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# UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

VIENNA, AUSTRIA

AND

# ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

RABAT, MOROCCO



PROJECT PROFILES

FOR

MANUFACTURE OF

ELECTRICITY GENERATION, TRANSMISSION

AND

DISTRIBUTION EQUIPMENT

IN

ARAB COUNTRIES

EXECUTIVE SUMMARY

DEVELOPMENT CONSULTANTS INTERNATIONAL LIMITED

MANAGEMENT CONSULTANCY DIVISION

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# PROJECT PROFILES
# FOR
# MANUFACTURE OF
# ELECTRICITY GENERATION,
# TRANSMISSION AND DISTRIBUTION EQUIPMENT
# IN ARAB COUNTRIES

## EXECUTIVE SUMMARY

APRIL 1996

DEVELOPMENT CONSULTANTS INTERNATIONAL LIMITED
MANAGEMENT CONSULTANCY DIVISION

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DCIL-105/AC-5/1116 April 26, 1996

United Nations Industrial
Development Organization
Vienna International Centre
P.O. Box 300
A-1400 Vienna
Austria

Attn.: Mr V Koloskov

Project Profiles for manufacture of electricity generation, transmission and distribution equipment in Arab countries

Dear Sirs :

We take pleasure in submitting twenty (20) copies of our Executive Summary Report on the subject assignment.

We trust that this Report and all the other eight Project Profiles will meet with your approval.

We also look forward to associating ourselves with your further assignments.

Thanking you and assuring you of our best services,

Very truly yours :
DEVELOPMENT CONSULTANTS
INTERNATIONAL LIMITED

Siddhartha Ganguly
Project Coordinator

**ACKNOWLEDGEMENT**

We wish to record our sincere appreciation of all the help and assistance extended to us by the United Nations Industrial Development Organization (UNIDO) and Arab Industrial Development and Mining Organization (AIDMO) for preparing the Project Profile Reports. Amongst others, in particular our thanks are due to Mr V Koloskov of UNIDO, Vienna and Mr Mohamed Karbid, Secretary General of AIDMO who have been involved with this project right from the beginning. They have communicated to us regularly with their valuable comments and observation during the currency of the entire assignment. Needless to say, their help and inputs have gone a long way in ensuring successful completion of the Reports.

We also convey our thanks to all concerned officials of UNIDO and AIDMO including Mr M Kohonen, Mr Gardellin, Mr P Neumann, Mr A Malayeri. Mr W Kapfer, Mr C Guerkock, Ms W Job, Mr Adnan Al Kindi and Mr Mohammed Said Ali who have cooperated with us during various stages of the assignment.

# INDEX

**INDEX : TEXT**

# INDEX : EXHIBITS

## LIST OF ABBREVIATIONS

| | |
|---|---|
| A | Ampere |
| AC | Alternating Current |
| ACB | Air-Blast/Air-Break Circuit Breaker |
| ACSR | Aluminium Conductor Steel Reinforced |
| CCV | Continuous Catenary Vulcanisation |
| Cmil/ft | Circuit miles/feet |
| CNC | Computerised Numerically Controlled |
| CREB | Centre Rotating End Break |
| DC | Direct Current |
| EHV | Extra High Voltage |
| HT | High Tension |
| HV | High voltage |
| IRR | Internal Rate of Return |
| KVA | Kilo Volt Ampere |
| lpm | Litres per minute |
| LV | Low Voltage |
| MCC | Machine Control Centre |
| MDCV | Mitsubishi Dainichi Continuous Vulcanisation |
| $mm^2/m$ | Square milimeter square per meter |
| MOCB | Minimum Oil Circuit Breaker |
| MS | Mild Steel |
| MT | Metric Tonne |
| MV | Medium voltage |
| MW | Mega Watt |
| OCB | Oil Circuit Breaker |
| PVC | Polyvinyl Chloride |
| RCC | Reinforced Concrete Construction |
| $SF_6$ | Sulphur Hexaflouride |
| TPA | Tonnes per Annum |
| VCV | Vertical Catenary Vulcanisation |
| XLPE | Cross Linked Polyethylene |

# SECTION - 1
# INTRODUCTION

# INTRODUCTION

The Sixth Arab Industrial Development Conference held in Damascus, Syria in October, 1984, stressed the importance of the manufacture of electrical power generation, transmission and distribution equipment in Arab countries among the Arab joint venture projects. Subsequent to the recommendation, Arab Industrial Development and Mining Organization (AIDMO) prepared a sectoral Study Report on past and present status of electricity energy sector in the Arab world, its future development and future demand-supply of various equipment associated with the electrical energy sector.

The sectoral study was completed in September 1986 and reviewed by an Expert Group meeting in June 1987 which agreed that the electric energy sector which had been growing remarkably in the recent past would continue to grow at a much higher rate in future. The Group further recommended that a comprehensive time bound programme should be taken up for achieving self-sufficiency in manufacturing relatively simple and medium technology products. Simultaneously, possibility of acquiring the capability to manufacture high technology proucts should also be explored. Manufacturers from the Arab World were also advised to advertise and promote their products to Arab Electrical Authorities.

In continuation of these recommendations, AIDMO in consultation with United Nations Industrial Development Organization (UNIDO) shortlisted eight (8) such products and intended to jointly prepare individual Project Profiles on

all these products. The major objective of preparing these profiles is to provide sufficient information to prospective promoters and sponsors in Arab and other countries for identifying suitable products for local manufacture on a regional basis and/or within countries.

Development Consultants International Limited (DCIL) was selected by the UNIDO as consultant for preparing these project profiles after a global bidding. All the eight project profiles have been prepared in detail and will act as the basic document for further investment decisions.

# SECTION - 2
# SCOPE OF SERVICE

## SCOPE OF SERVICE

The consultant's Scope of Service included preparation of project profile for the following products :

- High Voltage and Ultra High Voltage Towers
- Bare Wires
- Overhead Line Accessories
- Steam Boilers
- Steam Condensers
- Circuit Breakers and Isolators
- Electrical Motors
- Underground Cables

The activities performed under each of the above 8 (eight) products included the following :

- Description, special characteristics, features and uses of the product
- Identification of major end-user industries
- Assessment of present capacity
- Assessment of supply and demand for the product in the designated region
- Identification of demand-supply gap and evaluation of the possibility of entering the market
- Description of basic manufacturing process
- Process flow chart

- Brief specification of plant and machinery, and their indicative prices
- Estimated requirement of raw materials, and their indicative prices
- Estimated requirement of utilities such as power, water, compressed air, fuel oil, etc.
- Estimated requirement of manpower
- Estimated requirement of space, and plant layout
- Plant location
- Project cost estimate
- Project financial analysis and financial evaluation
  - Phased capital expenditure plan
  - Costs of production
  - Computation of working capital
  - Statements of inventory, interest and depreciation
  - Tax computation
  - Projected profit and loss statement
  - Projected balance sheet
  - Projected cash flow statement
  - Break-even analysis
  - Internal rate of return
- Project implementation schedule

This study is confined to the following 13 countries -

| | |
|---|---|
| Algeria | Bahrain |
| Egypt | Iraq |
| Jordan | Kuwait |
| Libya | Morocco |
| Saudi Arabia | Sudan |
| Syria | Tunisia |
| U.A.E. | |

A separate market survey, according to the AIDMO, was not required to be carried out prior to preparing these Project Profiles, since the information and projections contained in the Sectoral Study conducted by them was indicated to be adequate for the purpose. Therefore, the Section titled 'Market Analysis' is based entirely on the Sectoral Study carried out by the AIDMO.

