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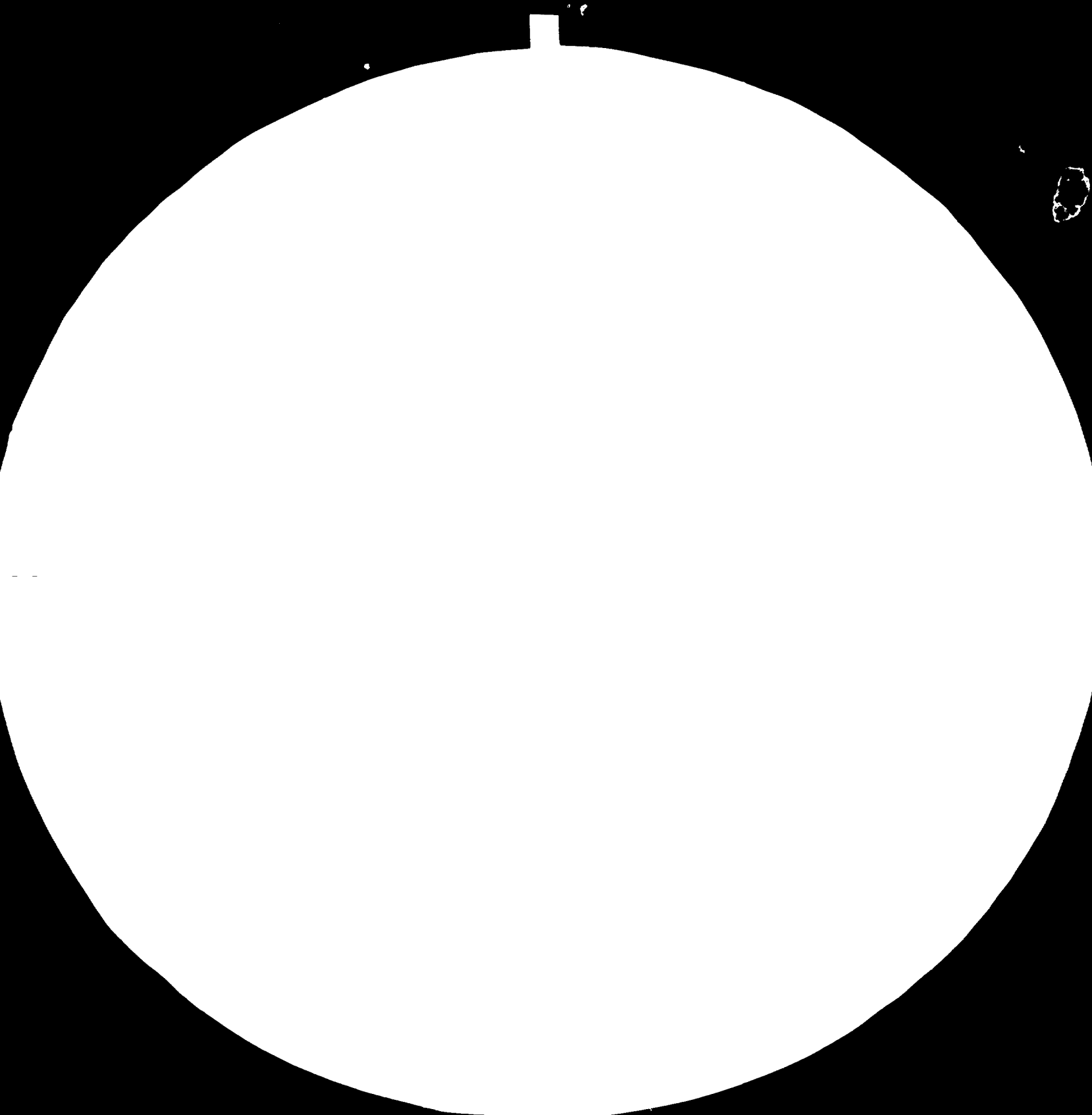

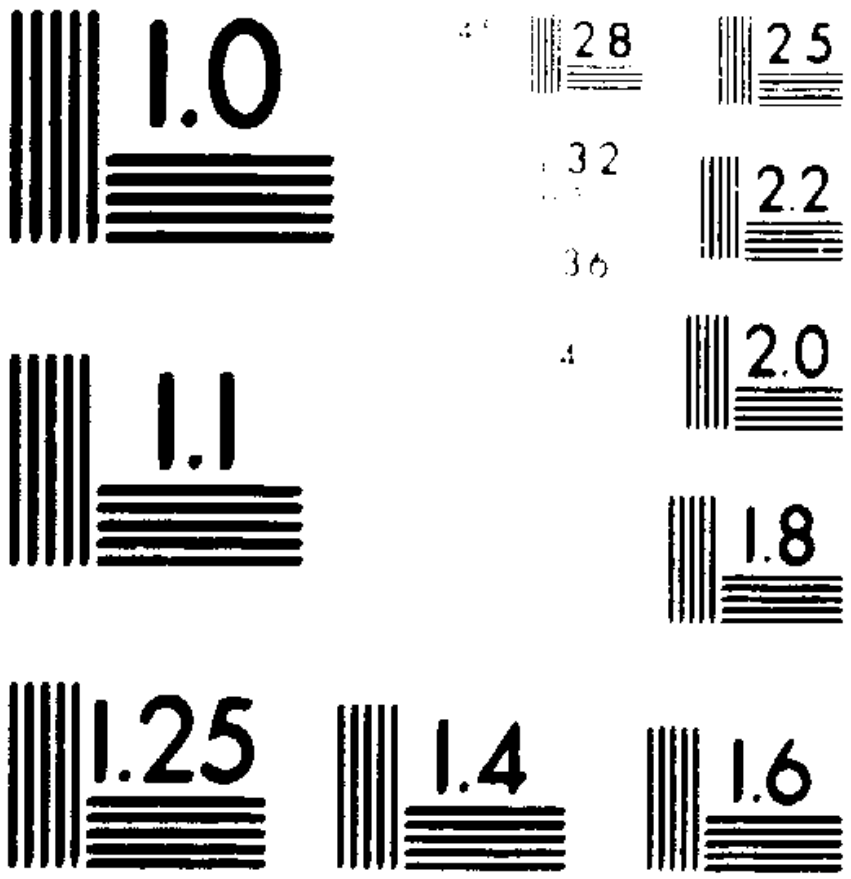

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27 August 1983
English

ASSISTANCE TO THE

TANZANIA INDUSTRIAL RESEARCH AND DEVELOPMENT ORGANIZATION

(TIRDO)

DP/URT/78/019

TANZANIA

TERMINAL REPORT

Prepared for the Government of the United Republic of Tanzania by the United Nations Industrial Development Organization, as executing agency for the United Nations Development Programme.

