EXECUTIVE SUMMARY

0.1 INTRODUCTION

O.1.1 **Underground Telephone Cables:** The sheath of a telephone cable buried underground sometimes gets damaged, e.g., during digging by another agency. Water enters the cable core radially at the point where the sheath is damaged. If the conductors are paper-insulated the water seeps through the paper and comes in contact with the conductor leading to circuit failure.

Even when the conductors are plastic-insulated, the water travels longitudinally inside the cable core and comes in contact with the conductor at some point where there is a pinhole in the insulation. This causes circuit failure at a point far away from the point where the sheath damage occured.

0.1.2 **Jelly Filled Cable:** Various methods were tried to block the longitudinal flow of water inside the cable. The latest method is to fill the entire air space inside the cable by a soft, inert, water repellant material, leaving no space for the water to go. Petroleum jelly, gelled mineral oil, or modified polybutene is used as the filling compound.

0.1.3 **The Manufacturing Process:** Continuous Cast Copper Rods of about 8 mm dia are first reduced to a diameter of 2 to 3 mm and stored. These are then drawn into wire of requisite dia for the conductor (ranging between 0.4 mm and 0.9 mm), annealed, and insulated with polythene, all in one tandem line which is also equipped with computerised automatic controls to ensure product quality. The insulated conductors are then twisted into pairs. The pairs are stranded into Units. The Units are then twisted together to form the cable core. The core is filled with jelly and sealed with a core wrap of plastic tape. A laminate of aluminium foil coated with polythene on both sides is then wound over the core wrap with a specified minimum overlap. When a sheath of black polythene is extruded over the cable, the poly-al laminate beneath gets bounded to the PE sheath. When required, an armour of two layers of galvanised steel tape is wound over the sheath, and a tight fitting polythene jacket extruded over the armour, the space between the armour and the jacket being flooded with a water resistant compound.

0.1.4 **Major Capital Equipment:** The major machines required are Rod Breakdown, Tandem Wire Drawing and Extrusion lines, Twinning and Stranding machines, Drum Twisters, Jelly-filling tanks, Sheath and Jacket Extrusion lines and Armouring machines. Typical specifications of the Tandem Wire Drawing and Insulating line are given in Annexure 3. The testing equipment recommended by DOT is indicated in Annexure 4.

0.1.5 **Major Raw Materials:** The major items to be bought out are Copper rods, Polythene for conductor insulation, Polythene for sheath, Filling Compound (Jelly), Poly-Al laminate strips, Galvanised steel tape, Wooden drums, and other miscellaneous items like polyster tape for core wrap, binders, water proof tape for bedding under the armour, end sealing caps, etc.

0.2 STRUCTURE OF THE INDIAN INDUSTRY

0.2.1 **History:** Manufacture of telephone cables was reserved for public sector till 1983, the Government policy was liberalized and a number of firms in the private sector and the joint sector were given licenses for the manufacture of Jelly Filled Telephone Cables together with approvals for foreign collaboration, there after.

0.2.2 **Licensed Capacity:** M/s Hindustan Cables Ltd. has a licensed capacity of 76 Lakh Conductor Kilometers (LCKM). Twelve other units together have licences totalling 89 LCKM. The Government has increased the Minimum Economic size of a unit to 12 LCKM. Enhancement of lincensed capacity has been sought by eight units and when they are granted, the licensed capacity will go up by 39 LCKM, taking the total licensed capacity to 204 LCKM.

0.2.3 **Distribution of Licensed Capacity:** Three units in the public sector account for 81 LCKM of the licensed capacity. Five units in the private sector account for 27 LCKM and eight units in the joint sector for 57 LCKM. The unit locations are distributed over 13 States of India.

0.2.4 **Installed Capacity:** The total installed capacity in ten new companies which have gone into production by 1990 is 77.75 LCKM. This is in addition to the installed capacity in Hindustan Cables Ltd.

0.2.5 **Investments:** The total investment in the units other than Hindustan Cables Ltd is about Rs. 234 crores. The project cost per LCKM ranged between Rs. 1.32 crores and Rs. 4.61 crores.