# SECTION - 3
# ORGANISATION OF THE REPORTS

## ORGANISATION OF THE REPORTS

The contents of all the eight Reports have been organised in a manner as to present the reader with a logical sequence of analysis and findings.

The Reports begin with an introductory Section. Salient features of the project have been summarised in the following Section. The Section presented thereafter describes the product with a view to familiarise the reader with its features, characteristics and uses. The Section titled 'Market Analysis' provides demand projections. Plant capacities and recommended locations for establishing the proposed manufacturing facilities are discussed in the next Section.

Manufacturing process is dealt with in a separate Section, titled 'Manufacturing Process'. This is followed by a Section on 'Plant and Equipment'. Estimates of raw materials and other inputs, requirement of utilities, and estimates of space and layout are presented in separate Sections respectively. These are followed by a Section on estimated requirement of manpower and the recommended organisation structure. Section-12 deals with financial analysis and evaluation of the projects. The last Section presents the implementation schedule and associated key activites for setting up the projects.

# SECTION - 4
# SUMMARY OF FINDINGS

## SUMMARY OF FINDINGS

The present study is carried out for 13 Arab countries located in the Middle East and North African region, where manufacturing facilities for the 8 products should be set up. Considering the local demand in this designated region and the economies of production scale it has been suggested that in all 17 plants be set up to manufacture these products.

Exhibit-1 shows the plant location for each of the 8 products. Distribution of these projects countrywise is presented in Exhibit-2. It may be observed from these exhibits that except Sudan, all the other 12 countries have been provided with facilities for setting up at least one plant.

Details of individual projects are summarised in the following pages.

JOB NO. : DCIL-105 EXHIBIT : 1

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**
**AND**
**ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION**

**PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES**

**PLANT LOCATIONS**

| Sl No | Products | Countries | | | | |
|---|---|---|---|---|---|---|
| 1. | HV and UHV Towers | Algeria | Egypt | Iraq | Saudi Arabia | |
| 2. | Bare Wires | Bahrain | Iraq | Kuwait | Morocco | Syria |
| 3. | Overhead Line Accessories | Jordan | Tunisia | | | |
| 4. | Steam Boilers | Egypt | | | | |
| 5. | Steam Condensers | Algeria | | | | |
| 6. | Circuit Breakers and Isolators | Morocco | UAE | | | |
| 7. | Electrical Motors | Saudi Arabia | | | | |
| 8. | Underground cables | Libya | | | | |

JOB NO. : DCIL-105 EXHIBIT : 2

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION**

**PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES**

**COUNTRYWISE DISTRIBUTION OF PLANTS**

| Sl. No. | Countries | Products | |
|---|---|---|---|
| 1. | Algeria | HV and UHV Towers | Steam Condensers |
| 2. | Bahrain | Bare Wires | |
| 3. | Egypt | HV and UHV Towers | Steam Boilers |
| 4. | Iraq | HV and UHV Towers | Bare Wires |
| 5. | Jordan | Overhead Line Accessories | |
| 6. | Kuwait | Bare Wires | |
| 7. | Libya | Underground Cables | |
| 8. | Morocco | Bare Wires | Circuit Breakers and Isolators |
| 9. | Saudi Arabia | HV and UHV Towers | Electrical Motors |
| 10. | Sudan | - | - |
| 11. | Syria | Bare Wires | |
| 12. | Tunisia | Overhead Line Accessories | |
| 13. | UAE | Circuit Breakers and Isolators | |

# HIGH VOLTAGE
# AND
# ULTRA HIGH VOLTAGE TOWERS

# HIGH VOLTAGE AND ULTRA HIGH VOLTAGE TOWERS

## Product

Transmission Towers are an integral part of the overhead electricity transmission network. They support the other major components of the network like line conductors, insulators, accessories, etc. High voltage (HV) towers are used in 60 KV to 225 KV lines, whereas lines above 300 KV have Ultra High Voltage (UHV) towers. These towers are made of steel structures and cost nearly 35-45% of the total cost of overhead transmission network system.

## Market

Demand for towers depends upon the setting up of additional power generating capacity and corresponding increase in transmission and distribution network. According to a sectoral study conducted by AIDMO, the addition in overhead transmission network will be 8,750 Km (UHV) and 51,862 km (HV) respectively during 1996-2000 period. Correspondingly the annual demand for transmission towers during this period will be 43,750 tonnes (UHV) and 2,28,193 tonnes (HV) respectively.

## Plant Location

To meet the demand for transmission towers in the Arab region, 4 manufacturing plants will be set up. The countries where these plants will be located are Algeria, Egypt, Iraq and Saudi Arabia.

**Manufacturing Process**

Manufacturing of towers consists of fabrication of structural steel members as per drawing, hot dip galvanising of the members and despatch to site for erection. Fabrication consists of operations like cutting, shearing, notching, bending, drilling, etc. Identical structures, i.e., leg members, cross arm members, etc., are bundled together before despatch to site.

**Equipment**

Out of the four plants, three will have a capacity of 36,000 TPA while the fourth plant will be of 18,000 TPA capacity. Main production equipment in these tower manufacturing plants consist of universal punching, cropping, shearing and notching machine, cold circular saw, beam bending and straightening machine, hydraulic press, galvanising tank, etc. Facilities for material handling, tool room and maintenance have also been provided. Tower testing station is an important part of the plant, adequate provision for which has also been provided.

**Raw Materials**

Major raw materials for manufacturing towers include steel angles, channels, plates, nuts and bolts for rivetting, etc. Zinc and other chemicals like Sodium Hydroxide and Ammonium Chloride are also required.

**Utilities**

The 36,000 TPA tower manufacturing plants shall have a connected load of 695 KVA to be fed by a 1,000 KVA transformer. Water will be fed from a 20 $m^3$ overhead tank with 2 numbers 190 lpm capacity pumps. The 18,000 TPA plant

shall need 410 KVA of power to be supplied from a 500 KVA transformer. Water requirement for this plant shall be met by overhead tank of 12 $m^3$ and 2 numbers 120 lpm pumps.

**Space**

The 36,000 TPA plants will be set up on an area of about 28,500 $m^2$ and the 18,000 TPA plant on 17,000 $m^2$. These include the area for tower testing station and provision for future expansion.

**Manpower**

The 36,000 TPA plant shall require 706 people including skilled and unskilled workers while the 18,000 TPA plant shall be managed by 442 person.

**Financial Parametres**

As the plants will be set up in four different countries financial parameters like project cost, operational costs, profitability, break-even point, IRR, etc., will be different. These are presented in Exhibit-3, which also summarises the salient features of the projects. The capacity utilisation for the projects are estimated to be around 80% in the first year, 90% in the second year and 100% from the third year onwards. The average selling price is taken as US $ 1,160 per MT except the Egyptian plant which is US $ 1,100 per MT.

**Implementation Period**

The 36,000 TPA plant will be set up in 30 months' time while the 18,000 TPA capacity plant shall be commissioned in 24 months.

