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END - OF - ASSIGNMENT REPORT

NAME	: JAGDISH PRASAD, M.Sc., Ph.D.
PROJECT NO.	: DP/SYR/86/011
PROJECT TITLE	: Optical Technology Development
COUNTRY OF ASSIGNEMENT	: Syrian Arab Republic
POST TITLE	: UNIDO Consultant
PERIOD	: From 13.12.1986 to 19.1 .1987
DISTRIBUTION	: 4 copies to UNIDO Headquarters 1 copy to UNDP Representative 1 copy to project files

CONTENTS

1. BACKGROUND

i)Scientific Studies and Research Center (SSRC) is a public autonomous institution, sponsored by the President of Syrian Arab Republic. It was founded in 1969 at Damascus. SSRC is devoted to the development and rationalisation of the scientific research related to applied sciences and technology. The 1986 annual budget of SSRC was 120.000.000 Syrian pounds with faculty strength of about 1000 persons.

ii)In 1984, the consultants Fulmer Research Laboratories of U.K. recommended the establishment at SSRC of a Center for Technological Development for carrying out : long term applied research, product and process development, training, and short term technical services.

iii)In 1986, under contractual obligation, a technological study report was submitted by Kombinat Veb Carl ZEISS JENA, which covered technical details for the establishment at SSRC of optical and optomechanical workshops at laboratory level.

iiii)The execution of the project in Optics Technology area at SSRC is included in: (i) sixth five year economic and [illegible] development plan of the Syrian Arab Republic for the period 1986 1990; and (ii) fourth country programme of UNDP for the period 1987 1991.

2. DUTIES

The following statement, reproduced ad verbatim, has been made in the consultant contract by the responsible Department of UNIDO at the Headquarters, covering my mission.

"WORK ASSIGNMENT. Review and assess the technological study for establishing an optical and mechanical workshop prepared by the firm Carl ZEISS; provide recommendations on the implementation of the plans of organisation and bringing into operation of the optical laboratory and optomechanical workshop and organisation of the pilot scale production of optical components; prepare draft project document for a technical assistance project in cooperation with the local authorities.

3. RESULTS

a. Review and assessement of the technological study report prepared by VEB CARL ZEISS JENA

Review

A direct contract (Value US dollars 31 500) was concluded between SSRC and Kombinat CARL ZEISS JENA (KCZ) on 2end October 1985 requesting KCZ to prepare complete technological study concerning the establishment at SSRC of optical and mechanical workshops suitable for manufacturing optical elements and systems in the laboratory work conditions.

As a consequence, a comprehensive technological study report running into three parts has been submitted in 1986 by KCZ to SSRC.

Part I (246 pages) deals with the purpose of the laboratory; definition of quality requirements of telescopes, binoculars, and optics for transmitter and receiver systems; optical glass quality criteria; tolerance parameters of lenses, prisms, parallel plane plates, graticules and thin film coatings; optical specification sheets of 24 lenses, penta, roof edge and right angle prisms and graticule substrate, with explanation of various parameters used; optical tooling and mountings; description of the different technological processes involved in the manufacture of precision optical elements; interference filters and their characterisation; optical contacting technology; optical glass working machines requirement, optical measuring and testing devices, their principle operational mode and performance data; image quality assessment; recommended measuring instruments; environmental testing; work organisation methods; and training.

Part II (133 pages + 2 drawings) deals with the equipment and laboratory installation proposal. The total project cost indicated is above 4.5 million US dollars with break up as: cost of processing machines, devices, measuring and test instruments, tools and auxiliary materials from KCZ 2.5 million US $ + know how charges for special technologies - 1.0 million US $ + cost of special test equipment and machines from other sources - 1.0 million US $ + cost of other items for which the prices are not indicated.

Part III (269 pages) deals with prospectus documentation for machines, measuring and test devices.

Assessment

1. The study report submitted by KCZ is very comprehensive and contains wealth of information. It can be made use of by the project in planning the layout of the optical workshops for proper work flow, understanding the basis of preparation of optical design data sheets, manufacturing technology, quality assurance and other connected technological aspects.

2. KCZ report may however not be suitable directly for implementation at SSRC for the following reasons:

   i) It does not provide enough scope for the creation of indigenous research and development base.

   ii) The optical elements identified for production would not lead to the creation of the capability of total system development.

   iii) It is considered difficult by SSRC to mobilise financial resources to the tune of 4.5 million US dollars.

b- Recommendations on the implementation of the plans of SSRC in the area of optics technology

Work performed

i) Participated in the meeting held at SSRC on 20/12/86, which was attended by: representative State Planning Commission, project coordinator, Mrs. M. Kallas, and me.

The background and rationale of the project document prepared earlier by SSRC was presented by the project coordinator. The comments which were prepared earlier by the consultant on KCZ contract proposal were read out to the counterparts.

SSRC team explicity stated that the work plan of the proposed project document may not be restricted to KCZ report. Instead, it should be formulated in a manner that maximum benefit results from the investment made. Furthermore, while the ultimate goal is to establish research and development facilities for work in optical and optomechanical fields, but the project implementation can be so conceived that a few prototypes of common optical instruments/components are realised during the process. It was anticipated that adoption of this approach can in the long run also make

visible economic impact.

A study report (three volumes) prepared by KCZ for the establishment at SSRC of "Optical and Mechanical Laboratory" were received by me for general review and assessment.

ii) Participated in the meeting held at SSRC on 22/12/86, which was attended by: Deputy Resident Representative, UNDP; project coordicator, project group leader, and me.

The strategy to be followed for the formulation and support of the proposed project was discussed.

iii) The tentative draft project document entitled "Optical Technology Development", which was written earlier by the consultant, as a preparatory work for the mission, was copied to the counterparts for internal study and discussion. Advise was given that the equipment list contained therein is to be taken only as indicative of requirements and needed revision, both in terms of final selection and cost.

iv) For assistance in the preparation of the list of expendable and non-expendable equipment required at the project, the company catalogues available at SSRC were studied. The choice of suitable equipment and function of individual items were discussed with the counterparts. The final list of equipment was also checked by Dr. T. Tarbadar (professor in optics at the University of Damascus) and approved.

v) In consultation with the project coordinator and project group leader, the optimum/available staff strength for the project and fellowship training details were worked out, which are given in Annex I.

An analysis of the data presented reveals that:

- At the level of engineer/Ph.D/ M.Sc. the required staff strength is 7. Available are 5. One more is under training in U.K. and is expected to join the project in January, 1989.
- At B.Sc. level. Required-5. Available-1. One more is under training in Canada and is expected to join the project in January, 1988.
- Technicians. Required-16 . Available-3. Additional 4 technicians required for mechanical workshop and tooling sections can possibly be arranged by internal mobilisation at SSRC with the concurrence of the concerned Head, from the model workshop of Electronics Technology Division (ETD).

vi) In consultation with the project coordinator and project group leader, it was felt that besides fellowship training, for providing an opportunity in acquainting with recent developments in optics technology, the project document may also contain the elements of a study tour for four members at senior level for two weeks duration, to the various research design and development establishments and production organisations, devoted to optical materials and optical/optoelectronic instrumentation in a developing country like India.

The composition of the study team can be decided by the responsible National Organisations i.e, SSRC and State Planning Commission, in consultation with UNDP.

vii) In consultation with the project coordinator & project group leader, the requirement of international experts i.e chief technical adviser and short term consultants; and UN volunteers was closely scrutinised vis-a-vis the needs of the project and incorporated in the document.

viii) Participated in the meeting held at SSRC on 27/12/86, which was attended by: Dr. T. Tarbardar, project coordinator, project group leader, eng. N. Jbeiro, Mrs. M. Kallas and me. Minutes of the meeting were formulated.

The conclusions arrived at were : KCZ report in its present form is not suitable for direct implementation by SSRC because of several reasons; the objectives of the project should remain setting up optical and optomechanical workshops, training, prototype development and batch production; project should receive full report from SSRC and UNDP; and SSRC should foster still closer interaction in the project with academic institutions.

