# TRANSFER OF TECHNOLOGY IN ASHUGANJ THERMAL POWER STATION EXTENSION UNITS

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BUET 1991

# TRANSFER OF TECHNOLOGY IN ASHUGANJ THERMAL POWER STATION EXTENSION UNITS

A project submitted to the Department of Industrial and Production Engineering, Bangladesh University of Engineering and Technology, Dhaka, in partial fulfilment of the requirement for the degree of POST-GRADUATE DIPLOMA (IP).

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September, 1991

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## C E R T I F I C A T E

This is to certify that this work has been done by me and it has not been submitted elsewhere for the award of any degree or diploma.

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TRANSFER OF TECHNOLOGY IN ASHUGANJ THERMAL POWER STATION EXTENSION UNITS


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# A C K N O W L E D G E M E N T

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# ABSTRACT

Study and research on technology and its characteristics as an integral part of development studies are stressed in the current work. Currently there is an increasing awareness on study of technology due to its implications on patterns of development. There is more frequent transfer of technologies in the North to South direction and South being the recipient in the global context. It is therefore becoming a growing concern due to the south becoming more and more dependent on imported technology supplied by the developed suppliers from the North.

A review has been made on the transfer of technology in the past two decades. The outcome of the review was presented. Thus it was found that in the past two decades there had been enormous supply of technology from the developed nations to the developing nations with specific aim of developing human resources of the recipients. During this period the process of technology transfer, technology absorption, technology acquisition and generation of similar technology should continue which should lead to the creation of an competent management setup capable of managing the right type of technology compatible with the specific organizational needs. But in reality not much progress has been observed as such study on technology and its effective transfer has become an important issue for developing nations to reduce dependence on foreign technology.

From the review it was suggested that the developing countries adopt a clear cut policy on the import on technology including a regulatory mechanism to control its flow. Thus the problems associated with technology transfer should be manageable.

This study takes a view that the transfer of technology as an integral part of the total process of managing an enterprise. The importance of this study is lying with the experience gained from

one organization/project that has implemented and used modern technology in its contribution to the development of the country.

The current work is closely linked to the working experience of Projects in their implementation, commissioning, operation and guarantee period maintenance phases. The failures and flaws as observed in technology transfer to the Project Management Staff of the owner were discussed.

In the present work, the areas and stages of the Projects were identified where miserable failures were observed to transfer the technology to the recipient. The problems and issues of such failures were also listed along with reasons. However the small areas of success in effective transfer of technology was also identified. The evaluation of the performance of the Project Management Team of the Bangladesh Power Development Board (BPDB) in effective implementation of the project was done. The capability of the team was examined with a view to utilize them in implementation of similar kind of Project to be undertaken by BPDB in the near future. The weaknesses of the Project Management team were also identified.

The current work has suggested guide lines to the policy makers in the energy sector of the country on technology transfer.It also tried to streamline the managers of the power plants and other high tech projects on how to go for an imported technology and how to set terms & conditions etc.in the contract documents to secure successful human resources development programme. Procedures right from the negotiation stage of the project for effective transfer and management of the technology and development of capability have been outlined as well.

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## Chapter I

## INTRODUCTION



### 1.1 TECHNOLOGY AND ITS TRANSFER IN DEVELOPING COUNTRIES

Technology is prime-determinant of a country's progress towards industrialization and automation. By adapting modern technology by the developing nations the gaps between developing and developed nations in technological sophistication level should tend to be minimized gradually.

Technology is defined in terms of different types of knowledge bases. These knowledge- bases may be embodied in the form of machinery or equipment or in the form of information like design or specifications or in the form of know-how etc. and are either proprietory or non- proprietory (1). The proprietory knowledge is marketed in captioned projects. The buyer pays for it in the form of technology cost apart from the material cost associated with it. It is reported that the major cause of excessive payment for the purchased technology is due to lack of bargaining power of the buyer. A survey (2) indicates that 80-90% of technologies in the developing nations are owned by multinational corporations(MNC). They market this technology to the developing nations at a high price with formal agreement of effective transfer of technology to the recipient. The general tendency of a public sector corporation management is in favour of strategic decision to acquire such foreign technology in order to raise the country's overall level of technological sophistication. As a result this has pushed the country to a large financial burden. An effectiveness of a transfer of technology is measured in terms of profitable tangible and intangible benefits from an investment.

## 1.2 TRANSFER OF TECHNOLOGY IN PUBLIC SECTOR:BANGLADESH CONTEXT

The transfer of technology particularly to the sector corporations is one of the prime goals in a purchase contract that can take various forms as direct foreign investment, joint venture, turnkey projects or license agreement. The mode of transfer is governed by a variety of factors that influence both the seller and the buyer.

In the present work, a case study was chosen to critically review and study the process of transfer of technology to a public sector establishment.The case Projects are Ashugonj Thermal Power Station Extension(ATPSE) Units 3,4 and 5 which have been briefly described in chapter 3. This work is closely linked to the working experience of the writer of this thesis. The experiences were in implementation, commissioning, operation and guarantee period maintenance of the Projects. During the writer's involvement in the project for about three years failures and flaws in the technology transfer were discussed. Identification of causes and mistakes thereof are also done. These experiences and lessons learned from such mistakes evolved questions as to which extent and level of current Power Plant technology had been transferred to the Bangladesh Power Development Board's (BPDB) Power Plant Management. The problems encompass the attitudes of Multinational Corporations' tendency for it's short term profit making rather than sharing a sense of social responsibility which could help transfer of technology to BPDB management and develop recipient's human resources as well.

## 1.3 OBJECTIVES OF THE STUDY

The purposes and objectives of the study are:

i) To identify the areas of the power plants where technology have been effectively transferred,

ii) To identify the stage(s) for successful transfer of technology,

iii) To identify the areas and to which extent technology has not been transferred effectively.

iv) The study also aims at ascertaining the reasons for any failures in the transfer process.

v) The study investigates the possibility of developing a process in developing human resources against projects and identify the bottlenecks in the process if any.

In view of managing similar power plants coming up in the near future the study will narrate the capabilities of ATPSE Management and will closely examine their performance. These could be useful in effective implementation, taking over and maintenance of those plants.

The study will discuss at which extent the dependence on foreign technology could be gradually be reduced.

## 1.4 SCOPE AND LIMITATIONS OF THE STUDY

Scope of the study :

The scope of the study is limited to the ATPSE projects of the BPDB with the different international agencies participated in it. The present work is limited to horizontal transfer of technology which involves the transfer of proven and tested technology from one country to be adopted, modified or applied in another country.In this case project the proven and tested thermal power generation process developed as lots under management and guidance of many international agencies was transferred in a different environment and management set-up of BPDB at Ashuganj Power Station Complex.

The concern of this study is also largely the proprietory knowledge that is marketed to a sector-corporation of Bangladesh is paid for by the buyer as software technology part of the turnkey project contract price.

The scope of present study concerned the capacity of the plant and the scope of work of the Projects as mentioned in chapter 3 which is described below in brief :

| | |
|---|---|
| Plant Capacity : | Generation of 3x150 i.e. 450 MW electrical power by three 150 MW thermal power stations with required auxiliary and ancillary facilities. |
| : | 230 KV double circuit transmission line between Ashuganj and Ghorashal (about 50 KM, 124 towers) including 230 KV substation and switchyard at Ashuganj and hooking up arrangement at Ghorasal sub-station . |
| : | Computerized thermal power process training Simulator. |
| Scope of work : | This includes design, supply, erection, installation, commissioning testing, commercial operation, handing over etc. by the Contractors of three thermal power plants with their associated facilities, one transmission line with substation and a training simulator under overall supervision and co-ordination of the Consultants. |

The study refers to the socioeconomic condition of the country limited to the period 1985-88.

Most of the information and data used in this study are from author's own experience and observation at the projects. Discussion with Senior Officials, Deputy Managers, Engineers of the projects at different stages of the projects helped to collect relevant data also. Discussion with Consultant's Engineers and Contractor's Engineers were the other sources of information.

The study and investigation on Transfer of Technology are limited to the implementation, test operation and guarantee period maintenance phase of the projects only.

Limitations of the study :

Though technology transfer has become one of the most pursued topics for technological developments in developed countries in the past decades, very little work has been done in the country in the past. Currently and in the recent past focus is given in developing countries to select right type of technology which would derive and bring the highest benefit for the country. Sufficient literature and relevant documents are not readily available on the subject matter.

The study does not attempt to assess the cost of technology transfer on the subject projects.

The extent to which reliability and completeness of data and information available are subject to error and misjudgment due to time limit of present study. The quality of study would depend on the availability of the concerned people for comment , openness to pass opinions without reservations and paying proper interest and enthusiasm to the study by concerned officials of the project management of BPDB.

# Chapter 2

# LITERATURE SURVEY AND BACKGROUND STUDY

## 2.1 DEFINITION OF TECHNOLOGY

Technology has been defined by Poats(10) as "knowledge systematically applied to a practical task." Technology refers to different types of knowledge and experience and sometimes experience based precise knowledge which may be embodied in the form of machinery or equipment or in the form of information (design, specifications) or in the form of know-how (like technical, managerial or conceptual skill) utilized to deliver goods or services to the mankind(1).

The nature and effects of technology are viewed at different angle by people having different background of knowledge and intention. Technology is not free but a marketable commodity and a price is always tagged on it. In other words technology is a body of knowledge (constitutes hardware & software) that enable the ideas, innovations, concepts and techniques of science to be applied for the purpose of seeking readily useful and primarily commercial ends(2). The technological system is dominated by the engineering approach combined with entrepreneurship(13).

The transformation of resources and provision of services by technology has become the main engine of economic growth as depicted in Fig. 2.1. Technology is a process by which certain resources as land, manpower, skill are employed to obtain some desired products like food grains, clothing, building material(5).

In Fig 2.2 inputs, outputs and determinants of technology are described as well as their relationship and characteristics. In Fig 2.3 an isolated view of four components of technology_ Technoware, Humanware, Inforware & Orgaware and their involvement in determining technological change are shown. In Fig 2.4 the

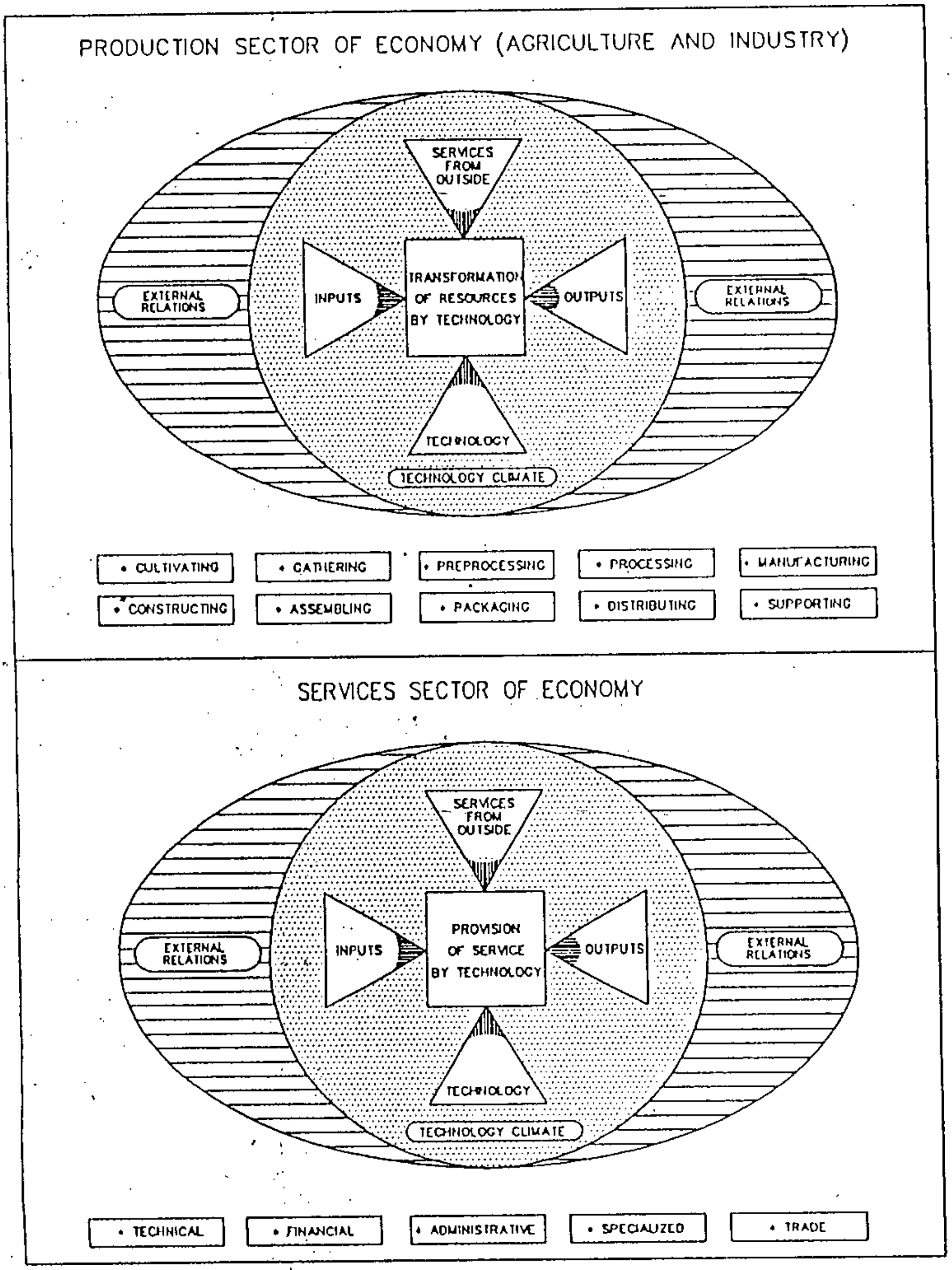



Fig 2.1 : CONTRIBUTION OF TECHNOLOGY IN TRADITIONAL ECONOMIC SECTORS

Fig: 2.1

## TRANSFORMATION OF RESOURCES BY TECHNOLOGY

| INPUTS | OUTPUTS |
|---|---|
| Natural resources (Local production and import) | Consumer goods (Local consumption and export) |
| Intermediate goods (Local production and import) | Intermediate goods (Local consumption and export) |
| Technology (Local production and import) | Capital goods (Local consumption and export) |
| Utilities and services | By-products and wastes |

## PROVISION OF SERVICES BY TECHNOLOGY

| INPUTS | OUTPUTS |
|---|---|
| Customers (Individuals and organizations) | Satisfied customers (Individuals and organizations) |
| Intermediate goods (Local production and import) | Serviced facilities (Personal and organizational) |
| Technology (Local production and import) | Constructed facilities (Equipment and structures) |
| Utilities and services | By-products and wastes |

## DETERMINANTS OF TECHNOLOGY CLIMATE

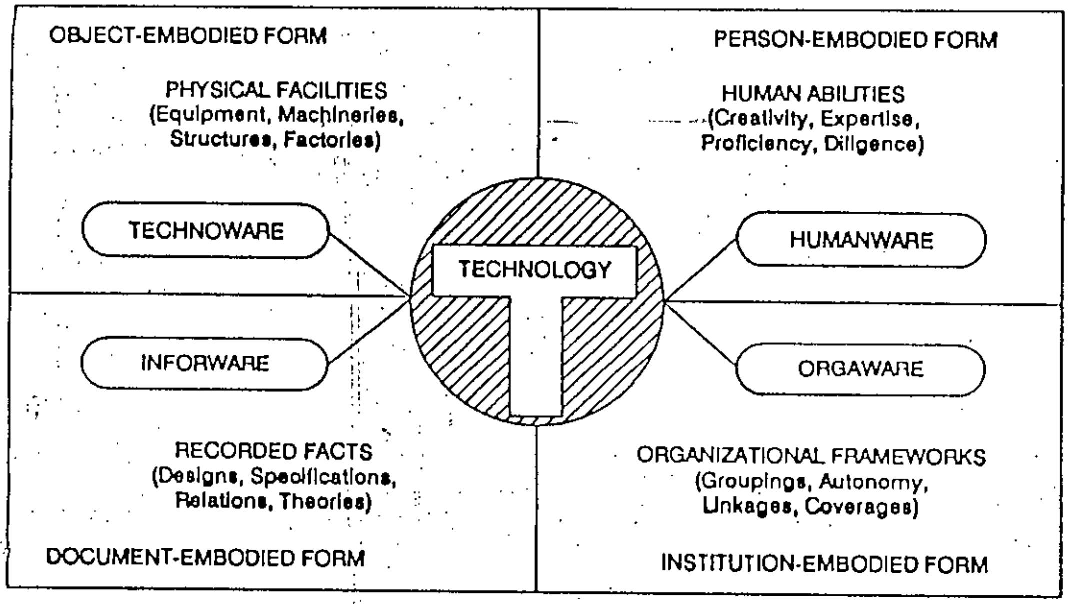
- Status of socio-economic development
- Status of utility and support services
- Transport and communication facilities
- Stock of science and technology personnel
- Research and development expenditures
- Academic science and technology status
- Science and technology in production and services activities
- Innovation and specialization efforts
- Macro-level commitments and effectiveness of decision-making process

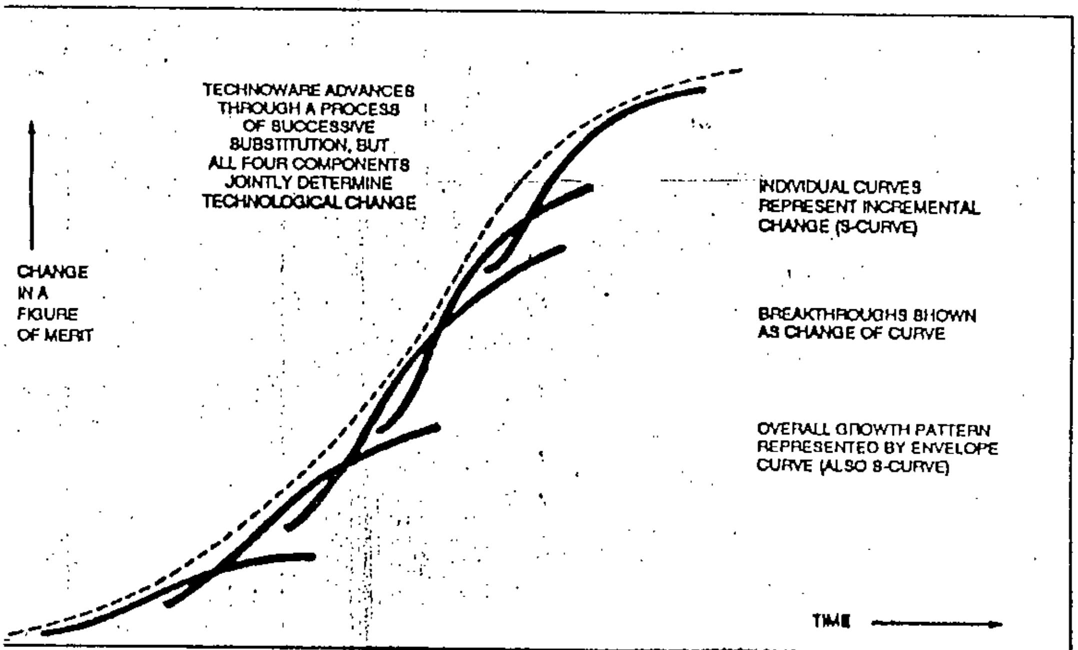
## DETERMINANTS OF EXTERNAL RELATIONS

- Balance of payment situation
- Import dependence of the country
- Export performance of the country
- Foreign assistance to own resource ratio
- Local technological capability
- Geo-political alignment of the country

INPUTS, OUTPUTS AND DETERMINANTS FOR TECHNOLOGY

Fig: 2.2



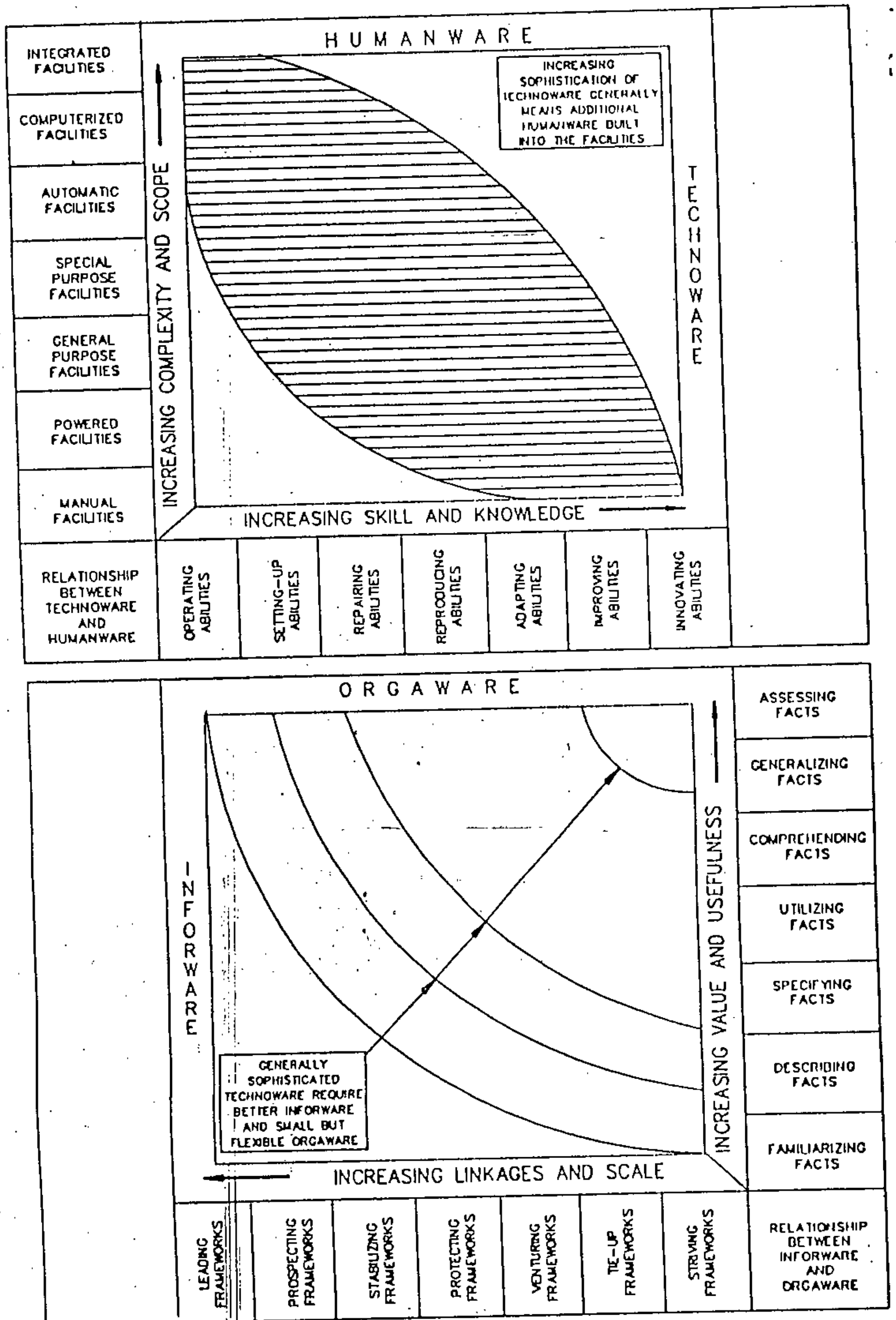




Two major implications of the technological change process

Single S-curve : Eventual catch-up possible due to upper limit of technology growth curve
Multiple S-curve : Selective leapfrogging possible through skipping of intermediate curves

TECHNOLOGY COMPONENTS AND CHANGE PROCESSES

Fig: 2.3




TECHNOLOGY COMPONENT INTERACTIONS AND CHOICES

Fig: 2.4

interaction of technology components and choices are elaborated.

Appropriateness of technology relates to the developmental objectives and the socioeconomic reality of a country and doesn't imply any inherent quality of a technology. Appropriate technology aims at better balance of three levels of technology in order that technological participation of the economic development process become very effective. These three levels of technology are modern, intermediate and simple technology(5). In Fig 2.5 the instrument of technology development are described and in Fig 2.6 macroindicators of technology development are presented.

On the account of technology content added and technology infrastructure base a possible approach to design technology based assessment methodology could be framed out. Technology assessment provides systematic tools or approaches to reach selection of appropriate technology.

### 2.1.1 HARDWARE AND SOFTWARE TECHNOLOGY

Technology is employed through knowledge and machine or equipment or tools which are hardwares to solve practical problem. On the other hand human involvement takes place for the hardware to be productive. These two wares are described below :

#### A. Software Technology:

Technique belongs to the software part of technology and basically refers to more innovative aspects and institution of the participants of the society. This comprises of the following types of knowledge :-

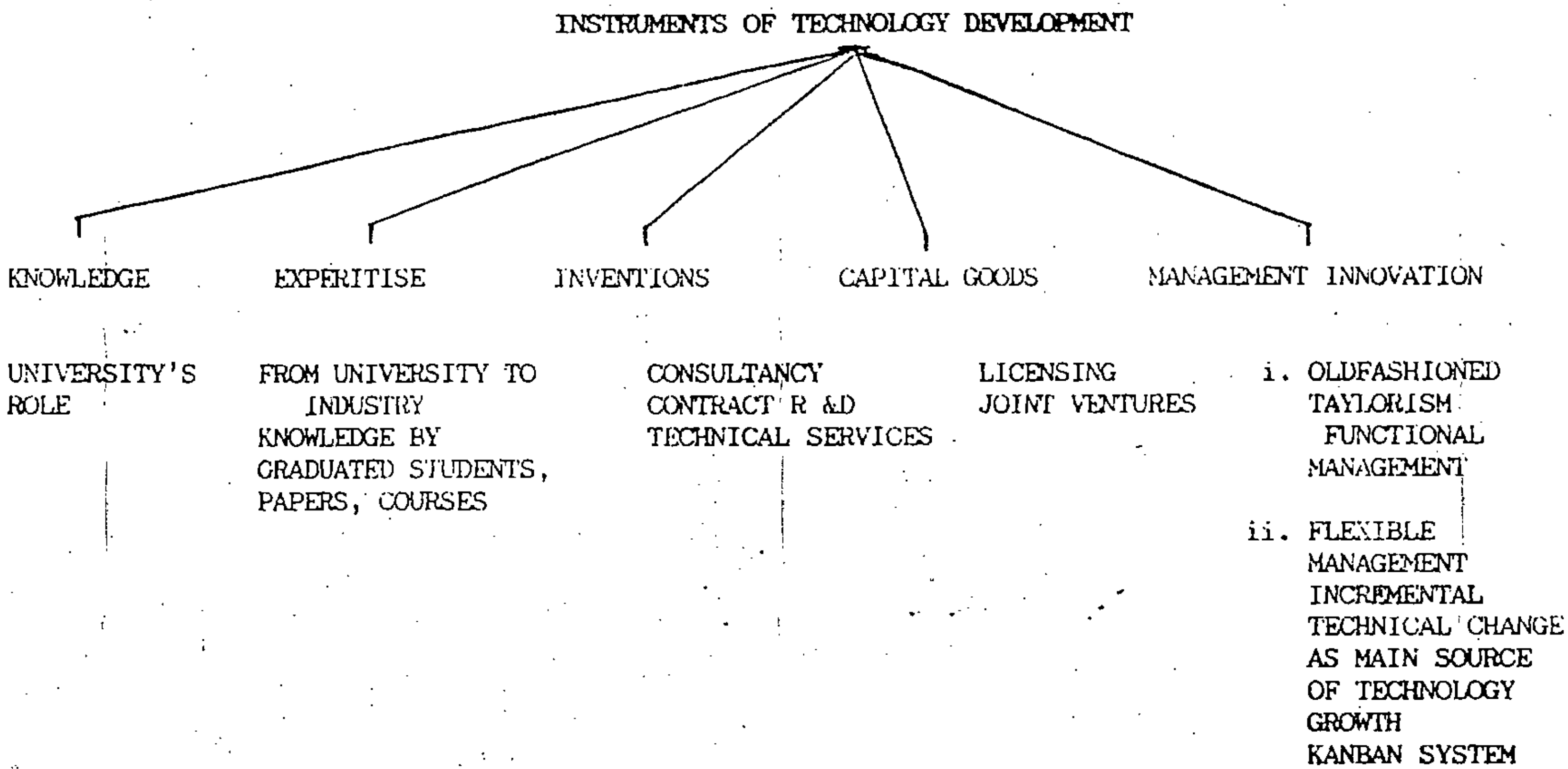

INSTRUMENTS OF TECHNOLOGY DEVELOPMENT
KNOWLEDGE
EXPERITISE
INVENTIONS
CAPITAL GOODS
MANAGEMENT INNOVATION
UNIVERSITY'S ROLE
FROM UNIVERSITY TO INDUSTRY KNOWLEDGE BY GRADUATED STUDENTS, PAPERS, COURSES
CONSULTANCY CONTRACT R &D TECHNICAL SERVICES
LICENSING JOINT VENTURES
i. OLDFASHIONED TAYLORISM FUNCTIONAL MANAGEMENT
ii. FLEXIBLE MANAGEMENT INCREMENTAL TECHNICAL CHANGE AS MAIN SOURCE OF TECHNOLOGY GROWTH KANBAN SYSTEM

Fig: 2.5

Fig 2.6 : **MACRO INDICATORS OF TECHNOLOGY DEVELOPMENT**

INVESTMENT CAPABILITY

* INCREMENTAL CAPITAL-OUTPUT RATIOS (ICOR)
* SELECTION OF PROJECTS, CHOICE OF TECHNOLOGY, PROJECT ENGINEERING, IN PROJECT, PROJECT MANAGEMENT

PRODUCTION CAPABILITY

* TOTAL FACTOR PRODUCTIVITY
* PRODUCTIVITY OR CAPITAL/LABOR/MANAGEMENT

INNOVATION CAPABILITY

* NO. OF SCIENTISTS, ENGINEERS IN R & D PER MILLION POPULATION
* R & D EXPENDITURE AS % GNP
* PATENT APPLICATIONS/REGISTERS TO RESIDENTS PER MILLION OF POPULATION

1. System- Specific Knowledge: Information passed by a firm acquired through participation in projects or in manufacturing certain products. It comprises knowledge of procedures connected with a particular system or technology.

2. Firm-Specific Knowledge : It results from the firm's overall activities and it could be organizational as well as technical.

3. Industry-Specific Knowledge : Information common to an industry, profession or trade; possessed by all firms in the industry engaged in manufacturing a particular line of products.

4. General Knowledge : Information of nonvocational in nature and can be dispensed by the general education system. It includes basic skill such as arithmatics and computer programming, as well as basic mechanical skills such as the ability to perform basic engineering drafting.

B. Hardware Technology

Hardware technology are developed in a society as per its set objectives, accumulated level of knowledge, input resources and entrepreneurial and organizational skill achieved at a given point of time of that society(5).

They are mainly physical items or considered as embodied knowledge(2):

1. Capital goods( machine, tools etc.)

2. Blueprints

3. Technical specifications

4. End-use type products (automobiles, television, computers etc.)

2.1.2 NATIONAL POLICY ON TECHNOLOGY

The principal objectives of national technology policy of a country should be :

1) The creation of the national institutional framework for the widest possible access to technology

2) The development of an indigenous capacity for generation and application of technology so as to make optimum use of resources.

3) Control of import of technology through policy intervention and to develop the required capacity to bargain for the technology on the basis of technology need assessment of individual organization concerned(1).

With a view to develop platform for the technological competence advanced centres for education & research had been setup. The Council for Scientific & Industrial Research (BCSIR) laboratories under the Ministry of Education, Government of Bangladesh is one of such centres. There are about 60 R & D institutions and supporting facilities developed within the

Universities, Research Council, Government Dept. and NGOs(6). Despite the existence of a wide range of institutions the link between them and the producers is rather weak. Since the bureaucracy determines the policy decision affecting scientific,institutional and industrial sector any communications between these three sectors thus depends on the bureaucratic mechanism(1).

The National Council for Science & Technology (NCST) is the policy institution of science and technology for the country. This is a broad based body with the President of Bangladesh as its Chairman and the Prime Minister heads the Executive Committee of the Council (ECNCST). The Science and Technology Division acts as the Secretariat of the NCST. Though NCST has formulated a Science Policy (1986) but it has yet to start performing its policy functions. At this stage NCST must drive their effort to build a viable base of technological competence(6).

The ECNCST has made some decisions which will have far reaching consequences in industrial development of Bangladesh. These are as follows:

- integration of technological consideration in the Fourth Five Year plan (1991-1995)

- greater budgetary allocation for scientific & technological R&D in order to gradually arrive at targeted allocation of 1% of GNP

- to prepare revenue and research budgets separately for R&D institutions of the country.