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JOB NO. : DCIL-105 EXHIBIT : 3

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION**

**PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES**

**SALIENT FEATURES OF THE PROJECT**
**Product : High Voltage and Ultra High Voltage Towers**

| Sl. No. | Salient features | Location of the plants | | | |
|---|---|---|---|---|---|
| | | Algeria | Egypt | Iraq | Saudi Arabia |
| 1. | Plant Capacity (TPA) | 36,000 | 36,000 | 36,000 | 18,000 |
| 2. | Capacity utilisation (%) | | | | |
| | - Year 1 | 80 | 80 | 80 | 80 |
| | - Year 2 | 90 | 90 | 90 | 90 |
| | - Year 3 onwards | 100 | 100 | 100 | 100 |
| 3. | Total area requirement (sq m) | 28,500 | 28,500 | 28,500 | 17,000 |
| 4. | Manpower requirement (nos) | 706 | 706 | 706 | 442 |
| 5. | Project cost (million US $) | 23.87 | 17.76 | 20.87 | 10.06 |
| 6. | Debt equity ratio | 1:1 | 1:1 | 1:1 | 1:1 |
| | - Equity (million US $) | 11.94 | 8.88 | 10.43 | 5.03 |
| | - Loan (million US $) | 11.94 | 8.88 | 10.43 | 5.03 |
| 7. | Investment in land and building (million US $) | 13.80 | 10.03 | 12.30 | 5.50 |
| 8. | Investment in plant and equipment (million US $) | 3.03 | 3.03 | 3.03 | 1.57 |
| 9. | Implementation period (months) | 30 | 30 | 30 | 24 |
| 10. | Revenue at maximum capacity utilisation (million US $) | 41.76 | 39.60 | 41.76 | 20.88 |
| 11. | Loan repayment period (yrs) | 9 | 9 | 9 | 9 |
| 12. | Break-even point (%) | 73.25 | 28.43 | 53.88 | 60.86 |
| 13. | IRR (%) | 34.85 | 91.30 | 58.47 | 52.62 |

# BARE WIRES

# BARE WIRES

## Product

Bare Wires are used in overhead conductors for transmission and distribution of electrical energy. Bare wires may consist of a single solid wire or a group of wires stranded together. Aluminium and copper are the most commonly used materials for bare wires. Aluminium with steel reinforcement (ACSR) is the most commonly used conductor. Important electrical properties of bare wires are resistivity, current carrying capacity, inductance, capacitance and corona effect.

## Market

The demand for bare wire conductors depends upon addition in installed power generating capacity and corresponding increase in transmission and distribution network. Estimated annual demand for bare wire conductors of various voltage classes during 1996-2000 period is about 5,84,000 km or equivalent to about 2,00,000 tonnes.

## Plant Location

To meet the demand for bare wire conductors in the Arab region 5 manufacturing plants need to be set up. The plants will be set up in Morocco, Bahrain, Syria, Iraq and Kuwait. However, only the plant in Bahrain will have provision to manufacture UHV bare wire conductors.

## Manufacturing Process

Bare wires are manufactured by drawing down pre-treated larger diameter aluminium and steel rods to smaller

diameters. The drawn wires are then 'process annealed' to restore its ductility which sometimes gets reduced due to repeated drawing. Steel core wires of ACSR type conductors are given a coat of zinc by hot dip galvanising. Finally several smaller diameter bare wires are twisted to form bundled conductors.

**Equipment**

Each of the five manufacturing plants have been designed to produce an average of 16,000 tonnes per annum or 48,000 km per year of bare wires. Main plant and equipment consists of rod breakdown machine, stranding machine, pointing and threading machine and welding sets. Suitable facilities for materia handling, toolroom and maintenance and auxiliary equipment have also been provided.

**Raw Materials**

Principal raw materials to manufacture bare wires consist of EC grade aluminium/aluminium alloy rods, copper rods and galvanised steel wires.

**Utilities**

The plants shall have a connected load of about 700 KVA to be met by 2 x 500 KVA transformers. Other utilities like compressed air and water for human consumption purpose will also be supplied by suitable equipment.

**Space**

The plants will be setup on an area of about 22,000 $m^2$ inclusive of area for future expansion. Adequate space for roads have been provided to facilitate movement of heavy trucks and vehicles.

**Manpower**

All the plants will operate in double shifts. Total manpower is estimated to be 138 including 93 skilled and unskilled workers.

**Financial Parameters**

Since the five manufacturing plants will be set up in five different countries, all the financial parameters including project cost, operational costs, break-even point, IRR, etc., will vary from country to country. These are summarised in Exhibit-4, which also presents the other salient features of the projects. The selling price is assumed at US $ 7,500, US $ 3,700, US $ 8,900 and US $ 4,200 per tonne for UHV, HV, MV and LV conductors respectively.

**Implementation Period**

The projects are expected to be implemented within a period of 27 months.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES

SALIENT FEATURES OF THE PROJECT
Product : Bare Wires

| Sl. No. | Salient features | Location of the plants | | | | |
|---|---|---|---|---|---|---|
| | | Morocco | Bahrain | Kuwait | Iraq | Syria |
| 1. | Plant Capacity | | | | | |
| | - TPA | 17,600 | 15,900 | 15,600 | 15,200 | 16,900 |
| | - KM per year | 53,500 | 27,700 | 49,900 | 49,800 | 60,500 |
| 2. | Product mix | | | | | |
| | o UHV Conductors | | | | | |
| | - TPA | - | 7,500 | - | - | - |
| | - KM per year | - | 3,000 | - | - | - |
| | o HV Conductors | | | | | |
| | - TPA | 5,700 | 2,800 | 3,600 | 3,700 | 3,300 |
| | - KM per year | 3,500 | 1,700 | 2,800 | 2,300 | 2,000 |

JOB NO. : DCIL-105 **EXHIBIT : 4**

| Sl. No. | Salient features | Location of the plants | | | | |
|---|---|---|---|---|---|---|
| | | Morocco | Bahrain | Kuwait | Iraq | Syria |
| | o MV Conductor | | | | | |
| | - TPA | 3,100 | 2,100 | 3,200 | 4,100 | 2,600 |
| | - KM per year | 10,000 | 7,000 | 7,100 | 13,500 | 8,400 |
| | o LV Conductors | | | | | |
| | - TPA | 8,800 | 3,500 | 8,800 | 7,400 | 11,000 |
| | - KM per year | 40,000 | 16,000 | 40,000 | 34,000 | 50,100 |
| 3. | Capacity utilisation (%) | | | | | |
| | - Year 1 | 40 | 40 | 70 | 70 | 60 |
| | - Year 2 | 50 | 50 | 75 | 75 | 70 |
| | - Year 3 onwards | 60 | 60 | 80 | 80 | 80 |
| 4. | Total area requirement (sq m) | 21,600 | 21,600 | 21,600 | 21,600 | 21,600 |
| 5. | Manpower requirement (nos) | 138 | 138 | 138 | 138 | 138 |
| 6. | Project cost (million US $) | 10.69 | 11.45 | 11.99 | 13.40 | 10.56 |
| 7. | Debt equity ratio | 1:1 | 1:1 | 1:1 | 1:1 | 1:1 |
| | - Equity (million US $) | 5.35 | 5.73 | 5.99 | 6.70 | 5.28 |
| | - Loan (million US $) | 5.35 | 5.73 | 5.99 | 6.70 | 5.28 |
| 8. | Investment in land and building (million US $) | 6.48 | 7.14 | 7.36 | 8.78 | 6.56 |

