OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

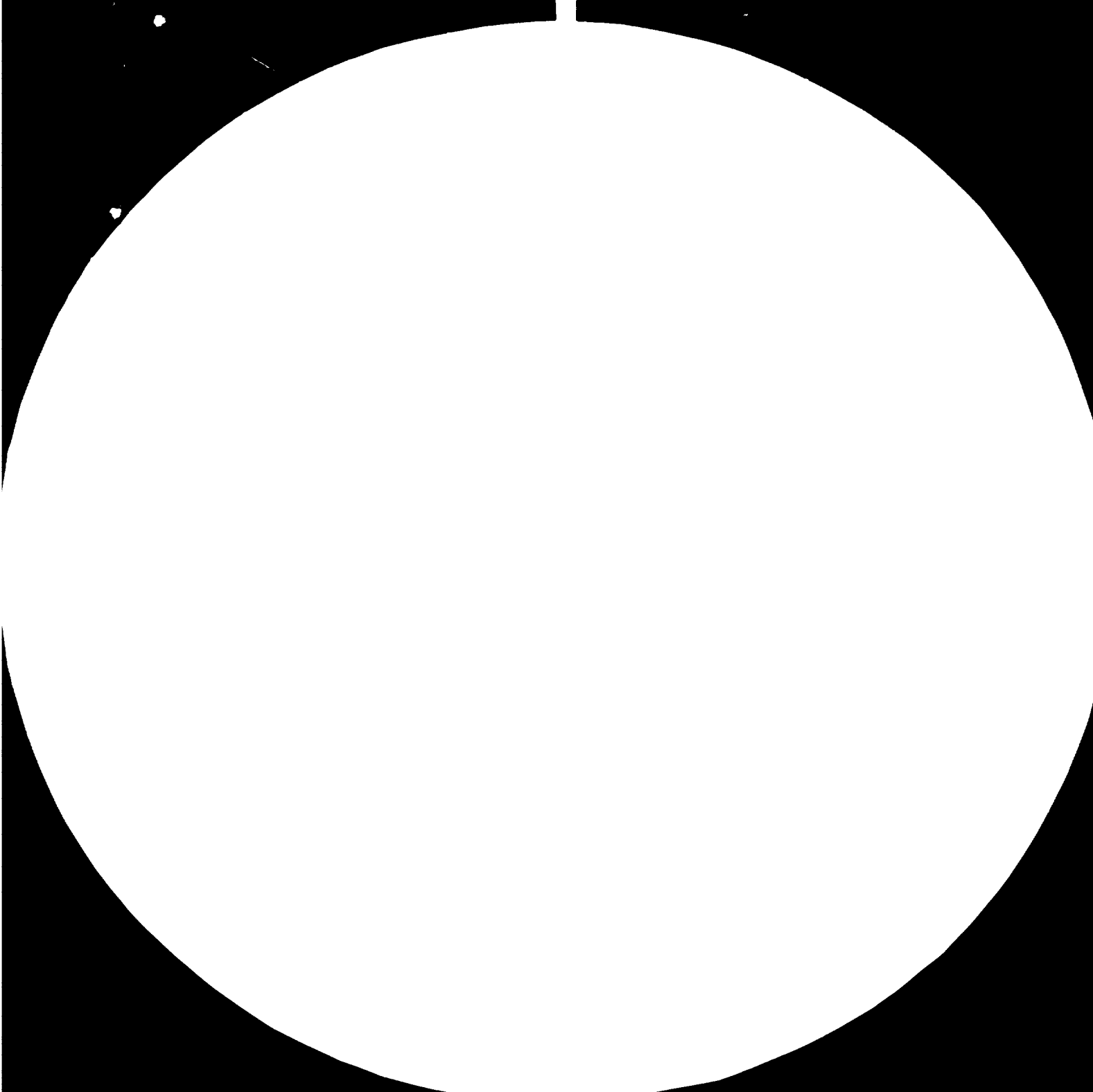
FAIR USE POLICY

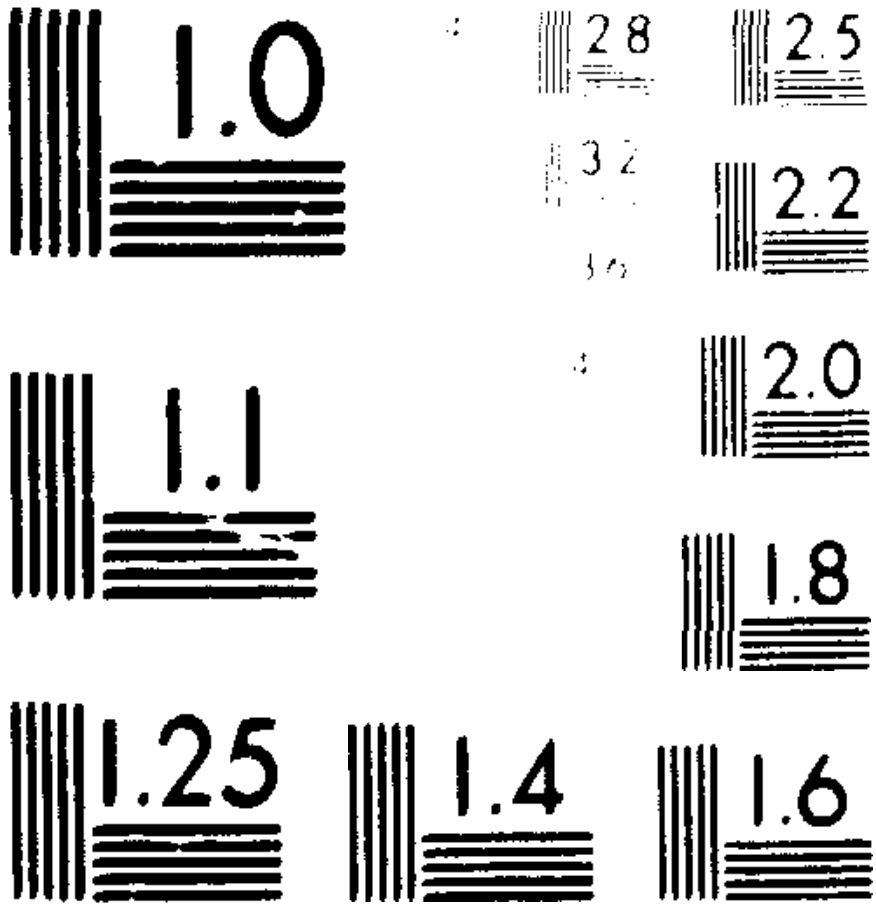
CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org





