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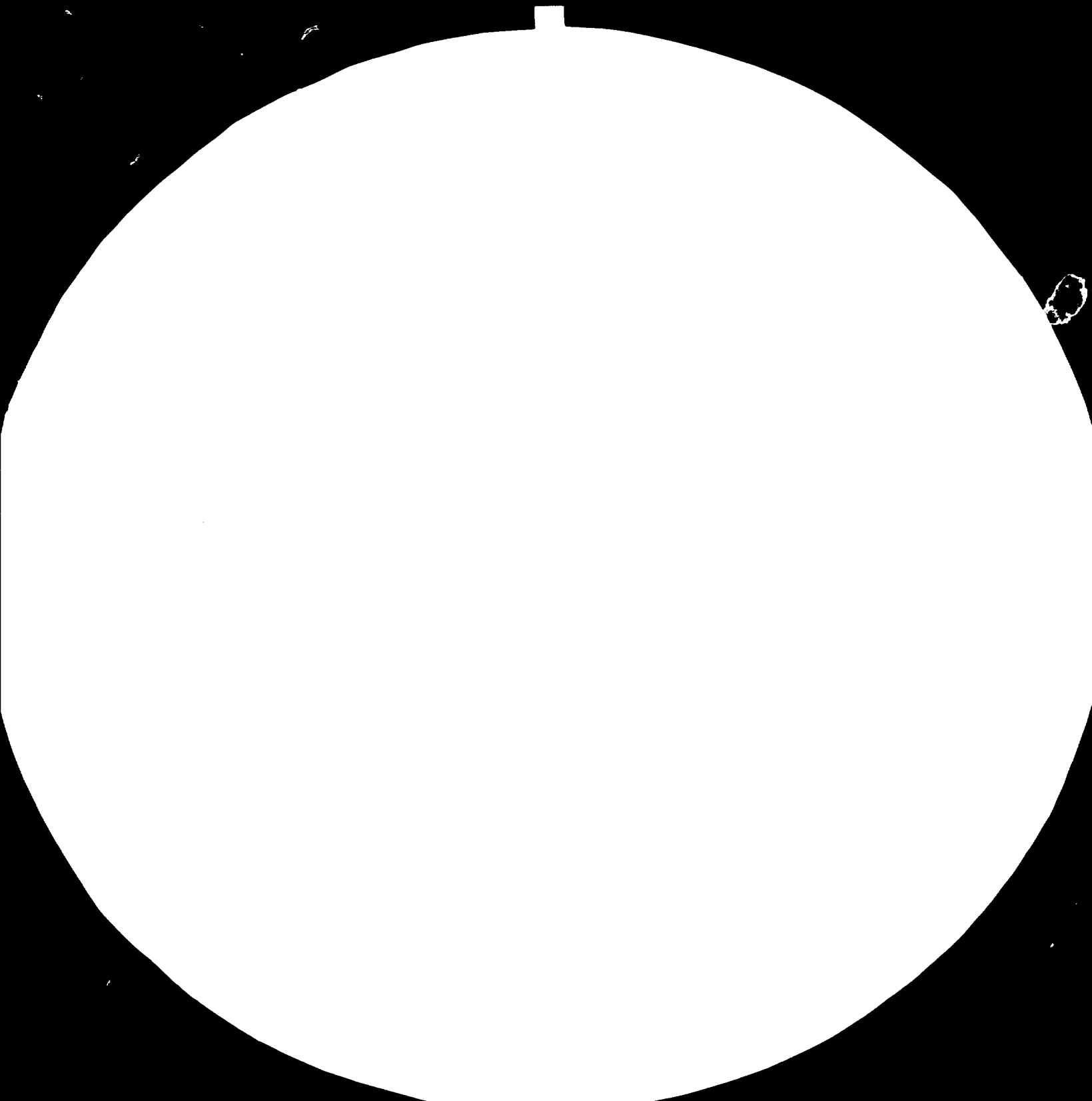