JOB NO. : DCIL-105 EXHIBIT : 4

| Sl. No. | Salient features | Location of the plants | | | | |
|---|---|---|---|---|---|---|
| | | Morocco | Bahrain | Kuwait | Iraq | Syria |
| 9. | Investment in plant and equipment (million US $) | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 |
| 10. | Implementation period (months) | 27 | 27 | 27 | 27 | 27 |
| 11. | Revenue at maximum capacity utilisation (million US $) | 51.38 | 48.75 | 63.01 | 65.01 | 65.24 |
| 12. | Loan repayment period (yrs) | 9 | 9 | 9 | 9 | 9 |
| 13. | Break-even point (%) | 24.30 | 30.10 | 46.90 | 38.40 | 28.40 |
| 14. | IRR (%) | 73.50 | 84.50 | 61.80 | 72.50 | 93.20 |

# OVERHEAD LINE ACCESSORIES

# OVERHEAD LINE ACCESSORIES

## Product

Overhead line accessories are important components of overhead transmission and distribution system. They are used to anchor towers, join the conductors at supply take-off and mid-span points, support and reduce vibration in conductors. Different types of accessories which are used in overhead transmission and distribution network include clamps, spacers, vibration dampers, guys and anchors, insulator fittings, hardware, corona shields, etc.

## Market

Overhead accessories are used together with conductors. Thus, laying of additional transmission and distribution network will directly determine the demand for these products. According to the sectoral study carried out by AIDMO the average annual demand for conductors in the Arab region during 1996-2000 period is estimated to be around 1,30,000 km inclusive of all the voltage classes. Based on this and weight of conductors by voltage class, the annual demand for overhead accessories during this period works out to about 35,000 tonnes.

## Plant Location

In order to meet the demand two plants, each with a capacity of 12,000 TPA are proposed to be set up in this region. These plants shall be located in Tunisia and Jordan.

**Manufacturing Process**

Manufacture of overhead accessories involve different mechanical processes. Hardware like hooks, clevises, anchors, etc., are forged from mild steel or high tensile steel and then galvanised. Aluminium and aluminium alloy components like clamps, spacers, insulator fittings, etc., are made of aluminium pressure die casting. All the forged and cast components are further machined to introduce desired properties and finish to the accessories.

**Equipment**

Each of the two plants will have aluminium pressure die casting shop, forging shop, cast iron foundry, forming and fabrication shop, machine shop and galvanising shop. Facilities for material handling have been provided in individual shops. Other sections like quality control and material testing laboratory, maintenance shops and auxiliary equipment have also been provided.

**Raw Materials**

Major raw materials to manufature overhead accessories include aluminium tubes, rounds and flats, mild steel angles, plates, pipes, prealloyed aluminium ingots for pressure die casting, mild steel rounds and squares for forging, cast iron foundry raw materials like steel scraps, foundry returns, sand, etc., zinc, sulphuric acid and bath alloying elements for galvanising and miscellaneous items like steel grits for shot blasting, grinding wheel, etc.

Utilities

The connected load for both the plants will be 4,100 KVA. For this, 4 numbers 1,000 KVA step down transformers and 3

numbers 300 KVA lighting transformers have been provided. The average water requirement of 35 $m^3$/hour shall be met from two overhead tanks, each of 250 $m^3$ capacity and 2 pumps of 100 $m^3$/hour capacity each. Other utilities like compressed air, fuel oil, fire protection system, etc., shall also be adequately met.

**Space**

Each of the plants shall be set up on an area of about 57,000 $m^2$. This includes workshop buildings, administrative buildings, auxiliary buildings, effluent treatment plant, open space and area for future expansion.

**Manpower**

Each of the two plants will work in double shift. Total manpower required is estimated at 893.

**Financial Parameters**

The project cost for setting up the plant in Jordan is estimated to be around US $ 44.43 million, while the same for the plant in Tunisia is US $ 41.82 million. These plants have been assumed to operate 80% and 90% capacity utilisation during the first and second year of operation. From third year onwards, the plants will reach 100% capacity utilisation. Other financial parameters like, break-even, IRR, etc., will also vary for these two plants and are shown in Exhibit-5. The exhibit also summarises the salient features of the proposed project.

**Implementation Period**

Both the projects are scheduled to be operative within 36 months.

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JOB NO. : DCIL-105 EXHIBIT : 5

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION**

**PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES**

**SALIENT FEATURES OF THE PROJECT**
**Product : Overhead Line Accessories**

| Sl. No. | Salient features | Location of the plants Jordan | Tunisia |
|---|---|---|---|
| 1. | Plant Capacity (TPA) | 12,000 | 12,000 |
| 2. | Product mix (TPA) | | |
| | o Clamps and Yoke plates | | |
| | - aluminium | 708.00 | 708.00 |
| | - steel | 214.00 | 214.00 |
| | - ductile iron | 10.00 | 10.00 |
| | o Compression & Mid-span joints | | |
| | - aluminium | 580.00 | 580.00 |
| | - steel | 17.00 | 17.00 |
| | o Corona shields & Arcing horns | | |
| | - aluminium | 22.00 | 22.00 |
| | - steel | 2,530.00 | 2,530.00 |
| | o Spacer | | |
| | - aluminium | 70.00 | 70.00 |
| | - steel | 155.00 | 155.00 |
| | o Armour rods | | |
| | - aluminium | 730.00 | 730.00 |
| | o Vibration damper | | |
| | - cast iron | 950.00 | 950.00 |
| | o Nuts & bolts | | |
| | - steel | 180.00 | 180.00 |

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JOB NO. : DCIL-105 EXHIBIT : 5

| Sl. No. | Salient features | Location of the plants Jordan | Tunisia |
|---|---|---|---|
| | o Socket, clevis & hardware | | |
| | - aluminium | 190.00 | 190.00 |
| | - steel | 1,370.00 | 1,370.00 |
| | - ductile iron | 40.00 | 40.00 |
| | o Guy wires | | |
| | - steel | 908.00 | 908.00 |
| | o Stay rods, washers, cross arms, etc. | | |
| | - steel | 3,526.00 | 3,526.00 |
| 3. | Capacity utilisation (%) | | |
| | - Year 1 | 80 | 80 |
| | - Year 2 | 90 | 90 |
| | - Year 3 onwards | 100 | 100 |
| 4. | Total area requirement (sq m) | 57,000 | 57,000 |
| 5. | Manpower requirement (nos) | 893 | 893 |
| 6. | Project cost (million US $) | 44.43 | 41.82 |
| 7. | Debt equity ratio | 1:1 | 1:1 |
| | - Equity (million US $) | 22.21 | 20.91 |
| | - Loan (million US $) | 22.21 | 20.91 |
| 8. | Investment in land and building (million US $) | 25.00 | 24.25 |
| 9. | Investment in plant and equipment (million US $) | 8.14 | 8.14 |
| 10. | Implementation period (months) | 36 | 36 |
| 11. | Revenue at maximum capacity utilisation (million US $) | 54.48 | 47.27 |
| 12. | Loan repayment period (yrs) | 15 | 15 |
| 13. | Break-even point (%) | 72.20 | 63.00 |
| 14. | IRR (%) | 20.10 | 22.80 |

# STEAM BOILERS

# STEAM BOILERS

## Product

Steam Boilers are used in power plants to generate steam which subsequently drives the main prime mover, i.e., steam turbine. The fuel used for firing boilers are either coal, fuel oil or gas, or a combination of these. The boiler consists of cylindrical drums with hemispherical heads and is installed in power plants along with several other accessories and attachments which act in tandem.

