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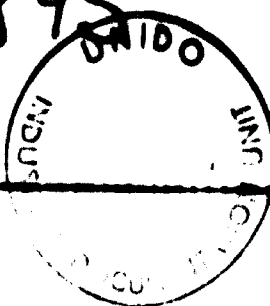
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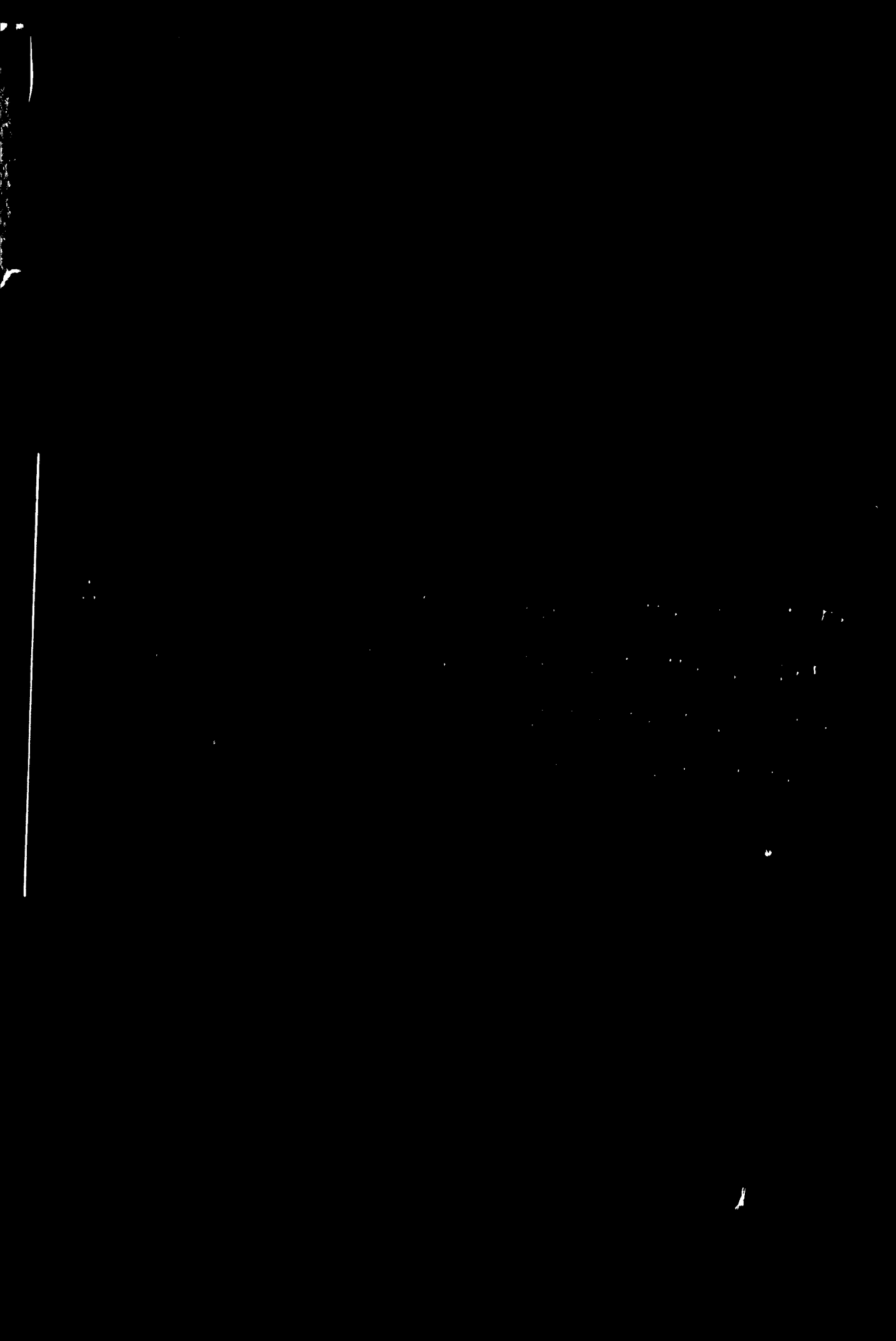
ELECTRIC WIRE AND CABLE MAKING[✓]
IN THE SYRIAN ARAB REPUBLIC

by

L. Lighty
UNIDO Expert

[✓] The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO.

