6. PROFILE ON PRODUCTION OF PORCELAIN INSULATORS

TABLE OF CONTENTS

I. SUMMARY

This profile envisages the establishment of a plant for the production of porcelain insulators with a capacity of 1,400 tonnes per annum.

The present demand for the proposed product is estimated at 800 tonnes per annum. The demand is expected to reach at 2075 tonnes by the year 2017.

The plant will create employment opportunities for 67 persons.

The total investment requirement is estimated at Birr 48.39 million, out of which Birr 19.93 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 27 % and a net present value (NPV) of Birr 39.79 million discounted at 8.5%.

II. PRODUCT DESCRIPTION AND APPLICATION

Porcelain insulators are used for supplying electricity. The lines of high voltage transmission systems are usually composed of wires of copper, aluminum copper clad or aluminum-clad steel, which are suspended from tall lattice work towers of steel by strings of porcelain insulators. There are the super high tension and high tension insulators used for transmitting electricity along a transmission line from the power station to the substation. There are the high, middle, and low-tension insulators used for transmitting electricity from a substation to the consumer through Ethiopian Electricity Power Corporation (EEPCo.)

In planning to establish a porcelain insulator plant, it would be advisable to begin manufacturing of low-tension and high tension insulators which are easy to manufacture. Then by gradually acquiring the manufacturing technology, manufacturing should shift towards more complicated shape or high tension insulators.

III. MARKET STUDY AND PLANT CAPACITY

A. MARKET STUDY

1. Past Supply and Present Demand

There are a variety of electrical insulators that are demanded for power transmission, conduit tubing and various machines. These include glass, ceramic, plastic and made of other materials. The demand for porcelain/ceramic insulators in Ethiopia is mainly met through import. Import of porcelain/ ceramic in the past 10 years is provided in Table 3.1.

Table 3.1

IMPORT OF PORCELAIN/CERAMIC INSULATORS (TONNES)

Year	Quantity
1997	78.2
1998	119.7
1999	344.1
2000	53.9
2001	207.2
2002	126.8
2003	306.8
2004	52.0
2005	1,350.1
2006	252.4

***Source*:-** *Compiled from Ethiopian Customs Authority.*

The data in Table 3.1. reveals that consumption of porcelain insulators in the past years has been generally increasing although there was some fluctuations from year to year.

When the data set is analyzed by grouping in to three periods the average quantity imported during 1997-2000 was about 149 tonnes. In the three consecutive years, i.e., 2001-2003 the yearly average quantity imported increased to 214 tonnes. Similarly the yearly average quantity imported during 2004-2006 has sharply increased to 555 tonnes.

The average consumption of the recent two years (2005/2006) is assumed to fairly reflect the current effective demand. Accordingly current effective demand is estimated at 800 tonnes.

2. Projected Demand

Porcelain insulators are used mainly for transmitting electricity along transmission lines from the power stations to end users., i.e., households, factories, service sector etc. This implies that the demand for insulators grows parallel with the development and expansion of electricity in the country.

Ethiopia is considered to be among the few countries in the world endowed with huge potential for hydropower development. In order to utilize this huge resource, the Ethiopian Electricity and Power Corporation (EEPCo) has developed a generation and transmission plan up to the year 2025-. The plan is based on the nations targets for economic development in that period. In addition to the power requirement of the modern sector, rural electrification is also given high priority in the plan. Considering the above situation, demand for porcelain insulators is assumed to grow by 10% per annum. The projected demand for porcelain insulators upto year 2017 is shown in Table 3.2.

Table 3.2

PROJECTED DEMAND FOR PORCELAIN INSULATORS (TONNES)

Year	Quantity
2008	880
2009	968
2010	1,065
2011	1,171
2012	1,288
2013	1,417
2014	1,559
2015	1,715
2016	1,886
2017	2,075

A plants that can cover about 20-30% of the total demand can be envisaged in SNNPR.

