

MP-R
CEN-R

हर मशीन का परीक्षण

stop



'S

6701

~~4001~~

DANGEROUS TRUCK WITH SIEMENS

by P. RAMAMURTI

An investigative analysis of the process of mortgaging a core public sector undertaking to a West German multinational and its impact on other industries.

MP-R
CEN-R
6701

Publication

in select

STOP BHEL's DANGEROUS TRUCK WITH SIEMENS

— An Investigative Analysis

P. RAMAMURTI

General Secretary

Centre of Indian Trade Unions

C. I. T. U. LIBRARY

ACC No.....6701.....

DATE.....16-11-2005.....

CLASS No.....

CENTRE OF INDIAN TRADE UNIONS,

6, Talkatora Road, New Delhi-110 001

November 1978

A CITU Publication

Published by P. Ramamurti, General Secretary, Centre of Indian Trade Unions, 6, Talkatora Road, New Delhi-110 001 and printed at the Syndicate Printers, 50, Ellis Road, Mount Road, Madras-600 002.

CONTENTS

I. <i>Foundations of Independent Industry for Power and Engineering Equipment</i>	1
II. <i>Beginning of Reversal of the Path of Self-Reliance</i>	8
III. <i>KWU Equipment Forced on India</i>	15
IV. <i>The Proposed Agreement for "Broad-based Co-operation"</i>	22
V. <i>Wide entry of Siemens into the Indian Market</i>	28
VI. <i>Indigenous Development and Self-Reliance Buried</i>	31
VII. <i>Impact of the Agreement on other Industries</i>	35
VIII. <i>Cost of the Agreement to the Country</i>	37
IX. <i>Export Performance</i>	42
X. <i>Key Men Behind Collaboration with Multinationals</i>	50
XI. <i>Raghavan's Ouster Due to Pressure of Siemens and its Lobby</i>	57
XII. <i>Stop this Sell-out</i>	61
XIII. <i>Conclusion</i>	67
<i>Appendices</i>	70—136

Author's Preface

Recently, at a press conference in Madras, I had questioned the wisdom and propriety of the Fifteen Year Agreement for Broad-based Co-operation (a new fashionable name for collaboration), extendable for a further period of ten years, that the Board of Directors of the Bharat Heavy Electricals Limited (BHEL) proposes to enter into with Siemens Aktiengesellschaft, a multinational based in West Germany. That statement had led to a public protest by the top management of the BHEL which, however, did not come out with any answer to the concrete objections I had raised to the proposed agreement. It was only stated that my comments were "exaggerated and inaccurate".

Many economic journals, such as the **Economic Times**, the **Business Standard**, the **Financial Express** and the **Economic and Political Weekly**, as well as national newspapers like **The Hindu** followed with articles and editorials critical of the proposed agreement.

What surprised me was that the spokesman of the Ministry for Industrial Development of the Government of India, which is examining the proposal and has not yet taken any decision, should have come out regretting my statement. Naturally I felt that powerful forces are bent upon pushing through the proposed agreement—a **collaboration agreement the like of which the country has not seen so far**. I felt it my duty to mobilise public opinion, both inside Parliament and outside, against this proposal, which, if it materialises, will bury the indigenous technology already developed, kill many industries, sound the death-knell of all prospects of indigenous development of technology in many vital sectors and place our country permanently in dependence upon multinationals for its scientific, industrial and technological development.

I therefore decided to investigate more fully the working of the BHEL and enlisted the co-operation of a number of economists and scientists, who worked under my guidance. They were able to interview a representative cross-section of the engineering, technical and managerial personnel of not merely the BHEL but of other organisations, including scientific establishments. I also had before me numerous unpublished documents of the BHEL. The present publication is based upon the material thus gathered.

During the course of the investigations, which were mainly aimed at an in-depth study of the proposed long-term agreement,

I found that the process of sell-out to Siemens had started already in 1974 and an ominous agreement concluded in 1976. I also discovered shocking facts about the Libyan and the Malaysian contracts. During the last few years, the style of management in this public sector undertaking has led to frustrations among executive engineers and junior engineers and technicians.

Hence I found it necessary to include an analysis of those aspects also, although the main aim of the publication is to mobilise public opinion against the proposed long-term collaboration.

I have included as appendices certain unpublished documents of the BHEL, such as the Memorandum of Understanding on Broad-based Co-operation between BHEL and Siemens, the Internal Audit Report of September 1977 on the Libyan project and so on, which make the publication bulky. But this could not be avoided since I did not want to be accused of twisting facts or of lack of objectivity in my criticism and comments.

I must pay a warm tribute to the economists and scientists associated with this research for the painstaking labour they have put in and for the unstinted co-operation they have given me in unbounded measure. For reasons which need no mention, I cannot reveal the names of these collaborators or of the technical and other personnel in the BHEL and in other organisations who spoke out to my collaborators. They were all motivated by the highest sense of patriotism.

To all these friends, I express my grateful thanks for enabling me to perform a national duty.

P. RAMAMURTI

General Secretary

Centre of Indian Trade Unions

I

Foundations of Independent Industry for Power and Engineering Equipment

For an underdeveloped country, technical collaboration with an advanced foreign industrial undertaking is nothing to be abhorred in the initial stages. But the price it has to pay for getting out of the stage of underdevelopment must not be heavy and, in any case, should not be such that the country, after overthrowing the direct political rule of the imperialist power, goes under the economic exploitation of the imperialists—the very purpose which the direct political power over colonial possessions served.

Historical experience shows that this has been possible, after the initial technical collaboration, by resorting to adaptation, modification and development of technology indigenously and by quickly developing scientific, engineering and technical personnel in the underdeveloped country concerned and by infusing the patriotic impulse in those personnel.

In this respect, India is most fortunately situated. First, even before Independence, India was the most industrially developed among the colonial countries. Some of its scientists had achieved a world-wide repute. And after Independence, the output of engineering, scientific and technical personnel was so phenomenal that today it has the third largest number of such personnel in the world. That they are second to none in any country is proved by the fact that a large number of our scientists, engineers and technicians are eagerly scouted by the multinationals of many advanced countries and lured away on lucrative terms to serve in foreign countries—mostly in the United States, West Germany, Switzerland and so on. Their talent for research in all fields is utilised by the multinationals to their advantage.

It is in this context that the management of the Bharat Heavy Electricals Limited, a public sector undertaking wholly owned by the Government of India, set before the venture very laudable objectives. These declared goals and objectives, which were published in the Company's First Corporate Plan (1974) are :

- (i) to manufacture and supply power equipment to the extent of over 4,000 MW per year by 1980 and more if possible for further growth,

- (ii) to erect and commission projects quickly on a turn-key basis,
- (iii) to promote satisfactory after-sales service to ensure the optimum availability from the installed power units,
- (iv) to sell BHEL products and services to other countries and gain a respected place among the international manufacturers of power equipment,
- (v) to develop R & D (Research and Development) activities in such a way as to reduce dependence on foreign technologies and to keep the industry continuously up-to-date,
- (vi) to develop new energy sources such as solar and geo-thermal, and
- (vii) to develop a new style of personnel management best suited to an industry of this type in the public sector.

(emphasis added)

It is from the point of view of these goals and objectives—particularly of the fifth goal, the reduction of dependence on foreign technology—that the proposed Agreement with Siemens is being examined in this publication. During the course of the inquiry, it has come to light that the proposed Agreement is only a further projection of a course charted out a few years earlier. It has become necessary to trace briefly the course of the organisation and the policies pursued from time to time.

The first of the manufacturing units now comprising the BHEL was set up in 1956 in Bhopal as the Heavy Electricals (India) Limited. The plant was set up in collaboration with Associated Electrical Industries (now a constituent of the General Electric Corporation) of the United Kingdom to manufacture power generation equipment and auxiliaries. Among the items of equipment that the plant produced were hydraulic and steam turbines, matching generators, large transformers, switchgear and industrial and traction motors. Most of the machinery and equipment for this plant had been imported from the United States, the United Kingdom and Japan.

BHEL was set up as a separate company in 1964 to add to, and complement, the Bhopal (HEIL) plant's production of power generation equipment. BHEL's first manufacturing plants were set up in Hardwar, Hyderabad and Tiruchirapalli.

The Heavy Electrical Equipment Plant at Hardwar was set up in collaboration with Prommashexport of the USSR for manufacturing high-capacity generators and turbines in the range of 100-200 MW and also large capacity traction equipment. Most of the equipment for the plant was imported from the USSR.

The Heavy Power Equipment Plant in Hyderabad was set up with the collaboration of Skodaexport of Czechoslovakia to manufacture power equipment upto 200 MW. The High Pressure Boiler Plant in Tiruchirapalli was set up with the collaboration of Skodaexport to manufacture boilers for power generation and industrial use. A large part of the equipment was imported from Czechoslovakia.

BHEL gained rich experience through these technical collaborations. Indian engineers received intensive and lengthy training in the Soviet Union and Czechoslovakia, where in-depth engineering skills were imparted to them. Many of the engineers, both senior and others, who received such training testified to the unstinting manner in which the Soviet and Czech collaborators unhesitatingly made available to the Indian engineers their **design calculations** as well as their **design philosophy**. Soviet and Czech engineers also worked in the various units of the BHEL in India with the latter's personnel and helped them in **further** developing the designs originally supplied.

It is now contended by the top policy-makers of the BHEL that these collaborations with the USSR and Czechoslovakia were entered into merely to acquire "manufacturing knowhow", which means the knowhow to manufacture to designs supplied by the collaborators. This contention stands refuted by what the engineers who have received training in these countries and others have revealed, namely that both **design calculations** and **design philosophy** (that is, the method of calculations and the philosophy underlying the designs) were fully imparted by the collaborators. It is further disproved by the fact that the BHEL engineers had, with some help from the engineers of the collaborating countries, further developed the original designs. They had been successful in doing this on their own, as will be seen later.

In reality, these collaborations had resulted in establishing a heavy electrical industry in this country. It is also an indisputable fact that as a result of the intensive in-plant training and the transfer of "engineering knowhow", as opposed to the transfer of mere "manufacturing knowhow", BHEL succeeded to a limited extent in establishing an engineering base. In a good many product areas, this engineering base was BHEL's strength compared with its competitors within and outside the country. As a result, specific demands from clients could be successfully met. Activities connected with such work for meeting the market demands often crossed the conventional boundaries of systems and application engineering as well as product engineering and tended to get extended even to the **product development** areas.

BHEL supplied three 100 MW boilers for the Badarpur Power Project and three others of the same order to the Obra Power Project. BHEL also supplied Madras Refineries with two boilers.

and auxiliaries of the capacity of 58 tons per hour. The Company exported to Malaysia 60 MW and 100 MW boilers. New Zealand purchased hydro-generators of 50 MW and 100 MW. All these were designed entirely by BHEL engineers. It should also be noted in this connection that the transformer plant of the BHEL in Jhansi was designed and put up by our own engineers, without any foreign collaboration.

All these facts indisputably testify to the larger fact that an independent heavy engineering base, although modest, as well as a heavy power project base were established. They also completely disprove the contention of the new policy-makers that only "manufacturing knowhow" was transferred by the first collaboration agreements.

As a result, the BHEL felt confident by 1972 to establish its own centralised Corporate R & D Division in Hyderabad in order to supplement and co-ordinate the R & D work going on in the various individual units. The potential for self-reliant development had already revealed itself as detailed above.

In 1974, the Heavy Electricals (India) Limited at Bhopal was merged with the BHEL. The undertaking's manufacturing capacity rose considerably. Production of equipment rose from 346 MW to 1356 MW capacity, according to the "Ten Year Digest" published by the BHEL in 1977.

The merger enabled BHEL to pool the technical information gathered and assimilated from different sources at great cost and to rationalise design and production at the various manufacturing centres.

The organisation was now a giant by the standards of developing countries. A transformer factory was put up at Jhansi, a foundry and forge factory at Hardwar and a control equipment factory in Bangalore. The total power generation capacity installed in India by BHEL upto 1973-74 was 910 MW; by 1976-77 an additional 3912 MW had been installed (p. 9, BHEL Ten Year Digest, March 1977). The undertaking has now the capacity to manufacture 4,000 MW of power equipment annually, in addition to various engineering products.

It is worth taking a brief stock of the units within the BHEL, with its 55,000 employees of whom 10,000 are trained engineers and technicians in order to understand the wide and varied capability it has acquired and developed over the years in the field of manufacturing power and engineering equipment:

- (1) The Heavy Electrical Equipment Plant, Hardwar, manufactures turbo-sets, hydro-sets and electrical machines.

- (2) The Bhopal plant manufactures hydro-and turbo-sets switchgear and control gear, rectifiers, capacitors transformers, traction and industrial machines.
 - (3) The Hyderabad plant manufactures industrial turbines and turbo-sets, compressors, pumps and circuit-breakers.
 - (4) The Transformer Plant at Jhansi manufactures instrument, power and special purpose transformers.
 - (5) The High Pressure Boiler Plant at Tiruchirapalli manufactures steam generators, boiler house auxiliaries and valves.
 - (6) The Central Forge and Foundry at Hardwar, when completed, will supply all BHEL units with heavy steel castings and forgings.
 - (7) The Seamless Tube Plant at Tiruchi, when it goes into production, will manufacture boiler quality seamless tubes.
 - (8) The Control Equipment Division at Bangalore will manufacture an extensive range of electronic and mechanical control equipment including thyristor converters and diodes.
 - (9) The Ceramic unit in Bangalore will meet BHEL's insulator needs.
 - (10) The Project Equipment Division provides complete engineering services for thermal, hydro and nuclear plants and for industrial systems in which BHEL equipment finds application.
 - (11) The Power Projects Division provides turn-key services for the erection and commissioning of power projects.
 - (12) The Oil Rigs Division manufactures drilling rigs for oil exploration.
 - (13) There are then the marketing and sales division, the export division and so on.
- And last, but the most important of all,
- (14) The Corporate R & D Complex. Hyderabad provides central facilities for basic research.

It is on this sound foundation, with the potential for self-reliant development clearly demonstrated, that the BHEL proclaimed the goals and objectives in its First Corporate Plan in 1974 which has already been cited. The most important of these goals is "to develop R & D activities in such a way as to reduce dependence on foreign technologies".

In line with this, the BHEL management laid down the principles for seeking foreign collaboration in the publication,

"Capital Budget Manual". According to it, the logical procedure for deciding on and seeking a commercially viable technical collaboration is as follows :

First, the Marketing Division, on the basis of the intelligence it has gathered, reports to the concerned engineering department about the development or the possible development of demand for a particular product.

Second, the concerned engineering department would thereafter undertake a careful and detailed study of the available in-house technology and submit a report to the management.

Third, the management would, after consultation with the R & D Division, formulate and execute a plan for either in-house development or import of technology. In case import of technology is opted for, a careful study of all the technology available in various foreign countries will be undertaken. The various foreign technologies available will then be rated by the product engineers and by R & D on the basis of a detailed examination of the costs and the foreign exchange requirements in the initial stage and at subsequent stages of development.

BHEL, in its growth, has had to face difficulties typical of any heavy industry operating in an underdeveloped economy. The chief of these is the problem of an uncertain and unstable market. This problem had been aggravated by the weakening of the Government of India's planning process. It had created considerable difficulties for an organised developmental effort in BHEL. Its engineering function had been under the constant and intense strain of catering to a disconcertingly unstable market where multinationals hold sway. Many bureaucrats at all levels and others even at the level of Ministers had developed vested interests in imported power equipment.

In these conditions, resorting to exports was thought to be a way out for solving these market difficulties. But that way, BHEL came into sharper confrontation with the rapidly changing technologies of international monopolists in the areas of power equipment.

As a result, the engineering departments of BHEL have found themselves unable to stabilise and consolidate their young technical and organisational base. In the field of turbo-generators, for example, successive changes have been forced upon them with such bewildering rapidity that they have not yet been able to concentrate and stabilise on any category of design. Short-sighted and whimsical decisions by the top management, without consultation with the executive engineers and others, have been entirely responsible for this state of affairs. The growth of this major public sector undertaking's function has recently been

horizontal, and not vertically integrated. This has inevitably hampered the development of an in-depth knowhow of the products which are being marketed.

Organisational inexperience, incompetence and unwillingness to experiment and learn by experience on the part of the top management have undoubtedly added to the difficulties, which could have been surmounted given the will, devotion and commitment to the cause of national self-reliance. Consolidation and documentation of engineering designs, practices and experience have been virtually absent. Technical documentation has usually related only to standardisation and rationalisation of raw materials and components for aiding and supporting production.

विदूषक कारखाना

अनुष्ठा

हर मशीनरी को नरम्मत

II

Beginnings of Reversal of the Path of Self-Reliance

Using the situation of a market with constantly changing demands as an occasion as well as a cover, the existing line of development was sought to be reversed. Instead of paying attention to overcoming the weaknesses already pointed out, the top management sought the easy way of indiscriminate import of technology, rather than relying on and encouraging the creativity of their undoubtedly talented engineers and technical personnel. A proliferation of collaboration agreements extending over longer periods of time and covering production in which certain levels of expertise had already been attained followed.

The new generation of collaborations was entirely with Western multinationals. In 1971, BHEL entered into a technical collaboration with Combustion Engineering Inc. (CE), a leading boiler manufacturer based in the United States. Soon after, an agreement was signed with Air Preheater Inc., a subsidiary of CE. Among the other collaboration agreements entered into thereafter were those with Kuhnle, Kopp and Kausch (West Germany) for fans; with AB-Svenska Fabriken (Sweden) for electrostatic precipitators; Copes-Vulcan (USA) for soot blowers; Siemens (West Germany) for thyristor convertors and diodes; and Alsthom Savoisienne (France) for transformers.

BHEL's top management found its own guidelines and procedures laid down in the "Capital Budget Manual" (already cited) most inconvenient to follow. Those guidelines were therefore quickly put aside. Most engineers of BHEL bitterly complain that most of these collaboration agreements were entered into without following the rigorous selection procedure laid down in the Manual and the decisions on collaboration have been taken at the top level without the involvement of the engineering personnel at all.

Also, the noble objective of reducing dependence on foreign technical collaboration, proudly proclaimed in the First Corporate Plan, was given a quietus.

Siemens' Big Entry

It is with this new line of the top management of growing collaboration with foreign finance capital and particularly with multinationals, that Siemens of West Germany gradually extended its influence in BHEL. Siemens cunningly exploited the genuine technical and organisational difficulties—which, as we noted, could have been overcome given the will and commitment to indigenisation—and the compromising tendencies of the top management of BHEL. Through improper influence, manoeuvres and possibly outright corruption, Siemens today commands an extremely privileged position in the BHEL. There is every reason to believe that in this it struck a deal with the caucus of Mrs. Indira Gandhi that was running amuck in the country.

A vivid example of the new West German style of penetration into the Indian economy, which provides important lessons, is an agreement which was signed with Kraftwerke Union (KWU), a wholly owned subsidiary of Siemens, in 1976 at the height of the Emergency—when Parliament itself was reduced to a nullity. It was the first major foothold for Siemens in India's heavy electrical industrial sector.

Sometime in 1973 the BHEL management came to the conclusion that it would be necessary to go in for the manufacture of 500 MW capacity power generation equipment by 1980. The proposal was put up to the Government of India, and, with its approval, preliminary steps in this direction were taken. The Union Ministry for Industrial Development (Heavy Industries) recommended the development of 500 MW sets indigenously and further examination in this direction.

BHEL had already considerable experience in the manufacture of Soviet-designed 200 MW equipment. So an expert team consisting of Research & Development engineers within BHEL was set up to look into the matter. The committee proposed two designs for the manufacture of generators. One from Hyderabad was for the manufacture of 425-500 MW generators and one from Hardwar was for the manufacture of 500 MW generators. It appears that the R & D engineers stated confidently that they could develop a turbine of 420 MW capacity, with the existing 200 MW and 110 MW turbines, by what is known as the "shell" method. For reasons unknown, this proposal of the R & D at Hyderabad was not seriously considered. The committee, however, concluded confidently that BHEL could, based on its own experience, design the required generator. It was of the opinion that the turbine technology alone should be imported.

In 1974, the Chairman overrode the committee's recommendations to the utter dismay and frustration of the R & D engineers and decided that both turbine and generator technology should be imported.

A team of senior BHEL engineers visited various countries for protracted negotiations with various international firms. They had talks with Brown Boveri & Co. of Switzerland, MAN of West Germany, General Electric Corporation of U. K., Kraftwerke Union of West Germany and Skodaexport of Czechoslovakia. And three years ago, some foreign firms interested in collaboration for the manufacture of 500 MW equipment visited India and held talks with the BHEL management.

Mr. V. Krishnamurthy, then Chairman of BHEL, observed in a note dated June 5, 1974 as follows :

"it will be some time before these laboratories start functioning and generate data to support our own development work for larger capacity (steam turbine) sets". (emphasis added)

It will be seen from this that the capacity of the BHEL engineers to develop larger capacity turbines is not disputed. The Chairman only says that it would take some time for the laboratories already put up to start functioning and generate supporting data. Given the will and the firm commitment to developing our own technology, the process of functioning the laboratories could have been accelerated. Instead, the management opted for imported technology, as has been pointed out earlier.

Consequently, Mr. Krishnamurthy continued in his note :

" Acquisition of design knowhow would, therefore, be necessary. Participation of BHEL's team of designers in the design effort and acquisition of basic data and support computer programmes from the collaborator will have to be ensured under this arrangement. This would enable BHEL's design teams to develop the designs of the next higher capacity set, say 750 or 800 MW on their own, as by then the R & D laboratory facilities, which are so essential, would have been set up by BHEL and be fully operative", (emphasis added).

It is clear from this that only the import of 500 MW turbine technology was contemplated. Development of higher capacity sets was to be undertaken by our own engineers who have the necessary talent for it, and the laboratory facilities were to have been got ready for such a development.

The note went on to argue :

" In the case of the turbo-alternator, the recommendation made by BHEL earlier remains unaltered, viz., that the full machine can be designed indigenously. Such an effort will be possible in the time frame already worked out, based on and

embodying well-known design principles and features of construction incorporating certain modern and technological aspects from the BHEL's present range of ratings of turbo-alternators which can be scaled up suitably. However, it should be recognised that even in respect of turbo-alternators there are some points which require further detailed analysis.

"During the past few months a literature survey of the different kinds of investigations that have been conducted by different manufacturers has been made on the above problems. The design calculations on the turbo-alternator have also been commenced for the two variants, a rating of 400-425 MW and one of 500 MW, as the turbo-alternator can be designed to suit the turbine which may be of either rating. As this would be the first step for commencing the design and development work by the team as proposed above, it has been estimated that a total time of 102 weeks will be required for completion of the detailed design drawing in a phased manner and it would be possible to order the major requirements of materials but subject to investigations listed above within a period of 18 to 32 weeks again in a phased sequence.

"The layout for the turbine house has been optimised by means of a joint study undertaken by BHEL and M/s. Tata Consulting Engineers and the main parameters and the details of equipment have been finalised. However, these will also be discussed at the inter-departmental meeting so that a broad consensus emerges in order to allow BHEL to proceed with the design of the turbo-alternator. During the initial period of 18 weeks when the preliminary design work on the turbo-alternator gathers momentum, it is expected that an agreement will be reached on the choice of one of the firms for assisting BHEL in the steam turbine. With this approach, all the main equipment required for 500 MW thermal set would be ready for installation as scheduled already in 1980".

Quite apart from what has been said against the import of the 500 MW turbine in view of the admitted potential for developing the sets indigenously, the fact remains that this note by the Chairman of BHEL speaks of a decision already taken to manufacture generators (turbo-alternators) indigenously. Why and how this decision was reversed remains to be known.

In pursuance of this decision to import technology for both the 500 MW and the matching generator, another technical committee of the BHEL was appointed to evaluate the offers made by several manufacturers of power generation equipment. The committee ranked the alternatives in the following order: Brown Boveri & Co. (Switzerland), MAN (West Germany) and General Electric Corporation (U.K.). KWU was not in this list of alternatives at all.

This, evidently, was not to the liking of the higher-ups. Hence the task of choosing a collaborator was taken away abruptly in 1976 from the Corporate R & D Division, Hyderabad to the office of the Chairman, Mr. Krishnamurthy. Another committee was set up, but this time with only one technical member, Dr H. N. Sharan, BHEL's Director (Engineering), a man known for his close ties with the West German electrical industry, particularly with Siemens. Details about him will be given later in this account. The other members of the committee were Messrs. N. Sondhi, V. Krishnamurthy, S. V. S. Raghavan, A. Mazumdar and R. V. Subramaniam, who was later replaced by B. Sinha.

This committee invited bids from 17 firms and then narrowed down the choice to five. It was in the following order : General Electric (USA), General Electric Corporation (UK), MAN and Alsthom (West Germany and France) Brown Boveri (Switzerland) and KWU (West Germany), a wholly owned subsidiary of Siemens.

Even in this rating, KWU came last. It is not known to be a front-rank manufacturer of turbines and there is certainly strong doubt about its capability to outbid other competitors in this field. However, during the whole period of complicated negotiations, KWU appeared very well informed on inside developments in the committee and apparently was always one step ahead of its competitors. Evidently, a member (or members) was regularly posting information to KWU. Finally, the choice fell on KWU on the spurious ground that it was 'marginally' better commercially.

As a result of all these shoddy manoeuvres, a 15-year collaboration agreement with KWU was signed in 1976. This agreement has been kept a closely guarded secret. What we know of it is from statements in Parliament, leak-outs in the press, and other sources which cannot be revealed

This collaboration, it should be noted, is not just for equipment and technical knowhow regarding 500 MW turbines and generators as had been planned earlier. It is for an entire range of power equipment from 200 MW to 1000 MW. As has been noted, BHEL has already been manufacturing 200 MW turbines of Soviet design at Hardwar. It should also be remembered that the potential for indigenous development of higher range turbines over 500 MW, which was confidently asserted in Mr. Krishnamurthy's note of June 5, 1974, was also given the go-by.

Spokesmen for Mr. Krishnamurthy, now Secretary for Heavy Industry in the Ministry of Industries, have been stating to the press that "highly favourable" terms have been obtained from KWU for BHEL. However, past experience in dealing with

multinationals, and particularly with KWU and its parent organisation, Siemens, has been highly disappointing. For example, in the collaboration agreement entered into in 1974 for drive turbines, it was noted that the German multinational was singularly reluctant to pass on its engineering knowhow. Another collaboration agreement for thyristors and diodes yielded no result for two years because of pressure for further concessions by Siemens. The German firm, it appears, raised the prices of equipment and sought to impose the condition that only its equipment should be bought. Work on this project began to move only after considerable and protracted negotiations by teams from BHEL.

