CHAPTER 0

EXECUTIVE SUMMARY

0.1 INDUSTRY OVERVIEW

Although pottery and ceramic industry is of prehistoric origin in India, the HT Insulator industry has a recent origin. The first unit was set up in the fifties at Bangalore. Some units were set up in the sixties but the main expansion of the industry took place in the seventies. The HT Insulators are used in electrical transmission lines, substations and electrical equipment. Different types of insulators are used for each application.

There has been upgradation of transmission voltage and plans are afoot to instal 765 KV AC transmission lines. The industry would need to develop and produce HT Insulators of higher ratings for transmission lines, substations and equipment.

There are 14 units manufacturing electroporcelain high tension insulators. Two of these units are in small scale sector. These have installed capacity of 85,050 tonne per annum. One small scale and one organised sector unit have stopped production of insulators. The capacity of these two units are 5000 tonne per annum.

The demand and average production of the HT Insulators during the last nine years have been around 31,000 tonne per annum.

More than 60% of the installed capacity is lying idle with the industry due to lack of domestic demand. With the implementation of the approved projects, the unutilised capacity would increase from 60,000 tonne to 1,00,000 tonne approximately. Since the domestic demand is not likely to increase proportionately at least for the next five years, the only possible way for improving the efficiency of the industry is to enter the world export market.

0.2 TECHNOLOGY OVERVIEW

All the units in the organised sector have been set up with foreign technology through foreign collaborations. The collaborations were entered into initially to set up the projects and number of units subsequently had entered into supplementary collaborations to upgrade and enhance the product range. Each unit in the industry has been acting as a sealed compartment and centre of an exclusive secret technology. There has been very little exchange of technological information amongst the units of the industry. The industry has done well to adapt the foreign technology. Over the past decade, it has produced major equipment and testing equipment on their own. Porcelain Insulator Industry in India has substantially matured and even is in a position to pass on technology to any third country who may want to set up such a plant in association with them.

0.3 CONTEMPORARY TECHNOLOGIES

Electroporcelain and toughened glass are the two types of insulators that are being used for high tension transmission lines and equipment throughout the world. The world market comprises of the power projects being set up mainly in the under developed and developing countries using electroporcelain and toughened glass insulators. In India also toughened glass insulators are being used in transmission lines. A comparative statement of some characteristics of porcelain and toughened glass insulators is given in Table-1. However, it may be noted that this comparison is not exhaustive, as complete data on properties and performance of glass insulators is not available due to its limited use so far.

Toughened glass insulator technology acquisition and adaptation has not received sufficient attention so far in the country. The only unit which has been given the licence for manufacture of toughened glass insulators has set up an assembly line. Production of glass shell which indeed is the real technology is yet to start. Generally glass tends to deteriorate in outdoor applications as it is not crystalline. It is amorphous and also in a metastable state. Also surface damage in glass insulators leads to shattering, while porcelain insulators can withstand reasonable degree of surface damage. Performance of glass is yet to be proved in EHV system trial in tropical countries. Long rod porcelain insulators have been developed and are being used along with Disc Insulator strings.

TABLE -1

COMPARISON OF ELECTRO PORCELAIN AND TOUGHENED GLASS INSULATORS

SL. NO.	CHARACTERISTIC	PORCELAIN INSULATOR	TOUGHENED GLASS INSULATOR
1	2	3	4
1.	Dielectric Rigidity at 25 Deg.C. and 50 HZ.	160 KV/cm	250 KV/cm
2.	Modulus of Elasticity	10700 daN/Sq.mm	7200 daN/Sq.mm
3.	Tensile Strength	4 daN/Sq.mm	12 daN/Sq.mm
4.	Coefficient of Thermal Expansion	7.5×10^{-6}	9.1×10^{-6}
5.	Effect of cyclic temperature changes	Hoop stresses generated with change in the temp. Insulator's mechanical strength reduces due to the difference in coefficient of thermal expansion for porcelain and steel parts. Co-efficient of Thermal expansion - Cement 10×10^{-6} malleable fittings 11.5×10^{-6}	Insulators strength is appreciably affected
6.	Electrical Puncturing strength	Low	High (Absolute value of Dielectric strength cannot be measured due to

1	2	3	4
			discharge in the air before reaching the voltage level to cause the puncture).
7.	Electromechanical failure	Gradual which could be due to electro-mechanical fatigue	Sudden scattering caused by impacts exceeding the explosive stresses in the skin of insulators.
8.	Weights of 90 KN disc insulator	6.2 Kg	4.0 Kg 35.4% lower than porcelain.
9.	Flaw detection	Not easy. Damaged piece may remain in service over long long periods increasing losses.	Disc shatters and can be sighted easily from a distance.
10.	Fire Hazard	Opaque, does not focus sunrays & hence no fire hazard.	Likely to focus sunrays. Fire may be caused if concentrated on dry Grass.
11.	Stresses in the Insulator body	No stresses in the body of the Insulator.	There is dynamic equilibrium of stress in the body of Insulator. Due to toughening, the skin of Insulator is in compression and interior is in tension.
12.	Product Range	Covers the complete range for transmission and apparatus application.	Covers only transmission and substation insulators due to mass production technique used and consequent limitations in producing small quantities.