An effective transfer of technology depends on the developing of the national policies for encouraging indigenous development of technology. So, it is necessary for allocation of adequate resources for R&D efforts in order to develop a competent indigenous capacity base to develop, generate and apply technology apart from absorbing the imported technology from abroad. In many cases resource investment to absorb an imported technology by the indigenous expertise will be much more than the cost of that imported technology itself .

As already mentioned that there exists a very weak linkage between the R&D institution responsible for generation of technology and the industries( which are supposed to apply these technologies) which can be strengthened by close links, positive interventions of concerned ministries with the institutions. This will help to play an effective policy on technology and to materialize the findings in the R&D laboratory in the industry.

It is realized that a technology plan constitutes far more than a collection of just R&D project proposals. One may infer that technology policy "cuts across several policy areas of a nation, it is not a compartmentalized policy,but rather a mode of analysis, promotion & control that affects most policies, deals with goals & programmes in many areas, makes use of a variety of intervention mechanisms, operates through many departments of the Government and uses universities, industrial firms and non-profit organization" (5).

In fig 2.7 two essential prerequisites are presented for effective policy planning in order to bridge the gap between technology assessment and real technology- based development. In the top frame, the overlapping portion of three circles representing respectively Research & Development Institutions,Academia, and Industry due to their interactions should be required to strengthen linkage with the help of catalytic and dynamically active intermediaries. Here the major problem is weak linkage and micro-level isolated excellence. In the lower frame the major problem is micro-level climate creation and policy harmonization. Solution lies on a participative decision making process with harmonization of interests.

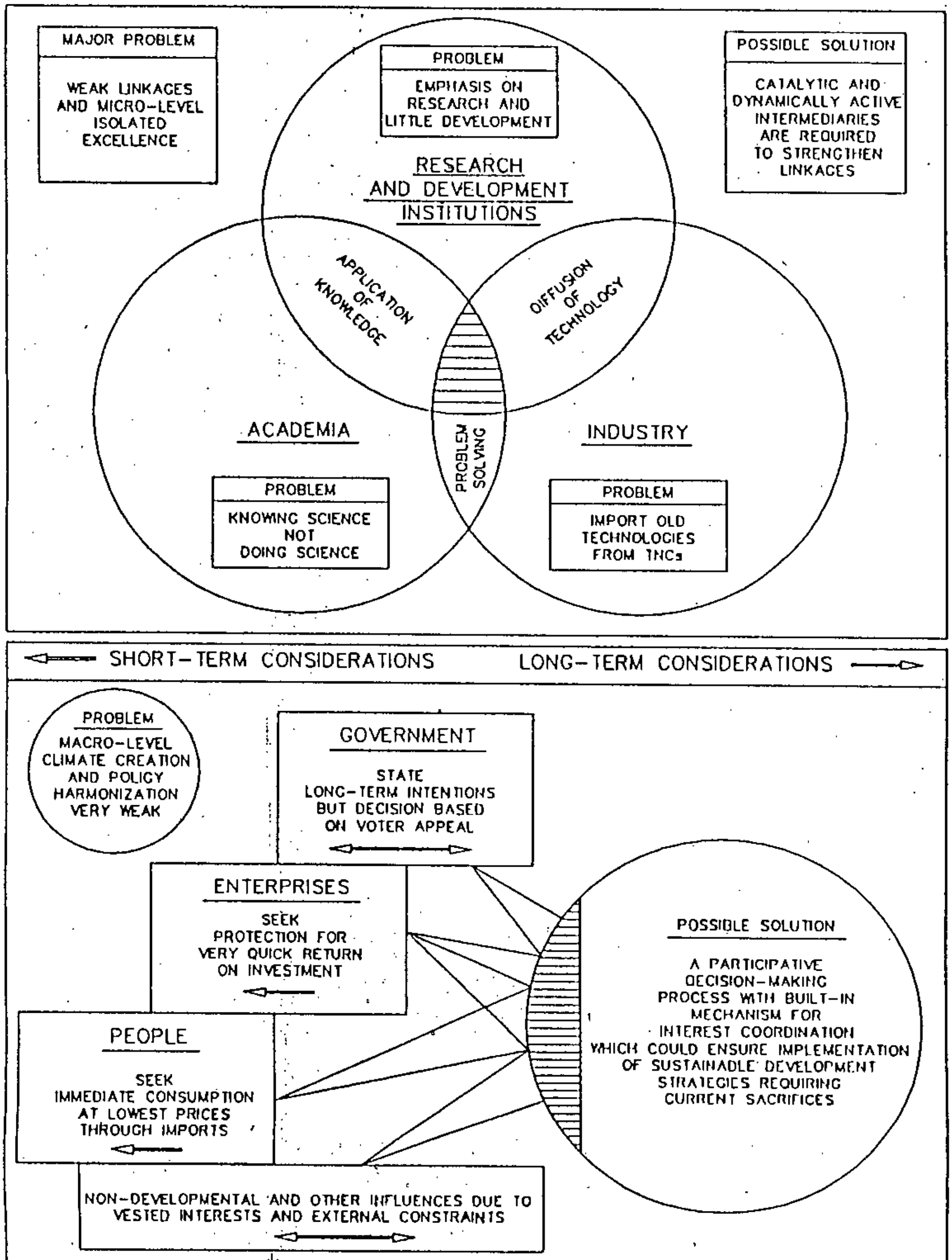



**Fig 2.7** : TWO ESSENTIAL PREREQUISITES FOR POLICY EFFECTIVENESS

In the developing countries the economic and financial policy makers are often not guided by any set of technology policy. But their decision can have far reaching effects on the course of technological development.Besides frequent policy change to be avoided through enactment of laws favouring inclusion of Science & Technology plans in the constitution(8).

In evaluating any technology suitable for development, policy makers need to recognize that all forms of technology are not adaptable to suit the factors of production endowed to Bangladesh. Generally a distinction is drawn between Core technology and Ancillary technology. Core technology is central to manufacturing process allowing little flexibility to shift from capital to labour in intensive methods of production whereas Ancillary technology (handling, movements, storage, packaging etc.) has greater flexibility for labour intensive operations(1).

With a little development of indigenous technological base and generation of own technology on many required fields Bangladesh will have to depend on imported technology for some more decades, so it is necessary to screen the imported technologies during the planning stage of a project with objective of self reliance, save excessive or overpayment for imported technology and judge the real necessity of it. So, an investment intervention has become necessary to regulate the flow of technology to Bangladesh from the developed countries.

## Policy Intervention

In developing countries deliberate planning and the government intervention on the technology market have recently proved to be fruitful in transfer of technology rather than for a free market of technology. Such interventions have been made through formulation and implementation of appropriate policy measures and policy instruments. Policy instruments are to be designed to influence all components of technology to break the vicious circle of underdevelopment (Fig 2.8).

An appropriate atmosphere or climate conducive to develop, generate, absorb and apply technology must be present in a country if it wants to be self-reliant and develop its own economy. To create such a healthy technology climate only the ministries, Govt. department and agencies are not enough but they are to be integrated with some special efforts and institutional initiatives. In order to implement government intervention process in control of flow of technology such special efforts or policy measures are the essential ingredients. They lead to formation of appropriate policy instruments.

Policy Instruments

Policy instruments are modes of promotion and control affecting other policies, dealing with goals and programs in many areas, making use of a variety of intervention mechanisms, operating through many departments of government, and influencing the activities of a wide variety of government and non-government instruments. Policy instruments, once formulated, need a vehicle or an organizational set-up to operate it. Depending on the origins of policy initiatives, formulating agencies, desired impact and mode of application, the various policy instruments which influence all the four components of considerations in the planning process may be generally considered to fall under four different categories, viz., Legal, Fiscal, Financial and Economic Instruments(8).

i) Legal Instruments: They are in the form of laws, decrees, regulations, by-laws, contracts and formal agreements. Some of them are to protect right of intellectual property (Patent Law, Copyright Law, Trademark Law, Licensing Rights etc.). Others may deal to regulate, protect and conserve the environment and natural

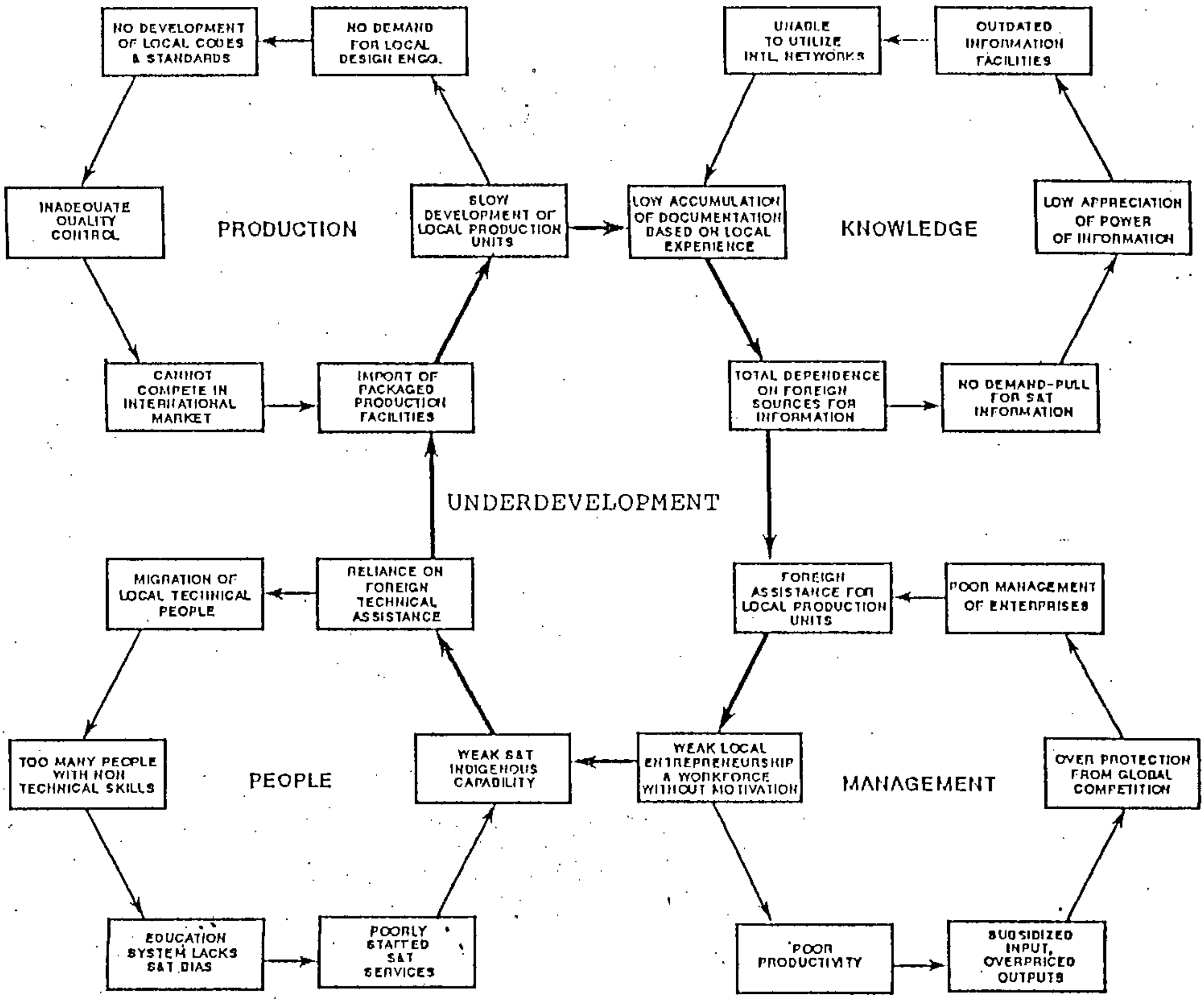



FIG. 2.8 VICIOUS CIRCLES OF TECHNOLOGICAL UNDERDEVELOPMENT.

resources or to promote certain economic activity. There are still some legal instruments to deal foreign collaboration and import of technology.

ii) Fiscal Instruments: The principal role is to raise funds for the revenue and development expenditure of the government. It certainly affects structure and pace of technological development. They are in the form of corporate tax, customs, excise, value added tax, sales tax etc.

iii) Financial Instruments: Appropriate financial policy instruments regulate technological developments. They affect banking policies, special credit agencies, interest rates, capital flow directions, exchange rates etc.

iv) Economic Instruments: These instruments take the form of Macro-economic measures and include: subsidies, Pricing, Policies etc. These are often employed in conjunction with appropriate Legal Instruments in order to promote certain production sector(s) in the country.

### 2.1.3 TECHNOLOGY RELATED ACTIVITIES AT VARIOUS LEVELS OF NATIONAL PLANNING

Technology based development planning has not yet become an standard practice in developing countries. The national planning process takes into consideration integration of technology due to development of recent decision support tools(8). Such planning exercise would need active participation of various ministries, agencies and the private sector. Development planning activities can take place at different levels starting from the highest national level upto the project level. Five different levels have been identified as follows :

| | | Levels |
|---|---|---|
| * | Project / Enterprise | 1 |
| * | Program / Specific products | 2 |
| * | Sub sector / Specific industry or corporation | 3 |
| * | Sector | 4 |
| * | National | 5 |

Fig 2.9 shows these different levels and the various clusters of Technology related activities which take place within each level. Concerned agencies responsible for such activities have also been shown in the figure.

Following aspects and characteristics are important in order to appreciate the activities at the various levels:

* Activities vary with respect to range and nature at the various levels.

* Each level contributes to the overall process of integration of technological considerations in different measures.

* The volume as well as dimension of the problem faced during the implementation of technology related activities differ with different stages of growth of technology.

* Every level need to fully appreciate its own role, its limitations, interactions with other levels and have a holistic view of the activities taking place at other levels during the planning process.

* Without such mutual role appreciated, role conflicts often results which lead to confusion and ultimately slow down the implementation process during technology development efforts.

| LEVEL | TECHNOLOGY RELATED ACTIVITIES | CONCERNED AGENCY/ PERSONNEL AUTHORITY |
|---|---|---|
| PROJECT/ ENTERPRISE | Procurement of equipment<br>Selection of contractors and consultants<br>Erection schedules<br>Specifications<br>Recruitment | Project/Enterprise Management Team |
| PROGRAM/ SPECIFIC PRODUCTS | Product mix<br>Choice of techniques<br>Reverse engineering<br>Febrication program<br>Environmental considerations<br>Marketing<br>In service training<br>Skill development<br>Extension | Cluster of similar Enterprises/ Program Coordination Division |
| SUB-SECTOR/ SPECIFIC INDUSTRY/ CROP. | R & D<br>Design engineering<br>Choice of technology<br>Manpower planning<br>Pre service training<br>Project formulation<br>Project monitoring<br>Technology contracts<br>Technology diffusion<br>Information storage and retrieval<br>Standardization<br>Foreign trade | Government Departments, Large Corporations - Public & Private |
| SECTOR | R & D, Technology generation<br>Technology assessment/choice of technology<br>Assessment of needs and capabilities<br>Technology Forecasting<br>Information networking<br>Project appraisal<br>impact analysis<br>Human resource planning<br>Targeting<br>Institutional training and planning | Ministry Concerned |
| NATIONAL | Macroplanning, perspective planning<br>Resource assessment and planning<br>Prioritization<br>Identification of components of each technology domain<br>Technology import modalities<br>Reward and compensation system<br>Overall policy planning | Parliament/Cabinet National Planning Authority |

Figure 2.9: Technology Related Activities at Different Levels.

The two major ingredients of national planning are explained and given below :

a. Implementation of plan    b. Monitoring and review

a. Implementation of plan :

Involvement of the various levels of units / agencies or selection of the project managers and his participation in the plan formulation stage may provide the appropriate downstream activities in the implementation process..

In the existing procedures in a traditional socio economic plan seems to stress only the modalities for fund disbursement and phasewise implementation of physical construction involved. Thus apart from designing guidelines only, a plan implementation implies to focus on other important factors as follows :

* Efficiency of legal, fiscal, financial and other economic policy instruments in the achievement of technological targets;

* Progress in matching efforts in research and development along with development of indigenous design capability in the technology concerned;

* Dynamic human resource and skill development along with the creation of an innovative climate.

* Establishment of information network to ensure interlevel flow of information and inter-action with global networks.

Implementation agencies at each levels need to be revamped to adapt appropriate procedures considering the above mentioned additional factors. The question of role conflict has been highlighted. Indeed, resolution of role conflict of different levels during planning stage is a primary requisite for plan implementation.

In Fig 2.10 it is shown how the technology related activities relate with the different agencies in government / economy. For the case project Ashuganj Thermal Power Station Extension (ATPSE) Units 3, 4 and 5 agencies involved under the three lower levels. These are very relevant in consideration of transformation to physical activities. When Fig. 2.10 is viewed in conjunction with Fig. 2.9 it would help to setup proper modalities for the assessment procedures envisaged. Fig 2.11 presented in a matrix form the agencies which may benefit from the results of different assessment procedures.

b. Monitoring and Review:

Monitoring and review are essential activities in all plan implementation processes. Such activities provide feedback and help in making appropriate adjustments in schedule and budget. Thus it assists to formulate more realistic schedule for the similar other projects to be undertaken in the future. In monitoring implementation of a project special consideration as stated already in the previous section may be taken as guidelines.

In the existing practices, implementation of projects is monitored only to the extent of fund disbursement and physical progress only. But technological consideration is not given proper importance. Measurement of output performance and regular policy review (in respect of policy instruments) need to become a regular feature of monitoring activity. The technology decision support tools provide appropriate touchstones for such monitoring process.

Regular publications of technological indicators based on the given assessment tools will not only help in monitoring implementation but also constitute appropriate measure for external as well as internal reviews for preparing the post completion report and making an impact analysis during the entire growth process of a technology.

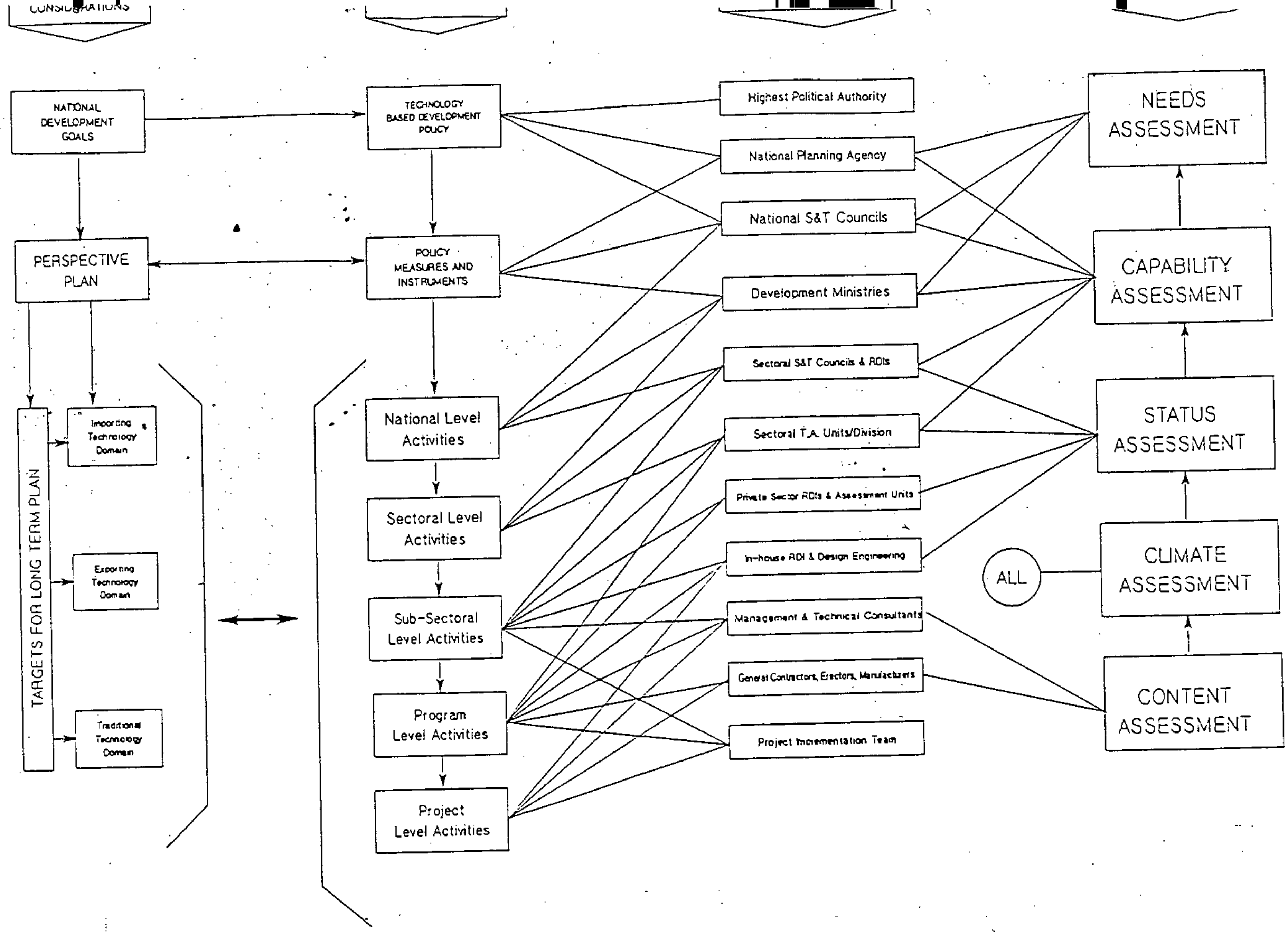



FIG.2.10 IMPLEMENTATION MECHANISM FOR TECHNOLOGY BASED DEVELOPMENT PLANNING.

Fig.2.11: Utilization of Results of Assessment by Different Implementation Agencies

| Agency Utilizing Assessment Results | Technology Content Assessment | Technology Climate Assessment | Technology Status Assessment | Technology Capability Assessment | Technology Needs Assessment |
|---|---|---|---|---|---|
| Highest Political Authority | | * | * | * | * |
| National Planning Agency | * | * | * | * | * |
| National S&T Councils | | * | | | |
| Development Ministries | * | | * | * | * |
| Sectoral S&T Councils & RDI's | * | | * | * | * |
| Sectoral TA Units/Divisions | * | | * | * | |
| Private Sector RDI's | * | | * | * | * |
| In-house RDI's & and Design Engineering | * | | * | * | * |
| Management & Technical Consultants | * | * | * | * | * |
| General Contractors, Erectors, Manufacturers | | | * | | * |
| Project Implementation Team | | | | | |

This review and adjustment process may be carried out at regular intervals. Each year, the planners and those agencies responsible for implementing the plan must review the progress and make pertinent adjustments in order to bridge the gaps, develop capabilities and meet the needs.

## 2.2 TRANSFER OF TECHNOLOGY

Technology Transfer in the earlier centuries was simple and straight forward because the principal knowledge-base of the technological progress was artisan ingenuity. The transfer was nothing but apprenticeship. The gap between the donor and the recipient in term of literacy was not substantial. But currently the process has become difficult and complex as technology has become more and more capital, scale and skill intensive. As a result the gap between the seller and the buyer has widened to an alarming extent.

In Fig. 2.12 a systemic approach towards technology transfer and related ingredients has been shown wherein solutions of technology related subjects can be found out.

Now a days there are two ways of acquiring necessary technology either develop it in-house or purchase it. Developing is generation of technology. Purchasing is transfer of technology. Transfer occurs due to existence of "buyers" (transferees) and "sellers" (transferors) with both parties having similar and or dissimilar very often conflicting economic and social interests arising from discrepancies between anticipated benefits.

The strategies of development in the country enunciated under various national Five Year Plans emphasis on technology with due weighage . This strategy of development relied on imported technology from the developed countries in various forms. These may be in the form of foreign private investment, joint venture, turnkey project or may be under licensing agreement. In the past

### TECHNOLOGY TRANSFER

Technology transfer can mean different things -- from producers to users or from one place to another place (industry/ region/ country).

There is no donor or recepient -- it is a deal between a buyer and a seller.

Old technoware can be bought in seller's market, humanware import is temporary, inforware is generally not sold and orgaware cannot be readily transplanted.

For optimal transfer the technology gap between partners should neither be too large nor too small. Large gap - no assimilation, and small gap - rivalry.

### APPROPRIATE TECHNOLOGY

Although appropriateness is not an intrinsic quality of any technology, all labour-intensive, cheap and old technologies are generally branded as appropriate.

Less sophisticated imported technoware often requires more sophisticated humanware equipped with better inforware to produce quality outputs.

Any technology is appropriate at the time of development with respect to the surroundings and objectives.

Appropriateness evaluation for both transfer and development decisions are dynamic and involves value-based judgement of users.

### SELF - RELIANCE

Lack of appreciation that self-reliance is not self-sufficiency, but ability to participate on own strength in international technology market.

Self-reliance means acquiring capability to adapt and improve imported technologies, and also to produce some state-of-the-art technologies for consumption and export to make import possible.

Make-some and buy-some technology is the most pragmatic strategy for sustainable and self-reliant development in an increasingly interdependent world.

One important requirement for self- reliance is to encourage creativity, innovation and completion.

### TECHNICAL COOPERATION

Cooperation among developing countries, though desirable, remains unsuccessful due to tradition, mistrust, uneven partnership and market competition from similar industrial development patterns.

Mutuality of interest is the foremost requirement for workable technical cooperation among developing countries.

Areas of cooperation need to be determined on economic grounds with the philosophy of technological specialization based on dynamic comparative advantage.

Fruitful cooperation is possible to monitor international technological trends and to develop methodologies for technology management through exchange of experiences.

Fig 2.12: CONSIDERATION OF SELECTED IMPORTANT ISSUES two years foreign investors are encouraged by the government to set-up export oriented industries in order to enhance rapid growth in the industrial sector.

Technology transfer can be either vertical or horizontal. Vertical transfer is normally internal to the enterprise. It evolves by incorporations of new scientific knowledge/innovations from the idea stage to its final physical shape. Whereas horizontal transfer represents the transfer of proven and successfully tested technology in a territory to the transferee's territory. During its transfer process it can be modified, adapted to local conditions or can be integrated to the indigenous technology of the country of the recipient.

Since technology transfer in the present case study is mostly concerned of development of a highly skilled and competent capability base in implementation phase of the area of power generation technology, this study will mostly focus and investigate the extent to which skill and capability were developed to the Client's project management team from the expatriate manpower set-up of the technology sellers. This work does not concern the commercial activities that brings about a wider application of the technology from the imported source.

To minimise dependence on foreign technology as well as reducing the country's gap in technological sophistication level compared with the imported technology, and to achieve rapid development import of technology must be selective. Though vertical transfer of technology is the ultimate goal of the recipient the process of transfer can be more effectively achieved by horizontal transfer of technology.

Since technology imported from foreign sources having different cultural base and beliefs there exist a noticeable gap in attitude, values and beliefs between the project management of the transferors & the transferee.

The transfer and development of technology involved acquiring the capability in choosing a technology which can be absorbed and to gradually acquire the skill to generate it. The relative variation in such capability depends on :

1. The strategy of development to be adapted by the country whether it is for self-reliance or dependence.

2. The level of complexity of that technology in terms of capital intensity and the level of professionalism or skillness required.

3. Mode of acquiring the technology, licensing, turn key or otherwise. Contractual clause can support opening of technology transfer acting as an incentive when passing through various phases of technology transfer.

In the area of production technology the concept of group technology or cell manufacture had been introduced since more than two decades. As per this concept the plant layout is reorganized from process to a product basis. It reduced material handling and different products came under the direct responsibility of a particular section. Group technology thus help to reduce cost and simultaneously improve production for same operator skill.

Through a selective policy of importing technology the Government of the country has encouraged import substitution for a few items. Though such policy was framed for protection of indigenous industry, sufficient safeguards against the price and quality ofproducts have not been taken. Under this policy the Government has to allocate foreign currency component of items which are free to import. Public enterprises thus have to approach the Government for allocation of foreign currency to procure spares and replacements. The objective of such restriction is to encourage indigenous source of supply or to utilize their own manufacturing/ workshop facilities. As an alternative the donor agency is approached for allocation of foreign currency to procure such spares.

Public enterprise should engage themselves to segregate imports under heads such as raw materials, stores and spares, manufactured components, tools and parts so as to control import. Yearwise comparative figures to be arranged so that dependence on foreign import could be assessed and reduced within a reasonable time.

Some technology transfer operates the pace of indigenization and is dictated by the terms and conditions of the agreements. In the utilization of human resource during the implementation of public enterprise projects the contractors are to utilize local indigenous manpower at least upto certain levels, say they cannot bring from abroad some special technicians or skilled manpower below the levels of foreman etc. This constraint helps to train local manpower and create opportunity of employment.

Technology transfer also can be visualized by progressive manufacture of some equipment by way of gradual deletion of components for input and production of the same locally. Similarly for process plants through different stages deletion can be effective say during the erection state of some section/ plant undertaken by local technicians and engineers. Even complete manufacture of a section/plant in a large process plant should be possible under licensing arrangement. The supplier would provide the design, specification and drawing and quality control requirements, the local engineers will do the rest including erection trial run and set to operation. In such a case local manufacturing and heat treatment facility etc. will be made available.

To achieve self reliance and sustainable growth it is needed to gear the industries upto research and development. This phase of development within industry demands a multi-disciplinary approach because it is necessarily interdependent on related fields of science and technology. The focus has to be on the direct application of knowledge and skill.

## 2.2.1 MECHANISM OF TRANSFER OF TECHNOLOGY

The mechanism for technology transfer depends on the needs and motives of the seller (the donor). Technology needs arise from the desire to fulfill the void existing in a society for the specific services or products as well as to have a competitive edge for certain sophistication level in a particular technology.

The two parties (transferees and transferors) at transaction normally are governed by the policies and regulations prevalent in their respective countries. Those policies and regulations can be termed as constraints. Within these constraints both of them try to maximise their advantages. They also try for alternative modes for selling/acquiring the technology. These options give rise to many crucial determinants which are the bargaining issues for both of them. The bargaining determinants are as follows :

1) The monopolistic or competitive situation in which both the seller and the buyer of the technology are placed.

2) Alternative markets to both the seller and the buyer.

3) Availability of information on alternative source of technology, particularly for the buyer, and their respective costs and benefits.

4) The prevalence of regulatory mechanisms in donor and host countries which lay down ground rules for such transfer of technology.

The above factors or determinants assumed equality between the parties in the bargaining table. In reality the situation is lopsided because the process of acquiring technology allows the seller to have the upper hand and normally the seller dominates in the game. This is true specially when the buyer is from a third world country such as Bangladesh.

In the process of acquiring technology the receiver gains in experience and the lopsided balance tends towards equality gradually. This process is nothing but attaining at higher stage of capability from a lower stage.

In Bangladesh the sector corporations/other buyers prefer to import technology from foreign source guided by regulatory mechanism. This type of technology is limited to small equipment, completely assembled machines or equipment, small plant or equipment in CKD condition etc. The construction/erection part of the plant is well grasped by the buyer and even in many cases commissioning and trial operation can be conducted by locally available expertise. However, in some larger plants only a supervisor from the exporting manufacturer are brought to plant site during commissioning of the plant under such import/export type of technology transfer. The terms & conditions of such purchase/transfer are set in the purchase document accordingly.

In case of turnkey projects where the receiver is at their initial stage of development prefers to depend on capital, expertise and information. This arrangement is normally exercised for huge plants producing sugar, fertilizer, paper & pulp, leather, steel and allied products, cement and allied items, chemicals, automobiles, different other engineering products and utility process plants of high technology. There is/are always a few donor agencies, expatriate consultants and turnkey contractors participating in the project at various phases. Due to weak and nonproficient personnels in the leadership of the recipient side the seller always succeed in bypassing/neglecting the issue of technology transfer and training up buyer's personnels.

In turnkey project arrangement the seller (transferor) assumes whole responsibility of design, plan, preparation of specifications, manufacture, procurement, shipping, site delivery, construction, erection, precommissioning, quality control, commissioning, initial operation, reliability test run and handing over of the project to the transferee. In some cases the client appoints a Consultant who works as single responsibility on behalf of the client for selection, planning, implementation and termination of the project. This Consultant's appointment is normally approved by the financial agencies. In absence of a Consultant, in place of a turnkey contractor a General Contractor is selected by the client to assume all responsibility of the Consultant and the turnkey Contractor mentioned above.

However, in cases where the seller or donor of technology experiences restrictions on export of technology or cannot achieve advantage to bargain favourable terms and conditions during the negotiation stage and also fails to procure handsome profit out of their business due to capable and well managed purchaser, they go for direct investment or joint venture with licensing agreement.

When deciding on a license agreement as a form of technology transfer, both sellers and buyers of technology see several specific payoffs. For sellers these are as follows :

1. The earning of additional income from technologies which are at the end of their product life in the domestic markets.