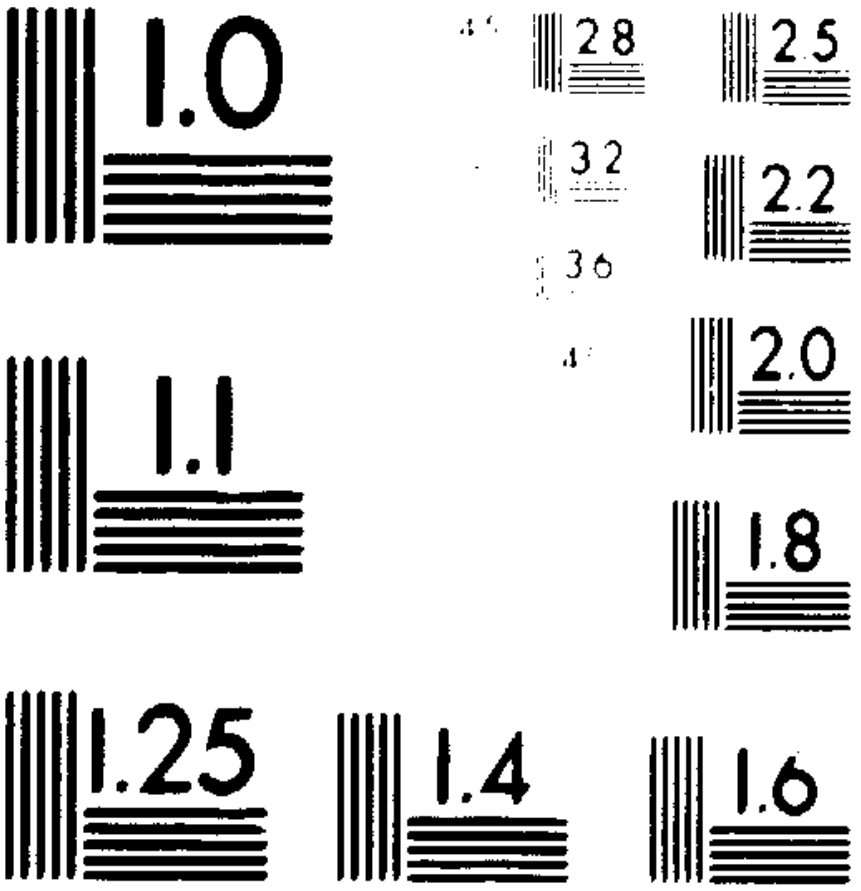

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16 March 1984
ENGLISH

TRAINING IN REPAIR AND MAINTENANCE OF ELECTRONIC EQUIPMENTS

DP/TUR/76/048
TURKEY

Terminal report

Prepared for the Government of Turkey
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of László Vermes, electromedical expert

United Nations Industrial Development Organization
Vienna

V.84-83446

Explanatory notes

References to dollars ($) are to United States dollars, unless otherwise stated.

The monetary unit in Turkey is the Turkish lira (LT). During the period covered by the report, the value of the Turkish lira in relation to the United States dollar was $US 1 = LT 378.