The agreement with KWU is for 15 years. Its costs, according to the statement made by the Minister of State for Industries, Miss Abha Maiti in the Lok Sabha on March 15, 1978 are:

- (1) An outright payment of DM 7.3 million (Rs. 2.92 crores), one third of which was to be paid within 30 days of the signing of the agreement, one third on completion of supply of documentation, and the balance in stipulated instalments
- (2) Royalty at the following rates:
 - (a) 4 per cent of the net invoiced value of the first 5 turbo-generator sets to the KWU design, 3 per cent of the net invoiced value of the next 5 sets, and 2 per cent of the net invoiced value of all the sets produced beyond the tenth set.
 - (b) For components and parts of turbo-generator sets sold by BHEL, royalty will be paid at 4 per cent. For components used and sold in T. G. sets of other ratings to be manufactured by BHEL, a royalty of $2\frac{1}{2}$ per cent will be paid. In addition, BHEL shall pay to KWU 5 per cent of the value of windings used in other products of BHEL which incorporate the insulation system technology of KWU.

Scuttling of Products Already Developed

A despicable feature of this agreement is the provision that BHEL will have to pay, in addition to the other exorbitant levies, 5 per cent of the value of the windings used in other products of BHEL which incorporate KWU's insulation system technology. The windings, it bears emphasis, are the BHEL's own. Its engineers have developed an insulation system of epoxy resin, mica paper and glass paper. It is considered to be of world class and India can justly be proud of its engineers in this field. There is also not the slightest need to give up this system and import

new technology for the insulation system from KWU which is not known to be better than what our engineers have developed. Despite strong protests, the top management of BHEL decided to cast away our insulation system and replace it with KWU's micalastic system. This will cost Rs. 20 crores over the contract period.

A great disadvantage of this agreement is this. The 200 MW turbines presently being manufactured by BHEL work at 130 atmospheres steam pressure. If the KWU turbine is to reach the higher efficiency, the cycle pressure has to be increased to 150 atmospheres. Without adopting the higher pressure, the KWU turbine does not deserve even a rupee price increase. BHEL is now coercing the Central Electricity Authority, the Electricity Boards and the National Thermal Power Corporation to accept the 150 atmospheres pressure cycle, saying that this would be the future standard for Indian power plants. But how much it would cost for the boilers, regenerative heaters, feed pumps, piping, the water-heating plant and so on on account of the change-over to the higher pressure is of no concern to the BHEL management.

III

KWU Equipment Forced on India

A super-thermal power project of 500 MW is scheduled to be put up by the Tatas in Maharashtra with World Bank aid. One of the conditions of this aid is that a global tender must be called for in the supply of the equipment. But the turbine component has been removed from the equipment to be tendered for, and this is to be supplied by KWU via the BHEL management and its mentors in the Ministry of Industry. Since the World Bank insists on global tenders, the turbine purchase is to be financed from aid from the West German Government. This means, the price of this turbine will be what KWU dictates and India has no choice to buy any better quality turbine that may be available from any other source. According to Tata engineers, since the other items of equipment are being purchased from the USA on the basis of global tenders, they would have to go out of their way to integrate the KWU turbine with the rest of the equipment.

It had been noted earlier that Mr. Krishnamurthy, in his note dated June 5, 1974, proposed going in for foreign collaboration to acquire design knowhow for 500 MW turbines only on the grounds that the functioning of BHEL laboratories would take some time, and there was urgency to acquire the knowhow for 500 MW turbines so that BHEL could start producing 500 MW sets by 1980. He had also stated that once this was acquired, BHEL engineers would be able to develop higher range generators, say 750 or 800 MW, because the laboratory facilities would be ready. However, the agreement signed was for 200—1000 MW range turbines. Strangely enough, although two years have passed since the agreement for 200—1000 MW range turbine sets was signed with KWU (in August 1976), BHEL has not been able to take any steps to acquire and utilise the knowhow. This is owing to a variety of economic and technical reasons. Above all, there was no encouraging market for 500 MW equipment.

Thus, the pretext of urgency for the signing of the agreement falls to the ground. Other ulterior motives and interests connected with this multinational were the real motivating forces behind this agreement.

With no market for 500 MW equipment in sight, a hasty decision was taken to change over from the existing design for 200 MW steam turbines to KWU design and specifications.

BHEL has openly admitted that the 200 MW turbines manufactured on the design technology acquired from the Soviet Union are sturdy. The two sets already installed in Obra and Badarpur have been working satisfactorily from the very beginning and no teething troubles have been encountered.

The justification worked out by the top management for this decision to change over is as follows: (i) the Soviet-designed turbines have a higher heat rate and hence a higher fuel consumption; (ii) they do not have flexible operations for two-shift running, and (iii) they are ill-equipped to work under conditions of varying frequencies. The reasoning has no basis in fact. The cost implication of this new collaboration has even now not been satisfactorily evaluated. What will be the capital cost of installing the new machinery to manufacture turbines of the new design? What will be the foreign exchange involved in this? What will be the cost of production of the turbine on the new KWU design? It will certainly be much more than the cost of the turbine of the existing design, for the German technology is high cost technology.

Taking into account the interest charges on the new machinery to be set up—for it is entirely an additional cost—and the depreciation charges, what will be the total additional cost that the country has to pay for every turbine of the new design? What is the interest charge on this additional cost, at the prevailing bank rate of 15 per cent?

If all these are properly worked out, it will be found that even with a marginally higher fuel consumption, the existing design turbines will work out much more economical, considering the availability of cheap coal in India.

As per the second reason advanced, namely that the turbines of Soviet design are difficult to operate in two-shift running (because they take a longer time to prepare for starting), it is noteworthy that Poland, which produces sets of the same design, has modified the design and removed the difficulties. In fact, the engineers in the R & D Division had initiated projects in this direction. These were systematically scuttled by the top management. At any rate, Poland offered the knowhow of these modifications to BHEL **free of cost**. The only stipulation it made was that until BHEL's Heavy Forge and Foundry went into production, BHEL should buy all its heavy forging requirements from Poland, which would be sold at a price below that of the lowest tenderer in a global tender. Such an attractive offer, which would have cost BHEL nothing and removed the difficulties in two-shift running, was rejected out of hand for obvious reasons.

The third and last objection, that the present turbines are ill-equipped to work under conditions of varying frequencies, is rejected by the BHEL engineers as completely baseless. In fact, these turbines are working under conditions of varying frequencies in the Soviet Union and Poland and engineers from Odra and Badarpur where they have been installed reported no difficulty in this regard. With this change-over and stopping of production of the existing design turbines, the BHEL has to meet the market demand from the various State Electricity Boards who have placed orders for 200 MW power sets. Till the machinery for production is installed and production starts, BHEL has committed itself to buying at least 15 complete sets from KWU. It has agreed to supply the Madhya Pradesh Electricity Board for its Korba project two 200 MW steam turbines imported from KWU. In the actual negotiation of the price, KWU quoted DM 25 millions, and after a good deal of negotiation, the price has been brought down to DM 20 millions. That works out to about Rs. 8 crores and, together with the customs charges, freight and insurance, the total cost is Rs. 12 crores. The price of the set presently being produced at BHEL on Soviet design is only Rs. 6.4 crores and BHEL had already agreed to supply to the Madhya Pradesh Electricity Board the imported sets at this significantly lower price.

In this deal with the Madhya Pradesh Electricity Board alone, BHEL will lose over Rs. 11 crores. This is apart from the fact that the country has to pay Rs. 16 crores of foreign exchange, even assuming that the sets would be carried in Indian ships and no foreign exchange would be required for freight charges. And for every set that will necessarily have to be imported till BHEL goes into production, either BHEL or the State Electricity Boards would have to pay an additional Rs. 6 crores—apart from the waste of a minimum of Rs. 8 crores of the country's precious foreign exchange per set imported.

As for the spare parts required for these sets that will go into production, it is anybody's guess what price KWU will demand. It is obvious that BHEL cannot produce the whole of the turbine for a long time. Parts will be produced here gradually and, until BHEL is in a position to produce all the parts, those that cannot be produced will have to be imported from KWU and assembled in India. These prices have not been settled, and BHEL will have to pay the exorbitant prices demanded by KWU and that too in foreign exchange.

And this is by no means all. After going in for the KWU turbine, it was discovered by a non-technical person that the generators being produced for the 200 MW turbines could not be fitted into the KWU turbines, because they rotated in the wrong direction! It is not known whether the BHEL will go in for the import of generators to match the KWU turbines from KWU.

It has already been noted that the cost implication of the change-over to KWU technology has not been satisfactorily worked out to this day. It was estimated, before the agreement was signed in August 1976, that the modifications to the shop-floor at Hardwar in order to produce the new KWU equipment would cost only Rs. 5 crores.

But already, twenty 200 MW sets on the present Soviet design have been produced and about 35 sets are in the pipeline. Once these sets are commissioned, they would be requiring spare parts and replacements for their lifetime, that is for about 25 years. If these spare parts are not produced, the generation of power in the projects where these turbines and generators are installed would come to a standstill. Hence it is not possible to do away with the existing shopfloor. The switchover to the new technology would actually mean having a parallel factory in operation. As against the estimate of Rs. 5 crores for the change-over put up before 1976, now a conservative estimate of Rs. 50 crores has been put up to the Union Government by BHEL's top management. The capital of the whole Hardwar complex, including the turbine manufacturing plant, before this agreement was only Rs. 100 crores.

More than all these, there is a major technical problem. The turbines that BHEL, Hardwar has been manufacturing all these years are of the impulse type. This is also the type that the most advanced manufacturers of steam turbines, including the General Electric Inc. (USA) and others, are using. On the other hand the new KWU turbines are of the reaction type, which is totally of a different classification. It has been observed by experts that in this type of turbine, power is more difficult to regulate.

BHEL engineers have, over the years, acquired considerable experience with impulse type turbines and its R & D has also been working in this area. All this rich experience gathered over the years and the considerable output of research will have to be buried ten fathoms deep and the engineers will have to begin work anew on reaction turbines of the KWU.

It was also discovered that the condenser BHEL is presently manufacturing cannot be fitted in to the turbine of KWU design. Generator sets can be adapted and manufactured to suit KWU turbines, but condensers cannot be so manufactured. Either we have to buy them from KWU or buy the manufacturing knowhow from them or put up new facilities to manufacture them.

Apart from the heavy cost involved in this agreement in monetary terms and in terms of valuable foreign exchange resources, the colossal waste of the national reservoir of talent gathered through years of experience and research—which any country should cherish and an underdeveloped country should cherish all the more—is incalculable in terms of money.

An apologia is being advanced to the effect that the switch-over to the new technology would enable us to compete in export markets. This is an insult to the intelligence of the Indian people. Are they so naive as to swallow the story that the multinationals, and particularly KWU and its parent company Siemens, will part with their high-cost, advanced technology to BHEL so as to enable the latter to compete with them in international markets? The pity of it is that this excuse is being put out after the bitter experience gathered in the past with these two companies.

Mr. Krishnamurthy has been boasting to a few of his chosen "confidants" that there is an added "incentive" to this agreement. It is that the West German firm has "secretly" agreed to "share nuclear technology." Why, it will actually give the BHEL the technology to develop nuclear steam generators! The equipment, it is said, will be manufactured at Tiruchirapalli and is to be used in the Narora Atomic Power Project in the first instance. Mr. Krishnamurthy is reported to have stated that apart from himself, only Dr. H. N. Sethna Chairman of the Atomic Energy Commission, knows about this in India and that even the West German Government at Bonn has been kept in complete darkness about this wonderful secret.

The fact is that more than a hundred senior and junior engineers and administrators of the BHEL have been given this "confidential" information, reported to have been conveyed to his "confidants" by Mr. Krishnamurthy. Such being the case, how can it remain a secret? Combustion Engineering of USA, one of the collaborators of BHEL at Tiruchirapalli, is reported to have taken it up with the U. S. Government, which, in turn, is reported to have taken it up with the Bonn Government. Knowing the extremely tough stances taken by Western Governments in passing on any form of nuclear technology to developing countries (except to a very few chosen ones considered to be absolutely reliable allies), this unwritten "secret incentive" story cannot be anything but a nursery tale to be peddled to children.

As already stated, the entire exercise for this agreement started in 1974 and culminated in August 1976. That was the heyday of Indira Gandhi's rule, with her caucus running riot in the country at the height of the Emergency.

Nothing could be done without the knowledge and consent of this caucus and one interesting detail is known about the BHEL's connection with it. Mr. V. Krishnamurthy, then Chairman of BHEL, invited Sanjay Gandhi for the opening of the Heavy Foundry and Forge Plant at Hardwar, expending no less than Rs. 1.5 lakhs from the funds of BHEL for that "great honour". What role the caucus had played in the choice of this multinational, which was thought not fit enough even for consideration

by the R & D engineers of BHEL and which was rated the last even by a hand-picked Committee with only one or two technical men can be known only by further investigation.

It should also be noted that the then Prime Minister was shouting the loudest against the multinationals and imperialists. Her Commerce Minister spoke in strident tones against their depredations of the underdeveloped countries at the UNCTAD Conferences in Rome and Nairobi; and she herself condemned the multinationals and thundered against their loot of underdeveloped countries, including India, at the Colombo Conference of Non-aligned Countries.

Thunder against, and condemn, the multinationals in words, but in action bury the already developed indigenous technology, scuttle the potential for indigenous development and R & D, and open the door wide for deep penetration into the country's economy by the very same multinationals—this was the double-talk and hypocrisy practised by the previous Government. The deal with KWU is the crassest example of it.

The Union Industries Minister, Mr. George Fernandes, has been correctly pointing out to the press that this anti-national agreement was signed by the BHEL during the Emergency regime, when he was in Tihar jail. What must be added, of course, is that each and every decision to implement the agreement was taken **after** he became Minister for Industries. In fact, the decision to change over the 200 MW turbines to KWU design was taken only during his stewardship.

For years, the application of the Tatas to put up a 500 MW power project with imported equipment was being opposed by the Industries Ministry, the Planning Commission and so on, and the question was pending when the Janata Government came to power. At the first Tripartite Indian Labour Conference—held after the Janata Government came to power—the author raised the issue and demanded that the Tatas' application for importing this equipment should not be granted. Instead, two 200 MW and one 110 MW set of BHEL's own manufacture could be put up. He also pointed out that if the 500 MW set tripped, the total power supply would stop, whereas by installing two 200 MW and one 110 MW sets there was no danger of all the sets tripping simultaneously.

Despite all these considerations, the Tata application was cleared by the Industries Ministry.

It is also significant that this clearance came only after the agreement with KWU had been signed. This enabled the top

BHEL management to impose the KWU turbine on the Tata project, as has been pointed out earlier.

If these and other decisions in implementation had not been taken by the Janata Government, the loss would have been restricted to the payment of one-third of the lump sum that had been paid within a month of the signing of the agreement, in monetary terms, a little below Rs. 1 crore.

Mr. George Fernandes cannot wash all responsibility off his hands, by maintaining that he had inherited this odious agreement from the previous regime !

IV.

The Proposed Agreement for “ Broad-based Co-operation ”

Emboldened by the easy success that they achieved in their manoeuvres for bagging the agreement for collaboration in the manufacture of 200-1000 MW range power generation sets, Siemens has been vigorously manoeuvring for another agreement with BHEL and has already initialled a “ Memorandum ” which is the draft of the agreement for technical collaboration that is proposed. The Board of Directors of BHEL has exhibited an unseemly eagerness to conclude the agreement and has quickly recommended to the Industries Ministry of the Government of India that the proposal be approved so that the formalities of signing can be gone through and the Agreement made effective.

This proposed Agreement, if accepted, will last for 15 years extendable for a further period of 10 years—that is for a total of 25 years. As before, the text of this Memorandum has not been published but it is claimed that this Agreement will be a major gain for BHEL as well as for the country.

The text of the Memorandum, which is given as an Appendix herein, however gives a totally different picture. Siemens has made sure that every advantage—technical, financial and other—accrues to itself and has secured the broadest possible range of products (mechanical, electrical, and electronic equipment) in the Agreement. On the other hand, it has made no concrete commitment for any significant transfer of technology to BHEL.

The technical scope of the collaboration has been specified under the heading “ Contract Products ”, which are listed in Annexure II of the Memorandum. They cover a wide range of products—all the power generation products that are currently being manufactured by BHEL, accounting for approximately 40 per cent of its total production. They include electric motors, generators, turbines, circuit breakers and switchgear, insulators, transformers, semi-conductors, and power electronics. They include, besides, the application and systems engineering for energy generation, transmission and distribution, industrial equipment for steel plants, rolling mills, electrolysis, and industries such as textiles, cement, petrochemicals and fertilisers.

A careful study of the Memorandum will show that this proposal, if it goes through, will have ominous and disastrous consequences not only for BHEL but for a number of industries in the country, both in the public and private sectors.

The reason for choosing Siemens for this kind of Agreement has been stated thus in the Memorandum of Understanding :

" BHEL has the maximum number of collaboration agreements with Siemens... Hence being already familiar with their technology, it seems to be but desirable to further extend our connection ".

What a wonderful reason ! The proponents do not assert that in every one of these products covered by the Memorandum Siemens technology is the most advanced. Has this reason got anything to do with the goals so pompously declared in the BHEL's first Corporate Plan, " to develop R & D activities in such a way as to reduce dependence on foreign technology " ? On the contrary, the Agreement means that for the next 25 years BHEL will be importing complete manufacturing knowhow ready-made from Siemens for a good part of its output.

The items, under the heading " technical knowhow ", to be supplied by Siemens are grandiose and impressive to read :

- (a) The information to be supplied by Siemens shall comprise :
 - (1) The basic manufacturing and systems engineering knowhow related to Contract Products and specified in detail in Annexure II. This comprises results of developments carried out by Siemens in its factories and central research and development departments for the development of new manufacturing technologies in order to permanently improve its manufacturing technologies, manufacturing organisations etc.,
 - (2) The special manufacturing knowhow related to Contract Products. This comprises the knowhow which is available with Siemens for the manufacture, quality control and testing of Contract Products.
 - (3) The knowhow for Contract Products. This comprises the calculation, design, assembling, erection, commissioning, maintenance and operating information.
 - (4) The applications engineering knownow relating to the areas covered by Annexure I.
 - (5) Information on Siemens' organisation and management system and practices in selected areas as listed in Annexure III.

(b) The technical information to be supplied by Siemens shall consist of :

- (i) existing information on Contract Products and application engineering ;
- (ii) information on improvements and modifications on Contract Products and application engineering ;
- (iii) information on new developments of Contract Products and application engineering ;
- (iv) information on general management areas. **Available written** documentation in the relevant factories, engineering departments, central research and development departments and/or obtained from licensees "

A careful reading of the above formidable list will show that the same items are repeated in different language to make impressive reading. It is pertinent to note that **only available documentation will be given.**

The Memorandum adds : " Where fulfilment of the objectives of this collaboration will not be met (here the drafter slipped up and instead of using the term "co-operation", calls it what it really is, "collaboration") by the available written documentation it will be supplemented by :

- " (i) Subsequent clarification to be supplied in written form **to the extent to which Siemens considers is necessary.** (emphasis added)
- (ii) Verbal information to be imparted to BHEL personnel delegated to Siemens for training "

So clarification will be given in written form only to the extent that Siemens considers necessary and not to the extent that BHEL wants !

As for oral transmission of clarification, the clause relating to training of BHEL personnel makes the intention of Siemens clear. Siemens' commitment is to provide for the training of BHEL personnel for 120 man-months per annum. This works out to training, for periods of one year, 10 BHEL personnel annually. What an insignificant number considering the wide range of collaboration, the large technical area, the vast number of products and application engineering and systems engineering, that have been listed. It is evident that Siemens has no intention of imparting any in-depth engineering knowhow to BHEL and it will, in reality, only effect the superficial technology transfer of selected design packages at its discretion. BHEL's task will be merely to manufacture according to specifications supplied by Siemens.

It is claimed as a great advantage that Siemens, as a member of the High Voltage Direct Current Transmission Group, offered to make the technology of that group available to BHEL. But the clause in the Memorandum shows that Siemens makes no such firm commitment. All that the Memorandum states is, "Siemens is a member of the High Voltage Direct Current Transmission Working Group consisting of Siemens Aktiengesellschaft, Allgemeine Electricit  tats Gesellschaft (AEG), Telefunken and Brown and Boveri & Cie, Aktiengesellschaft. Siemens is prepared to **endeavour to the best of its efforts**, that BHEL may for HVDC Projects in India, or where supplies from India are advantageous, to be included in project consortiums which in each such event render necessary technical assistance in the design, manufacturing, application engineering, etc." Thus, Siemens will only "endeavour to its best of its efforts". Whether the other members of the group will respond is wholly another matter.

Moreover the HVDC Group is not recognised as the best in this area, whereas Soviet technology in this field is acknowledged the world over as the most advanced and commercially viable.

It is also claimed that Siemens has agreed to the transfer of technology from the Fifty Cycle Group. But the actual clause relating to this in the Memorandum reads :

"Siemens—as a member of the Fifty Cycle Group—is prepared to **endeavour to the best of its efforts** that a collaboration between this group and BHEL may be established through Siemens as a representative of the Group". Again Siemens will only "endeavour to the best of its efforts". Whether the members of the Fifty Cycle Group will agree to transfer their technology to a poor cousin collaborator of Siemens, and if so on what terms and at what cost, are all in the realm of speculation.

Great publicity has been undertaken to the effect that Siemens has agreed to receive part of the payment due to it under the collaboration Agreement in kind, that is, it will buy equipment made by BHEL. Again, the actual clause in the Memorandum shows the dubious nature of this claim. The clause reads :

"Siemens agree to **endeavour to the best of its efforts** to buy from BHEL in lieu of payments due under a (i) and a (ii) of this para, contract products or other equipments from BHEL subject to their **being available at quality and delivery acceptable to Siemens at International price levels**" (emphasis added).

See how much this offer of buying has been qualified. First, Siemens does not make any firm commitment to buy but "will

endeavour to the best of its efforts". Secondly, the quality and delivery must be acceptable. Acceptable to whom? To Siemens, because BHEL has no say in this. Thirdly, prices must be of international levels.

The Memorandum provides that Siemens and BHEL will take up, in selected areas, development on a joint basis and the proceeds from licensing the results will be shared by the two in proportion to the development costs that they incur. Given the scale of their R & D expenditure, Siemens will certainly dominate all such projects. BHEL engineers of the R & D expect that their talents and services will be exploited to the best advantage of Siemens and with very little financial gains accruing to the BHEL.

It is also claimed that as a result of this, other R & D results of Siemens will be available to BHEL. This is also a bogus claim, for the relevant clause says that they may be made available only on mutually acceptable terms and conditions. By this hedging Siemens can demand such heavy prices as to make it impossible for BHEL to obtain such reasonable results.

Restrictions on manufacture and selling

The memorandum says under this heading :

" Siemens agrees to grant to BHEL within the technical scope of the co-operation under information furnished from time to time as well as under any respective Siemens patents :

- (i) **a non-exclusive manufacturing and selling right in India; provided, however, that Siemens shall not grant additional manufacturing licences in India, except to Siemens India Limited and its associates** without prior consultation of BHEL and agrees not to enter into such other agreements if the interests of BHEL are seriously affected. BHEL appreciate that for successful implementation of this long term collaboration it is necessary that **BHEL does not normally enter into new collaboration with third parties in the Contract Products area.** However, BHEL and Siemens accept that considering the position and role of BHEL in the Indian environment, there may be occasions for BHEL to obtain knowhow in specific areas from other organisations for meeting specific situations. **BHEL will consult Siemens prior to any formal arrangements that BHEL may make in such cases. BHEL agrees not to enter into such other collaborations in case the interests of Siemens are seriously affected.**
- (ii) **a non-exclusive right to export to all countries of the world excepting countries where Siemens has prior manufacturing and licensing commitments "** (emphasis added).

Thus, under sub-clause (ii) above, BHEL is barred from exporting to those countries where Siemens has prior manufacturing or licensing commitments. It is understood that there are already 84 such countries including some developing countries. So much for the boasting that BHEL will be enabled to export more as a result of this Agreement.

In sub-clause (i), although there may be need for BHEL to enter into collaboration with third parties in some areas, such collaboration will be decided not by the heads of BHEL, but by the interests of Siemens. That means Siemens will have the power to veto such collaborations even though they may be a dire necessity for BHEL.

V

Wide entry of Siemens into the Indian Market

Through this Agreement, Siemens will get a big market in India itself, and that too at the expense of BHEL.

Siemens India is a subsidiary of Siemens with a wide network of sales organisations in India. It has also associates like the Cable Corporation of India (CCI) and Bharat Bijlee, who supplement the product range of Siemens India and who also receive the continuous technical assistance of Siemens to enable them to manufacture products of the newest Siemens designs (From the Memorandum).

According to a clause quoted above, Siemens will grant to BHEL **non-exclusive** rights to manufacture and sell in India, but Siemens is being permitted to grant additional manufacturing rights to Siemens India and Siemens' associates in India. Thus, Siemens India can compete with BHEL for the same products. In this competition, Siemens India will have all the advantages of a wide network of sales organisations already set up. Its prices will be lower, for it does not have to pay royalty and other charges to Siemens. Moreover, being a subsidiary of Siemens', it has complete access to all the latest technological developments, which Siemens may not choose to give to BHEL. Meanwhile, BHEL will be bound hand and foot and will not be allowed to enter into collaboration with third parties, if such a collaboration is **advantageous, for it will affect Siemens' interest!**

Another major entry for Siemens into the Indian market will be through the provision of "areas of interest". The Memorandum states:

"BHEL recognises the areas of interest to Siemens India listed in Annexure IV in addition to the areas in which they are currently active".

"Siemens, Siemens India and BHEL agree that Siemens India may enter into these areas either independently, or, subject to Government of India approval, jointly with BHEL."

It may be assumed that Siemens will grant exclusive rights to Siemens India for the manufacture and sale of all products

that come under this category of " areas of interest ". Their associates also have substantial interests in industries which manufacture equipment and component for the electronics industry. Thus a big market is being created for Siemens.

This clause, coupled with the collaboration for knowhow of application and systems engineering, for generation, transmission and distribution, industrial equipment for steel plants, rolling mills, and industries such as textiles, cement, petrochemicals and fertilisers opens the door wide for Siemens to penetrate our economy in several fields. BHEL's top management has been justifying the Agreement on the ground that it will provide BHEL with application and systems knowhow in order to help market entire systems and not just individual products.

Application engineering means tailoring an already developed product to suit a specific job or selecting a suitable type of product to meet a specific duty. This is one of the major activities that BHEL's product engineering groups are already performing. These groups claim a good measure of success. Are we to conclude that BHEL's product engineers have suddenly become incapacitated? When they have been performing this activity so far on their own, without any foreign assistance, are we to conclude, that they cannot further develop it? Under the smokescreen of stepping up the activity, the proponents of this Agreement seek to place the organisation completely at the mercy of Siemens and rely on it for ready-made capsules of application engineering and computer data.