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László Ligetky, an expert appointed by the United Nations Industrial Development Organization, undertook his assignment at Damascus, Syrian Arab Republic, on 16 February 1972. He discussed the main problems of the Syrian cable industry with Syrian specialists, both of the Union of Engineering and Chemical Industries (UNICHEM) and of the Barada Company, Damascus, the only cable factory in the Syrian Arab Republic.

In the course of his assignment he had discussions with the following Syrian experts:

Mohamed El Dick, General Director of UNICHEM

Kyarr Sibani, Technical Director of UNICHEM

Joussaf Furuk, General Director of the Barada Company

Moufak Bayroudy, Director of the Barada Company

Tayssir Saeboun, Technical Director of the Barada Company

Adnan Mustafa, Advisor of the Barada Company.

I. The Barada Company

The Barada Company, Damascus, is the only cable factory in the Syrian Arab Republic. It belongs to UNICHEM as a partly private, and partly nationalized, enterprise.

The Barada Company is a small factory comprising 170 employees. It receives one third of its energy supply from a network and two thirds from its own generators. The water required for the use of the factory is supplied by the company's own pump; drinking water is delivered by tanks. The toilet water is poured out without being purified.

The main products of the factory are the following:

power cables and wires with plastic and rubber insulation up to 1 kV

serial telephone cables (plastic insulated) up to 14 cores

military telephone wires.

All products are constructed according to the VDE (Verein Deutscher Elektrotechniker - German Electrotechnical Society) specifications.

The stock of machine tools includes:

- drawing machines (Cortinovis)
- pot-annealing
- a bunching machine (F. Pick)
- a stranding machine (De Angeli)
- extruders for both rubber and PVC (polyvinyl chloride)(Bandera)
- a continuous vulcanizing line (boiler 16 atU)
- maintenance workshop with tool machines
- wire-drawing die polishing workshop (well adjusted)
- wardwellian braiding machines.

The machines are about 15 years old, and technical conditions are rather poor; as there are three shifts, there is not enough time for maintenance. The stock of machine tools is not suitable for the production of all types of cables and wires.

The consumption of raw materials is the following:

- 800 tons of copper
- 400 tons of PVC
- 25 tons of synthetic rubber
- 75 tons of steel tape.

The staff is skilled but should have additional training abroad. The machines are old. There is a lack of space in workshops and of transport facilities.

1. Raw materials

An investigation should be carried out concerning the handling of raw materials in the Berada Company; and recommendations should be made with regard to storage and quality control of main raw materials such as conductor material (copper) and insulating materials, PVC, PE(polyethylene) and rubber.

(a) The ordering of raw materials

Conductor material is ordered in hot rolled rod form of EC (electrolysed copper) quality, from Johnson and Neph, (Manchester) and Royal Bafield (London). The expert recommends that there should be no change in delivery firms. The expert saw an offer concerning FRC (fire refined copper) quality and observed that EC is sufficient for the cable industry.

PVC is purchased from a firm in Lebanon. The offers contain specifications of materials, but they do not state whether data are minimal values,

or for information only. The expert recommends that a qualified Syrian engineer be sent to delivery firms at least twice a year to supervise the measuring of the guaranteed values in the laboratory of delivery firms.

PE is bought by careful tender evaluation, such a GFD 2408 product of Union Carbide. The expert recommends that the material be ordered.

Rubbers and additives are purchased from Bayer (Bayprene C 210) and from firms such as those given in the Bayer catalogues. The expert recommends that this method should not be changed.

(b) Storage

Conductor materials are laid in the yard; they are rolled down from vehicles. The expert recommends that there should be a covered storage place as soon as possible and that steps be taken to avoid having vehicles roll on the copper coils. A lift should be used.

PVC and PE are stored in small but high (up to 5 metres) storages. There is a danger of collapsing and because of the heavy weight the bags below can burst and in summertime the granulators (pellets) can stick together. It can also happen that the lower bags are stored for a longer time while only the upper ones are taken. The expert recommends a new building with sufficient space for plastics storage.

The quantities of rubbers and additives stored are sufficient.

(c) Quality control of raw materials

No instrument tests are carried out on raw materials. The expert recommends that some important properties of raw materials be tested as stated below, and a statistical evaluation be made four times a year.