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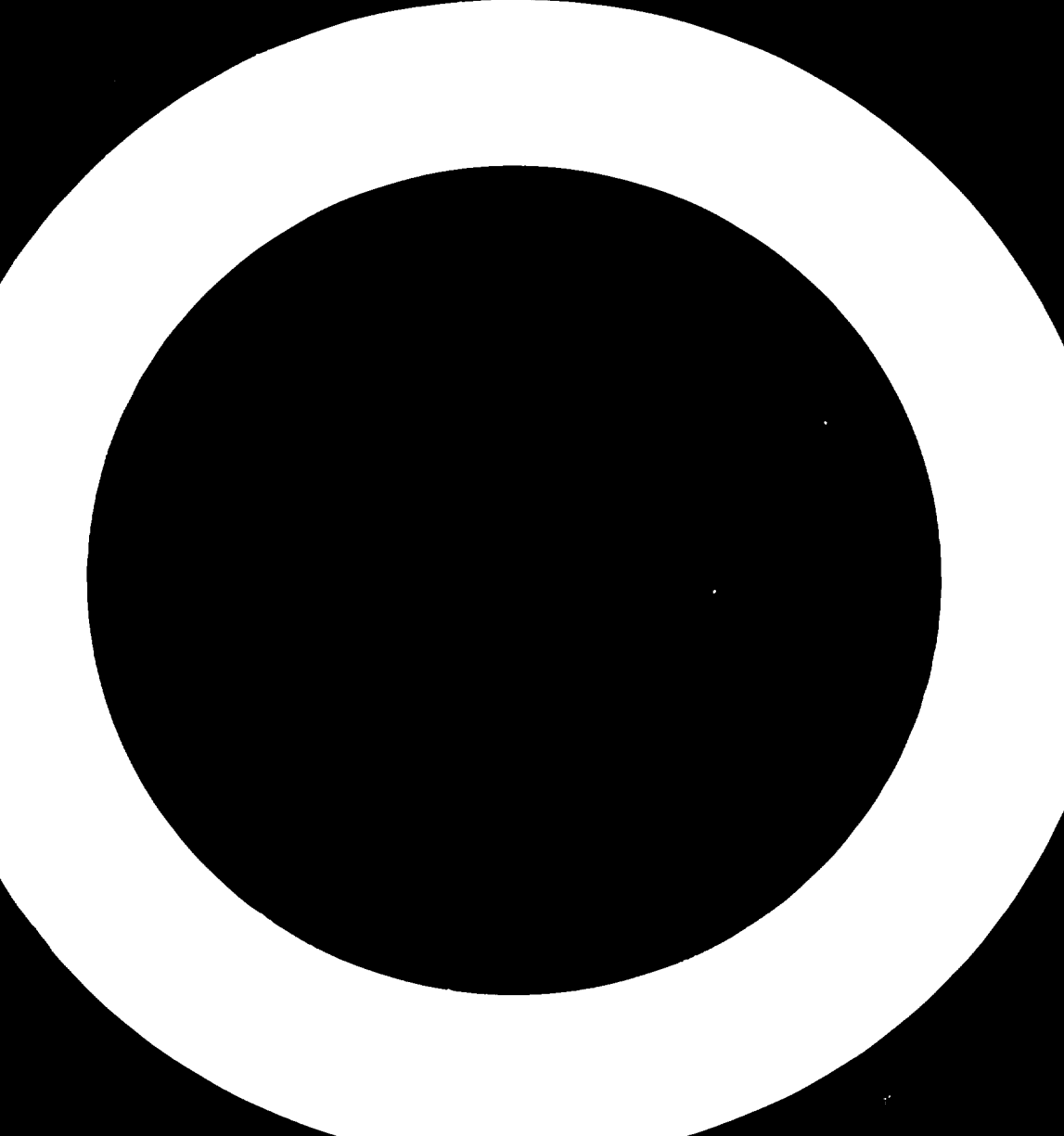
ABSTRACT

Within the framework of the United Nations Development Programme (UNDP) project "Training in repair and maintenance of electronic equipments" (DP/TUR/76/048), an electromedical expert was sent by the United Nations Industrial Development Organization (UNIDO), acting as executing agency for UNDP, to Gebze, Turkey, to train a group of Turkish engineers to serve as trainers in the repair and maintenance of electromedical instruments and equipment and to oversee the purchase and installation of necessary equipment at the Training Centre at Gebze.

The objective of the mission, which was carried out from 8 February 1979 to 31 December 1983, was the improvement of capability in repair and maintenance of electronic equipment used in hospitals and other health care institutions, through the establishment of a training centre for training technicians, who would later set up and operate repair and maintenance departments in enterprises or institutions.

During the follow-up project at the Gebze Training Centre the position of the teaching staff will be consolidated and the missing medical instruments will be installed. The training and service facilities will expand.

The establishment of a training support centre for biomedical technologies should be considered.



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INTRODUCTION

The implementation of the project "Training in repair and maintenance of electronic instruments" (DP/TUR/76/048) began on 8 February 1979, when the electromedical expert arrived, and ended on 31 December 1983. This report describes the objectives, activities, outputs and inputs as well as the environment in which the project took place.

The objective of the project was the improvement of capability in repair and maintenance of electronic equipment used in hospitals and other health care institutions, through the establishment of a training centre for training technicians, who would later set up and operate repair and maintenance departments in various enterprises or institutions.