## Market

The demand for boilers depends upon setting up new power generating stations and refurbishing of old ones. According to the sectoral study carried out by AIDMO, the increase in power generating capacity in the designated region will be about 9,300 MW by 2010. This will require setting up of power plants ranging from 30 to 600 MW capacities. The total demand for boilers in these plants will be 27 numbers during the 1996-2000 period.

## Plant Location

In order to meet the demand for boilers in the Arab region a single boiler manufacturing plant will be set up in Egypt.

## Manufacturing Process

Manufaturing process for boilers consists of two parts, i.e., customised items which are processed in the plant itself and several standardised, pre-engineered items which are procured from outside sources. Shop operations consist

of machining and fabrication of boiler quality steel plates, tube sheets, etc. Welding plays a very important role during the fabrication process. Bought out items like pumps, fuel firing equipment, instrumentation and control, etc., are either assembled in the shop or alternatively erected along with the main boiler structure at the site.

**Equipment**

The proposed plant will initially manufacture 5 numbers of 30 MW and 2 numbers of 150 MW boilers annually requiring about 8,600 tonnes of steel. The plant will have suitable equipment for tube and pipe shop, vessel shop, plate and structural shop, machine shop, forge and heat treatment shop, etc. Material testing, welding development, material handling and maintenance facilities have also been provided.

**Raw Materials**

Major raw materials required for this plant are boiler quality steel plates, tube sheets, supporting structures and manifolds. Items like fans, blowers, insulation material, valves, control system, motors, etc., will be procured from outside sources.

**Utilities**

The proposed plant will have a connected load of about 2,870 KVA. Keeping in mind the provision for future expansion 4 numbers 1,000 KVA transformers have been provided. Water will be supplied from 2 numbers 13 $m^3$ overhead tanks by means of 2 pumps, each having 14 $m^3$/hour capacity. Equipment have also been provided for compressed air supply, airconditioning, fire fighting and transportation.

Space

Total land area including that for future expansion is estimated at around 87,700 sq.m. Apart from main workshop and administrative building sufficient space has been provided for auxiliary buildings, storage and transport, etc., including raw material storage, finished goods storage, loading and unloading.

**Manpower**

The proposed plant which will operate in two shifts will provide employment for about 800 people. Nearly 80% of these will be skilled, semi-skilled and unskilled workers.

Financial Parameters

The project cost for setting up the boiler manufacturing plant is estimated to be around US $ 57.26 million. Investment in land and building is about US $ 34.7 million, while the same for plant and equipment is around US $ 10 million. The capacity utilisation of the project is assumed to be 60% in the first year, 80% in the second year and 100% from the third year onwards. Selling price for 30 MW boilers is assumed at US $ 3.6 million per unit and for 150 MW boilers is US $ 16 million per unit. The project breaks even at 69% and shows 13.6% internal rate of return.

Implementation Period

The project is expected to be implemented within a period of 33 months.

Salient features of the project are presented in Exhibit-6.

JOB NO. : DCIL-105 EXHIBIT : 6

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION**

**PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES**

**SALIENT FEATURES OF THE PROJECT**
**Product : Steam Boilers**

| Sl. No. | Salient features | Location of the plant Egypt |
|---|---|---|
| 1. | Plant Capacity (TPA) | 8,650 |
| 2. | Product mix (nos/year) | |
| | - 30 MW Boiler | 5 |
| | - 150 MW Boiler | 2 |
| 3. | Capacity utilisation (%) | |
| | - Year 1 | 60 |
| | - Year 2 | 80 |
| | - Year 3 onwards | 100 |
| 4. | Total area requirement (sq m) | 87,700 |
| 5. | Manpower requirement (nos) | 806 |
| 6. | Project cost (million US $) | 57.26 |
| 7. | Debt equity ratio | 1:1 |
| | - Equity (million US $) | 28.63 |
| | - Loan (million US $) | 28.63 |
| 8. | Investment in land and building (million US $) | 34.69 |
| 9. | Investment in plant and equipment (million US $) | 10.01 |
| 10. | Implementation period (months) | 33 |

JOB NO. : DCIL-105 EXHIBIT : 6

| Sl. No. | Salient features | Location of the plant Egypt |
|---|---|---|
| 11. | Revenue at maximum capacity utilisation (million US $) | 50 |
| 12. | Loan repayment period (yrs) | 15 |
| 13. | Break-even point (%) | 69.10 |
| 14. | IRR (%) | 13.60 |

# STEAM CONDENSER

# STEAM CONDENSER

## Product

Steam condensers are an integral part of the steam-based power generation system. They condense the exhaust steam at the low pressure end of steam turbines, which contains considerable amount of heat energy and recycle it back to the main cycle. This increases the thermal efficiency of the steam generation cycle significantly. Mixed jet condensers and surface condensers are the two main types of condensers. Surface condensers are the more preferred ones in modern power plants. It consists of shell, tubes and water boxes. Surface condensers are further classified according to position of tubes, number of passes, direction of condensate flow and shape of the shell, etc.

## Market

Steam condensers are used in association with steam boilers. Thus demand for boilers, which again depends upon setting up of additional power generating stations, will directly determine the demand for condensers. It is estimated, that the demand for condensers of various capacity power plants, i.e., from 30 MW to 600 MW shall be 27 numbers during the 1996-2000 period.

## Plant Location

To meet the requirement for condensers in the Arab region a single manufacturing plant is proposed to be set up in Algeria.

**Manufacturing Process**

Manufacturing process of surface condensers mainly involve metal working and metal forming, welding, tube bending, tube fitting and final assembly. The condenser shell is first fabricated from steel plates of varying thickness. Numerous holes are then drilled in the side plates of the shell to arrange for fixing of tubes. Tubes are produced from tube sheets and welded to the holes after necessary metal forming operations.

**Equipment**

The proposed plant is designed to produce 5 numbers each of 30 MW and 150 MW condensers respectively. The product mix can be altered/expanded later based on demand and continuous assimilation of technology. The plant is equipped with cutting and shearing machines, metal forming machines, drilling equipment and welding sets. Equipment have also been provided for material testing, material handling, welding development, toolroom and maintenance.

**Raw Materials**

Major raw materials for manufacturing condensers include steel plates for condenser shell, angles and channels, tubes and bought out component like manhole covers, piping, etc.

**Utilities**

The condenser manufacturing plant is provided with 2 numbers 1,000 KVA transformers to meet the connected load of 1,709 KVA. Two overhead tanks of 40 $m^3$ capacity each and 2 pumps of 20 $m^3$ per hour capacity will supply the water requirement. Four compressors of 3 $m^3$ per minute capacity will meet the compressed air requirement. Overhead tanks for

fuel oil and other associated equipment for air conditioning, fire fighting, etc., have also been provided.