2. The opportunity to experiment with a technology which has yet to be proven.

3. In certain cases to gain the goodwill of the host country governments and to obtain some publicity.

For buyers these are as follows :

1. The acquisition of ready-made technology is often easier than investment in research and development.

2. The opportunity to procure up-to-date technology in some cases.

3. Scope for unpackaging the technology can be built into the agreement.

The actual payoffs to either of the parties will ultimately depend on the technology package. It is here that the parties may, during the process of bargaining, seek advantages, depending upon the needs of the buyer and the motives of the seller.

By adapting licensing agreement the developing countries are likely to discourage the generation of indigenous technology. It is said licensing agreement devoids of the process of "learning by doing". The UNCTAD guideline for import of technology clearly prefers licensing to foreign private investment(1).

For selective inflow of technology through detailed screening is a must for a third world country and this is done by the government regulatory mechanism assisted by policy interventions. In many collaboration agreements limited foreign investment has been allowed in the form of equity or supply of equipment.

## 2.2.2 INTERNATIONAL TRANSFER OF TECHNOLOGY

In Fig. 2.13 a general pattern of international technology flow has been shown. The THIO( 7) represents the four components of technology namely Technoware,Humanware, Infoirware and Orgaware and their analyses have been also described in that fiegure.

An elaborate distinction can be made into three phases of Horizontal Transfer of Technology:

1. Material Transfer - Characterized by importation of new product or material with no adaptation to the local environment.
2. Design Transfer-Transfer of the capability to manufacture the product domestically.
3. Capability Transfer -Transfer of scientific knowledge and capability to develop new technology.

The ways and means of transferring technology are known as "linkages". Many diversified direct and indirect linkages have been used to transfer technology from the developed to developing countries. Different sources of technology transfer have different strengths & limitations, and different costs or benefits. The following are the major concerns of this study:

A. Direct Linkage
1. Operation of transnational corporations
2. Licensing arrangement
3. Hiring experts and contractors
4. Training of technical staff abroad

B. Indirect Linkages :

Purchase of machinery, equipment and components.

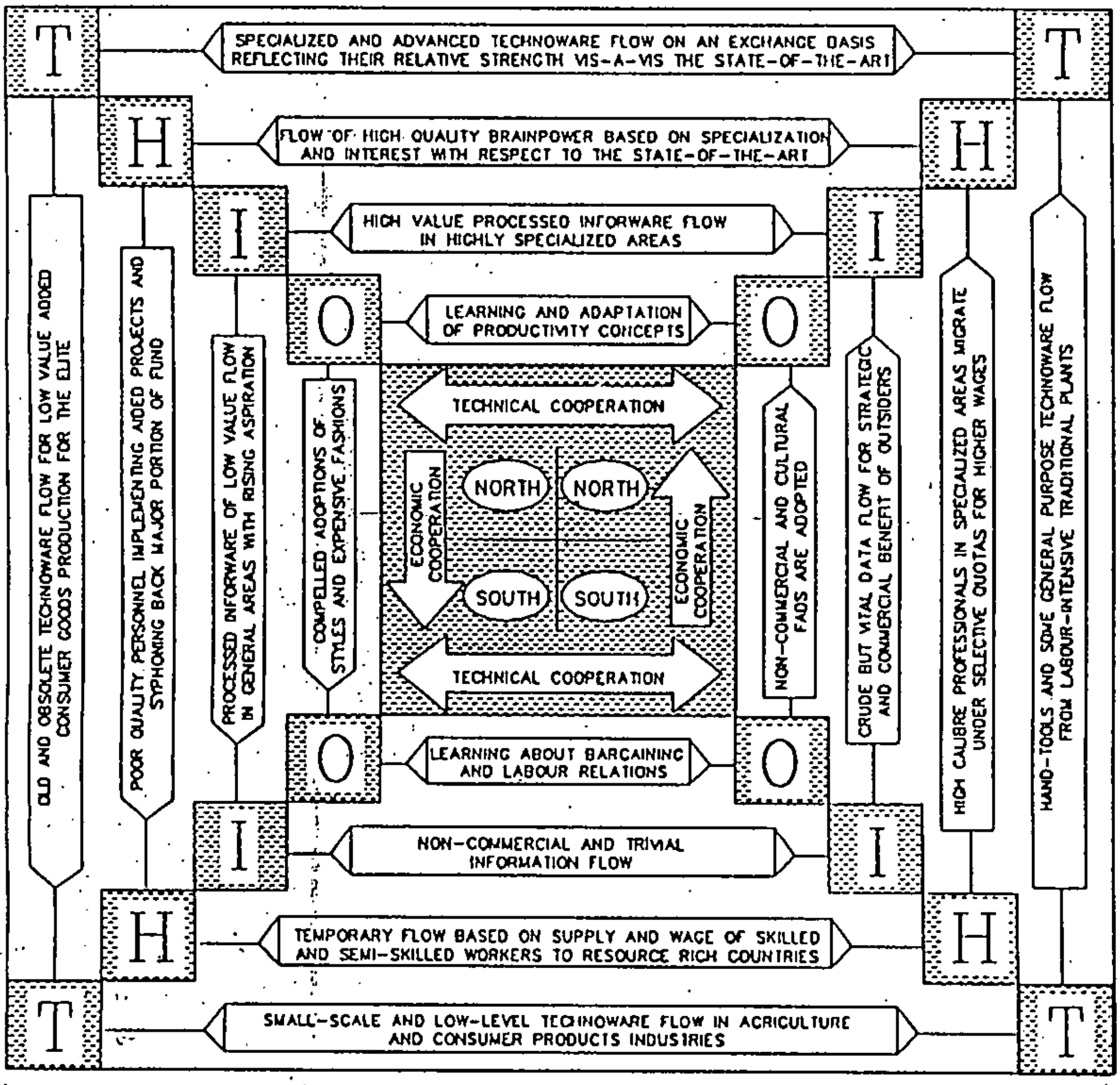



Fig 2.13 : GENERAL PATTERN OF INTERNATIONAL TECHNOLOGY FLOW

The present trend of technology transfer shows that developing countries are still very much guaranteed upto the commercial level. This occurs mostly in the manufacturing sectors. Transfer at this level can be further classified into three major forms of commercial usage:

1. Market Level -Whereby use is extended to a population or individuals or firms through a reproducible package of goods or services; a commodity or a service.

2. Production Level-Use of a technology, primarily related to a firm's in-house activities, although the source of technology may be external.

3. R & D Level-Where the application of a technology can be used to create products imitating those which are already using the technology; or to create new products.

However, in most developing countries, the achievement as to the extent of success in adaptation and assimilation are still stagnant at the market and production levels. Therefore, relatively a little attention will be given to the R & D level of transfer, considering the intended nature and objectives of the present study.

### 2.2.3 TRANSFER OF TECHNOLOGY TO DEVELOPING COUNTRIES

During the past decades, worldwide proliferation of technologies related to industrial production and consumption gave rise to the "myth" of international technology transfer. One of its implications is that prevailing modes of transborder flows of technology would decrease rather than increase the inequality of international economic and political relation. Despite the pros &

cons of international technology transfer as seen from the viewpoint of recipient (firm and host country), considerable amount of work, involving both theoretical and practical aspects of technology transfer have been carried out mainly to tackle problems like appropriateness and acquisition of technology and its assessment.

In Fig. 2.14 some common problems in developing countries on technology and its transfer have been described. In the context of a third world country like Bangladesh the status of four components of technology and the technology climate and constraints have been elaborately presented. A careful study of this table may lead to successful solution to the problems of technology transfer.

### 2.2.4 HOST COUNTRY'S PERSPECTIVE AND EXISTING TREND

The crucial role of technology in the growth process of a country has been well documented and now is universally accepted. It is established that the recognition and reward giving to domestic production of goods and services in a third world country like Bangladesh are essential for its long-term objectives. This process of transformation of indigenous resources to quality goods and services comparable to international standard can alleviate the technological capability of the country. Until such built up of indigenous technological capability reaches to a sufficient level the international transfer of technologies has become not only a necessary source of essential factor of production but also an important stimulus to the technological assimilation capability and consequently their capability to sustain technological growth.

**MANY PROBLEMS ARE DUE TO LACK OF UNDERSTANDING AND EXPECTATIONS BASED ON PARTIAL COMPREHENSION**

### TECHNOWARE

Outdated, inefficient and poorly maintained physical facilities for production, storage, handling and transportation.

Simultaneous development, transfer and diffusion of technoware are essential for catching up in selected areas.

### HUMANWARE

Lack of competence and general mis-match between skill supply and demand for economic activities in transformation and services.

Ultimate resource for technology -based development is humanware, and humanware development takes long time.

### INFORWARE

Inadequate appreciation of the value of information resulting in poor documentation and dissemination.

Inforware is the source of power, it is not given away free.

While inforware that will provide competitive edge in the world market is unlikely to be in the public domain, information on the location of such inforware may be.

### ORGAWARE

Poor work environment and old traditions resulting in low productivity and inefficient use of resources.

Little concern for improving the effectiveness and linkages of organizations for optimal return on limited investments.

To do the right thing is more important than doing things right.

### CLIMATE

Inferiority complex coupled with orientation to look to the glorious past than to the future are the barriers for innovation.

Compartmentalization of technology by institutional design and ineffective coordination by ex-officio committee members do not help.

Attention of top leadership devoted mostly to crisis management and finding fault with others.

Widespread preference for risk avoidance and using the excuse of a situation to avoid action.

Supportive climate facilitates productivity gain and reduces opportunities lost.

Creation of technology climate through mass-media and expositions.

### CONSTRAINTS

Heavy reliance on external funding and foreign assistance in policy analysis and decisions.

Marked indifference or even hopelessness feeling among leadership with respect to international relations and constraints for development.

The modus operandi of international financing institutions may inadvertently reinforce dependence.

Foreign assistance is conditioned by considerations other than the developmental needs of the recipient.

Attainment of autonomous decision-making capability using own people is most important.

Endogenous capability building has to be from within.

**THESE PROBLEMS ARE MOSTLY INTERNAL AND CAN BE CORRECTED WITH STRONG DETERMINATION AND POLITICAL WILL**

Fig 2.14 : SOME COMMON PROBLEMS IN DEVELOPING COUNTRIES

## 2.3 TECHNOLOGY ACQUISITION

The policies and strategies adapted by any organization for the purpose of acquiring technology have to be examined in the context of the organizational structure. The role a public enterprise play in the society introduces itself in the total political framework of the country. Public enterprises are controlled by the various departments of the Government which should be accountable to the Parliament. Thus their activities are under constant scrutiny and are discussed in public.

In acquiring a technology for producing a product/service the sector corporation/public enterprise has to negotiate agreements with a collaborator under varying condition. Following the selection of a collaborator the Government approval is necessary for the purpose of licensing/turnkey arrangement and import of equipment and machinery.

A collaborator is selected in any of the following ways :

1. Government directs the company to implement the agreement already entered into by it with a foreign firm.

2. Collaboration for certain products and then directs the company to follow up.

3. Government directs the company to follow up a project report of a foreign company prepared for a State Government.

4. With the approval the of Government of Bangladesh, the company/enterprise sometimes signs agreement with an existing foreign collaboration for the manufacture of an additional product.

5. The company/enterprise sends out global enquiries seeking collaboration for a new product.

6.By conducting negotiations with a prospective supplier for obtaining technical know-how against placement of order for machines/plants without payment of know-how fee or royalty.

After the collaborator is located care is to be taken to ensure that he has necessary expertise and proven experience by actually visiting their works in the line with technology to be acquired.

Once the source of technology is approved, the company has to seek the approval of various agencies within the Government such as Ministry of Industry, Ministry of Energy, Board of Investment, ECNEC, Finance Ministry, etc. For this the company has to prepare project reports/feasibility report for controlling agencies during various stages of approval. The complicated process of Government approvals not only cause delay but also give opportunity for public enterprises to face public scrutiny and opinion.

2.3.1 Joint co-operation or Development

In acquisition of technology the sector corporations/enterprises of Bangladesh many of whose life is more than 25 years or operating more than that period in the process of its development and technology transfer should limit their options to acquire technology. But in practice that stage has not been achieved by any enterprise/sector corporation/autonomous bodies. By now there should have been some selective purchase of technology for an old enterprise/corporation of Bangladesh which would become difficult to acquire, as manufacturers are not willing to sell their current technology - in fact such choice would have been the optimal strategy even applicable for the case project. As a strategy for acquiring technology, joint development has to be examined in the light of :

1.The speed at which the product or service is to be put into the market for the collaborators.

2.product/services to be flexible which is normally not possible in country like Bangladesh.

3.Cost, quality, and efficiency as such generation equipment/production machineries are not competitive.

4.The difficulties of establishing communication on a regular basis with the collaborator.

The different categories of technology acquisition are briefly described below :

(i) Turnkey type joint venture : In this category there may be a set of typical uses depending on terms and conditions of the agreement signed between the transferor and the transferee. Under one type the collaborator will have a percentage of investment in the project with the responsibility of establishing an Industrial unit. As such the collaborator will enjoy a certain percentage of profit sharing or will have other type of advantages as right of purchase of certain portion of produced goods at a previously fixed unit rate. The overall stake of the collaborator in the project agreement will depend on the bargaining power of the transferee, technology capability base and extent of their dependence in the imported technology. This kind of arrangement may focus on the following in the contract of agreement for the collaborator's involvement as :

1.Transfer of know-how on the technology or in the certain equipment.

2.Complete project planning.

3.Selection, supply, and commissioning of plant and equipment.

4.Supply of special tools, fittings and fixtures.

5.Planning of the organization and setting up of procedures and systems.

6.Training of clients manpower including engineers at various levels.
The above mentioned involvement may vary depending on the technology assessment capability and indigenization of the transferee.

There can be other type of turnkey arrangement as the case of the project ATPSE project. This kind of collaboration is very common in Bangladesh . Here the collaborator will have responsibilities of project planning, design and specification preparation, selection and test of equipment, erection commissioning at site, guarantee test and provisional handing over to the transferee. After the collaborator is relieved of their official taking over of the plant, 95% of the contract sum is released and in some cases 100% is released taking another guarantee (as Bank Guarantee) for the problems which may occur during the Guarantee period.

Under turnkey arrangement the Japanese arrangement with Hindustan Machine Tools was very successful in India in the year 1977-78. The collaboration agreement was highly successful in helping HMT to acquire expertise in the horological industry.(1).

(ii) Licensing Agreements or Selective Purchase:

This type of arrangement is mostly seen in the production activities. Here the client enters into licensing agreement with many manufacturers. For acquisition of technology in the production technology this arrangement may be termed as a dominant strategy of an industrial unit/sector corporation. The drawback in this type agreement might be that the technology acquired may not be of current technologies rather they might have reached their end of product life cycle. Yet the decision favoring this type of agreement should be based on demand of such technology to cater types of skills, the resource availability and the goal of economic development of the country.

(iii)Bulk Purchase

The strategy of acquiring technology through bulk orders may be resorted only under special circumstances. This may be merely a different mode of acquiring license agreement. Through bulk orders the company/firm acquires right to manufacture the equipment for which it would otherwise have to pay lump sum payments and royalties. The method tends to restrict choices of alternatives. The special circumstances referred to this kind of technology acquisition are 1) equipment for defence purposes, 2) the order may help to establish indigenous manufacture and help to save foreign currency on a recurring basis, 3) it may help to overcome the recession in a certain sector.

(iv) Joint Development

Under this arrangement both the parties work together to develop, manufacture and sell the products. In such arrangement the foreign partner normally look into business/contract of their which bring them higher added value products. Accordingly they divert the resources to such contracts/shops. Under this arrangement two corporations in the country can work jointly to deliver in the market some product in combination with two corporations research laboratory. The problems of joint development is that none has control over market so during implementation there should be amendment of contracts while developing a marketing products.

## 2.4 ABSORPTION OF TECHNOLOGY

Technology absorption is the capability of the user or receiver to adapt, assimilate, and master the technology. This depends on a variety of features, such as :

1. The nature of the technology packages which the seller and buyer have entered into, which basically an agreement to provide a range of information and services in return for payments made.

2. The overall technology policy and the interest available in its environment to support the enterprise in its attempt to absorb the technology(1).

3. Basic principles and techniques in the technology.

An effective absorption of technology which is an important aspect of any transfer, depends greatly on proper acquisition, on the exercises of an appropriate technological infrastructure, and on the required capability within the enterprise.

For effective absorption of technology it is to be transferred to the recipient completely so that they can master the technology.

The transfer of technology in depth is achieved at the end of a three stage process. The three stages enunciated by UNIDO are(1):

1. Access stage, when capability is transferred to a point where technical direction is provided by the collaborator to enable the achievement of the targeted performance.

2. Absorption stage, when required performance is achieved or obtained under the technical direction of enterprise managers.

3. The stage when overall control over the use of the technology for the benefit of the enterprise is done without reference to the licenser of the technology.

For technology absorption to be effective the enterprise need to move from manufacturing/generating to an engineering orientation. During the various stages of development of a company the experience regarding technology absorption to be carefully examined. The interaction process between the licensee and the licensor to be reviewed and the strategies to be checked for effectiveness - one such strategy may be learning by doing.

Stages of development at enterprise level for absorption of technology :

In an attempt to assist in the "reverse flow of technology" to developing countries the company/corporation should have its own stage of development. The concerned company or firm should record such stages of development. This process of development can be analyzed into four stages as :

1. The do-how stage
2. Selective specialization stage
3. Know-how stage
4. The selective technology/know-why stage

These stages highlight the process by which the company should gradually acquire basic skills which tend to specialization and which will become essential for indigenous development and finally the maturity to engage in the reverse flow or transfer of technology

The first two stages are crucial for development and as such stress to be given accordingly. In the first stage (do-how stage) focus is given on learning basic skills like turning, fitting and milling in a machine shop or rigging, fitting , welding in an erection site. Hence common pattern of training is to be imparted to achieve different levels of craftsmanship. Training is given to the craftsman, supervisor and engineers and emphasis is given on skills, accuracies and quality consciousness. These basic skills are then related to the assembly of an equipment or section of a plant thus progressively familiarizing the manpower with manufacturing/ erection technology. The skills imparted at this stage is duplication and objective is to provide skills and confidence to handle jobs independently.

After completion of basic training, they are given training in specialized skills; knowledge of intermediate products/ activities. The emphasis of this stage is an specialized technical training, standardization of manufacturing process, development of supervisory and managerial skills.

In the 3rd stage (know -how stage ) the stress is on the indigenous development of simple design and modifying the technology acquired through collaboration. At this stage, the emphasis will be on acquiring knowledge and skills in functional area like marketing, industrial engineering, design etc.

At the 4th stage ( selective technology/ know-how stages) the company sees itself having developed indigenous capability in critical areas such as design, development and manufacture of sophisticated equipments. In this stage ability much be achieved to choose the right type of technology for further diversification.

Learning by doing

The absorption of technology requires a conscious policy of learning by doing i.e." to seize every opportunity to solve problems associated with interalia the choice of technique, technology supplies, machinery supplies and the very products/services to produce. In this way they will develop inhouse capability to assimilate imported technology."

Supportive environment

In the process of acquiring technology and making agreement to acquire technology the surrounding environment should be well supportive to learn and absorb the technology. Peoples positive attitude towards the new and imported technology is required for effective transfer.

Interaction process

The importance of communication when people of different culture interacts becomes exposed when both works in the same work centre. This aspect is to be given proper weightage which help in absorbing the technology faster.

The absorption of technology is dependent on a clear policy on technology acquisition, the existence of technological infrastructures and by developing the required capability.

# Chapter 3

## THE CASE PROJECTS
(Ashuganj Thermal Power Station Extension Units - 3,4 & 5)

### 3.1 THE PROJECT INITIATION

Considering the fast growing demand of electricity in the country the need to enhance its power generation capacity was emphasised by a visiting World Bank mission team in August 1980. As per BPDB's proposal the World Bank agreed in principle to finance for power plants at Ashuganj as extension to existing units. These extension units were included in the country's Second Five Year Plan (1980-85) and the World Bank advised BPDB to undertake feasibility study on priority basis. In this regard a foreign firm M/s Lahmeyer International GmbH of the Federal Republic of Germany was engaged to conduct a feasibility study in November 1980. They recommended installation of.two units of generating stations at Ashugonj each of 150 MW with a future provision of a third unit having the same capacity. Subsequently M/s Lahmeyer International (LI) was retained as Consultant for the implementation of the extension units.

### 3.2 THE PROJECT DESCRIPTION

The project comprises of two 150 MW capacity thermal power stations (units 3 and 4)with some common auxiliary and ancillary plants and facilities. Ultimately the fifth unit (150 MW) was included during the implementation of the units 3 and 4. The plant is gas fired and equipped with all necessary auxiliary and ancillary systems including fire fighting and protection, communication and clock, plant security and computerized training simulator system etc. In order to transmit the generated electrical power a 230 KV double circuit transmission line system to connect the Ashuganj power station with Ghorashal power station(approximate distance 50 Km) had been included.

The project was on extension to the existing two units each of 64 MW thermal power stations. The existing infrastructure and facilities such as land, the jetty, internal roads, some of the residential accommodations, unloading crane at the jetty and inside the turbine house were available for the new stations.

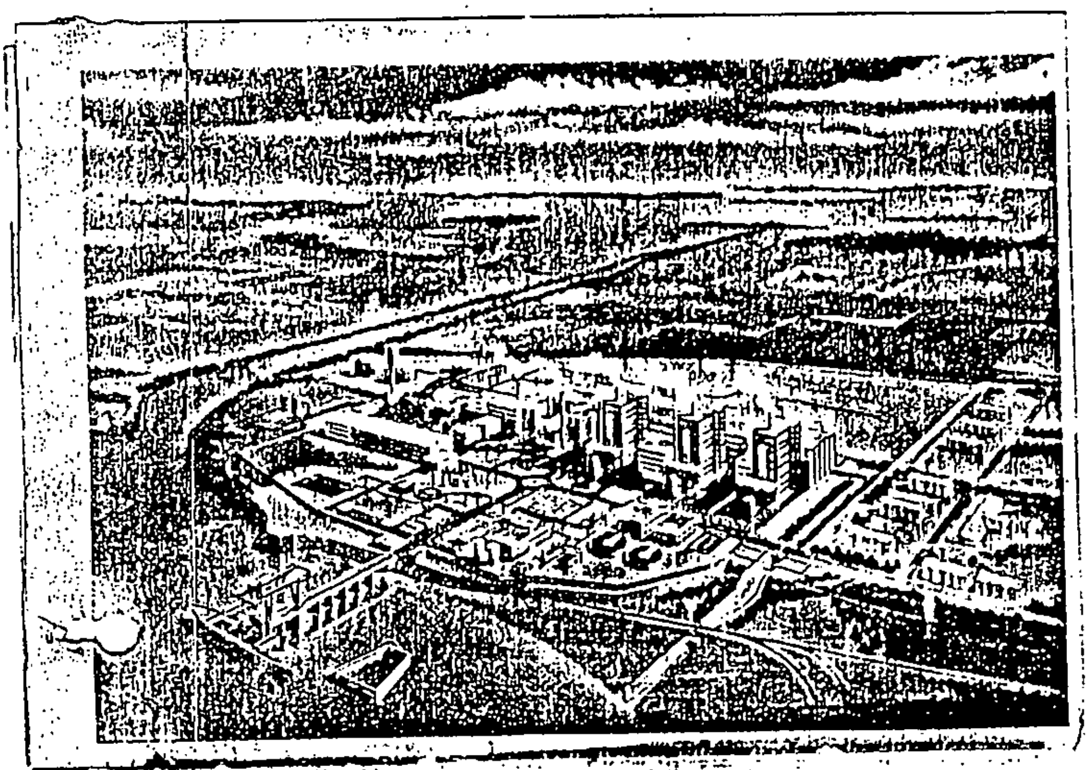
The boilers were open air installed for firing with natural gas. The steam turbine condensers were river water cooled. An utmost importance was given on the reliability and availability, convenience of operation and maintenance, neat and orderly arrangement in the project design. The functional requirements of the various systems and the pleasing physical appearance of the completed plants had been taken into account. To the North-East of the project the combined cycle gas turbine plant was installed.

In Fig 3.1 a bird's eye view of units 1-5 is presented.

### 3.2.1 PLANT LAYOUT

The existing power plants (unit 1 and 2) are situated at the south bank the of Meghna river, East of the railway bridge at Bhairab Bazar. The projects area extended from the North to the South about 400 m and from the East to the West about 550 m. In the north of the power plant the jetty with Intake goes about 70 m into the river. Above the intake channel jetty crane and rails are placed. The Intake channel was constructed on extension purposes (unit 3 and 4) and ends at the cooling water pumping station. But for Unit 5 a new Intake channel was constructed and the existing bypass Outfall channel was enlarged to contain the outflux water coming out from Unit 5 steam turbine condenser.

South-East of the existing pumping station are the water treatment plant with sedimentation basins, one settling tank, the



Ashuganj Steam Power Plant, Bangladesh : View of the plant on the Meghna river with units 1-5, total installed capacity 580 MW

View of Ashuganj Power Complex

Fig : 3.1

laboratory and one septic tank. At the South-East end of the power plant area the existing 33 KV and 132 KV switchyard are situated. To the West of it the new 132 KV switchyard with transmission line is situated.

The completed power station extension units 3,4 and 5 with all installations, structures, facilities embodying the existing installations etc. are shown as per layout drawing, plan and elevation drawings and the erection photographs in Figs 3.2 to 3.4.

Electricity generation and distribution diagram of the Projects is shown in Fig.3.5.

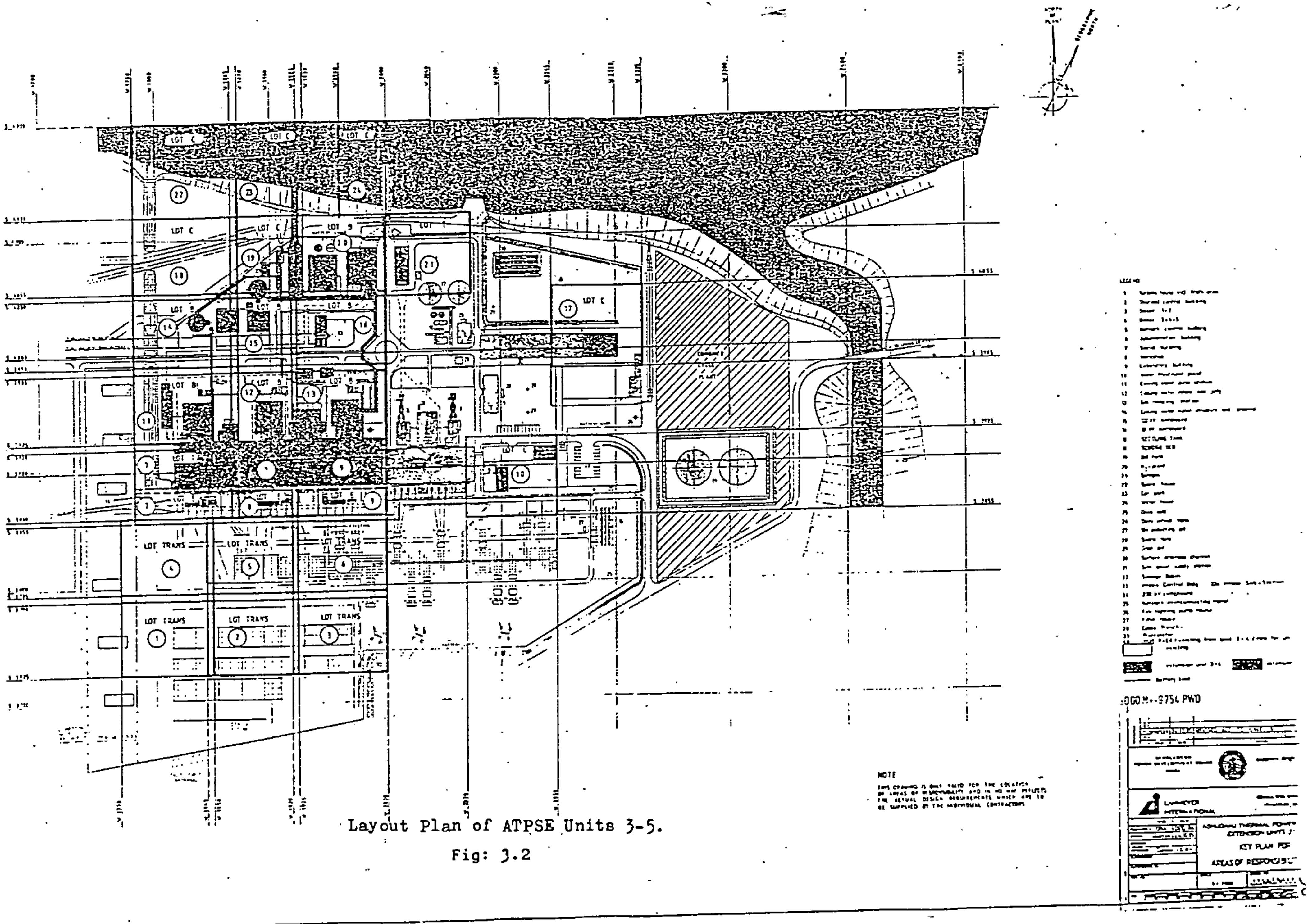
A brief outline of the Project is given in Appendix I.