The training centre was established and has been providing continuous service since early 1982. In various courses more than 200 technicians have been trained, although it was originally planned to train only 32. The level of education and the training programme, however, had to be lower than originally planned because of the inadequate qualifications of the Centre's teaching staff and the insufficient provision of medical instruments.

The training of the Centre's staff has been carried out by using local facilities and by sending them abroad on a fellowship basis. Thirteen teachers have been trained, eight are working at the Centre now, one was sent abroad by government counterpart for further training, the others resigned.

Until the end of 1982, which was originally scheduled as the termination date of the project, the TUBITAK/Marmara Scientific Institute was the implementing agency. In November 1982 the Government of Turkey requested the extension of the project for one year to bridge over to the follow-up, ensuring the uninterrupted continuation of the project implementation. UNDP/UNIDO agreed on the extension and an additional sum of $100,000 was allocated to project purposes. To make the budget complete a government cash contribution of LT 28.2 million was paid.

The Centre's staff has a good background in electronics, and knows the theory of various biomedical instruments very well. Although their skill in practical repair and maintenance work is still limited, a lot of equipment has been repaired by the Centre's staff and by the technicians attending various courses.

The Centre's laboratories are equipped with measuring and test instruments as well as components and tools. In the provision of medical instruments, however, there is still a shortage because of the administrative difficulties the counterpart has in transferring instruments from hospitals to the Centre. This has made the courses rather theoretical, with very little laboratory training.

During the implementation period, the first, second and third semester programmes were held. The third semester programme was exceptionally organized in hospitals, because no accommodation for technicians was available at Gebze.

Although the development of the project was impeded by insufficient and delayed inputs, the technicians are now trained on a continuous basis and the understanding of the importance of maintenance and service work has become evident, so that a new follow-up project was requested by the Government as a top priority.

The UNDP/UNIDO inputs expanded to attain the project achievements are:

Expert assistance	64.4 man-months
Training fellowships	81.0 man-months
Equipment	$226,411
Total expenditure	$712,405

Objectives of the project

While the objective of the project, as stated above, was the improvement of capability in repair and maintenance of electromedical instruments through the establishment of a centre for training technicians, the immediate objectives were: (a) to set up a training centre; (b) to train 15 electronic engineers, who would be the teachers and trainers in the Centre in the field of electromedical and X-ray equipment; and (c) to train 32 trainers in two courses in the field of electromedical and X-ray equipment.

Project design

One of the main problems in developing countries is the proper service of equipment used in hospitals and other health care institutions. An earlier UNIDO report (TUR/75/042) stated that in 1976 Turkey had biomedical equipment only in the hospitals of the Ministry of Public Health (in the amount of TL 924 million), and that about 95 per cent of the equipment did not receive proper repair and maintenance service.

The same tendency prevails in the level of the technical staff of the project.

In order to improve the capability of repair and maintenance of electromedical and X-ray equipment, it was decided to establish a training centre based on mutual co-operation between the TUBITAK/Marmara Scientific Institute as the government implementing agency and UNIDO.

The establishment of such a centre required a consideration of available resources, functional activities selected, the level of staff and many other factors.

One of the limitations foreseen was the recruitment of qualified electronic engineers with adequate experience in service and maintenance of biomedical instruments and at least some teaching experience.

Earlier investigations had shown that finding engineers with such qualifications for service and maintenance was a problem, so it was decided to train the recruited engineers in biomedical instrumentation during the first part of the project and that the trained engineers train technicians during the second part of the project.

When the implementation of the project started, it became clear that electronic engineers even without the knowledge of biomedical instrumentation were not available. This was the reason that made the project management turn to the Ministry of Public Education and ask for the participation of some of their teachers. Unfortunately only one of the provided teachers had a background in electronics.

Because of this the original teaching programme had to be modified, i.e. more emphasis was put on the training of electronic components and circuits.

Changes in the facilities, delays in the delivery of the instruments and in the alteration of the building of the Centre necessitated revisions in the scheduled plan of activities. The training of would-be trainers was modified and after their return from abroad additional time was provided for them. During this preparatory period specific subjects were selected and assigned to individual teachers preparing them for their later duties.

