circuit Board (PCB) Laboratory capable of producing double-sided PCB's, and a mechanical workshop. The existing equipment includes eight oscilloscopes, three microcomputer systems, one laser printer, four sweep function generators and a host of other testing and measuring equipment and tools. A dedicated team of engineers and technicians, with complete self-reliance, now provide maintenance and repair services for a wide range of nuclear electronic equipment from old to modern types at the DNRI, and also provide these services to other national institutions, mainly hospitals.

(b) The Department has developed a capability to design and construct some good quality but low-cost nuclear instruments, like charge-sensitive preamplifiers, amplifiers, spectroscopy amplifiers, single channel analysers, frequency counters, discriminators, linear gates, pulse generators, low- and high voltage power supplies, coincidence units, beta counters, survey meters,

nano-second pulse delays, time-to-amplitude converters, ADC's, dosimeters, counter/timer, etc. in NIM module as well as in Eurocard standard, capable of withstanding the high humidity of the local climate.

(c) The microcomputers supplied by the Agency have helped the team to upgrade their activities and embark on modern approaches to the design and manufacture of computer interfacing as required in various types of nuclear experiments, such as in gamma spectrometry, ore analysis and environmental monitoring. Specific mention may be made of the following:

- CAMAC/PC-XT- based data acquisition and processing system with automatic sample changer for XRF spectrometry and analysis.

- PC/AT - based spectrometer with automatic sample transfer and timing control for prompt-gamma analysis of short-lived radionuclides.

- PC/AT - based delayed neutron measurement system for simultaneous analysis of U and Th in natural radioactive ores, consisting of He-3 detectors, analog processors. automatic control and data processing.

- Apple-II-based multi channel analyser interfaced with a TLD system for personal dosimetry.

- PC/AT-based alpha spectrometer using surface barrier detectors for environmental monitoring of alpha-emitting radionuclides.

- A portable UP-based 4-channel gamma spectrometer for automatic determination of U, Th and K content in natural radioactive ores, used in geological prospection.

- PC/AT- based XRF spectrometer using Si (Li) detector for analysis of commercial gold .

- Other various types of nuclear spectrometers, both in Eurocard and NIM standards, using different types of Si(Li) and Ge(Li) detectors and scintillation counters, with complete analogue chain, computer interfacing boards and emulation software. These high quality instruments, mostly with 4K channels,

are being used for nuclear analysis (NAA, XRF) and environmental radioactivity monitoring.

- A sophisticated Compton-suppressed spectrometer for low-background gamma spectrometry, consisting of three measuring channels using NIM modules, all locally made, for use at the research reactor for nuclear reaction studies.

(d) The counterpart has also designed and fabricated a number of specialized equipment as needed in hospitals and nuclear medicine centres. Specific mention may be made of the following five special pieces of equipment designed and fabricated for medical purposes:

- Computer-based 2-channel and 4-channel renographs for thyroid up-take measurement. The fabrication of the four-channel renograph serving the dual purpose of kidney disease diagnosis and thyroid uptake measurement could be considered as a remarkable step forward in terms of user convenience and cost savings without sacrificing functional essentials. The two additional channels to the two conventional channels enables the simultaneous monitoring of the two kidneys, heart and bladder, providing the medical doctor with additional data for more refined and precise diagnostics. Alternatively, the four channels can also be used individually for thyroid uptake measurement.

- Mini-assay instrument, basically a single channel analyser with a well-type scintillation detector, used for in-vitro counting in Radio-ImmunoAssay (RIA) studies.

- Portable iodine uptake measurement instrument for thyroid studies in remote areas.

- Surface contamination monitor used for monitoring the radioactivity level of any surface contaminated by radioactive materials, especially liquids.

- Radioactivity warning instrument using a GM counter for monitoring gamma radiation level. A buzzing sound is made whenever the measured count rate surpasses a preset alarm level.

Detailed descriptions of the above five pieces of equipment are attached in **Annex 1.**

(e) Coupled with the capacity of the Dalat Nuclear Research Institute to supply suitable radioisotopes (I-131 and Tc-99m) for diagnosis. and the counterpart's ability to manufacture medical instruments for their studies, the project has stimulated five hospitals in South Viet Nam (Lam Dong, Khanh Hoa, Can Tho, Da Nang and Qui Nhon hospitals) to establish their own nuclear medicine laboratories.