Upon conclusion, the participating team had the benefit of discussions with Dr. A. W. Chahid, General Director, SSRC. He had also been briefed earlier by the project coordinator about the progress of work in the project. Dr. Chahid expressed his full agreement with the methodology and objectives of the project. It was further observed that the clearance of the project from UNDP should be solicited earliest, preferably not later than 31/03/87 so that the work plan could be pursued with priority.

ix) Upon request by the counterparts, an invited lecture entitled "Applied optics activities at CSIO, Chandigarh", was delivered by me at SSRC on 27/12/86 (Annex II). Copies of the lecture

were distributed to the audience. It was followed by interesting discussion.

x) With view to solicit the cooperation of all concerned departments of SSRC for the work of the project, in consultation and alongwith the project group leader, visits were made to the Library, Computer installation, ETD, Foundry, Central Mechanical Workshops (CMW), and Dimensional Metrology (DM) sections.

The library is located at the ground floor of Applied Physics Laboratories (APL) building. Subscription is made of reputed international journals in optics, like, Journal of the Optical Society of America, Applied Optics, Journal of Optical Engineering, Soviet Journal of Optics Technology, Optics Communication etc. Back volumes of some journals and standards books on applied optics are available.

Real time computer VAX 11/780 is installed on the first floor of APL building. It is equipped with sufficient peripherals for optical design work. Software programmes developed by Imperial College, London, on ray tracing, optimization, and performance analysis of optical systems were also available.

Electronics Laboratory (EL) is presently located on the second floor of APL building. In consultation with the project group leader, it has been suggested that this site can be used for housing the optical laboratories, in which case there would not be any difficulty in shifting the EL to identical premises on third floor of APL building. ETD is housed in building opposite to APL. The model workshop had some facilities in mechanical fabrication (turning, milling, sheet metal work, welding, carpentary, spray painting). ETL has set up advanced facilities in design and fabrication of printed circuit boards.

Foundry, CMW, DM sections are located adjacent to each other and in close proximity of APL. Induction melting furnace and heat treatment facility were available in the foundry. CMW is very well equipped with several lathes, milling machines, copying machine, etc. DM section, again, is very well equipped with profile projector, surface roughness measurement apparatus and other precise measuring instruments.

xi) The mechanism of providing mechanical inputs to the project was discussed with the project coordinator, project group leader, and other concerned counterparts. With their agreement, it was felt that head ETD can be requested to assume

this responsibility.

xii) The methodology of preparing mechanical engineering drawings of student microscope and lens mount was elaborated to the concerned counterpa . It was emphasized that efforts should be made such that the developed drawings carry all the necessary details and do not require frequent personal visits to the executing mechanical workshop for explanation of the job.

xiii) The plan of work incorporated in the project document was discussed in details with the project coordinator and project group leader and finalised .

xiv) For proper identification of the products for development, and for aid at the transfer of technology stage, assistance was rendered to the concerned counterpart, towards compiling statistical information of interest to the project, particularly in respect of professional scientific/optical instruments and raw materials.

xv) In consultation with the project coordinator and project group leader, efforts were made for induction of additional qualified scientists and engineers from SSRC into the optics project group particularly in respect of meeting the requirements of mechanical design and optics metrology.

xvi) In consultation with the project coordinator and project group leader, it was considered worthwhile to incorporate into the project document near its completion stage, the elements of technical cooperation in optics technology amongst the developing countries, particularly with the Ar . This will help continuous inter-change of informat·on and bringing about increased s ic and industrial interaction for mutual benefit.

xvii) Relevant information of interest to the project was extracted from the fifth five year economic and socie1 development plan of the Syrian Arab Republic for the period 1981-1985.

xviii) Participated in the series of meetings organised at SSRC , UNDP, UNIDO, concerning the formulation of the draft project document for technical assistance and discussion there upon with the concerned authorities.

Recommendations:

1 - The present project should be conceived as an institutional

activity at SSRC in the sense that the desired inputs should be made available with priority from all the concerned Divisions.

2 The execution of the Work Plan should again be done in an integrated manner, since the final acceptance of the product developed against the pre-set specifications is critically dependent upon the fabrication of the job-parts within the specified tolerances in each department and maintenance of rigid quality control checks at different sub-stages.

3 - For effective implementation of the Work Plan, a separate optics project group should be created, with optimum staff strength at different qualification levels, as given in Annex I.

4 - Recruitment action in respect of the remaining additional staff required for the optics project group should be initiated urgently i.e one physicist (M.Sc.), three B.Sc., and nine technicians. It is an imperative requirement, since eight of these staff members are included in the fellowship programme for training overseas.

5 - The services of the project leader should be made available full time to the optics group. He should not be loaded with other developmental activities, at least till the project picks up firm roots.

6 - An inventory of the machines, equipment and measuring tools available in the model workshops of ETD, CMW, Foundry, DM, and optics section of APL is recommended to be prepared earliest. This may include information on the points: Name of the machine, technical specifications, manufacturer's name, year of purchase, list of available parts and accessories, and general remarks about its present working condition. This documentation would be of immense help in determining the balancing equipment that should be further included in the equipment procurement list of the present project. It would also avoid unnecessary duplication.

7a The dissemination of knowledge regarding optics fundamentals and technological aspects should be urgently initiated amongst the available faculty members of optics group. It can be through the medium of lectures, seminars, discussions, demonstrations, circulation of technical literature and audiovisual presentations.

7b- KL/ report contains wealth of practical information. Efforts can be made by senior faculty members in the optics project group to share this knowledge pagewise with other staff including the technicians.

7c- Exercises in lens design of simple optical systems, say cemented and Fraunhofer's type doublet, can also be easily initiated, utilising the available software programmes and real time computer.

8a- Optical test equipment already procured by SSRC should be properly installed and put to use.

8b- Action for the procurement of focometer cum optical spherometer of Moller-Wedel make, for which the purchase order has already been placed by SSRC, should be pursued with priority.

9 - Efforts should be made to put into operation the Edwards 306 Coater already available at SSRC.

10- Since the equipment available in DM section is of high cost and it should maintain nominal accuracy over prolonged periods, so as to serve as standard with which the dimensions of the manufactured parts are checked, SSRC might like to consider to house it in dust free air-conditioned premises with additional working space.

11- SSRC might like to consider establishment of the additional facilities: (i) coordinatograph in PCB laboratory. It can also be used for making optical master gratings; (ii) Metal anodising tanks in CMW for meeting surface finish requirements, and (iii) Central store with good inventory of hardware, cutting tools, solvents, compcnents etc.

12- Further recommendations on the implementation of the plans of SSRC and bringing into operation in it of the optical laboratory and optomechanical workshop and organisation of pilot scale production of optical components are treated separately in an exhaustive manner in the draft project document (Annex III). For brevity reasons, these are again not cited here.

c- <u>Draft Project Document</u>

The draft project document is given at Annex III. The same has been formulated with the complete concurrence and discussion of the local authorities at SSRC and with advice of UNDP/UNIDO.

4. ACKNOWLEDGEMENTS

The consultant wishes to express his sincere thanks to all the officers, counterparts, and staff of SSRC for their extreme cooperation and assistance during the mission. Particular mention is made of: Dr. A. W. Chahid, General Director, Dr. M. Mrayati, Director Electronics Institute, Dr. A. H. Mansoor, Director of HIAST, Dr. A. Housari, Dr. A. Armanazi, Dr. F. Mousilli, Mrs. M. Kallas and Mr. B. Sibai Deputy Director State Planning Commission.

He is also grateful to: Mr. A. Konstantinov, Senior Industrial Development Officer, UNIDO, Vienna; Mr. Olav Svennevik, Resident Representative and Mr. A.S. Bedwi, Deputy Pesident Representative, UNDP for their continuous support and advice.

Finally, the consultant expresses his sincere thanks to Dr. S.R. Gowariker Director, Central Scientific Instruments Organisation, Chandigarh, for kindly according approval to undertake the present mission.

5. ANNEXES

Three annexes as per content list are attached to this report.

ANNEX I

OPTIMUM/available staff strength for the project and fellowship training details

Section	Recommended staff strength *			Particulars of National staff			Recommended Fellowship Training	
	E/P/M	BS	T	(name ,	Qualification	Age in years	**Duration(MM)	Place
Optical Workshop	-	1	6	Obaid	Bs	30	6	NML, Australia
				A & B	T	-	6 + 6	CSIO, Chandigarh
Optical thin film	1	-	2	Maya	E	30	6	Edwards/Balzers/Heraeus Leybold+CSIO
				Attar	T	30	6	CSIO
				Twakalna	T	30	-	-
Optical Metrology	1	1	1	C	M	-	6	CARL ZEISS, Sira, UK
				Ahmad +	Bs	32	-	-
Optical design & system engineering	2	1	-	Kousilli ○	P	37	3	Imperial College UK/Cerec - France
				Bisri ++	M	32	-	-
Optical assembly and repair	-	1	1	Halabi	T	28	3	CSIO
Graticulation	-	1	1	D	T	-	3	Graticule ltd, London
Mechanical design	2	-	1	Quaider	E	30	4	CSIO
				Hasdan	E	38	3	Institute of optics, Paris
Mechanical workshop and tooling	1	-	4	Abbasi	E	32	6	CSIO
Dimensional metrology ●	-	-	-	£	T	-	6	Carl Zeiss/Mitutoya Japan
Foundry and metallography ●	-	-	-	F	T	-	6	USA/India
Technical cooperation ●	-	-	-	Housari	P	49	3	India, South Koria & Japan

* E - Engineer, P-Ph.D, M-M.Sc., BS-B.Sc., T-Technician.