C.A. Stone
Chief Technical Adviser

1705

Table of Contents



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## GLOSSARY OF ACRONYMS AND TERMS

| | |
|---|---|
| CTA | - Chief Technical Adviser |
| ECU | - Economic Community Unit of Account |
| EDF | - European Development Fund |
| EEC | - European Economic Community |
| IRSI | - Industrial Research and Service Institute |
| PHASE I | - Project DP/URT/78/019 |
| PHASE II | - Project URT/81/037, a continuation of Phase I |
| SAP | - Government of Tanzania Structural Adjustment Programme |
| TBS | - Tanzania Bureau of Standards |
| TEXCO | - Tanzania Textile Corporation, a parastatal holding company |
| TIRDO | - Tanzania Industrial Research and Development Organization |
| TIPER | - Tanzania and Italian Petroleum Refining Co. |
| TISCO | - Tanzania Industrial Studies and Consulting Organization |
| TSh | - Tanzanian Shilling (TSh 12.17 = U.S.$ 1.00) |
| UNDP | - United Nations Development Programme |
| UNIDO | - United Nations Industrial Development Organization |

## SUMMARY

1. Implementation of Project URT/78/019, Assistance to the Tanzania Industrial Research and Development Organization (TIRDO), began on 24 August 1980 with the arrival of the CTA in Dar es Salaam. Phase I was concluded 30 June 1983. This Terminal Report describes the objectives, activities, outputs and inputs for this Phase of the Project together with the external environment in which the Project functioned. Recommendations concerning Phase II, now underway, are made.

2. The development objective was to create a capability within Tanzania to undertake industrial research and development activities in support of the country's long term industrial development plan through establishing the Tanzania Industrial Research and Development Organization. TIRDO now provides industrial energy conservation services, equipment repair and maintenance, industrial extension visits and a technical enquiry/information service. Limited chemical analyses are being performed, a survey of agro-industrial wastes has been funded and a proposal to undertake laboratory investigations of natural dyestuffs is in the final stages of negotiations. Fees totalling T.Sh. 85,359 were earned in the period 1 January to 30 June 1983 with the prospect for quadrupling this figure in the second half of the year.

3. The total staff has increased from 12 to 47 during the course of the Project while research officers and technicians have grown from 8 to 23 in number. There remains a shortage of senior personnel to design and manage projects, however. The Information Department, the Energy Conservation Centre and the Electronic Repair and Maintenance Division are fully equipped to carry out their respective functions in the staff houses which have been converted for office/facility use. Co-operative arrangements with the Central Veterinary Laboratory and the State Mining Corporation permit the use of their chemical laboratories and equipment until such time as TIRDO facilities are ready for occupancy. The travel required to achieve this co-operation stresses the limited transport capabilities, however.

4. The Organization, three years after establishment, is fulfilling its charter and providing services to industry in selected sectors albeit with constraints and limitations. The number of industries contracting for assistance is still small but increases as the reputation of TIRDO grows.

5. Government perception of TIRDO and its contributions to the national economy has been improved and the prospects for continued support strengthened as a result. The Organization will need to maintain and increase its services to industry as well as to continue publicizing its activities in order to retain Government support and to enhance the prospects for assistance from international agencies.

6. The UNDP/UNIDO inputs expended to attain the Project achievements are:

| | | |
|---|---|---|
| a) | Expert Assistance | 92.7 M/M |
| b) | Training Fellowships | 46.0 M/M |
| c) | Study Tours | 1.5 M/M |
| d) | Equipment | $363,300 |
| | Total Expenditure | $1,232,800 |

## INTRODUCTION

### The Establishment of TIRDO

7. The Tanzanian Industrial Research and Development Organization (TIRDO) was established by Parliamentary Act in 1979 following the breakup of the East African Community and the return to Tanzania of four national scientists and an expatriate adviser all formerly employees of the East African Industrial Research Organization based in Nairobi. The Organization was created at the mid-point of the Third Five Year Plan for Tanzania which included the first phase of a 20 year industrial plan.

8. A 40 hectare site had been acquired and architectural plans drawn for laboratories/offices and staff housing in anticipation of the legislation establishing TIRDO. Construction contracts were awarded in April 1979 with housing scheduled for completion in 1980 and laboratories scheduled for completion in 1982 with some buildings to be available for use in 1981. Construction costs were to be financed solely by the Government. The severe restrictions on development funds imposed beginning with FY 1982/83 had not been anticipated. As a result, facility construction plans are now limited to three priority buildings and completion of these is more than a year behind schedule.

### UNDP/UNIDO Assistance to the Organization

9. UNIDO fielded a preparatory mission of two experts for three months beginning in March 1979. The main objective of the mission was to prepare a draft Project Document for UNDP/UNIDO assistance to TIRDO. Implementation was a part of the Second UNDP Country Programme. The UNIDO mission together with four TIRDO staff members carried out a survey of 49 Tanzanian industries to ascertain their interest and needs for technical services. The Mission Report led to a Project Document and to a Policy Statement on the Mission of TIRDO.[1]

10. The Mission concluded that "The development of a fully staffed and equipped Industrial Research and Development Institute of the size of TIRDO requires a long time and substantial assistance. ——Assistance from a large number of multiple sources is needed for the development of TIRDO——". In retrospect, the Mission findings and the initial Project plan were unduly optimistic especially with regard to the availability of experienced, technically trained nationals to fulfill the staffing and training objectives put forward in the Policy Statement. Government planning for TIRDO and the Preparatory Assistance Mission did not have the full benefit of the UNDP/UNIDO evaluation of industrial research and service institutes (IRSI) begun in 1978 and completed in 1982.[2] More narrowly defined objectives for the establishment of the Organization might have resulted from the integration of the evaluation findings in TIRDO planning.

11. The Government of Tanzania, faced with unprecedented economic difficulties, formulated the National Economic Survival Programme in 1981. This was followed by the preparation of a three year (1982 - 85) Structural Adjustment Programme (SAP). One element of the proposed SAP was the

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1. UNIDO/IOD.287/Rev.1 27 November 1979

2. UNDP/PPM/TL 22 November, 1982

suspension of Government support for a number of development projects including TIRDO. Prompt efforts by the Organization and the Project to stress and strengthen the short-term, practical aspects of TIRDO's assistance to industry and to the national economy were required to maintain Government support. The Project activities and priorities were altered as part of the efforts to meet this challenge.

12. Phase I of the UNDP/UNIDO assistance project has extended into the Third Country Programme and has expended substantially more funds than initially programmed. This was largely due to the extension of Phase I for 18 months but also reflects the new objectives and activities which were introduced in response to changes in TIRDO schedules and to the decline in the Nation's economic circumstance. However, the ad hoc nature of the financing and the lack of consensus on longer term project plans were not conducive to efficient project implementation.

13. A joint UNDP/UNIDO Project Evaluation Team was fielded in March 1983 to review Phase I progress and to assess the Phase II Project design. Upon arrival, the Evaluation Team and Project Management were notified by UNDP/DSM that the 1983-86 Project Budget had been reduced to 53% of the original request and were handed prescribed yearly disbursements under the revised budget. A major task for the Team, TIRDO and the CTA therefore became the redesign of Phase II and the rationalization of the annual budgets. The Evaluation Report and the attenuated Phase II Project have since been approved.