10620

INDUSTRIAL TESTING, RESEARCH AND DEVELOPMENT CENTER

MEZZE, DAMASCUS

SYRIAN ARAB REPUBLIC

Final Report

of

Enrico Petrozzi

Expert in Testing and Calibration of
Electrical Equipment and Supplies

DP/SYR/72/006/11-06/B/31.3.A

May 1978

TABLE OF CONTENTS

1. SUMMARY

This report deals with the activities of the expert in Testing and Calibration of Electrical Equipment and Supplies, Enrico Petrozzi.

It covers the period of his assignment to the Industrial Testing, Research and Development Centre (ITRDC) Project from 22 February until 24 May 1978,

Brief Resumé

- The contacts with industries and import authorities are scarce; the adoption of IEC specifications would greatly increase the Centre's usefulness (2.1).

- The action of the previous expert was followed, and the first phase completed. (2.3)

- Equipment from the cable and motor factories was examined, faults found, remedies indicated. This initiative could have remarkable economical bearing, but the practical results appear - by now - small. A possible action is outlined (3.3 to 3.3.5)

- A repair laboratory was started by requisitioning its basic equipment (3.4)

- A training course was given to the counterparts, and some orientation for future courses is supplied. Educational equipment for the Training Unit was put under requisition (3.5).

- Some detail activities were brought out among which a note on "Maintenance and Repair" to be presented at a Baghdad Symposium. (3.7)

- Facilities have been commissioned for:
  - Testing laboratory
  - Educational Unit
  - Repair Laboratory

  for total 27,000 to 30,000 US$ (3.8)

- Only two recommendations are offered:
  - that the relevant authorities adopt the IEC specifications
  - that paramount importance be given to personnel training (4.1 and 4.2)

- A recommended list of IEC specifications, suitable for Syria (or any other developing country of comparable level) has been prepared, and was integrally accepted by the Standardization Committee (3.1 to 3.1.3 and Annex 2)

2. INTRODUCTION

2.1 The contacts between the Electrical Subsection of the Centre and the Electrical Industries are scarce. This is mainly due to the fact that the main electrical industries are three (cables, motors and freezers) plus some minor ones.

More numerous and interesting contacts should be developed with the Import Authorities, since:

a. The majority of electrical materials are imported, and

b. The quality of imported materials is very variable, ranging from the very good down to the non-acceptable.

Now, experience shows that Testing Centres can be fully utilized only where a legal instrument induces the Import Agencies to send the relevant samples to the Centre, the Centre tests them according to international regulations, and finally the Import Authorities utilize the Centre's reports in their financial-commercial decisions.

The key to such legal instrument lies in the adoption, by the relevant authorities, of the IEC (International Electrical Committee) specifications and regulations. "Adoption" would imply:

- A study to determine if IEC specifications are suitable for the true needs and situation of the Country (study already completed).

- A decision about the language, i.e. whether to accept IEC standards in the original French-English, or to proceed to their translation in Arabic.

- An administrative mechanism by which all important batches of locally made or imported materials are sampled, the samples are sent to the Centre, the Centre tests them and formulates the reports, these reports are utilized by the Authorities. All this should assume the aspects of a routine procedure.

Feasibility

In the reality, not many developing countries have brought into being an organization similar to the one outlined above.

- This is mainly due to the fact that Testing Centres have often assumed a prevailently "scientific" aspect, which makes them scarcely suitable for routine purposes;

- However, Syria offers a favourable exception to such a situation because the Centre's instrumentation - in its large majority - is suitable for useful industrial work. In addition, the Syrian Centre has set-up as a first thing a rich and well organized collection and library of specifications, standard rules, etc., both national and international, which keeps the Centre's activities constantly oriented towards internationally accepted regulations and recommendations.

In addition, the study (see above) to determine the adherence of IEC specifications to Syrian needs has been brought out by the UNIDO expert on mission and counterparts (see para 3.1 below) and the IEC specifications have been found suitable for the country.

The equipment to perform the electrical tests is partially present and its completion has been already ordered. The personnel has been trained and is now able to carry out the most important electrical tests.

Therefore, the proposal to adopt IEC specifications is feasible with the existing means and those foreseen for the immediate future.

The only action required of the Authorities is the adoption of IEC standards and the decision about their language, plus the consistent administrative machinery.

2.2 The second point stressed in this Report is Personnel Training, under the various forms of courses to be held locally and fellowships abroad (Point 3.5 and Recommend. 4.2).