RECOMMENDATIONS

1. The recommendations for the utilization of project achievements in the near future are given in the project document for the follow-up project. The planning for the establishment or expansion/consolidation of such centres should be realistic, perhaps even conservative in its outlook. The availability of manpower and development resources usually falls short of that planned, and the administrative difficulties often result in the inefficient use of the resources that are available.

2. The Gebze Training Centre should reach a plateau during the follow-up project. This will be reflected both in the consolidation of the position of its teaching staff and the installation of the presently missing medical instruments for the laboratories. The training and service facilities will expand and this will result in a growing appreciation from hospitals and other health care institutions.

3. Parallel with the Gebze Training Centre the establishment of a training and support centre for biomedical technologies should be considered. This centre could be located on the campus of Haydarpasa High School for Industrial Vocations. The two institutions would provide a desirable location for the Centre, because of the availability of manpower and workshop facilities. These better conditions would be more favourable for organizing advanced training in the field of sophisticated medical instrumentation.

4. The two centres, the Gebze Centre and the Haydarpasa Centre, could be considered a complementary establishment, each having its own field and covering together the whole biomedical instrumentation area.

5. In addition to the training, it should be taken into account how the trained technicians will contribute to increase the capability of service and maintenance potential of the country. More awareness from the Ministry of Health is needed of the fact that if the trained technicians would go back to hospitals they could establish service cores around themselves. They would need, however, proper working conditions, a permanent fund for spare parts and a little more acceptance of the technical service work from the hospital staff.

6. In increasing the service and maintenance capability of the country, training is only a first step, in addition to which the proper organization and management for the best utilization of project results should be established. These matters need special consideration at the preparation/implementation stage of the follow-up project.

I. WORK CARRIED OUT

The activities were carried out on the basis of the work plan of the Project Document. The output covers a wider scope than foreseen. The number of trained technicians was considerably higher and during the project effective repair and maintenance service was provided to various hospitals.

Preparatory work

The first few months of the field work concentrated mostly on the establishment of the conditions of operation of the Centre. The appointment of the counterpart staff, the work on the building provided through the Ministry of Public Education and the completion of the order of equipment were the major activities of this period.

Recruitment of trainees

The recruitment of trainees, who would later be teachers, was difficult. The original idea was to recruit trainees with a background in electronics and with proficiency in English, who would be trained only in the field of biomedical instrumentation. The low status accorded to persons involved in maintenance and repair work, however, caused difficulty in finding the right staff. This forced project management to turn to the Ministry of Public Education to ask for the participation of some of their teachers. Unfortunately, only one of the recruited teachers had a degree in electronics. The others were electrical engineers. Because of this the original training programme had to be modified to allow more time for teaching electronic components and circuits.

Training programme for teachers

The first part of the training programme took place at the Istanbul Technical University, followed by a half-year in-plant training course at Medicor at Budapest. The programme included a refresher course in teaching electronic components and circuits. After their return from Budapest, it was found that although the training was very useful the assigned teachers still did not have sufficient practice in the repair and maintenance of electronic instruments. The training period for teachers therefore had to be extended for an additional year. Each year, in-plant training programmes were organized for individuals at different hospitals concentrating on the education of repair and maintenance work.

The non-electronic background of the teachers therefore, caused a delay of one year in starting training courses for technicians. This extended teaching period, however, resulted in additional output, i.e. many medical instruments were repaired during this period.

This additional on-the-job training was prepared and led by the electromedical expert, with participation of locally hired trainers.

It was a request from the government counterpart, and UNDP/UNIDO agreed that instead of assigning an X-ray expert to the project as originally planned, the training in X-ray equipment would be held at Hatas A/S, which represents several medical instrument producers, such as Siemens and Philips. The available man-months has been transferred to budget line 11-02, ensuring the continuous services of the electromedical expert.

The training in X-ray equipment was organized partly in the repair and maintenance laboratory of Hatas, partly in different hospitals, where the trainees worked together with service personnel of the company on installed equipment.

Installation of laboratories

The work plan foresaw the establishment of three laboratories at the Centre: (a) Laboratory for electronic circuits and components; (b) Laboratory for electromedical instruments; (c) Laboratory for X-ray equipment.