The overall or systems engineering of projects does increase the marketability of the products and BHEL, having grown into a giant engineering complex, should adopt it. But to depend entirely on the systems engineering packages and systems selection guidelines borrowed from a foreign multinational can only be detrimental to the interests of BHEL. When a particular system is sold to a project, a number of components form a part of the system. The use of Siemens systems engineering would ensure that its products and components are used in every aspect of the projects put up to Siemens design and thus will open up a vast and varied market for its products and components.

Recently the Bokaro Steel Project took the control system from Siemens through the agency of BHEL. It cost Rs. 20 crores. The entire products and components to the value of Rs. 11 crores came from Siemens and the balance of Rs 9 crores was given as design engineering and other charges. It should be noted that the areas of systems engineering covered by the Memorandum match perfectly with list of products listed in Siemens India's "areas of interest" in Annexure IV. The list of "Contract Products" indicates where systems engineering will be necessary.

For example, where BHEL gets the contract for a total system project in a steel plant and rolling mill, Siemens India will reserve for itself the manufacture of the entire industrial electronics components and equipment for automation; for the systems in textile, pulp and paper mills, cement plants, petrochemical and chemical industry, fertiliser plants and in the food and plastic industries, Siemens India's "area of interest" is the requisite electrical equipment; when BHEL goes in for Siemens systems engineering in transportation, Siemens India will have reserved for itself the supply of remote control automation, the material handling equipment and the measurement and process engineering.

It is obvious that Siemens India and Siemens multinational will raise their sales many-fold and penetrate almost every heavy industry as well as utility industries.

It should be noted that previously the Government of India had banned foreign consultancy firms from working in India. The proposed Agreement is all the more reprehensible in view of the fact that consultancy services are sought from the very multinational which is manufacturing the products. Many senior BHEL engineers insist that it is not at all necessary to go in for foreign collaboration to develop systems and application engineering. It has already been stated that the engineers are performing the jobs involved in application engineering on their own, and it needs encouragement from the top and scope for concentration. BHEL has built up its own systems engineering divisions. A number of consultancy organisations like EPI, DIPL, Tata Consultants and Dastur & Co. are operating in the country with considerable success. The country today is technologically advanced enough for the import of systems engineering and consultancy in this field to be wholly unnecessary.

The only aspects of systems and application engineering in which they may encounter difficulties are those connected with transient and dynamic analysis. And on these the Memorandum of co-operation between BHEL and Siemens is ominously silent. They find no place in the concerned annexure. Even these difficulties can be overcome once the specific processes are studied and understood in detail. There is enough competence among BHEL's engineering personnel for this.

VI

Indigenous Development and Self-Reliance Buried

Thus this proposed Agreement is one in which the whip hand will be completely with Siemens in every respect and at every stage. It must be seen as a process of continued transfer of technology from Siemens to BHEL at the discretion of Siemens. All the advantages go to Siemens and the disadvantages to BHEL. A simple enumeration of some of the known facts will prove this to the hilt.

- (i) **Circuit Breakers:** The existing range of Siemens' circuit breakers does not suit BHEL requirements. It is BHEL that has to go in for considerable modifications. Moreover, Siemens has offered to supply circuit breakers with two interruptors as required, but these designs are yet to be tested by Siemens. For circuit breakers in the lower voltage range, Siemens is willing to offer the vacuum breaker technology but not the more advanced vacuum bottle technology. Further their vacuum breakers are neither the best nor the most economical, according to BHEL and other engineers.
- (ii) **Transformers:** The transformer technology to be supplied will cover all of BHEL's transformers except the 400 KV class. It is known that Siemens is not the best in this field and its experience in the 765 KV class is extremely limited. BHEL, on the other hand, has acquired considerable experience in this field and BHEL engineers say that it is Siemens that will benefit from the collaboration in this area.
- (iii) **Tap changers:** BHEL has already an excellent product and this will go completely out of use. There is no need for any collaboration in this product.
- (iv) **Diesel Locos:** Siemens has no adequate experience in this line and has not supplied any important component of diesel locos to the Indian Railways. If there are any spin-off benefits, they are yet to be demonstrated.

- (v) **AC and DC locos :** If Siemens motors are used, costs will rise.
- (vi) **Transportation systems :** Since Siemens does not make complete locos, a tantalising offer has been made that Siemens, as a member of the Fifty Cycle Group, will endeavour to the best of its efforts to get assistance from this group. However, it is doubtful if the traction equipment industry would hand over its technology to a poor cousin collaborator of one of its members. And if it does, its cost is bound to be prohibitive.
- (vii) **Switchgear :** It is stated that switchgear manufactured under Siemens collaboration will not be able to compete with those already being manufactured by Larsen & Toubro who have a collaboration with Brown and Boveri.

These examples are only illustrative and not exhaustive. It is relevant to have a few examples of the achievements of the R & D personnel of BHEL.

- They have designed a 15 MW turbo-generator for the Kalpakkam Atomic Power Project near Madras. This generator is of unusual parameters. Designs for low temperature and pressures had been available, but this design of BHEL's is for the high pressure of 110 atmospheres.
- The transformer factory at Jhansi has been wholly designed and erected by BHEL engineers. Several countries have requested BHEL to undertake similar factories for them.
- The largest synchronous motor to be designed and manufactured in India, a 9 MW motor, has just been successfully produced at the Hardwar factory.
- The Nagarjunasagar Steel Mills uses control devices completely designed and manufactured by BHEL, and no complaints about its working have come so far.
- 400 KV transformers have been designed and manufactured at Bhopal. These were developed from the previously imported technology for 220 KV transformers.
- Clophene, a noxious chemical which has to be imported for the manufacture of capacitors can now be replaced by a

safe castor oil based substitute successfully developed by BHEL researchers.

- BHEL's R & D has made significant progress in fluidised bed boiler research. A 10 tons/hr boiler and a smaller 2 tons/hr boiler are being tested out at Tiruchirapalli and at the Central Fuel Research Institute, Dhanbad, respectively.

BHEL's R & D reports for the years 1976-77 and 1977-78 list some of the important work in progress and work completed. Here is a short sample from these reports.

- The development of an epoxy resin encapsulated voltage transformer has been completed in BHEL. The new design is expected to save about Rs. 2 lakhs per annum for BHEL.
- Epoxy mica insulation has been developed for 120 MW turbo-generators.
- A large size squirrel cage motor in IEL frames has been developed on modular principles. The rationalised design will bring down cost and delivery time.
- The development of electro-hydraulic governors, expected to bring about a saving of Rs. 1 crore per annum, is at an advanced stage.
- Research on a double-shell design of steam turbine HP casing is at an advanced stage. When developed this will enable BHEL to offer 210 MW turbines with a shorter starting time.
- Research on developing and testing hydro-turbine models, aimed at creating a library of model profiles has also far advanced.

These are all achievements of which our people can legitimately be proud.

It is precisely at this time that this broad-based collaboration is proposed. If it goes through all the above achievements of our own engineers and scientific personnel in the field of R & D will have to be completely thrown overboard, since all these products will be replaced by Siemens designed products.

R & D engineers of BHEL are extremely angry and naturally so. For, if this Agreement goes through BHEL will completely rely on Siemens engineering knowhow and the results of their R & D. The process of technology transfer will completely bypass BHEL's own designers. Indeed with total dependence on Siemens for all such research for the broadest spectrum of products immediately and in the foreseeable future, what will be

the work of the 3,000 strong R & D Division at Hyderabad and the R & D divisions attached to each production centre? What will be the use of the complex of research laboratories, put up at the Hyderabad Corporate R & D Division and at other places? Our product engineers, whenever problems arise, will have only to send telex messages to Siemens and sit with folded hands praying that Siemens will deign to pass on the information. For the Memorandum says that it is not obligatory for Siemens to give the desired information. They will give only the information which they think necessary.

It is interesting to note here that Dr. Sharan, the Director (Engineering), had anticipated this. So, well before the Memorandum of Agreement was prepared, and probably when he was the chief negotiator, he had formulated the re-oriented goals of corporate R & D. No longer was it to be R & D for doing away with foreign collaboration and for self-reliance. In a note presented to the Board of Directors, he stated that BHEL, keeping in view "our economic and environmental conditions shall have, as priority areas of research, the development of solar power stations for individual and groups of villages and the development of bio-gas as an energy source."

The commercial exploitation of such sources is judged by senior scientists all over the world to be in the distant future. No major power generation equipment manufacturers have so far given any priority to such research. Dr. Sharan's R & D priority can only be understood in the context of the preferences he has for imported technology and to his aversion to any indigenous development effort.

VII

Impact of the Agreement on other Industries

A number of engineering and manufacturing organisations other than BHEL are reported to be deeply perturbed over the implications of the broad-based deal. Reports say that some of them have protested against the inclusion of some products in the proposed agreement.

BHEL is a dominant force and the pace setter in our country's electrical industry. Hence, anything it does has its impact on the industry. The proposed agreement will certainly hit very badly a number of research laboratories and a wide range of electrical and electronics industries outside BHEL.

The Central Electronics Engineering Research Institute at Pilani (Rajasthan) has for some time been doing research on thyristors for locomotive control. They have already supplied such equipment for diesel locos and a prototype for electric locos is now ready. If the proposed Agreement goes through, it is feared that the project will close down since Siemens will enter the area of transportation systems and control electronics.

The Minister for Industries recently announced that India and the EEC would jointly undertake a project on coal gasification. The leading institution in India is to be BHEL and for EEC a West German industry inevitably connected with Siemens. Electronics engineers believe that this project and the project to develop a Magneto-Hydro-Dynamic (MHD) Generator of 500 MW will be covered by the Agreement. There is already an MHD project jointly being developed at Tiruchirapalli by BHEL with Soviet scientists and scientists from the Bhabha Atomic Research Centre, Bombay. This project will have to be wound up if this Agreement is concluded. It will mean breaking a research tie with the acknowledged leader in this area, USSR. For the Bhabha Atomic Research Centre, it will also mean a sizable cut in funding. The Regional Research Laboratory at Hyderabad, which is commissioning a Lurgi plant imported at great cost for coal gasification and is now engaged in optimising its characteristics, will also be affected.

BHEL's incorporating Siemens systems engineering would mean the use of Siemens power electronic components in their

systems. This prospect of Siemens grabbing the entire field of power electronics in its systems has already made the electronics industry react very sharply against those aspects of the proposal with which the electronics industry is concerned. Bharat Electronics Ltd., Bangalore and the Chairman of the Electronics Commission are reported to have jointly protested against the Agreement on the grounds that BEL is today capable of manufacturing the power semi-conductors covered by the Memorandum.

The Electronics Corporation of India Limited (ECIL) has a fund of electronics knowhow. They have, on their own, developed process computers, programme logic control and data logging equipment. The Chairman of the Corporation has protested against these being included in Siemens India's "area of interest" and licences being given to them for their manufacture.

KELTRON of India, a Kerala State undertaking, already has a collaboration with Control-Bayly of France for the manufacture of power electronics. They fear that 30 to 40 per cent of their projects may be wound up if the Siemens Agreement is signed. The Kerala Chief Minister, Mr. A. K. Anthony, is reported to have strongly protested against it to the Industries Ministry of the Government of India.

The impact of the Agreement will not stop with this. Few manufacturers of electronic and electrical equipment will be able to supply components for BHEL projects to Siemens' specification. Siemens and its Indian subsidiary, Siemens India, will have a virtual captive monopoly market. Considering the expected scale of operations in the country, it will mean a greatly shrinking market for the Indian electronics industry, and for most of the small-scale units it will mean certain ruin.

One instance of a wholly indigenous R & D initiative which will be completely suppressed by the Agreement is the extended work on poly-crystalline silicon of electronics grade (99.99 per cent purity) by Dr. A. R. Vasudevamurthy of the Indian Institute of Science, Bangalore, which has been financed by Mettur Chemicals, a private sector enterprise. The Indian firm, which already faces serious competition in the Indian market by the collaboration of Grindwell Norton and Co. with a U. S. multinational, **Motorola**, now faces the prospect of Siemens also getting into the act.

VIII

Cost of the Agreement to the Country

The BHEL management has, in a press statement, stated that it has secured very advantageous terms, as the royalty to be paid is only 1.8 per cent. This is an attempt to suppress facts and mislead the people. Here are the financial burdens imposed on BHEL, that is on the country, in return for these dubious "services" to be rendered by Siemens :

" VII Consideration

- a) Subject to applicable taxes, BHEL shall pay to Siemens in consideration of
 - i) the supply of information by documentation and training of BHEL personnel, lump sum instalments in the amount of DM 5 million annually for the first to the tenth year of co-operation (i.e. DM 50 millions in all, equivalent to Rs. 20 crores).
 - ii) the rights granted under information and patents of Siemens royalties in the amount of 1.8 per cent of the **turnover** of BHEL during the term of co-operation. (emphasis added)
 - iii) other services to be rendered by Siemens including delegation of personnel to BHEL, the costs occurring for such services...
- c) Additional man-months of training and documentation shall normally be adjustable on a cumulative basis. Any excess over the stipulated minimum shall be chargeable at amounts to be agreed upon annually...
- d) other services to be rendered by Siemens are to be charged at costs".

It is significant that according to clause a (ii) relating to royalties, Siemens is to be paid at 1.8 per cent not of products

or systems where its technology is to be used. It is to be 1.8 per cent of the entire turnover of BHEL embracing all technologies, indigenously developed, American, British, French, Soviet or Czech and of all products and not merely of those covered by the Agreement

It has already been noted that Siemens has tied up the condition that the BHEL cannot export to countries where Siemens has manufacturing commitments. Where the BHEL exports, there also Siemens will make profits through the royalty clause. The BHEL may make a heavy loss in the export transaction, but Siemens will get its tribute.

A very conservative estimate of the total payments, taking the turnover of 1977 to be the average turnover for the 15 years of the Agreement period, is the staggering figure of Rs. 150 crores. BHEL's turnover in 1978 is an increase over that of 1977 and it is expected that over the next 15 years the turnover will progressively increase. Hence the actual payment during the contract period of 15 years will be much more than Rs. 150 crores and if it is extended for a further period of 10 years as stipulated in the Memorandum, one can imagine what the total payments will be.

This is apart from what losses the BHEL will suffer from the earlier decision of BHEL's to change over from the Soviet design to Siemens' design for the manufacture of 200 MW steam turbines, that had been referred to when discussing the earlier agreement.

This conservative estimate also does not take into account the enormous cost involved in remodelling, and in the purchase of components from Siemens till the time BHEL is able to manufacture them.

By importing systems engineering from Siemens, the BHEL will act as selling agents to Siemens and its Indian subsidiary, Siemens India, for all those components that go into that systems project. Only, the selling agent will not get any commission but the agent will pay tribute to Siemens for the honour of acting as its agent!

Quite apart from these, the detailed estimate of foreign exchange involved in this change-over to Siemens technology, the ultimate cost of the products, and so on have not been worked out. In fact, all the modalities that should be gone into before proposing a foreign collaboration agreement that have been laid down by BHEL itself have been buried deep.

Much more than the monetary loss is the total waste of the R & D developed by our engineers. This huge national waste of the talents of our engineers, technicians and scientific researchers, the loss of their morale and enthusiasm for patriotic efforts of self-reliance cannot be estimated in terms of money. **It is a national humiliation.**

An argument is put forward that it is because BHEL has inherited its design philosophy from many sources that it has been unable to establish a strong engineering base. Even a novice in science and engineering will scoff at this puerile prattle. In fact, the position should be otherwise. Exposure of BHEL's engineers and other personnel to a variety of design philosophies should actually widen their horizon and help them in establishing a stronger engineering base. Any specialist would testify to this.

There have been weaknesses. Some of them have been noted in the beginning. Complaints have come from many power plants that have installed BHEL equipment that some of them are not performing satisfactorily. The management of Santaldih power plant in DVC, the former Chairman of DVC and the present Chairman of the Madhya Pradesh Electricity Board, have publicly given vent to such complaints

There has been a total lack of co-ordination between the Marketing, Engineering and Power Projects (Erection) Divisions. As a result, responsibility is not fixed. Information on the defects noted does not reach the proper quarters. These facts are noted in a report on the organisation by A. Bogot, a recent visitor from one of the collaborators, Combustion Engineering who, however, was struck by the competence and eagerness to learn, assimilate and innovate as well as the devotion of the engineers at the production, executive and lower levels.

There is no doubt that owing to successive changes thrust on the engineers with bewildering rapidity, engineering departments have been forced to overstretch their capabilities. This has also contributed its share to the defects in many products.

During the course of his comments on the proposed Agreement, Mr. F. Haque, Executive Director (Commercial), says:

While a considerable amount of development work has been undertaken successfully to meet certain variations in designs a significant breakthrough in the area of product innovation or fundamental research has not taken place. Probably, because of the preoccupation with the normal jobs to meet customer commitments and **also lack of organised thrust in this direction.** Even in areas where there was a visible possibility of a successful development through our

own resources, we have been forced into some collaboration or other because of the time element. Partly due to the lack of effective planning for future requirements on the part of our customers and partly due to the inadequacy of our own assessment of the future, development work has not been started in time to meet the delivery requirement of the market. This has forced BHEL into a number of collaborations from time to time for specific products or designs resulting in difficulties—

- (i) for obtaining the best collaboration with reasonable terms and conditions and (ii) in convincing the Government that such collaborations were necessary and were not due to a total lack of effort or ability on the part of the Organisation.” (emphasis added)

Thus, it is admitted by F. Haque in his note dated April 6, 1978, that the number of collaboration agreements that had proliferated was due partly to lack of planning and partly to the inadequacy of BHEL's assessment of future demands which resulted in not taking up our own R & D in time, and was not due to the absence of R & D competence. Also admitted is the fact that as a result of hasty decisions to go in for collaboration, difficulties arose in getting the “best collaboration with reasonable terms and conditions,” which means, in plain terms, that the collaboration was neither “reasonable” nor the “best”. It is worth noting that the number of collaborations with Siemens and its subsidiaries was the largest.

The way to remedy this situation is to strengthen the Marketing Division so that information regarding future demand can be effectively given in time to the concerned engineering department to enable the starting of R & D in that product.

Opposition within BHEL smothered

Mr. S. V. S. Raghavan, Chairman of BHEL, circulated the Memorandum of Agreement on Broadbased Co-operation to a large number of personnel—product engineers, R & D engineers, etc.—and asked for their comments. Written comments from the overwhelming majority were extremely critical and were opposed to the proposal. The note by F. Haque, Executive Director (Commercial), is included as an Appendix. Other notes such as those by Mr. Basu, General Manager (Marketing), Mr. Khosla, Executive Director, Power Projects Division, Mr. Bhojwani, Engineering Manager in charge of control systems, Mr. Krishnamurthi, Engineering Manager in charge of capacitors, Mr. Chaudhuri, Engineering Manager in charge of traction motors and many others were much more outspoken and hostile. All their notes are not reproduced, for considerations of space. At

a meeting called for discussing the proposal later, a big majority of the engineers and others, except a few stooges were outspoken and opposed the proposal.

However, Dr. Sharan manoeuvred to have another meeting on the pretext that the engineers should give the matter second thought and study the proposal in greater depth. But many of the opponents of the proposal were not called to this second meeting and in their places, new ones were called.

There is a total absence of any organised opinion of engineers within the BHEL organisation. An association of the executive cadre is still taboo in BHEL, and all attempts to organise such forums in the past were severely dealt with by Mr. V. Krishnamurthy. In these conditions, the top management is in a position to browbeat all dissenters with threats of transfers or removal of persons from their fields of specialisation. The cases of Dr. M. Vishnu, a leading expert in turbine designs in the Corporate R & D Division, Mr. K. C. Vaish, the Executive Engineering Manager for steam turbines, Mr. Chakrabarty, Executive Engineering Manager for pumps, Mr. Chaudhury, Executive Engineering Manager for traction motors, Mr. Ganguly, Executive Engineering Manager for hydrogenerators and of many others are typical examples of the autocratic policy followed by the Director (Engineering).

In this background, the transfers and threats had the desired effect. Those who had earlier opposed the proposal fell in line with Dr. Sharan without stating any reason for their change of opinion. Other yes-men, of course supported the proposal enthusiastically.

IX

Export Performance

In the background of mounting criticism of this collaboration proposal in economic and other journals, people's attention was sought to be diverted by advertising the export performance of BHEL. A team of correspondents was sent to Libya—it is not clear whether the team was financed by the BHEL or the Ministry of Industry—and an article covering many pages of a weekly magazine, together with the photograph of Mr. V. Krishnamurthy, was published. The article applauded the assistance given by the Government, particularly through BHEL, in assisting Libya to put up a power project and other development works.

Our people would certainly be happy for all the assistance that our Government can give to development efforts in the underdeveloped countries. They would be happy if the Government and public sector undertakings would transfer to those countries whatever technology we have developed free of cost and without any royalty and other payments, unlike the multinationals.

But the other side of the story of export promotion by BHEL is not told. Earlier two projects had been put up by BHEL in Malaysia. The accounts for the project are not available. It is certain, however, that these projects have resulted in a heavy loss. For it is known that the BHEL had to go to the Government of India for a sanction of a net outflow of foreign exchange to the tune of Rs. 1.5 crores.

Our people would not grudge it even if the Government of India subsidised these projects in underdeveloped countries, especially when, in the name of 'export promotion subsidy', our people are forced to subsidise the consumption by the affluent people of Europe and America of even utility articles badly needed by our people.

However, what is one to say of these projects in Malaysia where BHEL has exported equipment which should have earned foreign exchange, but in practice resulted in a net outflow of foreign exchange?

The story of the turnkey power project being put up by BHEL at Tripoli in Libya is also of the same pattern. The contract for the project was concluded in 1976 and is of the order of Rs. 94 crores, out of which a commission of 25 per cent has to be given—one per cent to the Libyan Government by Libyan law, and 1.5 per cent to a local agent who is supposed to have secured the contract for BHEL. When the BHEL Chairman and top directors had made so many trips to Libya and carried on protracted and detailed negotiations with the officials of the Libyan Government, why it was necessary to pay nearly Rs. 15 crores to a local agent is a mystery.

The sub-contract for the civil works to be carried out in Tripoli was given to Gammon & Co., a firm of civil engineering contractors of Bombay. The facts about this sub-contract in the report of the internal audit carried out by Mr. V. S. Gupta, Deputy General Manager (A & T) of BHEL, are, to say the least, shocking. A sample of these facts are given below. (The entire report is given separately as an Appendix):

"A detailed and proper market survey is a pre-requisite for making a correct estimate of the cost of project/works for the purpose of accepting the terms offered by a tenderer and for fixing the rates for various items of work. In this case however, no reliable or correct market survey appears to have been conducted. This is evident from the following two important items in the schedule of quantities which constitute about 40% of civil work:—

- (i) For soft soil excavation work, a rate of L. D. 8.68 (L. D. stands for "Libyan Dinar") per cubic metre has been fixed. This rate has been found to be very much on the high side as compared to the normal rate in the area for excavation work even as per information available in the site records/accounts, inasmuch as **the authorities have themselves entered into a separate agreement for excavation work of exactly similar type within the area of the same civil work with a local firm of Messrs. Ginshiwa Sons, vide agreement dated 30-4-77 for about 70,000 cub. metres excavation at the rate of L. D. 2.10 per cubic metre for the total contract value of about L. D. 157,500.**

"It is also understood further that the sub-contractor Gammon have now appointed the same firm Ginshiwa for the excavation work allotted to them by the Company (BHEL) at rates even lower than L. D. 2.10 per cubic metre obtaining in the area. The excavation rate of L. D. 8.68 per cubic metre allotted to Gammon and Co. is thus more than four times the normal rate of L. D. 2.10 obtaining in the area." (emphasis added)

One Libyan Dinar is approximately equal to Rs. 3-00. This means that the rate fixed for Gammon and Co. is about Rs. 26-00 per cubic metre as against the normal rate obtaining in this area, about Rs. 6-30. And Gammon and Co. have further sub-contracted this work to Ginshiwa at rates even less than Rs. 6-30 per cubic metre, and pocketed the balance of Rs. 20-00 per cubic metre.

The report continues :

"The total quantity of earth work as per the schedule of quantities comes to about 90,590 cubic metres. This would result in excess payments to the tune of L. D. 596,082 (L. D. 786,321-190,239), equivalent to about Rs. 1.8 crores.

- ii) Besides the above, the additional quantity of one lakh cubic metres of excavation work referred to earlier would result in excess payment of about Rs. 2 crores. The total excess payments involved in excavation would thus be of the order of Rs. 3.8 crores...

" High Rate for Concrete Work

For concrete work of all grades, a rate of L. D. 44 per cubic metre (Rs. 132-00) has been fixed in the schedule of quantities. This rate also appears to be highly excessive in view of the fact that :

- (a) cement has to be supplied by the Company (BHEL), so the sub-contractor has to provide for only sand, metal plus labour for laying concrete, and
- (b) the normal rate of readymade concrete including cement in the market in Tripoli is only L. D. 12 (i. e. Rs. 36-00) per cubic metre. In Tripoli, because of large-scale construction activities, readymade concrete with facilities to lay the same is openly available. Even our site-office has made a number of such purchases for its own construction work, eg., purchases of two lots of twelve cubic metres and eight cubic metres of concrete from the open market on 12-7-1977 at the rate of L. D. 12 per cubic metre, as per entries in the cash book...

"Now as per schedule of quantities the total quantity of concrete comes to 30,213 cubic metres on which the excess payment at the rate of L. D. 30 per cubic metre works out to L. D. 906,390, equivalent to about Rs. 2.7 crores." (emphasis added).

Elsewhere in the report, the following has been stated :

“ Lack of correct physical survey :

- (i) Under ‘ turbine hall and control room annexe,’ ‘Earthwork excavation’ has been described as “ excavation in rock ” and thereby allowed double of the normal rates in L. D. 17.33 per cubic metre as against the rate of L. D. 8.68 per cubic metre, the quantity having been estimated at 16,000 cubic metres. On actual working it was found that there was no rock in the excavation work which was in soft soil. This has become a matter of dispute between the Company and the contractor who claims L. D. 17.35 for 19,515 cubic metres. This makes a difference of L. D. 169,200, equal to about Rs. 50 lakhs.

It is relevant to note that in ‘ turbine hall and control room annexe’ only one ‘excavation in rock’ has been provided and the item for ‘excavation in soft soil’ has been totally omitted in spite of the fact that the soil in question could not be totally rocky for the simple reason that the excavation in the entire adjoining soil has been provided for at the rates applicable to non-rocky soft soil.

- (ii) Under the head ‘cooling water system’ for the part ‘settling basin and feeding pool’, volume of work for the item of excavation has been estimated at 27,000 cubic metres. This has been found to be an awful underestimate as the work till Sept. ‘77 has reached 90,246 cubic metres and as per the revised estimates the additional work is likely to be one lakh cubic metres. This item alone will result in additional payments to the tune of L. D. 8.68 lakhs, i.e., about Rs. 2.5 crores to the sub-contractor...”

Under the heading “ **Lack of correct specification/designation/estimation** ”, the report notes the following in respect of requirements of structural steel :

“ According to the tender for civil works, the requirement of structural steel was estimated at about 400 tonnes...