2.3 The expert has kept Mr. M. Ipacs Final Report as a guide, and many of Ipacs's recommendations have been followed. With this, the present expert would consider the first phase of the Project as completed.

3. MAIN ACTIVITIES AND FINDINGS

In compliance with the expert's job description:

3.1 Preparing industrial standards

The expert and his counterparts have spent three weeks of intensive work in selecting a list of IEC-Cennelec specifications suitable for local conditions in the 1978-88 decade, and subdividing the items according to two priority criteria. This list was submitted to the Consultive Electrical Committee who integrally accepted it, only suggesting that the two priority criteria be subdivided into four. Apart from this, both the Centre and

the consulting committee recognized that IEC specifications are suitable for adoption in Syria, in principle. Since then, the action on industrial standards has developed into two branches:

3.1.1 The local Consulting Committee, after having appointed several sub-committees, will decide whether to adopt IEC regulations in the original or in the Arabic translation. Contacts are being taken with other Arab Countries to coordinate action.

3.1.2 The expert and counterparts have utilized the IEC publications to select which tests are both urgent and feasible, and on which materials. Having performed this selection, three activities followed:

- The personnel was trained to carry out those international tests which were both urgent and feasible with the existing equipment;

- Requisition forms for complementary instrumentation have been issued, each instrument being justified by the relevant IEC specifications.

- A list of the tests that the Electrical Subsection is able to perform right now - and their price list - were prepared for distribution among Industries and Authorities who may be interested in having some materials tested. List and prices are presently at the Ministry of Industry for approval.

3.1.3 Thus the Electrical Subsection has done its own part of work and is waiting for the official adoption of IEC specifications and of an administrative machinery to have the samples brought to the Centre for testing, as a routine procedure.

3.2 Introduce Modern Methods in Testing and Calibration, Prepare Technical Documentation

IEC-Cennelec publications minutely dictate the test procedures and therefore the methods to follow and the equipment to utilize; they must be considered "modern", since they are kept up to date at the origin. The technical documentation prepared is the selected list of IEC publications of para. 3.1 above, attachment No. 2.

3.3 Testing Appropriate Electric Equipment

Contacts have been developed with three industries:

3.3.1 Cable factory. Some 30 tons defective "quad" cable were lying in the junk-yard, while additional defective cable was being produced. Cable samples have been carefully sectioned and micrometrically inspected, and the fault was localized in the defective operation of the P.E. extruding machine, or its cooling bath. The finding was communicated to the Cable Factory, who acknowledged.

When the fault in the extruding machine is repaired, the ITRC intervention will have determined quite a substantial saving, given the high cost of this cable.

3.3.2 Motor Factory. A summary market inspection showed that hundreds of locally made motors burn out precociously. Some charred motors have been inspected and the fault easily found: the "condenser-cut-off-collar" resulted made of low grade plastic, which warps or blocks on the shaft at any slight temperature increase. This causes the condenser to burn-out, and the "90°" coil burns in turn. The factory was advised to adopt a better plastic material for the molded collars, and acknowledged.

Here again, the Centre's action would involve important savings, if followed.

3.3.3 Refrigerator Factory. Mr. M. Ipacs had carried out an exhaustive test in 1976, recommending also a set of testing apparatus to be purchased by the factory to carry out routine tests. Since the factory asked once more for such a list, we took advantage of this for recommending a new list of apparatus, in accordance with IEC specifications.

3.3.4 Minor Production and Imported Materials. The Centre purchased on the market some items such as electric heaters, electric ranges, plugs, outlets and cords. The tests were meant as a practical training for the personnel, since samples randomly purchased on the market have neither statistical nor legal consistency. Statistically correct sampling rules (also clearly illustrated in the IEC documents) must be applied, to give this action the required validity.

3.3.5 Economical bearing, practical results

Both interventions of ITRDC in fact of cables and motors have a considerable economical bearing, due to the high price of "quad" cable and the inconvenience of burnt-out motors and their replacement.

It is, however, the expert's opinion that such initiatives of the Centre - as well as those taken in the past - are insufficient by themselves to create routine (or at least frequent) ties between the Electrical Subsection and Industries.

Once more, the adoption of IEC Standards - which implies the existence of a Quality Control Service - appears the specific way to put the Centre and its Quality Control Electrical Laboratory, at the service of Industries and Import Agencies.

3.4 Repair Laboratory

With the present work-load and existing equipment, the fault statistics is (for all electric and electronic equipment present in the various laboratories and services of the Centre).

- 1-2 faults a year to be repaired in the existing Workshop;
- 2-3 faults a year to be repaired in the future Laboratory;
- 1-2 faults a year requiring re-shipment to the supplier.

With the Electrical Subsection at full work-load, and the training course on, the fault statistics will possibly increase to:

- 3-4 faults a year for the Workshop
- 6-9 " " " " " Laboratory
- 2-3 " " " " requiring re-shipment.

Such figures, in themselves, would scarcely justify the creation of a Repair Laboratory. The considerations which make a Repair Laboratory mandatory are that: "by repairing one learns to design", and that the "Research and Development" activities of the Centre will certainly involve - in a not far future - some electric and electronic design.

It might be suggested that the Repair Lab and the Training-Educational Unit work strictly together since the two activities integrate each other in view of the same goal: to prepare personnel for future qualified work. From this point of view, the Repair expert should work in strict cooperation with an educational expert, able to supply, along with the technical notions, the logics to be followed in designing any new industrial device.

The present expert has issued the requisition forms for some basic repair laboratory equipment, tools and components, to be furtherly expanded by the second phase expert, according to his views.