0.4 MANUFACTURING INFRASTRUCTURE

Latest equipment such as microprocessor controlled firing kiln, photoscanning lathes, automatic grinding and airing machines and others available internationally for the manufacture of HT Insulators have been installed selectively by the industry to meet the product quality requirement. Computerised controlled tunnel and shuttle kiln are being used by a number of units. For firing of insulators, earlier consumption of furnace oil was around 440 ltrs per tonne of insulators. This has been reduced to around 230 ltrs per tonne resulting in almost 50% savings in energy requirements (Ref. Actual assesssment of data at Jayashree Insulators).

0.5 MAJOR CAPITAL EQUIPMENT

Major capital equipment like photoscanning microprocessor controlled lathes/forming machines, automatic insulator grinding and cutting machines, kiln designs, microprocessor controls and critical kiln equipment etc. are not available from indigenous sources. Requirements of these equipment is being met through imports. There is scope for acquisition of the latest technology for manufacture of major capital equipment indigenously to meet the long range demand of the industry.

0.6 NATIONAL TEST FACILITIES

National Test House, Calcutta has set up facilities for testing insulators upto 200 KV. CPRI, Bangalore is equipped to carry out acceptance tests up to 400 KV. Steep wave front test facilities which were not available earlier have recently been added. Also in 1989-90, BHEL developed facilities for steep wave front test.

It is understood that a mini High Voltage Laboratory is being constructed by CPRI. This will be equipped with test set rated for 100 KV AC, 420 KV DC, 420 KV lightning impulse and 420 KV switching impulse.

There is a need to create adequate testing facilities for steep front performance, accelarated ageing behaviour, power arc behaviour, behaviour under various pollution conditions. For HVDC applications a number of tests (Ionic Accumulation Test. Thermal

Runaway Test and other) are required for which national testing facilities need to be developed.

0.7 TECHNOLOGY GAPS

Porcelain Insulator technology and Infrastructure has been sufficiently developed to meet present and immediate future requirements. The toughened glass insulator production technology has just been brought into the country. However, the present stage is only of assembling imported glass shells. Technology transfer arrangements for manufacture of toughened glass insulators should not only be hastened but should also take care of future R & D programmes.

0.7.1 Raw Materials

Alpha Alumina required for high strength porcelain insulator is being imported. The quality of indigenously produced Alumina is not of the required standard. Rapid hardening high strength cement required for assembly of metal components is also being imported. The indigenously available cement is not of the consistent quality and reliability. Some Indian manufacturers are using indigenous cement with special curing techniques which gives excellent mechanical strength. The quality of raw material inputs available in the country has a direct bearing on the quality of the product and therefore crucial for achieving the export thrust.

0.7.2 Metallic Components

Generally these are over designed to ensure strength and reliability during service. Weight of the caps available in India is higher by 30 to 40% as compared to those from countries like U.K., France, Japan, and others. The Equality of forged ball pins is not satisfactory. The concentricity of ball and stem is difficult to be achieved within the specified limits and results in high rejections. There is a need for better quality control. This is particularly important if additional thrust for exports is to be made.

0.7.3 Research and Development

The industry is depending on foreign resources to update its technology and products. Own efforts and long range planning to achieve technological self sufficiency are limited. As per the feedback available, there has been only one exception of this trend recently. It is understood that Seshasayee Insulators in close liaison with Indian Institute of Science have directed their efforts to develop insulators for the proposed 765 KV lines. It is claimed by the company that the products would meet the specifications as and when finalised by CEA. Some of the areas requiring improvements and towards which R & D efforts could be directed are given below.

- High strength electroporcelain bodies for 400KV and higher voltages that could be fired at lower temperatures (below 1300 degree C.)

- Development of high strength quick setting cement for the insulator and metallic components to substitute current imports.

- High strength but lighter malleable casting of optimum design.

- H V D C Insulators

- Techniques and equipment for detection of faults, repair and replacement of Insulators on high voltage line-Improvement of the insulator design on ongoing basis involving different types of adverse environments based on collection of field data and its analysis.

0.7.4 Manufacturing and Testing Equipment:

Major manufacturing and testing equipment required for the industry are not available indigenously. The requirement is being met through imports. Steps to indigenise the major items of Plant and Machinery used for manufacture of electro porcelain insulators need to be taken up to achieve self sufficiency in the field. Special purpose modern equipment required for the manufacture of H.T. Insulators like pug mills, thyrister controlled filter presses for controlling moisture, insulators forming and making equipment including kiln are being imported.

0.7.5 **National Testing Facilities:**

The status of ceramic analysis and insulator testing facilities need to be improved to achieve international acceptance. CPRI is in the process of establishing HVDC tests facilities as per feed-back available from industry. Engineers from KEMA and CESI Laboratories have visited CPRI Laboratories and are satisfied with the facilities available. BIS is also taking steps for obtaining recognition of Indian manufacturing units and test houses in certain areas for export/import purposes. In due course, this recognition may also be extended to insulator industry.