(f) With the Agency-supplied equipment and spare parts, including electronic and other components as well as the Eurocard systems, the counterpart laboratory has already designed and fabricated some 300 units of about 50 different types of the nuclear and medical instruments as mentioned under (b), (c) and (d) above as per demands and requirements of the various research laboratories of DNRI as well as of other research institutes and hospitals, which were supplied to the end-users during the last ten years. One computer-based XRF spectrometer was also supplied to a gold processing company in Hanoi.

III

FINDINGS

The project VIE/4/009, coupled with the related projects VIE/4/002 and VIE/4/003, has helped in the establishment of a well organized laboratory at the Nuclear Electronics Department of the Dalat Nuclear Research Institute, both in terms of building laboratory facilities as well as qualified manpower. The Department has now attained a capacity not only to provide a good quality repair and maintenance service for the nuclear electronic equipment of the entire institute, but also for other national institutions in the country. In addition, the team have acquired sufficient expertise in the design and manufacture of a large number of nuclear instruments, from simple to sophisticated ones, including computer interfaced spectrometers and renographs for use in research laboratories and in hospitals, and have already supplied a number of them to the end-users. More importantly, the instruments have been designed to withstand the rough weather conditions of South Viet Nam, where high humidity is a menace to many of the equipment imported from abroad. The local manufacture is also cost-effective. It is estimated by the counterpart that the average cost of the instruments thus produced is less than half of the imported price, mainly due to cheap labour still available in Viet Nam, thus saving a considerable amount of foreign exchange which is now needed only to import electronic and other components not locally available and some specialized equipment, including detectors for specific purposes. However, the degree of cost-effectiveness needs to be established on the basis of a professional market study.

The value of the expertise that has been achieved can not be counted in monetary terms. It has given the team of engineers and technicians the self-confidence and self-reliance needed for designing and manufacturing reliable and dependable instruments according to the local demands for laboratory and medical uses in addition to performing their routine job of repair and maintenance. The staff are now capable of designing and fabricating sophisticated nuclear instruments in greater numbers for meeting growing national demands.

In recognition of his expertise in the field, the project counterpart was selected to serve as an expert on Agency TC projects in the Asia and Pacific region.

It has been reported that a part of the money earned from the supply of equipment to other institutions, including hospitals, as well as for the repair services rendered to them, goes to the staff of the Nuclear Electronics Department. This practice is a good incentive and should continue in order to keep the staff who may otherwise be attracted by better prospects and remuneration in industries (which are now beginning to grow fast in Viet Nam) where there is always a large demand for experienced electronics engineers and technicians.

The implementation of project VIE/4/009 went very smoothly. None of the problems encountered in executing the two previous projects VIE/4/002 and VIE/4/003, such as delay in expert clearance, delay in communication by the counterpart on the receipt of equipment, etc. were noticeable throughout the time of execution of this project. This may be due to the longtime association of the counterpart with the Agency staff, its procedures and requirements. A visit of the counterpart to the Agency Headquarters in connection with an Advisory Group Meeting on Spare Parts Supply was also helpful to sort out implementation issues.

The factors that have contributed to the success of the project, bringing considerable economic impact to the country, appear to be the following:

(i) Government's commitment to the development of nuclear science and technology.

(ii) Identification by IAEA TC programming mission, in collaboration with the national authorities, of nuclear electronics as a high priority area for Agency support as an essential prerequisite for the development of a national nuclear science and technology programme.

(iii) Well experienced national counterpart leadership in project planning and implementation.

(iv) Dedicated and motivated team of scientific personnel at the counterpart institute who are prepared and willing to learn, and work hard.

(v) Good project planning, in a phased and step-wise manner over a 13-year period with clearly defined objectives, inputs and outputs, with exercise of flexibility to solve unforeseen problems.

(vi) Emphasis in project plans on human resources development both through national training workshop with the help of IAEA experts and individual training abroad.

(vii) Emphasis on the provision of appropriate equipment - test instruments, electronic components, spare parts and computers - for developing a local capability for repair and maintenance as well as design and fabrication of nuclear instruments.

(viii) Availability of adequate and qualified staff and adequate laboratory space and other local inputs at the counterpart institute.

(ix) Good communication between national counterpart and IAEA staff (in particular the technical staff), including on-sight visits by the technical officer and area officers.

(x) Interest and keenness amongst staff of other national institutions and hospitals to benefit from the project by collaborating with the counterpart institute.