3.5 Training Syllabi

A 35-hours practical course was held to train personnel on the existing testing equipment. Its syllabus:

- Rehearsal of basic electricity notions;
- Description of typical IEC tests;
- How to prepare samples and carry-out tests;
- Limitations in the test equipment performance, dangers to personnel and testing equipment integrity;
- A few notions of electronics were also given, to illustrate the operation of some basic components recurring in most electronic apparatus (e.g. operational amplifier, integrator-differentiator and the like). See Annex 3.

After the course the counterparts proved to be able to utilize the existing equipment correctly. The course permitted also to clarify that future syllabi should start from arithmetics (powers of 10, roots, etc.), maths (exp and log, decibels, some elementary differentials and integrals, etc.), then proceeding to Ohm's applications (multiload resistive line, disturbance of the measuring apparatus on the circuit under test, etc.). Some notions on electrons and holes would be necessary to reach understanding of PNP and NPN semiconductors. After this preparatory phase the syllabus could follow the usual scheme of an instrumentation course.

The course should be of the "dedicated" type, i.e. not of a general nature but carefully programmed so as to adhere to the particular conditions; since the personnal is eager to work on equipment, this positive attitude could be valorized, and oriented towards future design and development activities.

3.6 Calibration, its true aspects

On this subject the expert would like to express an opinion of a personal and general nature.

It is noted that in many emergent countries ingent sums have been allocated to purchase exceptionally precise calibration instruments such as primary frequency standards, microsecond clocks, extremely sensitive pressure meters, quartz resonance thermometers and the like. It is also noted that such precious instrumentation has no occasion whatever of being utilized. Avoiding any criticism, the expert would suggest that the "key-word"

Calibration be re-dimensioned to its true value:

- Industrial activities usually need only modest accuracies (0.2 to 1%) which now-a-days are assured by any commercial instrument;

- re-calibration after repair is routinely performed by the repair personnel itself;

- Calibration and metrology experts could usefully orientate their action to quality control and acceptance tests according to international regulations, which is really needed.

The present considerations are offered to justify why the expert has found no instrument to calibrate during his mission.

3.7 Detail actions

3.7.1 Following a suggestion of SIDFA, a note on "Maintenance and Repair, Last Decade's Experience" was prepared for use at the Centre and to be presented at the Baghdad Electrical Industries Symposium, May 1978 (postponed). Its conclusions:

"The experience gathered during the highly signi-
"ficant last decade caused perhaps a shift in the
"bari centre of the subject: in 1970 everybody's
"attention concentrated on maintenance organization
"and facilities, while the present note points out
"the great importance of a constant, patient, com-
"petent (and often courageous) action by the main-
"tenance and repair supervisor and his men.

"Indeed, maintenance and repair assumes the aspect
"of a personal confrontation, or challenge, between
"a small group of men against an adversary called
"failure. In such a challenge the intrinsic human
"qualities of the maintenance people acquire para-
"mount importance.

"While the most frequent key-words in the 1970
"Duisburg Report are "management, programming and
"planning", the most frequent key-words in the
"present note are "personal responsibility" and
""training".

3.7.2 A method for calculating multi-load resistive lines by means of a laboratory model was elaborated for use in electric line dimensioning.

3.7.3 A "dummy load", variable between 1/2 and 3-1/2 KW was assembled in the workshop for testing transformers and appliances, and its operation is satisfactory.

3.8 Commissioning the Facilities

Requisition forms have been issued for equipment meant to:

- Complete the existing instrumentation for testing purposes, each new item being justified by the relevant IEC-Cennelec specifications.

- Supply a first base of apparatus and components to the new Repair Lab, leaving to the 2nd Phase expert/s wide possibilities of expansion and completion.

- Supply the educational equipment for a first training course, to be expanded in the future.

The sums involved, as far as the swelling prices permit to foresee, will range between 27000 and 30000 US$

To reduce the expense and - above all - to give the personnel a first occasion to calculate and assemble some apparatus, the requisition covers some loose instruments and accessories. Assembly sketches and instructions have been delivered to the counterpart.

Also this last point of the job description can be considered as complied with.

3.9 Counterparts

The counterparts, two engineers and three technicians (one of which a lady) have been constantly very polite.

The educational level of the technicians proved fairly good, therefore, an accurate training could give rather good results.

The general behaviour of the counterparts (continuity of action, attention, punctuality, etc.) could sometimes stand improvement.

The main difficulty was met with the language. Modern electronic instrumentation is made of "logics", so that any teaching, description or instruction implies a fairly good mastering of syntaxis (mainly the syntaxis of verbs and prepositions) because our discourse is essentially made of conditionals tied by a variety of prepositions, each condition and preposition corresponding to an electronic component. (Typical examples, the AND-NAND-OR-NOR logics).

The Project would be greatly advantaged if several units of personnel could follow a good course of any diffused language at the Centre's expense. Indeed, as far as the Electrical Subsection is concerned, the present level of linguistic knowledge could hinder the necessary exchange of information, unless the expert/s spoke fluent Arabic.

3.10 Acknowledgement

I wish to sincerely thank:

- Mr. K. Yassir, Resident Representative
- Mr. A.S. Salem, SIIFA
- Mr. Y. Kassab, Programme Officer
- Mr. Z. Sawaf, General Director of the Centre

for their competent guidance and assistance which permitted all terms of reference of my mission to be fulfilled.

In particular, they supplied me with precious advice in preparing the present report.

4. RECOMMENDATIONS

4.1 Adoption of IEC Specifications

The Centre has determined that IEC regulations apply to the objective situation in Syria, and has selected the most urgent ones. Some testing equipment is already present (completion already ordered) and the personnel has been trained.