**Space**

The condenser manufacturing plant will be set up on an area of 47,000 $m^2$ which includes open land area and provision for future expansion.

**Manpower**

The plant will operate in double shift and shall be managed by 378 people. This is inclusive of 257 skilled and unskilled workers working in two shifts.

**Financial Parameters**

The proposed project for manufacturing steam condensers is estimated to cost around US $ 43 million including an investment of US $ 30.23 million in land and building and US $ 3.63 million in major plant and machinery. The capacity utilisation of the plant is assumed to be 80% in the first year and 100% from the second year onwards. Selling prices have been assumed at US $ 1.3 million per unit for 30 MW and US $ 6 million per unit for 150 MW condensers. The project breaks even at around 85% and shows internal rate of return of 12.8%.

**Implementation Period**

The proposed project will be implemented in 27 months.

Salient features of the project are presented in Exhibit-7.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 7

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION**

**PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES**

**SALIENT FEATURES OF THE PROJECT**
**Product : Steam Condenser**

| Sl. No. | Salient features | Location of the plant Algeria |
|---|---|---|
| 1. | Plant Capacity (TPA) | 1,320 |
| 2. | Product mix (nos/year) | |
| | - 30 MW Condenser (Nos) | 5 |
| | - 150 MW Condenser (Nos) | 5 |
| 3. | Capacity utilisation (%) | |
| | - Year 1 | 80 |
| | - Year 2 | 100 |
| | - Year 3 onwards | 100 |
| 4. | Total area requirement (sq m) | 47,000 |
| 5. | Manpower requirement (nos) | 378 |
| 6. | Project cost (million US $) | 43.00 |
| 7. | Debt equity ratio | 1:1 |
| | - Equity (million US $) | 21.50 |
| | - Loan (million US $) | 21.50 |
| 8. | Investment in land and building (million US $) | 30.23 |
| 9. | Investment in plant and equipment (million US $) | 3.63 |
| 10. | Implementation period (months) | 27 |

JOB NO. : DCIL-105 EXHIBIT : 7

| Sl. No. | Salient features | Location of the plant Algeria |
|---|---|---|
| 11. | Revenue at maximum capacity utilisation (million US $) | 36.50 |
| 12. | Loan repayment period (yrs) | 15 |
| 13. | Break-even point (%) | 84.80 |
| 14. | IRR (%) | 12.80 |

DEVELOPMENT
CONSULTANTS

# CIRCUIT BREAKERS AND ISOLATORS

# CIRCUIT BREAKERS AND ISOLATORS

## Product

Circuit Breaker is a device used for making or breaking an electrical circuit under conditions of varying severity. The medium in which circuit interruption is performed may be either air, gas, oil or vacuum. Based on this Circuit Breakers are classified as Oil Circuit Breakers (OCB), Air break/air-blast Circuit Breaker (ACB) and Gas blast Circuit Breaker (SF6).

Isolators are disconnecting switches used primarily for isolating equipment from buses or line apparatus or for sectionalising buses or circuits. They are normally not intended to break load current and should be operated when the voltage across the contacts is not significant. Most commonly used isolators are Centre Rotating End Break Type (CREB) and Pantograph type.

## Market

Circuit Breakers and Isolators are important equipment used in power transmission and distribution including substations. Increase in transmission/distribution network and that of sub-station capacity will lead to increasing demand for these products. According to the sectoral study conducted by AIDMO, annual demand for Circuit Breakers and Isolators during 1996-2000 period were estimated at about 15,700 and 65,000 numbers respectively. However, as a conservative estimate it has been assumed that nearly 70% of the AIDMO projections will materialise and the demand is

likely to be about 11,000 and 45,500 numbers respectively during this period.

**Plant Location**

To meet the demand, two manufacturing plants are proposed to be set up in Algeria and the UAE. Both these will have capacity to manufacture 880 numbers of circuit breakers and 1,800 numbers of isolators annually of all voltage classes.

**Manufacturing Process**

Circuit breakers are manufactured out of several pre-engineered and bought out components. These include non-metallic components like insulators, bushings, porcelain rods, standard metallic components like ball and roller bearing, compressors, valves and electromagnetic components like relays, switches, transformers, etc. Manufacturing operations consist of metal forming and joining, machining and surface finishing, application of protective coatings, assembly of various components and testing. Manufacturing processes of isolators are similar to those of Circuit Breakers and comparatively simpler. Only the testing requirements are different.

**Equipment**

Both Circuit Breakers and Isolator manufacturing plants are equipped with Machine Shop, Fabrication Shop, Assembly Shop and facilities for galvanising, testing, toolroom and maintenance, material handling and auxiliary equipment. Machine shop comprises of Hacksaw, Lathes, Milling and Drilling machines, Fabrication shop includes Shearing machines, Bending and Folding machines, Welding sets, etc., while Assembly shop consists of Press, Soldering irons and Hand drills, etc.

**Raw Materials**

Most of the inputs for manufacturing Circuit Breakers and Isolators are pre-engineered components procured from external sources. These include contacts, arcing horn, casings, housing, valves, insulators, compressor, SF6 gas, motors, bearings, spacers, etc.

**Utilities**

Both the manufacturing plants shall need 2 numbers 500 KVA transformers to meet the connected load of 770 KVA. Water will be supplied from an overhead reservoir of 60 $m^3$ capacity by means of 3 borewell pumps, each having 200 lpm capacity. Compressors will meet the requirement of compressed air.

**Space**

The plants will be set up on an area of 33,750 $m^2$ measuring 250 m x 135 m. This includes 50% of the workshop built up area for future expansion.

**Manpower**

Each plant will work in double shift and employ 708 people. Out of these, 605 are skilled and unskilled workers.

**Financial Parameters**

Financial Parameters like project cost, operating cost, break-even, IRR, etc., for each of the two plants will vary as they are located in two different countries. These parameters are presented in Exhibit-8, which also summarises the other major features of the project. Each of these plants are assumed to operate at 80% capacity

utilisation in the first year, 90% in the second year and 100% from the third year onwards.

**Implementation Period**

The projects are proposed to be implemented in 24 months time.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 8

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION**

**PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES**

**SALIENT FEATURES OF THE PROJECT**
**Product : Circuit Breakers & Isolators**

| Sl. No. | Salient features | Location of the plants Morocco | UAE |
|---|---|---|---|
| 1. | Plant Capacity (nos/year) | | |
| | o Circuit Breakers | | |
| | - HT | 210 | 210 |
| | - MT | 670 | 670 |
| | o Isolators | | |
| | - HT | 200 | 200 |
| | - MT | 1,600 | 1,600 |
| 2. | Product mix (nos/year) | | |
| | o Circuit Breakers | | |
| | - 400 KV SF6 | 70 | 70 |
| | - 220 KV SF6 | 70 | 70 |
| | - 132 KV MOCB | 70 | 70 |
| | - 33 KV MOCB | 70 | 70 |
| | - 11 KV MOCB | 300 | 300 |
| | - 11 KV Vacuum | 300 | 300 |
| | o Isolators | | |
| | - 400 KV Pantograph | 100 | 100 |
| | - 220 KV CREB | 50 | 50 |
| | - 132 KV CREB | 50 | 50 |
| | - 33 KV CREB | 800 | 800 |
| | - 11 KV CREB | 800 | 800 |