** Estimated age. Not taken from records.

+ Studying physical measurements in Canada. Expected to join the project Jan 88.

++ Studying for Ph.D. in optical design at Reading University UK. Expected to join project in Jan 89.

● These sections already exist at SSRC.
Hence recommended staff strength is not indicated. Dr Housari will also serve as project coordinator.

○ Project group leader.

ANNEX II

APPLIED OPTICS ACTIVITIES AT CSIO, CHANDIGARH *

J. PRASAD, M.Sc., Ph.D.
UNIDO consultant
Scientific Studies and Research Center (SSRC)
DAMASCUS

1. Introduction

The Central Scientific Instruments Organisation (CSIO), Chandigarh is one of the National Laboratory under the Council of Scientific & Industrial Research, New Delhi. It was set up in 1959 with the primary objective of pursuing developmental activities in instrumentation field and allied sciences.

Research, design and development in the field of optical instrumentation and technology has remained as one of the major thrust areas of work at CSIO since inception. The initial efforts were directed towards the setting up of basic technical facilities and then gradually refining them and spreading to other domains. As such, over the years, a good nucleus has been created both in terms of equipment, facilities, qualified scientists and engineers and supporting technical staff to undertake challenging jobs at CSIO in this area of activity.

In previous years, with the primary aim of import substitution, the project work related mainly to the design and development of classical type of optical instruments, required in varied applications, like, education, surveying, projection systems, opto-medical instruments, simpler version of optical test instruments, analytical test instruments, and optical modules of varied specifications. Concentrated efforts were also made towards the commercial utilisation of results achieved and rendering technical consultancy to the industries for setting up commercial plants for the manufacture of precision optics.

During the last few years, however, the RD&D work is now gradually being emphasised in the areas of: optics for space and defence applications, fibre optics, holography, and the advanced versions of the classical type of optical instruments.

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* Invited lecture delivered at SSRC on 27.12.1986

In the following text, an effort is made to give a bird's eye view of the facilities established and the major programmes of work accomplished or presently being pursued in the applied optics field at CSIO.

2. Optical design

Buchdahl's aberration coeffi ient methods are largely followed in the development of optical system design. Software programmes have been developed for: MTF evaluation, automatic lens design, spot diagram etc. Two microcomputers of 8 and 16 bit configuration with 256K bytes and 128K bytes RAM respectively are available. A high speed DEC-20 computer of 32 bit configuration and 256K words core memory is also accessible to the design teams.

The major achievements made are: design of profile projection objectives of varied magnifications, fixed focus and zoom lenses for close circuit television , projection TV lens system, and multi-spectral camera lenses for Indian remote sensing earth satellite.

3. Optics fabrication technology

The optical workshops are equipped with: automatic lens curve generators, conventional multi-spindle grinding and polishing machines of various capacity ranges, universal glass milling machine, automatic centering and edging machines, laser centering device, autocollimator, digital spherometer, etc.

The workshop is engaged in the fabrication of optical components of medium to high accuracy. Some work has also been done on the development of off-axis paraboloidal mirrors, parabolic lenses, crystal optical components, and plastic fresnel lenses. Know-how has been generated and indigeneous commercial production established of the various types of optical glass working machines, radius turning attachment, toolings and fixtures.

The efforts are presently being made to enhance the capabilities to undertake fabrication of diffraction limited optical systems and optical elements required in coherent systems.

4. Graticulation

Infrastructural facilities for replication of metrological gratings for rotary shaft encoders and linear scales upto 350mm long with density of 50 lpm are available. HP laser interferometer, Model 5528, has recently been procured for checking the accuracy of linear scales.

An important achievement has been the indigeneous design and development of radial master generating engine. This can be employed for the preparation of radial patterns of desired geometry.

Efforts are being made to enhance the facilities so as to be able to undertake the replication of linear scales of still longer length (say upto 1.8m) to the required degree of precision.

5. Optical testing

The test facilities established enable: optical parametric measurements, determination of glass constants, and evaluation of geometrical aberrations in the visible range. The important equipment available are: Clave optical test bench with accessories, Twyman-Green interferometer, Tropel surface measuring interferometer, Nu2 research microscope, angle division tester etc.

For dimensional checking of precision mechanical parts, a separate metrological inspection laboratory is set up. Major optical equipment available therein are: Universal measuring machine, ISOMA profile projector, optical dividing head, tool room microscope. Talyrond 100, micro-optic autocollimator etc.

The Department of Science & Technology, New Delhi has identified CSIO for accreditation in the area of optical/photometry testing. Efforts are currently being made to set up an in-house MTF test bench facility based on knife edge scan principle, particularly suited to space optics.

6. Thinfilm technology

Infrastructural facilities for providing anti-reflection, reflection and semi-reflection coatings have been set up. The facilities include:

Edwards 19" vacuum coating unit with modulated beam photometer; HHV 19" coating plant with electron beam gun; talystep for thinfilm thickness measurement; and spectrophotometer for

transmission measur ment.

A microprocessor based recording spectrophotometer suitable for use in the spectral region 190-3000 nm with absolute specular reflectance accessory is available.

Narrow band interference filters for visible range, circularly variable neutral density filters, dichroic coatings are some of the important jobs already accomplished. Concentrated efforts are currently being made to develop the technology of fabricating multi-layer antireflection coatings suitable for space optics application.

7. Holography

An underground coherent optics laboratory equipped with active and passive vibration isolation systems having infrastructural facilities for the development of holographic optics, holographic and laser speckle non-destructive testing techniques has been established. Holo-spherical lenses, aspherics and diffraction gratings were developed on dichromated gelatin and on photo-resist recording media and further, these holo-elements have been successfully used for realising coherent and incoherent imaging systems. A digital laser power metor, laser speckle camera, laser scanning micrometer and a laser communication kit have also been developed. Work is being pursued in the field of display holography. The future plans relate to the development of a holographic tyre testing equipment, an automatic 3-D displacement measuring system using holographic and laser speakle techniques, commercial holography and laser based process control and metrological instruments.

8. Fibre optics

The earlier work at the Organisation was largely directed towards the technology development of drawing optical glass fibres; light guides, rigid and flexible image transmitting bundles and multiple fibres; and the design and development of different types of endoscopic instruments used for examination of the human body organs.

The emphasis has, however, now shifted towards the development of: technology of fibre optics communication systems for short-haul applications i.e. non P&T; passive components i.e. connectors, WDM's etc; plastic cladded silica fibres; fibre characterisation; and fibre splicing and termination equipment.

9. Instrumentation

Some of the major achievements towards the design and development of optical and electron optical instruments are:

* Bubble chamber scanners. These projection systems are used in high energy particle physics and help in tracing the trajectory of the nuclear event and thereby determining the particle kinematics.

* ARL projection units. These were developed as a substitute to British Admiralty stock and are used for training of navigators.

* Infrared sighting instruments comprising of IR gunner and commander periscopes, IR searchlight, and IR binoculars. The basic design was developed by IRDE, Dehradun. CSIO helped in commercial productionisation of these systems in association with an industrial firm. These were active systems.

* Projection systems for Kamorta class ships. These have been developed as per the requirement of Indian Navy and enable in dynamic situation, faster plotting of the coordinates of the approaching ships located within a given range relative to the parent ship.

* Atomic Abscrption Spectrophotometer. A prototype of this instrument was developed and sent to RRL, Bhubneshwar for elemental analysis of polymetallic nodules, mined from the ocean bed by NIO, Goa. For sequential elemental analysis, the facility of inductively coupled plasma atomic emission spectrometer has been set up.

* Aerial panoramic and other types of cameras for specialised applications.

* Scanning electron microscope of 300 A resolution. This was developed as a joint project in which several laboratories of the country participated. An improved version with 70 A resolution is under development.