It is, therefore, recommended that the relevant authorities adopt the IEC regulations and specifications as a whole (i.e. irrespective of their urgency).

It would be strongly recommended that the English-French original text (having legal value in International Courts) be adopted integrally, while suitable promptuaries for use at factories, laboratories, etc., could be prepared in Arabic.

The presence of a Syrian Delegate at IEC-Geneva (either permanent or at determined occasions) would sign a rather important landmark.

4.2 UNIDO help

UNIDO help is already described in Project Document SYR/77/004, which, under Point G I 17 (page 9) foresees 78 m/m consultant experts. The Syrian Authorities could request UNIDO to supply an expert in electricity-electronics training, in order to give all the personnel of the Electrical Subsection a 6 months course.

The expert should also install and bring into operation the educational equipment under order (expected time of arrival end 1978) before holding the course. Duration of mission, total 8-9 months.

One of the many fellowships foreseen by the Project Document could be assigned for sending the man in charge of the Testing Laboratory for 4-5 months to the test-and-acceptance Laboratory of a large organization such as "Chemins de Fer Federaux" or "Staatsbahn" or others, where numerous IEC tests are routinely carried out.

The importance of a language course has been stressed under Point 3.9.

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

PROJECT IN THE SYRIAN ARAB REPUBLIC

JOB DESCRIPTION
DP/SYR/72/006/11-06/B/31.3.A

Post title : Expert in Testing and Calibration of Electrical Equipment and Supplies

Duration : Three months

Date required : As soon as possible

Duty station : Damascus

Duties : The expert will be assigned to the Industrial Research and Development Centre and co-operate with local specialists. Specifically, the expert will be expected to:

1. Introduce modern methodology and techniques in testing and calibration of electrical equipment, supplies and instruments, including the preparation of required technical documentation.

2. Assist in testing appropriate electrical equipment, as well as in the calibration of electrical measuring equipment.

3. Participate in preparing industrial standards and specifications of locally manufactured and imported electrical products.

4. Assist, if required, in commissioning the facilities required for testing of electrical equipment and components, and the calibration of electrical measuring instruments.

5. Train counterpart personnel in the above-mentioned duties.

The expert will also be expected to prepare a final report, setting out the findings of his mission and his recommendations to the Government on further actions which might be taken.

QUALIFICATIONS : University degree or equivalent in mechanical or industrial engineering, with extensive experience in various aspects of manufacturing operations, such as production repairing and control, quality control, maintenance preferably, at the plant level.

LANGUAGE : English; Arabic an asset.

BACKGROUND INFORMATION : The industrial development of the country is regarded as the spearhead of the country's development programme. Despite the rapid growth of industry in recent years, the manufacturing sector is confronted with various problems, among which are lack of manufacturing standards and efficient quality control, the low level of technology and the shortage of managerial and technical skills. To assist the Government in its industrial development efforts UNDP has been providing the country with assistance in the form of both small and large scale projects. The Government has recently decided to expand the Industrial Research and Development Centre (IRDC) as a major UNDP project, to serve as an autonomous body under the aegis of the Ministry of Industry. The project is intended to assist the Government in setting up and initiating the activities of the country through carrying out industrial applied research and development in problems relating to feasibility studies, engineering, production, quality, standardization and applied metrology as well as by providing a wide range of technical consultancy services to industry, including provision of technical information, The Centre is also expected to advise and assist in technical matters in the preparation of the programmes of industrial development.

ANNEX NO. 2

SELECTED LIST OF NORMALIZATION REGULATIONS AND STANDARD TEST PROCEDURES

INDEX

CRITERIA. The present list of selected normalization rules and test procedures was prepared according to the following logical criteria:

All of the normalizations and test procedures issued by IEC and harmonized by Cennelec must be considered important and appropriate, however, each of the 563 (1977) IEC publications presents a different degree of immediate interest. The present list comprehends those IEC - Cennelec publications which present a higher probability of being applied in developing countries in the 1978 - 88 decade, and refer to electrical materials, appliances and machines (either locally produced or imported), which determine the good economy and safety of industrial processes.

From the present list of IEC - Cennelec publications all items which refer to "highly specialized electronic techniques" such as nuclear energy, radiology, telecommunications and the like, have been left for the future.

The items of the present list have been grouped by subject and sub-subject to make the research logical, and both IEC and Cennelec numbers are shown to permit an easy access to both collections. Should, in the future, some VDE or ANSI or other specification prove complementary to IEC - Cennelec, the respective indications can be added in an additional column left free for this purpose. The present list, in fact, must remain open for all future extensions and completions.

VOLUME OF WORK FOR THE NATIONAL STANDARDIZATION COMMITTEE

- The following list recommends the adoption of 115 IEC items plus 110 sub-items, i.e. 225 IEC leaflets in all for a total of 9000 pages approximately.

- Priority "A" (urgency) has been assigned to 110 IEC leaflets, amounting to 4800 pages. The remaining 115 IEC leaflets (or 4200 pages) have been confined to priority "B".

- The IEC publications contain numerous paragraphs which can be considered not strictly essential and could be perhaps abridged. Furthermore, the IEC publications are in two languages. Therefore, the above quoted numbers of pages can be divided by a factor 2.5 to obtain the number of standard "pages-in-print" to be elaborated by the National Committees and working Team/s. We have thus:

- Total "pages-in-print" to be elaborated: 9000 / 2.5 = 3600
  of which, Priority "A" : 4800 / 2.5 = 2000
  and Priority "B" : 4200 / 2.5 = 1600

Time required: Some tentative translation showed that a team made by one engineer, plus one assistant, plus one typist, can elaborate, translate and edit not more than 3 pages per working day.