### 3.2.2 PROJECT FINANCING

Project units 3 and 4 :

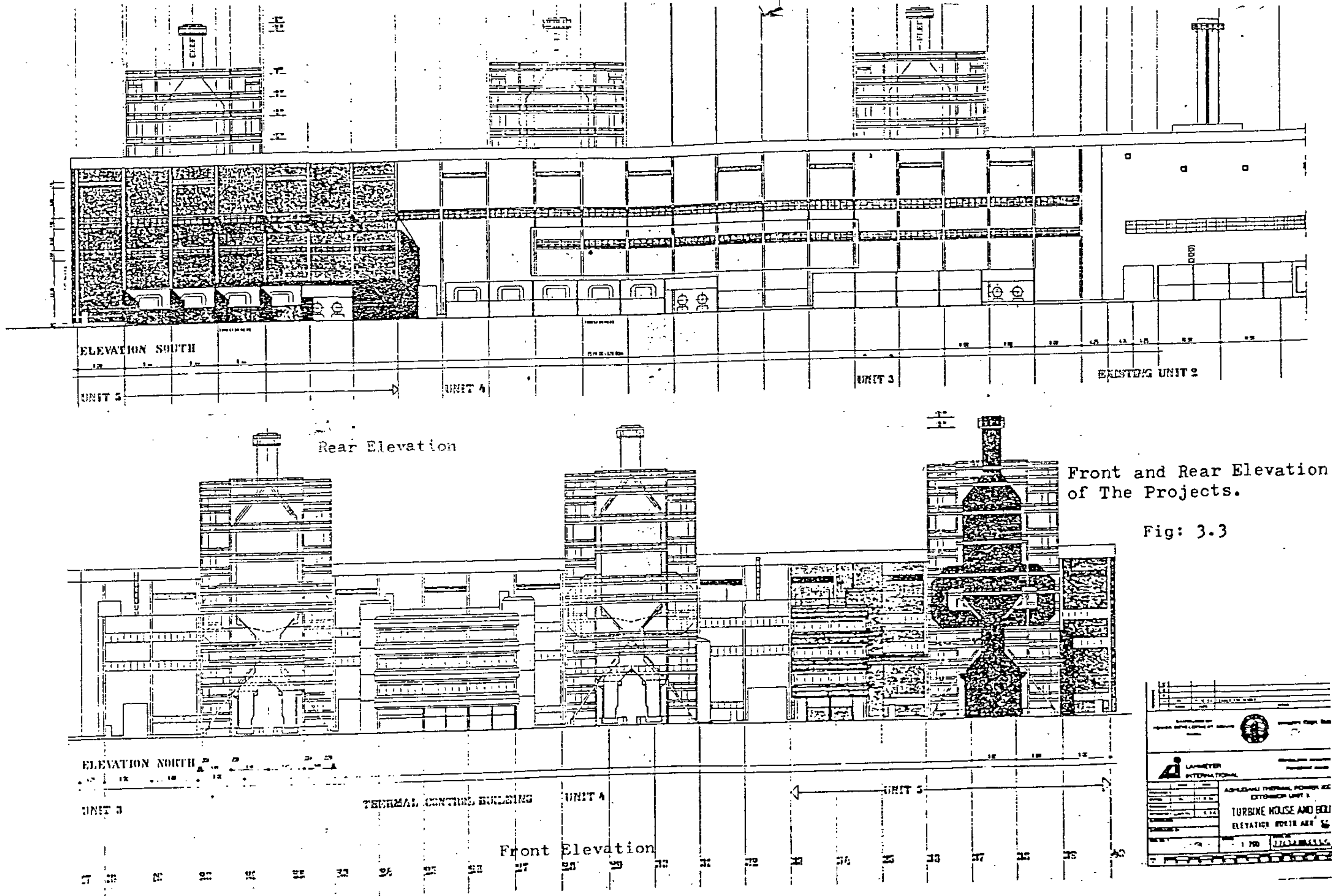
An appraisal of the project was made by IDA mission in May 1982 and proposed to finance the project on multi donor basis.At the initiative of IDA and GOB financial assistance for the project was finally secured from OPEC, KFW, KFAED and ADB in addition to IDA. The amount finance by different donors for the lots and dates of loan effectiveness are given below:

| Sl No. | Name of donor | Amount of allocation | Lot to be financed | Date of effectiveness |
|---|---|---|---|---|
| 1. | IDA (International Development Association, World Bank) | SDR 82.7 m US$ 92 m as credit. | Entire F.E. of lot-B, + part of local cost+part of consultancy Service. | 20.06.1983 |



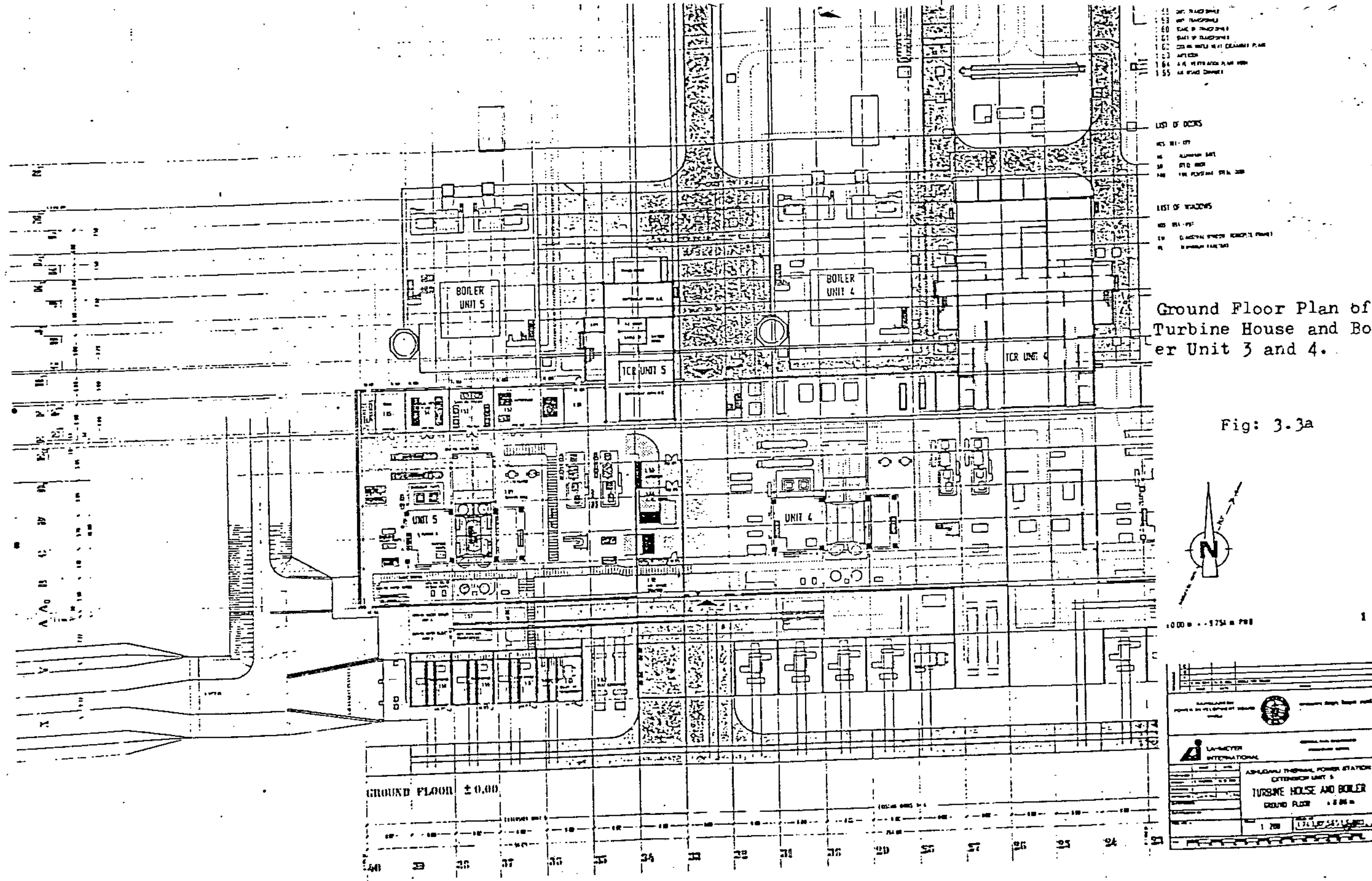

Layout Plan of ATPSE Units 3-5.

Fig: 3.2




Front and Rear Elevation of The Projects.

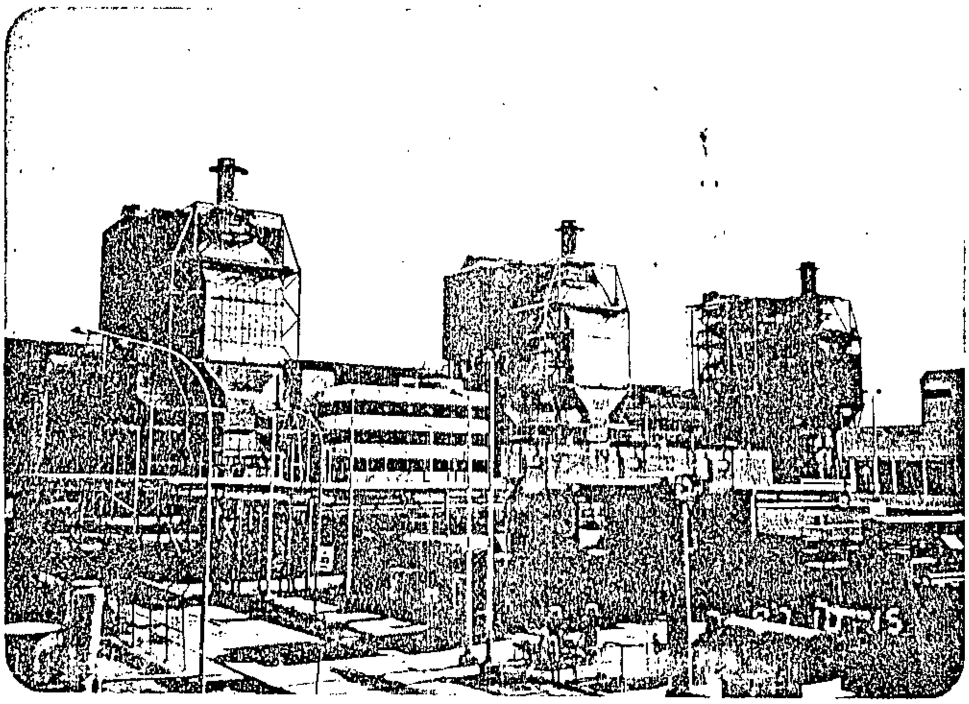
Fig: 3.3

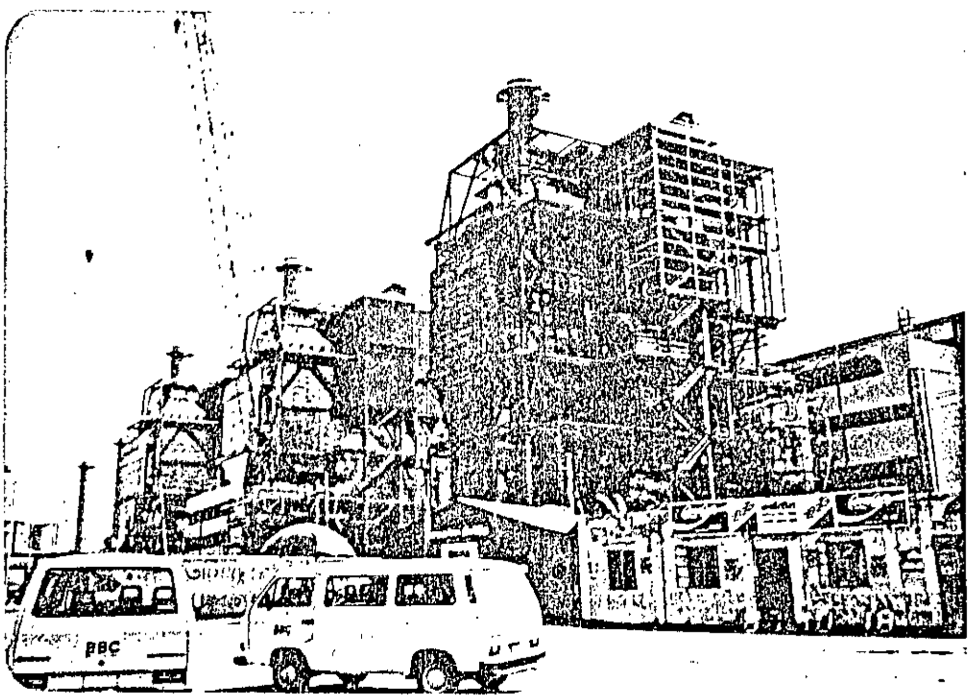



Ground Floor Plan of Turbine House and Boiler Unit 3 and 4.

Fig: 3.3a

Fig: 3.4 - Erection Progress Pictures





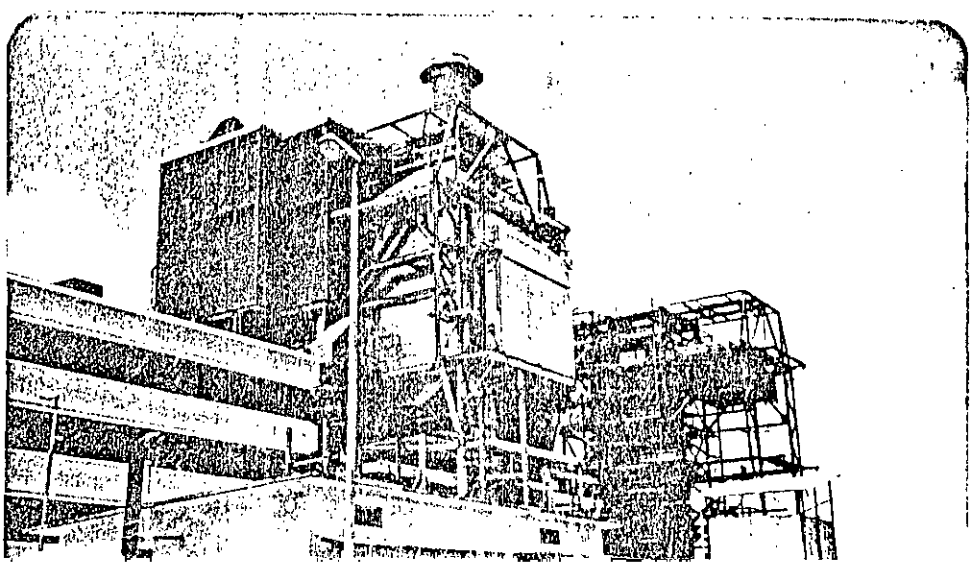
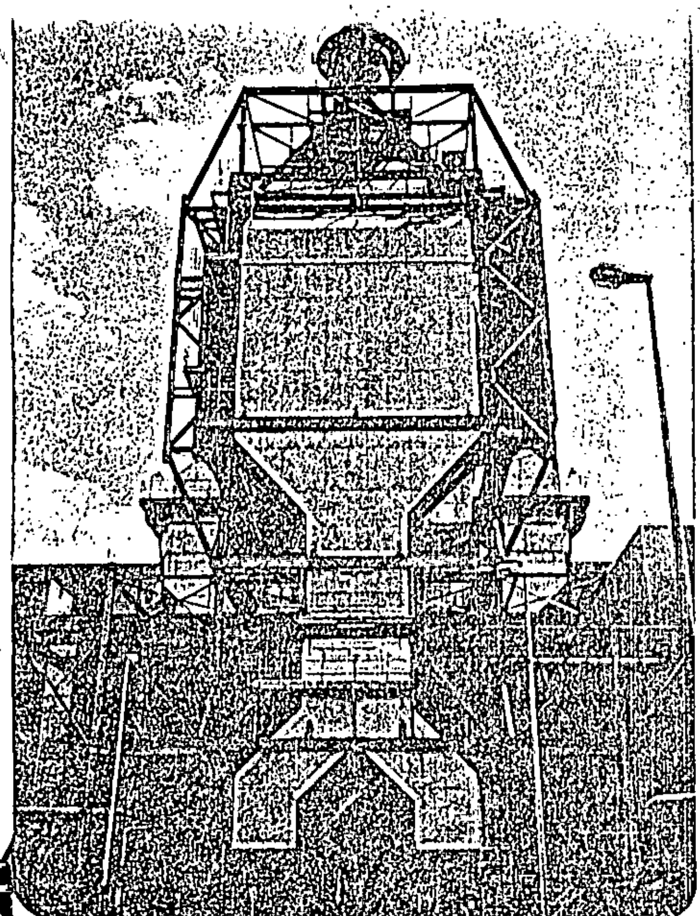



Fig: 3.4 - Continued



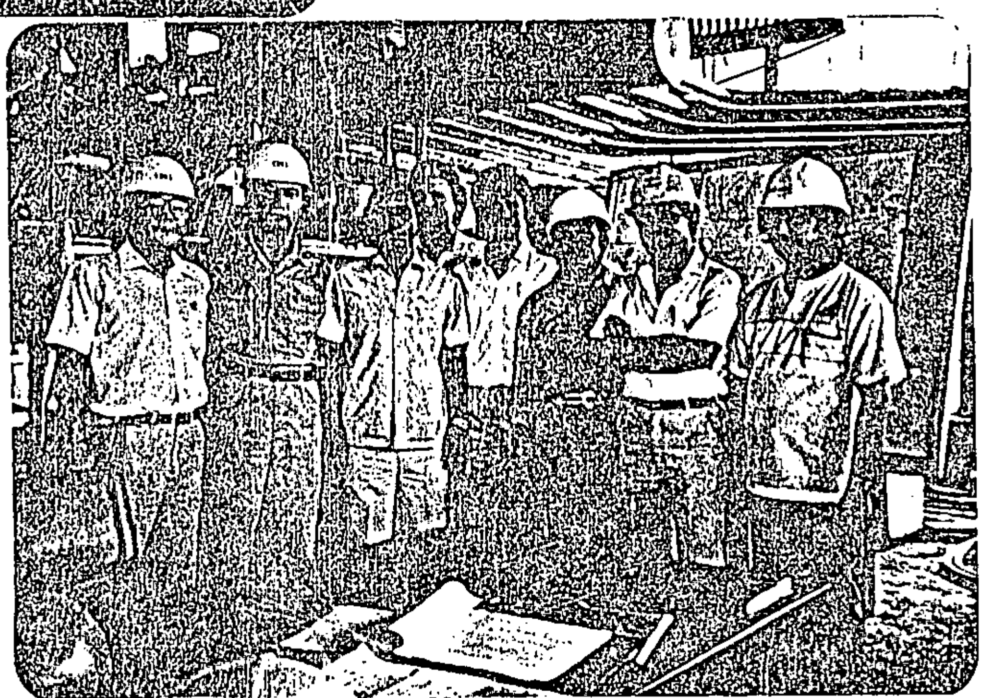
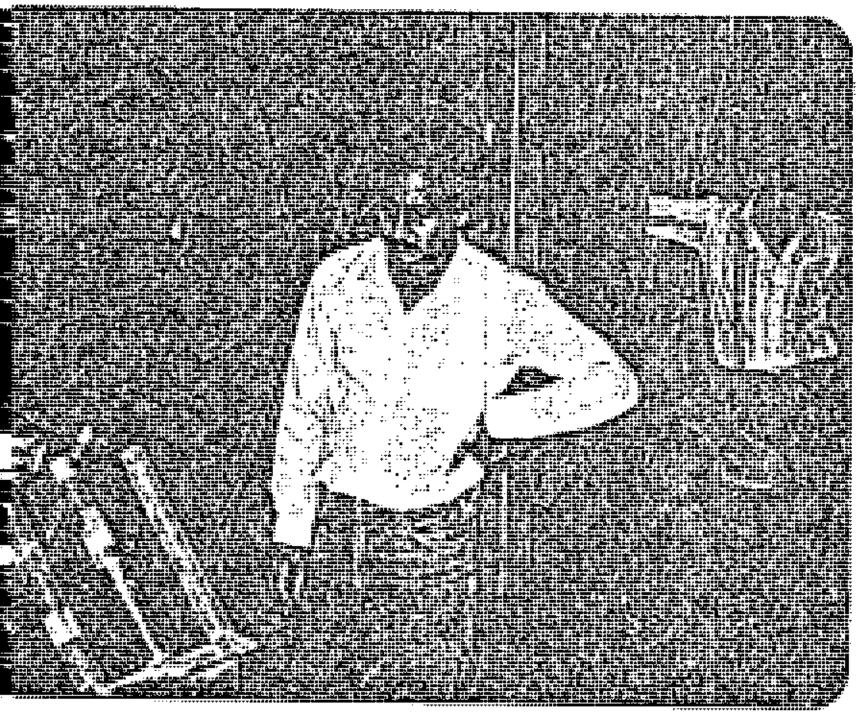


Fig: - 3.4 Contd.



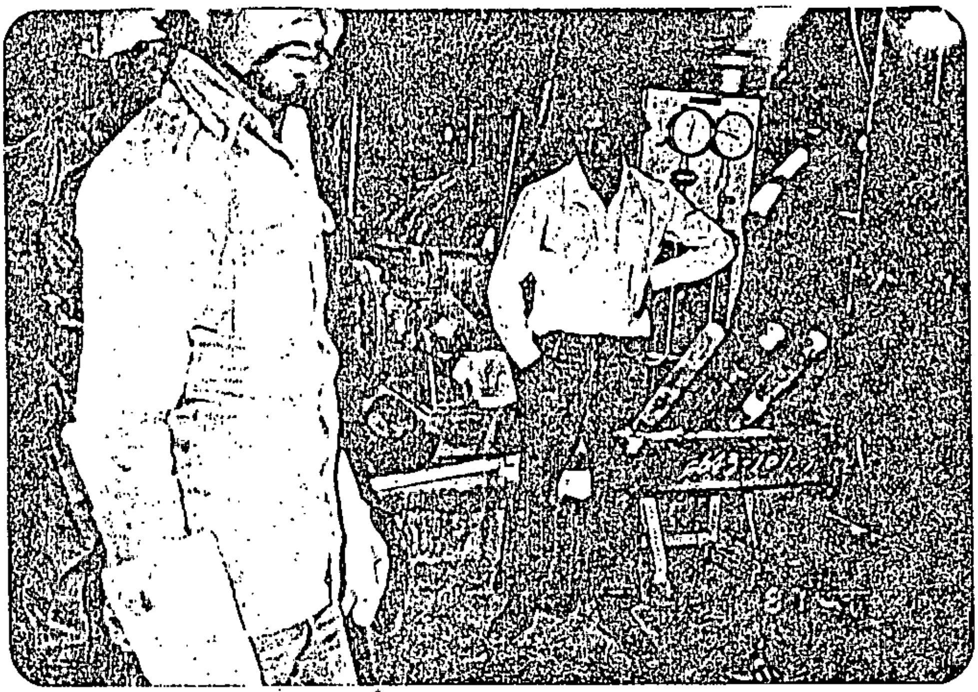
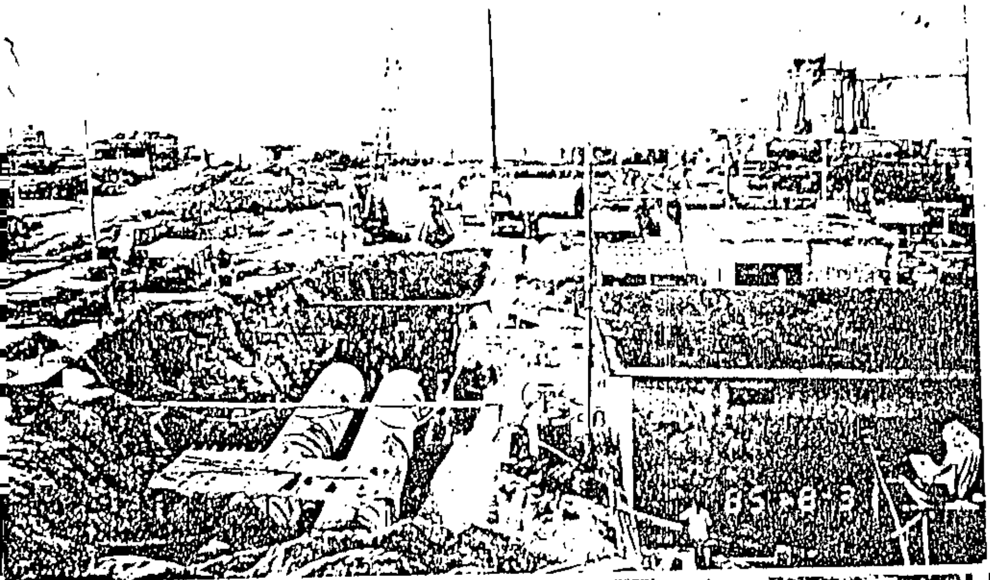
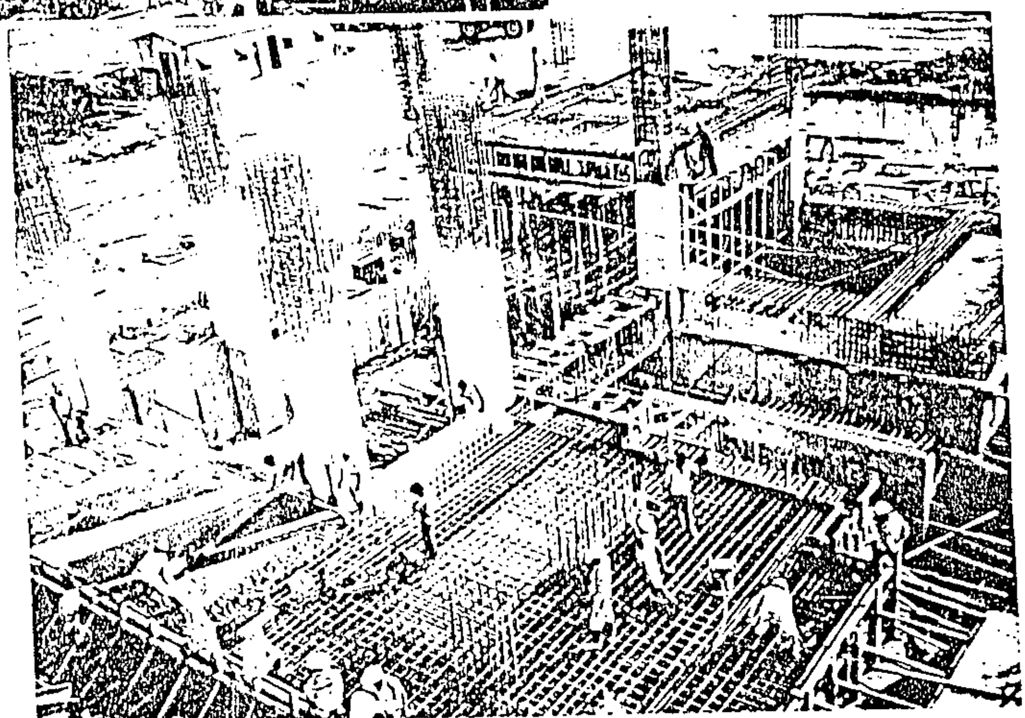
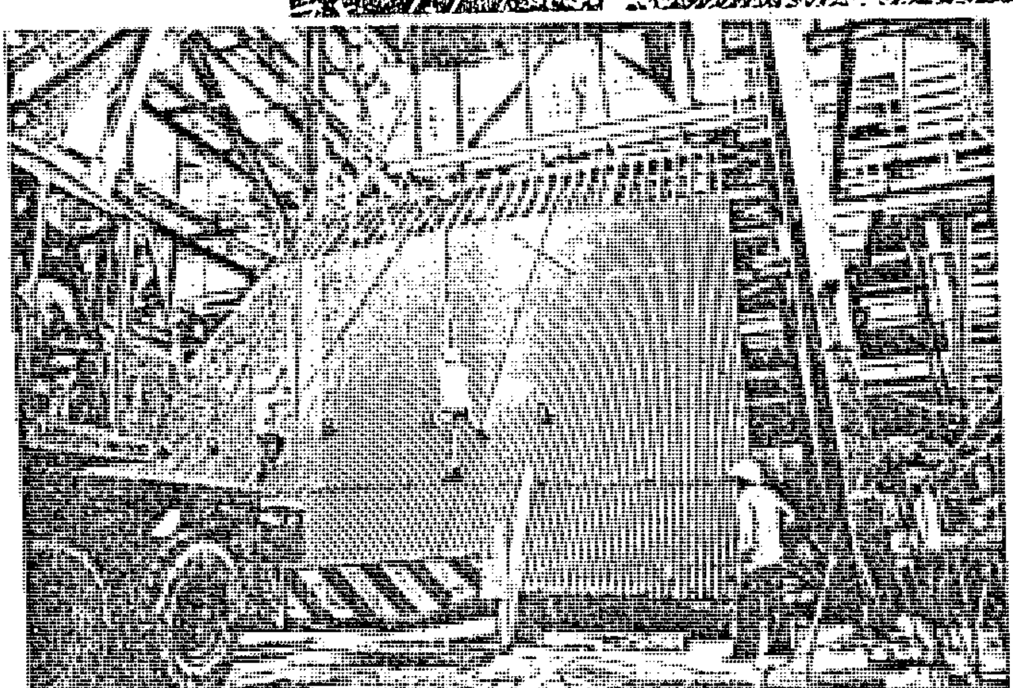


Fig: 3.4 - continued.







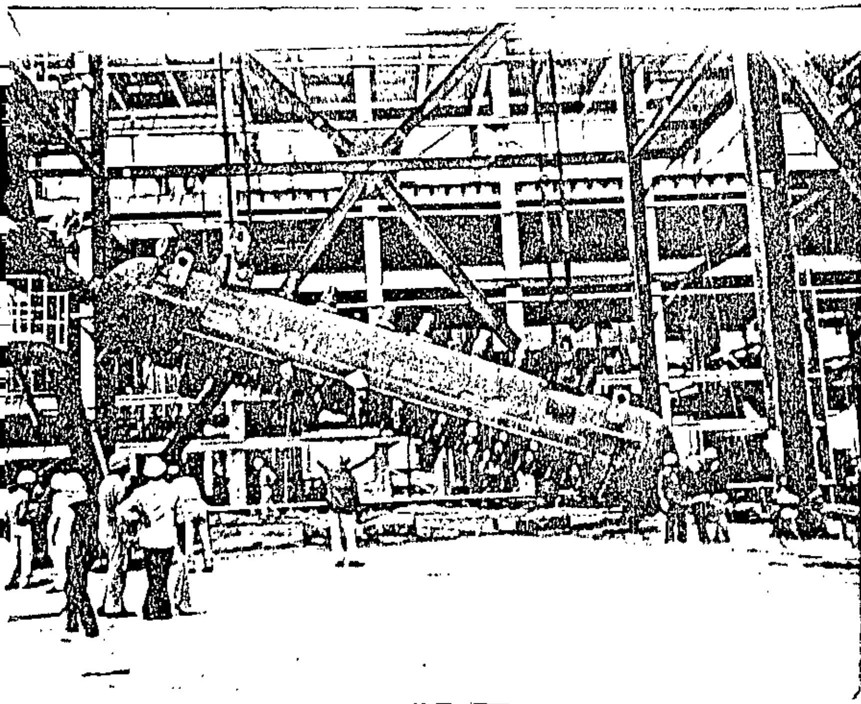
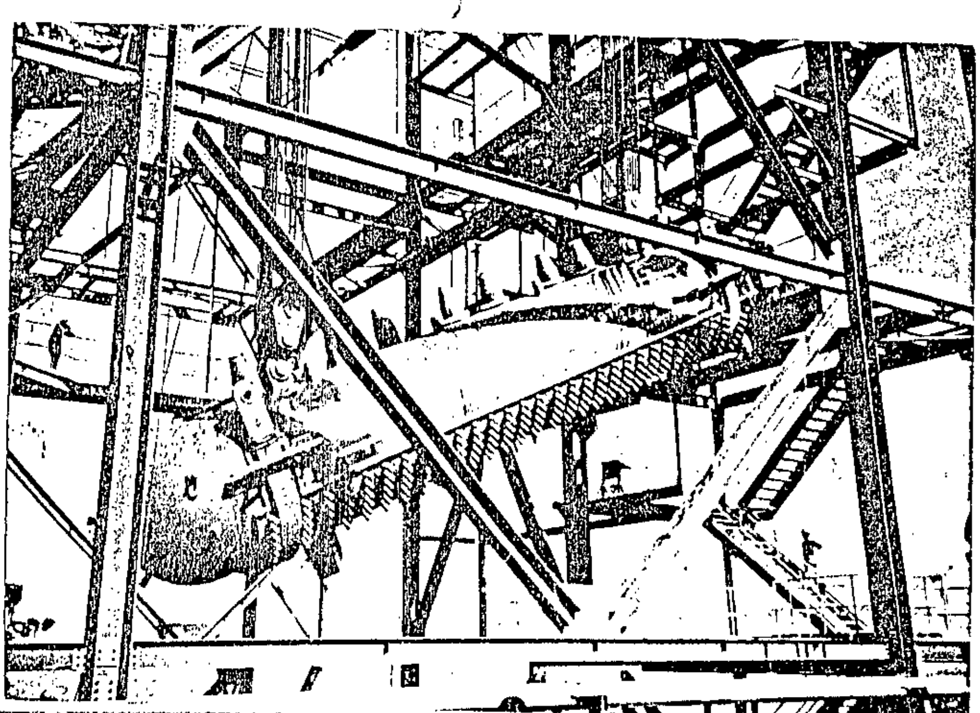


Fig: 3.4 - Contd.