3. Pricing and Distribution

A factory gate price of Birr 75,000 per tonne is assumed for sales revenue projection and financial analysis. With regard to distribution, direct sale to EEPCo is recommended since it is the major end user of the product.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

Based on the market study presented above, the envisaged porcelain insulator manufacturing plant will have a production capacity of 1,400 tonnes of insulators per year working 300 days, single shift of eight hours a day.

A further expansion of the plant after a couple of years, i.e., after achieving production and quality competence, could be considered since the demand is high.

2. Production Programme

The plant is expected to start production at 70% of its rated capacity in the first year, 85% and 100% in the second and third year of operation.

IV. MATERIALS AND INPUT

A. RAW & AUXILIARY MATERIALS

The raw and auxiliary materials for the production of porcelain insulators are ball clay, kaolin, feldspar and quartz, gypsum and additives.98% of raw materials and related inputs required by the envisaged plant are locally available in the region. The annual consumption at full capacity will be 2,200 tonnes per year.

The annual raw and auxiliary material requirement at full production capacity of the plant is presented in Table 4.1.

TABLE 4.1

RAW AND AUXILIARY MATERIALS REQUIREMENT AND COST AT FULL CAPACITY OPERATION

Sr. No.	Description	Qty. (Tonnes)	Unit cost ('000 Birr)	Total Cost ('000 Birr)		
				FC	LC	Total
1	Ball clay	586	2,611.00	-	1,530.05	1,530.05
2	Kaolin	345	900.00	-	310.50	310.50
3	Feldspar	415	740.00	-	307.10	307.10
4	Quartz	726	736.00	-	534.34	534.34
5	Fritted glaze	50	9,380.00	7,035.00	-	7,035.00
6	Matt glaze	25	11,200.00	280.00	-	280.00
7	Plaster of Paris	70	3,200.00	-	224.00	224.00
8	Zirconium	8	9,450.00	75,600.00	-	75,600.00
9	Defluculant (sodium silicate)	1.5	8.34	-	12.51	12.51
10	Defluculant (dispex)	0.5	21.17	10.59	-	10.59
	Total	**2,227**		**82,925.59**	**3,225.60**	**85,844.09**

B. UTILITIES

Electricity, water and fuel are the three basic utilities required by the porcelain insulators plant. Annual electric energy required is 950,000kWh. The annual expenditure on electricity is, therefore, Birr 449,920.00. Annual water consumption is estimated at 10,000m^3, which costs Birr 55,000 and annual kerosene and fuel oil cost is estimated at Birr 1.15 million. Thus, the total annual utilities requirement is estimated at Birr 1,699,920.

V. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Production Process

The production process of porcelain insulator making plant involves the following major manufacturing operations:

a) Body Preparation

The raw materials are roughly crushed by the jaw crusher, hammer mill and ball mill. The slip is further sieved and passed through the magnetic filter so that it is free from iron impurity as well as being uniform in particle size.

b) Shaping

Shaping is done by the casting mold method. The prepared cast slip is kept one day under gentle agitation. Next, the slip is poured into a casting mold to be de-hydrated and solidified into the shape of porcelain insulator. After the porcelain has been formed, it is subjected to a final purification process, bisque firing, before being glazed.

c) Glazing

Glazing is usually sprayed on the bodies either manually or automatically by using a glazing both. Glazing also can be done by dipping the molded ware in to a tank filled with glazing medium.

d) Firing

When glazing is completed the molded ware is ready for firing. Firing is a further heating step that can be done in kiln. A periodic kiln consists of a single, refractory-lined, sealed chamber with burner ports and flues (or electric heating elements). It can fire only one batch of ware at a time, but it is more flexible since the firing cycle can be adjusted for each product. A tunnel kiln is a refractory chamber can maintains certain temperature zones continuously, with the ware being pushed from one zone to another. Typically, the ware will enter a preheating zone and move through a central firing zone before leaving the kiln via cooling zone. This type of kiln is usually more economical and energy efficient than a periodic kiln.

e) Quality Control

The character of the raw materials is important in maintaining quality during the manufacturing process. The chemical composition, mineral phase, particle size distribution, and colloidal surface area affect the fired and unfired properties of the porcelain. With unfired body, the properties evaluated include viscosity, plasticity, shrinkage, and strength. With fired porcelain, strength, porosity, color, and thermal expansion are measured.