This would imply:
Elaboration, translation and editing of the IEC publications selected in this list:
3600 pages / 3 pages per day = 1200 working days or 1500 calendar days of one team,
of which, for publications indicated as "Priority A":
2000 pages / 3 pages per day = 666 working days or 800 calendar days
and for publications indicated as "Priority B":
1600 pages / 3 pages per day = 533 working days or 700 calendar days.

All the above figures are approximated and rounded.

Conclusion

The above figures show that the elaboration and translation of IEC publications would take a long time, unless several teams are set at work, which is not always possible.

Perhaps a reasonable solution would be to adopt the IEC specifications globally and in the original French-English texts, which have legal value in the International Courts.

Promptuaries, or summaries, or tables, could be prepared in the local language for use in industries, import agencies, laboratories, etc., as required.

Annex 2 (4)

SELECTED LIST OF NORMALIZATION REGULATIONS AND STANDARD TEST PROCEDURES

Appliances

Title	IEC N	Cenne-N	Others N	Priorities and Pages	Notes
1. APPLIANCES, domestic, also small industrial, Safety of --					
1.1 Execution and performance					
Electrical installations of buildings	364				
Scope, object, definitions	364-1			A 70	
Fundamental principles	364-2				
General requirements for installation	-3				
Performance of electric irons, methods of of measurement	311			B 30	
Performance of vacuum cleaners, methods of measurement	312			B 55	
Performance of fans, regulators	385			B 30	
Standards for plugs and socket-outlets, domestic	83			A 45	
Standards for plugs, sockets and industrial use	309	196		A 34	
1.2 Safety					
Safety of household and similar appliances	335				
General requirements	335-1			A 155	
Requirements for vacuum cleaners	335-2			B 13	
Requirements for electric irons	-3			A 25	
Requirements for dishwashers	-5			A 27	
Requirements for ranges	-6			A 34	
Requirements for washing machines	-7			A 31	
Requirements for shavers, clippers	-8			A 21	
Requirements for toasters, roasters	-9			A 26	
Requirements for floor treatment	-10			B 17	
Requirements for clothes driers	-11			B 19	
Requirements for warming plates	-12			A 19	

Title
Requirements for frying pans, etc.
Requirements for kitchen machines
Requirements for heating appliances
Requirements for blankets, pads
Requirements for water heaters
Requirements for electric toys
Requirements for refrigerators, freezers
Safety requirements, electronic equip.
Safety in electro-heat installations
General requirements
Requirements for resistance heat

Annex No. 2 (5)

IEC N	Oenne- N	Others N	Priorities and pages	Notes
335-13			A 21	
-14			A 32	
-15			A 23	
-16			B 92	
-21			B 26	
-22			A 37	
335-2-24			A 42	
65	96		B 129	
519				
519-1			A 41	
519-2			A 23	

SELECTED LIST OF NORMALIZATION REGULATIONS and STANDARD TEST PROCEDURES

Title	IEC N
2. Batteries, primary cells, accumulators	
2.1 Primary cells	
Primary cells and batteries	86
General	86-1
Specification sheets	86-2
Terminals	86-3
2.2 Accumulators	
Lead-acid starter batteries	95
General, test methods	95-1
Dimensions of batteries	95-2
Dimensions of terminals	95 -3
3. CABLES, conductors, wires	
3.1 General matters	
Properties of conducting materials: see under 9.1	
Nominal cross-sectional areas, etc.	228
Calculation of c.c. rating	287
Fire-resisting characteristics, cables	331
Flame-retardant character, cables	332
Current-carrying capacities of conductors, buildings installations	448
Calculation of resistance, guide	344
Test methods	540

Annex No. 2 (6)

Batteries, Cables

Conne- N	Others N	Priorities and pages	Notes
211		B 37 A 86 A 23	
		A 27 B 12 B 9	
and 9.2		B 57 A 68 A 10 A 10	
		A 26	
		B 12 A 108	

Title	IEC N
3.2 Various types of cables and conductors	
Guide to selection of H.V. cables	183
PVC flexible cables, cords, L.V.	227
Rubber flexible cables, L.V.	245
Impulse tests on cables	230
Tests on oil-filled and gas-pressure cables, accessories	141
Oil filled, paper	141-1
Gas pressure, internal	141-2
Gas pressure, external	-3
Test methods, polyethylene cables wires and cords	538
Low frequency cables	189
- General test methods	-1
Cables for inside installations	-2
Equipment wires	-3
Distribution wires	-4
Equipment wires, PVC	-5
Signalling cables	-6
Distribution wires, PVC	-7
Specifications for winding wires	317
Enamelled round copper wires of various types and usages	317-1 to 317-11
3.3 Radio Frequency cables	
Characteristic impendance, coaxial	78
Radio frequency cables	96
General requirements	96-1
Relevant specifications	96-2

ANNEX NO. 2 (7)

Cenne- N	Others N	Priorities and pages		Notes
		B	15	
		A 62		
		A 52		
48		A 11		
		B	37	
		B	25	
		B	27	
		B	47	
		A 44		
		A 38		
		A 15		
		A 14		
		A 23		
		B	22	
		A 22		
		B	c.s. 300	
120		B	11	
		B	81	
		B	32	