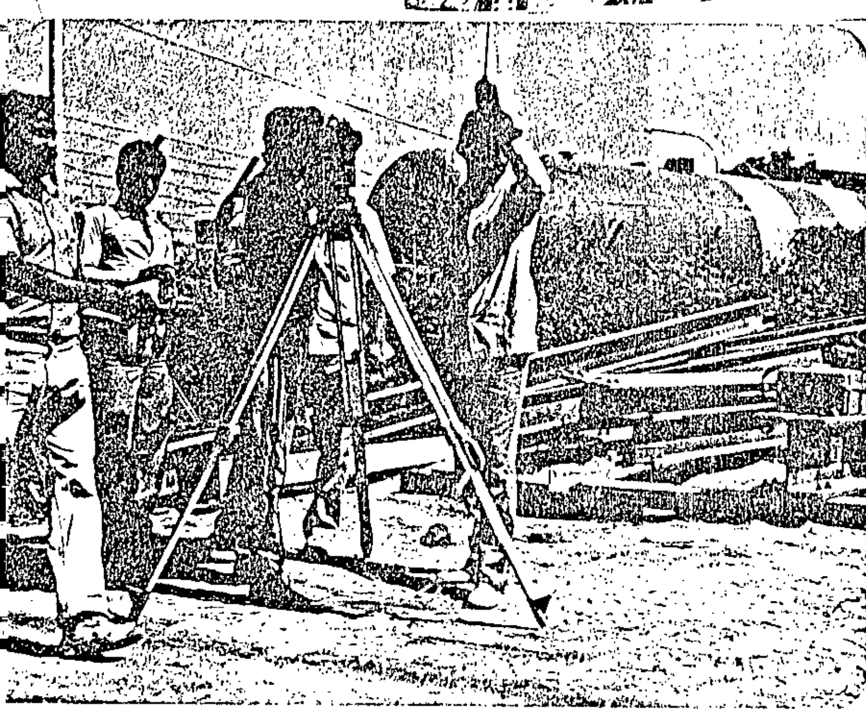
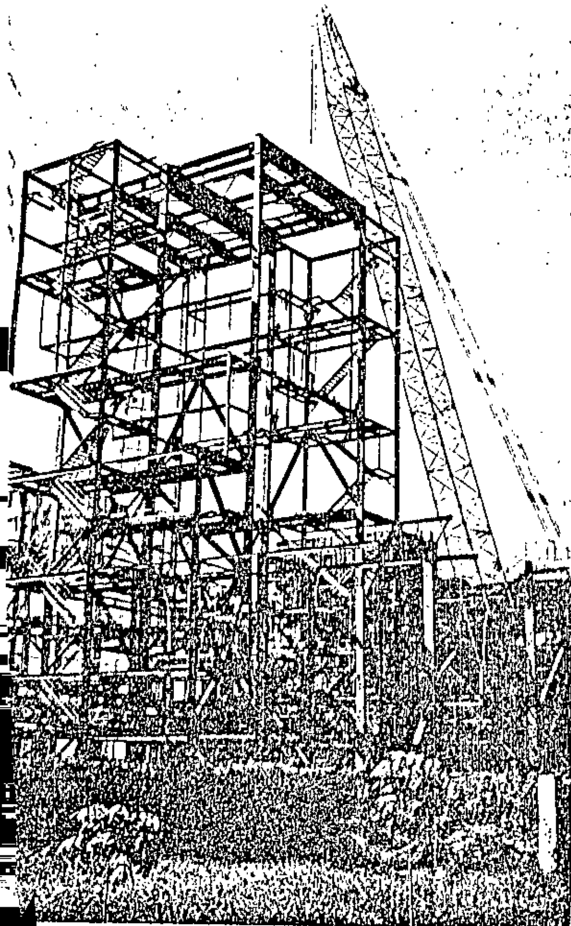
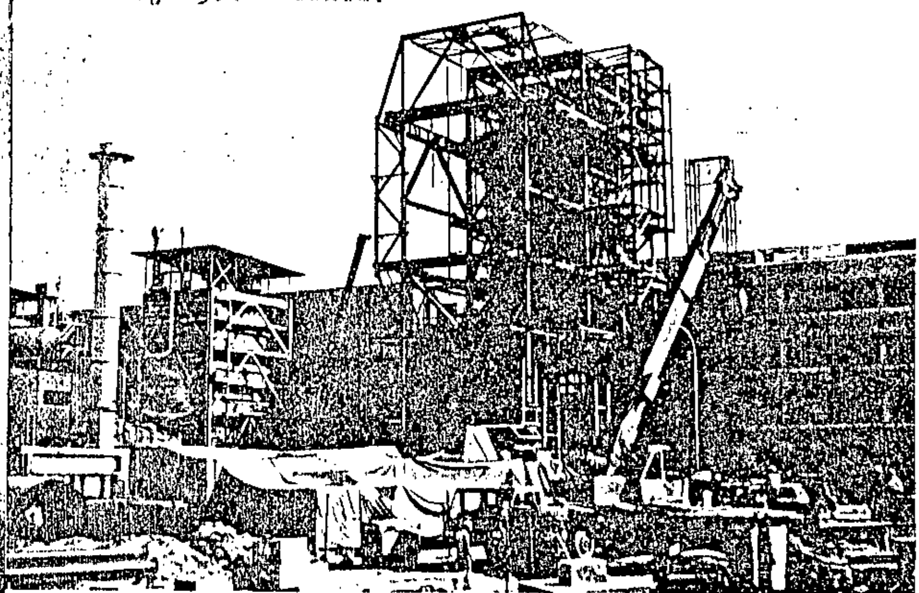
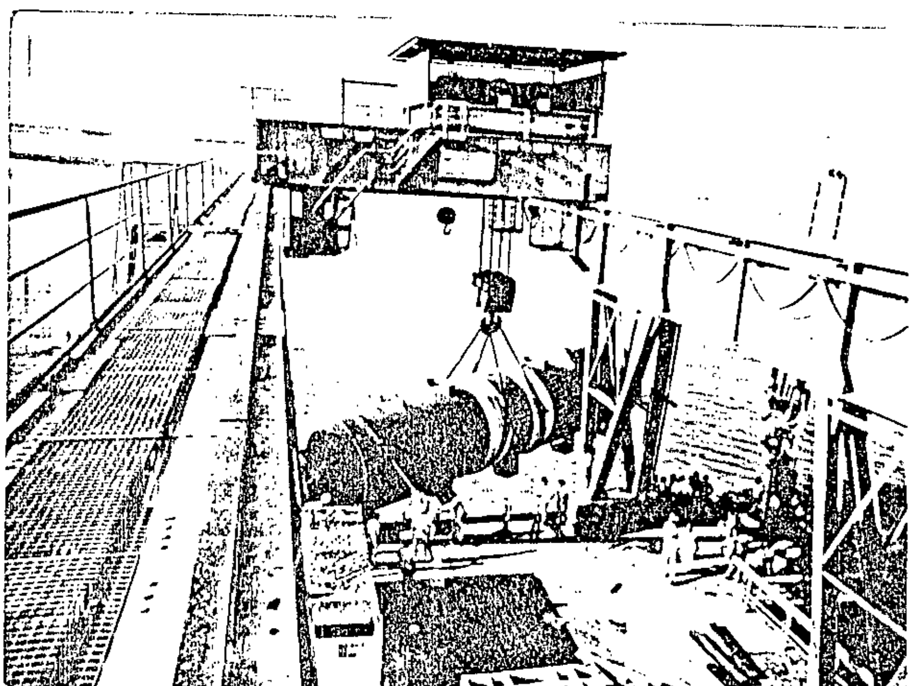
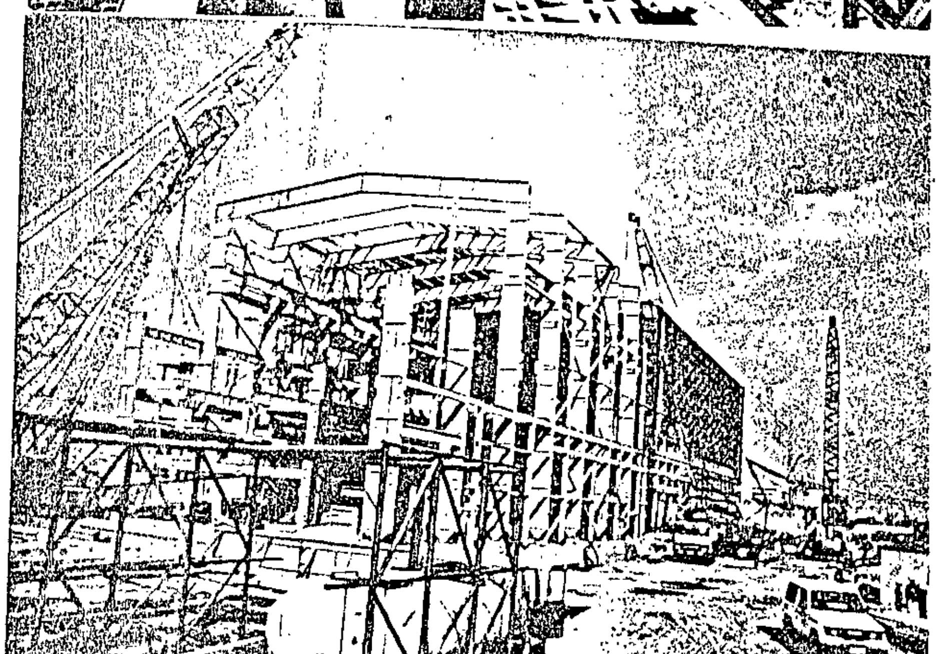


Fig: 3.4 - Contd.









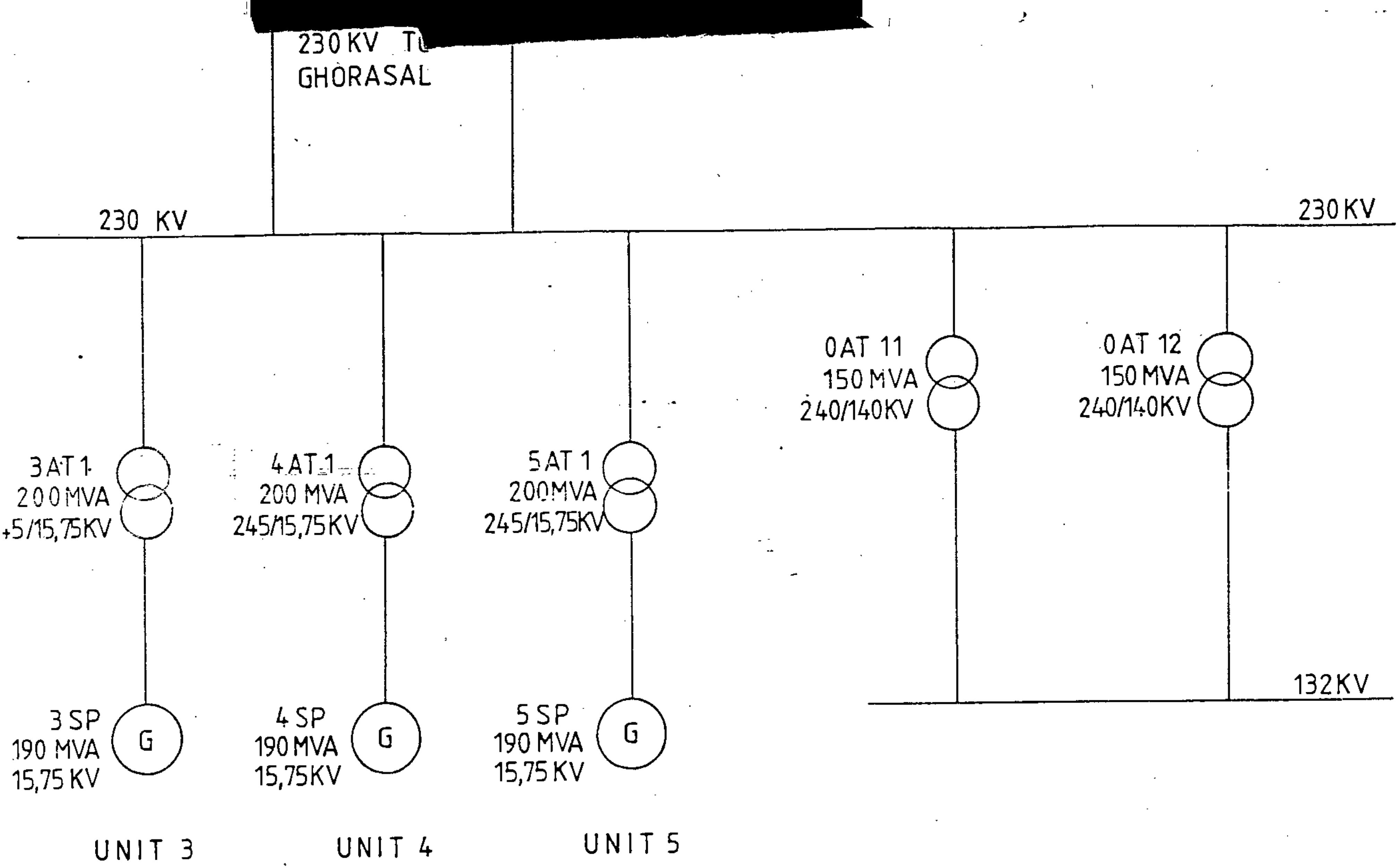



Fig: 3.5

CONTRACTOR: PEC, KOREA LOT "E" (ELECTRICAL WORKS)
LUCKY, KOREA LOT "TRANS" (TRANSMISSION LINE, SWITCHYARD)

| | | | | |
|---|---|---|---|---|
| 2. | ADB (Asian Development Bank). | US$ 35m as credit. | Entire F.E. of Lot-E and Lot-SIM. Part of Local expenses. | 22.06.1983 |
| 3. | KFAED (Kuwait Fund for Arab Economic Development). | US$ 35m as credit | Entire F.E. of Lot-TRANS and Lot-C part of local cost+part of consultancy service. | 21.06.1983 |
| 4. | OPEC (Organisation of Petrollium Expert Country). | US$ 30m as credit. | Entire F.E. of Lot-TRANS and Lot-C part of local cost+part of consultancy service. | 24.06.1983 |
| 5. | KFW(FRG) (Kreditanstalt fur wiederaufbau). | DM 115m + DM 10m (as tiegrant) | Entire F.E. of Lot-T. | 24.11.1983 |

Project Unit 5 :

It was agreed by the Co-financiers of units 3 and 4 project that from the savings of the existing credit, another similar unit of 150 MW would be financed. But the entire KFW grant for units 3 and 4 was used up, thus there was no savings. So KFW financed the required DM 65m for unit 5 project. The contracts and awards are given below :

| Project Lots | Contractors | Contract amount,m | Effective date | Commissioning date |
|---|---|---|---|---|
| 1. Lot-T | BBC, FRG | DM 120.772 +Tk 14.808 | 20.3.84 | 3rd Unit on 20.2.87 |
| 2. Lot-B | Mitsui & Co. Ltd, Japan. | Yen 9666185 +Tk 15.714 | 20.3.84 | and 4th Unit on 20.07.87 |
| 3. Lot-E | PEC, Korea | US$ 127 +Tk 12.03 | 20.3.84 | |
| 4. Lot-C | KDC, Korea | US$ 22.919 +Tk 140.617 | 20.3.84 | |

| | | | | |
|---|---|---|---|---|
| 5. Lot-TRANS LEC, Korea | | US$ 9.14894<br>+Tk 31.904572 | 18.10.84 | 31.12.86 |
| 6. Lot-SIM | Autodynamics, USA. | US$ 1.364381<br>+Tk 0.14 | 15.01.86 | 01.03.87 |

For Unit 5 the same contractors were retained at a total project cost of Tk 3238 m. This include savings from Unit 3 and 4 (Tk 1937.8 m) and additional finance by KFW of DM 65 m.

### 3.2.3 SCOPES OF WORKS

The scopes of work for the Consultants and Contractors are given as follows :

Consultant's scope of work :The contract Agreement No. 3759 dated October 22, 1982 and No. 1750 dated 27.02.1986 between Bangladesh Power Development Board and Lahmeyer International GmbH (with their local associates M/s Niaz and Associates Ltd.) covered consulting- services as under:

Tender Preparation and evaluation
Civil Design
Approval of Design and Manufacturing
Shop Inspection of Equipment and Material
Site Supervision and Quality Control
Commissioning
Project Co-ordination

Contractors' Scope of Work :

The scope of work comprised the complete design, construction, shop- testing, painting and marking, delivery, transport from shop to site, loading and unloading, storing at site, insurance, erection, start-up, testing, commissioning, trial run, initial operation, reliability test run, acceptance testing, putting into commercial operation and service during the guarantee period, (until final acceptance of the complete plant, including provision of all skilled, semi- skilled, and non-skilled workers, operation and maintenance of the plant.)

Project schedule :

The project schedule for unit 3 & 4 are presented in Fig.3.6.A cotract execution diagram is presented in Fig. 3.7.

The specifications and scope of supply of different lots are given in Appendix II.

3.2.4 TRANSFER OF TECHNOLOGY PROGRAMME OF THE PROJECTS

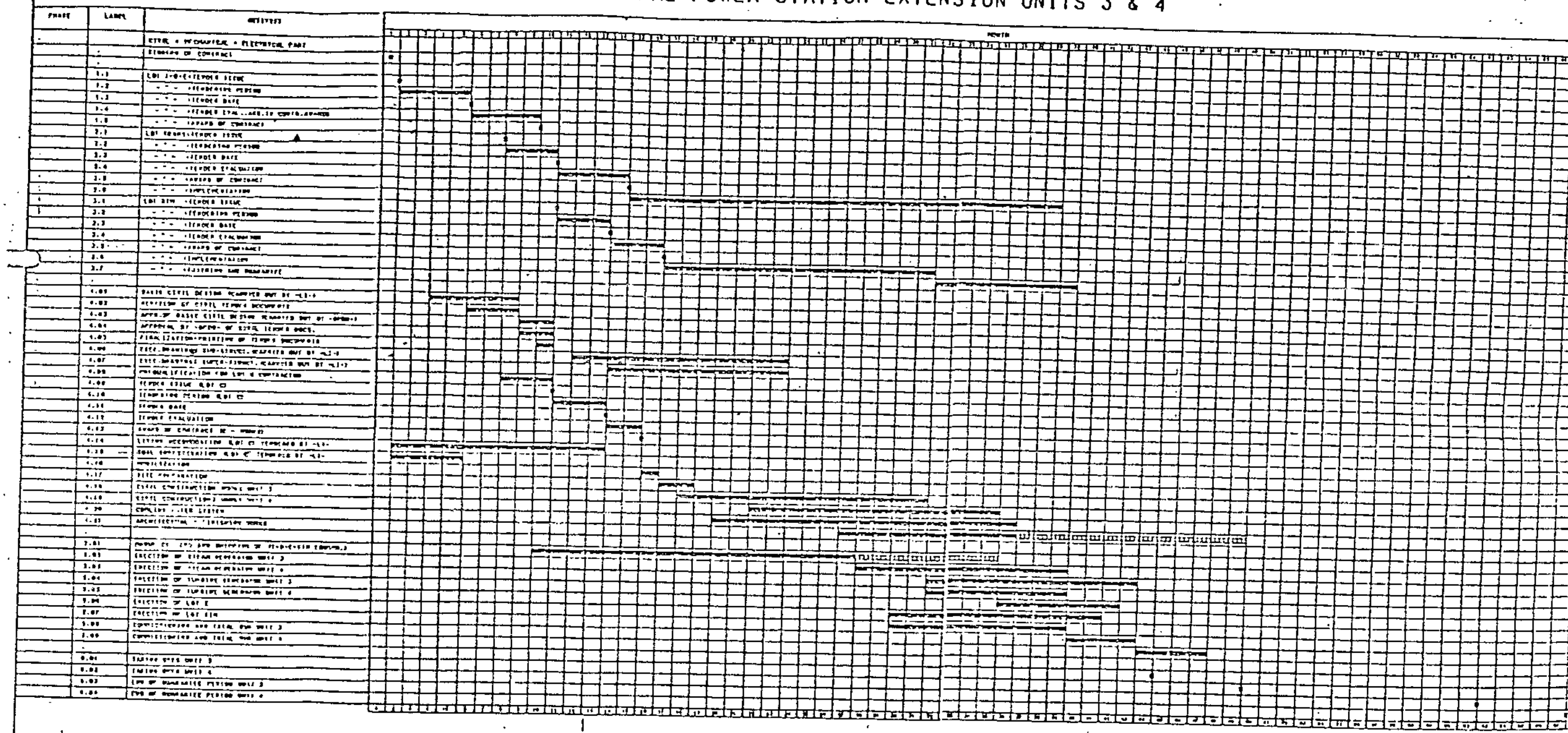
The transfer of technology programme under the case project was designed to develop the human resources of BPDB engineers/staff at various levels and capacities. The programme constituted mainly of :

1.To suggest specific design and specification requirements of thermal power station - BPDB deems suitable to their propose (on the basis of their past experience, environment and geographical requirements) during preparation of tender documents. To evaluate jointly with co-operation from the Consultant's engineers the bid documents submitted by the International bidders to select the most responsive highest evaluated lowest priced tender for contracts.

2.Participation in bimonthly co-ordination meeting for plant/equipment specification approval and review progress of implementation in Consultants and Contractors home offices by senior engineers of (Superintending Engineers) the Board and by the PD (Project Director) and SE's during site work phase.

3.F6reign training of Board's engineers at all Contractors shop during manufacture of project plant and equipment.

# ASHUGANJ THERMAL POWER STATION EXTENSION UNITS 3 & 4

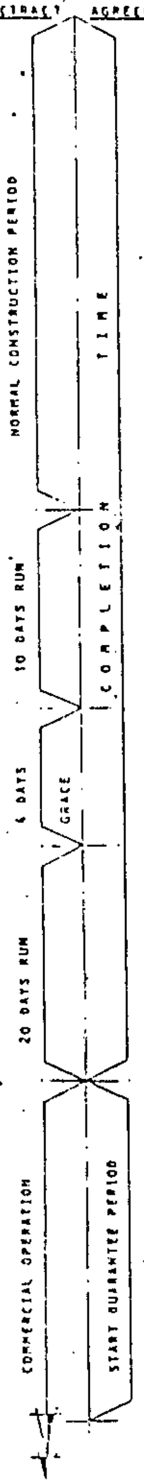



Time Schedule for Implementation of Project Unit 3 and 4.

Fig: 3.6

2.4 CONTRACT EXECUTION DIAGRAM

CONTRACT AGREEMENT




To be certified with various completion and test certificates for completed or partially completed sections of various works.

COMPLETION OF:

- All major construction work
- Preliminary and functional tests such as:
  - :Cold runing of Electric Motors
  - :Turbine turning gear.
  - :Final E. Switching tests.
  - :Functional loop tests.
  - :Setting / Pooing of safety valves,etc.

Contractor to submit programme 1 week prior to start of "PRELIMINARY AND FUNCT.TESTS"

INITIAL OPERATION

COMPLETION TO BE CERTIFIED WITH PROTOCOL SIGNED BY OWNER / ENGINEER / CONTRACTOR ( 5.6.4 (f) )

10 days on load run to demonstrate various load parameters and operating conditions.

Contractor to submit detailed programme for OWNER / ENGINEER approval 2 weeks prior to start of " INITIAL OPERATION ".

ANOUNCE RELIABILITY TEST RUN

WITHIN FOUR (4) DAYS AFTER RECEIPT OF THE PROTOCOL (5.6.4 (f) ).

Reconditioning work to be carried out during this period if required. ( 5.6.5 (a) ).

RELIABILITY TEST RUN

COMPLETION TO BE CERTIFIED WITH PROTOCOL SIGNED BY OWNER / ENGINEER / CONTRACTOR. (5.6.5 (f) ).

Plant shall be operated with assistance of Owners Staff.

PROVISIONAL ACCEPTANCE

PLANT READY FOR COMMERCIAL OPERATIN AND START OF 12 MONTHS OF 8000 OPERATING HOURS GUARANTEE PERIOD:

Completion of all outstanding work which may delay issue of FINAL ACCEPTANCE CERTIFICATE ( F.A.C. )

OWNER TO ISSUE " FINAL ACCEPTANCE CERTIFICATE " IN ACCORDANCE WITH SECTION IV ARTICLE 21.

FINAL ACCEPTANCE

FINAL ACCEPTANCE OWNER TO RETURN 5% GUARANTEE BOND:

Contract Execution Diagram of Project Unit 3 and 4.

Fig: 3.7

4.Local/site training of Board's engineers and staff on construction/erection, pre-commissioning, commissioning,trial operation and guarantee test. Site training of engineers and technicians were also in the programme during guarantee period maintenance of eighteen months after provisional handing over of the plants. (Programme -detail is given in Appendix-III)

5.Tracking of site progress in association with Consultant's site engineers.

6.Witness of all site tests checks including all construction/ erection & quality control activities and pre-commissioning and commissioning tests and inspection by BPDB PM engineers/ technicians.

7.Witness of receiving inspection of all plant equipment after these reaching site.

8.To assist the Consultant for locating adequate space from the constructions for their yard storage, preassembling storage, site office and accommodation etc.

9.To co-ordinate the Consultants and the Contractors in receiving inputs available as per contract terms and conditions from the existing power station management.

10.To attend all weekly site progress and technical meetings with Contractors at Consultants office.

11.To arrange to site arrival of BPDB's commissioning and protection test team to witness the final commissioning and guarantee tests of all major equipment under the case projects.

# Chapter 4
# RESULTS AND FINDINGS

## 4.1 IDENTIFICATION OF THE AREA OF SUCCESSFUL TRANSFER AND FAILURE OF TRANSFER OF TECHNOLOGY.

Successful transfer and failure of transfer of technology are identified on some area on the relevant programme as follows :

1. During the preparation of documents ( for international tenders to be floated for selection of Contractors) the draft documents were placed before all the design units of BPDB for their comments. During the process, BPDB design section was supposed to supply their design information of thermal power stations including analysis of fuel gas. But in fact the Consultants by their own initiative had collected them. They had to propose soil test in the civil contractors scope of work. The relevant infrastructural facilities detail in the Ashuganj area including weather and seasonal effects were also collected by the Consultant by their own initiative. The local consulting associate extended their assistance and co-operation by giving company during collection of these information.

2. During evaluation of tender documents submitted by international Contractors the participation of BPDB evaluation team was poor. Except following their official formal procedure and activities alike, practices and influence exerted by interested quarters and Contractors' indirect undersirable influence the members of the BPDB tender committee were observed to take non-interest in the matter.

3. During the participation of bimonthly co-ordination meeting abroad and attended by Superintending Engineers (SE) for giving approval of civil, electrical, mechanical and Instrumentation and Control ( I&C ) matters of the power station and approval of specification of equipment, plant and machinery the respective SEs seemed not having experience on similar activities. They were not at all interested to participate in the detail of discussion nor they were capable to discuss in detail on the technical specification of the plants. Only dependence on the Consultants in such important approval giving activities was their last resort.

In the following meetings in Bangladesh in the site office the project office employees were reluctant in participating the discussion; they were always dormant in the active discussion, raising no complaint nor suggesting any amendment on any matter of the Project. However, the complete co-ordination meeting minutes were signed by them before distribution which were concisely and presentably prepared by the Consultants.

4. Foreign training of client's engineers at the workshops of Contractors/Manufacturers of various lots were conducted in Tokyo, Manheim and Seoul. The training programmes were adequate and the trainees were trained by qualified and experienced training personnels. The material of training was of standard quality.

The engineers after returned seemed to have learnt in depth from the training but there were no scope of assuming in-line responsibility. Instead they were placed at different power stations where they belonged originally before training. However, only during the trial run of the units they were brought to Ashuganj site, but the project office was not sure and committed as how to utilize them by engaging them in their relevant area of training.

5. Local site training was co-ordinated by the Consultant and arranged by the Project Director with his SEs as per the programme enumerated. Contractor's/ Supplier's expatriate representatives from manufacturer's home office successfully conducted the training and taken written and oral examination. Active and interested graduate engineers did well in the examination but the most portion of trainees could not do well. Before starting the training a 300MW power station operation team was set up from amongst the project office engineers and from the existing power station engineers and staff. Training was imparted on them including engineers upto level of SE from the Project Director's office. It had been seen that the training was really successful to the active and interested engineers. They also proved to be good during the operation stages of implementation of the power stations.

6. The project office engineers were supposed to be residentatsite and should keep track of day to day site construction/erection and commissioning activities.But their presence was not at all enough. Only during the commissioning stage they were sometimes found in the field in the site and sometimes found moving in the site aimlessly though 48 hrs before each site test/ commissioning test they were handed over respective commissioning test procedure and notice of test.

7. Each and every site check,. test , inspection and quality control activity including Radiographic tests etc. should be attended by a representative of the client from their relevant sections (civil, electrical, mechanical & I&C ) and he would sign the document as witness. The clients relevant section/ SEs to be informed about the test 48 hrs. before the test takes place. In most of the cases nobody from the client was found attending the area after all formalities by the Consultant and Contractors are properly observed for their witness.

Only during the guarantee test of Boiler and Turbines, control and protection inspection test of electrical sub-station were duly attended by a good professional team of engineers and they seemed to be capable and competent to judge the test for required range of parameters' expected result.

8.No receiving inspection was attended regularly by client's engineers but they after presenting the relevant invoice by the Consultant approved the same.

9.The Project Director (PD) assisted by his SEs helped the Consultant with inadequate initiative to allocate space of stores, site office etc. to the relevant Contractors.

10.After one years of starting the site the SEs of relevant section would attend the weekly site progress meeting and technical meeting occasionally. They seemed to take a little interest in most of the matters and progress on the site erection/construction and commissioning activities.

11.The PD had successfully arranged the BPDB protection team to witness during the relevant tests.

## 4.2 IDENTIFICATION OF THE STAGES OF SUCCESSFUL TRANSFER OF TECHNOLOGY

The total process of transfer of technology is divided into three stages referenced to as stages A, B and C.

Stage-A : At this stage the key climax or knowhow of the process is transferred.

Stage-B : This stage is typically characterized by the extensive recruitment of permanent staff or collection of both human and physical resources. It refers to internal transfer of technology in a multinational corporation. In this stage a MNC hires consultant and contractor to design and prepare specification, and supervise and manage the technology to cover their void of technological expertise normally for the plants with most modern control and protection etc.

Stage-C : It is in this stage the success of the entire project is put into test for the first time. The process of test provides technology transfer of the project from the transferor to the transferee.

Regarding technology transfer under stage-A the technology in the form of only operation of thermal power generation and transmission process was transferred to the BPDB. However, no effective transfer in manufacturing, erection maintenance, and overhaul of power plants were observed, though the technology transfer programme designed in the projects aimed at transfer of technology having different degree of stresses on manufacture, erection, quality control and maintenance and overhaul of the power plants.

Under stage-B of transfer of technology, partial collection of physical resources as drawings and specification, contract documents, literature (provided by consultants/contractors) and equipment was done indirectly i.e. through the supervision of the Consultant which has helped to a little extend to fill the elevant void of the Board on thermal power process. The transfer may be termed as internal as the Consultant was appointed by the Board and the international Contractors (mainly the MNCs) were appointed by the Board after approval by the Consultants. On supervision and management of the relevant technology during implementation of the projects not much progress by BPDB was observed due to want of a proper capability base to absorp the technology, incompetence, lengthy bureaucratic procedure and non-interest of the Project Management team. However, at the end the PM team in association with Power Station management took over all the documents and plants handed over by the Contractors under supervision of Consultants.

At stage-C success was somewhat achieved in the commissioning activities. Initial operation and reliability test run/commercial operation and guarantee tests were witnessed and in many cases participated by Boards staff/engineers of lower and mid levels when most of them grasped adequate knowledge during these processes of tests.

The Reliability Test run and Guarantee Test Run Protocol are the complete documents which can focus the success of Board's Project office and Power Station-Extension Management in this stage.

### 4.3 IDENTIFICATION OF THE EXTENT OF FAILURE ON TRANSFER OF TECHNOLOGY

The Thermal Power Generation and Distribution Process was failed partly in respect of technology transfer as :

1. All staff/employee did not achieve adequate knowledge and knowhow on the process. Only a few of them really acquired expertise on process operation.

2. Compared to generation, transmission and distribution personnel learned somewhat better and higher.

3. The senior engineers (SEs, PDs/Additional Chief Engineer) could not grasp the required level of knowledge and expertise as should have been acquired based on the extensive programme designed in the project management.

4. The thermal power generation process in maintenance, erection, precommissioning, commissioning was not grasped by the PM team to a good extent. Though BPDB being a public enterprise/sector corporation recruited world renowned Consultant and internationally successful Contractors a little success was observed in respect of

their coverage of void on relevant expertise on the technology due to lack of their indepth involvement in relevant stages as design, preparation of specification, evaluation of Contractors offers, approval of contractors specification, supervision of construction/ erection works and ultimately managing the technology.

The whole project was put into performance test which delivered results on guarantee parameters in order to accept the projects or to penalize the Contractors as per terms and conditions of contract. The extent failure was noted are organizational drawbacks and lack of continued interest from initial commissioning to guarantee acceptance of the projects which showed lack of communication in the organization of the client.

4.4 REASONS OF FAILURE OF TRANSFER OF TECHNOLOGY

The reasons of failure as discussed partially in the previous sections are now listed as follows :

1. The personnel selection of the Project Directorate assumed to take overall responsibility of the project implementation. The personnel from and above XEN level was improper and most of them did not have power station and factory related or construction/ erection related experience. Most of them belong to electricity sales and did not possess any generation background.

The next lower level of personnel the Assistant Engineers were initially selected mostly from one set of experienced engineers with diploma. In the initial stage mostly/no graduate engineers were selected for the project office at the Assistant Engineer level. Only a few of them was found assisting the PD on some paper work matter. The Diploma engineers were not experienced in the line of generation related experience nor they had any background of construction works of such volume. Later in the beginning and during the commissioning stages a bulk of graduate engineers were transferred to the project office.Many of them took foreign training on Power generation in Contractors' home office under this Projects' fund. All those engineers were given site training and assumed to attend/witness all site pre- commissioning tests etc. During the commissioning phase of power plants these site-trained engineers were transferred to the newly established 300 MW Power Station Extension set up under the leadership of Additional Chief Engineer,Operation & Maintenance (Ashuganj Power Complex). They assumed their responsibility as the existing power station management. So, any transfer of technology in the implementation stage that took place was carried over to the P/S management and not retained to the Project Directorate. At this stage the Project Directorate was automatically converted to the set-up as before like the original set-up.

2. A traditionally conceived idea was prevailing within the PM team that the project office is to assist the Consultant/Contractor on behalf of the Government in activities such as issuing/endorsing some matters as signing of invoices, dealing with local public, strikes etc. All other duties and responsibilities and matters relating to transfer of technology of the project is sole responsibility of Consultants and Contractors. This did not let the PM staff/employees learn from the site activities.

3. It was evident from the behaviour and modus operandi of ATPSE project office that technology-based development was solely left to chances. There was lack of deliberate effort to achieve it, dependence on the others and shift of own responsibility to foreigners (Consultants, Contractors) was one such important reason of failure of transfer of technology in the case project. Lack of determination of the PD and that transmitted to his engineers was another specific reason of the failure though a very good programme was chalked out for successful transfer of technology.

4. Strong determination, close supervision of the Board and their project office sustained political will could guarantee a successful transfer of technology which was completely absent in the case.