(i) Conductor. The following parameters, which are given in data sheets concerning Hungarian cable wires (No.21.1.1), should be checked:

- geometrical size
- ultimate tensile strength
- elongation at break
- electric conductivity (or resistivity)
- bending test.

(ii) PVC compound. The PVC compound is delivered in sealed polyethylene bags; the delivery is to be supervised; no damage of bags should be allowed. Sample sheets of the delivered material should be requested from

the firm that sells it. On that sheet the following is to be measured:

- tensile strength
- elongation at break
- dielectric loss factor
- volume resistivity
- cold bend test
- cold flex test

after ageing repeatedly:

- tensile strength
- elongation at break.

(iii) PE compound. The PE compound has the same requirements as the PVC compound except for the additional melt-flow-index requirement.

(iv) Rubbers. Samples must be made both of smoked sheets (a type of natural rubber) and Bayrene C 210 according to the requirements of production; the following are to be measured before and after ageing:

- tensile strength
- elongation at break
- volume resistivity.

In summary, the cable factory is not able to control the quality of raw materials and it does not send quality-control engineers to delivery firms. The main raw materials are of good quality; for commercial reasons the sources of materials cannot be changed. The expert recommends that the quality control of raw materials be introduced as soon as possible.

2. Recommendations for quality control during the processing of products

Quality control during the processing of products is recommended to ensure certified properties of cables and wires.

The situation in the Barada Company requires a more rigorous quality control. The stock of machine tools of the factory is not suitable for the production of all kinds of cables and wires. The annealing equipment is unable to produce copper wire without an oxide layer; the annealing grade of wires is unknown. The stranding machine is in a rather poor condition; there are no suitable stranding or twisting machines for insulated wires. As the same machines twist insulated wires with a cross-sectional area of 0.5 mm^2 and those with an area of 70 mm^2 , there are

breaks in the wires in insulated cores.

The problems can be solved by the reconstruction of the cable factory. The expert's recommendations are given in the following paragraphs (see also annex III).

(a) Conductor

The following parameters are to be checked:

geometrical size

tensile strength

elongation at break

electric conductivity after each of the following technological steps:

wire drawing

annealing

stranding

covering

core laying up or twisting up.

A specific date should be set to control each technological step and to check the change in the quality of conductor material caused by processing. This is important since in the insulated form there is no possibility of increasing the conductivity of the conductor by annealing. Geometrical size, tensile strength and elongation at break are to be measured only after the statistical data have been obtained and after annealing.

(b) Insulating process

The expert recommends that the spark-test equipment be adopted in every extrusion line. This cannot be done now because of lack of space. Every worker would control his production and would be able to intervene and correct the parameters such as: suitability of temperature of extruder, dirt (he could stop and clean the machine etc). So long as this is not possible, the only available spark-test equipment should be used at the end of the production line, at least to control the product before delivery.

(c) Laying up or twisting of cores

The water immersion voltage test is to be carried out after cabling. The voltage withstand test is to be performed on every product; also recommended is a test for the continuity of conductor. After the technical reconstruction of the factory these tests can be given up.

(d) Jacketing process

This process is also to be followed by a voltage withstand test carried out as recommended by VDE. The problems caused by technological factors cannot be solved with control tests in the processing line. Some of the defects can be avoided with recommended measures, which will be stated later.

3. Supervision of the transport of the product

The products of the cable factory should be packed according to the requirements. The mark is required on the products; the products arrive into the storage either in coils, carefully tied, or in drums, upon request.

The expert recommends a larger storage building for the cable factory.

4. Evaluation of the technical level of the laboratory

The cable factory has begun to install its laboratory according to plan of its own. The following main equipment has been bought: Megohmmeter (Radiometer), Wheatstone bridge, tensile machine for bigger size of wire etc.

The existing working area can meet the requirements for some two years at the present level.

Well skilled and experienced staff are not available. The expert recommends that a team, consisting of workers, technicians and engineers, be sent to a developed country to practise the testing of materials and products, to get acquainted with testing methods and equipment and to analyse tested data statistically, in order to be able to point out the causes of faults of products. This team would then be able to train the other members of the staff to carry out testing procedures with the existing equipment.

(a) Equipment

The following equipment is recommended:

(1) For conductor:

tensile strength machine for wire of 0.1 to 1 mm²;

Thompson bridge for conductivity measurements;

bending facilities for fatigue test.