## External Sources of Foreign Assistance

14. The Organization came into being at a time when the attitudes of assistance agencies visa vi institution building were undergoing change. Support for organizations per se was diminishing in favor of discrete projects with more quantifiable outputs. In Tanzania, assistance emphasis also was shifting from industry toward agriculture and the utilization of natural resources. These factors coupled with the lack of suitable buildings in which to house project equipment and activities have impeded the acquisition of other foreign assistance for TIRDO.

15. After a number of revisions, a Proposal for Technical Assistance to TIRDO has been officially submitted to the local Delegation of the European Community by the Government. The request has been forwarded to Brussells and is scheduled for review and EDF decision in September 1983. The proposal includes training, equipment and expert assistance for the Chemistry and Engineering Departments in the period 1984-86.

## PART I OBJECTIVES AND PROJECT LOGIC

16. The development objective of the project was to create a capability within Tanzania to undertake industrial research and development activities in support of the country's long term industrial development plan through establishing the Tanzania Industrial Research and Development Organization.

17. The immediate objectives of the project were modified during the course of the project. The objectives in effect at the termination of the project (Revisions 'G' and 'M') were as follows:

1. Establish the framework for the capabilities of the Analysis Department and lay down the foundations of the Food and Engineering Departments based on the needs of industry.
2. Setting up of an Industrial Information System covering information retrieval, enquiry services and an R&D registry.
3. Organise, equip and initiate operation of an electronic repair and maintenance function to serve TIRDO, other institutions and industry.
4. Identification of foreign sources of assistance which could provide expertise, equipment and training facilities.
5. Establish an energy audit service at TIRDO with trained staff capable of conducting energy audits and assisting individual companies in implementing energy conservation programmes.

### Project Logical Design

18. The resources required to establish a multi-branch IRSI will vary depending upon the functional activities selected, the level of staff sophistication and other factors. However, the inception and establishment of even a modest IRSI would need financing well in excess of the original project budget and even of the eventual Phase I expenditure. This was recognized from the outset and the initial project plan (Rev. 'C') emphasized the planning and laying of foundations for most TIRDO Departments while limiting support for operational activities to the Industrial Information System and to Analysis. These had been identified as prominent industrial needs by the Preparatory Mission. The identification of foreign sources of assistance was also accorded priority in further recognition of the extended resources needed to achieve the development objective. Thus the project 'philosophy' was to initiate and sustain a limited set of priority activities and to provide TIRDO with the basis for attracting additional technical assistance in support of the remaining functional areas. This approach was consistent with the anticipated UN funding levels but made the critical assumption that other technical assistance would be available at levels in accord with staff and facility expansion plans and on schedules complementary to the UNDP/UNIDO project.

19. Changes in facility completion dates, delays in the granting of technical assistance for the Chemistry and Engineering Departments and alteration of Government priorities all necessitated revisions in the specifics but not the spirit of the project design. In the absence of facilities and equipment, a series of short-term expert missions were substituted for scheduled, fixed term appointments to accomplish planning for chemistry, food technology, engineering and instrument repair and maintenance (Annex I lists expert missions). Two of these mission reports

were source documents for the preparation of proposals to a multilateral assistance agency which, if funded, would substantially broaden the functional base of the Organization.

20. Conversion of staff houses to office space permitted the establishment of an industrial information and extension service in 1981 as planned. A tripartite decision was taken in July 1981 to also initiate a much needed instrument repair and maintenance service since such operations could be conducted from converted housing and required only a nominal investment in equipment. Industrial energy conservation services were added to the portfolio of activities in 1982 as a partial response to the SAP and to Government concern about near-term, practical contributions to the economy by the Organization.

21. Therefore, the project as implemented has been designed to focus primarily on three selected priority functions for which self-reliant capabilities could be developed within the time and budgetary constraints. The mix of inputs employed (expert assistance, training and equipment) was a compromise between the need for early provision of practical, fee earning services and the extensive staff development requirements of TIRDO. The project design further assumed that international assistance for other functional areas could be obtained and provided support to the Organization in the pursuit of that objective.

22. Phase II of the project is designed to raise TIRDO capabilities to the level of self-sufficiency in all functional areas initiated under Phase I. Given the greatly reduced budget, only one new activity will be started. The manufacture of products such as pipe insulation from locally available, non-metallic minerals is to be assisted. This Project plan is based upon the firm belief that the existence of a small number of truly competent services provides a better base for the future growth of TIRDO than a more diverse but (most probably) less effective set of functions.

## PART II PROJECT OUTPUTS AND ACTIVITIES

23. The outputs produced from the activities undertaken in Phase I cover a wider scope than might be inferred from the immediate objectives. The work plan also called for assistance in organizational planning and in the development of technical management skills. In addition, it has proven necessary to provide both technical and managerial guidance to many of the individual projects and service functions not specifically assisted by the Project. The Project outputs and the activities carried out are discussed in the paragraphs following.

24. A preliminary organizational and institutional framework was to be developed. The framework was to define the main directives of research and development for Tanzanian industry and allocation of staff, facilities and funds among TIRDO itself, other government organizations and foreign resources. This rather ambitious statement assumes an ability on the part of the Organization and the Project to influence ministries and other parastatal organizations which is not totally consistent with the realities. Through many visits to industry, organizations and government offices by project experts and national staff, the picture of local needs, existing capabilities and institutional plans has been refined. Selected co-operative arrangements have been made with some organizations. Decisions

have been taken to pursue lines of activity parallel to other organizations when the demand for service is great enough or when the existing function is not of adequate quality. Also, new services have been initiated to fulfill unmet needs. There now exists a framework defining TIRDO directions for the near term. The formulation calls for close liason with Tanzanian industry and the conduct of services which can immediately contribute to increased productivity and production levels. Energy conservation, the supply of technical information, repair and maintenance of equipment, chemical and physical analysis of raw materials all typify the framework. This framework will require continuing adjustment as the resources available to the Organization increase and as local industry undergoes change. Tanzania has more technical organizations than it can presently support thus 'equitable' distribution of development resources is not possible. Those organizations which can demonstrate capability and productive activities are more likely to obtain commensurate support, however.

25. A preliminary plan and work programme of limited scope was developed for the Chemical/Analysis functions through a short-term expert mission which included some visits to local industry. This plan has since been modified in several respects. The chemistry, analysis and food technology activities have been combined in a single unit in recognition of the limited number of senior staff available to manage these functions. Continuation of a marginally productive study located in the Kilimanjaro region and utilising two senior chemists since the beginning of the Project should be reconsidered by TIRDO. The work programme for the Chemistry and Food Technology Department emphasizes inorganic analysis, product improvement projects and the development of intermediates for industry which can be made from local resources. Lack of equipment and laboratory space are major constraints to these activities. The work programme will require expansion and revision when external assistance for this activity becomes available.