“ On further assessment of the requirement of structural steel, it has been found that a total quantity of 2,590 MT will be required for the civil works...”

The report states :

“ Tender revised to favour Gammon

"Some of the clauses in the tender which were unfavourable to the sub-contractor have either been deleted or relaxed by the memorandum agreed to subsequently apparently after negotiation (Annexure 10). Some of these are likely to result in substantial extra cost to BHEL."

One or two examples of such modifications are enough to show the enormous and unusual concessions given to Gammon and Co

"All risk insurances, third party insurance and export credit guarantee corporation cover for the whole project including work covered by civil work sub-contractor has been made the liability of BHEL." (emphasis added)

The clause prohibiting the covering of works before inspection by BHEL engineers and without notice for seven days had been deleted. A clause which provided for recoveries where the cement used by Gammon and Co. is less than the theoretical quantities has been deleted (in other words, BHEL is to pay for material not actually used). The clause fixing the responsibility for provision of drinking water, sanitary arrangements for their workers and an inspection cabin on Gammon and Co. has been deleted.

According to the auditor's report, at least 22 such modifications to the tender in favour of Gammon and Co. have been made. These can be found in the text of the report given in the Appendix. The report states:

"a comparative statement of receipts regarding the civil works in Libya has been prepared and is attached as Annexure 'D' which will show that as against the possible receipt of L. D. 6.3 million (about Rs. 19 crores) the expenditure by way of payments to the sub-contractor and cost of material, etc., for the civil work (excluding other administrative expenses) would far exceed L. D. 9 million (i.e., about Rs. 27 crores)"

Quite apart from these are the excess expenditures incurred as a result of under-estimation of requirements of many items such as structural steel. Repeated calculations and recalculations undertaken after the author made the public statement referred to earlier are unable to put the expected loss at any figure less than Rs. 30 crores.

There is also a penalty clause which imposes a penalty if the project is not completed within the scheduled time. The project is already nine months behind schedule. If the Libyan Government enforces the penalty clause, the loss may be Rs. 35 crores or even more.

It must be remembered that as part of this contract of Rs. 94 crores, the hardware that BHEL would be exporting would comprise only Rs. 35 crores. The balance will go for civil works in Libya and expenditure incurred for administrative and engineering personnel and procurement of material in foreign countries. These latter payments will have to be made by BHEL in foreign exchange.

Under the circumstances, the net foreign exchange earnings would be either nil or, as in the case of the earlier Malaysian projects, there may actually be a net outflow of foreign exchange. In the earlier Malaysian contract also, one of the causes for the financial debacle was a gross underestimate of the quantity of civil works. (At that time, those who were in overall supervision of the projects were Mr. V. Krishnamurthy and Mr. V. R. Deenadayalan, the present Executive Director in charge of the Tiruchirappalli plant.)

The auditor's remarks that "no reliable or correct market survey appears to have been made" and the excess quantity of civil works that had to be put in was "the result of a wrong and incorrect survey at the initial stages" does not appear to be correct. Naturally, an internal auditor of the Company, who is working under the former Chairman and present Secretary of the Ministry, has to work under great constraints and when such shocking facts are recorded in the course of his audit, he has to be extremely careful and guarded in his comments.

The auditing officer himself had stated at the beginning of the report:

"It appears from the records (memo for 78th meeting of the Board) that prior investigations were made in Libya by a team of BHEL engineers about site conditions, working conditions, current market rates of civil engineering works etc."

It is incredible that the entire team which had investigated the market rates prevailing in Libya, would not have reported that the prevailing market rate for earth work was only L. D. 2.1 per cubic metre and that for ready-made concrete, **including the cost of cement that goes into its production**, it was only L. D. 12 per cubic metre. (The rate paid to Gammon and Co for concrete was L. D. 44 **excluding the cost of cement**.)

It is equally incredible that all the senior engineers comprising the team were so 'incompetent' as to make such fantastically gross underestimates of various aspects of the civil works such as soil conditions, quantity of earthwork etc.

Their work had been supervised by Dr. Sharan, the Director (Engineering) who is supposed to be an 'expert', and by Mr. V. Krishnamurthy, an engineer (although only a licenciante) who had risen to the top-most position in BHEL by virtue of his supposed outstanding merits and competence. These two visited Libya often during that period. In this connection it should be noted that Gammon and Co. was selected as the sub-contractor in preference to a well known Madras firm whose tender was 40 per cent lower than that of Gammon and Co.

It is recorded that Mr. V. Krishnamurthy had stated that the Libyan contract could go through only on the condition that Gammon and Co. be appointed as sub-contractors for the entire civil works component of the project.

In this context, the modification of so many clauses of the tender to the great advantage of Gammon and Co. and to the disadvantage of BHEL, which according to the audit report are "likely to result in substantial extra cost to BHEL," assumes tremendous significance. Normally, under such circumstances, immediately after the receipt of the audit report, action would have been initiated against the members of the team of engineers who made the prior investigation for having misled the Board, as a result of which the Company incurred losses amounting to crores of rupees. No such action was initiated.

One would expect that these facts would have been brought to the notice of Parliament. The annual reports of public undertakings are supplied to members and are placed on the table of Parliament. Even the Minister for Industries had not been told of these facts, which were sought to be suppressed. This is evident from the following incident.

Some time in June 1978, when the author mentioned to Mr. George Fernandes in his office in Udyog Bhavan that the Libyan contract was going to result in a loss of at least Rs. 30 crores and that Dr. Sharan had very much to do with the existing state of affairs, the Minister disbelieved it and said that Dr. Sharan was not in BHEL at all when the contract was made. When the author told him to verify this, Mr. Fernandes got in touch with Mr. V. Krishnamurthy, who was then Secretary for Heavy Industry in his Ministry, through the telephone and asked him when the Libyan contract was made. Mr. V. Krishnamurthy informed him that it was done in 1976. By then Dr. Sharan had been promoted as Director (Engineering). Mr. Fernandes then told Mr. Krishnamurthy that he was told that the Libyan contract would result in a huge loss. The author did not hear what Mr. Krishnamurthy told the Minister, but in a minute, the Minister told the author that the sub-contractor for civil

works, Gammon and Co., was making some extra claims, that these could be managed and that false reports were being given to the author about its financial position by some interested persons.

It is evident that Mr. V. Krishnamurthy was suppressing facts even from the Minister.

All these clearly show that a shady deal had been struck. Who were the actual beneficiaries? Who shared this huge loot, amounting to tens of crores of rupees, of the public exchequer? Who had stipulated that the Libyan contract would go through only on condition that Gammon and Co. was given the sub-contract for the entire civil works? Answers to all these questions can only be found by a thorough and full-scale investigation.

Again, it needs emphasising that the contract was concluded at the height of the Emergency, when Mrs. Indira Gandhi and her caucus were all-powerful, and when all norms and procedures laid down for administrative propriety were trampled upon with impunity.

X

Key Men Behind Collaboration with Multinationals

The two key men behind the proliferation of collaboration deals with multinationals are Mr. V. Krishnamurthy, former Chairman of BHEL and at present Secretary (Heavy Industry) in the Ministry for Industries, and Dr. H. N. Sharan, at present Director (Engineering) of BHEL.

Mr. V. Krishnamurthy is just a licentiate in engineering, who worked in the Madras State Electricity Board in a very junior post and later joined the BHEL. His rapid rise to top positions in BHEL is rather mysterious.

Soon after he came to a key position in the Tiruchi Plant, he exhibited his zeal for foreign collaboration. He was instrumental in the first collaboration with Combustion Engineering of U. S. A. It is noteworthy that after he went to the United States and negotiated the agreement, Mr. O. S. Murthi, who was Chairman, and Mr. S. V. S. Raghavan went to the United States and brought down by 15 per cent the monetary payments to Combustion Engineering negotiated by Mr. Krishnamurthy.

After he became the Chairman and Managing Director of BHEL, Mr. Krishnamurthy perhaps felt the need for someone who could be passed off as a person with a great deal of expert knowledge in electrical equipment manufacture. He brought in Dr. Sharan, who was working with Sulzer Brothers of Switzerland, in 1974 on very special terms. He also inducted a Mr. Shukla, who was working in the United States, and appointed him Marketing Officer in the Deputy Manager's grade in 1975. Within a year and a half, Mr. Krishnamurthy gave him a double promotion to the Senior Manager's grade. Mr. Shukla has been going abroad almost twice a month in the name of sales promotion. Why sales promotion in foreign countries should have been necessary when BHEL's order books were full with orders to be executed inside the country, is indeed a mystery.

Mr. Krishnamurthy, after he became Chairman, appointed an English consultant, Mr. John Marsh, as a management consultant to BHEL on a substantial payment. This Englishman used to

make occasional visits to India at the expense of BHEL. There are reported to be no written reports of his available at BHEL. He used to deliver occasional lectures to the management personnel. Most of those who have come across Mr. Marsh scoff at his claiming the competence to give any useful advice on management. In all likelihood, Mr. Marsh was a contact man useful for entering into collaboration with multinationals.

Mr. Krishnamurthy's successor as Chairman and Managing Director politely terminated Mr. Marsh's connection with BHEL within a few months of his assuming office.

But Mr. Krishnamurthy, in his capacity as Secretary (Heavy Industry) in the Ministry for Industries under whose charge BHEL also falls, in response to a demand made by Mr. Marsh invited him to come to India and undertake a study of the 'organisational dynamics' of BHEL. The Board of Directors of the BHEL was not consulted before inviting him, but the entire expenses were charged to BHEL.

What study Mr. Marsh made of BHEL's 'organisational dynamics' and what report he submitted is not known to anyone in the BHEL. It is not known whether the permission of the Minister was obtained for inviting this gentleman.

Mr. Krishnamurthy, apparently, is so enamoured of everything foreign that he went in not only for importing foreign technology galore from multinationals, but also sought foreign assistance in management, when there are so many well-known institutes of management in the country. No other public undertaking in the country seems to have sought consultancy service in management from foreign countries.

It is noteworthy that just as it was during his tenure as BHEL Chairman that the numerous agreements with multinationals were arrived at, it was soon after Mr. Krishnamurthy became Secretary (Heavy Industry), that the application to grant a license to the Tatas to import equipment for a 500 MW project in Maharashtra, which had been held up for some years, was cleared.

The decision to switch over from the present design for 200 MW steam turbines to KWU design was also taken after he became Secretary (Heavy Industry).

Dr. Sharan, who comes from Bihar, graduated in engineering in India and went to England and obtained a doctorate in engineering. He has an English wife, who continues to be a British citizen, and three children, two of whom are studying in England.

Thereafter, he worked with Sulzer Brothers in Switzerland. He was reported to have been heading the R & D section concerned with boilers and nuclear technology when Mr. Krishnamurthy recruited him. One would certainly be glad if an Indian heading a research section of a multinational had given up his lucrative job and come back to India to help the development of indigenous technology in our country. One would appreciate his high sense of patriotism. In that case one would not grudge even the fact that such a man was appointed on unusual terms. Dr. Sharan of course, is allowed to go to England on leave and the entire expenses for himself and his family are borne by the BHEL. Indian executives of any company in the public or private sector are not allowed to do so.

But the actual performance of Dr. Sharan during his four year service with the BHEL shows he had accepted the job in BHEL with motives exactly the reverse of those of advancing indigenous development of technology !

A new separate R & D division, known as the Energy Systems and New Products Division (ESNP Division), was created for him at Delhi and he was appointed as its Head and Advisor in Delhi. Why this new establishment was necessary, when a Corporate R & D Division had already been started in Hyderabad in 1972 and necessary facilities were being set up, is known only to Mr. Krishnamurthy and Dr. Sharan. This was done evidently to enable Dr. Sharan to cultivate the higher-ups in the Government in Delhi.

Within two years, Dr. Sharan was made the Director (Engineering) of BHEL, overlooking the claims of senior engineers of proven competence. The ESNP Division, especially created in Delhi for this 'great' researcher, was dismantled and merged with the Corporate R & D Division at Hyderabad as soon as Dr. Sharan became Director (Engineering). The achievements of the special R & D Division in Delhi during its period of existence are not known.

However, Dr. Sharan did succeed in his mission of cultivating the higher-ups in Government. By 1976 he was made a member of the National Committee on Science and Technology (NCST), the Council for Scientific and Industrial Research (CSIR), the Energy Research Council, etc. That was at the peak of the Emergency and all top appointments were made by Mrs. Indira Gandhi and the caucus around her.

This man who was brought to BHEL as a great expert in research for advancing the development of indigenous technology, however, exerted all his efforts in tying BHEL to West German multinationals, particularly Siemens, through collaboration agreements. Instead of concentrating on research, he frequently went abroad.

Some of the efforts he made, and 'successes' achieved in this direction during his short tenure, are given below :

- (1) Within a year of his appointment he made a proposal, which was accepted by Mr. Krishnamurthy, that the BHEL host an "Indo-German Power Symposium". The purpose of this symposium is obvious.
- (2) A collaboration agreement for HP-LP bypass systems was signed in 1975 with Sulzer Brothers (now a subsidiary of Siemens) within a year of his joining BHEL.
- (3) Technical collaboration agreements were entered into with Siemens for power electronics and drive system designs.
- (4) BHEL recommended installation of gas turbines in collaboration with foreign firms to the Maharashtra State Electricity Board and the whole evaluation was entrusted to the BHEL. The technical evaluation was manipulated, undue favour shown to KWU, and collaboration with it recommended.
- (5) A technical collaboration exists already with Czechoslovakia for setting up feed pumps for 500 MW units. BHEL decided to look for a new technical collaboration for the development of the same product. Adroitly, the choice was restricted to only a few firms, Sulzers, KSB of West Germany, Hitachi of Japan, and so on, overlooking many leading international firms in this field. The final recommendation was Sulzer Brothers, with whom Dr. Sharan was working earlier. Mr. Chakraborti of Hardwar lost his post for his firm opposition to this deal.
- (6) For perpetuating tie-ups with West German multinationals, even R & D efforts are being tied up with them in what are called joint R & D projects. Examples are a research project of BHEL for the development of a 10 KW solar power plant, and for the development of fluidised bed combustion boilers in collaboration with West German institutions—although it is well-known that in research in these areas the West Germans are far behind many other countries.
- (7) Several more research projects have been tied up with Sulzer Brothers, Lurgi and other institutions of West Germany.

- (8) A collaboration agreement was signed with MAN of West Germany for the manufacture of seamless tubes in the Tiruchi unit. The association of MAN with Sanjay Gandhi's Maruti plant is well-known.
- (9) A proposal to set up a mica tapes manufacturing plant in Bihar by the Mica Corporation of India (a subsidiary of the Government-owned MMTC) is being sought to be torpedoed by Dr. Sharan. The plea is that BHEL is switching over to the Siemens Micalastic insulation system.
- (10) Dr. Sharan is moving heaven and earth to persuade the Ministry of Electronics to put up a National Institute for Silicon, which is to use the obsolete technology acquired by BHEL from Siemens. This proposal, if it materialises, will help Siemens dominate the manufacture of silicon chips in the country.
- (11) The signing of the collaboration agreement with Siemens for 200 — 1,000 MW steam turbines has been dealt with in detail earlier. The terms of the agreement were in favour of Siemens, BHEL having to pay 4 per cent of its turnover as royalty in addition to the down payment and so on.
- (12) The decision to switch over to Siemens designs for the manufacture of 200 MW steam turbines, which BHEL is already manufacturing with comprehensive knowhow acquired from the Soviet Union, and the disastrous consequences of this decision, have been dealt with in detail earlier.
- (13) And now to crown all these tie-ups with West German multinationals, the overwhelming majority of which were with Siemens and its subsidiaries, comes this proposal for a 15-year collaboration with Siemens for the production of electrical products that BHEL is currently manufacturing, for import of systems and application engineering and for importing its management practices! This has been discussed in detail.

It has already been stated that many top executive engineers in charge of products had either to lose their posts or face other types of victimisation for their opposition to this course of collaboration and scuttling of independent R & D for a rapid development of independent self-reliant technology. The most glaring instance of this is the removal of Mr. K. V. Balakrishnan, a senior engineer of proven competence who was in charge of the Corporate R & D Division in Hyderabad from its inception in

1972 and who successfully built up the whole complex. He has been shunted on deputation to the Libyan Government, a job which any engineer even one much junior to him, can perform.

Preoccupied with negotiating and pushing through so many collaboration agreements in such a short time, and shuttling between India, West Germany, Switzerland and other countries for that purpose, and with frequent trips to Tripoli for the Libyan contract, how could Dr. Sharan find time for the organisation of any R & D effort or for attending to the numerous engineering problems of BHEL in the country? The only instance of any research and development attributed to him was the installation of a solar water heater in the then Prime Minister, Mrs. Indira Gandhi's residence and another in his own residence. The one in his residence was hastily dismantled in May this year when controversies arose openly about BHEL in the press. As for the one put up at Mrs. Indira Gandhi's residence, the present Prime Minister, Mr. Morarji Desai, is reported to have said that it does not work. This solar water heater may not even be Dr. Sharan's original effort, for in many foreign countries they are already in use and he might have imported them in the name of research in solar energy systems!

The irony of it all is that it was in 1974 that BHEL in its first corporate plan pompously proclaimed "the development of R & D activities in such a way as to reduce dependence on foreign technologies" as one of its principal goals. And it is exactly in that year that Dr. Sharan was recruited to work for an entirely contrary course: to increase dependence on foreign technology and finally to make BHEL permanently dependent on foreign technology. The proliferation of collaboration deals has been mounting exactly from that year, 1974.

It is no wonder that Dr. Sharan, with all the preoccupations described above, has rarely visited the numerous projects of BHEL in India which are waiting for the solution of many engineering problems. The host of complaints that have been openly voiced about BHEL's equipment in recent times testifies to the neglect of such problems. It is also no wonder that he finds no time to discuss the numerous engineering problems that BHEL faces with senior engineers even when they come to Delhi, where the corporate office is situated.

The inventory of power equipment lying idle in power station sites waiting for erection and commissioning was 3,000 MW in 1974. Now, after four years of erection and commissioning by BHEL on a turnkey basis, this idle inventory is 10,000 MW. When the country is crying out for power and its industries are starved of power, Dr. Sharan has no time to

look into this vital problem. Nor did Mr. Krishnamurthy have the capability to set right the organisational lag which has led to this mounting waste of national resources.

This mockery of the goal of 'reducing dependence on foreign technology' has resulted in the foreign payments of BHEL by way of royalty and other charges going up from Rs. 5.7 crores in 1976-77 to Rs. 13 crores, a jump from 1.3 per cent to 2.7 per cent of its total turnover. How much greater this increase will be after the switchover of 200 MW turbines to Siemens technology and the materialisation of the proposed long term collaboration is a frightening prospect to contemplate.

XI

Raghavan's Ouster Due to Pressure of Siemens and its Lobby

On March 29, 1978, the Minister for Industries, Mr. George Fernandes, in the course of his reply to the debate on the demand for grants for his Ministry, referred to the high salaries and perquisites of company executives and to the fear that if they were reduced talented persons would not be attracted. Countering this line of argument he said, "BHEL's performance this year is 550 crores of rupees of production and profit Rs. 75 crores. This is BHEL's performance. No matter what complaints people (private company executives) have, BHEL's Chief Executive is being paid Rs. 3,500 or Rs. 4000 (actually it was Rs. 3500) a month and **he does a good job.**" (emphasis added)

This is probably the first time in the history of Parliament that a Minister for Industries has paid a compliment to the chief executive of a public sector undertaking on the floor of the House. That he should have chosen to pay this compliment to Mr. S. V. S. Raghavan, who took charge as Chairman and Managing Director on September 1, 1977, that is, just a little over six months previous to this statement, was noted by several people, including the workers and employees of the Company. The value of production at BHEL was Rs. 190 crores in the first half of 1977-78. The year ended with a production worth Rs. 550 crores, i.e., it almost doubled in the second half. This was probably the reason why the Minister chose to pay this public compliment in Parliament.

And yet, within a month of this compliment, Mr. George Fernandes asked Mr. Raghavan to go on three months' leave preparatory to termination of his services with BHEL. Naturally, this led to a public controversy and many newspapers have, in the absence of any explanation whatsoever for this amazing action, brought out their own versions of the causes leading to Mr. Raghavan's ouster.

The Minister is reported to have stated to friends that he had to choose between Mr. Krishnamurthy and Mr. Raghavan and he chose Mr. Krishnamurthy. He is also reported to have said that

"Raghavan is an honest, hardworking and straightforward man, but he is not able to get on with his team."

Mr. Raghavan tried to introduce the new management culture that the Minister had promised to do in the first meeting of the Joint Council of trade union and management representatives. He also sought to implement the declaration made by the Minister in that meeting that charges of corruption against officials, if made by trade unions, would be seriously taken note of, investigated and acted upon.

The issue of circulars by Mr. Raghavan inviting the opinion of all concerned with a view to evolving a just and equitable promotion and salary policy so that arbitrariness, favouritism and nepotism might be minimised, if not completely eliminated, and the initiation by him of enquiries and action against some of the top executives when concrete charges or complaints had been made by trade unions must certainly have alienated some of the executive officers.

Mr. Raghavan issued a circular to all engineering personnel seeking their views for improvement in efficiency in power plant erection; he asked the Engineering Division at Hardwar—where engineering, manufacturing and all activities connected with the manufacture of steam turbines are being carried on—to deal directly with the collaborator on all problems that arose so that technology could be quickly absorbed (previously this was done through the corporate office, through the Director (Engineering)); he refused to immediately accept a proposal of Dr. Sharan's for a collaboration with Sulzer Brothers or KSB of West Germany for the manufacture of boiler feed pumps but referred it instead to a committee consisting of the Member (Operations) of the Central Electricity Board, the Chairman of the Andhra Pradesh Electricity Board (who is also a Director of BHEL), the Executive Engineer, BHEL, Hyderabad, and others to examine the proposal from the point of view of national and consumers' interests; he drew up a plan for quick indigenisation for the manufacture of 200 MW steam turbines whose manufacture had been switched over to KWU technology—all these must have embittered Dr. Sharan.

Mr. Raghavan also circulated the proposed Memorandum of Agreement with Siemens to a wide spectrum of engineers for their comments and called a meeting of engineers to discuss the proposal. Such a thing had never before been done in BHEL's history.

He also asked Dr. Sharan to cut down his foreign tours to the minimum and start visiting BHEL's sites in India and concentrate on attending to their problems.

Mr. Raghavan sent the internal audit report on the Libyan deal to Dr. Sharan and asked him to take steps to ensure that such lapses did not occur again.

This style was unlike that of his predecessor, Mr. V. Krishnamurthy.

Mr. Krishnamurthy's interference went to the extent of asking for an explanation from the Chairman for his decision asking the Engineering Division at Hardwar to directly deal with the collaborator on all questions that arose in the implementation of the collaboration agreement, a decision which was wholly within the competence of BHEL and in which no policy or financial burden was involved.

The Secretary seems to have stopped a proposal by the Chairman to pinpoint accountability whenever BHEL equipment was found defective.

One would have expected the Minister to find out what the differences were between the Chairman on the one hand and the Secretary and the others on the other hand and pinpoint who was right and who was wrong. This is particularly so when the performance of the Chairman was openly praised and there were no charges of corruption or malpractices against him.

In this connection it may be mentioned that though Mr. George Fernandes has been a trade union leader of long standing, he did not care for the joint memorandum of all trade unions in BHEL and all the national trade union centres, who, despite their differences, together demanded reconsideration of his decision. (See Appendix)

Under the circumstances, when the Minister chooses to dispense with the services of the Chairman without any enquiry being conducted or any charges levelled, rumours are widely prevalent.

At the press conference held by the author at Madras when he was commenting on and criticising the proposed agreement, the pressmen repeatedly pestered the author with questions about alleged interests that the Minister had in concluding the agreement. They asked him whether the close association that Mr. Fernandes had with the Socialist International and particularly with Mr. Willy Brandt had anything to do with it. The author stated that he had no evidence to that effect and that he was hopeful that his public comments would receive due consideration from the Minister. The Minister must thank his own Secretary for the persistence of these rumours, for the Secretary is reported to be telling his friends that no matter what might be the

opposition to the proposed agreement with Siemens, it would go through because the Minister is firmly on his side !

The Raghavan episode raises a fundamental issue of Government policy. What is the relationship that should prevail between the Secretary of the Ministry and a public sector undertaking for which the Ministry is responsible? Is the Secretary a super-boss of all the undertakings for which the Ministry is responsible or is he only to tender advice to the Minister in the formulation of policies?

The Jaganmohan Reddy Commission has said that officers of the civil service had constitutional protection and should not feel helpless when they gave correct advice to their superiors. For this purpose it has recommended statutory safeguards to ensure that no action is taken against them simply for differing with their political bosses.

Does this not apply also to the officers of public sector undertakings? Are they to be removed simply because they differ with the Secretary of the Ministry?

If this position continues, then no chief executive of a public sector undertaking will have the guts to take any initiative, and the public sector would be unable to attract independent, talented people with a sense of self-respect. The so-called autonomy of public sector undertakings will be a myth.

The continuation or otherwise of the officials of public sector enterprises in service must be based only on their accountability judged by performance and incorruptibility.

The abrupt termination of the services of a man of proven efficiency is widely attributed to the Siemens lobby in BHEL and the Government.

XII

Stop this Sell-out

In the previous chapters, the systematic manner in which from 1974, the development of indigenous technology was being sabotaged has been narrated. It has also been shown how the proposal for entering into a collaboration agreement for 500 MW steam turbines was processed, and how this finally ended in the collaboration agreement for the manufacture of 200 MW – 1000 MW range steam turbines being concluded in 1976 with KWU of West Germany.

The fact of the existence of the potential for indigenous development is further confirmed by a note prepared by the Heavy Industry Division of the Ministry of Industrial Development in 1973, when the proposal for 500 MW was referred to it. Mr. Mantosh Sondhi was then the Secretary for Heavy Industries in the Ministry.

It is a document remarkable for its cogency. It aims at examining alternative approaches to the manufacture of 500 MW thermal power stations by the end of 1980. The three alternatives examined are (i) conventional licence agreement; (ii) initial purchase of finished units and manufacturing knowhow as a package deal; and (iii) indigenous design and engineering effort with selective technical assistance and import of knowhow.

There is internal evidence in the document to show that it has been prepared after a discussion with and a thorough study of the documents on the subject by BHEL, the National Council for Science and Technology and the Task Force for Science and Technology of the Planning Commission.

The note lists the principal items of equipment that go into a 500 MW power plant and takes them one by one.

With regard to boilers, it says : " BHEL, Tiruchi, has developed a very good design and engineering organisation. It is capable of taking up original work in this particular field, with the standard information it has already secured from

Combustion Engineering and the training in Europe and United States which its personnel have acquired. It is possible for BHEL engineers at Tiruchi to develop, on their own, with very limited consultations that may be needed with Combustion Engineering, the steam generators to match the 500 MW unit."