(ii) For insulating materials:

dielectric loss factor bridge with varying frequency range and with varying voltage range
cold-bend test measuring equipment
cold-flex test measuring equipment
melt flow index test
ultrathermostat for water bath
electric strength test
measuring ring electrode.

All the above mentioned equipment was selected in catalogues of Felten and Guilleaume and M. Frank, both firms in the Federal Republic of Germany. The equipments make accurate tests, and are easy to handle.

5. Outline proposal for the organization and activity of a technical department to be created in the cable factory

The personnel, i.e. engineers and technicians, must be ensured for this department.

Several study works abroad should be organized so that these experts could gain experience.

(a) Organization of technical department (see annex I)

This department would be responsible directly to the technical director.

(b) Activity field

(i) Library of technical documentation. This section would have the task of collecting published technical and scientific literature, such as:

technical journals

books

standards

prospective materials for cable-making machinery and products of cable industries abroad.

A list of recommended technical journals is given in annex IV.

(ii) Development of product and technology. This section should know the national requirements (cables) on long-term basis; evaluate the imported cable assortments (taking into account the quantity required yearly);

make proposals to extend the production scale; request investment (manpower machines and buildings), raw materials and transport facilities; take part in international fairs to be able to follow the developments and markets of foreign countries; supervise the technical level of machines in the factory and propose to renew or change them; make drafts for standards on raw materials and products of the factory (quality and testing requirements).

(iii) Investment planning. This section should study the technical literature and prospect materials of foreign cable-making machinery groups; collect the requirements for purchasing new machines (by development section and production section) make a technical and financial provisional plan to be able to invite a tender; after evaluation of tenders make conditions (some Syrian workers have to be skilled abroad for the purchased machine); and control the investment (both technically and financially).

(iv) Certifying laboratory. This section should supervise the quality of raw materials and recommend the purchase of the most adequate materials; give permission to use the controlled material; when the material is not suitable for quality reasons, make reclamation; using its equipment carry out performance tests requested by production sections on semi-fabricated products; certify the products of the factory carrying out test procedures given in standards; make analysis (statistical evaluation) of the formation of refuses and give exact data as to who or what caused it.

(v) International co-operation. The cable industry involves the following questions:

- metallurgical
- mechanical
- chemical
- plastic-processing
- electric design.

The international co-operation is very important in the cable industry. Some of the problems can be solved economically only by international co-operation. This group has the task to organize international technical/economic/commercial long-term co-operation between the cable factory in the Syrian Arab Republic and the cable industries of other countries. A co-operation plan includes:

exchange of experience
exchange of technical documentation upon request
mutual study tour to train the experts
specialised research work by one partner and the exchange
of the results.

6. Extension of the production of the Barada Company

The Syrian Government has begun the electrification on a large scale and the probable demand of electric cables and wires will be high, which means that a well developed cable industry will be needed.

The Barada Company has no quality control and no suitable stock of machine tools for the production on a larger scale. Therefore, either the Barada company should be reconstructed or a new factory should be built.

In either case the expert recommends the following:

- (a) Collect a team of foreign technical advisers and Syrian experts to carry out a careful pre-investigation (marketing, economical planning etc.) to be able to make invitation for tender;
- (b) Organise study tours to cable factories of tendering countries before tenders come in;
- (c) Evaluate the tenders, make decisions;
- (d) Reconstruct the existing factory or build a new one under the supervision of the team;
- (e) Train abroad engineers, technicians, workers (machine operators);
- (f) work at least one month in the presence of foreign technicians of delivery firm after the investigation.

Conclusion

The stock of machine tools and the technical conditions of the Barada Company are not suitable at all. The production of certified electric cables and wires needs a considerable investment.

The expert recommends for the existing factory:

- (a) Annealing under steam or the use of continuous annealing machines;
- (b) Utilization (or selling) of pickling acid;
- (c) Measurement for extending the service life of lubricating emulsions of drawing machines;
- (d) Extension of service life of drawing dies by use of arcured diamond dies for small size wires;
- (e) Cleaning of extrusion machine etc.;
- (f) Introduction of quality control of raw materials and products.

II. Cable consumption in the Syrian Arab Republic

The Barada Company is the only cable factory in the Syrian Arab Republic. As the factory cannot supply all the country's needs, cables and wires have to be imported. The Syrian Arab Republic imports:

- medium-voltage power cables
- overhead cables for electric transmission lines
- installation wires
- control cables
- telephone wires and cables
- magnet wires
- other special cables and wires.