26. A first draft of a TIRDO management manual to include policies, procedures, organization and financial data was a planned output which has been only partially achieved. There are important cultural considerations which advocate the preparation of such a manual by the national staff and this approach has been taken. Further, operational procedures for the various service functions differ from one another and individual manuals are needed for each. Three segments of the manual pertaining to the total Organization have been completed. A fee structure which covers brief consultancies, service tasks and extended projects has been developed and implemented. A research and service policy document is complete and will be submitted to the TIRDO Council for ratification at their next meeting. An organizational structure is in effect and the current chart is shown in Annex 2. The Information Department and the Electronics Division have prepared policy statements and procedures for the conduct of their respective activities. In the case of Electronics, further clarification and revision of the service procedures is required. This has been deferred until later in Phase II when a new industrial electronics expert is scheduled to arrive. Budgetary and financial procedures are set by the Ministry for Industries, the Parliament and Government auditing practices and are outside the purview of the Project. Matters such as accounting for staff time, official work assignments, project financial control and report review and approval are still being handled on an ad hoc basis. These procedures should be formalized and documented.

27. A recommended medium-term training programme has been developed and is outlined in Annex 3. However, to date the training for TIRDO research officers and technicians has been less effective than might be wished and the implementation of further training should take into account the lessons learned. There is a great disparity between the problems facing Tanzanian industry and those found elsewhere including many other developing countries. Thus training abroad, especially short-term fellowships, must be very carefully structured if it is to be relevant to local needs. It has also been found that most industrial research and development institutions are not well prepared to provide the training necessary to increase the practical skills of developing country trainees. The fellow is either integrated into ongoing projects having marginal relation to his training needs or is allowed to pursue his own inclinations but with limited guidance and access to necessary equipment and facilities. Considerably more effort need be devoted to training design and it is imperative that TIRDO and the Project correspond directly with the training institution in advance in an effort to ensure that the fellowship meets its objectives. On-the-job training also requires more organization and attention by the experts. With the notable exception of the documentation training carried out by the Information Retrieval expert, local training has tended toward 'do as I do' rather than addressing specific knowledge and skill requirements. The emphasis placed on early establishment of operating services at TIRDO has contributed to on-the-job training problems in the past. However, if Phase II is to achieve self-sufficiency for all the ongoing functions supported by the Project, more attention will have to be devoted to staff training.

28. Another output was to be a computer aided information system. This was to be accomplished through the purchase of micro-computers and associated software with the training and system development to be carried out by an associate expert. Unfortunately, this post is only now being filled. Two personal computer systems with spares were purchased and appropriate commercial computer programs were acquired from time to time. The CTA has placed the equipment in operation and, together with the Information Expert, instituted informal training for several staff members on an 'after hours' basis. A system of computerised company files is nearing completion and will permit retrieval in terms of company products, size, location, etc. as well as the nature of TIRDO interaction with the company. A system for storing and retrieving all technical documents is still undergoing development and test but should be implemented shortly. The computers can have application to TIRDO and Project management and to many engineering problems as well. It is hoped that the associate expert for this task will arrive in November as scheduled and permit full advantage to be taken of the computer capability which has been installed.

29. The Parliamentary Act establishing TIRDO designates as one of its functions - "to establish a system for the registration of, and to register, the findings of applied research carried out within Tanzania, and to promote the practical application of those findings in industrial production;". This same responsibility appears in the charter of TISCO and TBS and the establishment of a registration system was included as a Project output. This task has been integrated with the general organization of the document collection in the Information Department. Tanzanian reports are classified and shelved separately but are contained within the overall classification/retrieval system by subject matter. The major problem

remaining is the more effective acquisition of relevant documents. Much of the applied research being carried out in Tanzania has the support of either bilateral or multilateral assistance agencies. A direct approach to all of these agencies to obtain past and future reports appears to be the most effective mechanism. Staff resources have not been adequate to initiate and personally followup such an acquisition programme in addition to their other duties. However, a combined letter and personal visit approach has been designed and will be implemented as staff time permits.

30. Detailed instrument and equipment specifications for the Analysis Division (read Chemistry and Food Technology Department) were a major output of expert mission 11-05 and are contained in the mission report. These extensive recommendations were the basis for a greatly curtailed proposal to the European Community. The analytic equipment thus proposed is given in Annex 4.

31. A survey of engineering and other industries was carried out as part of expert mission 11-03 and led to a preliminary work plan for the Engineering Department. The mission report outlines an extensive programme well beyond present staff size and capabilities but which can serve as guide to departmental decisions for some years to come.

32. Expert mission 11-03 also generated a prioritized list of equipment and tools for the Engineering Department. This list was organized in a manner compatible with the work programme above and the recommendations were used to select items for the proposal to the European Community. Annex 5 is the attenuated list of engineering equipment as proposed to the EEC.

33. Specification of equipment and supplies for the electronics (equipment repair and maintenance) activity was effected under expert mission 11-04A. Procurement was undertaken in the period before mission 11-04B began and the majority of the items were available upon the expert's return. The equipment and supply needs for this activity have since been reviewed semi-annually with additional procurements made on the basis of experience gained. The group is now quite well equipped to carry out its function.

34. Training for local personnel in electronic equipment maintenance, calibration and repair has proceeded slowly. The two staff members initially hired were experienced but needed on-the-job training. The programme suffered from the problems discussed in Para. 27 above. The resignation of the senior technician after one year of duty negated plans for fellowship training since the one remaining engineer was hard pressed to meet the demand for services. The recent hiring of a junior technician reopens the fellowship possibility which is now being actively explored.

35. Another training output was fellowships for ten junior and senior staff members by the end of 1982. Eleven fellowships for nine staff members totalling 46 man months of training had been completed by April 1983. In addition, the Project had assisted with the award of two other fellowships from non-project sources. Annex 6 lists the current TIRDO technical staff, their educational background and special training received.

36. The Project also was to assist the Director General of TIRDO in the preparation of agreements and project documents for the co-operation with sister institutes, inter-governmental and non-governmental organizations and governments. This has been accomplished and the documents for which Project assistance was rendered are listed in Annex 7.

37. A preliminary work plan and specification of instruments and equipment for the Food Technology Department was contained in the report for expert mission 11-08. This report was based on a survey of the food industry carried out by the expert and his counterpart. The work programme outlined activities for a five year period following the commissioning of laboratories.

38. An energy audit service was to be established within TIRDO equipped to undertake industrial energy audits and the implementation of conservation measures. The Energy Conservation Centre has conducted 14 industrial audits to date and is scheduled to carry out 15 additional plant surveys in the next five months. This forthcoming programme is sponsored by the Tanzania Investment Bank under World Bank auspices. The equipment required for an effective service is largely on hand with two shipments scheduled to arrive shortly. The service has received national recognition and is a consistent source of fees to the Organization.

39. Three people have been trained in energy audit and energy conservation techniques. Fellowships followed by intensive on-the-job training in the conduct of energy audits has proven to be successful. Further training as recommended in the reports of expert missions 11-09 and 11-54 is needed however, and is included in the medium-term training programme.