* Cereal grain analyser used for simultaneous determination of moisture, oil and protein by infrared absorption method is being currently developed in association with Electronic System Punjab Limited, Mohali.

* Development of plasma dry processing systems, such as, plasma etcher, reactive ion etcher, together with end point detector are planned for development in the area of micro-electronics.

ANNEX III

UNITED NATIONS DEVELOPMENT PROGRAMME

Project of the Government of The Syrian Arab Republic

TITLE	: Optical Technology Development
NUMBER	: DP/SYR/86/011
DURATION	: Two years and six months
PRIMARY FUNCTION	: Institution Building cum Direct Support
GOVERNMENT SECTOR	: Industry ACC Classification : Industrial Development Support Services (0510)
EXECUTING AGENCY	: United Nations Industrial Development Organization (UNIDO)
STARTING DATE	: 1 April 1987
GOVERNMENT INPUTS	: LS 4078.000 (in kind)
GOVERNMENT COST-SHARING	: Equivalent to US$ 500.000 in local currency (Syrian Pounds in cash)
UNDP INPUTS	: US$ 1500.000

Signed _____ _____

on behalf of the Government — Date

_____ _____

on behalf of the Executing Agency — Date

_____ _____

on behalf of the United Nations Development Programme (UNDP) — Date

CONTENTS

PART I. LEGAL CONTEXT

This project document shall be implemented within the legal framework envisaged in the Agreement between the Government of the Syrian Arab Republic and the United Nations Development Programme signed by the Parties concerned on 12 March 1981. In particular, the provisions of Article _____ paragraph _____ obligating the Government to apply the Provisions of the Convention of Privileges and Immunities shall be deemed to apply *mutatis mutandis* to technical assistance carried out in accordance with this document.

PART II. THE PROJECT

A. Development Objective

Contribute to the scientific and technical development of Syria, through the application of modern optical techniques, better utilisation of local manpower and raw materials, import substitution, generate self reliance, provide training to the nationals in new technology areas, develop indigenous capability in R & D , and effect improvement in the quality of education with the availability of better demonstration equipment. The project shall thus directly facilitate the implementation of the social, economic and industrial development plans adapted by the Government.

B. Immediate Objectives

Through the implementation of this project it is intended to achieve the following objectives:

- To establish the physical facilities i.e. workshops and laboratories - quired in Optical Technology Development, develop related scientific techniques, and strengthen the capability of SSRC in applied optics domain;

- To utilise these facilities for training of local manpower in optical techniques, development of prototypes of optical instruments and components needed for educational purposes, and preparation for know-how transfer to industry.

C. Special Considerations

Creation of the technical facilities in optical engineering

deserves special consideration for the following reasons:

a - The availability of optical instruments in Syria would improve the quality of education being imparted in the various stages of study.

b - The manpower and the raw materials (plate glass) available in Syria can be utilised for fabricating simple optical elements required at school and college levels.

c - This will help in generating self reliance and import substitution.

d - The optics technology is largely labour oriented and hand skill dependent. This industry can therfore provide gainful employment to the weaker sections of the society.

e - The activity can in the long run become the focal point for the transfer of technology to the interested entrepreneurs. It can thus become the basis for the establishment of new industries through the application of advanced technology.

f - The project can provide a good basis for scientific cooperation in the field of optical instrumentation and technology amongst developing countries, particularly with Arab World.

The project is included for execution in the sixth five year economic and social development plan of the Syrian Arab Republic for the period 1986-1990. It is also included in the fourth country programme of UNDP for the period 1987-1991.

D. Background and Justification

Scientific Studies and Research Center, Damascus

The Scientific Studies and Research Center (SSRC) is a public autonomous institution, sponsored by the President of the Syrian Arab Republic. It was founded at 1969 in Damascus. A branch of SSRC dealing with avionics is established, at Aleppo.

SSRC is devoted to the development and rationalisation of the scientific research related to applied sciences and technology. It is managed by the departmental heads and board comprising of independent distinguished scientists and engineers. The President of the Board is the General Director, appointed by a presidential decree.

SSRC is subdivided into:

1) Scientific Research Departments covering the fields: Electronics & Applied Physics, Informatics, Mechanics, Chemistry & Biology and Economics.
2) Higher Institute for Applied Sciences and Technology (HIAST).
3) Electronics technology laboratories which are equipped with advanced facilities in printed circuits boards design, and fabrication.
4) Administrative social services, technical services, scientific cooperation and industrial liaison sections.

The scientific & administrative staff at SSRC is about 1000 permanent members.
The annual budget is about 120 million Syrian pounds.

SSRC has already carried out national level tasks in the areas of : remote sensing, telecommunication, electronic data processing, data automation in distribution circuits, and chemical technology.

In cooperation with French educational establishments, HIAST is already running a five year regular degree level course in Informatics with an annual intake of about 60 students. Upon completion of the common course for 3 years at HIAST, the students in other streams (applied mathematics, fine mechanics, applied physics, energetics with a special emphasis on solar energy), are sponsored for remaining courses in France. However, HIAST has plans to gradually start these courses.

SSRC has also been involved in organisation of international cooperation activities like, seminar sessions of the Arab School for Sciences and Technology; exchange of researchers and foster common researches in Linguistics and Informatics with the National Organisations for Scientific Research, Algeria; cooperation with European Economic Community in the areas of: remote sensing, solar energy, computer & signal processing, optics & lasers, and lubricants; and cooperation with French Organisations GEFIE, FNEGE and AFPA in the field of education.

Center for Technological Development

In response to a request from the Syrian Government for consultant services by letter dated 30th November 1984, the Overseas Development Administration engaged Fulmer Research Laboratories Ltd of U.K. under British aid arrangements to advise the government on the feasibility of establishing a Center for Technological

Development (CTD) to be located at SSRC, Damascus.

In their final report, the consultants have concluded that there is a need for an organisation with capabilities in corporate planning and long term R & D to supplement the existing activities of SSRC. It has been remarked that these new functions would enable Syria to identify world wide technological developments and the needs of the Syrian economy in order to plan, execute and industrialise new technologies.

It has further been suggested that CTD must be involved in : long term applied research, product and process developments, training and short term technical services. The R & D department should establish a number of technology areas as (skill centers). Initially, some low risk projects with high probability of success should be undertaken for generating confidence.

Technological Study Report of Kombinat VEB Carl ZEISS JENA

A direct contract (value U$ 31500) was concluded between SSRC and Kombinat VEB CARL ZEISS JENA (KCZ) on 2nd October 1985 requesting KCZ to prepare a complete technological study concerning the establishment at SSRC of optical and mechanical workshops suitable for manufacturing optical elements and systems in the laboratories work-conditions.

As a consequence, a comprehensive technological study report, running into three parts has been submitted by KCZ to SSRC. Part I deals with General Remarks: Part II with Equipment and Laboratory Installation Proposal; and Part III with Prospectus Documentation for Machines, Measuring and Testing Devices.

The above technological study can be made use of by the project in planning the lay-out of the optical workshops for proper work flow and understanding the basis of preparation of optical drawings, manufacturing technology, quality assurance, and connected technological aspects.

International Trends

Optical and optoelectronic instruments are extensively employed for varied applications in diverse areas e.g. education, ophthalmology, endoscopy, survey, astronomical and terrestrial applications, earth resources surveying, industrial process and control, oceanography, avionics, medicine, etc. These are now considered as essential tools.

During the last two decades, there has been considerable stimulation of interest in this exciting branch of physics, because of the availability of fast electronic computers of large memory and their utilisation for undertaking various design and process functions; advancements in the design of transducers, detectors and extremely low loss filters; development of wide variety of materials transparent in different spectral regions; availability of high power lasers; and rapid progress in fiber optics technology, long distance communication satellite links, holography, optical image processing, etc.

Economic Background

The manufacturing industry represents only a small proportion of the gross national productivity of Syrian economy. Further the existing Syrian industries have been largely established on turn-key type projects or under licence agreements from overseas. Whenever new technology has been required, in most cases, it has been brought in under fresh agreements, rather than substituted by in-house developments. It is now increasingly felt by the State Planning Comission that the present practice is not the appropriate approach and strenuous efforts should be made for the development and application of advanced technologies in the Syrian economy which can even lay the basis for new industrial activities.

In Syria there are at present no public or private sector industry engaged in the manufacture of optical instruments and systems. The requirement of even commonly used instruments for education, sighting, surveying, etc is entirely met through imports. In fact this situation tends to prevail in the whole Arab World and other neighbouring African countries.