Because of its rapid industrial development, the Syrian Arab Republic will need a well organized cable industry in the near future. As a result of electrification and automation, products of the cable industry will be needed. Electrical energy produced at the Euphrat dam will need a distribution network. Chemical, food and some other industries consume a considerable amount of electric power. Products of the cable industry will be needed by the telephone network. Cables and wires are also used for military purposes.

It should be noted that the products of the cable industry are sold at especially high prices all over the world, at a 35 to 45 per cent profit. This profit would remain in the Syrian Arab Republic.

III. Recommended investment for a new cable factory

If the Syrian Government decided to establish a new cable factory, it would be desirable to have an investment plan, for both financial and technological reasons.

A technological plan should first be made, taking into consideration the required scale and capacity of production. A technical adviser, who should be a senior engineer in the cable-making industry (see annex II), should plan the production line in such a way as to use the same machines for several purposes so that investment costs could be reduced.

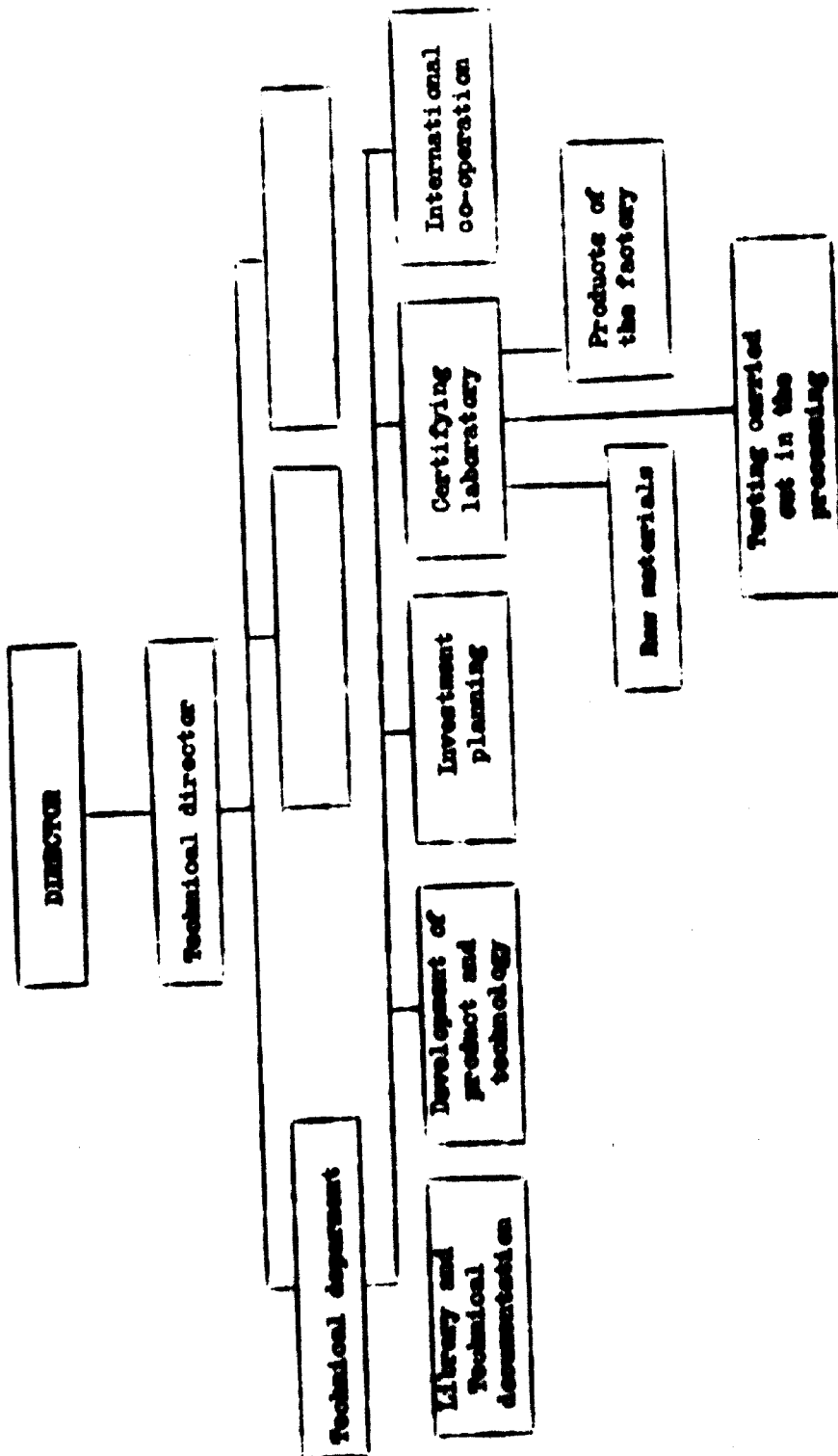
In co-operation with the technical adviser a tender should then be sent to several important enterprises in developed countries. Both financial and technical aspects should be taken into account when evaluating tenders. The technical adviser should also recommend that the "relative optimum" be found.