40. The Tanzanian companies which have been provided with energy audits are listed in Annex 8 together with the estimated annual energy savings for each. TIRDO engineers have assisted two of these firms, TIPER and the Tanzania Distilleries Ltd., to achieve savings through the adjustment of their furnaces. A few other companies have undertaken some of the recommended improvements on their own initiative. However, the majority of the energy conservation measures remain to be implemented. Lack of foreign exchange to purchase materials and fittings is a severe constraint but greater effort is needed to seek ingenious solutions and to take better advantage of local materials. TIRDO is investigating the potential for the local manufacture of insulation materials but, so far, quantifiable reduction in industrial energy consumption is minimal.

41. The Project has assisted the Information Department to acquire periodicals, handbooks and other reference material including microfiche of UNIDO documents and to form a collection of industrially useful technical information. Reprographic equipment, filing aids, indexing materials, audio-visual equipment, etc. have also been provided to assist with the establishment of industrial information and extension services.

42. The Information Department now publishes the TIRDO Newsletter on a quarterly basis with a distribution to more than 200 industrial managers, government officials, development assistance officers and institutional officers. The letter emphasizes TIRDO activities but also contains information on industrial capabilities of general interest. A Current Awareness List is printed on a random schedule to inform the readers of recent technical acquisitions and articles of potential interest. The department has organized a quarterly seminar for the technical staff of industries, organizations and institutions. This informal group meets to discuss current problems and resources for their solution.

43. The Project provided assistance instrumental in the electrification of the housing estate and in the conversion of six of the twenty houses to office facilities. Two laboratory buildings and a plant facilities building have now been completed by the construction contractor and outfitted with temporary lighting and water fixtures. The official handing over to TIRDO is now scheduled to take place 2 September 1983. These buildings will house the Chemistry and Food Technology and Engineering Departments. Other TIRDO functions will remain at the housing estate. The site plan with the completed buildings indicated is shown in Annex 9.

## PART III ACHIEVEMENT OF IMMEDIATE OBJECTIVES

44. The framework for each of chemical analysis, food technology, engineering, equipment repair and maintenance, industrial information services and industrial energy conservation exists both in the form of reports with medium to long-term planning horizons and in the form of current operations in each of the sectors. These activities are, in some cases, constrained by the availability of staff, equipment and facilities but nonetheless they provide direct evidence of achievement of the objective.

45. The industrial information system is functional and has now responded to 66 technical enquiries, made visits to 102 companies and established linkages with local and foreign technical organizations. The activities include scheduled publications and seminars as well as informal communications concerning TIRDO activities. The staff is presently providing training on the organization of information systems to a UNIDO fellow from Malawi. The national staff are scheduled to assume full responsibility for the operation and management of the Information Department in October 1983. The department would benefit from the addition of at least one more documentation officer and will require further support for training but the Project objective has been fulfilled. This activity would benefit greatly from short-term expert assistance to review operations and progress after one year of self management. Funding for this mission is not included in Phase II.

46. Establishment of an electronic repair and maintenance function at TIRDO is proceeding although full implementation has fallen behind the original schedules. Staff turnover and delays in recruiting a second UNIDO expert are the major factors contributing to schedule slippage. Test and calibration equipment, repair aids, generalized spare parts, etc. are all on hand and the facility is well equipped to carry out its function. The Division began providing repair and maintenance services to industry and institutions in October 1982. More than 15 clients have been assisted, most of whom are repetitive customers. The value of the equipment serviced is estimated to be more than TSh 1,000,000 (US $ 85,000). Fees collected to date total TSh 84,214. Early efforts to attract clients were not sufficiently aggressive especially in the industrial sector where in-plant service and rapid response are important. The national counterpart has taken steps to improve the utility of the work for industry and to actively seek their business. At present the demand for service greatly exceeds the staff capacity to respond. The objective has literally been met but further inputs are required to achieve self-sufficiency and to develop the function to the level where it can meet the national demand for equipment repair and maintenance. Phase II of the Project continues expert assistance and training for this purpose.

47. Foreign sources of technical assistance have been identified and the Project has provided support to the Organization in the preparation of documentation for grant and project requests totalling US $1.5 million. Awards of all requests are still pending, however. The availability of laboratory facilities in the near future should aid the search for further project-oriented foreign assistance. This objective has been achieved but, in view of the magnitude of assistance which could be utilised, efforts to identify and obtain foreign aid should be continued.

48. In the nine months since the initiation of fellowship training, an effective industrial energy conservation service has been established. Many of the major energy consumers have been audited and plans to audit 15 more companies have been made. This service has attracted national attention, has helped to publicize the practical nature of TIRDO services and is now a consistent source of fees. The Centre is adequately equipped but could benefit from the further training planned in Phase II. Achievements of this objective have exceeded expectations.

## PART IV UTILIZATION OF PROJECT RESULTS

49. The development objective was to create a capability within Tanzania to undertake industrial research and development activities in support of the country's long term industrial development plan through establishing the Tanzania Industrial Research and Development Organization. Utilization of the project results can be measured in terms of organizational growth and in terms of services provided. The total staff has increased from 12 to 47 during the course of the project while the professional staff has grown from 8 to 23. TIRDO has become a coherent organization with a growing appreciation for the needs of industry and four functions (industrial information, equipment maintenance and repair, energy conservation and chemical analysis) have been established to fill some of those needs. Fees derived from services to industry in the first half of 1983 totalled TSh 85,359. It is anticipated that fees in excess of TSh 350,000 will earned during the second half of the year.

50. The relatively small number of projects undertaken has made it possible to ensure an objective forecast of the results to be provided and to maintain high standards in the performance and reporting of the work. Continuing emphasis on the quality of its 'products' will be required if the Organization is to keep and enhance its reputation. Given the present level of technical management experience, it will be necessary for TIRDO to exercise restraint in the selection of and in the number of projects pursued for some time to come.

## PART V FINDINGS

51. The establishment of a multi-branch IRSI in developing countries has merit especially where there are limited technical manpower resources. A multi-branch activity can make more effective use of manpower and of infrastructure than can a series of mono-branch institutes. The diversity of skills available in an organization with multiple functions is also an advantage when dealing with many industrial problems since the problems tend to be multi-faceted in nature. However, the staff of a multi-branch institute must learn to work closely with company engineers and technicians who have specialized production and equipment knowledge.

52. The planning for the establishment or expansion of an IRSI needs to be very realistic, perhaps even conservative in its outlook. The availability of manpower and development resources usually falls short of that planned and often results in the inefficient use of those resources that are available. Also, the staff training and deployment plans do not always take proper account of the pressure that may be put on the organization to produce early outputs from the development investment.

53. The investment required to establish an IRSI is large and the likelihood that assistance will be required from more than one foreign organization is also large therefore. There is need in such situations for joint planning from the very inception by all parties concerned as well as close coordination during any joint implementation. This project would have benefited from closer liason among prospective assistance organizations during the planning stage.

54. The Tripartite system of project review and evaluation has not proven particularly effective for this project. A proforma approach and inherent conflict in the management roles of UNDP and of the executing agency were contributory.