Title	IEC N
4. CAPACITORS, power	
Power capacitors	70
Series capacitors, power systems	143
Electrolytic, aluminium, general use	103
A.C. motor capacitors	252
Coupling capacitors	358
5. FUSES, LIGHTNING ARRESTERS	
Fuses, definitions	291
Fuses, low voltage	269
General requirements	269-1
Fuses, industrial applications	-2
Fuses, domestic "	-3
Fuses, high voltage	282
Current limiting fuses	282-1
Expulsion and similar	282-2
H.V. fuses, capacitor protection	549
Lightning arresters	99
Non-linear resistors	99-1
Expulsion type	-2

Annex No. 2 (8)

Cenno-N	Others N	Priorities and pages	Notes
		B 75	
59		B 53	
		A 39	
		A 43	
		B 40	
		A 9	
		A 81	
		A 20	
		A 44	
		A 5	
		A 55	
		B 24	
		B 75	
		B 109	

Title

6. ILLUMINATION, lamps, accessories

6.1 Filament lamps

Tungsten filament lamps, general serv.
  long life lamps
Edison screw lamps
Lamp caps and holders
  Lamp caps
  Lampholders

6.2 Fluorescent tubes

Tubular fluorescent lamps, general
Ballasts for ditto
Lampholders for ditto
Starters for ditto

6.3 Mercury and sodium lamps

High pressure mercury lamps
Ballasts for ditto
Low pressure sodium lamps
Ballasts for ditto

7. INSULATORS, glass, ceramics

Dimensions of insulators above 1000 V
Characteristics of string insulators
Tests on insulators, ceramic or glass,
  above 1000 V

ANNEX NO. 2 (9)

IEC N	Comne- N	Others N	Priorities and pages	Notes
64	199.1		A 59	
64 A	199.2			
238	66		A 66	
61	65			
61-1			B 113	
61-2			B 38	
81	81		A 188	
82			A 102	
400	198		A 51	
155	197		A 27	
188	82		A 62	
262			A 51	
192	219		B 38	
459			B 49	
273			A 36	
305			A 10	
383			A 59	

Title	IEC N	Cennel N	Others	Priorities and pages	Notes
8. MACHINES, rotating, toolmachines, accessories					
8.1 Electrical equipment of --					
Electrical equipment, machine-tools	204	93		A 71	
as above, for general use	204-1				
Current carrying capacity	204-1-B	93-1		A 13	
Series production machines	204-2	93-2		B 33	
Electronic equipment, toolmachines	204-3	93-3		B 43	
8.2 Rotating machines					
Rotating machines	34	53		B 79	
Ratings and performance	(34-1)	(53-1)		A 79	
Losses and efficiency, determination	-2	-2		B 55	
Synchronous machines, tests	-4	-4		A 87	
Degrees of protection, enclosures	-5	-5		A 32	
8.3 Accessories					
Motor capacitors, as under 4., capacitors					
Low voltage motor starters	292				
Direct-on-line, a.c.	292-1			B 73	
Reduced voltage, a.c. star/delta	292-2			B 38	
Rheostatic rotor starters	-3			B 65	
Two-step autotransformer	-4			B 43	
Brushes, carbon, nomenclature	276	56		B 35	

ANNEX NO. 2 (11)

Title	IEC N	Cennel N	Others	Priorities and pages	Notes
9. MATERIALS, raw, aluminium, copper, insulating, magnetic					
9.1 Aluminium and alloys					
Aluminium stranded conductors	207			B 19	
Aluminium alloy, stranded conductors	208			B 19	
Aluminium steel reinforced	209			B 33	
Aluminium alloy, steel reinforced	210			B 31	
9.2 Copper					
Resistance, copper, internat. standard	28			A 9	
Calculation of resistance	344			A 11	
9.3 Insulating materials					
9.3.1 General for solid materials					
Insulation coordination	71				
Terms, definitions, rules	71-1			A 45	
Application guide	71-2			A 127	
Recommendations for classification	85			A 31	
Insulation resistivity, volume & surface, insulating materials	93			A 25	
Insulation resistance, test methods	167			A 21	
Standard conditions of tests	212			A 17	
Recommended methods of test, solid	243			A 28	
Permittivity of insulating materials, dissipation factor	250			A 56	
High voltage test techniques	60				
Definitions, test requirements	60-1			A 43	
Test procedures	60-2			A 52	
Measuring devices	60-3			A 21	

Title	IEC N	Cennel N	Others	Priorities and pages	Notes
9.3.2 Insulating, air					
Spare gaps, one sphere earthed	52			B 37	
9.3.3 Insulation, oils					
Dielectric strength, insulating oils	156			A 15	
Insulating oils, new, specifications	296			A 19	
In-service maintenance, supervision of insulating oils	422			A 32	
Oxidation stability, assessment of	74			A 19	
Oxidation stability, test method	474			A 21	
Method of sampling oils	475			A 22	
10. MEASURING INSTRUMENTS, meters, recorders					
Direct acting instruments, recommendations	51	49		B 105	
Indirect acting instruments	484			B 93	
Safety requirements for meters	414	215		A 50	
Watthour meters, class 0.1-1-2, A.C.	521			B 51	
Wh meters, acceptance tests, class 2	514			A 71	
11. RELAYS					
Electrical relays	255				
Contact performance	255-0-20			A 41	
All-or-nothing relays	255-1			B 67	
Single input, time not specified	-3			B 91	
Single input, time specified	-4			B 85	

Title	IEC N	Cennel N	Others	Priorities and pages		Notes
12. RESISTORS						
Fixed resistors	115					
Terms, methods of test	115-1			B	41	
Low power, non-wirewound	115-2			B	21	
Wirewound, type 1, test methods	115-3			B	15	
Fixed, wirewound, type 2	266			B	43	
13. SAMPLING PROCEDURES, inspections, statistical reliability						
Sampling plans, inspections	410			A	82	
Sampling of oils	475			A	22	
Reliability, definitions, mathematics	271			B	53	
Reliability, preliminary considerations	272			B	7	
Reliability clauses, inclusion into specifications	409			B	21	
Managerial aspects of reliability	300			B	15	
14. SAFETY AND PROTECTION						
Classification of equipment regard protection	536			A	11	
Effects of current on humans	479			A	10	

For all particular types of protection, see under the respective items.