After the tenders have been evaluated and a tender chosen, an order should be placed. At this stage it is important to specify the requirements, such as guarantees of capacity, length of service, degree of safety, details of installation, skill (in the Syrian Arab Republic and abroad), capacity of the staff for quality control of products taking into consideration that a good developed civil engineering is available in the Syrian Arab Republic.

UNIDO could support the development of the Syrian cable industry by sending one or more technical advisers to the Syrian Arab Republic to train the employees of the cable industry.

Annex I

Organisation of the technical development



ANNEX II

Job description

Post title: Consulting engineer, expert in electric wire and cable making.

Duration: One to two years.

Duty station: Damascus.

Purpose of project: To extend the production, capacity and productivity of the Syrian cable industry. The expert will be responsible to the Union of Engineering and Chemical Industries (UNICHI) to which he will render his technical services for the advancement of the Syrian cable industry. He will be expected to:

- (a) Carry out a preliminary investigation to get acquainted with all the circumstances, requirements and plans pertaining to the new installation, so that he could contribute with his advice and recommendations;
- (b) Follow his preliminary technological investigations along the lines of the required production scale of the cable industry and with his experience support the carrying out of a tender invitation with optimized conditions;
- (c) Take part in evaluation of tenders submitted to UNICHI for a cable-making plant. A comparison should be made by means of a thorough analysis of tenders bearing in mind the agreed product and output specifications, local manpower conditions and so on;
- (d) Evaluate the tenders and rate them for their acceptability in relation to technical suitability, financial viability, guarantee, delivery and installation conditions, extent of complementary services, training facilities and so on;

- (e) Support the Syrian cable industry with his experience to control the installation of investment, to set it up, to train manpower and to introduce the quality control of raw materials and products;
- (f) Sum up the recommended development conception of the Syrian cable industry for the next five years.

Qualifications:

Senior engineer with extensive experience in electric wire and cable making (chiefly with plastic insulation).

Language:

English.

Annex III

Price list of recommended equipment

The following material-testing equipment is recommended for the quality-control department of the Brada Company:

- (a) Thompson bridge (product of Felten und Oellichs, Federal Republic of Germany, measuring the resistivity of copper wires from 0.1 to 10 mm with resistance etalon and normal element); \$ 1,500;
- (b) Dielectric loss factor bridge (product of Felten und Oellichs, Federal Republic of Germany, measuring dielectric loss and relative dielectric constant of insulating materials on maximum 500 V and 1 megacycle; equipped with guard electrode system and stabilized power supply); \$ 1,500;
- (c) Megohm meter (radiometer, product of Denmark, equipped with guard electrode system); \$ 1,000;
- (d) Tensile strength machine (for insulating materials and plastics, measuring from 0 to 250 kp., product of the German Democratic Republic or of Hungary); \$ 1,500;
- (e) Melt flow index equipment for polyethylene (product of Frank and Son, United Kingdom of Great Britain and Northern Ireland); \$ 2,000;
- (f) Cold-bend and cold-flex test measuring equipment for plastics (product of Frank and Son, United Kingdom of Great Britain and Northern Ireland); \$ 200;
- (g) Bending machine for fatigue test (product of the German Democratic Republic or of Hungary); \$ 100.

Micrometers and other tools would also be needed.

The above prices are approximate. Inquiries should be made for exact prices.