0.8 RECOMMENDATIONS

i) Expansion of Industry

In view of the excess capacity further expansion of electro-porcelain insulator capacity should not be encouraged. Stress for developing the glass insulator technology is essential to achieve worthwhile export of insulators. As regards porcelain insulators which have 60% to 70% share in the international market and the technology for which is in the advanced stage in the country should further be promoted by way of pooling the resources for producing excellent quality of insulators, giving relief to offset increased cost of fuel, energy and other input.

ii) Foreign Collaboration

The industry and national research institutions have the capability to upgrade the technology with their own R&D. Easy availability of foreign collaborations for technology upgradation has become an impediment in the way of technological self reliance. Current trend of depending on foreign sources needs to be discouraged. On the other hand, the industry which has acquired a sufficiently good base should be encouraged to initiate its own R&D projects to achieve technological self sufficiency.

iii) Research and Development

The linkage between the R & D institutions and the industry should be strengthened so that the work carried out in the institutions is industry oriented. The industry should make good use of the expertise and facilities available with the institutions by jointly or individually sponsoring research projects.

In line with the recommendations of the Insulator Sub Committee Report, 1986-88, a specialised centre may be created in a suitable national institute for undertaking research on various aspects of Insulators designs and raw materials used. This institute must take up R&D projects sponsored by the industry on a time targeted basis. The proposed R&D facility and industry need to work in close liaison with each other. The progress on the research projects must be reviewed at least twice a year, by a committee of experts from the industry, senior scientists of the institutes and DSIR to ensure efficient planned function as a commercial organisation and make available to the industry its achievements on reasonable terms for commercial exploitation. Details and terms of mutual participation of industry and the institute could be worked out jointly.

iv) Special Purpose Production Equipment

An assessment of the demand during the next five years for special purpose production equipment such as pugmills, controlled moisture filter presses, shaping machines, glazing machines, grinding and cutting machines for solid core insulators and equipment bushing should be made. If there is sufficient demand, the technology acquisition and their manufacture should be encouraged. Existing units producing similar equipment may be encouraged to diversify and upgrade the technology. Alternately a new project could be started wherein the latest equipment needed for HT Insulator and other allied industries could be manufactured.

v) Kiln

Special types of kiln are required for firing of wares in the ceramic industry. So far this technology has not been developed in the country, although experienced personnel in erection and commissioning are available in the country, who have installed a number of kiln based on imported designs. An appropriate technology tie up with one of the leading specialists in kiln technology could be done to expedite its indigenisation.

vi) Testing Facilities

The testing facilities under one roof are available with CPRI, Bangalore, but are inadequate to meet the requirements of the industry. It is understood that CPRI has taken steps to enhance their facilities. Also test facilities at the national level need to be established to undertake specific tests (Ionic Accumulation test, Thermal Runaway tests, and other,) for HVDC applications.

vii) Fuel for kiln Firing

In order to improve the quality and appearance of the fired insulators the international trend is to use natural gas as the firing medium. Since the availability of the gas has improved, the HT insulator industry should be given preference for its allocation.

viii) Exports

Export of HT insulators is the only solution to effectively utilise the excess installed capacity in the industry, which would increase further because of the approvals already given. In order to enable the industry to have the requisite competitive edge over the international competitors, a number of measures would need to be taken up on priority. These are discussed in the subsequent paragraphs.

ix) Export-Competitiveness

China and Korea are exporting insulators at 50% to 60% of the export prices offered by Indian Manufacturers to establish themselves in the international export markets. Special subsidy based on the study and evaluation of bidding pattern of China and Korea in the international tenders, should be given to the industry at least for about 5 years to counter the export tactics of these countries. It has been observed even in the case of other items that these countries use such strategy to make an entry in the export market and subsequently raise their prices to make the exports commercially viable.

x) Export of Toughened Glass Insulators

Russia and other East European countries are the traditional major users of glass insulators. This is a major market segment which needs to be tapped. In view of the growing trade between India and Russia the export potential for toughened glass insulators should be exploited. These should be encouraged to be produced in India with the latest technology. Such a measure would enable the establishment of toughened glass insulator industry to enter the global insulator exports market for which India does not have the capability so far.

xi) Priority for Allocation of Natural Gas

The industry may be given priority in allocation of natural gas for firing of the insulators to improve the quality and finish in line with the trend elsewhere in the advanced countries.

xii) Quality of Raw Materials

The ultimate quality of the product is determined by the quality of the raw material inputs available. This has a direct bearing on our ability to achieve the thrust toward exports. Since the sources of raw materials used by the various manufacturers are common, a thrust is required for documentation of the raw material specifications and proper gradation of the raw materials to ensure the consistency of quality.

xiii) Technology Export

The electro-porcelain insulator industry in India is fairly matured and has acquired the capability and know-how to manufacture HT insulators at par with those manufactured in advance countries. Due to limited domestic market, the Indian companies should pursue the possibility of technology export to developing countries which form a growing market .