Facilities Available at SSRC

The technical facilities available at SSRC, which are considered relevant to the needs of the project are now outlined.

- Nucleus of qualified National staff with advanced training in optical instrumentation and engineering from overseas.

- Real time computer, Systime make, VAX-11/780 of 32 bits word configuration and 4 Mega bytes memory with peripherals (ten interactive terminals, plotter, two disk drives, tape drive and graphical I/O). This can be fruitfully employed in optical system design.

- Software on ray tracing, optimization and performance analysis of optical systems.

- Optical test instruments, like focometer cum optical spherometer, concave grating monochromator, optical bench with accessories, resolution target, interference and neutral density filters, He-Ne laser, and assorted optical components.

- Foundry equipped with induction melting furnace, and heat treatment facility. This can be used for casting of optical tools.

- Mechanical workshops equipped with lathes, milling, copying, drilling, welding, bending, cutting and wood working machines. Spray painting facility is also available.

- Dimensional metrology section which is equipped with profile projector, surface roughness measurement apparatus, and precision measuring instruments.

- Printed circuit board, design and fabrication facility. It has been set up at advanced level and is very well equipped. A horizontal bed, reduction camera is also available which can be employed in graticulation work.

Keeping into view the above considerations, and the facilities already available at SSRC, there is full justification for the establishment of the present project at SSRC. It is expected that in the long run, through the implementation of the present project, SSRC will become a focal point for the indigenous design and development of optical and optoelectronics instruments and subsequent transfer of technology to the interested entrepreneurs and diffusion of expertise in the region.

E. Outputs

a) Related to Immediate Objective "i":

1. Install and put into operation the machines and equipment required for the establishment within SSRC of the optical and optomechanical workshop, optical design and system engineering, optical assembly and repair, and optical thin film technology laboratories.

2. Develop the techniques of pattern making in wooden shop; ferrous castings in foundry shop; optical tooling, jigs and fixtures in optomechanical workshops; precision optical elements in optical workshops; and reflection/anti-reflection

coating in thin film technology laboratory.

3. Develop the technique of replication of reticles.

4. Develop capabilities in optical design through the application of avaibable real time computer and software programmes.

5. Develop system engineering design capability which shall comprise working out specifications of the various sub-systems against the given functional requirements.

6. 17 SSRC staff members will receive overseas training in the different fields of optical technology.

7. 4 SSRC senior managers will upgrade their experience in acquainting with modern developments in optical technology through undertaking a study tour to industrialised countries.

b) **Related to Immediate Objective "ii":**

1. Design data sheets of different optical elements giving constructional parameters together with tolerancing.

2. Design data sheets of optical tooling, mounts, jigs, fixtures and mechanical hardware together with tolerancing and surface finish requirements.

3. Training schedules illustrating methods of fabricating optical and mechanical components to the pre-set specifications and sub-stage inspection, final quality checks, and assembly.

4. Train up to 100 artisans, technicians and specialists from SSRC, industry and academic institutions through special seminars, workshops or short term training courses.

5. Prototypes of optics kit, student microscope, and assorted optical components of high precision.

6. Technical manuals and know-how documents of optics kit and student microscope.

F. Activities:

For Output "a":

i. The international experts will review and assess the equipment already available at SSRC of their respective specialisation and advise in the additional equipment to be provided to meet the project goals.

ii. Detailed specifications and requisitions will be prepared by the experts in consultation with the SSRC staff concerned.

iii. The equipment procured by UNIDO Headquarters will be installed and put into operation under the guidance of the international experts and consultants.

iv. Advice and guidance will be provided by the international experts and short term consultants in respect of the following:

- Location of individual machine and test equipment in the existing premises.

- Service and maintenance schedules to be put into practice.

- Staff requirement in the constituent laboratories.

- Upkeep and cleanliness standards to be observed.

- Work flow pattern.

v .Advice and guidance will further be provided by the international experts in work demonstration and establishment of required techniques in different laboratories.

vi .The international experts will prepare the training programmes for fellowship training to be arranged by UNIDO.

vii.SSRC management will select appropriately qualified candidates for the fellowship training overseas.

viii.The international experts in consultation with the SSRC management will prepare recommendation on study tour programmes to be arranged by UNIDO.

For Output "b":

i .The international experts will provide consultations and guidance to the SSRC staff engaged in the design and development of specific optical systems and illustrate standard methods of preparing design data sheets.

ii .The international staff will prepare the training programmes and give advice and guidance in developing schedules for the fabrication, testing , assembly, and quality assessment of the manufactured parts.

iii.The international experts/consultants will, in cooperation with SSRC staff, organise and conduct training seminars, workshops or short-term courses for technical persons from industry and academic institutions on different aspects of optics technology.

iv .In consultation with international experts, SSRC staff will carry out survey of the indigenous annual requirement of optics kit and student microscope for use in schools, colleges and universities, establish the technical specifications, unit cost, and functional requirements.

v .The international staff will provide consultation and advice in the development of the prototypes of specified optical instruments and components required for educational purposes.

vi .In consultation with international experts, SSRC staff will prepare technical manuals of the prototypes developed in Arabic language.

vii.The international staff will provide advice and guidance in the preparation of the know-how documents, which shall become the basis of the transfer of technology to the industry.

G. Inputs

1. Government Inputs

The government shall, through the implementing agency, the Scientific Studies and Research Center (SSRC), provide the following inputs:

1.1 Personnel

- A project coordinator for maintaining liaison with UNDP and international agencies.

- A project group leader who will be responsible for the technical execution of the work programme in consultation with the international staff deployed on the project. He will serve as the main counterpart to the CTA and co-manager of the project. Upon the scheduled departure of the CTA, he will take over the project management.

- A co-project leader at senior level who will be responsible for meeting the requirements of optical tooling and mechanical parts needed in the project in accordance with the system design developed. He will coordinate such activities with the mechanical workshop, metrology, casting shop and also provide inputs from the model workshop of electronics technology laboratories of SSRC.

- Seven senior staff members at the level of qualified engineer or M.Sc or Ph.D who will serve as sectional project leaders.

- Five graduates in science who will serve as scientific staff in different sections.

- Sixteen technicians in different technology areas. The technicians will be the counterparts of the UN volunteers, who will train them on-the-job to enable them to operate on their own upon departure of the UNV's.

- Other supporting staff as may be required for effective project implementation.

1.2 Premises

- The international and national project personnel will be provided with adequate office accommodation in the Applied Physics Laboratories of SSRC, with the necessary office furniture, equipment and supplies, as well as telephone communication, electricity and other utilities. Adequate hall/conference room will be made available when needed for conducting meetings and/or organising seminars.

- Complete second floor of Applied Physics Laboratories building of SSRC, with necessary modifications shall be made available for housing the different sections of the optics laboratory.

- Suitable residential furnished accomodation shall be provided, free of cost, to the six UN volunteers required for the project.

1.3 Salaries and travelling expenses of the National Staff

The government shall continue to pay the local salaries and appropriate allowances for all personnel sent on fellowships and study tour during their absence abroad, in accordance with applicable government rules and regulations.

Travel allowances for National project personnel will be paid from the regular operating budget of the Government.

1.4 Cost sharing

The Government shall make provision for cost sharing equivalent to US$ 500.000 in local currency (Syrian Pounds in cash). This amount is included in the UNDP budget.

1.5 Miscellaneous

Office facilities, supplies and stationary, operating and maintenance provisions for offices, utilities, and office equipment will be provided from the regular operating budget of the Government.

2. UNDP/UNIDO Inputs

2.1 International Staff

- Expert in optical instrumentation and technology (split missions:1987 4m/m;1988-1989:21m/m)	25m/m
- Short term consultant in optics fabrication (1988)	6m/m
- Short term consultant in thin film coating (1988)	3m/m
- Short term consultant in optical testing (1988)	3m/m
- Short term consultant in technical cooperation (1989)	1m/m
- UN volunteers in the areas of: optics fabrication; thin film coating; optical design; optical testing, assembly and repair; optical tooling and mechanical	126m/m

design (1988-1989 : 21 m/m each)

2.2 Training

Fellowships

- Optical workshop technology : (5 fellowships of 6 months each) 30m/m
- Thin film technology : (2 fellowships of 6 months each) 12m/m
- Optical metrology : (1 fellowship of 6 months) 6m/m
- Optical design and system engineering : (1 fellowship of 3 months) 3m/m
- Optical assembly and repair:(1 fellowship of 3 months) 3m/m
- Graticulation : (1 fellowship of 3 months) 3m/m
- Mechanical design : (2 fellowships of 3 and 4 months) 7m/m
- Mechanical workshop and tooling : (1 fellowship of 6 months) 6m/m
- Dimensional metrology : (1 fellowship of 6 months) 6 m/m
- Foundry and metallography : (1 fellowship of 6 months) 6 m/m
- Technical cooperation : (1 fellowship of 3 months). 3m/m

Study Tour

- A study tour for managerial and technical staff of the SSRC will be organized by UNIDO upon the recommendations of the international experts.