After the final inspection will be carried out for crack, dirt, pinhole, and others tests are conducted, the porcelains will be packed for dispatch.

2. Source of Technology

The technology for the manufacture of porcelain insulator plant can be obtained from the following companies.

a) HAJUNG
Korea Heavy Industries Construction
Changwon – shi, Keyongnam
Tel 0551-278-6114
Fax 0551-278-5551

b) OMEGA FURNACE
Industries
14, Saritwri Compound
S.M Road, Jalahalli West,
Bangalore – 56 0015, India

B. ENGINEERING

1. Machinery and Equipment

Plant machinery and equipment required for porcelain insulator plant is presented in Table 5.1. The total investment cost of plant machinery and equipment is estimated at Birr 19.9 million.

Table 5.1

MACHINERY AND EQUIPMENT AND COST OF PORCELAIN INSULATORS PLANT

Sr. No.	Description	Qty.		Cost (Birr)	
			LC	FC	Total
1	Glaze preparation				
	Ball mill	2 (3)		1,486,547.75	1,486,547.75
	Empty pipe line	Set			
	Vibrating screen	1			
	Glass fiber reinforced drums	6			
2	Body preparation				
	Ball mill	1		2,211,953.90	2,211,953.90
	Empty pipe line	Set			
	Concrete bunger	3			
	Discharge line, water dosing etc.	Set			
3	Casting				
	Dryer unit, ceiling	Set		4,169,498.97	4,169,498.97
	Casting bench	Set			
	Humidity drier	1			
4	Glazing				
	Felting table and accessories	6		1,344,488.74	1,344,488.74
	Visual inspection table & accessories	3			
5	Grinding				
	Grinding booth and tools	3		24,790.03	24,790.03
	Bisquet kiln	1		5,276,468.67	5,276,468.67
	Kiln car	10		939,014.30	939,014.30
	Truck	LS		96,473.75	96,473.75
6.	Mold preparation				
	Plaster preparation, plaster mixing, vacuum extraction	Set		818,427.40	
7	Care mold and drying unit	LS		1,425,173.70	1,425,173.70
8	Mold preparation	LS		329,950.48	329,950.48
Total			**-**	**18,122,787.69**	**18,122,787.69**
Insurance, Customs Duty, Inland Transport, Bank Charge, Etc.			1,812,278.77	-	1,812,278.77
Grand Total			**1,812,278.77**	**18,122,787.69**	**19,935,066.46**

2. Land, Building and Civil Works

The envisaged plant will require a total land area of 10,000m^2. The total land lease value for 80 years, of land holding at the rate of Birr 0.625 per m^2, is therefore Birr 500,000. The floor space required for the building and other facilities will be about 4,500m^2. The total estimated cost of building and civil works, at the rate of Birr 2,500 per m^2, is about Birr 11.25 million.

Therefore, the total cost of land, building and civil works is estimated at Birr 11.75 million.

3. Proposed Location

Based on availability of raw material Hosaena town of Lemo woreda in Hadiya zone is proposed as location for the envisaged porcelain insulator manufacturing plant.

VI. MANPOWER & TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

The porcelain insulator manufacturing plant will require manpower both for administration and production activities. The total number of manpower requirement is 67, of which 12 are administration staff and 55 are involved in production activities.

The total number of labuor cost is Birr 542,252. The detail manpower requirement and estimated annual salaries are presented in Table 6.1.