During the implementation period all of the delivered instruments were put into operation after calibration. Special lectures were arranged for teachers to familiarize them with the operation and usage of these instruments.

The original funds for equipment were unfortunately kept very modest, taking into account, that the Centre would be incorporated into the Marmara Research Institute. The Centre, however, was established in a building supplied by the Ministry of Public Education, and everything had to be purchased from the original modest fund. This financial limitation did not make possible the purchase of more expensive medical instruments from various hospitals. There were several unused, outmoded medical instruments, which could well have been used for teaching purposes. The Ministry of Health promised to supply these medical instruments to the Centre but because of administrative difficulties not a single instrument was delivered till the end of 1982, although a protocol was signed between the Ministry of Health and TUBITAK to the effect that the required medical instruments would be provided by the Ministry of Health. After the beginning of the present bridging project some instruments were delivered. There were, however, few instruments compatible to patient treatment with which training activities could be planned. Most of them were electrical ovens and heaters. No X-ray equipment was provided, which made it impossible to complete the planned X-ray laboratory.

The medical instruments available at the Centre were purchased partly from Government Cash Contribution locally, partly from a modest fund established by transferring to equipment budget line of all the unused accrued money of the 1982 budget. Part of these ordered instruments are still under customs clearance procedure, so they cannot be installed.

The laboratories for electronic components and circuits are functioning well. The instruments ensure a proper operation of them. The furnishing and the alteration of the former building provide adequate comfort for both the theoretical and laboratory works.

In addition to the laboratories the Centre has an auditorium, some offices and miscellaneous rooms, such as a dark-room for X-ray picture developing.

It was agreed by all parties of the project that training in repair and maintenance cannot be separated from the repair and maintenance service, and that the Centre should provide such a service. One of the laboratories was therefore turned into a workshop, which has all the necessary tools and equipment and is ready to accept equipment for repair.

Training programme

The training programme for technicians, which was prepared by the electromedical expert, was based on the experience with teachers training and on the estimation of the level of participant technicians.

The fact that government rules do not allow the employees to be absent from their duty station for more than three months had to be taken into consideration. Consequently, the whole programme is now on semester basis, each semester lasting three months.

Another output of the project is a detailed survey of medical instruments existing in hospitals and of the service needed. This survey was prepared by the technical staff of the Centre, which visited various hospital departments. The list can be used later, when selecting the instruments to be serviced.

Following the permanent assignment of teachers to the Centre, their individual objectives have been established to give them opportunity to prepare themselves for their future duties. Parallel with the preparation of courses the preparation of lecture notes in Turkish was started. Technical reports and notes of 21 courses have been completed and printed. Parallel with the preparation of teaching programme some auxilliary equipment has also been made for testing and calibration purposes.

In addition to the lecture notes, technical books were ordered and a moderate library was established. Although a considerable amount of different instruments and component catalogues has been gathered, mostly from local dealers, there is still a shortage of technical periodicals and magazines because of limited funds.

Training of technicians

The Centre was originally scheduled to organize courses on a continuous basis in repair and maintenance of biomedical equipment for technicians, who were already working in hospitals and different medical institutions.

Based on the original work plan, 2 technician training courses were scheduled, each for one year, for 16 technicians. Since government rules do not permit the employees to be away from their duties for more than three months continuously, it was necessary to interrupt courses after each three-month session.

The total training programme was originally planned to be divided into four semesters. After the courses had begun, the level of participant technicians was found to be very uneven and lower than estimated. The training programme, which had originally also covered the highly sophisticated instruments, had to be adjusted.

In agreement with the government counterpart the more complex advanced biomedical equipment was eliminated from the training programme, which is now focusing on the relatively simple but more often used biomedical equipment. The training for the advanced sophisticated medical equipment should be included in the new follow-up project. The location of the project at Istanbul at Haydarpasa Vocational High School gives better conditions of operation.

Follow-up project

One of the major outputs of the project was the awareness and understanding of the importance of repair and maintenance work in general. Before the implementation of the project, there was doubt about the importance of service work.

During the project implementation the significance of such work had been proved and the evidence of that willingness is the fact that the Government of Turkey requested United Nations assistance in establishing another centre for training in maintenance and repair of advanced medical instruments.