With regard to boiler house auxiliaries, the note says that "with the preparatory work done by them (Tiruchi unit) for the indigenous manufacture of these auxiliaries for the 200 MW unit it should be possible for them to project and develop their own designs for equipment, suited for the 500 MW sizes."

As regards feed pumps, the note says that despite efforts at indigenous development, "there may be need to import some feed pumps for the prototype 500 MW unit. But the numbers and the capacity of those pumps will be so chosen as to fit in maximally with our overall system design. This should lead to better system performance when the pumps are later made in the country."

With regard to condensers and heaters, it says that "BHEL would confidently state that in respect of steam generation, boiler house auxiliaries, condensers and heaters, which constitute **more than 60 per cent of the money value** of equipment involved in a 500 MW unit, it should be possible for them to develop the designs through indigenous efforts even within a comparatively shorter period."

As regards turbo-generators and steam boilers, the note says that "a number of modifications to suit our conditions have also been made in these designs. The work of the Design Departments in BHEL and HEIL plants has, therefore, been significant and a stage has now been reached when they can confidently face the challenging tasks involved in the design and development of larger sets."

It was against this background of development of design and engineering that had already taken place that the three alternatives were discussed.

Alternative (i): Conventional Licence Agreement

The note says that this course was perhaps the best when an adequate number of trained engineers/scientists and necessary technological infrastructure was not available in the country.

At the same time it noted: "However, experience has shown that very often collaborators do not provide for the complete knowhow package and do hold back certain essential elements of

information for which they demand special charges or separate agreement. **As for design background, this is not furnished even on payment of special charges."**

This was not the experience in the cases of collaboration with the Soviet Union and Czechoslovakia. As already pointed out, they trained our engineers in their factories and transmitted to them not only manufacturing knowhow and design calculations but also design philosophy. One of the top engineers, Stapel Izat, when he was deputed to the Soviet Union to negotiate the purchase of some important component, was told by the Soviet people, "This is the last time we will supply the components. We have already given you all the information and training for its manufacture. Why don't you manufacture that yourself instead of coming to us again and again for its supply."

This experience assumes tremendous importance in regard to the proposed long-term collaboration proposal with Siemens and the provision in the memorandum of understanding that Siemens will only furnish information **which they think necessary.**

Alternative (ii): Initial Purchase of Finished Units and Manufacturing Knowhow as a Package Deal.

The note states that "the foreign suppliers will not be interested in passing on all the production knowhow to a manufacturing plant unless it be at an enormously high price." They will also be unwilling to train our engineers to acquire the expertise in the various specialised fields necessary for us to be independent of them.

On the basis of these and other considerations the note asserts that this course "will result in an increase in our dependence on foreign suppliers for a longer time than necessary, not only for supplies of essential components and materials, but also in tackling the large number of operational and maintenance problems that may arise with the commissioning of large size sets. It will also lead to large recurrent outflows in foreign exchange. **This is not a hypothesis, but a conclusion based on our own experience."**

Alternative (iii): Indigenous Design and Engineering Effort with Selective Technical Assistance and/or Import of Knowhow.

The note took into account the fact that many completely new design and engineering problems are likely to be faced. However, it was confident that "With the available expertise it is considered feasible to tackle a number of these on our own." We could, however, have "foreign assistance to the extent necessary to conform to time/cost frame's."

It also noted the limited areas where foreign assistance may be necessary.

Considering all the factors involved it listed the great advantages in opting for this course. "Firstly, it enables the building up of indigenous design and engineering competence and, as a result, the confidence to undertake design, engineering, construction and erection of projects entirely on our own in the next phase. Secondly, a design evolved in this way, by a team which involves specialists who have had first hand experience with the fabrication of smaller size equipment in our plants, is most likely to be one which maximises the utilisation of manufacturing facilities that we already have in our plants. Consequently, the lead times involved in prototype production and in setting up regular production are likely to be better and production costs, both capital and recurring, lower. Thirdly, and as a consequence of the first two advantages, the import content in terms of material components and sub-assemblies is likely to be less than in either of the two other alternatives. This is because there is more opportunity to draw up performance and industrial standards which are compatible if not identical to, what the rest of our industrial system is producing."

Thus the competence and capability of our engineers to develop 500 MW equipment is confidently asserted in this note. It only points out that there will be a time lag of about two years if this course is preferred to the other two. But even with regard to this, the note says that past experience has shown that the time schedule given by foreign collaborators is never adhered to.

What action was taken in respect of this note is not known. Mr. Krishnamurthy's note dated June 25, 1974 has already been noted. In that note he does not question the capability of our engineers to develop 500 MW sets. The only ground on which he recommended foreign collaboration was that indigenous development would take a longer time.

That there was no such urgency is now clear. As has been pointed out, although the agreement was concluded in 1976, no steps for manufacture of 500 MW sets have so far been taken. And even if there was such an urgency, collaboration would not have helped, for as the note referred to points out on the basis of experience, manufacture does not start according to schedule.

In this connection, the recommendation made by a high level Expert Committee on Fuel Policy, Government of India, in its Report of 1974 (Appendix VI) assumes importance. The Report stated: "A comprehensive survey of the problems involved in developing a 500 MW generating unit has been made and it is the considered view that the development responsibility

could be shared by the existing organisations in the country. The Committee recommends that the design, development and manufacture of 500 MW generating units should be entrusted to an Indian-agency with a time-bound programme to get the commercial production of such sets started in the early Eighties. The committee welcomes the initiatives already taken in this regard by the NCST (National Council on Science and Technology) and the Government "

It was precisely in this year that Dr. Sharan was taken on as a great expert on research and development, and since then the initiative for indigenous development has been brutally murdered.

The course of events since then has been fully traced. Instead of collaboration for a few critical areas, collaboration was proposed for 500 MW steam turbines. This ended with collaboration for 200-1000 MW steam turbines, and finally changed over our present 200 MW sets to Siemens technology !

All these clearly show that the attitude adopted by the top management of BHEL in the early seventies towards further and dangerous massive collaboration showed no recognition of the potential for self-reliant development that had already been revealed as the first collaboration agreements progressed and of the fact that by 1972 the foundation was laid for a separate R & D division to supplement and co-ordinate the R & D efforts in the various units of BHEL.

If this positive trend had been grasped and encouraged with some honesty and integrity, the import of technology, would have gradually declined and BHEL would have been more selective in importing technology, choosing only specific areas where the need was real and import of technology was unavoidable. This fact has been further confirmed in the note of Dr. Haque, Director (Commercial), which has been referred to earlier.

On top of all these comes this final act of sell-out to the West German multinational, Siemens; for collaboration for the development, on the basis of research carried on by Siemens, of **all the electrical products that BHEL is already manufacturing and also for systems and application engineering !**

Power generation is not a field where the most sophisticated equipment is absolutely essential. India can do for a long number of years with our own indigenously developed technology, with limited foreign help where it is unavoidable. Even then, who is to decide that in all the products listed in the memorandum for long-term collaboration that Siemens technology is the best and most sophisticated in the world and it is going to remain so for the next twenty five years?

What is surprising is that the BHEL top management has made this recommendation to the Janata Government which, in its election manifesto, declared that it would work for self-reliance. The Janata Government has reiterated this in the Industrial Policy Resolution and has categorically stated that foreign collaboration will be sought only in certain critical areas, where it is absolutely unavoidable.

XIII

Conclusion

The present period is one when the exploiting forces of the multinationals are regrouping and are looking for new methods of penetration into the economies of the underdeveloped countries and exploiting them in the face of the striving on the part of these countries for independent economic development and self-reliance, after winning political freedom. In countries like India where a certain level of development has already taken place and the foundations for further development indigenously have been laid, these multinationals are showing a growing interest in moving into heavy industries, otherwise known as 'core' sectors. This poses a great threat to self-reliance and the independent development of scientific and technological experience.

The proposed agreement with BHEL is clearly an attempt to gauge the climate for further penetration in this direction. If this agreement goes through, it is certain that the West Germans will move into other fields. They have already expressed their interest in other areas such as metallurgy and mining. This import of Siemens technology and systems and application engineering will act as a lever in their designs.

This policy will inevitably lead to increasing surrender on the scientific and technological front. The virtual dismantling of a unified research establishment, the Council for Scientific and Industrial Research (CSIR) and the relegation of the laboratories to the various Ministries has already had a debilitating effect on basic research. The laboratories and the scientific personnel working there are finding that their programmes and priorities are manipulated by bureaucrats in the crudest manner possible. Basic and high technology research has been downgraded and any spurious programme passing off as "rural development research" is promoted. These brilliant men are faced with a situation where, because of increasing enhancement of foreign technical collaboration, their own work suddenly turns out to be absolutely useless and an utter waste of energy and hard work. As a result, demoralisation and frustration among scientists have reached a peak. This is evidenced by the fact that while in the past the number of CSIR scientists who resigned their jobs in order to go abroad was never more

than 20 per year, last year alone, the number of scientists who left the country is reported to be 142. Most of them have secured employment in research laboratories in the advanced countries. Their talents are recognised and used by the multinationals to their advantage, but cannot be used for the advancement of our own country!

The proposed broad based Agreement between BHEL and Siemens is bound to result in the exodus of brilliant engineers in the public sector who have shown their mettle and capability, and in their services and talents being utilised by the multinationals to further their interests.

As far as BHEL is concerned, the proliferation of uncoordinated collaboration agreements in the seventies has inevitably introduced its own problems and weaknesses. Serious gaps and lags have revealed themselves. An undertaking which used to boast of impeccable performance has had to face in recent years serious complaints about the performance of its equipment from its customers, chiefly the State Electricity Boards. Instead of coordinating action by the various divisions of the undertaking and concentrating on rectification of these defects and perfecting the equipment, the management has been running after export markets in order to get applause from abroad and for image-building, and concentrates 25 per cent of its personnel on equipment for the exports which form only 5 per cent of its production.

The question naturally arises, why should BHEL run after export markets when the country is so short of power and all the equipment BHEL can make will not satisfy the needs of our power projects and it has to extend production to cater to the needs of the country?

In the final analysis it is clear that the vastly increased reliance on foreign technical knowhow that will be the inevitable consequence if this broad based collaboration agreement with Siemens is in force for 25 years, will be the biggest obstacle to BHEL developing along sound and healthy lines.

The multinationals are able to conspire and manoeuvre to push their plans through because of the secretive way the executive functions. Such serious proposals are put up and processed by its directors and pushed through by the executive behind the backs of Parliament and the people. Having their lobbies and henchmen in these undertakings and in key sections of the bureaucracy renders the task of these multinationals easier.

The Public Undertakings Committee of Parliament can investigate some of these deals only after they become a **fait accompli**.

There can be and should be no secrecy about such proposals. They must be placed before Committees of Parliament whose reports should be placed before Parliament and the people before such agreements are concluded.

The grave danger to the country can be fully grasped if it is remembered that the firm of Siemens was among the most prominent supporters of Hitler's Nazi regime in Germany. Siemens, along with its fellow monopolists, the Krupps, the Thyssens and A. G. Farben, financed Hitler's rise to power and made enormous profits during Hitler's regime. The Siemens firm was among the leaders in using Jewish slave labour to run its industries. Siemens followed right behind Hitler's armies in their aggression. When the Nazis occupied Paris, Siemens' share of the booty was the city's electric supply system. They immediately dumped their power equipment on the French power systems.

It is this monopoly, with its insatiable thirst for loot, that advertises itself as "helping to engineer the future of India."

All Members of Parliament, all those interested in the healthy and self-reliant development of our country and in ending its exploitation by the multinationals must prevent this proposal for a disastrous, anti-national sell-out.

APPENDIX I

INTERNAL AUDIT REPORT ON BHEL's TURNKEY PROJECT IN LIBYA

BHEL has entered into a turnkey contract with Messrs. ECT, Tripoli for the construction of a 2x120 MW oil fired thermal power station extension project at Tripoli. The sub-contract for the completion of the civil works has been given by BHEL to Gammon India Ltd. The agreement was entered into on 17-11-76 by which the original tender documents were modified and some special conditions were agreed upon. The total value of the contract for civil works in the schedule of quantities has been estimated at L. D. 6061668 (about Rs. 18 crores). This is about 75% of the total value of about Rs. 24 crores for the entire erection work of the power project for civil, mechanical and engineering works.

An examination of the contract documents and other relevant records has been made during the audit of the accounts and other transactions of the Tripoli site. The following comments are offered on some of the important aspects :-

- (i) Some of the clauses in the tender which were unfavourable to the sub-contractor have either been deleted or relaxed by the memorandum agreed to subsequently apparently after negotiations (Annexure 10). Some of these are likely to result in substantial extra cost to BHEL.
- (ii) It appears from the records (Memo for 78th meeting of the Board) that prior investigations were made in Libya by a team of BHEL engineers about site conditions, working conditions, current market rates of civil engineering works etc. It is, however, found that the schedule of quantities containing the details of the aggregate contract as regards the extent of work involved for various items has not been prepared with due care; inasmuch as the estimates for some of the important items have been found to be abnormally low. In fact, the quantities as well as the rates fixed for them do not appear to have been based on correct and reliable physical as well as market survey results. It is noticed that in the case of one important item, specification had not been correctly reflected in the tender.

Lack of correct physical survey :

- (i) Under turbine hall and control room annexe, 'earth-work excavation' has been described as 'excavation in rock' and thereby allowed double of the normal rates, in L. D. 17.35 per cub. met. as against the rate of L. D. 8.68 per cub. met., the quantity having been estimated at 16000 cub. met. On actual working it was found that there was no rock in the excavation work which was in soft soil and was entitled to the normal rates of L. D. 8.68 per cub. met. This has become a matter of dispute between the Company and the contractor who claims L. D. 17.35 for 19515 cub. met. This makes a difference of L.D. 169200, equal to about Rs 50 lakhs.

It is relevant to note that in 'turbine hall and control room annexe' only one item 'excavation in rock' has been provided and the item for 'soft soil excavation' has been totally omitted in spite of the fact that the soil in question could not be totally rocky for the simple reason that the excavation in the entire adjoining soil has been provided for at the rates applicable to non-rocky soft soil. This serious omission on the part of the persons responsible for conducting the original survey and for preparing the tender documents is likely to cause embarrassment as well as substantial avoidable expenditure to the Company.

- (ii) Under the head 'Cooling water system' for the part 'settling basin and feeding pool', volume of work for the item of excavation was estimated at 27000 cub. met. On actual working this has been found to be an awful under-estimate as the work till Sept. '77 has reached 90246 cub. met. and as per the revised estimates the additional work is likely to be 1 lakh cub. met. This item alone will result in additional payment to the tune of L. D. 8.68 lakhs i.e. about Rs. 2.5 crores to the sub-contractor.
- (iii) The above situation is naturally the result of wrong and incorrect survey at the initial stages.

Additional items :

- (i) A number of items of work are not covered by the specifications in the "schedule of quantities", having not been anticipated at the earlier stages. The sub-contractor would be entitled to 30% extra payment over the direct cost on such items if the value of the

extra items does not exceed 2% of the contract value and if this 2% is exceeded, the percentage of extra payment over cost will be 45%. As per present indications, the value of the additional items is likely to be quite large and, in any case, much above 2% of the contract value.

- (ii) A glaring instance of items of additional work is the item "pumping out water" out of the sub sea level soil during the course of laying down concrete. As per estimates this work is likely to continue for six months, and the rate for this new item of work involving substantial volume has yet to be decided upon.
- (iii) It is very relevant to point out that as per the original tender, the dewatering process was a part and parcel of the general 'excavation work' or 'concreting work' as per para 14.01 of Section B of Vol. III (i.e. general requirements) and this additional item of work has therefore arisen due to subsequent deletion of this para 14.01. Prima facie there does not appear to be any justification for the deletion of this para from the final agreement for the simple reason that dewatering cannot be avoided when the work has to be done below sea level at site on the sea coast as in the instant case. This is likely to cost quite substantially to the Company.

Lack of correct market survey :

A detailed and proper market survey is a pre-requisite for making a correct estimate of the cost of project/works for the purpose of accepting the terms offered by a tenderer and for fixing the rates for various items of work. In this case however, no reliable or correct market survey appears to have been conducted. This is evident from the following two important items in the schedule of quantities which constitute about 40% of the civil work :

- (i) For soft soil excavation work a rate of L. D. 8.68 per cub. met. has been fixed. This rate has been found to be very much on the high side as compared to the normal rate obtaining in the area for the excavation work even as per information available in the site records/accounts, inasmuch as the site authorities have themselves entered into a separate agreement for excavation work of exactly similar type within the area of the same civil work with a local firm of Messrs. Ginshiwa Sons vide agreement dated

30-4-77 for about 70000 cub. met. excavation at the rate of L. D. 2.10 per cub. met. for the total contract value of about L. D. 157500.

It is also understood further that the sub-contractor Gammon have now appointed the same firm Ginshiwa for the excavation work allotted to them by the Company at rates even lower than L. D. 2.1 per cub. met. The excavation rate of L. D. 8.68 per cub. met. allotted to Gammon is thus more than four times the normal rate of L. D. 2.1 per cub. met. obtaining in the area.

The total quantity of earthwork as per the schedule of quantities comes to about 90590 cub. met. This would result in excess payments to the tune of L. D. 596082 (L. D. 786321-190239), equivalent to about 1.8 crores.

- (ii) Besides the above, the additional quantity of about 1 lakh cub. met. of excavation work referred to earlier would result in excess payment of about Rs. 2 crores. The total excess payments involved in excavation would thus be of the order of Rs. 3.8 crores.

In case a prior and proper market survey had been conducted, the fixing of the excavation work rates at four times that of the normal market rates could perhaps have been avoided or the rate could have been successfully negotiated at a much lower amount.

High rate for concrete work :

For concrete work of all grades, a rate of L. D. 44 per cub. met. of concrete has been fixed in the schedule of quantities. This rate also appears highly excessive having regard to the facts that

- (a) cement is to be supplied by the Company (so the sub-contractor has to provide for only sand and metal plus labour for laying concrete) and
- (b) the normal rate of ready-made concrete including cement in the market in Tripoli is only L. D. 12 per cub. met. In Tripoli because of large scale construction activities, ready-made concrete with facilities to lay the same is openly available. Even our site office has made a number of such purchases for its own construction work e. g. purchases of two lots of 12 cub. met. and 8 cub. met. concrete from the open market on 12-7-77 at the rate of L. D. 12 per cub. met. as per the entries in the cash book.

It is also understood that the expenditure of laying the concrete as per the market rates for this item of work can be easily worked out. In this respect a chart (Annexure A) is enclosed according to which the rate (with 40% profit on the cost of materials and hire of machines and wages etc.) comes to L. D. 14 per cub. met. as regards the cost of material and laying of the concrete in the hands of the sub-contractor.

Two case studies conducted at site for determining the exact cost of concrete and its laying per cub. met. (Annexure B & C) also indicate that the rate per cub. met. comes to L. D. 12.64 and L. D. 13.05 per cub. met. subject to a profit rate of 40% in the hands of the sub-contractor.

Having regard to the fact that (a) the market rate of concrete with cement is L. D. 12 per cub. met. and (b) as per the annexures the rates (including 40% profit) vary from L. D. 12.64 to L. D. 14 per cub. met. of concrete, a reasonable, profitable rate for concrete work would be about L. D. 14 per cub. met. and not higher. The rate allowed to the sub-contractor as per the schedule of quantities is however L. D. 44 per cub. met. i. e. about L. D. 30 per cub. met. in excess of the normally reasonable rate for this item of work.

Now as per the schedule of quantities the total quantity of concrete comes to 30213 cub. met. for which the excess payment at the rate of L. D. 30 per cub. met. works out to L. D. 906390 (equivalent to about Rs. 2.7 crores).

This situation has arisen due to lack of correct and proper market survey in Libya in respect of this item of work, and also due to the failure to properly evaluate the tender by comparing the rates offered by the sub-contractor with reference to what the rates would work out in the light of such a market survey. It may be pointed out here that construction activity for civil works (buildings) is going on in Tripoli at a very large scale and hence a correct market survey could have brought forth very useful information regarding the reasonable rates for concrete work and other civil work and also regarding the sources/agencies engaged in the civil work activity.

Lack of correct specification/designing/estimating :

On test check one instance of specification of an important item of chimney work for tender purposes has also come to notice and some element of incorrect estimating/designing for steel requirements resulting in abnormally low estimates at the original stage has also been found. These are discussed below :

(i) Reinforcement Steel :

As per original estimate of requirement of reinforced steel the total quantity was worked out at 3300 MT on the basis of the designs prepared (as against 3600 MT shown in the tender) and accordingly the PCTW Cell initiated action for procurement. It is however found that as MS Bars procured were shorter than 10 m. in length, as envisaged in the designs, additional requirements of M. S. Bars have arisen due to extra lappings. A revised assessment of requirements of reinforcement steel has been made at 4952 MT as against 3300 MT for which procurement process has already been initiated and action has since been taken in PCTW also for obtaining the additional requirements. The increased requirements of reinforcement steel have resulted in extra expenditure of about Rs. 535 lakhs towards cost of procurement of additional steel and there will be a corresponding consequential increase in the payments to sub-contractors also due to additional tonnage used in the reinforcement steel used in civil works being L. D. 70 per MT. The additional payment due to the sub-contractor works out to L. D. 115040, i. e. Rs. 34.69 lakhs. The total additional expenditure that way may touch the figure of Rs. 70 lakhs.

It needs to be looked into as to whether this extra expenditure is due to incorrect specification by PCTW itself or omission to take the actual availability of steel of less than 10 m. length while estimating the initial requirements. This would reveal either omission to procure the right type of material by the PCTW or failure on the part of the designer to keep in view the type of steel actually available in India. It is however understood that entire additional steel procured is not due to extra required for lappings of steel bars of shorter length only but also due to incorrect assessment of requirements at the time of issue of tender. The extent of additional requirements due to procurement of short length bars and also due to incorrect initial assessment on the basis of wrong designing needs to be examined for remedial action in future.

(ii) Structural Steel :

According to the tender for civil works, the requirement of structural steel was estimated at about 400 MT. However, the PCTW cell on the advice of

PED had initiated procurement action for 570 MT of structural steel as indicated below :

General structural steel including galvanized gratings, handrails, chimney bendings, bolts and nuts	510 MT
Chequered plates	47 MT
metal embedded inserts	13 MT

On further assessment of the requirement of structural steel, it has been found that a total quantity of 2590 MT will be required for the civil works as indicated below :—

General steel works	2000 MT
embedded inserts	230 MT
chequered plates	35 MT
ladders, stairs and HR pipes	50 MT
gratings	20 MT
bolts and nuts	25 MT
stop and log gates including gates lifting arrangement	230 MT
Total	2590 MT

Action has since been taken to procure additional requirements of structural steel also and the extra payment envisaged for these additional requirements is of the order of about Rs. 98 lakhs. This will also entail additional payment to the sub-contractor Gammon at the rate of about L. D. 481-20 per MT, amounting approximately to L. D. 962400 i. e. Rs. 2.89 crores. The total extra cost would thus be of the order of Rs. 3.87 crores (say about Rs. 4 crores).

Evidently, the increase in requirements of structural steel is due to incorrect assessment at the initial stage of tendering. The correct position may require to be examined in depth to avoid recurrence of such huge under-estimates in future.

(iii) Chimney work :

Para 14.03 of Book No. VI Section C—' Design requirements' of the contract with ECT, Tripoli dealing with chimney work provides the following specifications :

- (i) The reinforced concrete stacks shall be lined with acid resistant bricks of at least 10 mm thick set in acid resistant mortar.

- (ii) The lining shall be separated from the concrete by an air gap at least 20 mm and not more than 25 mm.
- (iii) The lining shall be supported in corbels in sections not higher than 10 m. and each section will be connected with the next by expansion joint of corrosion resistant material which is also to be used to protect the corbel face if required.
- (iv) The air gap between the lining and concrete shall be connected between sections and ventilation holes to atmosphere provided at the bottom and top of the stack.
- (v) In order to achieve correct position of the lining it shall be built up against a layer of polystyrene foam of the appropriate thickness.
- (vi) The upper part of the stack shall be externally protected with bituminous paint or other approved paint and top rimmed by cast iron cap. The cap shall be made of corrosion resistant cast iron with a minimum of 4% silicon and with less than 0.005% phosphorus etc.

However, according to 'addendum to specifications' issued as one of the documents of tender and made as a part of the sub-contract with Gammon the following specification has been mentioned for acid resistant lining in para 8 thereof.

- (i) The brick lining shall be of fire brick conforming to "specifications for moderate heat duty fire clay refractories, group A, IS 506 (latest edition)." They shall be laid with appropriate fire clay mortar specified in latest edition of IS 195 specifications for fire clay for lining refractory bricks.
- (ii) The brick lining shall be self-supporting and shall be built after the shell is completed and in accordance with the details shown on the drawings. Particular care should be taken to keep the air space between the lining and shell walls free from mortar droppings and other refuse.
- (iii) **The top 20 m. of lining shall be of acid resistant bricks laid in acid resistant mortar conforming to appropriate standards. The lining shall be banded with MS flat rings of section 75 x 6 mm. These bands shall be drawing up strongly around the brick lining before being welded. The bands shall be**

placed on the outside of the lining at not more than 1.5 m. as shown in the drawings throughout the height of lining, including bands just above and below the flue openings and below each change of thickness of lining.

It is thus observed that while the specification laid down by ECT requires provision of acid resistant bricks for entire height of the chimney stack, the specification included in the 'addendum to specification' forming part of the contract with Gammon requires that only the top 20 m. of the stack is to be provided with acid resistant bricks.

The Manager (Civil), Tripoli Sites, in his letter dated 5th Feb. '77 had indicated the specification to the contractor in the following terms :

" Lining for 105 metres chimney is of acid resistant bricks, 230 mm. thick from E. D. 1 metre to E. L. 50 metres and 155 mm. thick from E. L. 50 metres to E. L. 105 metres. Lining for 50 metre chimney also to be of acid resistant bricks 115 mm. thick throughout. For chimneys of both heights acid resistant flooring is to be provided ".

M/s. Gammon India Ltd., the contractor, in their letter dated 6th Feb. '77 brought to the notice of the Tripoli Site Engineer the discrepancy between the specification mentioned in the contract with M/s. Gammon India Ltd., and the specification now required by Manager/Civil for chimneys and have pointed out that there being a variation in the specification on which M/s. Gammon India have based their rates quoted earlier and included in the contract, a separate rate for acid resistant lining as per Manager (Civil) letter dated 5th Feb. 1977 will be submitted by them in due course. Evidently M/s. Gammon India Ltd., is likely to claim extra amount for this item of work separate from the contract terms. The exact extra expenditure that the Company will have to pay to the sub-contractor on account of the disparity in the specification mentioned in the Addendum to the specification in the notice for issue tender has yet to be assessed but the amount involved is likely to be quite large.