"Plastverarbeiter"

Zechner und Hühlig Verlag GmbH
6720 Speyer/Rhein
Daimler Str. 9
POB 68
Federal Republic of Germany

"Insulation"

Lake Publishing Corporation
El Paso /Texas
POB 21011
United States of America

General cable field

**"Elektrotechnische Zeit-
schrift A und B"**

VDE-Verlag GmbH
1 Berlin 12
Bismarckstrasse 33
Federal Republic of Germany

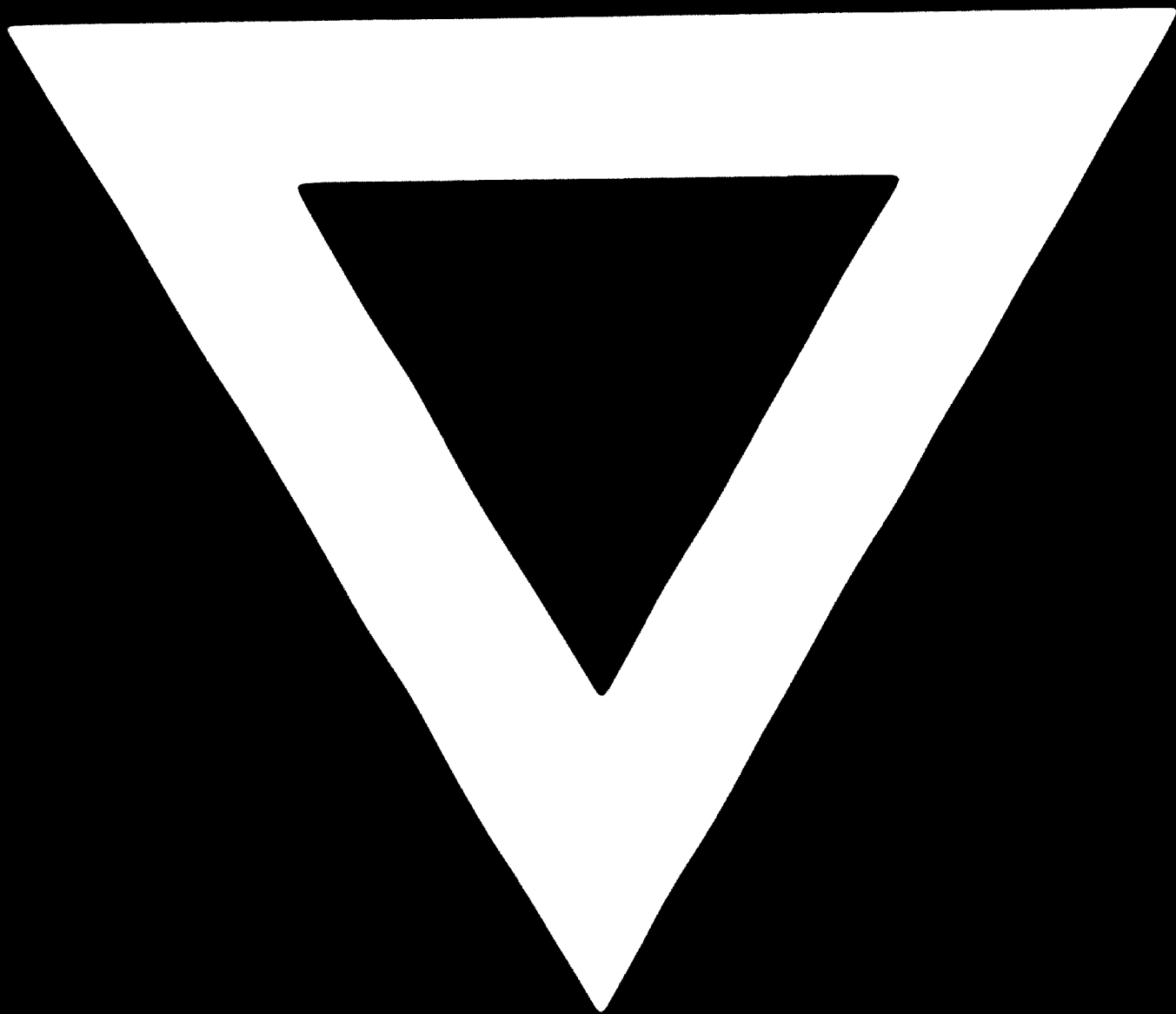
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Federal Republic of Germany

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Karte-Abteilung
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POB 80 50 01
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