2.3 Equipment:

Expendable equipment	US$ 197.480
Non-expendable equipment	US$ 796.260

Expendable and non-expendable equipment will be provided in accordance with the specifications prepared by the international

experts in consultation with the SSRC staff.

2.4 Subcontracts

- Subcontracts of 100.000 US dollars for acquiring the know-how and designs of optical elements, systems and machines; optical tooling, attachments, jigs and fixtures; master test plates/spheres and other items .

2.5 Miscellaneous:

- 90.000 US dollars to cover subscription to technical journals and periodicals, reports and sundry expenditures.

H. Preparation of Work Plan

A detailed Work Plan for the implementation of the project will be prepared by the CTA assigned to the project in consultation with National project leader /coordinator.

This will be done at the start of the project and brought forward periodically.

The agreed upon Work Plan will be attached to the project document as Annex I and will be considered as part of that document.

Tentative schedule of the Work Plan is given in the bar-chart.

I. Framework for the Effective Participation of National and International Staff on the Project

The project activities necessary to produce the indicated outputs and to achieve the project's immediate objectives will be carried out jointly by the national and international staff assigned to the project. The respective roles of each will be determined by their leaders, by mutual discussion and agreement, and will comply with the respective roles of national and international staff in accord with the established concept and specific purposes of technical cooperation. The balance and identification of these roles may change from time to time in accordance with changing patterns of progress of the project.

J. Development Support Communication

In the performance of its functions, the National project leader/coordinator shall maintain close working relationship with the following institutions :

- State Planning Commision, Damascus, soliciting information in respect of the emphasis being laid in tho sixth five year Economic and Social Development Plan period of the Syrian Arab Republic towards establishing indigenous capacity for the manufacture of scientific/optical instruments.

- Ministry of Higher Education & Ministry of Education soliciting information regarding the requirement of optical instruments and educational kits for primary, intermediate, secondary, professional, technical and normal schools; and universities.

- Central Bureau of Statistics, Damascus soliciting information regarding the import (preferably with classification) in Syria during the last five years of professional scientific / optical instruments.

- Industrial Testing and Research Center (ITRC), Damascus.

- Syrian Arab Standardisation and Metrology Organisation (SASMO), Damascus.

- University of Damascus, Damascus, fostering closer ties with the Department of physics, Faculty of Sciences for meeting future manpower requirements and academic support.

- Public sector industries, like, Syrian General Co. of Glass Porcelain Industries, Damascus; Syrian Arab Co. for electronic industries, Damascus; General Co. for steel and iron, Hama; General Co. for electric motors, Lattakia ; etc soliciting information about their product range and other relevant information.
A plan for Development Support Communication will be developed as an annex attached to the project document when the Work Plan is prepared, and will be reflected in the Work Plan itself. The plan will identify the nature of communication, its purposes, and the person or groups involved in the communications.

K. Institutional Framework

The project will be executed at the Scientific Studies and Research Center, Damascus, which is a public autonomous

institution sponsored by the President of the Syrian Arab Republic.

L. Prior Obligations and Prerequisites

1. SSRC shall arrange completion of air conditioning, dusty proofing, lighting, electical connections, compressed air connection, gas connection, cold and hotwater supply in the available premises for housing the optical laboratories before the provision of UNDP/UNIDO inputs.

2. The Government will provide the required national staff for the project before the provision of UNDP/UNIDO inputs.

3. The Government will ensure that the necessary facilities and equipment are available.

4. The Project Document will be signed by the UNDP Resident Representative on behalf of UNDP and UNIDO.

5. National staff appointed to the project will serve in accordance with SSRC regulations.

M. Future UNDP Assistance

The present project is to be considered as the first step towards the establishment of a Center for Technology Development (CTD) at SSRC. Upon successful evaluation of the project undertaken six months prior to the end, in the light of achievements made, future UNDP assistance will be determined in complementary projects within CTD, with the agreement of UNDP, UNIDO and the Government.

PART III :

SCHEDULES OF MONITORING, EVALUATION AND REPORTS

A. Tripartite Monitoring Reviews; technical reviews

The project will be subject to periodic review in accordance with the policies and procedures established by UNDP for monitoring project and programme implementation.

B. Evaluation

The project will be subject to evaluation, in accordance with the policies and procedures established for this purpose by UNDP. The organisation, terms of reference and timing of the evaluation will be decided through consultations between UNDP and the Government.

The project will also be subject to UNIDO's internal evaluation system. Specifically the project will prepare a Performance Project Evaluation Report every 12 months after the start of operations, preceeding Tripartite Review Meetings and a Terminal Report.

C. Progress and Terminal Reports

1. The Chief Technical Adviser in consultations with the national Project Coordinator, will prepare Project Progress Reports according to the UNDP policies and procedures. The National project Coordinator will prepare a final report at the end of the project's implementation.

2. The experts and consultants will prepare technical reports following each part of their missions.

3. The chief Technical Adviser will be responsible for the preparation of the Draft Project Terminal Report during the last months of his assignment, according to UNDP policies and procedures. The Executing Agency will be responsible for the preparation and issuance of the finalized Project Terminal Report.

PART IV : BUDGETS

The budgets covering UNDP contribution and the Government contribution to the projet are given in appendices A and B below, respectively.

UNIDO PROJECT BUDGET/REVISION

APPENDIX A

3. COUNTRY	4. PROJECT NUMBER AND AMENDMENT	5. SPECIFIC ACTIVITY
Syrian Arab Republic	DP/SYR/86/011	

10. PROJECT TITLE
Optical Technology Development

15. INTERNATIONAL EXPERTS (functional titles required except for line 11-50)	16. TOTAL		17.		18.		19.		20.	
	M/M	$	M/M	$	M/M	$	M/M	$	M/M	$
11-01 Chief technical adviser	25	207 650	4	31 400	12	98 400	9	77 850		
02										
03										
04										
05										
06										
07										
08										
09										
10										
11										
12										
13										
14										
15										
16										
11-50 Short term consultants	13	107 050	-	-	12	98 400	1	8 650		
11-99 Sub-total-International experts **	38	314 700	4	31 400	24	196 800	10	86 500		

21. REMARKS

** If more than 16 experts required check here ☐ and attach continuation sheet 1A This sub-total must include all experts.

CONTINUATION SHEET

4. Project Number DP/SYR/86/011	16. TOTAL		17. 1987		18. 1988		19. 1989		20.	
	M/M	$	M/M	$	M/M	$	M/M	$	M/M	$
UN volunteers (Functional titles required)										
14-05 Optical Tooling	21	36 785	-	-	12	21 020	9	15 765		
14-06 Mechanical Design	21	36 785	-	-	12	21 020	9	15 765		

UNIDO

PROJECT BUDGET/REVISION

4. PROJECT NUMBER DP/SYR/86/011		16. TOTAL		17. 1987		18. 1988		19. 1989		20.	
		M/M	$	M/M	$	M/M	$	M/M	$	M/M	$
OPAS EXPERTS (functional titles required)											
12-01											
12-02											
12-03											
12-99	Sub-total-OPAS experts **										
ADMINISTRATIVE SUPPORT PERSONNEL											
13-00	Clerks, secretaries, drivers		18 850		2 050		9 600		7 200		
13-50	Freelance interpreters (non-UNDP projects)										
13-99	Sub-total-administrative support personnel										
UN VOLUNTEERS (functional titles required)											
14-01	Optics fabrication	21	36 785	-	-	12	21 020	9	15 765		
14 02	Thin film coating	21	36 785	-	-	12	21 020	9	15 765		
14-03	Optical design	21	36 785	-	-	12	21 020	9	15 765		
14-04	Optical ass.testing & repair	21	36 785	-	-	12	21 020	9	15 765		
14-99	Sub-total-UN VOLUNTEERS **	126	220 710	-	-	72	126 120	54	94 590		
15-00	Project travel	-	30 500	-	3 00	-	22 500	-	5 000		
18-00	Other personnel costs (including UNIDO staff mission costs)	-	20 000	-	5 000	-	10 000	-	5 000		
NATIONAL EXPERTS (functional titles required)											
17-01											
17-02											
17-03											
17-04											
17-05											
17-99	Sub-total-National experts **										
18-00	Surrender prior years' obligations										
19-99	TOTAL-PERSONNEL COMPONENT	-	604 760	-	41 450	-	365 020	-	198 490		