ANNEX NO. 2 (14)

Title	IEC N	Connel N	Others	Priorities and pages	Notes
15. SWITCHGEAR, breakers, couplers, contactors					
15.1 General					
Definitions	277			A 23	
Breakers, guide to testing	267			B 17	
15.2 Low voltage					
Low voltage control switches	337				
General	337-1			A 43	
Special requirements	337-2			A 19	
Low voltage switchgear and controlgear	157				
Circuit breakers	157-1			A 111	
Low voltage control gear, contactors	158			B 81	
Low voltage air-break switches, etc.	408			A 84	
Degrees of protection, enclosures, LV	144			A 29	
Switches for appliances	328			A 95	
Couplers for appliances, household	320			A 97	
15.3 High voltage					
High voltage combinations	420			B 61	
High voltage contactors	470			B 51	
High voltage disconnectors, earthing	129			B 124	
High voltage switches	265			A 99	
High voltage metal enclosed	298	187		B 59	

Title	IEC N
16. TRANSFORMERS	
For the characteristics of materials, see under 9 :	
16.1 Power transformers	
Power transformers	76
General	76-1
Temperature rise	-2
Tappings	-4
Ability to withstand short-circuit	-5
Reactors	289
16.2 Measuring transformers	
Current transformers	185
Voltage transformers	186
17. VOCABULARY, SYMBOLS, DIAGRAMS, LABELLING	
International electrotechnical vocabulary	50
Measuring instruments	50-20
Energy generation	50-25
Electromechanical applications	50-35
Electroheating	50-40
Lighting	50-45
Rotating machines	50-411
Switchgear	50-441
Magnetism	50-901

ANNEX NO. 2 (15)

Cennel N	Others	Priorities and pages		Notes
aterials				
		A 43		
		A 25		
		A 28		
		A 21		
		B	39	
		B	62	
		B	42	
		A 88		
		A 81		
		A 32		
		A 40		
		B	359	
		B	194	
		A 60		
		B	56	

Title
Letter symbols
General Logarithmic quantities
Recommended graphical symbols
Symbols for A.C. meters
Symbols for types of construction and mounting arrangements of rotating machinery
Labelling on equipment

Main figures

Items	115
Sub items	110
A. pages	4800
B. pages	4200
A + B =	9000

ANNEX NO. 2 (16)

IEC N	Cennel N	Others N	Priorities and pages	Notes
27				
27-1	245-1		A 79	
27-3	245-3		B 21	
117-1 to 117-8			A 289 total	
387			A 16	
34-7	53-7		A 47	
417	243		A 147	

ANNEX No. 2

INDUSTRIAL TESTING, RESEARCH AND DEVELOPMENT CENTRE, SAR

PROGRAMME of the COURSE

on Electrical Tests and Quality Control

SCOPE

To enable 5 or 6 units of technical personnel to operate the existing equipment for quality control, according to IEC regulations.

CRITERIA

- To illustrate which types of tests the laboratory shall perform, according to the IEC regulations, on which types of samples;
- How to prepare the samples;
- How to handle the equipment;
- The above points will be preceded by a short recall of basic applied electricity and electronics, to the extent needed to understand how the equipment operates.

PROGRAMME

- Recall of basic laws of electricity, extended to the main "technician's problems", and those specifically recurring in quality control and acceptance tests	5 hours
- Units recommended by IEC-Cennelec, units used in manuals and catalogues, converstion tables	
- Visualization of current problems examples	5 hours
- Elements of electronics and measuring circuits	5 hours
- Types of tests usually required by industries, simple calculations required by same, selection of the appropriate apparatus to use	5 hours
- Illustrate each existing apparatus, its performance and limitations, careful handling, possible dangers	
- Examples on actual samples of dummies (some accessories to be purchased)	10 hours
- Preparation of samples: according to IEC regulations, and	
- Safety criteria	5 hours
Total "contact time" of course	35 hours

DETAILS OF THE COURSE

The course shall mainly deal with:

- Resistance of conductors
- Insulation resistance of solids (and oils)
- Break-down point of solid insulators
- Overheating of conductors and appliances
- Non-destructive tests
- Capacitance of cables, symmetry of cables (by microscope)
- V, A, W, R measurements
- Notions on operational amplifiers, derivators and integrators
- Use of oscilloscope, megger, nano-Ampermeter, Wheatstone bridge, RCL bridge, "limited" power supply, H.V. Breakdown apparatus.

The course will be attended by:

- Mr. Trad Trad, for general organization and translation
- Mr. Majed Nader
- Mr. Yassin Thalgeh, when available, as a help in calculus
- Mrs. Wafaa Sadaki
- Mr. Hekmet Bukay)
- Mr. Ibrahim Zaza) as helps in the applications

The course will take place in the Electricity Laboratory each working day from 9 to 10 a.m. Any absence should be communicated the day before during the lesson, and - in any case - justified.

UNIDO Expert