JOB NO. : DCIL-105 EXHIBIT : 8

| Sl. No. | Salient features | Location of the plants Morocco | UAE |
|---|---|---|---|
| 3. | Capacity utilisation (%) | | |
| | - Year 1 | 80 | 80 |
| | - Year 2 | 90 | 90 |
| | - Year 3 onwards | 100 | 100 |
| 4. | Total area requirement (sq m) | 33,750 | 33,750 |
| 5. | Manpower requirement (nos) | 708 | 708 |
| 6. | Project cost (million US $) | 17.95 | 18.67 |
| 7. | Debt equity ratio | 1:1 | 1:1 |
| | - Equity (million US $) | 8.97 | 9.33 |
| | - Loan (million US $) | 8.97 | 9.33 |
| 8. | Investment in land and building (million US $) | 9.48 | 10.16 |
| 9. | Investment in plant and equipment (million US $) | 3.74 | 3.74 |
| 10. | Implementation period (months) | 24 | 24 |
| 11. | Revenue at maximum capacity utilisation (million US $) | 38.42 | 38.42 |
| 12. | Loan repayment period (yrs) | 15 | 15 |
| 13. | Break-even point (%) | 70.40 | 84.00 |
| 14. | IRR (%) | 32.20 | 17.60 |

# ELECTRICAL MOTORS

# ELECTRICAL MOTORS

## Product

Electrical motors convert electrical energy, supplied from AC or DC source, to mechanical energy to a rotating shaft. All electrical motors have a stationary member, i.e., the stator and a rotating member, i.e., the rotor. Motors are classified based on the type of eletromagnetic field into squirrel cage induction motors, slip ring induction motors, synchronous motors and DC motors. Motors consist of an enclosure, necessary insulation and air ducts covering both the stator and the rotor.

## Market

Motors of various capacities are used almost for all industrial and domestic applications. However, according to the AIDMO report motors above 2 KW capacity only have been considered which is mostly used in industries. The estimated demand for electrical motors in the designated region is about 4,000 numbers during 1996-2000 period.

## Plant Location

A single plant for manufacturing motors shall be set up in Saudi Arabia to cater to the demand. The plant will initially manufacture only about 50% of the demand, i.e., about 2,000 numbers motors annually.

## Manufacturing Process

The basic manufacturing process for electrical motors consists of casting or fabricating the main frame,

preparation of stator cores, rotor shaft and coupling assembly, winding, insulation, assembly of bearing, fabrication of air ducts for cooling, assembly of terminal boxes, brushgears, slip rings, etc., and painting.

Equipment

The motor manufacturing plant will process about 1,400 tonnes of steel castings, forgings and sections annually. The main production sections consist of fabrication shop, machine shop, motor manufacturing shop, coil winding shop, commutator shop, assembly and paint shop. Conventional, as well as automatic machines like CNC machining centres, etc., have been provided for cutting, metal forming, machining, welding, drilling, etc. Facilities have also been provided for material handling, toolroom and maintenance and testing.

Raw Materials

Major raw materials for manufacturing motors consist of steel plates, forged MS shafts, angles and channels, phenolic resin, aluminium and copper bars and auxiliary equipment like fans, heat exchangers, ducting, pipes, etc.

Utilities

The major manufacturing plant shall have a connected load of 1,300 KVA to be met from 2 numbers 1,000 KVA transformers. Water shall be supplied from an overhead tank of 25 $m^3$ capacity through 2 x 12 $m^3$ per hour capacity pumps. Two compressors of 3 $m^3$ per minute capacity each shall meet the compressed air requirement. Equipment for airconditioning, fire fighting, etc., have also been provided.

**Space**

The plant shall be set up on an area of about 15,000 $m^2$. This will house the workshop building, the administrative building and the auxiliary buildings. Sufficient areas for open space and future expansion have also been provided.

**Manpower**

The plant, operating in two shifts shall employ 313 people. Except production other departments will work in single shift. More than 80% of the people are skilled and unskilled workers.

**Financial Parameters**

The estimated cost of the project is around US $ 13.62 million. The average capacity utilisation during the first two years of opertion is assumed to be 50% and 60% respectively, while from the third year onwards it will stabilise at 70%. The project breaks even at 49% and the IRR works out to about 18%.

**Implementation Period**

The project is expected to commence commercial production within 27 months from the date of commencement.

Salient features of the project are summarised in Exhibit-9.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 9

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION**

**PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES**

**SALIENT FEATURES OF THE PROJECT**
**Product : Electrical Motors**

| Sl. No. | Salient features | Location of the plant Saudi Arabia |
|---|---|---|
| 1. | Plant Capacity (TPA) | 1,400 |
| 2. | Product mix (nos/year) | |
| | o 2.01 KW - 4.00 KW | 906 |
| | o 4.01 KW - 5.00 KW | 814 |
| | o 5.01 KW - 7.00 KW | 349 |
| | o 7.01 KW - 10.00 KW | 511 |
| | o 10.01 KW - 30.00 KW | 535 |
| | o 30.01 KW - 100.00 KW | 326 |
| | o 100.01 KW - 1000.00 KW | 535 |
| | o 1001 KW and above | 71 |
| 3. | Capacity utilisation (%) | |
| | - Year 1 | 50 |
| | - Year 2 | 60 |
| | - Year 3 onwards | 70 |
| 4. | Area requirement (sq m) | 15,000 |
| 5. | Manpower requirement (nos) | 313 |
| 6. | Project cost (million US $) | 13.62 |
| 7. | Debt equity ratio | 1:1 |
| | - Equity (million US $) | 6.81 |
| | - Loan (million US $) | 6.81 |
| 8. | Investment in land and building (million US $) | 6.96 |

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 9

| Sl. No. | Salient features | Location of the plant Saudi Arabia |
|---|---|---|
| 9. | Investment in plant and equipment (million US $) | 3.44 |
| 10. | Implementation period (months) | 27 |
| 11. | Revenue at maximum capacity utilisation (million US $) | 13.03 |
| 12. | Loan repayment period (yrs) | 9 |
| 13. | Break-even point (%) | 49.40 |
| 14. | IRR (%) | 18.20 |

# UNDERGROUND CABLES

# UNDERGROUND CABLES

## Product

Underground Cables are used for transmitting electric power in bulk from a generating station to various load centres and ultimate end-users. It replaces overhead conductors as the transmission medium particularly in urban areas due to dense population, lack of space and safety and environmental factors. Main components of cables are a bunch of conductors, insulation and protective covering. PVC and XLPE are the two most commonly used type of cables nowadays. Main properties of cables are insulation, capacitance, inductance and skin effect.

## Market

Increase in power generating capacity and subsequent increase in transmission and distribution network affect the demand for underground cables. According to the sectoral Study conducted by AIDMO the demand for underground cables during 1996-2000 period is estimated to be around 37,000 km. As a conservative estimate it is assumed that around 70% of these projection will materialise. On this basis the demand for cables in the Arab region works out to about 25,600 km inclusive of all voltage classes.

## Plant Location

A single manufacturing plant is proposed to be set up in Libya.

