COST ADVANTAGE IN IMPLEMENTING 'MOST 2D' NESTING SOFTWARE AT BGR ENERGY SYSTEMS LIMITED, CHENNAI – AN ANALYTICAL STUDY

by

R. NAVANEETHA KRISHNAN

Reg.No. 71206631033

of

DEPARTMENT OF MANAGEMENT STUDIES

KUMARAGURU COLLEGE OF TECHNOLOGY

COIMBATORE

A Project Report

Submitted to the

FACULTY OF MANAGEMENT STUDIES

in partial fulfillment of the requirements

for the award of the degree of

MASTER OF BUSINESS ADMINISTRATION

MAY 2008

Declaration

I, **R. Navaneetha Krishnan (Reg. No.71206631033)**, final year MBA student of Department of Management Studies, Kumaraguru College of Technology. hereby declare that the project entitled **"Cost Advantage in implementing MOST 2D Nesting Software at BGR Energy Systems Limited, Chennai – An Analytical Study"** has done by me under the guidance of Mr.A. Senthil Kumar, Lecturer, KCT Business School, submitted in partial fulfillment for the award of the degree of Master of Business Administration of Anna University, during the academic year 2006-2008.

I, also declare hereby, that the information given in this report is correct to best of my knowledge and belief.

Place: Coimbatore

Date: 3.7.08

Signature of the Candidate

(R. Navaneetha Krishnan)

BGR ENERGY

BGR ENERGY SYSTEMS LIMITED
443 ANNA SALAI, TEYNAMPET, CHENNAI 600018 INDIA
TEL: 91 44 24352436 FAX: 91 44 24315678
E-mail: ppd@gea-india.com Web site: www.bgrcorp.com

Formerly GEA ENERGY SYSTEM (INDIA) LIMITED

POWER PROJECTS DIVISION

BGR/2008/STUD163
24th April 2008.

PROJECT COMPLETION CERTIFICATE

This is to certify that Mr. R. Navaneetha Krishnan (Roll No. 71206631033) a student of KCT Business School, Kumaraguru College of Technology, had under gone a project between January 2008 and March 2008 titled **"Cost Advantage in Using MOST 2D Nesting Software at BGR Energy Systems Limited, Chennai – An Analytical Study"**

During the tenure his performance was good.

Yours truly,

For **BGR ENERGY SYSTEMS LIMITED,**

M.RAJAMANICKAM,
GENERAL MANAGER - PROJECTS

KCT Business School
Department of Management Studies
Kumaraguru College of Technology
Coimbatore

BONAFIDE CERTIFICATE

Certified that this project report titled **"Cost Advantage in implementing MOST 2D Nesting Software at BGR Energy Systems Limited, Chennai – An Analytical Study"** is the bonafide work of Mr.R. Navaneetha Krishnan (71206631033) who carried out the research under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

Faculty Guide

Director

Evaluated and vice-voce conducted on ......03.07.2008..................

Examiner I

Examiner II

EXECUTIVE SUMMARY

Minimization of cost and increasing and increasing productive efficiency by reducing the wastage is a major concern in present day's manufacturing industries. Sheet metal industry is a kind of industry which suffers much loss because of wastage due to inefficient cutting of steel plates to get required shape.

Nesting sheet metal parts increases material utilization and helps in reducing material wastage. Nesting can be done efficiently by using suitable nesting softwares which further enhances material utilization rate and also reduces other expenses that are associated with manual nesting. This project examines cost advantage of using MOST 2D nesting software when compared to manual nesting process and evaluates this tool by comparing the output with another nesting tool. It helps the company in making a decision in buying the software that is more desirable in terms of both efficiency and investment. The results suggest that even an increase in material utilization rate by 0.5% has a great impact on cost savings and savings in labour cost is also considerable when nesting tools are used.

ACKNOWLEDGEMENT

It is inevitable that thoughts and ideas of other people tend to drift into subconscious when one feels to acknowledge helping derived from others. I acknowledge to all those who helped me in the preparation of this project work.

I wish to express my deep gratitude to **Prof.Joseph V. Thanikal** principal, Kumaraguru College of technology for his guidance and encouragement to complete my project work.

I wish to express my sincere thanks to **Prof.S.V.Devanathan** – Director, KCT Business School, for his continuous encouragement throughout my project.

I owe my heartfelt gratitude to my project guide **Mr.A.Senthil Kumar**, Lecturer, KCT Business School, for his help and valuable guidance given to me throughout my project.

I express my sincere thanks to **Mr. Rajamanickam**, G.M Projects – Power Projects Division, BGR Energy Systems Limited, Chennai for granting permission to do my project work.

I extend my sincere gratitude to **Mr.K.Krishna**, Engineer – Project Coordinator, BGR Energy Systems Limited, for his guidance to complete my project successfully. And also to the staffs of BGR Energy Systems Limited who furnished all the information related the research work.