## PART VI RECOMMENDATIONS

55. The recommendations for the near-term utilization of the limited resources available are embodied in the Phase II Project Document. They call for consolidation of the activities begun in Phase I and the initiation of work on manufacturing technologies for non-metallic mineral products.

56. TIRDO should be expected to reach a plateau in its growth by the end of the Project. Service functions should be well established, staff experience with industrial problems should have greatly increased and basic chemical and engineering facilities should be on hand. Realistic planning for the period 1985 - 1990 is needed well in advance. It is recommended that the project encourage and assist the Organization to develop plans for new and improved functions, associated staffing and sources of financing.

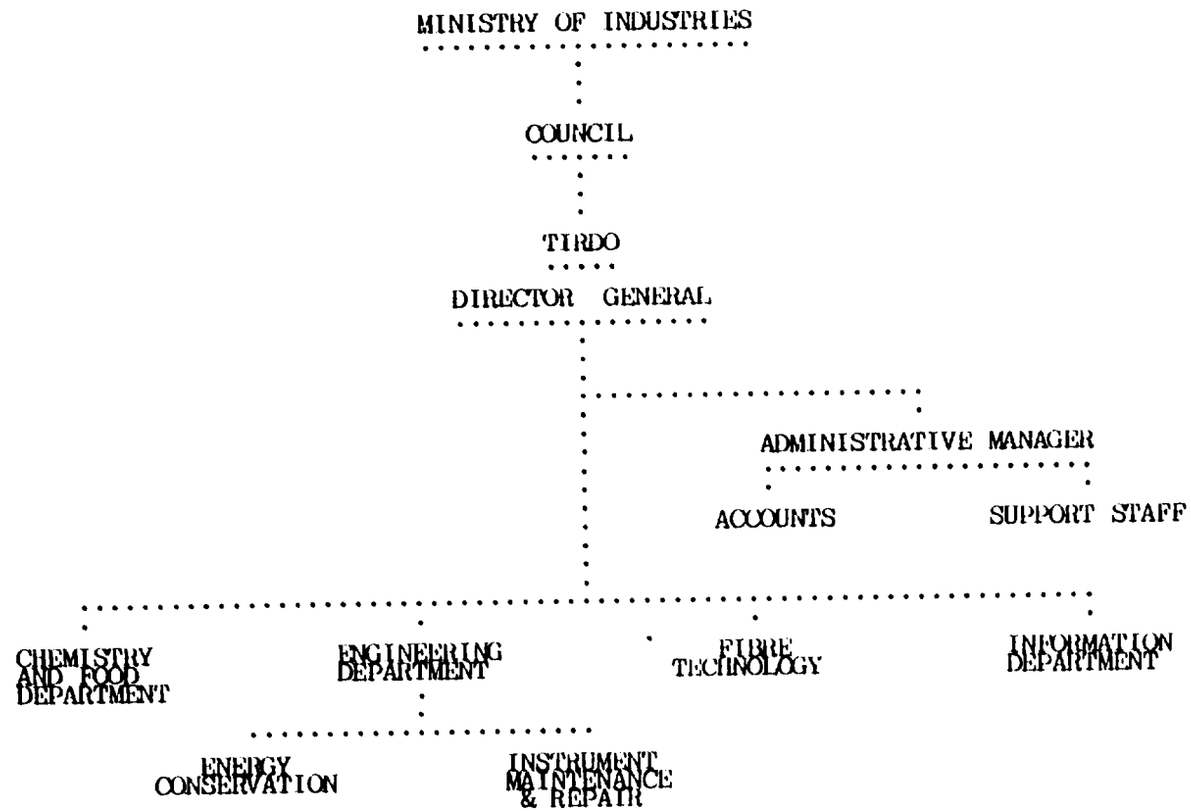
57. The TEXCO group of companies are the major clients for textile technology in Tanzania. It is recommended that TIRDO develop its plans in this sector in close coordination with TEXCO and give careful consideration to a truly collaborative program wherein TIRDO becomes the service, development and research institution for the industry.

58. The source of technical managers for the Organization remains a crucial and unsolved problem. Intensified recruitment is needed together with a programme to identify prospective section and department heads from existing staff so that on-the-job and formal training in management skills can be effected. It is recommended that the Project both urge and assist this process.

## ANNEX 1. EXPERT MISSIONS AND REPORTS

| Post | Expert | Report |
|---|---|---|
| 11-03 | F. J. Harbison | Development of TIRDO Activities in Engineering Services |
| 11-04A | Sital K. Suri | Electronics and Instrumentation |
| 11-04B | Sital K. Suri | Terminal Report |
| 11-05 | F. C. Strong | Analytical Analysis and Testing Services |
| 11-06A | R. Lafond | Industrial Information, Documentation and Extension Services |
| 11-06B | L. Aquino | Operational Guidelines and Procedures: Information Department |
| 11-07 | Kjeld Klintoe | Technological Information Services for Industry |
| 11-08 | Odon I. Vajda | Food Science and Technology |
| 11-09 | S. Rick | Industrial Energy Conservation Services |
| 11-50 | Michal Nowak | Chemical and Allied Industries Improvement |
| 11-54 | S. Rick and B. Cunningham | Energy Audits and Plant Refurbishment |

ANNEX 2. ORGANIZATION CHART : TANZANIA INDUSTRIAL RESEARCH AND DEVELOPMENT ORGANIZATION



ANNEX 3. RECOMMENDED MEDIUM-TERM TRAINING PROGRAMME

| Functional Area | Topic | Duration | Candidate | Project Support |
|---|---|---|---|---|
| Energy Audit | Industrial Process & Energy Systems | 4 mo. | P. Victus | yes |
| Energy Audit | " " " | 4 mo. | R. Nindie | yes |
| Electronics | Fundamentals of Fault Diagnosis & Repair | 3 mo. | S. Mziray | yes |
| Electronics | Operation & Maint. of Special Chem. Equip. | 2 mo. | D. Shirima | no |
| Electronics | Maint. & Repair of Off. Machines & Computer | 3 mo. | New Technician | yes |
| Electronics | Theory & Repair of Ind. Control Equipment | 3 mo. | New Engineer | yes |
| Industrial Extension | Functions of an IRSI Extension Officer | 2 mo. | E. Mlelwa | yes |
| Documentation | Information Management | 2 mo. | New Officer | yes |
| Engineering | Welding Theory & Practice | 3 mo. | New Engineer | no |
| Engineering | Mfg. of Insulation & Other Mineral Prod. | 3 mo. | G. Njau | yes |
| Engineering | Non-destructive Testing | 4 mo. | New Engineer | no |
| Engineering | Theory & Practice of Metal Working | 4-6 mo. | New Engineer | no |
| Engineering | Precision Machining | 2-3 mo. | New Artisan | no |
| Chemistry | Operation & Use of Spectrophotometer | 2 mo. | B. Mwingira | no |
| Chemistry | Operation & Use of Chromatographs | 2 mo. | B. Mndewa | no |