(xi) Recognition that the capability to maintain and repair instruments and produce them locally would be of high economic and scientific value to the national development activities in nuclear science and technology.

(xii) Good management at the two ends (counterpart institute and the IAEA).

This review is confident that if the above factors could be made effective in implementing similar projects in other developing Member States, those projects could also bring good dividends with far reaching economic and social benefits, including self-reliance and independence of import from abroad.

The success of the nuclear instrumentation projects at the Dalat Nuclear Research Institute in South Viet Nam has prompted the Agency to approve under RP 1993-94 a similar project VIE/4/012 - Nuclear Instrumentation Services, at the Institute of Nuclear Science and Technology in Hanoi, with the aim of providing better maintenance and repair services for the nuclear equipment of the Institute as well as of other institutions in the northern part of the country.

It is understood that a new request from the counterpart of project VIE/4/009 has already been included under RP 1995-96 under the title "Local Production of Nuclear Medical Instruments (VIE/4/013)", which aims at quality control of the equipment already developed, in addition to further enhancement of laboratory facilities, so as to enable the counterpart to undertake the design and manufacture of more sophisticated nuclear equipment for research and medical uses for which there is a growing demand within the country. The request also stipulates that the project activities will be sustained by the national authorities (after cessation of Agency assistance) on the basis of market supply/demand and cost/profit principles, with emphasis on humanitarian and social needs. It is also understood that there are national plans to establish a nuclear medicine centre in each of the 40 or so provinces/cities in Viet Nam, which also highlights the future demands for nuclear medicine equipment in the country.

Considering the success of the previous projects and the expertise that the counterpart has already achieved, this review supports the approval of the above project under RP 1995-96. This could also be developed as a key/model project. However, since the current status of nuclear instrumentation at the Dalat Nuclear Research Institute is based mainly on the Agency support for equipment, electronic components and other supplies, as well as for manpower training, this review feels that it would be necessary to seek further clarification from the counterpart and the national authorities (VINATOM) on the following points:

(i) Whether there is any national plan to expand the production capability based on the prototypes developed by the counterpart.

(ii) Local demands for each piece of equipment - current, short term (2 years) and medium term (5 years), both for nuclear and non-nuclear instruments, along with the number of existing nuclear medicine centres in the country and those likely to be created in the near future, which will be interested in the nuclear medicine equipment developed by the counterpart. (Determining the dimension of the potential market).

(iii) Cost effectiveness - cost of locally produced equipment vs. imported ones. This should be done for each and every type of equipment. And of course, savings of foreign exchange on each of them.

IV

RECOMMENDATIONS

1. Recognizing the considerable achievements in nuclear instrumentation at the Dalat Nuclear Research Institute, but mindful of the need for their quality assurance and quality control in order to ensure their good performance and reliability, this review supports the inclusion of the new request of the counterpart under RP 1995-96 (VIE/4/013).

2. The project counterpart should be advised to develop the nuclear medicine instruments so far designed and manufactured, with appropriate quality assurance/quality control, as a package for different nuclear medicine centres/hospitals in Viet Nam. The Agency may also help in creating interest in other developing Member States through the supply of some of these instruments under TC projects.

3. The Agency should encourage the counterpart and the national authorities (VINATOM) to explore the possibility of expanding the production capability for nuclear, medical as well as non-nuclear instruments, in order to transfer the technology and expertise achieved through the Agency-supported projects to the national economy. For this, a professional market study, covering the demand/supply targets, further training requirements, cost of production and benefits, etc. should be conducted to ensure sustainability of the project achievements. Otherwise, it is very likely that the trained manpower in this field may be lost in the stream of up-coming foreign industries/companies planning to set up their own industries in Viet Nam.

ANNEX

VIET NAM NATIONAL ATOMIC ENERGY COMMISSION
NUCLEAR RESEARCH INSTITUTE, DALAT

***

LOW-COST
NUCLEAR INSTRUMENTS
FOR
NUCLEAR MEDICINE

Da-Lat, 1993

LOW-COST

NUCLEAR INSTRUMENTS

FOR NUCLEAR MEDICINE

***

1. **Computer-based renographs (2-channel and 4-channel versions) with possibility of use for thyroid uptake measurement.**

2. **Mini-assay instrument for Radio-ImmunoAssay (RIA) measurement.**

3. **Portable iodine uptake measuring instrument.**

4. **Surface contamination monitor.**

5. **Radio-activity warning instrument.**

These instruments are newly produced by the Nuclear Electronics Department of the Nuclear Research Institute, Dalat, to serve the needs of nuclear medicine for:

- *Diagnosis*
- *In-vitro measurement*
- *Radio-activity control*

COMPUTER-BASED RENOGRAPHS

❋ ❋ ❋

❋ USE

The renographs are designed for dual purpose applications:

- For diagnosis of kidney functions;
- For diagnosis of thyroidal functions by Iodine uptake measurement.