5. Lack of effort for creation of technology climate by the project office management including those inputs to be given by the Head Office through Board's policy and guidance .

6. The status of utility and support services are so designed that they could not contribute enough to be a determinant of technology climate conducive for transfer of technology.

7. The local technological capability as part of total technological capability base of the Board was not at expected level for effective transfer of technology.

8. For the four components of technology such as Technoware, Inforware, Humanware and Orgaware the last two were weak in the present case. The first two were available from the Consultants and suppliers (Contractors). For Humanware i.e. human abilities or person - embodied form of technology such as creativity, expertise, proficiency and diligence was seen to be not effective and could not be seemed to flourish due to poor orgaware constituting groupings, autonomy, linkages and coverage.

9. There observed a deliberate lack of leadership and motivation responsible for the failure. The leadership base of the PD office lacks command and technological soundness apart from other necessary ingredients.

11. A healthy technology climate did not prevail in the PD office encouraging interaction of technology components.

12. Internal problems responsible for failure such as :

    i). Psychological obstacle in the form of inferiority complex of project staffs.

    ii). Lack of orientation.

    iii). Lack of positive attitude, enthusiasm and optimism for better future.

    vi). Ineffective co-ordination in acquiring technology by the PD.

    v). Top leadership was busy in finding fault of others and attention to silly and unimportant matters (how to protect and sell packing materials etc.)

    vi). Preference of risk avoidance by the PD and his SEs.

    vii). Too much dependence on others in respect of understanding and implementation management.

    Viii). High pessimistic feelings among leadership.

    ix). Poor work environment and old traditions resulting in low productivity and inefficient use of resources.

    x). Little knowledge by the PD to improve effectiveness and linkage of organization.

13. Lack of accountabilities in the organization.

14. No incentive for effective and good performance in the organization.

15. No index and measuring instruments was in vogue in the organization to measure the individual performance.

16. The whole office and the PD himself lacked occasional office decorum, attendance and discipline in the office, respect for elderly and sense of responsibility.

17. The senior level official created an atmosphere of politicized society in the office.

18. Lack of Government to public representatives working mechanism together to attain the transfer of technology through active participation in implementation of the projects.

19. There is unofficially and informally accepted feeling that Consultant to undertake all responsibilities and the Board's people to have a happy time passing in the site.

20. Initially during 1st and 2nd years there was tendency for all the project staff to stay at Dhaka and for very small reason to keep the PD office at Dhaka. The PD office was shifted to the site at the end of 1986.

21. The PM engineers and staff developed a tendency of depending on Consultants and Contractors by misinterpreting the contract documents that all responsibilities lies on them (Consultants/Contractors)till handing over the project to the P/S management.

22. Frequent transfer of SEs had caused problem and obstacle for smooth operation of the PD office.

23. The BPDB head office senior level officials as members and Chief Engineers were mostly ignorant in the subject , did not take interest, did not cross check and make enough site inspections in order to evaluate the extent of transfer of

technology effectively.

24. Delegation of power and authority did not take proper shape. The PD could not expose himself as to which extent of power and authorities he possessed.

25. The SEs could not know their authority and jurisdiction and what they are to supervise and their role side by side with Consultants.

26. The incompetent and incapable project office though had a beautifully chalked out technology transfer program did not have any specific schedule to achieve it and did not regularly track the programme.

27. Lack of professionalism amongst engineers of the PM team.

28. Want of effort for indigenization in the PD's office. They did not suggest during planning and implementation stage that the Contractors must utilize such indigenous resource from local source.

29. Lack of enlightened and continued leadership in the organization.

## 4.5 EVALUATION OF PERFORMANCE OF ATPSE PM TEAM

Through evaluation of performance of the corporation namely BPDB is not the scope of this study yet the success of the corporation depends on how well its strategy have evolved over the years and what types of organizational structure were designed to match the strategies, so that the corporation could implement them through their execution offices. The objectives of the organization as a whole including those of their Project Management /Power Plant Management /Regional office etc. translated to action, monitor and review the actions of feedback and transmit to the implementation unit for achievement of the designed goals are the complete line of activities. The long term objectives and goal, policies adopted to translate those goals into action of Project Management Team in line with the objective of the Board, constitute the strategy.

To evaluate the performance of the PM Team it is to be specified that the team does not encompass any diversification constituting the future growth of the corporation rather the focus is on the extent of the achievement in respect of its expected performance level on the implementation at the projects as set by the corporation. The performance of the PM Team is limited in the domain of managing the implementation of the technology and its acceptance to the designed and set parameters. However, due to corporation's programme to enter the ever increasing demand of power BPDB has to modify the strategy and revamp the organization for implementation of expansion projects.

The Project Management Team represented through office of the Project Director, ATPSE Units 3,4 & 5 at Ashuganj, Bramanbaria has matrix type organization as seen in the Fig 4.1. He is assisted by three Superintending Engineers(SE), as SE (Civil), SE (Electrical), SE (Mechanical). The SEs were assisted by Executive Engineers (XEN) and those by the Assistant Engineers, etc.

The BPDB PM Team is not a part of new strategy rather it is a part of the routine implementation cell of BPDB. When a project comes up BPDB assigns to such a organizational set up to look after implementation. The process was initiated since when in early sixties a PM team was formed for the implementation of Karnafully Hydroelectric Project at Kaptai.

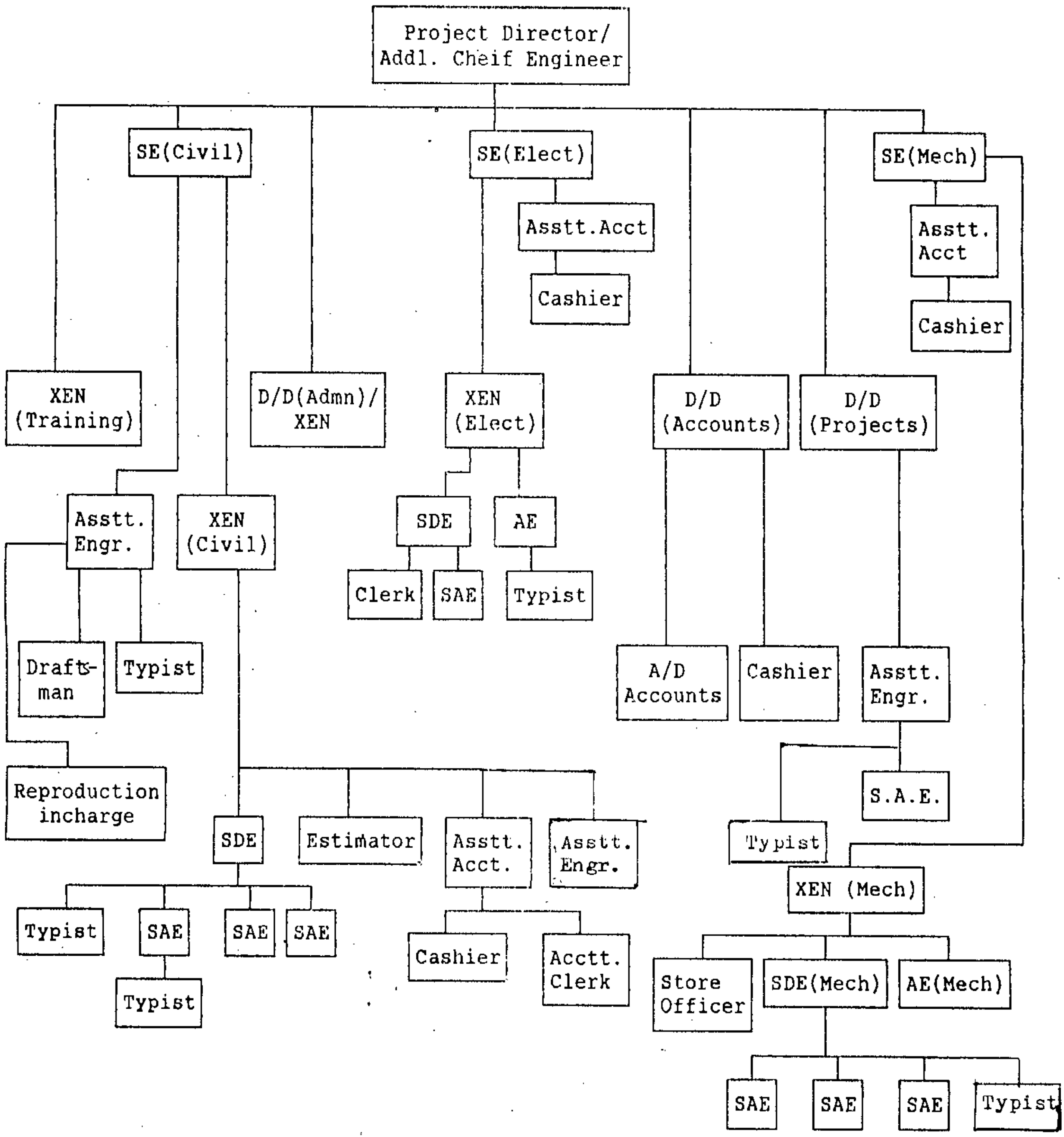



Figure: 4.1 Organogram of BPDB project Management Team. ATPSE Units 3,4 and 5.

That establishment was constituted of multidisciplinary prfessionals from power and water which in the future helped to emerge as two gigantic corporations; Bangladesh Power Development Board and Bangladesh Water Development Board. So, in order to successfully implement the said project the PM Team so assigned does not represent any modification of structure as no lack of structure to strategy was perceived.

The variables or indicators which play part in understanding organizational performance are presented as follows :

1. Adaption to environment.

2. Short term performance in terms of cost data relating selection of economic project equipment , quality control, inventory control, optimization of labour and time in the schedule.

3. The system approach wherein measurement of performance is linked to the achievement of objectives.

4. Contribution to national development.

5. Development of technology.

6. Indigenization effort.

7. Size and number of projects the PM Team managed.

8. Mastery of PM Team over the projects in implementation phase.

9. Human Resources Development effort.

10. Employment and regional development.

11. Social overheads.

12.Organizational culture.

The above mentioned indicators are described now and performance of the concerned project office are evaluated in comparison of them.

Adaption to environment: M/S. Snow and Miles classified types of organizational adaptation into four categories, out of which only following category suits to the present case project (other categories closely refer to product markets only) :

Reactors: Organizations unable to respond to perceived environmental changes (1).

With rapid growth of industries and number of consumers of electricity, irrigation systems etc. need of power was increased manifold in the late seventies which had triggered the necessity of electrical power particularly in the eastern zone. In one sense BPDB responded timely to the crucial need of electrical power, on the other hand due to BPDB's intention of setting up of additional power plants at Ashuganj establishment of site office at the plant area, delivery of construction equipment, plant and machinery at the site, construction manpower to site and interaction of local people with new environment so created composing of those construction people and due to formation of various interest groups in the project there developed a new environment responsible for the progress in implementation in the site area which failed to attract the BPDB officials to react positively, even they were found taking little interest in the project construction/erection activities. So, the PM team was observed not to respond to environmental change rather they seemed to be passive on many matters. But it was observed that the employees/officials of the existing power plant took interest in the new construction which was coming up physically day by day even they were not assigned for the new project.

The very reason of such behavior of PM team of BPDB was due to mainly selection of their 'officials having no background in industries/generation or in erection/construction fields. Rather most of them came from Electricity Sales Department. Besides, due to their own interpretation of turnkey arrangement, the ATPSE PM engineers unconsciously and sometimes consciously assured informally all responsibilities on the shoulder of the Consultant and thereby converting themselves as a rubber stamp only.

ATPSE PM team's behavior in this project implementation was not same during the whole implementation period. At the end when the powerplants were about to be commissioned the engineers went abroad for training from this project fund was informed to report to the Project Director's office on transfer. They were pushed to learn about the site test and inspection, commissioning, guarantee test and Operation and Maintenance of the project. They were partially entrusted with operation and maintenance of the projects after taking over. After repetitive push and pressure most of them learnt about operation of the project but their presence in site check and test,precommissioning tests was not that appreciative but thier involvement during initial operation and reliability test run and guaruntee tests were satisfactory.

During the process of handing over of the project to the power station management only a few engineers were seen to be capable to communicate (in terms of power station operation and maintenance) and to work with the Consultants and Contractors. The newly transferred engineers who were trained up abroad however shifted at this stage under the new set up of power station management taking partly some officials/employees from the existing power station.

If any initiative is taken to analyze the reasons of suchoverall and miserable failures of BPDB PM team, following main points may be listed:

i) Lack of accountability in the organization.

ii) Wrong placement of officials, not in commensuration with their previous experience.

iii) Senior engineers selected for the project was a bad selection in respect of sense of responsibility, initiative and technical soundness and above all leadership.

iv) Local interest group succeeded to obtain advantage over weak and inefficient project management set up.

Cost Data: The project directorate, an important part of the BPDB which is a public enterprise, had to operate under varied conditions and constraints. Though profit making is one of the most important target to generate surplus for reinvestment in order to increase generating capacity and extend transmission and distribution system, distribution of profit to the workers and staff, undertaking housing scheme for the staff and workers or extension of facilities in a station which are not presently available etc., yet it is likely to be a misleading indicator of performance if viewed to long term objectives.

The Board must have guideline in order to assess the performance of their Executives/ Managers (Project Directors /Operating Managers). In fact BPDB has no such guideline in practice. These guidelines may be various cost data or other parameters affecting the cost such as economic machine utilization, quality control, inventory control etc.

For a project like thermal power station the evaluation of performance of the projcet office staff is somewhat complex and can focus on such aspects as follows :

1. Since most of the contracts except that for Lot-C (excluding the Electro-Mechanical Portion) was a fixed price contract there was no question of reducing cost of contruction /erection and commissioning so, economic execution of the project here do not mean anything, in that way.

2. Normally in a contract there was provision of penalty per day basis against Contractors to fail in meeting a certain target date and is also against all main equipment whereas all the projects were completed ahead of schedule (mostly 2 months each), but there was no provision of awarding bonus for the project/ particular equipment for completing ahead of schedule.

3. The Contractors' good performance of completing a quality erection/ construction work, quality finishing work, quality assurance activities being upto the expected level, commissioning tests at satisfactory level, guarantee tests display and fulfil all guarantee data etc. do not reflect minimum expected performance of the Project Directorate the reasons of which are described in section 4.4. above.

4. Direct contribution of the project team in the Projects was through such activities which were solely vested on the PM team only for obvious reasons. Those were:

i) Final signing of contractors' progress invoices checked and approved previously by the Consultant for payment.

ii) Arrange and expedite Contractor's payment.

iii) Arrange local currency payment of Contractor if fund is not available.

iv) Arrange visa for Contractors site engineers, foremen and technicians.( No personnel below that level was allowed to recruit from abroad as per contract terms.)

v) To arrange for Contractors' site personnel for power, gas,water etc.from the existing power station authority.

vi) Arrange the inputs required from the existing Power Station Management such as initial requirement of demineralized (DM)water, inter connecting of many systems with those of existing systems such as filtered water system, fuel gas system, DM water system, low and medium voltage auxiliary electrical power supply, connecting generated power to existing 132 KV switchgeared etc.

vii) Arrange to contact law enforcing authority at Brahmanbaria and UNO in case of strike and site problem.

viii) Security and safety of all site personnel. Arrange security of all plant and materials etc. in the plant area surrounded by boundary wall.

ix) Allocating space for the Contractors for their storage yard, site office and preassembly work etc.

x) Arranging housing accommodation to the Consultants etc.

In all such cases the PD would work only when such requirement is endorsed by the Consultant in writing. But it was observed that the project office of BPDB did not always continuously work as expected and envisaged in the contract document with Contractors and Consultants. In most of these works the purpose was served due to Contractor's constant persuasion with patience.

All the above mentioned points do not represent any cost data or do not refer to any financial obligation attached to it, but in any failure or bottleneck of any of them would have adverse affect on the project which would have caused delay to the project. The delay would have financial implication in the project which can be calculated in the form of quantity of generated power (MWHR) which could be generated during the delay period.

The system approach: The system approach look in an enterprise is adapting its objective to suite the demands of the environment which are continuously changing. By this concept measurement of performance is linked to the achievement of objectives. The case project implementation was a success due to relentless effort and initiative of the Consultant and due to the hard labor and patience of the Contractors being each party with a system approach of their own system when their defined system is a subsystem to the projects as the whole system. Compared to the expected involvement of the project office the success achieved was really poor and unappreciative. This is clear that unless an internationally reputed Consultant was appointed to select Contractors, giving approval to equipment selected, complete civil design, detail site supervision and quality control, supervision of commissioning and site co-ordination there would not have been built such an efficient,finished and compactly laid out neat power stations with high grade of reliability, guarantee and quality assurance. The Management of the project Directorate was no way capable to replace the Consultant.

Contribution to national development: The thermal power stations of such sizes would fill the supply 'gap' by 450 mega watts. This would be a great contribution to the national development.

It cannot be gathered as to whether BPDB has practices like (i) to set performance goal to achieve their objectives in the form of annual target growth rate (ii) divide a few percentage of collection to shareholders and (iii) promote R & D as some percentage of their sales turnover etc. A survey may be conducted by BPDB interviewing the power station managers, asking them to list what they consider as vital contribution of BPDB to national development.

Development of Technology : Bangladesh Power Development Board in the last 30 years after its inception as the erstwhile EP WAPDA could not emerge as a remarkable enterprise in respect of efficient power supply nor it has assured high level of standard of service to its clients. Though in the last decade the generation capacity has increased to threefold, it has not directly or indirectly promoted technological development, neither it has substantially contributed to the sustenance for small subcontracting, manufacturers or small erectors so far implementation phase of power generation of the Board is concerned.

BPDB as an utility organization for a third world country like Bangladesh where there is no scope for any other organization to set up a parallel generation, transmission and distribution network to sale electricity to the consumers has no competition and on the other hand the consumers are bound to accept the level of services the Board offers. The initiative and tendency to offer good service to people or the consumers are about to be absent. Similarly with a view of poor social responsibility of the Board's staff and official the scope of indirect development of technology seemed very poor. The emphasis on quality and skill development to maintain minimum level performance as compared to the international standard do not get due importance. The idea of unilateral terms and conditions as per the contract between the Board and its consumers that the consumers cannot raise any question in case of power failure, interruption, voltage fluctuation etc. seems to have evolved from the very idea of having no competition to the Board.

The generation of BPDB is always exposed with most modern technology of power system of the world (as the case projects) through procurement of plants and machinery mostly by turnkey arrangements yet enough has to be achieved to learn the technology.

Efforts for indigenization: Under this heading two things could be discussed such as 1) local manpower and 2) local technology.

1) Local manpower : As per the contract between the Contractor and BPDB the Contractors were allowed to bring to site such manpower who are not locally available and particularly those above the level of foreman. Practically all the manpower came to site for construction/erection/fabrication consisted partly many people below foreman and supervisor. Some portion was also below that level i.e. semi skilled manpower. In many cases skilled labour, semi-skilled technicians are permitted to bring to site to do jobs very often done by local labour in any construction site. Contractors favor to bring their own people from home countries due to mainly their own comfort, communicational ease and tendency to employ their own people. But this was beyond the contractual terms and conditions. Visas and entry permit was also endorsed by the PD followed by endorsement of Consultants.

Altogether during the peak construction/erection period about three thousand people worked including helper to site managers out of which about 55% people were local whereas people at each of the following grades could easily be employed from within Bangladesh.

Helpers

Semi-skilled labour

Rigging Foreman

Commissioning Technician/(all grades)

| | | |
|---|---|---|
| Pipe fitters (all-grades). | Rigging supervisor | Painter,(all grades) |
| Piping chargehand | Structural fitter | Tile worker,(all grades) |
| Piping foreman | Welder,(High, Low, & medium pressure) | Ceiling fitter, (all grades). |
| Piping supervisor | Welding foreman | Mosaic Mason |
| Rod Binder | Welder helper | Mosaic fitter |
| Mason | General fitter (all grades) | Mosaic helper |
| Wood working technician | Mechanical fitter (all grades) | Auto Mechanic |
| Wood work foreman | Insulation fitter | Auto Mechanic Helper. |
| Form fitter | Insulation cladding fitter. | Auto Foreman |
| Form work foreman | Insulation foreman | Auto supervisor |
| Electrician-all grades | Lagging fitter | Store helper |
| Electrical fitter | Lagging foreman | Store fitter |
| Electrical foreman | Firebrick work fitter. | Store Supervisor |

| | |
|---|---|
| I & C fitter | Firebrick mason |
| I & C foreman | Airconditioning duct fitter |
| Erectors | Duct fabricator |
| Riggers | Airconditioning foreman |
| Heavy duty driver<br>Crane operator | Airconditioning supervisor. |

The list is not exhaustive. From here it is seen only except the very specialized jobs and representatives from the original manufacturer of equipment as required during any trouble of the equipment concerned all types of construction labours/technicians/ engineers are available in the country. The project management team of BPDB did not check the matter continuously neither they were careful to screen such inflow of foreign manpower in the site drawing huge foreign currency which could benefit the local manpower.

Besides, the PM team was equipped with all type of engineers, they hardly assumed serious responsibility of supervision due to many reasons stated in the previous section. So, as part of indigenization there was lack of effort from the PM team.

Local technology : In a close examination it can be seen following items of different lots of the Projects could have been procured/ manufactured from locally available facilities :

Lot B - Airduct

Top support beam

Recuperative preheater structure.

Recuperative preheater

Pipe rack structure

WTP Steel structure

Boiler Secondary platform

Machine room structure

Top enclosure

Wire meshing and framing work in Boiler.

Insulation wool work

G.I. sheeting work

M.S. sheeting work

Low pressure piping works

Steam drain and vent piping

All pumps upto 50 HP including turbing pumps within that power range.

All cast iron valves.

Cooling water system

Site hardware, as nuts, bolts, fasteners etc.

Lot-T

Turbine Table heat protective sheeting work Turbine enclosures framing work

All cast iron valves and butterfly valves

Framing and support plates, Hot well of condenser.

Lot-E

All airconditioning ducts

All chilled water piping and fittings.

All compressed air piping

& fittings.

All welding done under this lot.

| | |
|---|---|
| Lot-C | All embedded material works.<br>All embedded piping and sanitary & drainage piping works.<br>Lifting unit<br>Some small valves in screening plant and the Intake<br>Trash rack of screening plant etc. etc. |
| Lot-Trans | All Galvanized steel structure up to 4" size<br>All Galvanized hardware etc. |

In the tender document there was no binding to use local/ indigenous technology and materials. There was lack of effort during the project implementation of using locally available technology and materials and equipment. The Contractors were observed not been exposed as to what extent local material and manufacturing facilities were available.

Size and No. of projects the PM team managed: The PM team was designed initially to manage and implement two 150 MW gas fired, compact, water river cooled thermal power stations which later was extended for further one unit. So, this was three thermal power stations with required all auxiliaries, ancillary items, storage space, interconnection of some common/ auxiliary systems with the existing units, interconnection of some auxiliary/common systems between unit 3 & 4 , 230/132/33 KV switch yard with 230 KV substation, 50 KM 230 KV double circuit transmission lines between Ghorashal and Ashuganj, hooking up arrangement and feeders at Ghorashal 230 KV substation, computerized thermal process (power plant ) training Simulator, housing facilities and office of implementation and operation staff of power stations. In exchange rate of 1987 the total cost of projects the PM team was assigned to was about 1000 crore taka including F/C and L/C components. The implementation of staff housing scheme was independently done by the Project Director with the assistance of its own employees/ staff. All other portion was implemented under direct close supervision of the Consultant where Contractors worked directly under control of Consultant. Monitoring of Projects were done by the consultant as well. Compared to the size of the projects, extent and nature of activities included in the implementation of the projects the PM team was not to a considerable extend able to acquire the knowledge and technology except mainly endorsing papers/ permission needed and persuaded by the Contractors which were previously certified by the Consultants.

Mastering of the PM Team over the Project in implementation phase:

Mastering on the technology for successful transfer of technology may be termed as attaining at sufficient level of followings:

1. Technology Acquisition
2. Technology Absorption
3. Technology Generation
4. Challenge and Response
5. Role of Leadership
6. Organizational Ability

Examination of the PM Team in respect of these aspects will add to degree of mastering the PM Team has achieved in the process of proper evaluation on their performance.

In this paper under this chapter of the role of PM Team in respect of mastery on imported technology has already presented while discussing in detail the results and findings on technology transfer of the case project. This discussion has taken into consideration the ingredients of mastery of technology as presented above.

<u>Human Resources Development effort:</u> The ATPSE project inception through its transfer of technology programme has tried to ensure development of human resources of BPDB at different stages during the project implementation. The stages were (i) co-ordination meetings between SE and representatives of Consultants and Contractors for solving civil, electrical, mechanical, piping and I & C matters and for giving approval on specifications (ii) foreign training of Board's engineers during manufacture of equipment apart from imparting training by Contractor's training experts (iii) on site training of Board's engineers on construction/erection and quality control activities on site (iv) participation of Board's engineers/staff during commissioning and performance evaluation tests (v) participation of Board's engineers in operation and maintenance during guarantee period.

During explaining reasons of failure of technology transfer as already mentioned there lacked continuous efforts for HRD yet then there were stages in the process where a good number of personnels were trained to a good extent on the technology.

<u>Employment and Regional Development:</u> To run the project BPDB had recruited engineers/technicians, operators, officers, office assistants, typists, clerks and night guards afresh which was to the tune of 150 manpower. So, the project had created a permanent employment opportunity of 150 people.

Besides during the construction/erection of three years the Contractors had employed total about 3000 people in the peak period and total about 1000 people in the lean period. There were at least 20 construction sub-contractors who were engaged in the project during small construction and erection works. Due to the project implementation there constructed housing complex, roads, etc. which developed the region to some extent also.

As the construction sites were located at Ashuganj, the Ashuganj Bazar area was developed as there was huge infusion of fund from local/expatriate engineers and workers.
In a country like Bangladesh with high unemployment the employment so created both permanently and temporarily had added to the growth of the region as well to the country. BPDB's decision of setting up of power station at Ashuganj also reflects Govt.'s policy for geographical dispersion.

Social Overheads : Public enterprises as reputed employers provide a series of services to their employees ranging from housing and education to medical services, transport and subsidized canteen etc. In the case Project housing complex was built during the completion of the project which also continued during handing over of the project. After completion of the scheme there expected no housing problem. The Consultants office built for the project was designed for extension of the existing school after the termination of the project. During the planning stage there was provision of a 50 bed hospital which later was abandoned. There was no provision of a subsidized canteen in the extension project . The ATPSE Project as designed did not neglect the social overheads as presented above.

Organizational Culture : Organizational culture is widely accepted as an important variable in understanding organizational performance. This culture is reflected in the internal functioning of the organization, delegation of authority, the decision making process, role of leadership, type of motivators and adaptability to environmental changes(1). However for industrial enterprises in a third world country like Bangladesh these dimensions of organisational culture are always influenced by social structure. Social structure is governed by different set of values as values of kindship, community,local language, religious identity and concepts of duty which conflict with interest of industry. So it is generally expected that an organisation embedded in such a culture should practice in a way to achieve some of the demands of industry which are norms of productive activity.But it is already mentioned that the PM team of BPDB could make little progress in

transfer of technology and reasons thereof are also presented.
The internal functioning of the organisation was disturbed often for reasons stated in section 4.4. There was considerable evidents in the case that there existed or developed no definite pattern of authority as a result useful characteristics like "task orientation", emphasis on skills and quality of job, high level of integrity, commmittment and loyality and the concept of teamwork could not be attributed to the Projects to any appreciable level. However, unorganised loyality to the superiors and overall integrity were present which were not helpful to assist the HRD process.

Though the PM team is a part and parcel of the BPDB and guided by Board's set rules and regulations,practices for making decisions, yet there were area where the PM team was supposed to take decisions independently.They were to initiate and establish a decision making process to decide on many urgent and general types of matters relating to the implementation of the Projects. In fact, the PD would avoid his involvement to decide on such matters, pass most of them safely to the Consultants, partly to the existing Power Station management and partly to his Superiors at Dhaka.He also didnot involve his subordinates to work in a team for any decision making. PD as a leader could influence his subordinates but acceptance by them was not enthusiastic. To contribute to performance by the PM engineers there should have established practices of awarding for differentiation of rewards based on individual achievement. The PD office had no such practice of reward giving nor there were openings for individuals for opportunity of growth and development without discrimination. Even the project drawings,specifications,documents were not accessible nor readily available to the engineers/staff of the PM team.
It is earlier mentioned that the PD office failed to respond to adapt to the environmental changes. They could not adjust to the tangible changes took place during various phases of implementation.

Chapter 5

# CONCLUSIONS AND RECOMMENDATIONS

The present work was concerned with transfer of technology. A power generation Project was considered as a case.The content of transfer of technology in the present context was limited to the human resources development programme of the Project Management Team of the BPDB.The technology was totally imported.The objective was that HRD takes place effectively and are provided by the Suppliers. The present work was therefore directed towards an evaluation of the HRD process. It was expected that through this transfer of technology programme there would be reduction of dependence of the indigenous Project Management Team on imported technology.

The case projects comprised of two projects as Project unit 3 and 4 and Project unit 5 under 3x150 MW Ashuganj Thermal Power Extension Units of the BPDB . The implementation of Projects took place under direct supervision and co-ordination of a German Consulting House namely M/S. Lahmeyer International GmbH with five other International Contractors entrusted to five lots of plants and facilities.The overall supervision was the responsibilities of a Project Directorate office of the BPDB. The relevant programme on transfer of technology under the Projects thus created an excellent scope and opportunity to learn and consolidate the technology by the BPDB Project Management Team.

The overall objectives of the study are to identify successes and failures on technology transfer during the implementation phase of the case Project. The 'Results and Findings' of the study revealed that technology transfer in the form of human resources development by the Project Management Team of BPDB was not at all achieved to any appreciable extent, however only limited area was identified where this was successful. An effective HRD was achieved in only the operation of power plants but there lacked specific programme, effective organizational guidance and accountability so as to transfer high level of operational skill to the engineers/technicians/staff.Moreover no HRD

-as achieved in the power generation process (manufacture, erection, aintenance and overhaul). Due to lack of required capability-base nternal transfer of technology was not successful. In the process of ommissioning and handing over tests however, HRD was successful to ome degree at the mid and lower level of officials/engineers of BPDB.

It may be mentioned that in order to establish an effective HRD rocess a programme was prepared which could be regarded as an xcellent programme.But for reasons such as :i) want of definite plans nd failing to establish a competent Organisation , ii)lack of properly rganising a project review committee and iii) lack of overall apability-base to respond to the need & requirement of the case project etc. the HRD programme ended almost in a failure. The capability developed of the PM Team was analysed and found that it gained a little competence and would not be competent enough to manage a similar technology in the future.It is therefore recommended that the above shortcomings and deficiencies are removed in a future such projects. Thus a highly competent PM team would be developed in the country.This team would gain further momentum from future such experiences on 2 to 3 thermal power plant Projects jointly with a Consultant. Thus the PM team will be able to manage implementation of such a Project (without the involvement of a Consultant).

In order to overcome the shortcomings following recommendations are made on the basis of findings of the present study. These recommendations could be considered by BPDB, energy sector and agencies involved in project management of large turnkey plants for implementation :

1.During the initial selection of technology by the agency/sector corporation special attention to be paid for a comparative benefit/ cost analysis in response to various technology acquisition arrangements.

2.The manufacturing of generation system should set-up cells with their units to control imports with a view to achieving self-reliance. The cells are required to : 1) identify the items that were imported with a view to ending future import at the design stage itself, 2) the ancillary units and other manufacturers are to be encouraged to manufacture such items, 3) items which require high degree of quality and skill are to be manufactured by the manufacturing plants. In case of generation through subcontractors direct supervision should be applied . Government red tapism, licensing requirements and other bureaucratic procedures to be shortened in private sector in order for achieving capability base to select the technology which suits the situation.

3. During preparation of the contract with Suppliers/Contractors definite terms and conditions with a clause of achievement of HRD for client's engineers/staff to be related with payments and project progress. The progress schedule to be tied with HRD of the client.

4. The Board must be competent and cautious in selection and receiving a technology so that appropriate safeguards could be taken against old and outdated technoware not shifted to the recipient. It must be known that humanware import is temporary, infoware generally not sold and orgaware cannot be readily transplanted.

5. BPDB should be aware of the fact that the modus operandi of the International Financial Institution may inadvertently reinforce dependence.

6. The Board should look into the development achieved in energy sector by the NICs in Asia in the last one decade and take lessons from them.