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1. INTRODUCTION

CHAPTER 1

1. INTRODUCTION:

1.1. BACKGROUND OF THE STUDY:

1.1.1. NESTING:

Nesting refers to the process of efficiently manufacturing parts from flat raw material.

1.1.2. NESTING SOFTWARE:

Nesting software is used to optimally fit many different parts to a single sheet of material. Companies manufacturing parts from flat raw material such as sheet metal use a variety of technologies to perform this task. The sheet metal nesting for flat sheets and nesting for coils are different algorithms. Material may be cut using off-line blanking dies, lasers, plasma, punches, shear blades, ultrasonic knives and even water jet cutters.

In order to minimize the amount of scrap raw material produced by this process, companies use nesting software. The software analyses the parts (shapes) to be produced at a particular time.

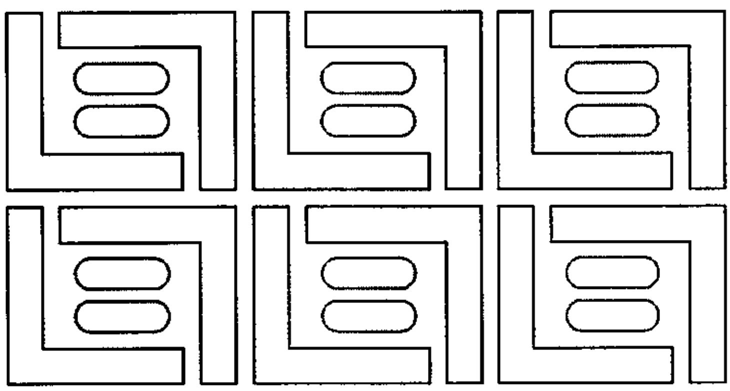

Fig 1.1: Minimizing waste by mixing different parts

Using proprietary algorithms, it then determines how to lay these parts out in such a way as to produce the required quantities of parts, while minimizing the amount of raw material wasted.

A number of off the shelf nesting software address the optimization needs. While some cater to only rectangular nesting others also offer profile or shape nesting where the parts required can be any odd shape and not just rectangles. These irregular parts can be created using popular CAD tools. Most of the profile nesting software can read IGES or DXF profile files automatically, a few of them work with built-in converters.

An important consideration in shape nesting is to verify that the software in question actually performs true profile nesting and not just block nesting. In block nesting an imaginary rectangle is drawn around the shape and then the rectangles are laid side-by side which actually is not profile nesting. There still remains a scope for waste reduction

Nesting software must take into account the limitations and features of the machining technology in use, such as:

- Machining cannot take place where the raw material is clamped into place;
- Some machines can access only half of the material at a particular time; the machine automatically flips the sheet over to allow the remaining half to be accessed;
- When punching, the width of the punch tool must be considered;
- Shearing may be permitted only in certain areas of the sheet due to limitations of the machinery;
- A laser can cut parts at any rotation; a punch can only do so at right angles;

Nesting software may also have to take into account material characteristics, such as:

- Defects on material that must be discarded;
- Different quality areas that must match corresponding quality levels required for different parts;
- Direction constraints, that may come from a printed pattern or from fiber direction;

Many machine manufacturers offer their own custom nesting software designed to offer ease of use and take full advantage of the features of their specific machines.

If a fabricator operates machines from more than one vendor, they may prefer to use an off-the-shelf nesting package from a third-party vendor. They then have the potential to run jobs on any available machine, and their staff should not have to learn several different software packages.

1.1.3. NEED TO USE NESTING SOFTWARES:

One approach fabricators are using to trim costs is by making better use of their raw materials, which can consume 50% of operational costs. To that end, many shops are exploiting nesting software to reduce material waste and realize substantial savings. They've found that improving nests even by 5% can minimize the raw material needed to complete a job and, thereby, slash production costs.

Better material utilization also makes a company more competitive in a global market. For instance, companies cutting 500 tons of steel per month can save about $250,000 with more-efficient nesting algorithms. One company recently used the economic benefits of nesting software to prevent moving its production to China.

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1.1.4. POINTS TO BE CONSIDERED WHILE PURCHASING NESTING SOFTWARE:

1. **Superior nesting algorithms** --Programmers continually develop algorithms that allow parts to be nested as tightly as possible, using the minimum amount of material. The user has full control of the material yield, including the ability to nest parts within parts. Without this, inside contours of geometries become waste.
2. **Motion optimization** - Machine motion can be controlled to perform common line cutting, bridge cutting, and variable quality, saving time and consumables. Even though tough decisions are made, as in punching between motion optimization and part quality, automatic or manual NC programming.
3. **Programming time** - The ability to import DXF, DWG, CADL, IGES, and HPGL lets programmers import from almost any CAD program. Automatically unfolding and importing parts from Solid Edge, Solid Works, and Inventor provides a seamless integration, which saves time and decreases part-geometry errors. Once geometry is imported, the nesting task is defined and the NC program is produced

with little effort. Simplified programming allowed a user to reorganize one of his four programmers and still increase throughput by 30%.