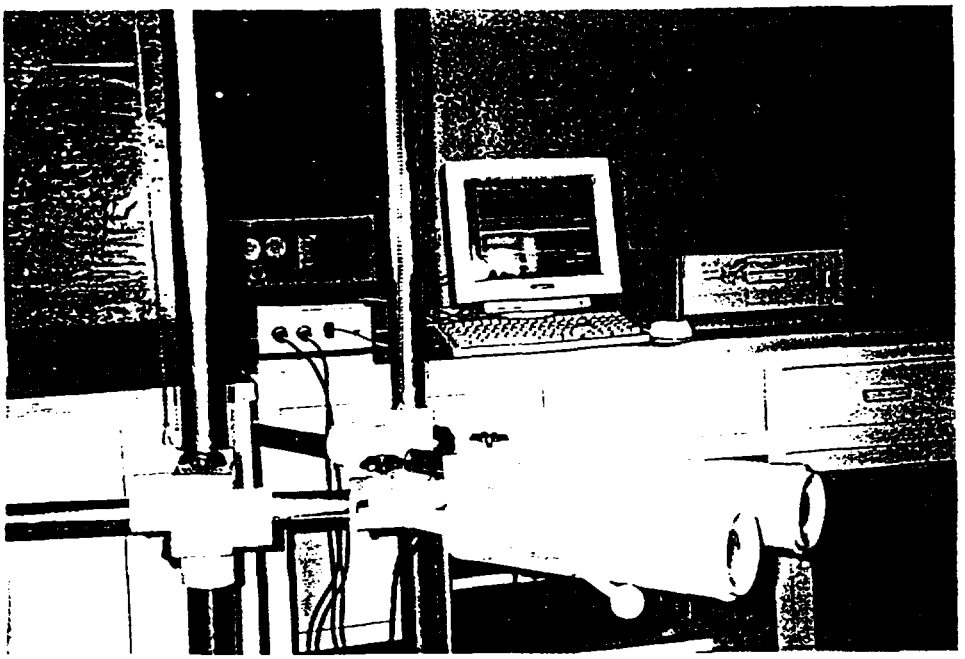
The 2-channel version is only for monitoring the two kidneys, while the 4-channel version permits simultaneous monitoring of the heart and the bladder which provides additional data for better diagnosis.

❋ DESCRIPTION

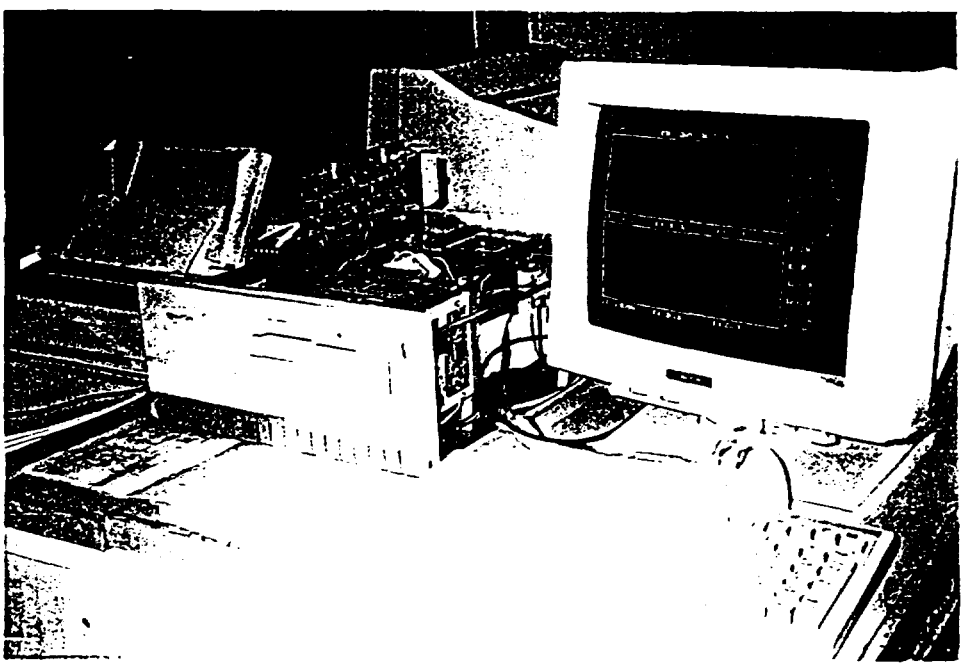
The instrument uses NaI(Tl) scintillation detectors to register gamma rays emitted from radioactive substance injected in the body, permitting the doctor to follow the state and rate of absorption and discharge of organs of interest (kidneys, heart, bladder). On the basis of recorded absorption spectra, the doctor can analyze for functional abnormalities.