7. BPDB should prepare an appropriate programme for phasewise acquiring of capability through their manpower development under assistance from any financing agency. Specific target would be to achieve capability of self-reliance of their engineers/staff so that BPDB would be able to select, supervise, implement and adapt imported technologies. Emphasis to be given to create an atmosphere of technology culture

8.In installing future thermal power stations the Board should make it a binding for the contractor to use indigenous resources such as available human resources, manufacturing facilities and materials. It may be noted that for a thermal power station such items and equipment as : equipment/sections like all type ducts for air systems, pipe rack structure, WTP steel structure, small pumps, vertical turbine & pumps, framing work of insulation works, wiremesh etc. are readily available in the country.

9.The general practice of a company/sector corporation is to seek collaboration following which Government approval is necessary for the purpose of screening, licensing and implementation of equipment/manpower. A complete line of activities to be formulated in order to avoid delay thus avoiding increased cost of technology due to inflation.

10.For proper absorbtion, technology capability of the user to be developed so that they can adapt, assimilate and manage the technology. This reflects existing technological infrastructure which will support the absorbtion process effectively.

11.To set-up a future PM team for execution of a large industrial unit attention be given so that the team is accepted in that environment.

12.BPDB should have their own clear cut objectives side by side they should set their performance goal. Suitable indices and comparators to be selected by the Board to measure the performance of the PM team as well as those of each individual of the team.

13.BPDB engineers and officials to be motivated to develop their consciousness to understand and be able to evaluate as to which extent of contribution they deliver for national development. They must also be conscious to give response as to which functions are responsible for national development.

14.BPDB to practise system approach to understand their performance as a whole. This adapts a broad based view of performance evaluation, thus linking technology, structures and performance, using multiple sets of criteria.

15.BPDB should arrange bringing in engineers/officials and motivate them so that they would be able to operate a healthy organizational culture which is identified as an important factor in understanding organizational performance. Periodic monitoring and review are to be carried out to assess the internal functioning of the organization like employee involvement and satisfaction, distribution of authority, decision making processes, role of leadership, innovation and adaptability of environmental changes which reflect the organizational culture as a whole.

16.Since project management involves a challenge and face uncertainty it should produce able leaders. In the crisis situation the BPDB could use such individuals who would be good managers to be able to combat crisis and develop themselves and the organization as a whole. The organizational challenge is the test of leadership, so a dynamic organizational atmosphere should prevail which can ensure a leadership process.

17.The general framework for technology assessments (Fig. 5.1) is to be consulted for developing a technology need assessment base in any sector corporation.

18.BPDB must give effort to develop their capability in terms of technology assessment need to assess alternative modes for importing technologies and the institutional and policy framework needed for them. The Board should as well endeavour to examine the major constraints for improvement of indigenous technology capabilities in the concerned sector.

19.The Government should adapt legislation to control flow of technology into the country.

20. The approach of the government towards selective flow of technology to be done through detailed screening at various levels. In this respect Government to setup such Board which would screen technology with definite guideline for ultimate selection of Industry.

21. Policy makers need to recognize that all forms of technology are not adaptable to factors of production endowed to the country. So, special measure to be taken during the selection process of the imported technology favouring institutional arrangement for the professional assessment of technologies from economic, social, political, energy and environmental angles.

22. The Government to focus on three areas which are significant for self reliance. Those are 1) adaptation 2) import substitution 3) indigenous research and development.

23. Emphasis on appropriate technology to be paid in macro and micro levels.

24. During the selection of a technology "essential consideration in macro analysis" shown in Fig. 5.2 should be followed, the relevant important topics of consideration must be enlightened. Special attention to be paid in the selection process on the science and technology indicators as per Fig. 5.3. As complementary to conventional economic analysis, benefit/ cost analysis etc. for selection of the technology to obtain required purpose is necessary to evolve methodologies intergating technological considerations with development planning, political, energy and environmental angles.

25. The imported technology is developed under competent intensive condition and such technology is to be adopted to local conditions. Thus technology imported in most cases become inappropriate as regard to factor use. The factor being labour resources. During selection of technology attention to be paid to consider the above.

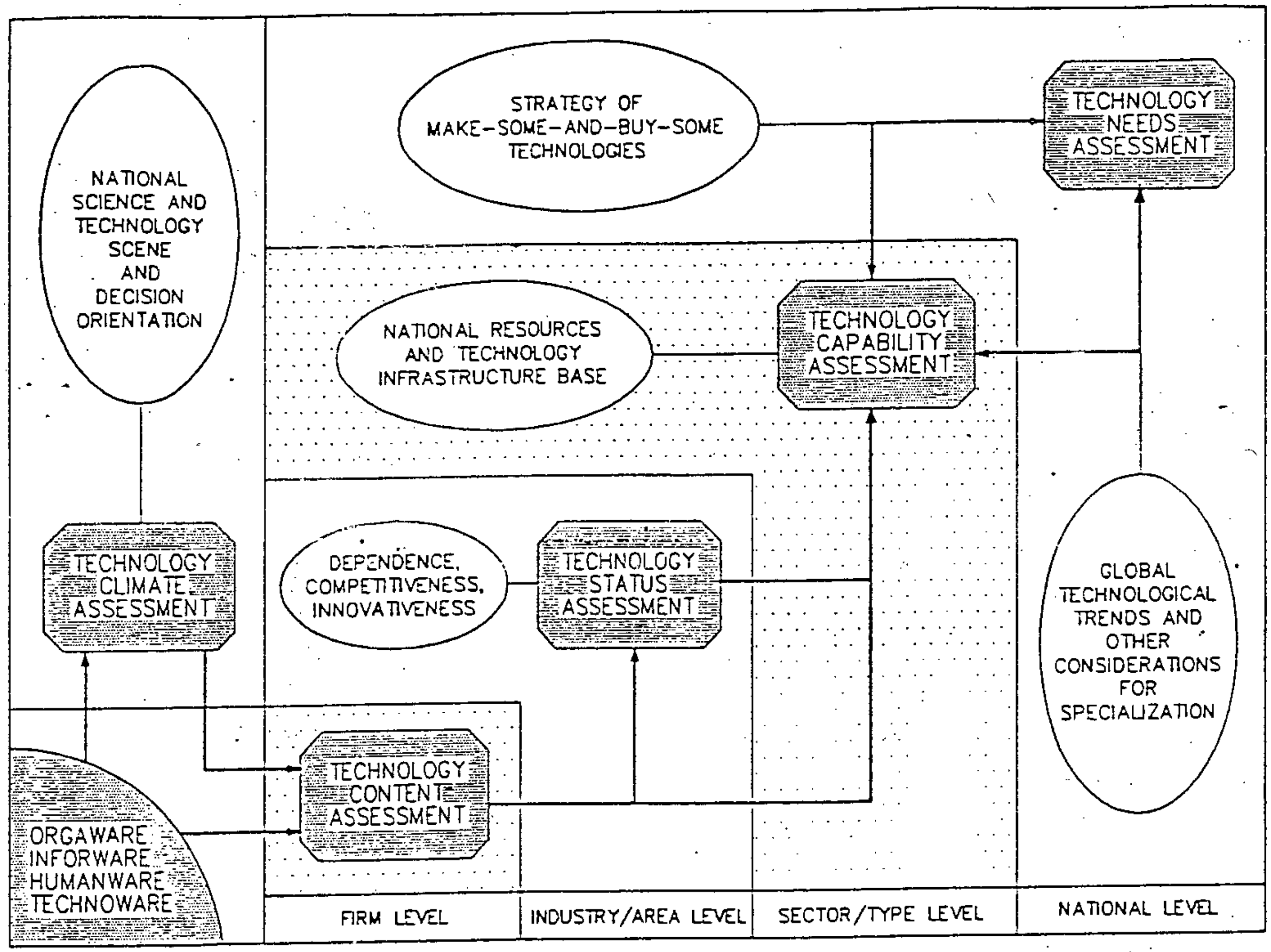



**Fig 5.1** : GENERAL FRAMEWORK FOR TECHNOLOGY ASSESSMENTS

**NATURAL RESOURCES**

Excessive export of natural resources temporarily help improve national income but cause depletion and irreversible environmental degradation

Due attention to natural resources depletion in the national accounting system is essential

**HUMAN RESOURCES**

Most developing countries have very large proportion of unskilled labour and a very low proportion of skilled human resources

Key factor in human resources development is achieving overall skill structure balance

**STRUCTURAL ADJUSTMENT AND BALANCE OF TRADE**

Steadily decreasing commodity prices and increasing prices of manufactured goods are resulting in the worsening of balance of payment situation

Achieving balance of trade and payment in terms of technology content is desirable in the long-run for sustainable development

Industrialization patterns adopted for employment generation do not consider technology in the structure of economy

Technology-based economic development can only be achieved through structural adjustment by types of transformation

**INFRASTRUCTURE**

Existence of sub-critical efforts, or counter-productive and isolated centres of excellence, are common

Conflicting and sometimes wrong policies and frequent change in policies with change of government

Strengthening of institutions and linkages and harmonious policy needed

**STATISTICAL DATA**

Data collected using the international standard industrial classification and the standard international trade classification are not compatible

Rearrangement of available national data sets by technological transformation type classification would be useful

**CAPABILITIES AND NEEDS**

Technological capability is dependent upon complex interactions among technological institutions, resource endowments and interest groups

No hierarchical derivation of technological requirements from socio-economic plans, which are vague and no consideration of world technological trends

Requires specialization on the basis of competitive advantage and not necessarily comparative resource advantage

Technology needs could be analysed in terms of importing, evolving and exporting technology domains

National technological capabilities and needs assessment have to be carried out in the context of one another

Fig. 5-2 : ESSENTIAL CONSIDERATIONS IN MACRO ANALYSES .

**CURRENTLY USED SCIENCE AND TECHNOLOGY INDICATORS (PARTIAL)**

| INPUT INDICATORS | OUTPUT INDICATORS |
|---|---|
| Stock of science and technology personnel by field of specialization, sectors of performance, qualification and type of work | Bibliometric measures based on publications and citations |
| Research and Development expenditure by type of expenditure, sectors of performance, source of funds, type of activity and field of specialization | Patents by subject and origin |
| Student enrolment and teachers by level of education and fields of study | Technology diffusion and trade in high technology |
| Quality of science and technology supportive services | Technology transfer payments (fees, royalties) |
| | Technology balance of payments |
| | Quality of products and after-sales services. |

Organizations : UNESCO; OECD; NSF (USA); SPRU (UK); IDRC (CANADA)

**FOCUS OF SCIENCE AND TECHNOLOGY CONSIDERATIONS**

| ILO | UNCSTD | UNCTAD |
|---|---|---|
| Studying effects of technological innovations on society and labour and fostering the application of appropriate employment generating technologies in developing countries. | Coordinating UN activities on science and technology for development and developing guidelines for developing countries in the area of science and technology policy. | Studying political, legal, policy and economic aspects of technology transfer and assessing the impact of new technologies on trade and prospects of developing countries. |

| UNESCO | UNIDO | UNCTC |
|---|---|---|
| Carrying out science and technology policy studies, facilitating international standardization of science and technology statistics and providing support services for fostering improved management of research and development. | Promoting industrial collaboration, facilitating innovation and application of emerging technologies, and assisting in industrial planning and infrastructure development in priority sectors. | Facilitating understanding of the functioning of transnational corporations and strengthening host country capacity to negotiate and secure effective international agreements. |

NEED METHODOLOGIES FOR INTEGRATING TECHNOLOGICAL CONSIDERATIONS WITH DEVELOPMENT PLANNING WHICH WILL BE COMPLEMENTARY TO CONVENTIONAL ECONOMIC ANALYSES

Fig 5.3 : LISTING OF AVAILABLE INDICATORS AND ACTIVITIES

26. Bangladesh Industrial policy should include such conditions so that it achieves following criteria : (1) Optimum utilization of installed capacity (2) maximizing production and adhering higher productivity (3) higher employment generation and (4) foster provision from export oriented to import substitution industries and spares.

27. Government should protect infant domestic industry by adapting a clear cut strategy of import substitution.

28. Mere protection of indigenous industries by Government policy is not enough, rather sufficient safeguards against price and quality of products will have to be taken into account in the national industrial policy and to be effected through proper organizational set-up.

29. The country should move to achieve at such a stage that the generation of new technology could be evolved within certain targeted period. This will be the logical sequence to successful acquisition and absorption of relevant technology.

30. To deal with national problems on power generation and transmission systems the BPDB officials should be increasingly concerned and more awareness to be grown about the importance of R&D in the Board.

31. The BCSIR should organize themselves to such activities as: 1) undertake transfer of technology and licensing of know how developed by R&D institutes in the country, 2) promote development projects in collaboration with industry, 3) promote indigenous technology abroad, 4) encourage incentive talent in the country.

32. Through setting up of industrial R&D actually located at power stations sustained efforts to be given by the Board to develop indigenous technology/ capability so that in the process dependence on foreign technology would be minimized or even technology is

generated to suit Board's requirements.

33.For effective transfer of technology from industrial to all levels sufficient number of engineers and designers are to be employed in research organizations.

34.Collaboration at both national and international levels between academic institutions, research organizations and the Board is recommended to undertake research on alternative and renewable sources of energy because of the inherent interdisciplinary nature of the field.

35.The gap remained between the industries and industrial research by BCSIR which is to be reduced by the Board by approaching the BCSIR for joint research or asking solution of problems plants normally suffer from. On the other hand the Directors/Sr. staff of BCSIR should move out of their laboratory and approach industries for their own acquaintances of the need of industries.

36.BPDB to invest and establish central R&D units in order to conduct research.linkage to be established on complex matters with the country's only technological University the Bangladesh University of Engineering and Technology and other technical research institutions.

37.Various R&D institutions at both government and private levels should suggest for appropriate measures for effective planning, transfer, research and development and diffusion of technology both imported and indigenous with particular reference to the structure and control of planning and implementing organs and their linkages.

38.Due to deficiencies of the existing Science and technology( S&T) infrastructure in the
country adequate stress to be given to reorganize and strengthen it through the National Council for Science and Technology (NCST) and its associates.

39. Research institution to generate S&T knowledge in designated priority areas by carrying out basic and applied research. For the case Project the BPDB should have its own R&D unit to do experiments, researches and engineering works, Pilot studies in order to acquire capability for identification, formulation, approval, performance, monitoring and evaluation of prototype small power stations.

40. The practice of running the industrial R&D should be like operating a business rather than Government departments. Linkage to be established between R&D units of production/ generation and education sector.

RECOMMENDATIONS FOR FUTURE WORK

Due to short span of time -frame this study could not employ an indepth data collection procedure. There is scope for future study taking into consideration for collection of data and information by sending previously designed questionnaires about the success and failure of HRD process to the concerned engineers/ staff of BPDB at various hierarchical levels, collecting their response, compiling and analyzing them with the help of a suitable method.

Future study on the Projects can also be focused on technology transfer with objective of assessing the extent of available indigenous materials, knowhow and manpower which can be utilized to generate a similar technology and identifying the present technological capability base of BPDB.

Further study on the projects can be carried out on Management Information System (MIS) followed by the International Contractors during implementation period and a suitable and effective MIS and Organizational Structure could be designed for BPDB to achieve the said technology transfer programme.

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# APPENDIX-I

## A BRIEF OUTLINE OF THE PROJECTS

1. Name of Projects : Ashuganj Thermal Power Station extension Units 3 and 4.
&
Ashuganj Thermal power Station extension Unit 5.

2. Capacity : 3x150 MW.

3. Scope of Projects : (i) Unit 3 and 4

(a) The Extension of The Ashuganj Steam Power Plant with two gas fired units of 150 MW each including boilers and auxiliary electrical and mechanical equipment including common systems like clean and filtered water system, DM Water system, compressed air system, HVAC system, circulating water system, cooling water system etc. etc.

(b) 230 KV Double ckt. Transmission line between Ashugonj and Ghorashal including 230/132 KV sub- station.

(c) A simulator to train BPDB's staff for the operation of Steam Power Plant.

: (ii) Unit 5

Extension of ATPS with another 150 MW thermal power plant including Intake channel, boiler, turbine and auxiliaries and all necessary electrical and mechanical equipment including circulating water system, clean and filtered water system, DM water piping, compressed air system, HVAC system, fire fighting system etc. etc.

4. Client : Bangladesh Power Development Board.

5. Projects Cost : Approx. total US$ 330 million,

(i) Unit 3 and 4 Figures in million Taka

Local Foreign Sub-total

| | | | |
|---|---|---|---|
| As per Project Proforma | 2825.4 | 4840.72 | 7666.12 |
| Revised estimate (January '86 price level) | 1021.78 | 4706.57 | 5728.35 |

(ii) Unit 5

| | | |
|---|---|---|
| Savings from Unit 3 and 4 | | 1937.8 |
| Finance from KFW | DM 65m | |
| Sub-total | | 3238 |

6. Approval Status : Unit 3 and 4

PEC Approval date 08-05-82
ECNEC Approval date 25-05-83

: Unit 5

GOB Approval date July 1985

7. Consultant : Lahmeyer International GmbH, Federal Republic of Germany.

Consultant's Project No. : 3759 and 1750 for project unit 3 & 4 and project unit 5 respectively.

8. Financing Agencies : IDA, ADB, KFAED, OPEC, KFW and GOB.

9. Year of Commencement : Unit 3 and 4

As per PP 1981-82
Actual 1982-83
Site Works 1984

: Unit 5

End (November) 1985
Site Works March 1986

10. Year of Completion : Unit 3 and 4

As per PP 1986-87
Actual revised
3rd Unit February, 1987
4th Unit July, 1987

: Unit 5

July 1988

11.Major Specifications :

(1) Steam Generator :

Manufacturer : MITSUI (IHI) Japan.

Capacity : 501 t/h.

Steam Pressure : a) Superheater outlet 135 bar,
b) Reheater outlet 30,9 bar.

Steam Temperature at superheater and reheater outlet:523 deg C
Fuel Gas Consumption : 30.880 kg/h.

Boiler Efficiency : 86.93%.

(2) Turbine Set:

Manufacturer : BBC, FRG.

Rated Terminal Output : 150 MW.

Maximum Terminal Output: 157.5 MW.

Vacuum (pabs) : 0.08 bar.

(3) Generator:

Number of Poles : 2

Number of Phases : 3

Rated Apparent Power : 190 MVA.

Rated Real Power : 152 MW.

Rated Power Failure CosØ: 0.8

Rated Voltage : 15.750 KV

Rated Current : 6965 A.

Efficiency : at power factor cos Ø = 0.8,
Real power 152 Mw 98.55%.

(4) Power Tranformers:

Manufacturer : HICO (PEC), Korea.

Capacity : 150 MVA

Rated Voltage : 240/140 KV

Project Lots

The entire works (Unit 3, 4 & Unit 5) were split up into various lots namely:

| | |
|---|---|
| Lot C | - Civil Works |
| Lot B | - Boiler Plant and Auxiliary |
| Lot E | - Electrical Works, Airconditioning and air-supply systems. |
| Lot T | - Turbine - Generator and Auxiliaries |
| Lot TRANS | - 230 KV Transmission Line Ashuganj / Ghorashal and H.V. - Switchyard. |
| Lot SIM | - Training Simulator (3759 Only) |

# APPENDIX-II

## SPECIFICATIONS AND SCOPE OF SUPPLY OF DIFFERENT LOTS.

**Lot "T" Turbine Generator and Auxiliaries for Unit 3 and 4**

Item 6 P - 1 - Turbine Generator Unit

-turbine, turbine instrumentation and control system, LP by-pass steam reducing station, lubrication oil system, generator, cooling and ventilating system, excitation system, generator instrumentation and control system, condensing plant with on-load cleaning system, air extraction system, local instrumentation and control system. Vibration and structural analysis of foundation. Form and reinforcement drawings, bar bending diagrams.

Item 6 P - 2 LP Heaters, Cold Condensate Storage Tank.

-2 LP heaters including auxiliary equipment.
-Cold condensate storage tank including necessary piping.
-Local instrumentation and control

Item 6 P - 3 - Steam, Condensate and Feed Water Piping System. Including all necessary hangers and supports, venting and drawing systems, valves, strainers, etc.

Item 6 P - 42 - Bus Duct System

-2 phase segregated generator bus ducts systems, with generator cubicles containing voltage transformers and earthing switches.

Item 6 P - 45 - L.V. Power Distribution System

-Two 400 V unit main distribution and one D.C. sub-distribution each for + 24 V and 220 V.

Item 6 P - 47 - Cables and Cable Fixing Material.

-All 6.6 KV and L.V. cables including accessories to establish the A.C. and D.C. power and control systems of Lot T.

Item 6 P - 48 - Lighting System

-Lighting and socket installation of the turbine hall including annexes on all levels.

Item 6 P - 49 - Grounding System and Lighting Protection.

-Grounding and lighting protection of all equipment, structures, buildings, supplied under Lot T.

Item 6 P - 51 - Instrumentation and Control.

-This item includes all measuring systems, alarm systems, remote logic control and interlocking systems, automatic analogue control systems, protection systems as well as the control desks and panels in thermal control room and the equipment cubicles and racks in electronics rooms.

Item 60 - 3 - Station Transformers

-Two 1.6 MVA, 6.6/0.415 KV unit station transformers, complete with control, lighting, grounding, etc.

Item 60 - 4 - Bus Ducts and Cables for Item 60 - 3

-Two sets of L.V. bus ducts; two 6.6. KV cable connections as well as all related transformers.

Lot "B" - Boiler Plant and Auxiliaries for Units 3 and 4

Item 6 P - 21 - Steam Generating Plant.

-Steam Generating plant consisting of :
steam generator with auxiliaries including economizers, evaporation system, H.P. superheater, reheater, drainages and vents, pipework and headers, pipes, protection devices, fittings, supports and suspensions, sheetings, start-up and low load system including 2 x 50 % h.p. by-pass reducing station, blow down, drains. Firing system including gas burners, gas supply, control air system, cooling air system, sealing and ignition air system, ignition system.

-Air flue gas system including :
2 forced draught fans, recuperative tubular air preheater, air ducts, flue gas ducts, stack.
Boiler accessories including :
refractory linings, boiler steel structures, boiler roof, cooling water system.
Boiler main hoist, FD-fan travelling crane
Stand-still preservation system, utility station, off-load cleaning facilities, paintings,
Local instrumentation and control system.

Item 6 P - 22 Steam and Feedwater Piping System.

-Including all necessary hangers and supports, venting and draining systems, valves etc.

Item 6 P - 23 - Fuel Gas System
-Including filters, heat exchangers, reducing valves quick closing valves, silencer and N2 system related instrumentation and control.

Item 6 P - 24 - Boiler Feed Pump Sets.

-2 x 125% Boiler Feed Pump Sets including ring section boiler feed pumps, couplings, motors, booster pumps, oil systems, related instrumentation and control, pipes and valves etc.

Item 6 P - 25 - Water Treatment Plant.

-Including demineralization plant, 2 lines, scavenger filters, cation and anion filters, mixed bed unit, make-up supply system, 2 storage tanks, piping, 4 demineralized water pumps.

Item 6 P - 26 - Chemical Laboratory Equipment.

-Complete with furniture, equipment and chemicals.

Item 6 P - 27 - Chemical Dosing System.

-Including hydrazing system, alcalising system, trisodium system.

Item 6 P - 28 - Cooling Water System

-Closed circuit cooling water system including 2 x 100% cooling water pumps, 1 auxiliary cooling water pump, 2 x 100% heat exchangers, 2 x 100% expansion tanks, 2 x 100% overhead tanks, pipework, valves and fittings.

Item 6 P - 29 - Drain and Sewage System.

-2 x 100% drain-pumps, clean drain tank, flash tank, sewage tank, 2 x 100% sewage pumps, piping.

Item 6 P - 30 - Fire Fighting System

-Including water supply installation and fire pumps, sprinkler system, water spray fixed system, underground fire service main hydrants, fire detection installation, fire alarm system, dry powder trailer, portable fire extinguishers, and refilling unit. Stress analysis of pipes and provision of necessary valve pits. Form and reinforcement drawings, including bar bending diagrams.

Item 6 P - 31 - Clean and Filtered Water System.
Item 6 P - 32 - Water Treatment Pipe Rack

-Including steel structures, pipe and cable trenches with all base plates, skims, wedging permanent and temporary field bolts etc. All embedded material.

Item 6 P - 245 - L.V. Power Distribution System.
-Two 400 V boiler sub-distributions
-One 400 V water treatment sub-distribution
-One 400 V laboratory sub-distribution
-One 400 V fire fighting sub-distribution
-One 400 V clean and filtered water system sub-distribution.
-One 220 V.D.C. sub-distribution
-One + 24 V.D.C. sub-distribution

Item 6 P - 247 - Cables and Cable Fixing Material.

-All 6.6 KV and L.V. cables and accessories to establish the A.C. and D.C. power and control systems of Lot B.

Item 6 P - 248 - Lighting System

-Lighting and socket installations of boilers on all levels, boiler areas, water treatment plant, laboratory building, fire fighting plant, clean and filtrated water plant and of all other equipment supplied by Lot B.

Item 6 P - 249 - Grounding System and Lighting Protection

-Groundings and lighting protection of all equipment structures and buildings supplied under Lot B.

Item 6 P - 251 - Instrumentation and Control.

-This item includes all measuring systems, alarm systems, remote logic control and interlocking systems, automatic analogue control systems, protection systems as well as the control desks and panels in the thermal control room and the equipment cubicles and racks in electronic room.

Item 60 12 - HP Heaters.

-Two HP heaters including auxiliary equipment
-Instrumentation and Control.

Item 60 - 13 - Feedwater Tank

-Feedwater tank including piping
-Instrumentation and Control.

Lot 'E" Electrical Equipment for Unit 3 & 4

Item 6 P - 19 - Air Conditioning and Ventilation System.

-Complete air conditioning and Ventilation Systems for all buildings.

Item 6 P - 141 - Power Transformers

-One 25 MVA, 132/6.9 KV start-up transformer-Two 15-MVA, 15-75/6.9 KV unit auxiliary transformer
-Four 1.6 MVA, 6.6/0.415 KV general station transformers.
-one 630 KVA, 6.6/0.415 KV station transformer
-Seven 200/3 MVA, 245/15-75 KV, single phase unit step-up transformers, connected to two three-phase banks (one single-phase unit for spare) including the related lighting, grounding, cabling, etc.
-Two 1000 KVA 6.6/0.415 KV general station transformers.

Item P - 142 - Bus Duct Systems.

-Six sets of metal enclosed 6.6 KV bus ducts and six sets of L.V. bus ducts.

Item 6 P - 144 - M.V. Power Distribution System.

-Two 6.6. KV, single busbar, unit supply distributions and one 6.6 KV, double busbar general supply distributions.

Item 6 P - 145 - L.V. Power Distribution System.

-One 400 V general main distribution board
-One 400 V emergency distribution board (with interconnection to existing plant).
-One 400 V general lighting distribution board
-One 400 V main intake distribution board
-One 400 V A/C distribution board
-220 V.D.C. distribution board
-$\pm$ 24 V.D.C. distribution board.

-231 V Safe A.C. distribution board.

Item 6 P - 146 - Rectifiers, Batteries & Inverters.

-One 220 V, 400A/1 hour battery with charger
-One + 24 V, 1000A/1 hour battery with charger-One 220 V.D.C. /231 V.A.C., 15 KVA safe A.C. inverter

Item 6 P - 147 - Cables and Cable Fixing Material

-All 33 KV, 6.6 KV and L.V. cables including accessories to establish the A.C. and D.C. power and control systems of Lot E.

Item 60 - 22 - Station Transformers

-Two 1.6 MVA, 6.6/0.415 KV unit station transformers, complete with control, lighting, grounding, etc.

Item 60 - 23 - Bus Ducts and Cables for Item 60 - 22

-Two sets of L.V. bus ducts, two 6.6. KV cable connections as well as related control cabling for item 60 - 22, station Transformers.

Item 60 - 24 - Compressed Air System

-All equipment, pipes, supports valves, instrumentation and control etc.sd to ensure proper, safe and easy operation and maintenance under all conditions.

Item 60 - 25 - Electrical System for 60 - 24
One 400 V sub-distribution board as well as the related cable, lighting and grounding systems for item 60 - 24, compressed Air System.

Lot "Trans" - 230 KV Transmission Line ASHUGANJ, GHORASAL and H.V. Switchgear

Item 6 P - 341 - Power Transformers

-Two 150 MVA, 240/140 KV network coupling transformers.

Item 6 P - 343 - H.V. switchgears

-One complete 230 KV outdoor switchgear consisting of 7 switchgear bays.
-One 132 KV outdoor switchgear extension consisting of 3 switchgear bays.
-One 33 KV outdoor switchgear extension consisting of 1 switchgear bay.

Item 6 P - 345 - L.V. Power Distribution System

-One 400 V sub-distribution and one D.C. sub-distribution each for 220 V and + 24 V.

Item 6 P - 347 - Cables and Cable Fixing Material.

-All L.V. cables including accessories to establish the A.C. and D.C. power and control system of Lot Trans.

Item 6 P - 348 - Lighting System

-Lighting and socket installation of out-door switchyards and transformer boxes related to Lot Trans.

Item 6 P - 349 - Grounding System and Lighting Protection.

-Grounding and lighting protection of all equipment/structures/buildings supplied under lot Trans.

Item 6 P - 350 - Electrical Protection and Control Equipment.

-Automatic control, protection and power metering systems installed in the NCR - Building such as protection systems for 230 KV/132 KV/33 KV switchyards, AVR for unit step-up transformers, synchronization for 230 KV/132 KV switchgears and energy metering for 230 KV/132 KV/33 switchgears.

Item 6 P - 351 - Instrumentation and Control.

-This item includes all measuring systems, alarm systems, remote logic control and interlocking system, as well as the panels and equipment cubicles in the network control room.

Item 6 P - 360 - Overhead Transmission Line

Lot Sim-Power Plant Training Simulator

The training simulator shall aid in the initial training as well as in refresher training of power plant operators for all operational phases of the plant. It consists of a computer model of the power plant combined with control desks/panels similar to thermal control room equipment.

Lot "C" Civil Works

-All buildings and structures as under shall be supplied and erected by the Lot C Contractor :

- o Turbine Hall
- o Thermal Control Building
- o Flocculator and Filter House
- o Water Treatment Building
- o Fire Fighting Station
- o Gas Reducing Station

Boiler Area Foundation etc.
Cable and Pipe Ducts
Drainage and Sewage System
Lifting Unit
Roads and Pavement
Cooling Water Intake System
Cooling Water Switch Gear Station
Cooling Water Outlet System

Storm and sanitary drainage

Circulating water system including screening plant, pumps nd pipes.

In case of project unit 5 the lot wise project specifications are similar and include all auxiliary, ancillary and unit systems for it which were common to previous project.