The proposal formulated by the short-term consultant mission in the draft project document in October 1982 was later discussed with relevant government authorities and a modified project document was formulated by national project coordinator. Furthermore a slight modification considering the budgetary questions was made and the final project document proposal was submitted to the Government.

II. ACHIEVEMENT OF IMMEDIATE OBJECTIVES

Setting-up of the Training Centre

The Training Centre was established and has been in operation since early 1982. The activities are, in some cases, constrained by the availability of staff equipment and facilities but they none the less provide direct evidence of the achievement of the objectives.

The lecture rooms, laboratories and offices have been carefully planned, and the alteration work has been carried out on the basis of the requirements. The construction of electrical network, and the arrangement of laboratories ensure continuous training and laboratory work.

The electronic component and circuit laboratories are well equipped with both measuring and test instruments and electrical and electronic components needed for laboratory exercises.

One of the laboratories has been slightly modified, turned into a repair workshop and equipped with the necessary tools purchased locally. This has been done so that no practical repair and maintenance training can be arranged without effective service work.

An audio-visual education laboratory has also been set up. It has language training equipment, and a closed circuit video recording system, which was especially useful in hospital work. Several recordings have been made in various hospitals.

Some problems remained unsolved during the implementation period, such as very unreliable water and electric supply of the whole area. The frequent and unexpected electric shortages made the laboratory work impossible many times. The insufficient water supply caused unacceptable working and living conditions.

Another problem is the high ground-water level of the area, and the insufficient isolation of the building, which caused such high humidity that most tools have already been strongly corroded and in several oscilloscopes the high voltage transformer has broken down.

The main problem, however, are biomedical instruments, which are the basis of the laboratory exercises, and should have been received from various hospitals.

Although medical instruments for the Centre's laboratories were promised by the Ministry of Health, they were not delivered because of administrative difficulties.

The installation of the electromedical instruments in the laboratory could not be completed and the related lecture notes could not be prepared.

The practical part of the training courses was based on simple medical instruments borrowed from different hospitals. The third semester training was held in different hospitals. The participating technicians were sent to several hospitals and worked there under the supervision of one teacher of the Centre's staff. They repaired several instruments, but the training was rather ad hoc, based on the equipment of the laboratories of the Centre.

The training in hospitals is important but it should be only one element of the practical training, and cannot substitute the part intended to be organized in the Centre's laboratories. This part of the programme should get acquainted the participants with the construction of equipment, its proper calibration, as well as trouble shooting methods. The two parts of the programme can be regarded as complementary to each other.

The X-ray laboratory has not been established because no equipment has been provided.

The building for the Centre and the teaching staff have been provided by the Ministry of Public Education and belong to Gebze Vocational High School. This was a considerable contribution to the realization of project objectives. The training of trainers and the preparation and installation of laboratories were started without delay.

The administrative dependency on the High School, however, caused complications in the operation of the Centre several times. The Centre differs from other vocational high schools, where teaching is based on a fixed programme, giving lectures mostly in standard technical subjects. The Centre, however, accepts trainees with different levels of education, intends to put the emphasis on practical training, so that biomedical instruments will continuously be involved in its operation.

Part of the biomedical equipment should be held in the Centre's laboratories but considering the fast development in instrumentation a continuous collaboration with different hospitals is of basic importance, which requires more flexibility in the operation of the Centre.

The travel and other related expenses of the Centre's staff to hospitals were temporarily financed from the project budget but proper solution needs consideration by the counterpart.

Training of 15 teachers

Fifteen electronic engineers with adequate knowledge of English were not available for the project. The assigned teachers had to undergo training in English and in electronics. The additional year spent on their education caused a delay also in starting the training of technicians.

The teaching staff of the Centre, which consists of eight teachers at the moment, is well trained in electrical and electronic components and circuits. Parallel with the normal technicians course, they arranged special short-term courses in analogue and digital integrated circuits for electronic graduated teachers of other vocational high schools. They are also giving a continuous technical support to the Industrial Electronics Department of Gebze School, which is being established.