A computer software has been developed permitting operation through MENU control, with the following features:

- Variable HV setting 0-2000V
- Time preset
- MCA (Multi-Channel Analyzer) mode: to acquire a differential spectrum which permits appropriate selection of low-level and window-width settings
- MCS (Multi-Channel Scaler) mode for acquisition of actual absorption spectra of interested organs
- All interested spectra and data are displayed on the monitor screen in color and can be stored in appropriate files in the computer hard disk or floppy disks
- Reports of individual patients with corresponding absorption graphs are printed on paper.



Computer-based 2-channel renograph
Shown are the two detectors housed in collimators, HV unit and computer system



Computer-based 4-channel renograph (detectors not shown)
Shown are the add-on cards plugged in the computer
The spectra are displayed on the monitor screen

MINI-ASSAY RIA-01

* * *

* USE

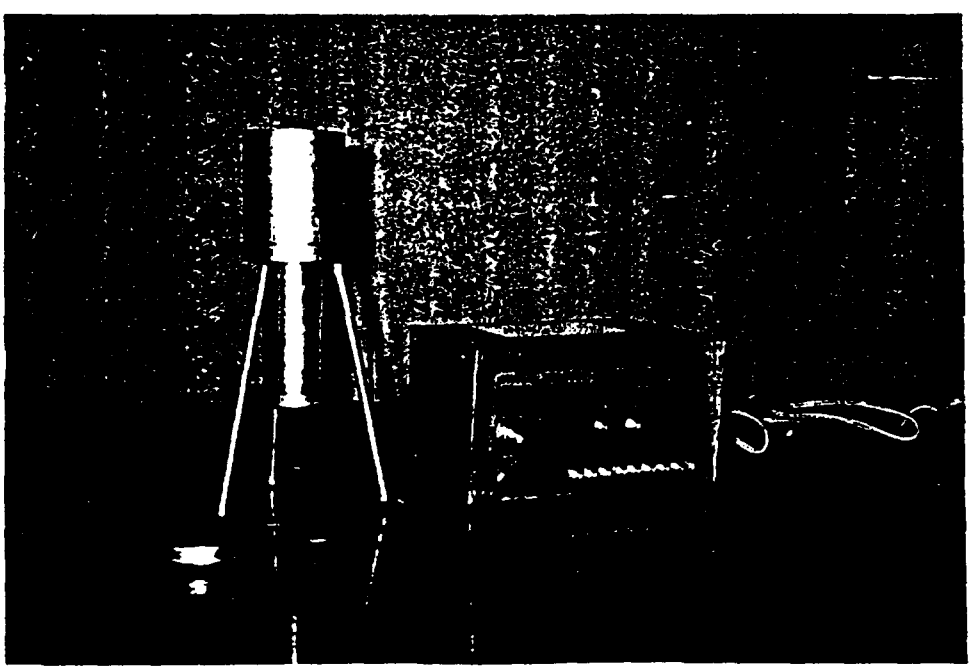
The Mini-assay instrument is used for in-vitro counting of samples as required in RIA (Radio-ImmunoAssay) studies.

* DESCRIPTION AND SPECIFICATIONS

The instrument is basically an SCA (Single-Channel Analyzer) using a well-type scintillation detector permitting counting of I-125-based RIA kit samples. The detector is lead-shielded.