It is necessary to investigate as to how such a major discrepancy was allowed to creep in while issuing the notice of issue of tender and as to whether or not a detailed comparison of terms included in the notice for issue of tender has not been made with the detailed specification required by the customer, M/s E C T. It has to be ensured that such a comparison is done now at least so that similar discrepancy does not come to notice after completion of the work and an occasion for redoing any part of the work at BHEL's cost will not arise in future. This

aspect needs to be examined in depth and also kept in view so that similar discrepancies are not allowed to arise in future contract terms wherever BHEL undertakes turn-key projects.

The above discussions have brought to light items of work involving (a) **excess expenditure** resulting from payments at rates higher than the normal market rates and (b) **additional expenditure** over and above the contract value due to abnormally low estimates made in respect of some items of work at the original stage.

Excess Expenditure.

The facts discussed in paras 4.1 and 4.2 above show that the possible excess expenditure on the two major items i. e. excavation and concrete work which is 37.19% of the total contract value (L. D. 2254413 out of L. D. 6061668) would come to about Rs. 6.5 crores (3.8 + 2.7 i. e. about Rs. 7 crores).

The position of other items of work is almost similar e. g. back filling etc. for which a rate of L. D. 3.20 per cub. met. has been fixed even against the normal rate of L. D. 2.10 per cub. met. for the excavation work itself, the rate for which is more than double the former. The excessiveness of the other rates can, however, be determined only after an indepth study of the corresponding local rates etc.

Additional Expenditure

Items of additional expenditure are going to arise due to gross under-estimation of the volume of work involved or the material required to be used or some items because of incorrect physical survey or incomplete designing etc. As discussed in para 3.2 additional expenditure in excavation work alone is likely to cost Rs. 2.5 crores and as explained in paras 5.1 and 5.2 the additional expenditure due to abnormally low estimates at the original stage in respect of requirements of steel may come to about 4.5 crores rupees. In addition there are other items of work like working in water, (as discussed in para 3.3) and items involving incorrect specification etc. (as discussed in para 5.3) which entail additional expenditure but the amount of which cannot be quantified at this stage. These will have the effect of increasing the cost of the civil works by more than 7 crores rupees. In this respect a comparative statement of receipts and expenditure regarding the civil works in Libya has been prepared and is attached as Annexure 'D', which will show that as against the possible receipts of 6.3 million L. Ds. (about Rs. 19 crores), the expenditure by way of payments to the sub-contractor and cost of material etc. for the civil work (excluding other administrative expenses) would far exceed 9 million L. Ds. (i. e.

about Rs. 27 crores). Steps are necessary to reduce the extent of the resultant loss.

As the variation may thus be more than 15%, the sub-contractor may also be entitled to claim higher rates by invoking clause 3.01 read with in clause 12.01.3 of the General Conditions of the contract. The clause (12.01.4) empowering the Power Engineer to seek revision of rates of the variation if the cost is more than 15% has, however, been subsequently deleted during negotiations.

The only conclusion which can be drawn from the above facts is that the physical survey of the site conditions and the market survey of the prevailing market rates of civil engineering works etc. had either not been conducted or done at all, or were not accurate and adequate and were deficient in the required material particulars. Besides, specifications and designing for some items for NIT purposes had also not been done with due care. These deficiencies adversely affected the settlement of the terms, conditions etc. of the contract and the rates for various items of work which are found to have been fixed at amounts much higher than those obtaining in the market there in Libya.

In the above background, it is felt that perhaps a global tender would have been more beneficial. This was particularly desirable when the entire payment is being made in foreign currency against the civil work sub-contract. Besides, the tenders from foreign firms, specially those having a Libyan base, could have thrown up a fund of useful information on the trend of the market conditions in Libya thus providing much more competitive and economical rates etc.

Suggestions :

The matter, in view of the foregoing observations, requires a thorough examination

- (a) to find out the scope of corrective measures for avoiding, as far as possible, making of excessive payments in the present contract and
- (b) to prepare proper guidelines for future regarding the award of such sub-contracts etc. on a correct and economically sound basis in the best interests of the Company.

Overseas Projects Divisions may please examine and take suitable action.

V. S. GUPTA

Deputy General Manager (A & T)

ANNEXURE 'X'

List of modifications/deletions of clauses in the general conditions of the contract and technical specifications at the time of finalisation of tender of M/s. Gammon India Ltd., disadvantageous to BHEL.

Memorandum of form of agreement and general rules and directions for guidance of the contractors.

Page 4—Item (d)—Security Deposit—Reduced to 5% from 10%

Page 5 —Deviation limits for keeping prices firm—
Reduced from 25% to 15%.

Special Instructions to Tenderers :

Page 10 — Item 25 All risk insurance, third party insurance and export credit guarantee Corporation cover for the whole project including work covered by the civil sub-contractor has been made the liability of BHEL.

General conditions of the contract :

Page 10A Clause 6.02 Deleted. This clause provided that even if some work or materials were omitted to be detailed in specifications and schedules, their cost will be considered within the contract price and no extra charges will be payable to sub-contractor.

Page 10A Clause 6.03.2 Requirements of execution of performance bond for 10% of the contract price deleted.

Page 36 Clause 9.08 The monetary limit for deduction to be made towards compensation for delays reduced from 10% to 5%.

Page 42 Clause 11.01.3

Period of 28 days allowed for issue of interim certificate reduced to 15 days to be reckoned from the date of receipt of application to the date of payment.

Page 52 Clause 12.01 (iii)

The clause giving right to engineer to fix the rates for altered/additional/substituted items which cannot be derived from the rates included in the contract with reference to the prevailing market rates substituted by "cost plus percentage base formula" (additional percentage allowed is 30% if the value of the item concerned is less than 2% of the contract value and it is 4.5% if more than 2% of the contract (value)).

Clause 12.01.4 &
12.01.5

The clauses giving right to the engineers of BHEL to fix rates where the quantities were in excess or less than the quantity specified in the tender by more than 15%, have been deleted.

Page 59 Clause 14.04

Deleted. The clause prohibited against covering up of works before inspection by BHEL engineers and without notice for 7 days.

Addendum to general conditions of the contract :

Page 12 Clause 5

Deleted. Similar provision, however, made in "Schedule I x — schedule for supply of materials" but the variation limits for wastage of cement has been reduced to 2%. No provision has, however, been made for any recoveries where the cement used in the work by the contractor is less than the theoretical quantities.

Technical Specification

Section B

General requirement :

Page 2	Clause 5.00 — Temporary fences	Deleted. This clause provided for sub-contractor's responsibility for erecting temporary fences for the portion occupied by him or allotted for his employees' quarters etc. Actually a compound wall had to be erected by the BHEL and the sub-contractor's staff from the works site under Libyan law. The sub-contractor has however disputed his liability to bear any portion of the cost due to deletion of this clause.
Page 5	Clause 18 — Provision of drinking water Clause 19 — Sanitary conveniences Clause 21 — Inspector's cabin	Deleted. The above clauses provided for responsibility on the part of sub-contractor to make above provisions at his cost.
Page 2	Clause 6.03 — Provision of access roads to sites	Deleted. A separate contract for construction of a dirt road for disposal of excavated earth has to be entered into with another contractor M/s. Ginshiwa Sons by BHEL.
Page 2	Clause 9	Use of materials obtained in excavation etc. This use has been allowed free of cost by adding the words 'free of cost' at the end of the clause.
Page 3	Clause 11.01	Deleted. This clause provided for responsibility on the part of the sub-contractor for verification of data supplied to him and if necessary amplifying such data by his own verification.

Page 3 Clause 11.02

By adding the words "and shall be paid for" the cost of verification of data, if required, has been made the responsibility of BHEL and cost thereof has to be borne by the BHEL, which would otherwise have been the responsibility of the sub-contractor.

Page 3 Clause 14.01

Deleted. This clause made the contractor responsible for executing the work in the contract in the dry and to make arrangement for supplying pumping power as may be necessary to pump out water etc. The deletion of the clause is costing BHEL considerably as it is not possible to work in the water which is seeping through in the area where cooling water system has to be constructed because of its very close proximity to the sea and the work having to be done below sea level.

Page 3 Clause 15.00

Deleted. This provides for the responsibility on the part of the sub-contractor for construction of Cofferdams to prevent sea water entering the works due to high tides. If such a situation arises any steps to be taken for preventing the high tides entering the site will be the responsibility of and to the cost of BHEL.

Page 4 Clause 16.00

Deleted. This clause provided for responsibility on the part of the sub-contractor for provision of fresh water, electricity and telephones.

(this has been taken over by BHEL)

Technical Specification

Materials and Workmanship:

Page 1 Clause 1.01

Modified. This clause provided that the cost of inspection and

testing of materials used in the work will be to the account of the sub-contractor. Due to addition of the expression "at the employer's cost", any expenditure to be incurred on this account will be at the cost of BHEL.

Page 1 Clause 2.03

By addition of the words "which shall be paid for" the cost of removal of unsuitable materials retained to support new works or to replace it by filling as decided by BHEL engineers, is now debit-able to BHEL whereas it was earlier the responsibility of the sub-contractor.

Page 4 Clause 3.01

Cement—Deleted. Although cement is supplied by BHEL, this clause included responsibility for providing additives which are required to be added to cement and this is the responsibility of the sub-contractor. Due to deletion of the clause, it is not clear whether the cost of the additives will be the responsibility of BHEL.

Page 5 Clause 3.03

Cement testing—Deleted. Presumably because the supply of cement is the responsibility of BHEL.

Page 3 Clause 3.08

Water for the concrete—By deletion of this clause the responsibility for providing approved water for concrete work which was the responsibility of the sub-contractor has been deleted, presumably because supply of water is arranged for by BHEL. The clause also provides for different types of water that can be used for different purposes of concreting.

Page 20 Clause 3.30

Deleted. This clause provided for conditions under which the concrete may be placed under water

		like using tremis pipes etc. With the deletion of this clause, the responsibility of the sub-contractor for doing work under water is not clear.
Page 26	Clause 3.43	Form work below water level—Deleted. This clause provided for responsibility on the part of the sub-contractor to prevent ingress of water.
Pages 23 & 27	Clause 3.37	Special instructions to concrete form work.
	Clause 3.45	Concrete carborandum finish. By modifying these clauses, it had been mentioned in the contract that no special finish for concrete work on the part of the contractor is envisaged. Any special finish, if required, will have to be paid separately by BHEL.
Page 29	Clause 3.53	Holes and fixings—Modified by addition of words "the responsibility of the contractor to the fixings has been restricted to the provision included in the bill of quantities". It is not clear what will be position if the quantity mentioned in the bill of quantity is exceeded based on detailed drawings or consultants' requirements.
Page 32	Clause 4.00	Steel work. Under the modification of the clause made, the supply of all fabricated materials is the responsibility of BHEL. This would possibly include all metal inserts also.
Page 38	Clause 4.11	Protection and painting of other metallic materials. Deleted. The clause provided for responsibility on the part of the sub-contractor for protection and painting of other metallic materials according to specifications mentioned therein. This deletion is perhaps due to responsibility to provide structural steel resting with BHEL.

Drainage and cable ducts. By additions made in the clause, the types of piping work has been limited to those detailed under the bill of quantities in the contract. If other types of pipes are required during the course of execution of work, the responsibility of providing such pipes may perhaps lie with BHEL and not with the sub-contractor.

ANNEXURE 'A'

ANALYSIS OF THE RATES FOR CONCRETE WORK

For one M3 (Cu. M.)

I. Cost of materials

(A) Stone Mettle 1 Cu. M.	L. D. 4
(B) Sand $\frac{1}{2}$ Cu. M.	L. D. 1
(C) Cement (to be supplied by BHEL)	Nil
Total	L. D. 5

II. Labour Cost

(On the basis of Market hire charges)

(a) Crane for 8 hours	L. D. 200
(b) Mixer for 8 hours	L. D. 100
(c) Vibrator 8 hours	L. D. 10
(d) Dumper for 8 hours 3 Nos. @ L. D. 10 each	L. D. 30
	L. D. 340
(e) Labour for work (2 at crane, 4 at cement & 6 at mixer) 12 workmen for 8 hours @ L. D. 5 per day i. e.	L. D. 60
(f) Rate of performance being 10 Cu. M. per hour, in 8 hours 80 Cu. M. of concrete will be paid i. e. 80 Cu. M.	L. D. 400
(g) Labour Rate for Cu. M.	80 Cu.M.

L.D. 5/-

L.D.10/-

III. Total for 1 Cu. M. of Concrete

Assuming that 1 Cu. M. of stone, $\frac{1}{2}$ Cu. M. of sand, required quantity of cement will be given. One Cu. M. of concrete

L. D. 10

IV Add Profit at 40 %

L. D. 4

Total L. D. 14

The normal rate for concrete work for Cu. M.

L. D. 14

ANNEXURE 'B'

WORK STUDY OF CONCRETING

220 KV SUB-STATION—FOOTING NO. 18-19D

Qty. of Concrete	13.62 Cu. M.
Machinery employed	2 Mixers
	4 Dumpers
	1 Tower crane
Total time consumed	2.5 Hours

Man Power :

One Mixer	7 workers	one supervisor
Second Mixer	7 workers	one supervisor
Four Dumpers	4 workers	
One Tower crane	1 worker	
Place of pouring	4 workers	one supervisor
	23 workers	3 supervisors

Total worker hours	$23 \times 2.5 =$	57.5 Hours
Supervisors	$3 \times 2.5 =$	7.5 Hours

Suppose including overtime labour is costing 4 L. D. per day and a supervisor is costing 8 L. D. per day.

So worker	=	0.50 L. D. per hour
Supervisor	=	1.00 L. D. per hour
So the total cost of man power	=	$57.5 \times 0.5 + 7.5 \times 1.00$
	=	$28.75 + 7.50$
	=	36.25 L. D.

So the cost of manpower per Cu. M. = 2.66 L. D./Cu. M. (A)

Cost of aggregate and sand per Cu. M. 3.00 L. D. (B)

Cost of curing or for applying chemical for airing per Cu. M.	0.5 L. D.	0.50 L. D.	(C)
Total of A + B + C		6.16 L. D./Cu. M.	
Total cost of overall supervision for Elect. Mech. say 25%		1.54 L. D./Cu. M.	
ADD		7.60 L. D./Cu. M.	
40% Contractors Profit		3.04 L. D./Cu. M.	
		11.64	
Cost of depreciation of Machinery		1.00 L. D./Cu. M.	
		12.64 L. D./Cu. M.	
(Depreciation value has been taken, taking into consideration that the machines have got reduced value by 50,000 L. D. at the end of project)			
		12.64 L. D./Cu. M.	

ANNEXURE 'C'

T. G. HALL

Footing No. 18 C

Machinery employed 4 Mixers
 2 Dumpers
 1 Crane (Tata P & H)

In one hour crane operates 10.5 times say 10 times
 So, in one hour concrete consumed is 4 Cu. M.

Man Power :	One Mixer	7 Workers	One Supervisor
	Second Mixer	7 Workers	One Supervisor
	Footing	4 Workers	One Supervisor
	Crane	3 Workers	
	Dumper	4 Workers	

25 Workers 3 Supervisors

Total Worker Hours 25 Hours

Total Supervisor Hours 3 Hours

Considering Labour @ 0.5 L. D. Per hour and Supervisor rate
 @ 1.00 L. D. per hour.

Total cost of man power $25 \times 0.5 + 3 \times 1 = 15.5 \text{ L. D.}$

So cost of man per Cu. M.	=	3.87 L. D. (A)
Cost of aggregate and sand per Cu. M.	=	3.00 L. D. (B)
Cost of curing or for applying chemical for curing per Cu. M.	=	0.5 L. D. Cu. M. (C)
Total A+B+C	=	7.37 L. D. / Cu. M.
Cost of overall Supervision for Elec. Mech. side	=	1.84 Cu. M.
		9.21 L. D. / Cu. M.
Add 40% contractors profit		3.68 C. D. / Cu. M.
		12.89 L. D. / Cu. M.
Cost of depreciation of machinery		1.00 L. D. / Cu. M.
		13.89 L. D. / Cu. M.
(L. D. 1.00 / Cu. M. has been taken presuming that all the machinery depreciates for 50,000 L. D. at the end of project.)		
		13.89 L. D. / Cu. M.

ANNEXURE ' D '

Comparative statement of receipts and expenditure on civil works at Libya

1. Receipts

- (1) Total contract price with ECT Libya L. D.
for Turnkey project. 32,293,157
- (2) Amount apportionable to Civil works only out of
(1) above.

	L. D. Portion	C & F Portion	Total in L. D.
Unit I & Common works	2,932,150	1,428,500	4,360,650
Unit II	915,000	421,500	1,336,500
Sub-station	355,000	245,000	600,000
	4,202,150	2,095,000	6,297,150

EXPENDITURE

Amount payable on account of Civil Works to Sub-Contractors etc.

Amount payable to M/s. Gammon India	L. D.	6,061,668
Additional payment anticipated on account of additional excavation work for 1 lakh Cu. M.		868,000
Cost of cement including transport etc. @ 20 L. D. / MT for 15500 tonnes		310,000
		<u>7,239,668</u>
Cost of Reinforcement Steel 4950 MT at Rs. 2000 / MT	Rs. 99,00,000	
Cost of Steel Structural 2500 MT at Rs. 5000 / MT	Rs. 125,00,000	
Total cost of Steel	Rs. 224,00,000	
Addl. payment due to sub-contractor due to increase in tonnage of structural steel and reinforcement steel over initial estimates or bill of quantities	746,700	
Structural steel 2000 × 480 L. D.		960,000
For Steel 1650 × 70 L. D.		115,500
		<u>9,061,868</u>

Items for which extra expenditure is yet to be assessed :

- (1) Dewatering working in dry-cooling water systems and
- (2) Use of Acid Resistant bricks in Chimneys etc.

APPENDIX II

A PROGRAMME INVOLVING THE DESIGN AND MANUFACTURE OF A 500 MW THERMAL GENERATING SET: PREPARED FOR THE UNION MINISTRY OF INDUSTRIES (Undated, likely date early 1973)

The Power Development Plan for the seventies envisages large-scale addition of 110, 120 and 200 MW thermal units in the different regions of the country. Although the Decade Plan does not mention the next higher sized unit, there is little doubt that we will need to go in for such a larger unit in the 1980s. If this is accepted and a time target of end-1980 is set for the introduction of such a unit into commercial operation, action will have to be taken now to secure the designs, and build up the necessary engineering and production capability. On the basis that the unit be of 500 MW capacity, the present note aims at examining the alternative approaches which can be adopted for undertaking such a task and in recommending a specific course of action.

2. The principal equipment that go in a 500 MW Thermal Power Station are:-

- (i) Coal handling equipment and ash handling facilities.
- (ii) Steam generating equipment and auxiliaries.
- (iii) Steam turbines and turbo-generators.
- (iv) Heaters, condensers and coolers.
- (v) Feed pumps, condensate pump, circulating water pump, water treatment plant etc.
- (vi) Instrumentation and controls, station cranes, etc.

The broad list given above does not include the outdoor step-up station, involving power transformers, switchgear and bus-ducts. It is limited to the major items both in terms of technical importance and value.

3. Steam Generating Equipment:

3.1 Boiler

There are two principal manufacturers in the country, viz. AVB, Durgapur, and Bharat Heavy Electricals Limited at Tiruchi.

They have a running agreement with Babcock and Wilcox of U. K. and Combustion Engineering of United States, the two most renowned boiler designers in the world. Between the two organisations, Bharat Heavy Electricals Limited, Tiruchi, has developed a very good design and engineering organisation. It is capable of taking up original work in this particular field, with the standard information it has **already** secured from Combustion Engineering and the training in Europe and United States which its personnel have acquired. It is possible for BHEL engineers at Tiruchi to develop, on their own, with very limited consultations that may be needed with Combustion Engineering, the steam generators to match the 500 MW unit. The consultation with Combustion Engineering would essentially relate to the problems involved in adopting a controlled circulation boiler as against the natural circulation boilers presently under manufacture in the country. The controlled circulation boiler has an advantage in unit sizes of 500 MW. Studies on the relative merits of the controlled circulation and natural circulation boilers are already in progress. In the development of the design for 500 MW steam generator, only the basic concepts of Combustion Engineering will be used; otherwise the designs will have to be totally new to suit Indian coals and operating conditions which are peculiar to this country. No serious difficulty is, however, anticipated in regard to development of a design for steam generators for the 500 MW or even other sizes.

3.2 Boiler House Auxiliaries :

The Tiruchi Unit of Bharat Heavy Electricals Limited are manufacturing a large number of boiler house auxiliaries, including coal pulverisers, fans, soot blowers, dust collectors, etc. With the preparatory work done by them for the indigenous manufacture of these auxiliaries for the 200 MW unit, it should be possible for them to project and develop their own designs for equipment, suited for the 500 MW sizes.

4. Feed Pumps :

This is a highly sophisticated piece of equipment and indigenous expertise for this product is limited. However, knowhow for such pumps for units upto 110 MW has been secured by the Hyderabad unit of BHEL from its Czechoslovak collaborator. The course of action proposed therefore is to mount a design and development effort which will make full use of that knowhow and perhaps also secure some additional foreign assistance on a selective basis. Despite such a strategy, there may be need to import some feed pumps for the prototype 500 MW unit. But the numbers and capacity of those pumps will be so chosen as to fit in maximally with our overall system design. This should lead to better system performance when the pumps are later made in the country.

5. Condensers and Heaters :

No major difficulty is expected in developing suitable designs of condensers and heaters for the 500 MW Block.

6. BHEL would confidently state that in respect of steam generation, boiler house auxiliaries, condensers and heaters, which constitute more than 60 per cent of the money value of equipment involved in a 500 MW unit, it should be possible for them to develop the designs through indigenous efforts even within a comparatively shorter period. It is only in the area of steam turbines and turbo-generators where technological capability has to be built up.

7. Turbo-generators and Steam Turbines:

The Heavy Electrical Equipment manufacturing Plants at Hyderabad, Bhopal and Hardwar have acquired the necessary expertise in the design and manufacture of standard thermal sets of 110 MW, 120 MW and 200 MW ratings, the basic designs for these sets having been obtained from the Czech, British and Soviet collaborators respectively. While the 110 MW and 120 MW reheat turbines and turbo-generators have been successfully manufactured, the production of 200 MW sets at Hardwar is under way. The design, technology and manufacturing practices were obtained from the three main collaborators under Licence Agreements. Their terms as well as the extent to which transfer of knowhow has been effected varies from case to case. Unfortunately, the information obtained from different sources has not yet been collected by any agency. No analysis has been made on the feasibility of standardisation of components or for determining the most suitable design for Indian conditions. Nevertheless, the information obtained has been absorbed to a reasonable extent by the staff in the plants and a number of modifications to suit our conditions have also been made in these designs. The work of the Design Departments in BHEL and HEIL plants has, therefore, been significant and a stage has now been reached when they can confidently face the challenging tasks involved in the design and development of larger sets.

8. Against this background, the following 3 alternatives can be considered for the development of a design for 500 MW turbo-generators and steam turbines :

- (i) to enter into a licence agreement with one of the reputed manufacturers in the world with sufficient experience of building such large size sets which have proven their performance of satisfactory operation for a number of years.
- (ii) to purchase a few sets in fully manufactured condition from one of the reputed manufacturers abroad and

obtain the design knowhow and **guidance** for the manufacture of these units as a part of the purchase deal.

- (iii) to undertake the Design and Development (D & D) effort indigenously with selective assistance from foreign agencies who have adequate experience in the particular areas of specialisation.

9. Alternative (i): Conventional Licence Agreement :

This has been the standard route adopted so far by practically all our large-scale enterprises including those in the electrical industry. At a time when adequate number of trained engineers/scientists and necessary technological infrastructure were not available in the country, such a route was perhaps the best to ensure that manufacturing time was cut down and foreign exchange saved. This route has also helped in the creation of a manufacturing base within the country. However, experience has shown that very often collaborators do not provide the complete knowhow package and do hold back certain essential elements of information for which they demand special charges or separate agreements. As for design background, this is not furnished even on payment of special charges. At the same time we have felt the need and also been able to mount an indigenous effort to fill the gaps in the technology supplied by the collaborator within a reasonable time. The modification of the designs of the existing 200 MW turbo-generator at Hardwar to increase the capacity to 235 MW for MAPP and to render it suitable for being coupled to the nuclear turbine under manufacture at HEIL, Bhopal, is one such example. Efforts of this kind have paid dividends in increasing the confidence level of our engineers and technicians and in building up their technological capacity. It is felt, therefore, that with the plants having been in production for some time and having acquired the basic expertise, it may not be necessary to go into a full licence agreement for all our future needs. Secondly, as far as the methodology of development is concerned, another licence agreement may not provide a new or fresh approach different from that already known through past licence agreements. Lastly, continuous resort to licence agreements will curb the initiative and enthusiasm of our design and development teams for tackling new problems.

10. Alternative (ii) : Initial Purchase of Finished Units and Manufacturing Knowhow as a Package Deal

It is necessary to note the following aspects of this alternative. First, the foreign supplier is essentially interested in sale and consequently in negotiating with the ultimate purchaser

and not with a manufacturing plant. Secondly, there will be no interest unless we give an indication about our willingness to purchase components for a number of sets of the same design on a continuing basis. If the number of sets to be **purchased** is restricted to two or three, then clearly the foreign suppliers will not be interested in passing on all the production knowhow to a manufacturing plant unless it be at an enormously high price. They will also be unwilling to train our engineers to acquire the expertise in the various specialised fields necessary for us to be independent of them. So, if they at all show interest in such a deal, they may well ask for an order of a large number of complete sets spread over 3 or 4 years. Thirdly, they will not be willing in any event to redesign their equipment to suit conditions and engineering standards obtaining in our country. Though this alternative may result in shortening the time of delivery of the **first few sets**, it will result in an increase in our dependence on foreign suppliers for a longer time than necessary, not only for supplies of essential components and materials, but also in tackling the large number of operational and maintenance problems that may arise with the commissioning of large size sets. It will also lead to large recurrent outflows in foreign exchange. This is not a hypothesis but a conclusion based on our own experience. Despite an agreement to buy in whole or parts of 10 numbers of 120 MW sets and the payment of **recurring** knowhow fee/royalties, the Bhopal Unit has not been able to secure the knowhow for the manufacture of turbine blades for these sets from their British collaborators. This has resulted in their continued dependence on the foreign supplier.

Alternative (iii): Indigenous Design and Engineering Effort with Selective Technical Assistance and/or Import of Knowhow.

Basic Philosophy

The design of a 500 MW turbo-set may not involve merely a scaling up of existing designs for 200 MW systems. Many completely new design and engineering problems are likely to be faced. With the available expertise it is considered feasible to tackle a number of these on our own. However, the development effort will be guided by the philosophy that in those areas/sub-systems where expertise, test facilities, or even process knowhow does not exist, we will not hesitate to seek foreign assistance to the extent necessary to conform to time/cost frames. But in all such cases care will be taken to see that the necessary back-up effort (counterpart teams etc.) is committed **right from the beginning**.