0.2.6 **Market Demand:** The major customer is the DOT. Their likely demand during the period 1990 to 1995 was estimated at 700 LCKM. The offtake in the year 1990-91 was lower than what was projected earlier. The actual demand from DOT will depend upon the resources made available to the DOT in the eighth plan when finalized. The non-DOT demand is estimated at 15% of the DOT demand.

0.2.7 **Capacity utilization:** The few units that had obtained quality approval from DOT early were able to get the orders. Their capacity utilization had reached nearly 90%. As more and more units are securing the approval, the capacity utilization on an average may drop to about 60%. Capacities are still being expanded. When the total reaches 200 LCKM, an average of 80% utilization may be expected provided the DOT's projected purchases materialise.

0.2.8 **Foreign Collaborations:** HCL had a collaboration with M/s Standard Telephones and Cables of England. The new licensees have entered into collaboration with 7 other companies from 5 countries. The terms of all agreements are similar. The new collaborations are all reported to have been successful.

0.2.9 **Small Scale Sector:** It seems unlikely that manufacture of the jelly filled cables can be undertaken in the small scale sector except perhaps, for very small size cables.

0.2.10 **Ancillary Industry:** Manufacture of Jelly Filled Telephone Cables is not an Assembly type of Industry. There are no piece parts or subassemblies that can be farmed out of ancillary units. Cable Jointing material is an important accessory which the cable user needs and provides scope for auxillary industry.

0.2.11 **Production Units:** Four units were visited during this study, when they were setting up production. Data provided by them at that time, updated to the extent possible, are presented together with data on five other companies collected from business journals.

0.3 INTERNATIONAL DEVELOPMENTS

0.3.1 **Variety of Types of Cables:** A wide variety of telecommunication cables forms the back bone of today's world wide telecommunication net-work which makes possible the ushering in of the Information Society.

Advances in Telecommunication Network Technology have led progressively to the development of newer types of cable over the years. The operating life of a telecom cable is of the order of 30 to 40 years. As a result many different cable types are still in use all over the world.

0.3.2 **Evolution of Cable Technology:** Cable factories the world over were modernized during the 1970's. Tandem operation of sequential processes, use of computers for process control, and use of robots for handling and storage between processes, led to substantial improvements in product quality as well as production efficiency.

0.3.3 **Cable Practices In Some Other Countries:** In the Netherlands the aqua-block technique is still used extensively for longitudinal water blocking, instead of jelly filling. In Sweden jelly filled aerial cables were introduced for PCM junctions in the rural network.

0.3.4 **Current Trends:** PVC Cables are fire retardant but do produce a lot of smoke in the event of fire. New halogen free materials which retard fire without producing smoke in the event of a fire are being developed.

Insulation materials using high performance polymers are being used for cables which need to perform under harsh conditions like high temperatures. As regards conductor material, 6 out of 13 questions being studied by CCITT Study Group VI, relate to copper conductor cables while the other 7 refer to optical fibre cables. This is indicative of the continuing interest in copper cables even after the advent of optical fibre.

0.3.5 **Optical Fibre Cable:** Optical fibre cable with its large bandwidth is being increasingly used in the trunk-and the junction - network. Experiments to study the potential demand for delivery of more sophisticated services to sub-scriber like Broadband ISDN, Cable TV, etc by using optical fibre cable instead of copper cable for the connection from the telephone exchange to the sub-scriber premises, are being conducted in advanced countries like the USA, Japan, UK etc., where the provision of telephone service has reached a saturation point.

0.3.6 **The Indian Scene:** The telephone density in India is now about 4.5 per thousand population, as compared to over 800 per thousand in advanced

countries. The demand for sophisticated services other than plain ordinary telephone service may not arise fast enough in India to justify large scale use of optical fibre in the subscriber loop connection in the next decade or so.

The introduction of Remote Line Units has the effect of reducing the length of the subscriber loop, particularly in the urban areas. This may lead to a reduction in the requirement of large size cables.