## ANNEX 4. PROPOSED CHEMICAL EQUIPMENT

| | ECU |
|---|---|
| **1. ANALYTICAL INSTRUMENTS** | |
| IR Spectrophotometer | 16 300 |
| UV-Visible Spectrophotometer | 7 750 |
| Flame Photometer | 2 600 |
| Colorimeter | 3 350 |
| Polarimeter | 1 750 |
| Refractometer | 1 650 |
| Gas Chromatograph | 16 200 |
| Thin Layer Chromatograph | 1 200 |
| PH Meters | 1 000 |
| Potentiograph | 4 700 |
| | 56 500 |
| **2. GENERAL LABORATORY EQUIPMENT** | |
| Microscopes | 6 000 |
| Balances | 6 000 |
| Ovens, Furnace & Centrifuge | 15 000 |
| Fractionating Still | 12 000 |
| Water Distillation Unit | 8 300 |
| Glass Blowing Equipment | 8 000 |
| Voltage Stabilisers | 4 500 |
| Refrigerator/Freezer | 2 500 |
| Kjeldahl Apparatus | 5 250 |
| Fume Hoods | 5 000 |
| Misc. tongs, spatula, crucibles, equip. stands, etc. | 17 950 |
| | 90 500 |
| **3. CHEMICALS & GLASSWARE** | |
| Misc. reagent grade chemicals | 20 000 |
| Laboratory Glassware | 20 000 |
| | 40 000 |
| **4. SPECTROSCOPIC AIDS & SUPPLIES** | |
| Collections of Spectra | 5 000 |
| Sample Preparation Equipment | 3 000 |
| Standards | 5 000 |
| | 13 000 |
| TOTAL ..... | 200 000 |

## ANNEX 5. PROPOSED ENGINEERING EQUIPMENT

| | ECU |
|---|---|
| **1. METAL WORKING MACHINERY** | |
| Reciprocating Hacksaw | 1 970 |
| Vertical Bandsaw | 8 570 |
| Centre Lathe & Accessories | 14 760 |
| Bench Drill | 1 200 |
| Pillar Drill | 3 320 |
| Pedestal Grinder | 2 170 |
| Bending Rolls (manual) | 2 100 |
| Arbor Press | 1 000 |
| Cutting Tools, Drills, Blades, etc. | 4 260 |
| Sheet Metal Folder | 2 460 |
| Tube Bender | 1 600 |
| Pipe Threader | 700 |
| Fly Press | 890 |
| | 45 000 |
| **2. WELDING EQUIPMENT** | |
| Oxy/Acetylene Set | 1 850 |
| Manual Metal Arc Set | 1 100 |
| Metal-Inert Gas Set | 2 170 |
| Metal Spraying Equipment | 3 700 |
| Welding Consumables | 2 180 |
| | 11 000 |
| **3. MEASURING & DRAFTING EQUIPMENT** | |
| Surface & Angle Plates, Vee & Gauge Blocks | 1 850 |
| Micrometers, Calipers, Vernier Gauges, etc. | 5 200 |
| Portable Hardness Tester | 1 750 |
| Tachometer & Vibration Meter | 900 |
| Drawing Boards, Instruments & Supplies | 2 700 |
| | 12 400 |
| **4. NON-DESTRUCTIVE TESTING EQUIPMENT** | |
| Portable Industrial Radiographic Set | 18 000 |
| X-Ray Development Equipment & Supplies | 1 000 |
| Portable Ultrasonic Flaw Detector | 14 000 |
| Magnetic Crack Detector | 1 800 |
| Dye Penetrant Kits | 800 |
| | 35 600 |
| **5. WOODWORKING EQUIPMENT** | |
| Universal Woodworker | 9 200 |
| Wood Lathe & Tooling | 5 500 |
| | 14 700 |
| **6. HANDLING EQUIPMENT & METAL STOCKS** | |
| Forklift | 7 500 |
| Flat, Round & Bar Stock (non-ferrous & speciality steel) | 8 800 |
| | 16 300 |
| TOTAL ..... | 135 000 |

ANNEX 6. TIRDO TECHNICAL STAFF 30 JULY 1983

| NAME | POST & SPECIALITY | DEGREE & DATE | SPECIAL TRAINING | CURRENT RESPONSIBILITY |
|---|---|---|---|---|
| Haule, P.K. | PRINCIPAL R.O. Chemistry | Ph.D.Chem. 1972 | | Chemical and Food Projects |
| Mwingira, B.A. | SENIOR R.O. Chemistry | M.S. Chem. 1969 | | Coffee Processing Improvement |
| Mndewa, B.S.E. * | R.O. I Chemistry | M.S. Chem. 1977 | Chemicals from plants | Coffee Processing Improvement |
| Makinge, F.K. * | R.O. I Chemistry | M.S. Chem. 1974 | Mineral processing | Essential Oil Production |
| Njau, G.J. | R.O. II Chemical Engineer | M.S. Ch.Eng. 1983 | Iron ore reduction | Sponge Iron from Tanzanian Ores |
| Chando, R.A. * | R.O. II Civil Engineer | B. Eng. 1979 | Facility maint. & repair | Energy Cons. & Industrial Mainten. |
| Tarimo, J.S. | R.O. II Textile Technologist | B.S Educ. 1978 | Textile machinery | Inventory of Agro-industrial Waste |
| Shigavalle, M.A.N. | R.O. II Textile Technologist | B.Sc. 1979 | Textile machinery | " " " |
| Victus, P. * | R.O. II Mechanical Engineer | B.S. Eng. 1980 | Prod. eng. & energy cons. | Industrial Energy Conservation |
| Ganyara, M.A.L.L. | R.O. II Analytical Chemist | M.S. Chem. 1977 | | Extraction of Natural Dyes |
| Magashi, A.N. * | R.O. II Textile Chemist | B.S. Chem. 1980 | Fabric dyeing & finishing | Performance of Natural Dyes |
| Kahatano, J. | R.O. II Analytical Chemist | M.S. Chem. 1980 | Ph.D. Analytic chemistry | Training Fellowship |
| Nyonyi, J.L.M. * | R.O. II Food Technologist | M.S. Biol. 1982 | Flour & feed formulation | Grain substitutes in Poultry Feed |
| Nindie, R.M. * | R.O. II Mechanical Engineer | B.S. Eng. 198 | Energy conservation | Pyrolysis of Wastes & Energy Cons. |
| Kashaija, A. | R.O. II Food Technologist | B.S. AGRIC. 1981 | | Refining of Edible Oils |
| Shirima, D.M.D. | R.O. II Electronic Engineer | B. Eng. 1979 | | Electronic Repair & Mainterance |
| Nyonyi, W.N. * | R.O. I Documentation Officer | M.A. Educ. 1980 | Info classifying/retr'val | Industrial Documentation & Enquiry |
| Tingo, A.J. * | R.O. II Extension Officer | B.Sc. 1976 | Extension methods | Industrial Extens./Problem Ident. |
| Mlelwa, E.H. | R.O. II Extension Officer | B.Sc. Mech. 1982 | | Industrial Extens./Problem Ident. |
| Mziray, S.N.E. | Tech III Electronic Technician | Cert. E. E. 1981 | | Electronic Repair & Maintenance |