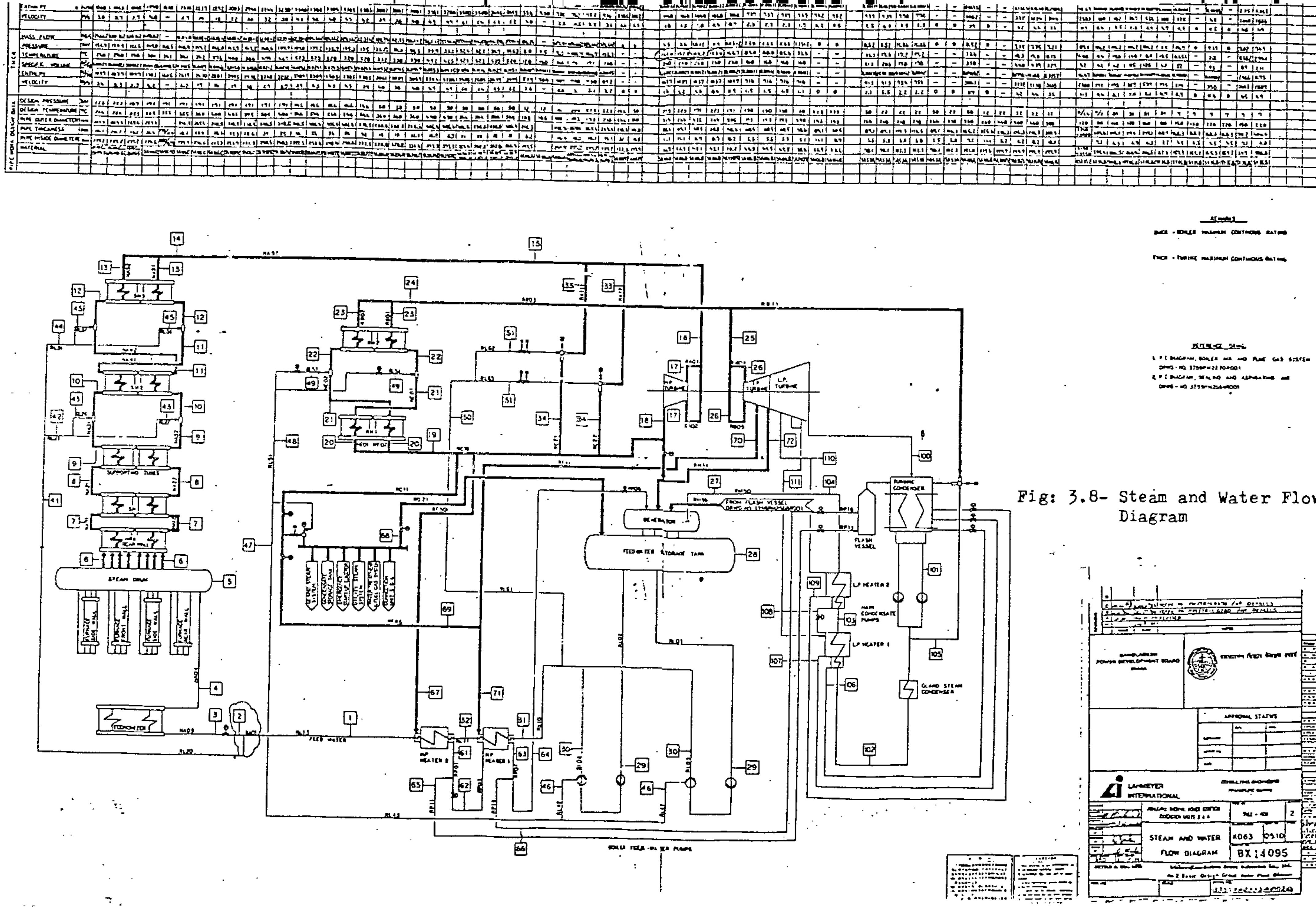
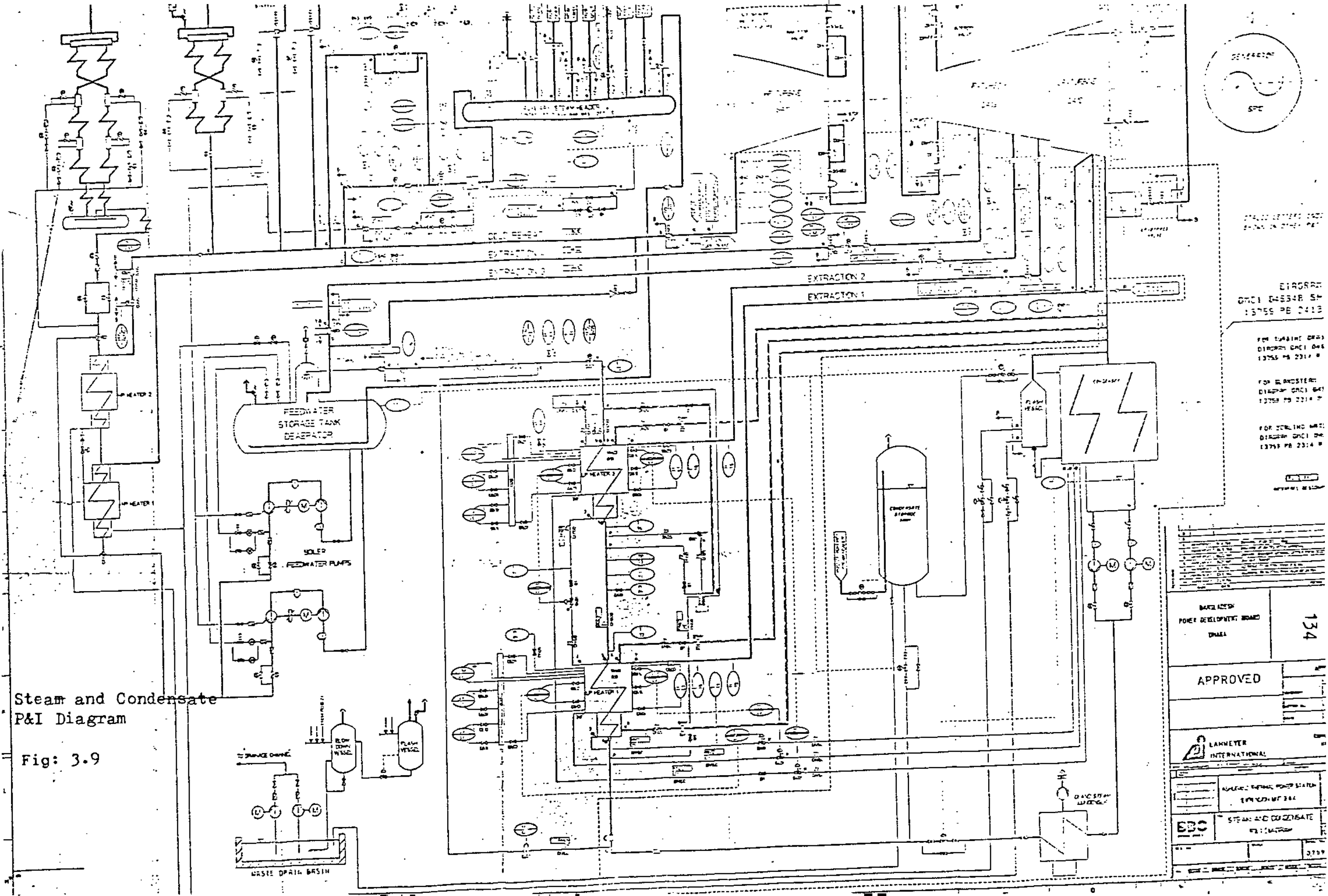
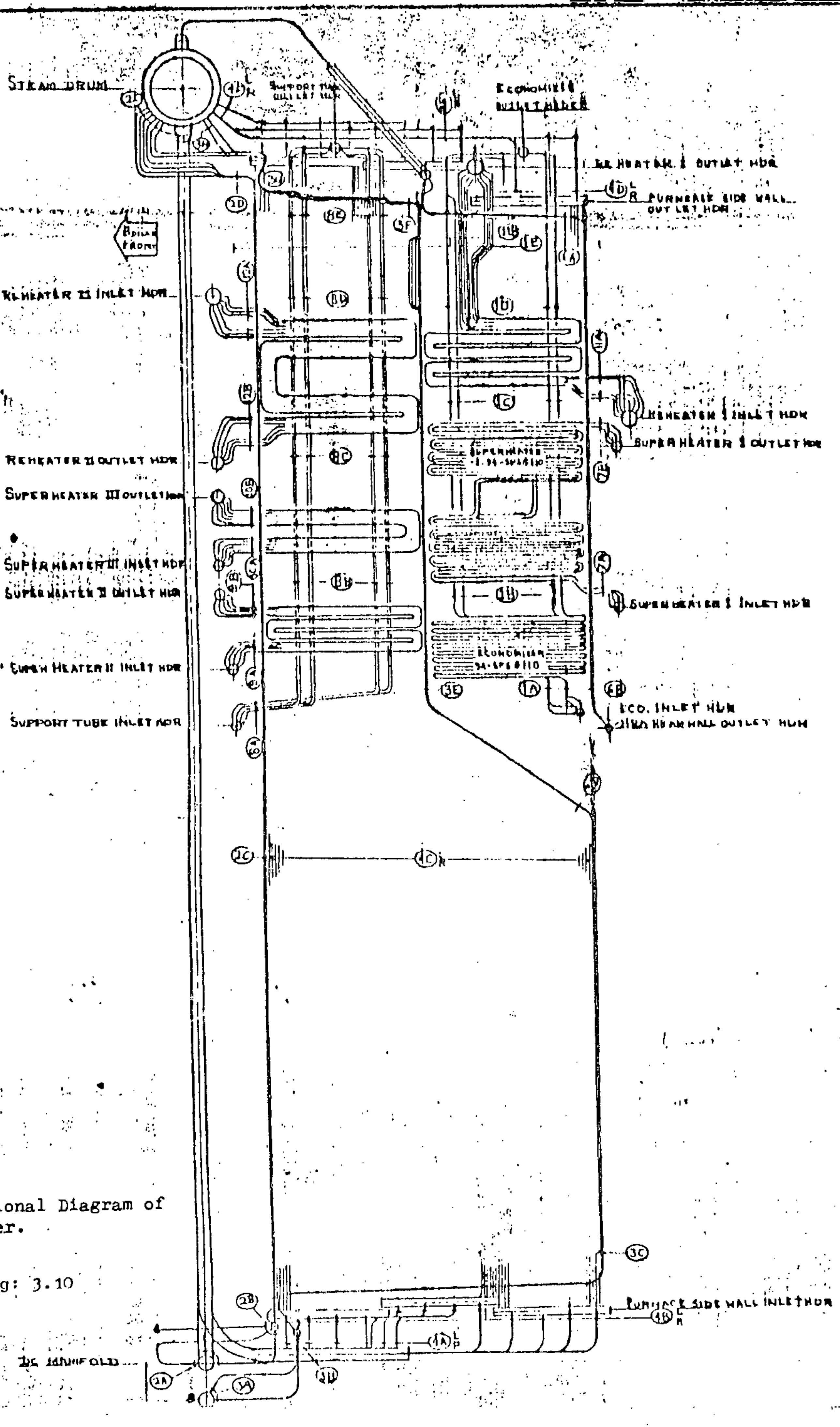



Fig: 3.8- Steam and Water Flow Diagram



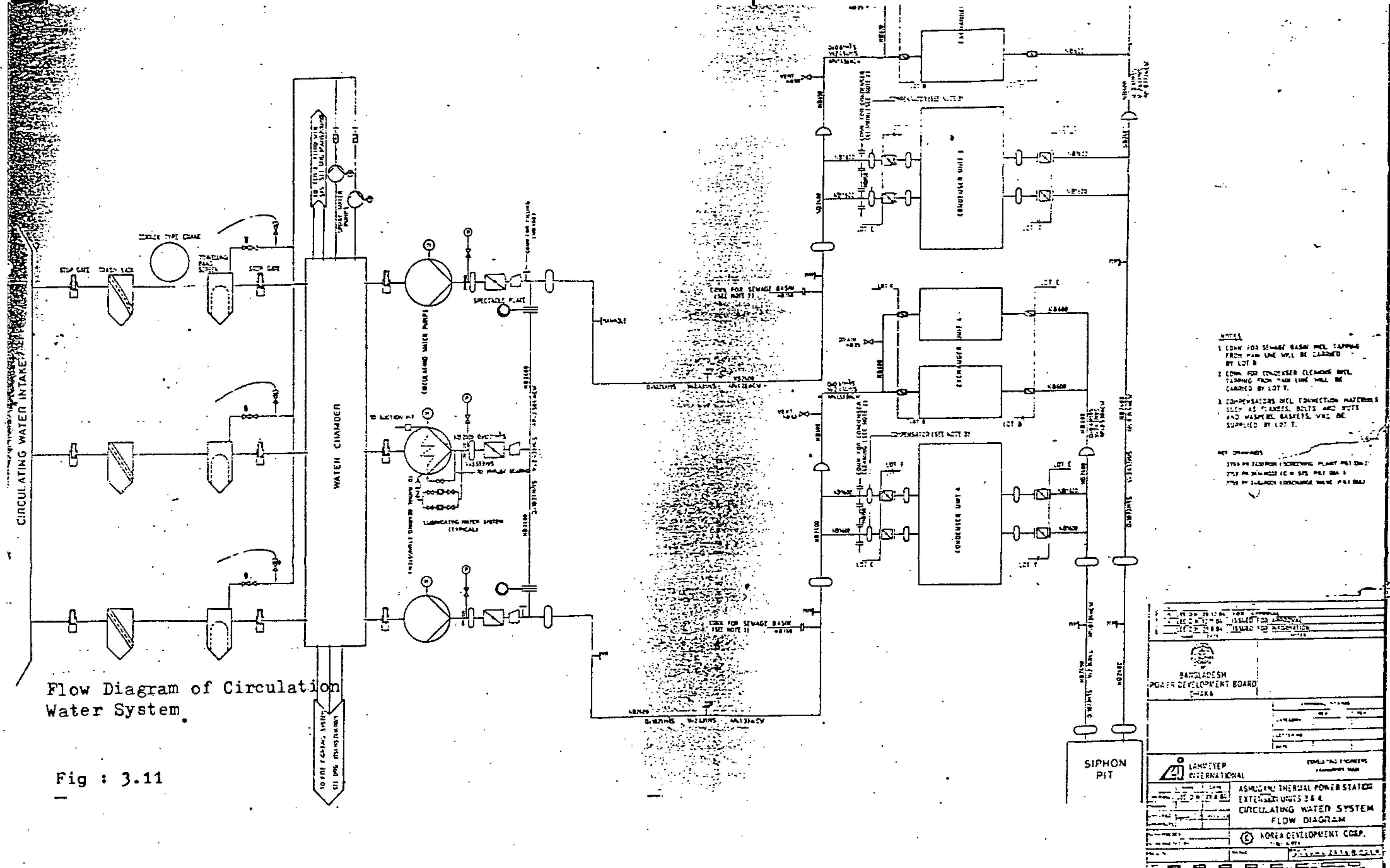

Steam and Condensate
P&I Diagram

Fig: 3.9




Sectional Diagram of Boiler.

Fig: 3.10




Flow Diagram of Circulation Water System.

Fig : 3.11

# APPENDIX-III

(On site training programme)

| NAME | DATE | NOTES |
|---|---|---|
| | | |
| | | |
| T.MATSUMURA | JUN.13.85 | FIRST ISSUED. |

BANGLADESH
POWER DEVELOPMENT BOARD
DHAKA

বাংলাদেশ বিদ্যুৎ উন্নয়ন বোর্ড

## APPROVAL STATUS

| | REV. | REV. |
|---|---|---|
| CATEGORY | | |
| LETTER No. | | |
| DATE | | |

LAHMEYER INTERNATIONAL

CONSULTING ENGINEERS
FRANKFURT (MAIN)

ASHUGANJ THERMAL POWER STATION
EXTENSION UNITS 3&4

WORK No. 5411-428 5112-430

The Owner's Personnel
Training at Site
(Training Schedule)

| CLASSIFICATION | LEAF No. | SCALE |
|---|---|---|
| K048 | 009 | |

DRAWING No. BDB35074

T.M. DATE ISSUED.

MITSUI & CO., LTD.

Ishikawajima-Harima Heavy Industries Co., Ltd.
Boiler Plant Division

SCALE

DRWG. No. 3759 PM 0011 L 002

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

| | |
|---|---|
| L I (H) | 4 |
| L I (S) | 2 |
| PDB (H) | 4 |
| PDB (S) | |
| ボ建プ | 1 |
| ボ建計 | 1 |
| ボ運技 | |
| ボ基設二 | |
| 一ボ設一 | |
| ボプ設二 | |
| ボ制設 | |
| ボ燃技 | |
| 三ボ鉄設 | |
| IPC設 | |
| 相3生管 | |
| 相3ボ工技 | |
| 相3品管 | |
| ㊍新宿 | 1 |
| MBK(ダッカ) | 1 |
| 現地 | 1 |
| 控 | 1 |
| 合計 | 16 |
| 出図先 | |

1. General

1) The purpose of the training is to let the Owner's personnel understand the basic philosophy of MITSUI/IHI Boiler Plant and to operate this plant efficiently and smoothly.

2) MITSUI/IHI will carry out comprehensive class-room and on-spot training of the operation and maintenance personnel appointed by the Owner for the plant, during construction, erection, testing and commissioning.

3) The attached lists show the class-room lecture at site. This lecture will be carried out as follows.

   a. Place : Ashuganj Thermal Power Plant

   b. Period : About 2 weeks

4) The efforts will be exercised by MITSUI/IHI to operate the plant by the Owner's operation personnel under MITSUI/IHI supervision and guidance.

   This training will be carried out ON-JOB training basis as time passes of site work progress.

5) Above-mentioned training program would be modified suitably upon mutual consent between the Owner, the Engineer and MITSUI/IHI at later stage.

## The Class-Room Training (1/4)

| No. | Description of Training | | Remarks | Periods |
|---|---|---|---|---|
| 1 | Boiler<br>6P-21<br>6P-29 | 1) Outline of Boiler<br>2) Process Flow<br>3) Construction | 3759PM2210Q001<br>3759PM2210Q002<br>3759PM2210L003 | 1.0 Day |
| 2 | Steam & Water System<br>6P-22<br>6P-24<br>60-12<br>60-13 | 1) P. & I Diagram<br>2) FW Pump Set<br>3) Deaerator & HP FW Heater | 3759PM2413R001<br>3759PM2568R001 | 1.0 Day |
| 3 | Fuel Gas System<br>(6P-23) | 1) P & I Diagram<br>2) Fuel Gas Reducing System<br>3) Gas Burner | 3759PM2260R001<br>3759PM2250R001 | 1.0 Day |
| 4 | Boiler Air & Flue Gas System<br>(6P-21) | 1) P & I Diagram<br>2) FD Fan<br>3) Recuperative Air Preheater | 3759PM2270R001 | 0.5 Day |

## The Class-Room Training (2/4)

| No. | Description of Training | | Remarks | Period |
|---|---|---|---|---|
| 5 | Sealing Aspirating & Service Air System<br><br>(6P-21) | 1) P & I Diagram | 3759PM2564R001 | 0.5 Day |
| 6 | Instrument Air Supply System<br><br>(6P-21) | 1) P & I Diagram | 3759PM2564R001 | 0.5 Day |
| 7 | Cooling Water System<br><br>(6P-28) | 1) P & I Diagram<br><br>2) Cooling Water Pump<br><br>3) Heat Exchanger | 3759PM2428R001<br>3759PM2428R002 | 0.5 Day |
| 8 | Clean & Filtered Water System<br><br>(6P-31) | 1) P & I Diagram<br><br>2) Related Auxiliary Equipment<br><br>3) Operation & Maintenance | 3759PM2448R001 | 1.0 Day |

## The Class-Room Training (3/4)

| No. | Description of Training | | Remarks | Period |
|---|---|---|---|---|
| 9 | Water Treatment Plant<br>(6P-25) | 1) P & I Diagram<br>2) Related Auxiliary Equipment<br>3) Operation & Maintenance | 3759PM2442R001 | 1.0 Day |
| 10 | Chemical Dosing & Sampling Equipment<br>6P-21<br>6P-27 | 1) P & I Diagram<br>2) Related Auxiliary Equipment<br>3) Operation & Maintenance | 3759PM2445R001<br>3759PM2446R001 | 0.5 Day |
| 11 | L.V. Distribution System<br>(6P-245) | 1) Single Line Diagram<br>2) Operation and Maintenance | | 0.5 Day |
| 12 | Fire Fighting System<br>(6P-30) | 1) P & I Diagram<br>2) Fire-Fighting Pump & Auxiliary Equipment<br>3) Operation & Maintenance | 3759PM2566R001 | 1.0 Day |

## The Class-Room Training (4/4)

| No. | Description of Training | | Remarks | Period |
|---|---|---|---|---|
| 13 | Automatic Boiler Control System<br>(6P-251) | 1) Control Diagram<br>2) Control Equipment<br>3) Operation & Maintenance | | 1.0 Day |
| 14 | Burner Management System<br>(6P-251) | 1) Control Diagram<br>2) Control Equipment<br>3) Operation & Maintenance | | 1.0 Day |
| 15 | Operation & Maintnenace of Boiler | 1) Cold Start<br>2) Warm Start<br>3) Shutdown<br>4) Maintenance | | 1.0 Day |

No.

(The Class Room Training Schedule)

ASHUGANJ THERMAL POWER STATION

工事番号 5411-428　工事名称 EXTENSION UNITS 3 & 4　数量

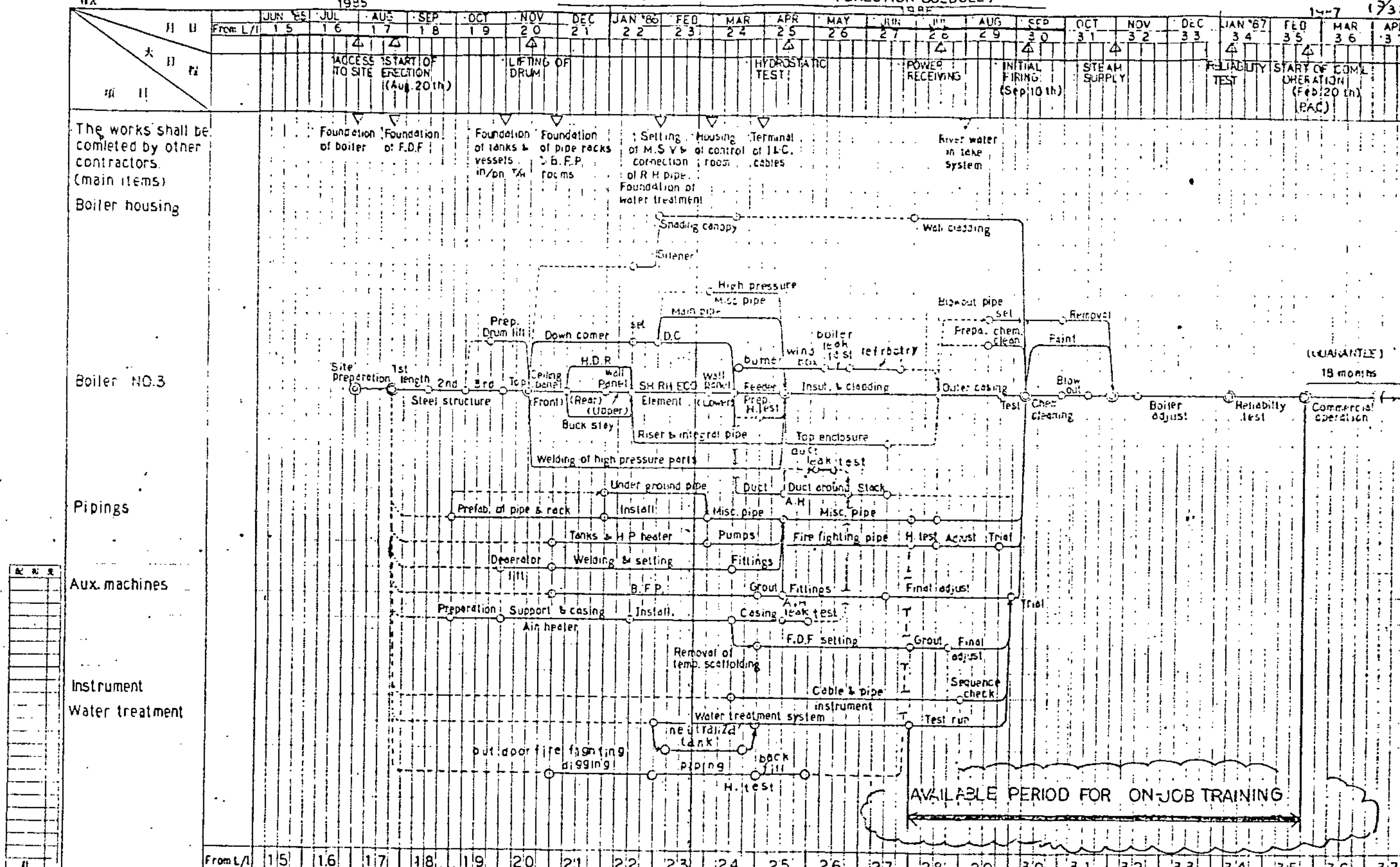
注文主 BPDB　納期 年 月 日　納入先

| No. | 名称 | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 13 | 14 | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Boiler | | — | | | | | | | | | | | | | | | | |
| 2 | Steam & Water System | | | — | | | | | | | | | | | | | | | |
| 3 | Fuel Gas System | | | | — | | | | | | | | | | | | | | |
| 4 | Boiler Air/Flue Gas System | | | | | — | | | | | | | | | | | | | |
| 5 | Sealing Aspirate & Service Air System | | | | | — | | | | | | | | | | | | | |
| 6 | Instrument Air System | | | | | | — | | | | | | | | | | | | |
| 7 | Cooling Water System | | | | | | — | | | | | | | | | | | | |
| 8 | Clean & Filtered Water System | | | | | | | — | | | | | | | | | | | |
| 9 | Water Treatment Plant | | | | | | | | | — | | | | | | | | | |
| 10 | Chemical Dosing Sampling Equipment | | | | | | | | | | — | | | | | | | | |
| 11 | L.V. Distribution | | | | | | | | | | — | | | | | | | | |
| 12 | Fire Fighting System | | | | | | | | | | | — | | | | | | | |
| 13 | A.B.C. System | | | | | | | | | | | | — | | | | | | |
| 14 | Burner Management | | | | | | | | | | | | | — | | | | | |
| 15 | Operation & Maintenance of Boiler | | | | | | | | | | | | | | — | | | | |

記事

3759 PM0011 L 002　BDB35074

(ERECTION SCEDULE)




CDDS 5074

3750 P 0311 002

| | |
|---|---|
| 4 | APR. 1985 |
| 3 | JAN. 1985 |
| 2 | OCT. 1984 |
| 1 | Sep. 1984 |

BANGLADESH POWER DEVELOPMENT BOARD

ASHUGANJ THERMAL POWER STATION

5112 - 420

145

BROWN, BOVERI & CIE · AKTIENGESELLSCHAFT

BBC BROWN BOVERI

postal address
Brown, Boveri & Cie · Aktiengesellschaft · Postfach 351 · D 6800 Mannheim 1

Lahmayer International Gmbh
Site Office,
Ashuganj.

PB/FA-102

Attn: Mr. J. J. Ronayne
Chief Resident Engineer.

Date 23.09.86

your ref | your letter of | in charge of subject of this letter: Mr. Schneider | ☎ (06 21) 381- | Our ref (please quote in your reply) GK/BBD1/Sch/Fr

3759 ATPS
Ext. 3 & 4

Subj: Training on Site according Contract Para 5.5.8.2.

Dear Sirs,

According to the meeting held in LI-Office Sept. 22nd, 1986 we herewith confirm that a.m. Training on Site for Lot-T will start October 11th, 1986.

Our training programme will be as follows:

The subject will be sub-divided into four major parts:

1) Mechanical Commissioning
2) Electrical " (I&C)
3) " " (Generator)
4) Maintenance Instructions.

Responsible for the training on Site will be Mr. Bender, who will arrive shortly.

The four parts mentioned above will include the following items:

1) Mechanical Commissioning:

1. Cross-section drawing — GMD0 981 572 / 3759 PB 2310 S003

2. Control diagram for turbine — GMD0 681 858 / 3759 PB 8242 R001B

Legend to control diagram — GMD0 681 858 LE / 3759 PB 8242 R002C

contd..P/2.



Address: Mannheim-Kafertal, Kallstadter Str. 1
Telephone: (06 21) 381-1 · Telefax (06 21) 3818788
Telex: 462 4110
Telegrams: brownboveri mannheim

BROWN, BOVERI & CIE · AKTIENGESELLSCHAFT

BBC BROWN BOVERI

... 2 ...

| | | |
|---|---|---|
| | Description of control diagram | GMD0 681 858 BE<br>3759 PB 8242 R003B |
| 3. | Turbine protection testing | GMD0 957 534<br>3759 PB 8660 S005B |
| 4. | Control diagram oil and air supply systems for turbine | GMD0 681 859<br>3759 PB 8242 R004B |
| | Legend to control diagram oil and air supply systems for turbine | GMD0 681 859 LE<br>3759 PB 8242 R005B |
| | Description to control diagram oil and air supply systems for turbine | GMD0 681 859 BE<br>4759 PB 8242 R006A |
| | Oil purification plant complete | GMD0 752 146 E<br>3759 PB 2314 S051 |
| 5. | Jacking oil system diagram | GMD2 727 152<br>3759 PB 2314 R001 |
| 6. | Control diagram gland steam system | GMD0 686 408<br>3759 PB 8242 R007B |
| | Legend to control diagram gland steam system | GMD0 686 402 LE<br>3759 PB 8242 R008C |
| | Description to control diagram gland steam system | GMD0 686 408 BE<br>3759 PB 8242 R009B |
| 7. | Control diagram extraction system | GMD0 689 193<br>3759 PB 8242 R010A |
| | Legend to control diagram extraction system | GMD0 689 193 LE<br>3759 PB 8242 R011B |
| | Description to control diagram extraction system | GMD0 689 193 BE<br>3759 PB 8242 R012A |
| 8. | Steam and condensate diagram | GMC1 046 348 Bl.1 u. 2<br>3759 PB 2413 R001F<br>3759 PB 2413 P002H |
| 9. | Turbine drain system diagram | GM01 046 352<br>3759 PB 2314 R001C |
| 10. | Gland steam system diagram | GMC1 046 353<br>3759 PB 2314 R002B |
| 11. | Sealing water system diagram | GMC1 046 355<br>3759 PB 2314 R003B |
| 12. | Condensate pump diagram | GMC1 046 354<br>3759 PB 2463 R001A |
| 13. | Condenser water side and auxiliary eg. diagram | GMC1 046 350<br>3759 PB 2316 R001F |

14. Turbine oil-and generator air coolers, cooling water side diagram — GMC1 046 356 / 3759 PB 2314 R004B

15. Turbine oil draining diagram — GMC1 046 351 / 3759 PB 2314 R005C

16. Instrument air diagram — GMC1 046 357 / 3759 PB 2564 R001A

17. List of valves — GMC1 139 295 / 3759 PB 2480 L001

18. Thermal expansion diagram — GMD0 983 177

2) Electrical Commissioning (I&C)
(to follow)

3) Electrical Commissioning (Generator)
(to follow)

4) Maintenance Instructions:

1. General description of the condensing turbo generator set with reheat.
2. Alignment of base plates and bearing pedestals with "throughgoing" anchor bolts and hydraulic stretching devices
3. Lubrication of sliding bearing pedestals
4. Completely assembled hp-turbine
5. Completely assembled lp-lpturbine
6. Rupture diaphragm
7. Alignment and coupling of shafts
8. Rigid coupling
9. Three surface journal bearing
10. Assembly of the combined reheat intercept and stop valve
11. Assembly of the combined reheat bypass valve
12. Assembly of the live steam valve
13. Assembly of the live steam main stop valve
14. Tightening of flange bolts by means of hydraulic stretching devices
15. Cleaning of pipes
16. Insertion of the generator rotor
17. Fan assembly

18. Flat gasket
19. Flushing lube and governing oil lines.

he training will consist in Classroom and on Job Training, the ercentage of Classroom and on Job Training is dependend of the ubject actually trained and should be mutually agreed between he Lecturer and the people to be trained.

t the beginning of the training we will hand over to each trainee ll material and manuals necessary against signing of an acknowle- gment of receipt.

ne Lecturer will have an attendance list in which each trainee fter the lessons will have to sign to allow a proper follow up each lesson and trainee.

anking you,

remain,
urs faithfully,

Schneider
perintendent.

# Notes of Conference

ent: Bangladesh Power Development Board

Division: Mechanical

ject: 3759 ATPS Ext. Units 3 and 4

Project No.: 3759

oject: Training at Site.

Serial No.: 353

ce and Date Meeting: LI-Site office 22.09.1986

CSD No.: 0080

es prepared by: Scheja

Issue Date: 23.09.1986



ribution: BPDB-PD/BPDB-Site/PP/TR/CRE/SRE(C)/SRE(E)/ SRE(M)/CCE/RE(TS)/RE(E)/RE-E .

Enclosures:

sent:

| LI | BBC |
|---|---|
| Mr. Ronayne | Mr. Schneider |
| Mr. Lippert | Mr. Lang |
| Mr. V. Winning | Mr. Hanchwitz |
| Mr. Scheja | |

Action by and Date

1.0 GENERAL

Beside several discussions and written information with the Contractors the Engineer called again for a Site meeting to improve the preparation work to be done by the Contractors concerned.

2.0 CONTRACT ITEM SECTION V/5, ITEM 5.5.8.2

This item - Training at Site with the sub-items a,b,c,d,e, and f was discussed in detail with BBC.

As a result, the following steps have to be taken by BBC to compile a test programme to teach the trainee according their contractual obligations :

- Preparation of a training programme divided in chapters for activities (Lessons) for construction,erection,testing and commissioning.

LAHMEYER INTERNATIONAL

Consulting Engineers

# Notes of Conference

Project No. : 3759

Serial No. : 353

CSD No. : 0080



Action by and Date

- Submission of this programme to the Engineer for approval.

- Time schedule for all programmes as listed above including duration of the individual lectures and relation to the activities listed on in the programme.

- Preparation of instruction materials of sufficient quantity to illustrate all components necessary for the training basic requirements as per item 5.5.8.2.C.

- Training Personal chart which clearly defines the responsible Engineers for section as : Mechanical, Instrumentation and Control, Electrical etc.

BBC promised to start with the training at Site beginning of October'86.

The Engineers advised BBC that at least for the INITIAL OPERATION Phase of the Project the Owners staff must be educated to be able to assist during the initial run as per contract requirements item 5.6.4.

The Contractor has to take into consideration that for on the spot demonstration a groups of max. 10 trainee should participate otherwise the effect of the demonstration will be insufficient.

For LI

নং 83201
তাং 23/2/99

For BBC