0.3.7 **PIJF Cable Specifications:** The Indian specification are more rigid than others in two respects.

The Oxidation Induction Test is specified in India as a measure of the expected life of the material used for conductor insulation under working conditions.

The water penetration test aims to assess the effectiveness of longitudinal water blocking. The period of 14 days specified by DOT is longer than what is specified by some other administrations. The Indian specification was based on the experience with cables made in India earlier. As confidence level in the quality assurance procedures adopted by the manufacturer goes up, the period of 14 days may be reduced.

0.4 TECHNOLOGY STATUS OF THE INDUSTRY

0.4.1 **Sucess of Liberalised Policy:** After the liberalisation of Government policy, a number of new manufacturing units are now producing cables of acceptable quality. They are also steadily expanding the range of sizes of cable produced.

0.4.2 **Range of Sizes:** Ten units have now obtained Quality Approval from DOT for sizes ranging from 10 pairs to 2400 pairs and conductor size varying from 0.4 mm to 0.9 mm.

0.4.3 **New Types of Cable:** Use of cellular polythene, also called foam polythene, for the conductor insulation help in obtaining the same inter wire capacitance as can be obtained by using a thicker insulation of solid polythene. A thin 'Skin' layer over the cellular insulation offers more advantages. Samples of Foam Skin insulated jelly filled cables have been successfully produced by the Indian manufactureres.

Cables suited for transmiting Pulse Code Mod ted Digital Signals need to

incorporate a special screen between the pairs carrying signals of the 'go' and 'return' directions. Some of the units have developed samples of PCM cables also. A polythene insulated, self supporting aerial cable mainly intended for use as telephone distribution cable is being developed.

0.4.4 **Indigenous Capital Goods**: A number of machines like Rod Breakdown Machines, High Speed Twisting Machines, Drum Twisters, Armouring Machines, and Rewinding machines, used in the manufacture of jelly filled cable, are now produced in India. Some of the machines are yet to prove their reliability in the field.

0.5 TECHNOLOGY ABSORPTION AND GAPS

0.5.1 The technology for the manufacture of the cables has been well absorbed. The gaps appear to be in the area of raw materials. The cost of raw materials forms nearly 60% of the cost of production of the cable.

0.5.2 HDPE and MDPE are used for conductor insulation while LDPE is invariably used for the sheathing. Pigments are added at the extrusion stage. Anti-Oxidants are added to enhance the life of the insulating material in conjunction with the pigment material and the filling compound.

Indigenous sources for these materials are coming up. About half the requirements are still imported. The base resin for the black LDPE is available indigenously. The filling compound may be petroleum jelly, gelled mineral oil, or polybutene. Some indigenous sources of supply have come up but the adequacy in terms of quality as well as quantity is yet to be stabilized.

Poly-Al strips are now available from indigenous sources. The technology for the production of aluminium foils is to be perfected. Galvanised Steel Tape for armouring is readily available.

Continuous cast copper rods are prefered to hot rolled rods. M/s Hindustan Copper Ltd have set up a plant at Taloja in Maharastra with a capacity of 60,000 tonnes per annum. Some more units have been licensed. Wooden Cable drums have been used traditionally. Steel Drums of rigid as well as the collapsible variety have been developed by Hindustan Cables Ltd.

With paper insulated conductors twist joints were common. With polythene

insulated conductors, insulation displacement type connectors have come into vogue where the conductor joint is also protected against moisture. Modular connectors in strips of 25 (or 20) pairs of conductor joints have been introduced. Thermoshrink wrap around sleeves are used as splice enclosures for splices on polythene sheathed cables. Indigenous manufacture has been commenced.

0.5.3 **Research and Development** : Telecom Research Centre of the Department of Telecommunications, M/s. Hindustan Cables Ltd, Central Power Research Institue, M/s. Indian Petrochemical Corporation, and the Defence Metallurgical Research Laboratory, are the major organizations doing R&D work in this area. Some of the other manufacturers like Vindhya Telelinks, Finolex, Karnataka Telecables and Sterlite are also doing some development work.