R.O. = Research Officer * = UNIDO Fellow

## ANNEX 7. PROJECT CONTRIBUTIONS TO TECHNICAL ASSISTANCE DOCUMENTS

| Title | Date |
|---|---|
| Technical Assistance Proposal to the EEC | 19/05/81 |
| Revised Technical Assistance Proposal to the EEC | 11/09/81 |
| TIRDO Development Plans and the Role of a Technological Institute in Tanzanian Industrial Economic Development | 11/05/82 |
| Technical Assistance Proposal to the EEC | 13/08/82 |
| Revised Technical Assistance Proposal to the EEC | 28/10/82 |
| Draft Technical Assistance Proposal to the EEC | 02/02/83 |
| Furnace Adjustments for Energy Conservation - Proposal to the Tanzania & Italian Petroleum Refining Co. | 17/02/83 |
| Terms of Reference for and Industrial Energy Conservation Programme - Preliminary Document to the Tanzania Investment Bank | 01/03/83 |
| Technical and Economic Feasibility of Natural Dyestuff Utilization - Proposal to Tanzania Textile Corp. | 19/03/83 |
| Production for Energy Conservation - Preliminary Proposal Outline to the UN Capital Development Fund | 18/04/83 |
| Industrial Energy Conservation Services - Proposal to the Tanzania Investment Bank | 16/05/83 |
| Terms of Reference for Energy Conservation Studies in Fifteen Companies - International Tender for Consulting Services | 21/06/83 |
| Technical and Economic Feasibility of Natural Dyestuff Utilization - Revised Proposal to TEXCO | 06/08/83 |

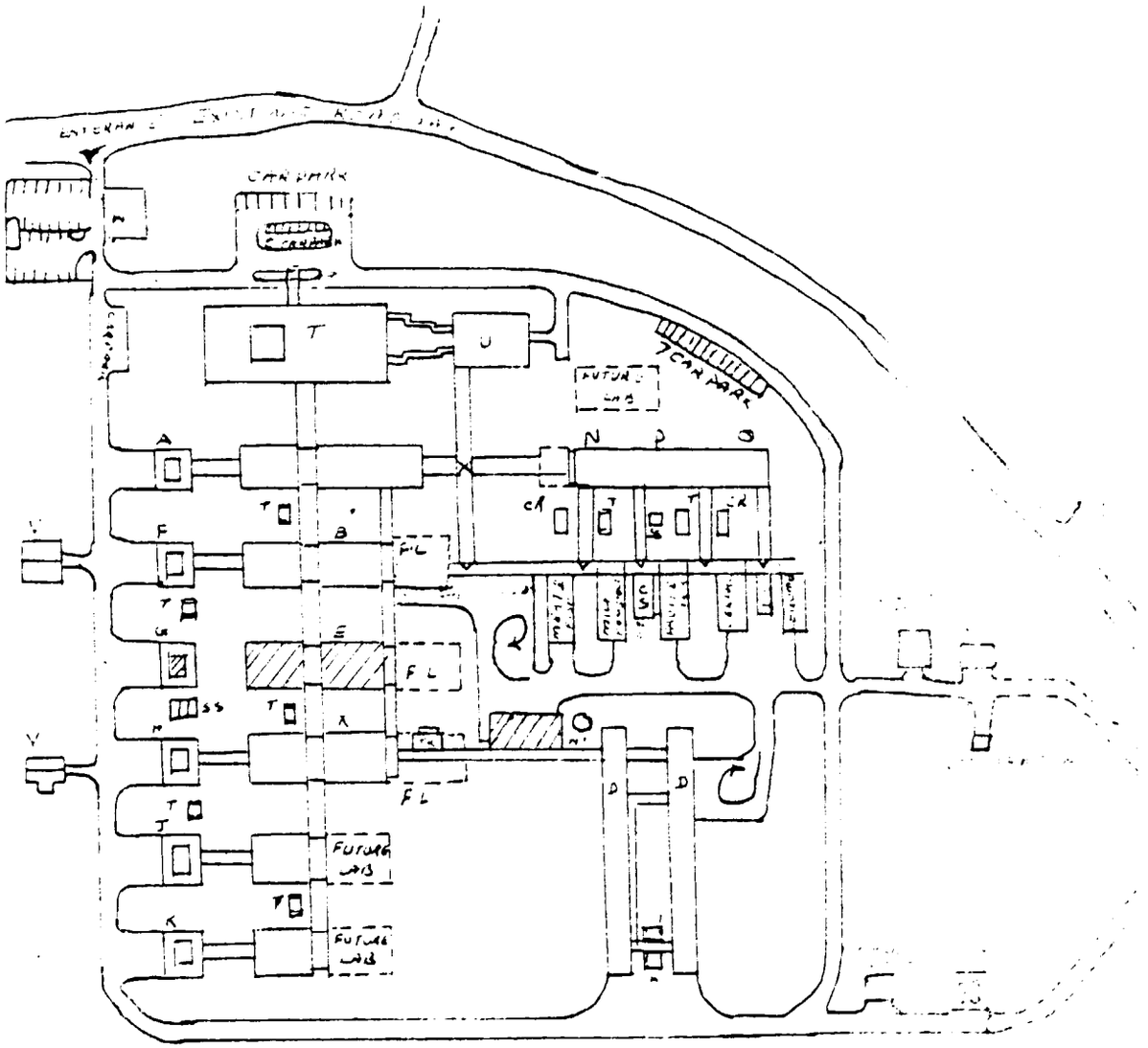
ANNEX 8. TANZANIAN INDUSTRIAL ENERGY AUDITS & POTENTIAL ANNUAL SAVINGS

| Company | Annual Savings (TSh) | Percent of Energy Cost |
|---|---|---|
| Blanket Manufacturers Ltd. | 140,000 | 14 |
| Tanganyika Dyeing & Weaving Mills | 972,000 | 9 |
| Kioo Limited (glass mfg.) | 5,419,600 | 16 |
| Tanzania Breweries Ltd. | 3,600,000 | 25 |
| Aluminium Africa (Aluco Div.) | 962,000 | 38* |
| Tanzania Portland Cement | 12,540,000 | 14 |
| Kibo Paper Industries | 305,250 | 8 |
| TIPER (refinery) | 7,518,950** | 10 |
| Tanzania Distilleries Ltd. | 652,200 | 35 |
| TANITA Co. Ltd. (cashew nut) | 266,300 | 32 |
| Morogoro Tanneries Ltd. | 635,900 | 19 |
| Tanganyika Packers Ltd. | 739,500 | 35 |
| Coast Textiles Ltd. | 355,100 | 14 |

* Percentage of fuel oil costs - electricity consumption not available

** Calculated on the basis of delivered fuel oil price in Tanzania

ANNEX 9. TIRDO SITE PLAN

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