Table 6.1

MANPOWER REQUIREMENT AND ANNUAL LABOR COST

Sr. No.	Job Title	No. of Persons	Monthly Salary (Birr)	Annual Salary (Birr)
	A. Administration			
1	General Manager	1	2,500	30,000
2	Executive Secretary	1	1,000	12,000
3	Finance and Administration Head	1	1,800	21,600
4	Accountant	1	800	9,600
5	Store Man	1	600	7,200
6	Clerk	1	350	4,200
7	General Service	6	200	14,400
	Sub-Total	**12**		**99,000**
	B. Production			
8	Engineer (Production & Technique)	1	1,800	21,600
9	Supervisor	3	800	28,800
10	Quality Control Staff	3	500	18,000
11	Laboratory Staff	3	650	23,400
12	Casters	20	500	120,000
13	Skilled Workers	10	650	78,000
14	Assistant Skilled Workers	15	250	45,000
Sub Total		**55**		**334,800**
Worker's Benefit (25%)		-		108,450
Grand Total		**67**		**542,250**

B. TRAINING REQUIREMENT

Lack of trained casters or technical personnel can constitute a significant bottle-neck to project implementation and operations. Therefore, the production supervisor, kiln operations, casters and technicians need to be given two months training on production activities, repairing and maintenance activities.

The training cost is estimated to Birr 250,000.

VII. FINANCIAL ANALYSIS

The financial analysis of the porcelain insulator project is based on the data presented in the previous chapters and the following assumptions:-

Construction period	1 year
Source of finance	30 % equity
	70 % loan
Tax holidays	3 years
Bank interest	8%
Discount cash flow	8.5%
Accounts receivable	30 days
Raw material local	30days
Raw material, import	90days
Work in progress	5 days
Finished products	30 days
Cash in hand	5 days
Accounts payable	30 days

A. TOTAL INITIAL INVESTMENT COST

The total investment cost of the project including working capital is estimated at Birr 48.39 million, of which 27 per cent will be required in foreign currency.

The major breakdown of the total initial investment cost is shown in Table 7.1.

Table 7.1

INITIAL INVESTMENT COST

Sr. No.	Cost Items	Total Cost ('000 Birr)
1	Land lease value	500
2	Building and Civil Work	11,250
3	Plant Machinery and Equipment	19,935.07
4	Office Furniture and Equipment	125
5	Vehicle	250
6	Pre-production Expenditure*	2,458.11
7	Working Capital	13,869.99
	Total Investment cost	**48,388.17**
	Foreign Share	27

** N.B Pre-production expenditure includes interest during construction (Birr 2.16 million) training (Birr 250 thousand) and Birr 50 thousand costs of registration, licensing and formation of the company including legal fees, commissioning expenses, etc.*

B. PRODUCTION COST

The annual production cost at full operation capacity is estimated at Birr 93.26 million (see Table 7.2). The material and utility cost accounts for 93.87 per cent, while repair and maintenance take 0.21 per cent of the production cost.

Table 7.2

ANNUAL PRODUCTION COST AT FULL CAPACITY ('000 BIRR)

Items	Cost	%
Raw Material and Inputs	85,844.09	92.05
Utilities	1699.92	1.82
Maintenance and repair	199.35	0.21
Labour direct	216.9	0.23
Factory overheads	108.45	0.12
Administration Costs	325.35	0.35
Total Operating Costs	88,394.06	94.78
Depreciation	2678.51	2.87
Cost of Finance	2185.76	2.34
Total Production Cost	**93,258.33**	**100**

C. FINANCIAL EVALUATION

1. Profitability

According to the projected income statement, the project will start generating profit in the first year of operation. Important ratios such as profit to total sales, net profit to equity (Return on equity) and net profit plus interest on total investment (return on total investment) show an increasing trend during the life-time of the project.

The income statement and the other indicators of profitability show that the project is viable.

2. Break-even Analysis

The break-even point of the project including cost of finance when it starts to operate at full capacity (year 3) is estimated by using income statement projection.

$$BE = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 30\ \%$$

3. Pay Back Period

The investment cost and income statement projection are used to project the pay-back period. The project's initial investment will be fully recovered within 4 years.

4. Internal Rate of Return and Net Present Value

Based on the cash flow statement, the calculated IRR of the project is 27 % and the net present value at 8.5% discount rate is Birr 39.79 million.

D. ECONOMIC BENEFITS

The project can create employment for 67 persons. In addition to supply of the domestic needs, the project will generate Birr 27.12 million in terms of tax revenue.