Areas and Scope of Foreign Assistance Needed

A preliminary study of the expertise and facilities relevant to this project, already available indigenously or which can be built up at a pace consistent with a target date of end 1980 for the first commercial 500 MW station to be operational, has been made. This study has revealed a tentative list of areas in which assistance from reputed foreign manufacturers/institutions would be required :

Steam Turbine

- (i) Data on well-proven profiles of blades for steam turbines and assistance for the development of certain aerodynamic profiles, particularly in the supersonic region.
- (ii) Evaluation of the performance of the turbine and the temperature stress distribution in transient stage.
- (iii) Advice on safe limits in certain vital areas for the satisfactory operation of a turbine ; and
- (iv) Advice on steam distribution elements and governing system/scheme, with reference to type of governing, mode of effect in the governing and the dynamic analysis of the system under transient stages under individual performance and with grid.

Turbo-Generators

- (i) Evaluation of vibration characteristics of sector body.
- (ii) Design of stator core suspension.
- (iii) Critical speed programming of turbo-set with rotor coupled and individually.
- (iv) Calculation of stress as in retaining ring unit with packing/nut.
- (v) Thermal and ventilation calculations for the estimation of temperature and coolant requirement in stator core, stator winding, rotor body and rotor winding.
- (vi) Estimation of end part heating under different loading and power factor regimes and measures to cool the same ; and

- (vii) Adoption of thermo-reactive insulation system for the manufacture of turbo-generator stator bars.

It appears that in some of these areas foreign assistance/information could be drawn through existing licence agreements for smaller size equipment and full use will be made of this resource, before entering into new arrangements.

This alternative has a number of advantages. Firstly, it enables the building up of indigenous design and engineering competence and as a result the confidence to undertake design, engineering, construction and erection of projects entirely on our own in the next phase. Secondly, a design evolved in this way, by a team which involves specialists who have had first hand experience with the fabrication of smaller size equipment in our plants, is most likely to be one which maximises the utilisation of manufacturing facilities that we already have in our plants. Consequently, the lead times involved in prototype production, and in setting up regular production are likely to be better and production costs, both capital and recurring, lower. Thirdly, and as a consequence of the first two advantages, the import content in terms of material components and sub-assemblies is likely to be less than in either of the two other alternatives. This is because there is more opportunity to draw up performance and industrial standards which are compatible if not identical to what the rest of our industrial system is producing.

Assuming that proposals made by foreign collaborators with whom preliminary discussions have been held are valid, adoption of Alternative (iii) in regard to the steam turbine and the turbo-generator appears to lead to realising the first commercial 500 MW unit, about 24 months later than if we follow Alternatives (i) or (ii). It must be pointed out, however, that apart from the expertise and other technological resources which adoption of Alternative (iii) should enable us to build up, our past experience with licensed manufacture of even turn-key projects has been that they actually take longer than claimed at the outset.

Pre-Requisite for Success if Alternative (iii) is Adopted :

The design, development, engineering construction and commissioning of a 500 MW unit by means of the strategy formulated as Alternative (iii) will call for a major effort mounted by a National Project Team. Many ingredients will go to make the effort a success. First, human, technical and organisational resources will have to be brought in and directed, without reference to agency or departmental jurisdiction. Secondly, there will be need to adopt the most flexible managerial practices including the devolution of considerable financial powers to the programme manager viz. BHEL. However, as the NCST-Planning

Commission Task Force for the Science and Technology Plan has indicated in its Interim Report, and as this note has attempted to show, all the available evidence suggests that if these inputs are provided the programme can be brought to fruition on time.

It may be pointed out that as indicated right at the beginning of the note, the discussion in this document has been on the assumption that the unit will be of 500 MW capacity. However, in view of the great importance of the question of unit size, it would seem worthwhile for the National Project Team mentioned above to consider this matter in depth, present the alternatives with their respective costs and benefits and make a final recommendation.

TIME FRAME FOR THE TOTAL 500 MW UNIT DESIGN AND ENGINEERING PROJECT

If alternative (iii) is followed in regard to the steam turbine and turbo-generators, the broad time schedule for the project in this case is expected to be as follows :

ACTIVITY	COMPLETION DATE
1. Detailed Report bringing out all the technical aspects of the problem, and containing a task identification statement, with a time schedule and development cost estimates. This Report would also recommend the exact size of the Unit and the criteria for choosing such a size.	End March 1973
2. Completion of design calculations, identification of knowhow/expertise/facility gaps and recommendations both for new facilities to be set up, equipment to be procured as also for securing foreign assistance, with preferred sources of such assistance and tentative terms and conditions indicated.	End December 1973
3. Technical Project Report-Detailed equipment specifications and issue of purchase orders for important and long delivery items.	End March 1975

ACTIVITY	COMPLETION DATE
4. Preparation of detailed design drawings.	End March 1976
5. Preparation of manufacturing drawings and designs for jigs, tools and fixtures.	End March 1977
6. Manufacture and testing of prototype turbo-set.	End March 1979
7. Operation of prototype as commercial unit.	End December 1980

APPENDIX III

MEMORANDUM OF UNDERSTANDING ON CO-OPERATION

between

BHARAT HEAVY ELECTRICALS LIMITED
(hereinafter referred to as " BHEL ")

and

SIEMENS AKTIENGESellschaft
(hereinafter referred to as " SIEMENS ")

BHEL is the leading Indian enterprise in the field of heavy electrical equipment and systems for the energy, industry and transportation sectors. It has also a leading position in equipment like steam generating plant and auxiliaries, compressors, steam turbines for drive applications, pumps, valves, oil field equipment, intermediate products like castings and forgings and seamless steel tubes. It has established an excellent record of growth over the years which is reflected in the turnover, profits, order-book, productivity and diversification programmes.

27th September, 1977

BHEL has been operating in close technical collaboration with leading international organisations in specific product areas. A high level of technology absorption has been attained and this has enabled BHEL to establish itself as a national leading agency in technology development in a wide spectrum of products and systems. To further this effort BHEL has established developmental facilities at its manufacturing establishments and more recently has created new facilities to concentrate on basic research and development work in many areas, such as material sciences, non-conventional energy sources, MHD power plants, fluidized bed boilers. Simultaneously keeping in view the fact that it operates in a sophisticated technology-based area, BHEL is continually making arrangements to ensure technical co-operation with leading international technical organisations. Such co-operation is aimed at ensuring access to basic knowhow and know-why in the design, engineering, manufacturing, application and system engineering and operational aspects.

Siemens is a leading international organisation with operations extending over a wide spectrum of products and systems. Together with its subsidiaries like Kraftwerke Union

Aktiengesellschaft and Transformatoren Union Aktiengesellschaft in Germany (hereinafter referred to as 'KWU' & 'TU' respectively) and its associates like Fuji Electric Co. in Japan and Allis-Chalmers Inc. in USA its operations cover the entire spectrum of electrotechnical products and systems and world markets. It has extensive and prolonged experience in the field of technology transfer and broad based technical co-operation through wide licensing and patenting operations, its collaborations with Fuji, Allis-Chalmers and others, and operation of its own subsidiaries in most parts of the world.

To maintain its leading position in the world Siemens has established extensive Research and Development facilities and spends as much as 8% of its worldwide sales on Research and Development. More than 40% of its products are less than five years old.

The Energy Division of Siemens (UB E) is the largest division of Siemens and accounts for 31% of the total sales. The Energy Division's activities cover a wide spectrum of products and total systems and has many parallels with the operations of BHEL. It is responsible for the development, manufacture and marketing of products and equipments for power generation and distribution, industry, transportation, measurement and process control and process engineering.

In 1957 Siemens established a subsidiary in India, the Siemens India Ltd. ('SI'). This company receives the full technical backing of Siemens in all aspects and has at any time complete access to the technical knowhow of Siemens subject only to the policies, guidelines and regulations of Government of India. Siemens maintains a 51% interest in SI. Due to its technical and managerial competitiveness and the abilities of its skilled workers—for the training of whom SI has received broad recognition—Siemens India plays an important role in the industrial scene of India. Its manufacturing establishments and sales network cover a wide variety of medium size electrical equipment for utilities and industry. It has associates like the Cable Corporation of India ('CCI'), Bharat Bijlee ('BB') who supplement the product range of Siemens India and who also receive continuous technical assistance of Siemens' design. SI is at present employing, together with CCI and BB, 8500 workers and technicians and has contributed a remarkable part to the economic development of India.

Starting in 1974, BHEL and Siemens (including KWU) have concluded technical collaboration agreements under which BHEL obtained access to the manufacturing, design and systems engineering knowhow of Siemens for turbo-sets, industrial

turbines, thyristor convertors and control systems for industrial application and the application engineering as well as the required thyristors and diodes for such equipment.

These collaborations have brought different factories, design, application engineering groups of Siemens and BHEL in close contact. The managements of the companies also appreciate the long term objective of each other.

Taking into consideration BHEL's future growth programmes and developmental needs particularly in the area of heavy electrical equipment, application engineering and systems engineering for heavy industries and Siemens's as well as SI's future prospects and role in these fields. BHEL and Siemens have come to recognise that a broad-based co-operation between them including SI would benefit these organisations. The co-operation shall particularly give BHEL, within the scope of this Agreement, complete access to the technical know-how of Siemens and its subsidiaries and, to the extent that Siemens is entitled to, of associates—and vice versa—including not only product design but also manufacturing technologies, application engineering and assistance in other aspects. It is further intended to establish an exchange of advance information with Siemens/SI regarding the introduction of new products, mutual supplies, market data, etc. to enable the partners to offer products of newest design for the benefit of the Indian market. BHEL and Siemens shall endeavour to implement the co-operation in a manner that will ensure that BHEL absorbs know-how to the maximum extent with optimum deployment of resources and in shortest possible time.

While details in various specific issues and areas can be spelt out later and will take their own time, both parties have come to a broad understanding on the scope, content and devices of implementation for such a broad-based and long-term co-operation arrangement. This memorandum aims at spelling out broad aspects of this understanding, including the compensation terms.

I. Technical Scope of Co-operation

(a) The technical scope of the co-operation shall cover the following areas :

(i) most of the products and services offered by UB E division and application engineering for application areas where these products are used.

(ii) selected products of the UB E division.

- (iii) selected products of the central research and development department (ZT),
- (iv) selected products of the KWU,
- (v) products of the TU.

The product groups and application engineering areas are listed in Annexure-I (the products as per Annex-I are hereinafter referred to as "Contract Products").

- (b) The parties agree that all rights and obligations of the parties with respect to Power Transformers and reactors in the 400 KV class shall only come into existence on the date BHEL and Siemens agree to its inclusion.
- (c) Siemens is a member of the High Voltage Direct Current Transmission Working Group consisting of Siemens Aktiengesellschaft, Allgemeine Electricitäts Gesellschaft/AEG—Telefunken and Brown, Boveri & CIE Aktiengesellschaft. Siemens is prepared to endeavour to the best of its efforts that BHEL may for HVDC projects in India or where supplies from India are advantageous to be included in project consortiums which in each such case are established by the above group and in such event, render necessary technical assistance in the design, manufacturing, application engineering, etc.
- (d) Siemens—as a member of the Fifty Cycle Group—is prepared to endeavour to the best of its efforts that a collaboration between this group and BHEL may be established through Siemens as the representative of the group.
- (e) The scope of the co-operation in the area of steam turbines and generators between BHEL and Siemens/KWU covers the range of steam turbines and generators upto a rating of 200 MW/250 MVA under this memorandum of understanding.
- (f) The parties agree to terminate the existing Technical Collaboration Agreements between Siemens and BHEL on the date the broad based collaboration will commence and to include their technical scope into the broad based collaboration.

- (g) Subject to a mutual understanding the scope of the technical collaboration can be extended to include additional products of the UB E division of products of other divisions of Siemens and/or its subsidiaries and associates on terms and conditions to be agreed upon on a case to case basis and after getting approval of Government of India.
- (h) The parties agree that the co-operation shall not adversely affect the present collaboration agreements of BHEL with third parties or agreements of Siemens and its subsidiaries with SI and other parties in India. Details of these agreements and the manner in which the respective parties will operate in these areas will be spelled out in the detailed broad technical collaboration agreement.

II. Technical "know-how" to be supplied by Siemens

- (a) The information to be supplied by Siemens shall comprise :
- (i) the basic manufacturing and systems engineering know-how related to Contract Products and specified in detail in Annex-II. This comprises results of developments carried out by Siemens in its factories and central research and development departments for the development of new manufacturing technologies in order to permanently improve its manufacturing technologies, manufacturing organizations, etc.
 - (ii) The special manufacturing know-how related to Contract Products.

This comprises the know-how which is available with Siemens for the manufacture, quality control and testing of Contract Products.
 - (iii) The know-how for Contract Products.

This comprises the calculation, design, assembling, erection, commissioning, maintenance and operating information.

- (iv) The application engineering know-how relating to the areas covered by Annex-I.
 - (v) Information on Siemens' organisation and management system and practices in selected areas as listed in Annex-III.
- (b) The technical information to be supplied by Siemens shall consist of :
- (i) existing information on Contract Products and application engineering.
 - (ii) information on improvements and modifications on Contract Products and application engineering.
 - (iii) information on new developments of Contract Products and application engineering.
 - (iv) information on general management areas.

available written documentation in the relevant factories, engineering departments, central research and development departments and/or obtained from licensees.

Where fulfilment of the objectives of this collaboration will not be met by the available written documentation it will be supplemented by :

- (i) subsequent clarification to be supplied in written form to the extent which Siemens considers is necessary.
- (ii) verbal information to be imparted to BHEL personnel delegated to Siemens for training.
- (iii) verbal information conveyed through Siemens engineers deputed to BHEL.

The parties are of the opinion that as a result of activities listed above, BHEL will be in a position to fulfill the overall objectives of this agreement.

III. Technical Assistance to be rendered by Siemens

- (a) Siemens is prepared to delegate a reasonable number of its personnel to BHEL to assist BHEL in various aspects of this co-operation.

- (b) Siemens is prepared to accept a reasonable number of BHEL engineers.
 - (i) for preparation of tenders/design/drawings under its supervision for specific enquiries/orders received by BHEL ;
 - (ii) for training in all functions related to the manufacture of Contract Products and application engineering. Such training shall be performed in the relevant factories, offices, engineering departments and training courses of Siemens and the relevant subsidiaries.

The deputation of BHEL engineers under (i) above as well as the training under (ii) above would be part of the training man-months accepted hereunder.

- (c) Where manufacturing technology adopted by BHEL differ on account of equipment configuration of practices in vogue in BHEL, Siemens, subject to engineering capacity available therefore, will try to help BHEL in adapting the know-how available with Siemens to make it applicable to BHEL operations.
- (d) Any special engineering for project assignments that may be taken up by Siemens at BHEL's request for enabling BHEL to undertake specific jobs in India and abroad will be at extra costs to be settled from case to case. The basis of arriving at such costs would be built into the Broad Based Collaboration Agreement.
- (e) Subject to Government of Germany regulations and mutual agreement of the parties, Siemens is prepared to accept in its own establishments or that of its subsidiaries/associates, employees of BHEL as Siemens employees for specified periods in various allied fields.

IV. Training and Documentation

For an effective transmission of know-how. Siemens agree for the following provision of training and documentation :

- (a) an average of 120 man-months of training per annum, covering technical and other areas, as well as project assistance referred to under III. This however would not include short term visits by BHEL executives to Siemens not connected with technical information or training, for the following :

- (i) review of the co-operation, including meetings of different committees, sub-groups etc.
 - (ii) visits for seeking specific clarifications, settling of terms, scope, commercial/technical implementation, etc. of this co-operation.
 - (iii) visits in connection with specific commercial contracts, tenders, projects in which BHEL is expecting to participate using contract products and application engineering.
 - (iv) visits of senior executives of BHEL to get acquainted with overall set-up of Siemens, its factories, products, laboratories and training establishments.
- (d) an average of 50000 pieces of documents per annum.

This does not include documents prepared by BHEL personnel deputed to Siemens.

These man-months and documentation are agreed to be available to BHEL on a cumulative basis.

V. Joint Developmental Programme

- (a) Siemens and BHEL agree to take up in selected areas, developmental projects on a joint basis. The results of such projects will be available to both the parties for commercial exploitation by themselves. Proceeds of licencing to third parties would be shared reasonably among the parties having relevance to the developmental costs incurred by the parties.
- (b) Siemens and BHEL agree to share information developed by either of the parties in the course of their developmental work in other areas on terms to be agreed upon mutually.

VI. Rights to Manufacture and Sell

- (a) Siemens agrees to grant to BHEL within the technical scope of the co-operation under information furnished from time to time as well as under any respective Siemens patents :
 - (i) a non-exclusive manufacturing and selling right in India ; provided, however, that Siemens shall not grant additional manufacturing licences in India except to Siemens India Ltd. and its associates without prior consultation of BHEL and agrees not to enter into such other agreements if the interests

of BHEL are seriously affected. BHEL appreciate that for successful implementation of this long term collaboration it is necessary that BHEL does not normally enter into new collaborations with third parties in the contract products area. However, BHEL and Siemens accept that considering the position and role of BHEL in the Indian environment, there may be occasions for BHEL to obtain know-how in specific areas from other organisations for meeting specific situations. BHEL will consult Siemens prior to any formal arrangements that BHEL may make in such cases.

BHEL agrees not to enter into such other collaborations in case the interests of Siemens are seriously affected.

- (ii) a non-exclusive right to export to all countries of the world excepting countries where Siemens has prior manufacturing and licencing commitments.
- (b) BHEL will have the right to sub-licence the rights granted hereunder to another Indian party with prior written consent of Siemens.

VII. Consideration

- (a) Subject to applicable taxes, BHEL shall pay to Siemens in consideration of
 - (i) the supply of information by documentation and training of BHEL personnel, lumpsum instalments in the amount of DM 5 million annually for the first to the 10th year of co-operation.
 - (ii) the rights granted under information and patents of Siemens royalties in the amount of 1.8% of the turnover of BHEL during the term of co-operation.
 - (iii) other services to be rendered by Siemens including the delegation of personnel to BHEL, the costs occurring for such services.
- (b) In the computation of royalties payable to BHEL landed cost of purchases from Siemens, KWU, TU and Siemens India within the technical scope shall be deducted.
- (c) Additional man-months of training and documentation shall normally be adjustable on a cumulative basis. Any excess over the stipulated minimum shall be chargeable

at amounts to be agreed upon annually. The basis therefore shall be built into the co-operation agreement.

- (d) Other services to be rendered by Siemens are to be charged at costs.
- (e) Siemens agrees to endeavour to the best of its efforts to buy from BHEL, in lieu of payments due under a (i) and a (ii) of this para Contract Products or other equipments from BHEL subject to their being available at quality and delivery acceptable to Siemens at international price levels and to form consortiums with BHEL in case of projects outside of India which are of mutual interest.

VIII. Review of Co-operation

- (a) Siemens and BHEL agree to nominate a senior level executive in their respective organisations to be responsible on a full time basis for coordinating and monitoring the proper implementation of the co-operation. They will have sufficient support in the form of technical personnel, a proper organisational set-up and an office to perform this function.
- (b) For a proper implementation of the co-operation Siemens and BHEL agree to constitute a high level Steering Committee consisting of top management executives (Board level) from both the companies. This Steering Committee shall meet at least once a year, alternatively in India and West Germany.
- (c) This committee shall be aided by the full time coordinators as well as by Reports from Groups to be constituted for major product areas on the implementation of the co-operation in respective areas. The number of such groups shall not exceed—and shall meet in places agreed upon from time to time.

Normally such groups will consist of representatives of Development, Engineering, Manufacturing and Quality Control functions from either side.

IX. Term and Termination

- (a) The co-operation shall be for a period of 15 years.
- (b) It shall, however, be open for a further extension, subject to Government of India approval for another 10 years, on terms to be mutually agreed to. For this purpose, during the twelfth year of operation of this co-operation the parties agree to initiate discussions.

It is understood that information of new developments would continue to flow to BHEL even after the twelfth year when the parties have agreed to extend the co-operation. Should BHEL decide not to extend the co-operation, the information flow on new developments shall cease by the end of the twelfth year but shall be available to BHEL thereafter on terms to be mutually agreed.

- (c) After expiration of the Agreement, BHEL is entitled to make use of the rights granted by Siemens under its information and patents without payment of royalties.

X. Siemens India Ltd.

BHEL recognises the areas of interest to Siemens India listed in Annex. IV in addition to the areas in which they are currently active.

Siemens, Siemens India and BHEL agree that Siemens India may enter into these areas either independently, or, subject to Government of India approval, jointly with BHEL. Both parties shall continually review these proposals before any steps are taken for implementation.

XI. Draft of the Agreement

The above is a record of understanding of the parties in the matter of the proposed co-operation. The parties agree to enter into an agreement to be drafted on the basis of this memorandum of understanding after BHEL obtains approval of the Government of India.

New Delhi, the

Erlangen, the

Bharat Heavy Electricals Limited

Siemens Aktiengesellschaft

ANNEXURE I

The technical scope of the co-operation shall cover the following areas:

1. Product

(a) Electrical motors :

- ac-ht asynchronous motors above 200 KW
- dc motors above 200 KW

- dc special purpose motors
(mill type motors, traction motors)
- flame-proof motors above 100 KW

(b) Electrical generators :

- diesel engine - and turbine driven generators above 2500 KVA and upto 250 MVA.
- hydro generators
- rotary synchronous condensers

(c) Steam turbines upto 200 MW

(d) Circuit breakers and switchgear

- medium and high voltage circuit breakers
(including e.g. vacuum circuit breakers)
- medium voltage on-load switches.
- SF₆-insulated metal-enclosed switchgear.
- high voltage isolators.

(e) porcelain insulators and bushings for low, medium and high voltage.

(f) medium and high voltage lightning arrestors.

(g) medium and high voltage current and potential transformers.

(h) energy meters :

- single-phase and three-phase meters
- tariff-rate time switches.

(i) power semi-conductor components (diodes and thyristors) of sizes which meet as far as foreseeable the requirements of the range of contract products, zone refined silicon usable in the manufacture of power semi-conductor components and other semi-conductor devices.

(j) power electronic equipment for variable speed drives.

(k) all types of transformers and ratings excluding

- power transformers and reactors in 400 KV class.

- (l) static phase compensation equipment for industrial purposes.

2. **Application engineering for :**

(a) energy generation, transmission and distribution :

- complete equipment for hydro-electric power stations and storage power stations.
- synchronous condensers and auxiliary equipment.
- converter stations with rotating machines for utilities.
- equipment for automatic control of converters and synchronous condensers for utilities, hydro-electric power stations and converter stations.
- static compensators for industrial purposes, static frequency converters and static starting converters
- excitation and control systems for synchronous machines.
- power equipment for diesel power plants for continuous operation.

(b) energy transmission :

- transmission sub-stations and switch-yards including control boards for energy transmission (60 KV)

(c) industrial equipment :

industrial turbines and industrial power plants

- steam turbines for mechanical drives including supervisory equipment.
- steam turbo-sets upto a maximum capacity of 100 MW including mechanical and electrical auxiliary equipment as well as supervisory control and protective equipment.
- industrial turbine power plants upto a maximum capacity of 100 MW.

electrical equipment for steel plants and/supply auxiliary systems :

- basic oxygen plants
- electric arc furnace plants

- open-hearth steel plants
- continuous casting plants
- oxygen producing plants, water treatment plants
- electro-slag remelting plants
- compressed-air plants
- degassing plants
- blast furnace charging plants
- hot blast blower equipment
- direct reduction plants.

electrical equipment for rolling mills and processing lines:

- blooming mills
- plate mills
- hot strip mills
- heavy and light section mills
- rod and wire mills
- tandem cold mills
- reversing and non-reversing mills
- processing lines such as shearing lines, trimming lines, galvanising lines, pickling lines, coating lines, etc.
- rolling trains and special drives for rolling mills

electrical equipment for electrolyses for application in industry above 150 KA for :

- aluminium
- copper
- chlorine, hydrogen etc.

electrical equipment for variable speed drives for :

- mine winders, wire drawing machines
- machines for the production of cables, wire conductors and ropes.
- textile machines, pulp and paper mills
- cement mills

- petrochemical and chemical industry.
- fertilizer plants
- food industry
- plastic industry
- offshore equipment

electrical equipment for industrial electric heating :

- tube lines for longitudinally and spirally welded tubes
- inductive tube heating for forging
- inductive and conductive heating on the industry using iron or steel as forging, rolling mills.
- inductive melting
- annealing and heat treatment of wires and strips.
- heating plants for the production of tin plates (melting on)
- glass-melting.
- high frequency heating in the paper industry
- high frequency heating in textile and food industry
- high frequency heating in wood and plastic industry

traffic systems (excl. 50 cycle systems) :

- electric traction for rail cars, electric vehicles and trolley buses (excluding magnetically levitated high-speed vehicles and "H-Bahn" overhead cabin system with articulated vehicles)
- electric auxiliary equipment for traction vehicles with diesel or gas turbine drive
- overhead power transmission systems, local power supply systems, low and medium voltage transmission lines.
- electric propulsion systems and respective components for ships.

Basic manufacturing and systems engineering knowhow

The knowhow as defined in this Annex. II shall be made available insofar as it can be used for Contract Products.

1. Planning of manufacture of Products

- Calculation of areas for production, stores etc. Machine tools, special tools, fixtures etc.
- Transportation means
- Storage systems
- Material flow, specifications and sources of supply
- Number and qualification of personnel
- Preliminary and final layout
- Test equipment
- Auxiliary services
- Stagewise build-up of production and representative data on Siemens cost such as material, labour etc. for the purpose of BHEL preparing an Investment Proposal for Contract Products

For the above areas Siemens shall make available the existing information by transmittal of written documentation and or through visits of specialists.

The preparation of special technical reports, the rendering of planning assistance etc would be subject to an agreement on a case to case basis.

2. General Information

For designing work mainly based on DIN, IEC and ISO-Standards; e.g. calculation methods, monograms, graphs and computer programmes, purchase specifications, manufacturing documentation, testing information, erection, commissioning and operating information including maintenance and trouble shooting.

3. Manufacturing Information

- detailed manufacturing processes (technology and cost optimization) including machining, welding, soldering etc.

- assembly, process sheets
- manufacturing timing
- capacity planning and scheduling.

4. Quality Information

- quality planning
- planning for equipment
- incoming inspection
- manufacturing inspection
- final inspection
- quality control and quality assistance manuals.

5. Organisation, System and Methods Employed in

- production control
- order handling
- new product introduction
- value engineering
- selected areas in special manufacturing technology like N.C. machines, plasma cutting
- welding etc.
- material handling and storage
- general quality systems.