Technical specifications:

- Preset HV = 1300V (internal adjustment up to 1500V)
- 7-segment LED display with max. capacity 10^6-1 counts
- Preset time : selection by push buttons of 1, 2, 5 ,10, 20, 50, 100, 200, 500, 1000 sec and infinity
- Power supply: 110V/220V AC, 50 Hz



PORTABLE IODINE UPTAKE MEASUREMENT INSTRUMENT

* * *

* USE

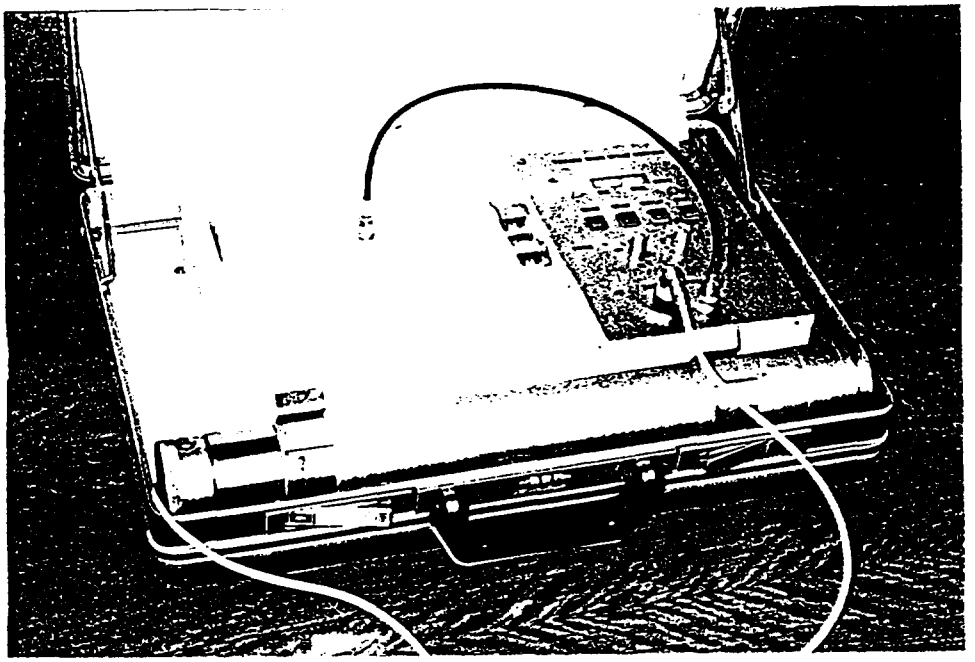
This is a portable, battery-operated instrument for thyroid uptake measurement to be used in the country side or remote area health care posts.

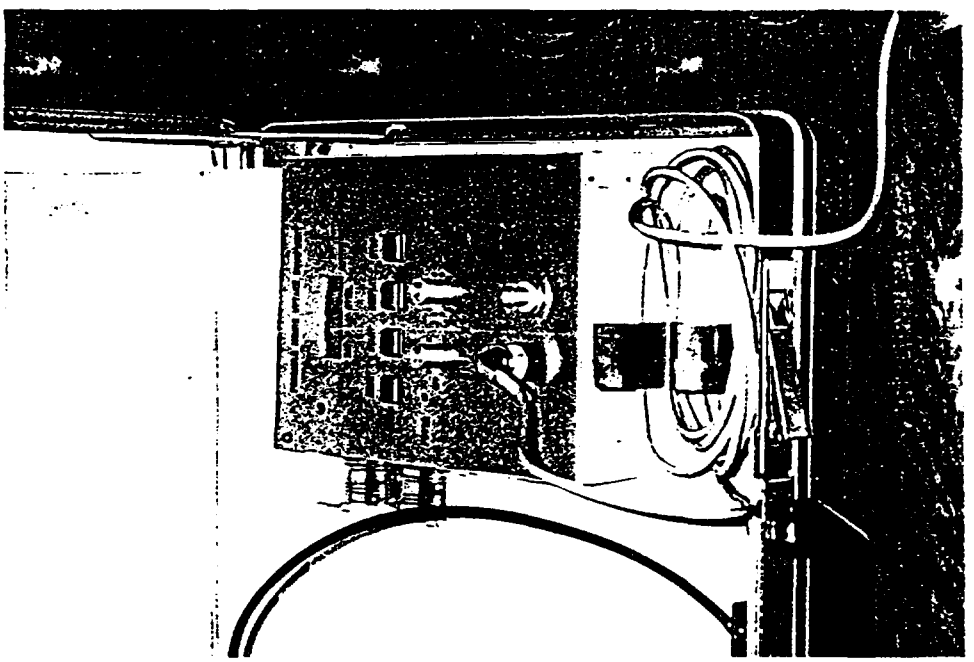
* DESCRIPTION AND SPECIFICATIONS

The instrument consists of a scintillation detector, a battery compartment and the electronic measuring block, all conveniently packed in an attaché-case. The instrument, basically an SCA (single-channel analyzer), has been designed, using CMOS components and special electronic circuit techniques for optimal prolongation of battery life-time.