**Manufacturing Process**

Cable manufacturing consists of producing bare stranded conductors and subsequent lapping with insulating materials and protective coatings. Larger diameter copper and aluminium conductors are drawn to smaller sizes, annealed to remove stresses induced during the drawing process and then twisted to form stranded conductors. Insulating and protective materials like paper, PVC, XLPE, etc., are then cured, impregnated and applied progressively on the conductors. Continuous Catenary Vulcanisation (CCV), Vertical Catenary Vulcanisation (VCV) and Mitsubishi Dainichi Continuous Vulcanisation (MDCV) are the most commonly used manufacturing processes practised nowadays.

**Equipment**

The proposed plant will manufacture 600 km of single core EHV/HV cables and 4,000 km of multicore MV cables annually. The main plant consists of Rod Breakdown machines, Stranding/Armouring machine, core laying machines, Vulcanising lines, Extrusion and Sheating lines, Annealing furnace, etc. Facilities for material handling, toolroom and maintenance, testing and quality control have also been provided.

**Raw Materials**

Major raw materials for manufacturing cables include copper, aluminium, steel tapes, polyethylene and PVC compound.

**Utilities**

The cable manufacturing plant will consist of 3 numbers 1,000 KVA step down transformer to meet the connected load requirement of 2,000 KVA and for future expansion. An

overhead RCC water storage tank of 200 $m^3$ capacity and 2 booster pumps, each of 50 $m^3$/hour capacity will meet the average water requirement of 20 $m^3$/hour. Requirement of fuel oil and compressed air have also been taken care of suitably.

**Space**

The proposed plant will be set up on a 49,500 $m^2$ land area. Apart from workshop and other buildings, about 80% of the workship built up area has been provided for future expansion.

**Manpower**

The plant will operate in double shift and managed by 262 people.

**Financial Parameters**

The estimated cost for setting up the cable manufacturing plant is around US $ 37.20 million. Investment in plant and machinery is about US $ 3.3 million while the same for land and buildings is about US $ 26.7 million. The plant will operate at 70% capacity utilisation in the first year, 80% in the second year and 90% from the third year onwards. Selling price is assumed at US $ 38,000/km for HV/UHV cables and US $ 25,000/km for MV cables. The project breaks-even at 45% and the internal rate of return works out to 50.5%.

**Implementation Period**

The project is proposed to be completed in 27 months time. Salient features of the project are presented in Exhibit-10.

DEVELOPMENT CONSULTANTS

JOB NO. : DCIL-105 EXHIBIT : 10

**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION AND ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION**

**PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES**

**SALIENT FEATURES OF THE PROJECT**
**Product : Underground Cables**

| Sl. No. | Salient features | Location of the plant Libya |
|---|---|---|
| 1. | Plant Capacity (Km/year) | 4,600 |
| 2. | Product mix (Km/year) | |
| | - UHV/HV Cables (Single Core) | 600 |
| | - MV Cables (Multi Core) | 4,000 |
| 3. | Capacity utilisation (%) | |
| | - Year 1 | 70 |
| | - Year 2 | 80 |
| | - Year 3 onwards | 90 |
| 4. | Total area requirement (sq m) | 49,500 |
| 5. | Manpower requirement (nos) | 262 |
| 6. | Project cost (million US $) | 37.19 |
| 7. | Debt equity ratio | 1:1 |
| | - Equity (million US $) | 18.60 |
| | - Loan (million US $) | 18.60 |
| 8. | Investment in land and building (million US $) | 26.71 |
| 9. | Investment in plant and equipment (million US $) | 3.28 |
| 10. | Implementation period (months) | 27 |

JOB NO. : DCIL-105 EXHIBIT : 10

| Sl. No. | Salient features | Location of the plant Libya |
|---|---|---|
| 11. | Revenue at maximum capacity utilisation (million US $) | 105.96 |
| 12. | Loan repayment period (yrs) | 9 |
| 13. | Break-even point (%) | 45.00 |
| 14. | IRR (%) | 50.50 |

Summarised investment in all the seventeen projects is presented in Exhibit-11. This exhibit also shows the countrywise investment which adds up to a total of around US $ 405 million for all these thirteen countries. The projects together will generate employment for nearly 8,200 people. Countrywise and projectwise employment generation pattern is shown in Exhibit-12.

JOB NO. : DCIL-105 EXHIBIT : 11

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES

COUNTRYWISE AND PROJECTWISE INVESTMENT

(Figures in Million US $)

| Countries | Projects | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | HV & UHV Towers | Bare Wires | Overhead Line Accessories | Steam Boilers | Steam Condensers | Circuit Breakers and Isolators | Electrical Motors | Underground Cables | |
| Algeria | 23.87 | - | - | - | 43.00 | - | - | - | 66.87 |
| Bahrain | - | 11.45 | - | - | - | - | - | - | 11.45 |
| Egypt | 17.76 | - | - | 57.26 | - | - | - | - | 75.02 |
| Iraq | 20.87 | 13.40 | - | - | - | - | - | - | 34.27 |
| Jordan | - | - | 44.43 | - | - | - | - | - | 44.43 |
| Kuwait | - | 11.99 | - | - | - | - | - | - | 11.99 |
| Libya | - | - | - | - | - | - | - | 37.19 | 37.19 |
| Morocco | - | 10.69 | - | - | - | 17.95 | - | - | 28.64 |
| Saudi Arabia | 10.06 | - | - | - | - | - | 13.62 | - | 23.68 |
| Sudan | - | - | - | - | - | - | - | - | - |
| Syria | - | 10.56 | - | - | - | - | - | - | 10.56 |
| Tunisia | - | - | 41.82 | - | - | - | - | - | 41.82 |
| UAE | - | - | - | - | - | 18.67 | - | - | 18.67 |
| TOTAL | 72.56 | 58.09 | 86.25 | 57.26 | 43.00 | 36.62 | 13.62 | 37.19 | 404.59 |

JOB NO. : DCIL-105

EXHIBIT : 12

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
AND
ARAB INDUSTRIAL DEVELOPMENT AND MINING ORGANIZATION

PROJECT PROFILES FOR MANUFACTURE OF ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION EQUIPMENT IN ARAB COUNTRIES

COUNTRYWISE AND PROJECTWISE EMPLOYMENT GENERATION

| Countries | Projects | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | HV & UHV Towers | Bare Wires | Overhead Line Accessories | Steam Boilers | Steam Condensers | Circuit Breakers and Isolators | Electrical Motors | Underground Cables | |
| Algeria | 706 | - | - | - | 378 | - | - | - | 1,084 |
| Bahrain | - | 138 | - | - | - | - | - | - | 138 |
| Egypt | 706 | - | - | 806 | - | - | - | - | 1,512 |
| Iraq | 706 | 138 | - | - | - | - | - | - | 844 |
| Jordan | - | - | 893 | - | - | - | - | - | 893 |
| Kuwait | - | 138 | - | - | - | - | - | - | 138 |
| Libya | - | - | - | - | - | - | - | 262 | 262 |
| Morocco | - | 138 | - | - | - | 708 | - | - | 846 |
| Saudi Arabia | 442 | - | - | - | - | - | 313 | - | 755 |
| Syria | - | 138 | - | - | - | - | - | - | 138 |
| Tunisia | - | - | 893 | - | - | - | - | - | 893 |
| UAE | - | - | - | - | - | 708 | - | - | 708 |
| TOTAL | 2,560 | 690 | 1,786 | 806 | 378 | 1,416 | 313 | 262 | 8,211 |