Some agree the best method of evaluating a nest is by sight, not the focus on unattainable sheet-yield percentages. Evidence however, has shown material yield is a key factor in manufacturing productivity. Recent studies by several major manufacturers found that 5% of material savings can translate to thousands of dollars in savings. This small change in yield cannot be visualized.

Some of the recent buzzwords in the industry include yield improvement, motion optimization, integration and automation, and range of solutions. When faced with today's manufacturing challenges, choose software on the forefront of development and technology. Look for a company that continually improves products to help users survive a tough economy. Some newer developments in nesting software include common line cutting, auto-dynamic nesting, and feature avoidance. Each of these features was designed to save users time and money.

1.2. REVIEW OF LITERATURE:

Scott Grindstaff[1] observed that one approach fabricators are using to trim costs is by making better use of their raw materials, which can consume 50% of operational costs. To that end, many shops are exploiting nesting software to reduce material waste and realize substantial savings. Better material utilization also makes a company more competitive in a global market. For instance, companies cutting 500 tons of steel per month can save about $250,000 with more-efficient nesting algorithms. One company recently used the economic benefits of nesting software to prevent moving its production to China.

Patrick Waurzyniak[2] observed that today's CAM software offers manufacturers a wealth of new capabilities, but many CAM packages are often seen as expensive and difficult to use.

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[1] Scott Grindstaff, 'Improving with Efficiency Nesting Software', by SigmaTEK Corp., Cincinnati, OH: Penton's Welding Magazine – January 2004.

[2] Patrick Waurzyniak, 'Buying CAD/CAM Software', Manufacturing Engineering - December 2004 Vol. 133 No. 6.

Defining objectives before buying new software is the key in evaluating CAM systems, says Chuck Mathews, vice president of DP Technology Corp. (Camarillo, CA). They recommend that buyers start with a clear definition of the scope and objectives for their CAM purchase. When the buyers clarify what they are trying to accomplish, it becomes easier for manufacturers to evaluate their alternatives and ultimately measure their success. Mathews also suggests, avoiding buyer's remorse by investing enough time to make an informed decision and limit the detailed evaluation to a maximum of three products; this is especially important for more-demanding applications. Evaluation should be based on the estimated return on the investment as we take into consideration how the CAM system can be the throttle body for the entire shop. We should open our mind to change and avoid being average by choosing a product because it feels safe.

Patrick Waurzyniak[3] observed that to stay competitive, today's CAM users need the best machining software available for their manufacturing operations. In a tough market, manufacturers require the most efficient solution to run complex machine tool equipment as productively as possible. Because of the myriad of differences between machine tool types and machine tool manufacturers, there is a higher level of support associated with a CAM product than almost any other software. In addition, since CAM software is powering a physical cutting process, even small mistakes can be devastating. With a strong support network in place, even the most experienced programmer can be confident in getting a valuable answer to questions.

David R. DeLalio[4] observed that the concern of modern manufacturing has always been the minimization of costs and increase of production efficiency. A great deal of research has been performed for all aspects of problems towards these ends. Sheet metal manufacturing is one activity that may benefit from additional investigation, particularly with regards to capacity and cost issues.

Nesting sheet metal parts increases material utilization and punch press throughput, and decreases costs by reducing setup time and total material requirements for a given set of orders. This thesis examines the changes to traditional capacity analysis introduced by the

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[3] Patrick Waurzyniak, 'Buying CAD/CAM Software', Manufacturing Engineering - December 2007 Vol. 139 No. 6.

[4] David R. DeLalio, 'Capacity Evaluation And Cost Optimization For Sheet Metal Punching', Department of Mechanical Engineering and Institute of Systems Research, University of Maryland, Master of Science, Thesis 1998.

regular use of part nesting as a weekly pre-production operation. New formulas are presented for capacity and material requirements. The problem is formulated for nesting a given group of orders in order to minimize associated costs. An integer programming model is developed to solve the optimization problem. and an application is developed using industry data. Results indicate accurate calculations for capacity and material use, and optimizing the nests further reduces costs.

Ghosh Diptesh & Das Shubhabrata[5] observed that this is a study of the behaviour of optimal solutions to combinatorial optimization problems when the costs of some of the elements in the ground sets of these problems vary. Denote the set of random elements by R. Since the optimal solution will depend on the costs realized by the random elements, which is not known beforehand, each solution S containing elements of R has an associated risk, measured by a risk function of the difference between the objective function value of S and that of the optimal solution at the costs that the elements of R realize. The study looks at decision rules that allow decision makers to choose solutions with minimum associated risk in such situations.