If additional individual budget lines are required, check here ☒ and attach continuation sheet 1A. These sub-totals must include budget lines listed on page 1A

UNIDO

PROJECT BUDGET/REVISION

4. PROJECT NUMBER DP/SYR/86/011	16. TOTAL		17. 1987		18. 1988		19. 1989		20.	
	M/M	$	M/M	$	M/M	$	M/M	$	M/M	$
SUBCONTRACTS										
21-00 Subcontracts	-	100 000		30 000	-	60 000	-	10 000		
28-00 Surrender prior years' obligations										
29-00 TOTAL-SUBCONTRACTS	-	100 000	-	30 000	-	60 000	-	10 000		
TRAINING										
31-00 Individual fellowships	85	195 500	76	174 800	9	20 700	-	-		
32-00 Study tours; UNDP group training	2	16 000	2	16 000	-	-	-	-		
33-00 In-service training										
34-00 Non-UNDP group training										
35-00 Non-UNDP meetings										
38-00 Surrender prior years' obligations										
39-99 TOTAL-TRAINING COMPONENT	87	211 500	78	190 800	9	20 700	-	-		
EQUIPMENT										
41-00 Expendable equipment	-	197 480	-	40 000	-	100 000	-	57 480		
42-00 Non-expendable equipment	-	796 260	-	100 000	-	600 000	-	96 260		
43-00 Premises										
48-00 Surrender prior years' obligations										
49-99 TOTAL-EQUIPMENT COMPONENT	-	993 740	-	140 000	-	700 000	-	153 740		
MISCELLANEOUS										
51-00 Sundries	-	90 000	-	20 000	-	50 000	-	20 000		
55-00 Hospitality (non-UNDP projects)										
56-00 Support costs (CC and DC projects only)										
58-00 Surrender prior years' obligations										
59-99 TOTAL-MISCELLANEOUS COMPONENT	-	90 000	-	20 000	-	50 000	-	20 000		
99-99 PROJECT TOTAL	-	2 000 000	-	422 250	-	1 195 720	-	382 030		

GOVERNMENT INPUTS (IN KIND)

APPENDIX B

3. COUNTRY	4. PROJECT NUMBER AND AMENDMENT
SYRIAN ARAB REPUBLIC	DP/SYR/86/011

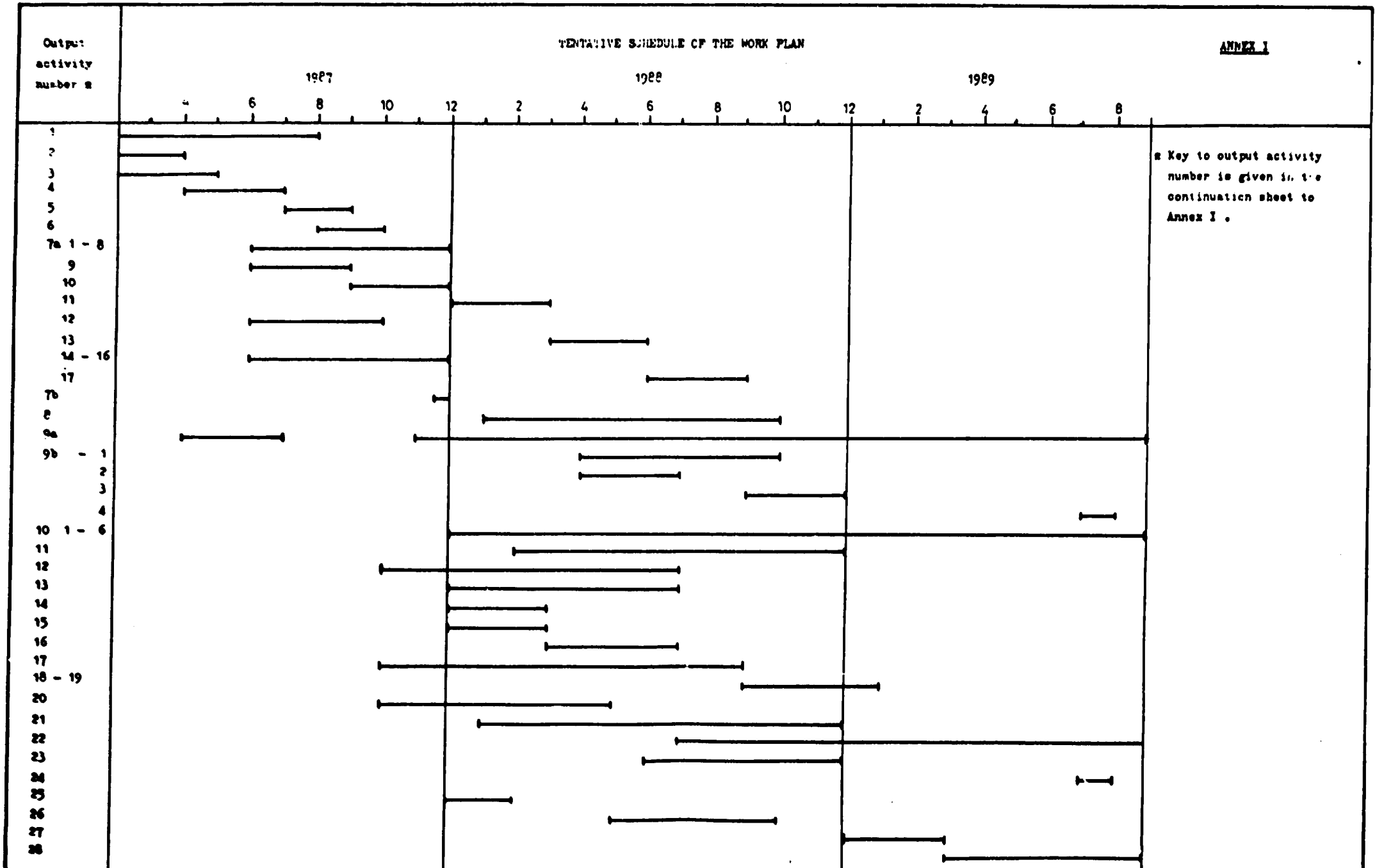
10. PROJECT TITLE

Optical Technology Development

	16. TOTAL		17.		18		19.		20.	
	M/M	$	M/M	$	M/M	$	M/M	$	M/M	$
10 - Project personnel	902	3 020 000	272	920 000	360	1 200 000	270	900 000		
19 - Component Total	902	3 020 000	272	920 000	360	1 200 000	270	900 000		
43 - Premises	-	350 000	-	250 000	-	50 000	-	50 000		
49 - Component total	-	350 000	-	250 000	-	50 000	-	50 000		
59 - Miscellaneous	-	708 000	-	94 000	-	338 000	-	276 000		
99 - Project total	-	4 078 000	-	1 264 000	-	1 588 000	-	1 226 000		

ANNEX I

TENTATIVE SCHEDULE OF THE WORK PLAN



a Key to output activity number is given in the continuation sheet to Annex I .