Technical specifications:

- Detector : NaI(Tl) scintillation detector
- DC Power : 6 DD-size batteries (9 V). Approximately 2 weeks life-time for continuous operation
- Current consumption: max 63mA with HV and display ON
- Preset time : $N \times 10^{M}$ sec where N = 1 to 10, M = 0 to 3
- Display: 7-segment LED with total count up to 10^{4} or 10^{5} range as selected by toggle switch.





The portable iodine uptake measuring instrument
Shown are the battery housing, electronic measuring block and scintillation detector

SURFACE CONTAMINATION MONITOR

* * *

* USE

The instrument is used for monitoring the radio-activity level of any surface contaminated by radio-active material, especially liquid.

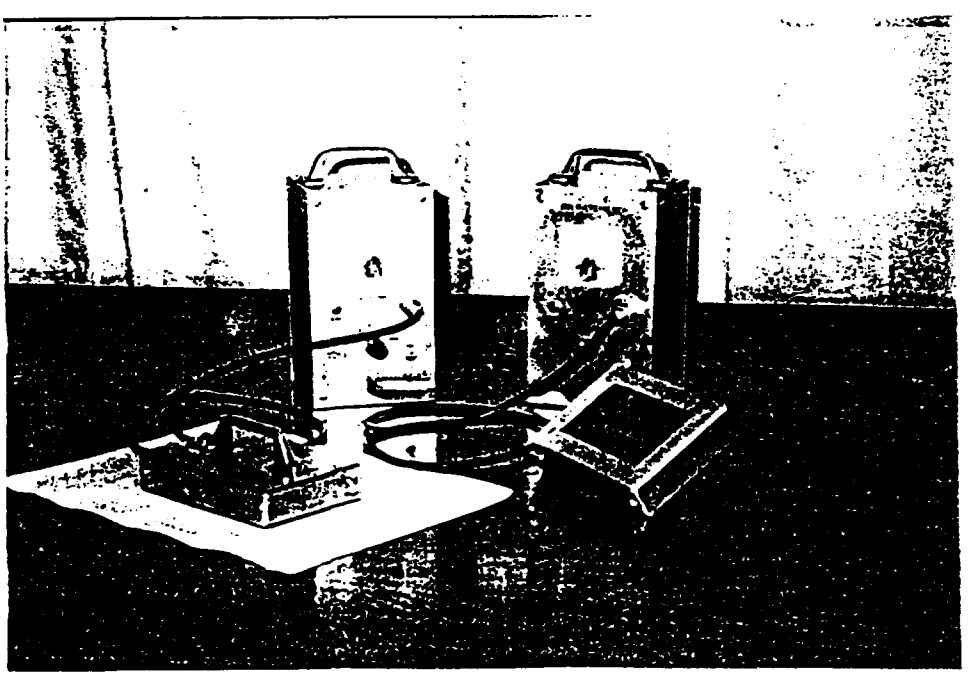
* DESCRIPTION AND SPECIFICATIONS

The instrument is battery-operated and uses a detector assembly consisting of 3 Geiger-Mueller counters.

Technical specifications:

- The count rates are indicated on panel meter with 4 max ranges: 10, 100, 1000, 10000 CPS
- DC Power: 6V, supplied by 4 DD-type dry batteries
- Audio: earphone for audible count rates.

To avoid contaminating the detector assembly, it is recommended to always cover it in a plastic bag.



RADIO-ACTIVITY WARNING INSTRUMENT

❋ ❋ ❋

❋ USE

This is an AC-power operated instrument using a GM counter for monitoring gamma radiation level. A buzzing sound is made whenever the measured count rate surpasses a preset alarm level.

❋ DESCRIPTION AND SPECIFICATIONS

Preset alarm levels can be 10, 100, 1K, 5K, 10K CPS.