The Central Power Research Institute provides facilities for testing the raw materials. They are also engaged in the development of indigenous technology for some of the items like anti-oxidants.

0.6 CONCLUSIONS AND RECOMMENDATIONS

0.6.1 **Conclusions:** The collaborations entered into for the manufacture of jelly filled cables have generally been successful. The position regarding supplies of such cables is now very satisfactory from the users' point of view.

The domestic demand for jelly filled cables is linked to the resources allocated to the DOT.

Quality wise there appears to be no difficulty for export. The cost of inputs being high, global competitiveness of prices is another matter.

The scope for small scale sector is very limited. There is hardly any scope for development of ancillary units as in the case of an assembly industry.

The manufacture of Jelly Filled Telephone Cables is raw material intensive. Indigenous development of the raw material technologies is therefore important.

0.6.2 **Recommendations**

(i) The major raw material for conductor insulation used is Medium

Density Polyethylene. The indigenous development of the material is necessary for updating the technology. M/s IPCL Baroda, the producers of PE can be identified for such development.

The other materials like filling compound, poly Al laminate strips and moisture barriers are also required to be fully indigensied to the required specifications.

(ii) PE gets degraded during processing polymerisation and use. This results in change of molecular weight, discolouration, change in viscosity, loss of physical properties and there is loss of clarity of speech etc. In order to retard the degradation, antioxidants are added in low concentration to PE. The foreign suppliers do not disclose the type of antioxidant used by them for commercial reasons. Development of antioxidants indigenously is necessary. CPRI has carried out some studies by using polymeric antioxidants such as O-cresol Novolac and Amino Novolac. The results obtained for PE are encouraging. Further R & D efforts to optimise the type and level of anti-oxidants for oxidation induction time studies should be encouraged.

(iii) Techniques for short term and long term performance of different cable components may be developed to ensure reliable performance of jelly filled cables.

(iv) Several types of moisture barriers are being used. Performance evaluation of moisture barriers, is required to ensure their adequacy.

(v) Studies to ascertain, compatibility of cable filling compounds with the materials used for conductor insulation needs to be undertaken with emphasis on permitivity.

(vi) Carbon black is added to the LDPE of the sheath/jacket to protect it from the ultraviolet rays of the sun. One of the questions under study by the study Group VI of the CCITT relates to the addition of carbon to polythene in order to improve its conductivity. This helps to earth the sheath continually, greatly reducing the problems of a lightning strike. These aspects of carbon black addition needs to be studied.

(vii) PE supports flame. PVC is fire retardant, but smoke and corrosive

gases are released during a fire which are injurious to human beings as well as to equipment. There is a worldwide interest in finding a material which is halogen-free and also fire retardant. M/s Hindustan Cables Limited is also working on development of such cable. Such cables find application on board ships, in high-rise buildings occupied by a large number of people and in underground railways.

(viii) In some areas in India, polythene sheathed cables have been attacked by rodents. The remedy adopted is to burry the cables to a depth of 2 meters below the ground level. Sometimes this depth is not maintained and cables get damaged. The possibility of using some additivies to the sheath PE to discourage rodents may be explored.

(ix) The reliability of a cable system depends not only on the cable itself but also on the accessories used in the field. A failure of one of the accessories may lead to a system failure. A system failure is often refered to as cable failure giving a wrong impression. Though it is not obligatory on the part of, cable manufacturers they may like to recommend/supply or even develop, such accessories with their cables, so that scope is reduced for their image being unjustly sullied.

(x) The main lead agencies that could be involved in the effort towards development of the raw materials technology are:

Telecom Research Centre, DOT.
M/s. Hindustan Cables Ltd.
M/s. Hindustan Copper Ltd.
M/s. Indian Petrochemical Corporation Ltd.
Central Power Research Institute.
Defence Metallurgical Research Laboratory.

It would be adviseable to constitute a coordinating body with representatives of these institutions as well representation from Telecom Cable Manufacturers Association, to facilitate coordinated development as well as periodic review and feedback.