KEY TO THE OUTPUT ACTIVITY NUMBER

Continuation sheet to Annex I

Output activity No.	ACTIVITY	Output activity No	ACTIVITY	Output activity No.	ACTIVITY
1	Building Completion	7a - 10	Mechnical design (Quaider)	12	Optomechanical workshop setting
2	Project group formation	7a - 11	Mechanical design (Ramdan)	13	Thin film laboratory setting
3	Recruitment additional staff	7a - 12	Optical tooling, jigs & fixtures (Abbasi)	14	Pattern making
4	Equipment requisition	7a - 13	Dimensional metrology E (Technician)	15	Optical tools casting
5	Tender evaluation	7a - 14	Foundry & Metallography F (Technician)	16	Work demonstration
6	Equipment order	7a - 15	Technical cooperation (Housari)	17	Optical design & sys. Eng. section setting
7a-1	Fellowship ; optical workshop technology (Obaid)	7b	Study tour (Senior members)	18-19	Opt. Test, Assy. & repair, sections setting
7a-2	Optical workshop technology A (Technician)	8	Equipment installation	20	Optics kit prototype Dev.
7a-3	Optical workshop technology B 1-3 (Technician)	9a	CTA placement	21	Student microscope prototype development
7a-4	Optical thin film & inst. dev. (Maya)	9b - 1	Consultant placement (Optics fabrications)	22	Assorted optical components development
7a-5	Optical thin film (Attar, technician)	9b - 2	Consultant (Thin film coating)	23	Reticles replication
7a-6	Optical metrology C (M.Sc.)	9b - 3	Consultant (Optical testing)	24	Technical cooperation strategy development
7a-7	Optical design & sys. engineering (Mousilli)	9b - 4	Consultant (Technical cooperation)	25	Writing of optics kit manual
7a-8	Optical assembly & repair (Halabi)	10(1-6)	UN volunteers placement	26	Optics kit evaluation
7a-9	Graticulation D (Technician)	11	Optical workshop setting	27	Student microscope evaluation

ANNEX II

Non-expendable and expendable equipment list

A : Non-expendable equipment

Optical workshop Machines

Ser. No.	Equipment	Qty	Total Price $
A.1	Lens curve generator RF-15 including coolant system with oil spray suction device, LOH make or equivalent .	1	23.250
A.2	Universal milling machine UFM with two angle milling units and coolant system, LOH make or equivaient .	1	27.350
A.3	Grinding & polishing machine PM 150, 2 spindle unit, with intermediate fittings, LOH make or equivalent .	1	14.270
A.4	Grinding & polishing machine PM 300, 2 spindle unit, model C with intermediate fittings, LOH make or equivalent.	1	17.775
A.5	Grinding & polishing machine PM 500 with 2 eccentric spindles and intermediate fittings, LOH make or equivalent.	1	13.100
A.6	Universal centering machine NG with bell clamping attachement, hinged, and coolant system, LOH make or equivalent.	1	24.670
A.7	Laser centering unit M2 for checking and precision cementing, complete, LOH make or equivalent.	1	20.220
A.8	Glass sawing machine Type GS 300 with normal accessories, DAMA make or equivalent.	1	22.175
A.9	Trepanning machine with diamond impregnated tools of various sizes and Habit drilling attachment, DAMA make or equivalent.	1	3.000

A.10	Single spindle roughers, capacity up to 75 mm, for use in grinding operation.	4	4.000
A.11	Roughing machine, double spindle capacity up to 300 mm for use in grinding operation.	1	2.000
A.12	Electric oven with thermostat control up to 150 C.	1	0.500
A.13	Strain viewer for glass testing	1	3.000
A.14	Deep freezer	1	1.000
A.15	Hot plate	1	0.300
A.16	Workshop tools, screw driver set, spanner set, wooden hammer, files etc.	1 each	0.500

ACCESSORIES

A.1	Diamond tools for RF1 complete set	1	8.500
A.3,A.4,A.5)	Polishing slurry tank, stainless steel, capacity 15 ltrs. with pump and cooling facility.	3	3.000
	- Heater with thermostat	4	1.600
A.6	Collimating unit 1060 G with clutch motor.	1	4.000
A.7	Diamond saw blade, diameter 350x1.2 mm	2	0.900
A.8	Coolant tank 120 ltrs capacity including one immersion pump.	1	1.000

Optical Test Equipment

Ser. No.	Equipment	Qty	Total Price $
B.1	Spherical radius measuring instrument type SPH 100, complete including dial gauges, support, auxiliary plate and dial gauge pins, power supply cable & plug, DAMA make or equivalent.	1	4.200
B.2	Autocollimation telescope, 50mm aperture, 200mm objective focal length with all accessories, CARL ZEISS make or equivalent.	1	30.000
B.3	Pulfrich refractometer, PR2, with all accessories, CARL ZEISS make or equiv.	1	10.000
B.4	Image collimator 30mm aperture, 200mm focal length with all accessories, CARL ZEISS make or equiv.	1	3.000
B.5	Optical test bench with collimators, nodal slides and other accessories, CARL ZEISS make or equivalent.	1	10.000
B.6	Surface measuring interferometer, Tropel make or equivalent with accessories.	1	50.000
B.7	Fringe viewer with monochromatic source, Moller make or equiv.	1	1.000
B.8	Standard spectral lamps with stabilized power supply, monochromatic filters, resolution targets, pinholes, neutral density filters.	-	5.000
B.9	Laser source He-Ne, 5 mw power, Spectra Physics make or equivalent.	2	2.000
B.10	Set of scratch/dig samples.	1	0.500
B.11	Orthotest, $\pm$ 1 u, Zeiss make or equivalent.	1	3.000

B.12	Optical flat 150 mm diameter.	1	1.000
B.13	Optical cube, 2 sec. accuracy	1	1.500
B.14	Optical square, 90 with adjustable mount.	1	0.600
B.15	Optical bevel protractor	1	0.400
B.16	Spectrophotometer with test cassette & reflectance accessory, Specord M40 CARL ZEISS make or equivalent.	1	21.000
B.17	Measuring instruments, outside micrometer, inside micrometer, floating carriage micrometer, vernier caliper, dial indicator with magnetic stand, height gauge, angle plate, Tesa or Mitutoya or equiv.	1 each	5.000

Optical Thin Film Technology

Ser. No.	Equipment	Qty	Total Price $
C.1	Vacuum coating plant 19", equipped with electron beam gun, and water chilling plant, with standard accessories, Edwards or BALZERS, Heraeus-LEYBOLD make or equivalent.	1	80.000
C.2	Optical thickness measuring unit, source as above.	1	12.000
C.3	Vapour degreaser, 150 mm diameter, VIBRONICS make or equivalent.	1	3.000
C.4	Ultrasonic cleaner, 150 mm diameter, VIBRONICS make or equivalent.	1	1.500
C.5	Electrostatic charge eliminator, SIMCO make or equivalent.	1	1.000
C.6	Laminar flow clean tables, 3ft x 6ft	2	6.000
C.7	Thin film hardness tester, Edwards make or equiv.	1	0.500

Non-expendable equipment to be identified during the operation of the project + provision for cost escalation, insurance and freight charges.	347.350
Sub-total of non-expendable equipment.	796.260 (US. dollars)

B : Expendable equipment

RAW MATERIALS/TOOLS/ATTACHEMENTS

Ser. No.	MATERIAL	QTY.	Price $
1	Optical glass in random size slabs in the refractive index range 1.51-1.77 and Abbe value in the range 63.8-26.3 of the following types(Schott make or equivalent):		
	- Boro-silicate crown	100 Kg	
	- crown	100 Kg	
	- barium crown	50 Kg	
	- dense barium crown	50 Kg	
	- dense flint	50 Kg	50.000
	- flint	50 Kg	
	- extra dense flint	50 Kg	
	- double extra dense flint	50 Kg	
	- barium flint	50 Kg	
2	- Ophthalmic glass sheets in standard size, 300 x 300 x 20mm	50 Kg	3.500
3	- Float glass plates - in standard size of 300 x 300mm of thichness 12mm, 19mm, 25mm.	30 each	3.500
4	- Abrasives (emeries 180, 220, 302, 302.5, 303, 303.5)	24 Kg	
	- cerium dioxide	4Kg each	
	- carborundum	5 Kg	7.000
	- AL2 03	5 Kg	
		5 Kg	
5	Pair of roughing, smoothing, blocking, polishing tools, templates, collets, clamping bells, jig for lens holding for vacuum coating, test plates.	30	5.000
6	Radius turning attachment	2	2.000

7	Pair of flat tools, 300mm diameter	2	2.000
8	Blocking materials, like, pitch, plaster of Paris.	30 Kg each	2.000
9	Cleaning agents, like, benzene, benzol, trichloroethylene, methylated spirit, isopropyl, anhydrous alcohol, kerosene oil, acetone, machine cutting oil.	5 ltr each	2.500
10	Polishing agents, like, - Polishing pads, felt, cloth, wax, teflon.		2.000
11	Optical cements, like, - Canada balsam, cellulose caprate, U.V. cement.		2.000
12	Thermal evaporation materials and sources, like, - Mg F2, Si o2, Ti o2, - Inconel, molybdenum, tungsten wire.		3.500
	Expendable equipment to be identified during the operation of the project + provision for cost escalation insurance and freight charges.		112.480
	Sub-total of expendable equipment		197.480 (US.dollars)