In the biomedical instrumentation fields, the teachers are now acquainted with a relatively large range of these instruments. Their skills in the practical repair and maintenance work, however, are not yet sufficient. This can be diminished by a continuous interactive collaboration with hospitals and other health care institutions.

Training of 32 technicians

The original objective was to train 32 technicians in the service and maintenance of biomedical equipment.

The number of technicians participating in various courses was significantly higher than originally planned. If short-term courses are also taken into consideration, then in different training courses altogether more than 200 technicians participated. Although this number is much higher than originally planned, the level of courses is lower than planned.

Most technicians attended only the first and second semester programme, which entitles them only to do some simple repair and maintenance work in a limited area of biomedical instrumentation. The third semester programme was organized only for 16 technicians.

This programme was held in different hospitals at Istanbul where the technicians forming smaller groups of three to four persons were working under the guidance of one of the teachers of the Centre's staff. They repaired many instruments but the programme was organized on ad-hoc basis, and therefore could not provide systematic knowledge in a certain field of instrumentation.

III. UTILIZATION OF PROJECT RESULTS

The objective was the improvement of capability in repair and maintenance of electronic equipment used in hospitals and other health care institutions, through the establishment of a training centre. The utilization of the project results can be measured in terms of organizational growth and in terms of services provided.

The Centre was established during the implementation of the project and provided continuous service for nearly two years. During this period more than 200 technicians participated in different training courses. The staff of the Centre and the participating techicians repaired biomedical instruments for an estimated value of about LT 15 million.

The project advocated the importance of service and maintenance work. This is one of the most important results of the project, reflected in a request for UNDP/UNIDO assistance in the establishment of a training and support centre for biomedical technologies.

IV. FINDINGS

The establishment of a training centre for service and maintenance is always complex, especially where two or more government agencies are involved and a share of the inputs and activities has to be organized.

The scientific institute TUBITAK and later the Ministry of Public Education were the government implementing agency. Although TUBITAK contributed a great deal in the establishment of the Centre it emphasized many times that the education of service technicians was not the responsibility of a scientific institute.

When TUBITAK had finished its mission, the problems had to be shared between the Ministry of Public Education and the Ministry of Health. Although the training specifically provided manpower in the field of biomedical instrumentation, less interest in the project was shown by the Ministry of Health.

The medical instruments that had been promised were not provided. There were problems with the accommodation and other expenditures of the participating technicians. The supply of components and spare parts needed for repair was still not adequate and the working conditions in hospitals for the training of technicians were still not satisfactory.

Also the administrative status of the Centre and the career of the teachers are still not clear, and there is a constant danger of losing them for better employment or salary prospect.

While some of these problems are still a drawback in the operation of the Centre, the immediate objectives were more than met. In the development objectives the milestone was put down and the understanding of the importance of the service and maintenance work was established.

Annex

JOB DESCRIPTION
DP/TUR/76/048/11-02/31.5.A

POST TITLE:	Electromedical Expert in [illegible] and Maintenance of Electronic Equipment
DURATION:	Twelve months; with possibility of extension
DATE REQUIRED:	August 1978
DUTY STATION:	Gebze; with travel within the country
DUTIES:	The expert will serve as the international counterpart to the national project co-ordinator and in conjunction with counterpart personnel will specifically be expected to: 1. Participate in the formulation and realization of the detailed training programmes of the whole training course. 2. Advise on and supervise the installation of the laboratory equipment. 3. Participate in the teaching and especially in the in-plant training phase which will be conducted outside of the country. 4. Co-ordinate and assist the local teaching staff, before and during the second training programme which will be conducted in Gebze. 5. Assist in the administration of the project. 6. Prepare a final report, setting out the findings of his mission and recommendations to the Government on further actions which might be taken.
QUALIFICATIONS:	Degree in electronic engineering and qualified instructor in the field of electro-medical equipment, with in-plant experience and teaching practice
LANGUAGE:	English; Turkish an asset
BACKGROUND INFORMATION:	The objective of the project is to establish a Training Centre in Repair and Maintenance of Electromedical and X-ray equipment, to train a group of fifteen trainers for the Centre, and to assist them in the design and conduct of the Centre's first training programme. The Centre will provide both theoretical and practical training and will function, initially, under the aegis of the Marmara Research Institute.