6. Systems Engineering (Scope to be confirmed by Siemens)

- Basic schemes (description/selection/calculation)
- General description of various sub-systems:
 - Control systems
 - Logic circuit systems (sequencing/interlocking)
 - Protection systems
 - Power circuit systems.
- Standard diagrams for various sub-systems.
- Selection/specification of components/hardware
- Layout/general arrangement

- Analysis and prediction of performance
- Commissioning and operating information
- Tender preparation

to be made available as written documentation, e.g.

- functional description
- data sheets
- circuit description
- electro-mechanical construction
- testing and maintenance rules
- design guides
- worked-out examples

by training

- course
- manuals

ANNEXURE III

Information about general management areas

1. BHEL is interested in an exchange of information and experience in general management areas. Siemens is prepared - insofar as it may reasonably be expected - to inform BHEL about practices, systems and organisation in the areas of

- business and financial planning
- personnel management
- design and engineering organisation of its energy division (UB E)
- tendering, including price calculation (therefore)
- management of projects / jobs (total turnkey power projects, industrial projects such as steel plants, etc.)
- financial accounting
- management development (including the management (of) institutes like Feldafing)
- research and development planning.
- and other areas where the parties agree to communicate relevant information.

- 2 Information in the above areas may be transferred by visits and meetings, exchange of available written information and participating in special training (resp.) management development/in company programmes.

ANNEXURE IV

Siemens India Ltd. — areas of interest (UB E)

1. Products

- 1.1 rotating machines
 - ac motors upto 2000 KW
 - syn machines upto 2500 KVA
 - dc machines upto 500 KW
 - special purpose ac machines such as cargo winch motors, centrifuge motors etc.
- 1.2 transformers upto 100 KVA including reactors, chokes filters etc.
- 1.3 1t switchgear
- 1.4 medium voltage switchgear upto and including 33 KV
- 1.5 switchboards upto and including 33 KV, including motors, control centres, control boards, instrument panels, desks etc.
- 1.6 measurement and process control equipment such as
 - transducers, controllers, indicators, recorders, gas analyzers, actuators, etc. with associated gear.
- 1.7 relays and relay control boards
- 1.8 industrial electronic equipment such as rectifiers, convertors and invertors, variable speed drives, contactless switching, controlling, monitoring and recording equipment.
- 1.9 remote measurement, control, supervision and data logging equipment.
- 1.10 equipment for automation in industry and utility, process computer
- 1.11 industrial television equipment and associated gear
- 1.12 turbine control equipment for steam and water turbine
- 1.13 x-ray analytical equipment
- 1.14 numerical control equipment for machines and machine tools
- 1.15 power line carrier equipment

2. application engineering

2.1 utilities

- 2.1.1 electrical equipment for water supply systems, irrigation and sewage pumping systems, sea water desalination etc.
- 2.1.2 sub-stations and switch-yards including control boards for systems upto 132 KV
- 2.1.3 distribution systems including capacitor banks.
- 2.1.4
 - relay and relay control boards
 - automation for power systems
 - load despatching systems
 - power line carrier systems
 - telemetering and remote control
 - process computer and data logging systems

2.2 industrial equipment

- 2.2.1 industrial diesel power plants with unit size upto 2500 KVA
- 2.2.2 electrical equipment in plant technologies such as chemical and petrochemical, pharmaceuticals, cement and refractories, sugar and beverage, paper and pulp, rubber, textile etc.
- 2.2.3 electrolysis plants upto 150 KA
- 2.2.4 electrical equipment for mining and iron and steel plants.
- 2.2.5 ore handling and beneficiation plants
- 2.2.6 drive technique for industry
- 2.2.7 control systems such as relay and contactless switching systems, monitoring and protocolling systems.
- 2.2.8 telemetering and remote control systems for industry.
- 2.2.9 numerical control systems.
- 2.3.0 process computers and data logging systems.

3. transportation

- 3.1 power supply for traction systems including remote control and automation.

- 3.2 electrical equipment for cranes and material handling for all applications.
- 3.3 equipment for ships and vessels including automation.
- 3.4 electrical equipment for dock installations and dock yards.
- 3.5 electrical equipment for lockgates.
- 4. measurement and process engineering for :
 - power generation and distribution
 - transportation systems and
 - industrial purposes.

APPENDIX IV

**Note on the broad based agreement by the Director (Commercial)
BHEL, dated 6-4-1978**

**Bharat Heavy Electricals Limited : New Delhi
Office of the Executive Director (Comml.)**

Broad based collaboration with Siemens

The proposed broad based collaboration with Siemens was conceived in the context of the present status of technology in BHEL - both engineering and manufacturing - and the need to give it the desired thrust and direction to enable BHEL to keep abreast with other reputed engineering organisations in the field of Power Engineering. So far, the development of BHEL in the area of innovation and design, it must be admitted, has been rather slow and has depended mainly on the following :

- 1.1. Different collaboration arrangements with reputed manufacturers for specific products covering a range of designs.
- 1.2. Limited technical assistance obtained from collaborations for a single product or a defined aspect of design.
- 1.3. BHEL's own development programmes.

2. While considerable amount of development work has been undertaken successfully to meet certain variations in designs, a significant breakthrough in the area of product innovation or fundamental research has not taken place probably because of the preoccupation with the normal jobs to meet customer commitments and also lack of organised thrust in this direction. Even in areas where there was a visible possibility of a successful development through our own resources, we have been forced into some collaboration or the other because of the time element. Partly due to the lack of effective planning for future requirements on the part of our customers and partly due to the inadequacy of our own assessment of the future, development work has not been started in time to meet the delivery requirement of the market. This has forced BHEL into a number of collaborations from time to time for specific products or designs resulting in difficulties—

- 2.1. for obtaining the best collaboration with reasonable terms and conditions.
- 2.2. in convincing the Government that such collaborations were necessary and were not due to a total lack of effort or ability on the part of the Organisation.

3. It is in this context that a broad based collaboration has been conceived primarily to give BHEL engineers support in the areas of specific products and their development and to assure a **total association** with the research and development effort of an established organisation which is in the fore-front in this field. This continued association with the R & D effort including fundamental research in areas like Plasma Physics, Material Sciences, Heat Transfer Phenomena, etc., is expected to give the BHEL engineers the necessary knowledge and capability to effect innovations and work out new designs for products and systems for which a demand will inevitably develop in the country.

4. While conceding the need for a continued tie-up with a well known and well established collaborator in certain areas, it has also to be ensured that because of availability of such external help, BHEL's own efforts at development do not suffer at any stage and no complacency sets in among our engineers. Apart from product development, systems suited to conditions obtained in India would become necessary and our own engineers will necessarily have to develop the expertise to design these systems.

5. There are certain specific benefits which should flow to BHEL under such a broad based collaboration. These will have to be fully identified. In the same manner there are certain aspects which have to be watched very carefully while negotiating such a **long term collaboration** covering a very large number of products. Here again **safeguards** will have to be provided, introducing, if necessary, appropriate clauses in the agreement itself to cover these significant aspects adequately. BHEL has to its credit an almost 15 year operation and has established itself technically and commercially over the years. It has built up a standing, a certain reputation for its products and certainly has an appreciable market share in the country itself. In addition to this, it has gone into exports recently and has its own areas of market interest conditioned by political and other affiliations. It is therefore a matter of great concern for BHEL to ensure that its export franchise is not unreasonably or irrationally cut down because of an all embracing long term collaboration which covers almost all the products under manufacture. It, therefore, becomes absolutely necessary to examine the implications of this collabo-

ration on the growth and trading position of each of the products taking into consideration the specific advantages in the field of design and manufacturing technology, attendant problematic reflections on the manufacture and cost of the product and possible repercussions on the market demand itself.

6. I am enclosing with this note two Annexures—one giving the benefits that ought to flow from such a broad based collaboration and the other giving specific issues which should be examined in detail to safeguard the interests of BHEL. The benefits which have been listed out constitute the very basis for entering into such a collaboration. The safeguards detailed are basically necessary for BHEL's survival as an economically viable engineering organisation. Based on these two lists, an analysis has been attempted giving merits and de-merits of this collaboration for each of the products.

7. Resultant investment and cost of manufacture by adopting Siemens designs and technology for our products is a very significant consideration in the Indian market. It has become more so by the policy of the Government, declared recently, that all power generation equipment will be procured resorting to global tenders. Margin of profit on traction equipment has come down considerably due to the institutional pricing adopted recently.

We are likely to face a similar situation in the area of generating plants. With international prices available to customers in India for switchgear, transformers, motors etc., associated with power stations, pressures will build up for similar treatment to other products. It is in this context also that we have to examine the financial implications of this collaboration, not to eliminate it and lose certain advantages but to enter it with care and discretion.

(Sd.) F. HAQUE
Executive Director
6 - 4 - 1978

ANNEXURE I

Basic benefits anticipated to flow out of broad based collaboration:

1. A coverage for engineering support, both for Products and Systems as a general policy measure.
2. Availability of designs and supporting manufacturing information for the current and future generation of Products and Systems.
3. Availability of "know-why" along with "knowhow" for Product and Systems design.
4. Availability of all processes and use of patents of Siemens and others currently being used by Siemens.
5. Assistance in vetting some of the new designs and systems prepared by BHEL.
6. Assistance in adaptation and modification of an existing design or a system to suit Indian market conditions, or a specific export requirement.
7. Assistance in even designing or developing a new product or a system required at a charge. The development work can even be jointly taken if feasible or BHEL engineers deployed on such an effort.
8. Free exchange of design or process information without questioning the need or otherwise for such information. BHEL on its part will ensure that such information is relevant to their needs of development to avoid unnecessary burden on Siemens manpower.
9. Total association with collaborator's present and future R & D efforts so that BHEL's are not only kept abreast of latest technology but also involved continuously in this development effort.
10. Association with certain relevant fundamental research in fields like Plasma Physics, Material Sciences, etc., which act as basic inputs for futuristic developments in design.

11. Availability of improved or better shop technology and processes including inventory control, production planning and control etc. This should also cover steps for better quality assurance and reduction of manufacturing cycle.

12. Identification of facilities required and changes to be brought about in shop administration for upgrading production and testing techniques to achieve greater output and better quality of products.

13. Assistance in BHEL offering composite schemes to the customer—either by the collaborator giving the required technical assistance or participating in the project itself if necessary.

14. For projects being executed in India or in a third country, collaborator's willingness to share the work with BHEL, associating BHEL as a sub-contractor—considering the high cost of manufacture in their own country such an arrangement would perhaps be advantageous to the collaborator.

15. To safeguard the business interests of BHEL as a licensee and extend to them facilities they would normally make available to their subsidiaries.

ANNEXURE II

Certain safeguards to be ensured in a broad based collaboration

1. There should be a positive certainty that for each product included, specific benefits accrue in engineering, design and manufacturing technology by entering into this collaboration consistent with our own status of development in this area. Superiority of the collaborator in the specific area should be established and benefits should be quantified in the nature of long term advantages. It is not enough if advantage accrues in one aspect of design or related to an individual item in the product range. Since continued royalty is to be paid for 15 years with attendant restrictions on export territory, the choice of products to be included has to be selective and well thought of.

2. Range of products covered (including anticipated short term developments) should be such that they suit the requirements of the Indian market primarily and also the likely demands of the export market.

3. There should be a reasonable certainty that the collaborator's designs and systems are economical and competitive under Indian conditions of manufacture and related to the price levels obtained in India for competitors' products.

4. Collaborator should agree to design or develop systems to Indian conditions, preferably by associating BHEL engineers in this effort. Such an assurance in specific areas should be formalised by introduction of an appropriate clause.

5. In areas where progressive indigenisation is contemplated—the pace of which cannot be pushed beyond a point for lack of specialised components and materials—there should be an arrangement whereby the component pricing is economical and bears a reasonable relationship with the total price of the product itself in a competitive market. In fact taking into consideration the likely lower prices in the Indian market and the inevitable need for a progressive indigenisation conditioned by non-availability of specialised materials and facilities for establishing manufacture to desired accuracies, the collaborator should be prepared in the initial stages to sell the components at special prices favourable to BHEL, not including the normal commercial and profit elements.

6. Designs accepted should not be such that the manufacturing technology and accuracies called for are such which involve high investment without compensatory benefits of volume and quality improvement to off-set the investment.

7. Recommended adoption of technology should not be totally repugnant to environmental conditions prevailing in our factories.

8. Regarding unreserved association of our engineers in the R & D efforts of the collaborator, there should be a categorical assurance in the agreement itself and not merely a policy pronouncement. This should also apply to fundamental research and futuristic activities.

9. BHEL should be free at any time to go to any other well-known or established organisation for assistance or a limited collaboration for a specific product for which BHEL has reason to believe that Siemens technology is not the best or of the desired level. This freedom should not be limited only to products not included in the agreement. BHEL is entering a long term collaboration for 15 years and no one can ensure at this stage that Siemens would continuously hold the existing position in superior technology or suitability of the product for Indian markets. If Siemens are not prepared to extend this facility to products covered by the collaboration then the only alternative is to be extremely selective in what we include.

10. Since BHEL is not starting from scratch and has acquired certain levels of expertise already and since it has built up areas of strong interest in the export market (conditioned by political and other affiliations), limitations imposed by this collaboration on BHEL's export franchise should be the basic minimum necessitated by the collaborator's interest to provide legal safe guards to his licensees and subsidiaries in their country of operation. Business interests of Siemens should not be the predominant factor in restricting the jurisdiction for BHEL.

11. There should be no bar on BHEL exporting its products to any part of the world as long as those products are not to Siemens design. The product cannot be classified as one adapted to Siemens design merely because the shop technology has been modified slightly and the equipment is processed through that shop.

12. BHEL is currently manufacturing products worth Rs. 550 crores almost all of which except industrial turbines and power electronic cubicles, are with designs other than Siemens. It is felt that royalties payable should cover only those products which we manufacture to the collaborator's designs and specific processes. Merely using a fitment or a component should not attract royalty on the entire product. Royalty can be paid to the extent of that fitment or component.

13. With the exceptions specifically made out for certain export territories, there should be no bar or any other type of pre-qualification for BHEL quoting to any customer regardless of the value of the quotation.

Brief note about each Product :

1. Traction equipment :

Notes on the subject prepared by Sri P. Choudhuri and Sri G. P. Dodeja have been studied.

1.1. Diesel Loco.:

Siemens do not have adequate experience in this line and have not supplied any equipment to the Indian Railways, which can be considered as an important component of the diesel loco. Considering this and Indian Railways' likely preference for certain manufacturers like GE of USA and GEC of UK, BHEL may not stand to gain much by including this product in the broad based collaboration. As a spin-off benefit of our upgrading the existing electric locos by Siemens technology, we may be able to redesign the 165 Motor with micaclastic insulation having better heat dissipation and obtain a better KW/KG ratio for venti-

lation of the motor. Constructional features having better ventilation and the technique of encapsulation may give improved operational performance. However a correct picture indicating specific improvements in design consistent with holding down the cost will emerge only after our engineers have made a detailed comparative cost.

1.2. A. C. and D. C. Electric Locos :

The technology of Siemens, from the first studies, appears to give a better utilisation of materials and a higher KW/KG ratio for the machines. The micalastic insulation with improved heat dissipation and vacuum pressure impregnation would generally give lower working temperatures for the same load. The process employed for armature impregnation would also give a better operational performance. The constructional features also seem to be better. However a detailed examination with design details would be necessary to come out with proper conclusions in this regard. At present Class H insulation is being used in BHEL motors which has a higher capability for heat withstand. An assessment will have to be made to ascertain if machines with Kapton covered conductor and Class F micalastic epoxy insulating system are able to meet the load requirements operating at a lower system temperature.

Siemens motors are designed using fabricated magnetic frames which when adopted in BHEL will necessarily put up the cost of the motor.

1.3. Transportation Systems :

It has been stated that though Siemens are not manufacturing complete locomotives, knowhow and assistance would probably be obtained through the 50 Cycle Group with whom Siemens are working closely in Germany. This is a doubtful point since many others who have a strong interest in the traction market in Europe and elsewhere are members of this group and may not like to part with this information to a party who is collaborating with one member of this group.

1.4. MTP, Tram Cars, Battery Vehicles, and H-Bahn Systems :

Siemens are fairly advanced in this area and will be able to give us all the technical assistance we need. The only issue to be checked is whether these designs are economical under Indian conditions of manufacture. The growth in the field of MTP is dependent on external conditions and one cannot with certainty forecast a high requirement in this field considering the pace at

which work is proceeding in Calcutta. The quantum of work anticipated for trolley buses and H-Bahn Systems will also not be very significant compared to other products in the transportation field.

1.5. Traction Control :

Siemens have a limited experience on the 1500 V system and the diesel electrical locomotives. They have the desired knowhow for MTPs, Tram Cars, Trolley Buses, etc. We do not have sufficient information regarding the hardware to make an assessment of costs. This will have to be obtained and a comparative study made before a decision is taken. In the meantime, however, certain systems like CAM Shaft Control of Siemens is being offered by BHEL to the Calcutta MTP system.

1.6. Traction Electronics :

In this area there is a possibility of our taking advantage of the collaboration significantly. As rightly pointed out by Sri Dodeja, we could take advantage to improve upon our existing products like Static Voltage Regulators, Frequency Regulators for DC Locomotives and E Type excitation control. The pace of development work taken up for thyristor controlled AC locomotives and Chopper Control Systems for DC locomotives could also be hastened.

2. The agreement should also stipulate assistance in our own developmental work taking into account environmental conditions as obtained in this country.

3. Switchgear :

3.1. Certain developmental work is in hand to meet the present and future requirements of switchgear in this country. While we are confident of successfully developing some of the products taken in hand, it has become necessary to take external assistance in the field of high voltage switchgear to meet the likely demand which is coming up shortly. We have no suitable breaker at the moment in the 400 KV class. The interrupting times proposed in certain areas with higher fault levels are such that the existing series of breakers in the minimum oil range do not meet the requirements.

3.2. The existing range of SF6 breakers with Siemens do not really fit into the pattern of requirements and Siemens were given an indication last year that cheaper versions of this gear with lower rupturing capacities would be necessary to be competitive in the market while offering suitable equipment. In line with this Siemens are developing a 31-40 KA breaker

with two interrupters in the 400 KV class which perhaps can compete with the existing air blast breakers in this range. In the lower voltages of 145 KV and 200 KV, again modification to the existing range of Siemens breakers may become necessary to compete successfully with the minimum oil and air blast breakers. At the higher KA level of 63, Siemens have a breaker with four interrupters which is expensive and may not be able to stand competition with the prices likely to be offered in India for air blast breakers. Siemens have confirmed now that they can give a 2 cycle breaker in this range.

3.3. Siemens also have the SF6 metal - clad circuit breakers. This breaker, however, may not be required immediately but the technology is available for making an offer when the requirement really comes up.

3.4. In the lower voltage class, Siemens are prepared to offer the vacuum breaker technology but are not prepared to part with the vacuum bottle technology. This would be a serious constraint and Siemens have been requested to include the bottle technology also under the scope of the agreement. It may, however, be mentioned that Siemens vacuum breaker in this voltage class is an adaption of their original minimum oil breaker and may not therefore present the best and the most economical design. GE of USA, GEC of UK, and Japan have full technology for this breaker and we are also investigating the possibility of getting this from them if Siemens is not really prepared to offer the bottle technology.

3.5. Siemens plans for developing SF6 breakers in the higher voltage classes will have to be ascertained. We may move over to either 765 KV or 1100 KV as the next transmission voltage and a requirement for $1\frac{1}{2}$ cycle breaker for these extra high voltage systems may come up.

4.3. Transformers :

4.1. The broad based agreement envisages collaboration for transformers except the 400 KV. In the field of transformers Transformatoren Union is one of the reputed manufacturers, but certainly not the best. ASEA, GE, and Westinghouse have an edge over Siemens. ASEA is in the forefront having got into the 765 and 1100 KV earlier than anyone else. Siemens' experience in the 765 KV class is rather limited and they have not been able to build up a large market. Regarding the manufacturing processes and the equipment used, their level of knowledge is not much higher than what is obtained in BHFL. However their designs may represent economy in materials and BHFL may also acquire certain benefits in shop administration. A detailed examination regarding weights, clearances, and the technology

adopted for obtaining these clearances has to be made to ascertain the specific benefits consistent with economy in manufacture. A clearer picture may emerge after our manufacturing teams have visited the works of Transformatoren Union.

4.2. Before entering into a collaboration for transformers, it would be necessary to examine the real need to do so keeping in view the existing collaboration with Alstom and the adoption of their technology to advantage in certain areas like construction of the tanks, etc. The integrally shaped tanks adopted by Siemens would certainly be more expensive than the straightforward design for tanks which Alstom follows.

4.3. Regarding the furnace and dry type transformers, we have cleared GEC of India recently to obtain technical assistance from GEC of UK with a proviso that this information, if required by BHEL, would be passed on to them. Since GEC of UK is a fairly reputed organisation for furnace transformers and has done considerable business so far, it is difficult to indicate any clearcut advantage by going to Siemens at this stage.

4.4. BHEL has developed its own economical designs for instrument transformers in the 400 and 220 KV range and there does not seem to be any specific advantage in getting into a collaboration for this product at this stage.

4.5. Regarding the tap-changers, we have an excellent product and there is really no need to switch over to Transformatoren Union design for this product. Our collaboration is with one of the world's most reputed firms for manufacture of tap-changers.

4.6. The one area in which we have no experience and where it would be advantageous to seek Siemens' assistance is in the area of high voltage DC Transmission.

4.7. Considering that benefits are rather marginal and that 400 KV transformers are already covered by another collaboration agreement, it is to be decided whether or not it is worthwhile for BHEL to include this product paying a royalty on a fairly large production of nearly 50 crores of transformers in the next two or three years.

5. Motors :

5.1. Siemens has a large range both in squirrel cage and slip-ring induction motors. Similarly for the DC machines also their range extends to larger capacities than what BHEL has at the moment.

5.2. Generally for SP/DP machines they seem to have a higher output to weight ratio. The design and constructional features of the Siemens motors are better. They have a better ventilation system and the micalastic insulation used allows better dissipation of heat. Total impregnation resorted to gives a better and trouble free operational performance. While the SP/DP/CACW enclosures are based on a modular concept, their designs for TEFC/CACA do not have the top hat construction and do not follow the modular concept. Again designs with CACA enclosures are not strictly to dimensions recommended by IEC.

5.3. Shaft center heights of Siemens machines are generally higher than those of other manufacturers for similar ratings, this difference being more prominent in the case of CACA machines.

5.4. More detailed examination regarding weights, outputs, temperature rises, etc. will have to be made to evaluate the merits of Siemens motors. Their cost of manufacture under Indian conditions has also to be assessed to ascertain their competitive nature in the Indian market. It has to be checked if resorting to Siemens designs and technology will reduce the manufacturing cycle consistent with lower costs aimed at. It should also be examined if this changeover increases our dependence on imports of specialised materials and components to manufacture these motors in India. The investment pattern for adopting the shop technology should also be spelt out.

5.5. There seems to be a positive advantage in change over in the SP/DP/CACW area. The picture is not that bright for the TEFC/CACA enclosures.

APPENDIX V

A MEMORANDUM OF BHEL TRADE UNIONS

Shri George Fernandes,
Hon'ble Minister for Industries,
NEW DELHI.

**Sub : Removal of Shri S.V.S. Raghavan, Chairman,
BHEL.**

Dear Sir,

We the undersigned workers' representatives coming from all the BHEL Plants want to place our viewpoint before you for your kind consideration and favourable action.

That it was a matter of great surprise to us to know the manner in which the BHEL Chairman, Shri S. V. S. Raghavan, was relieved of his responsibilities. We could not imagine for some time how such a thing could happen when the Ministry is headed by a prominent Trade Union leader of long standing like you.

Whatever experience we have about Shri Raghavan as Chairman, BHEL, we can say with confidence that he was trying to improve the matters in BHEL honestly and sincerely.

Whenever we have reported some malpractices in BHEL to him, he was keen to take steps to improve the matters.

Shri Raghavan's removal from the position of Chairman of BHEL is a clear indication of the upper hand given to the bureaucracy in handling the public sector affairs. Since all the central trade unions as well as the unions without central affiliations working in BHEL, despite their differences, have similar views on this question, we will request you to appreciate the gravity of the situation.

We therefore earnestly urge upon you to reconsider this question once again in the interest of proper working of this premier public sector undertaking.

With greetings

1. Sd/-Lakman Mishre,
Hardwar.
2. Sd/-S. Govinda,
BHEL, Trichy.
3. Sd/-B. K. Paliwal,
Delhi.
4. Sd/-Baraswar Ram,
Jhansi.
5. Sd/-BVSS Kulkarni,
BHEL, Bhopal.
6. Sd -R. S. Parman,
BHEL, HWR
7. Sd/-M. K. Biswa,
BHEL, HWR (CFFP)
8. Sd/-B Laxmanan,
BHEL, HWR

Yours sincerely

- Sd/-(N. G. Datta) AITUC
- Sd/-(M. N. Jha) BMS
- Sd/-(Ramjas Singh) INTUC
- Sd/-(Ramachandran) CITU
- Sd/-(M. W. Siddiqui) HMP
- Sd/-(A. K. Bhatnagar) HMS
- Sd/-(B. P. Aghi) BMS

APPENDIX VI

EXTRACT FROM REPORT OF THE COMMITTEE ON FUEL POLICY GOVERNMENT OF INDIA, 1974 (P. 106)

12.8 As already discussed in the Chapter on Policy for Power Sector, it is possible to increase the efficiency of use of coal in thermal power plants by technological improvements. Efficiency in the use of coal increases with the unit size of thermal power plant as follows :

	Size of Generating Set				
	60 MW	100 MW	200 MW	300 MW	500 MW
Coal (average calorific value of 4500 kcal/k required per kwh of energy generation)	0.67	0.60	0.53	0.52	0.50

The unit sizes upto 200 MW are being manufactured in the country.

12.9 The considerations on which the optimal size of the power plant has to be made have been discussed in Chapter IX. It is evident from the data that if regional grids become effective by the end of the Fifth Plan, thermal plants of unit size of 500 MW may become optimal in some regions. Development work on the manufacture of 500 MW units with indigenous knowhow should be taken up immediately. Although this task of developing individual components for such a large size plant would be time consuming and may call for large investments, it will provide an opportunity for developing the local design and development skills and would enable the country to take up the larger problems which will emerge in the power sector in future. A comprehensive survey of the problems involved in developing an indigenous 500 MW generating unit has been made and it is the considered view that the development responsibility could be shared by the existing organisations in the country. The Committee recommends that the design, development and manufacture of 500 MW generating units should be entrusted to an Indian agency with a time bound programme to get the commercial production of such sets started in the early Eighties. The Committee welcomes the initiatives already taken in his regard by NCST and the Government.

For copies write to

CITU Central Office
6, Talkatora Road
New Delhi-110 001

or

National Book Agency (P) Ltd.
12, Bankim Chatterjee Street
Calcutta-700 073

Price Rs. 5-00