Wang Hu, Li Enying, G. Y. Li and Z. H. Zhong[6] observed that in this study, an adaptive space mapping technique based on response of objective was suggested for solving practical engineering problems. Response surface methodology was engaged in approximation of objective and constraint functions based on coarser model. The fine simulation model is not only used for correction of the coarser simulation model and validation of final solution but also for applied construction of space mapping expression. Finally, genetic algorithm (GA) was used to optimize updated metamodel according to coarse model. The proposed method combines the space mapping technology based on response of coarse model and modification of design of experiment. It guarantees that metamodel based coarser model is stepwise updated in the right searching direction. For demonstrating practicability of developed method, it was applied for optimization of geometric parameters of addendum surface, blank holder force and drawbead restraining

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[5] Ghosh Diptesh, Das Shubhabrata, 'Analysis of the Behaviour of Optimal Solutions to Combinatorial Optimization Problems When Element Costs Vary': IIM, Ahmedabad – 2004.

[6] Wang Hu, Li Enying, G. Y. Li and Z. H. Zhong, 'Optimization of sheet metal forming processes by the use of space mapping based metamodeling method', M.O.E., Hunan University, Changsha, China; Journal - The International Journal of Advanced Manufacturing Technology, Publisher - Springer London, November 2007 Vol. s00170-007-1253-z

force in sheet forming problems. It was confirmed that the corresponding problem can be optimized successfully in remarkably short computing time by proposed optimization method.

1.3. STATEMENT OF THE PROBLEM:

Every percent counts when it comes to slashing production costs. Taking advantage of the latest nesting software helps companies better utilize material, and, in turn, remain competitive in a global market. This is because average material utilization when nesting is done manually is only around 85%, this can improved by using nesting softwares.

This project is to study about the cost advantages the company would gain when nesting softwares are used. Because, they've found that improving nests even by 5% can minimize the raw material needed to complete a job and, thereby, slash production costs.

1.4. OBJECTIVES OF THE STUDY:

PRIMARY OBJECTIVE:

1. To implement the optimal nesting using MOST 2D software.

SECONDARY OBJECTIVE:

1. To identify the cost saving due to material utilization between manual nesting and software's nesting.
2. To determine the cost savings in marking/labour charges.
3. To compare the cost advantage of MOST 2D over PLUS 2D.

1.5. SCOPE OF THE STUDY:

This project focuses on the cost saving using MOST 2D software in BGR Energy Systems Limited, Power Projects Division at its Warangal project of the thermal power plant. This study also helps to know the cost savings involved in marking costs. It helps to understand the overall production cost and gain competitive advantage.

1.6. METHODOLOGY:

Nesting is created using MOST 2D nesting software. The output of the nesting tool is compared with the manual nesting data which is already available in the fabrication department. The output of MOST 2D is compared with another nesting tool PLUS 2D to determine the most feasible nesting tool.

1.6.1. TYPE OF STUDY:

The type of study used for this project is analytical research, researcher has to use the facts and information already available and analyses these to make critical evaluation of the material.

1.6.2. DATA COLLECTION:

PRIMARY DATA:

- Primary data are collected from the output of MOST 2D software.

SECONDARY DATA:

- Data of manual nests collected from the fabrication report.
- Output of PLUS 2D software is a source of secondary data.

1.7. LIMITATIONS:

- The study depends on the efficiency and accuracy of the MOST 2D and PLUS 2D softwares which are used to determine the optimal nesting.
- Utilization rate calculated for manual nesting is an approximate value and not accurate.

1.8. CHAPTER SCHEME

Chapter 1: Introduction

It includes some sub topics like background, review of literature, statement of the problem, objectives of the study, scope of the study, methodology, limitations and chapter scheme.

Chapter 2: Organization Profile

Organization profile includes details on the history of the organization, management and organization structure, product profile and market potential, competitive strength of the company and a brief description on various functional areas of the organization.

Chapter 3: Macro –Micro Economic Analysis

Macro-Micro analysis deals with the prevailing scenario of the organization with respect to its respective industry.

Chapter 4: Data Analysis and Interpretation

The Chapter mainly deals with performing various calculations related to material utilization in order to analyze and compare the manual nesting's efficiency with that of the software.

Chapter 5: Conclusion

Conclusion includes the results and discussions put forth regarding the efficiency of manual nesting process when compared with nesting softwares and other suggestions.

2. ORGANIZATION PROFILE

CHAPTER 2

2. ORGANIZATION PROFILE:

2.1. HISTORY OF THE ORGANIZATION:

The Company was originally incorporated in 1985, as a joint venture between GEA Energietechnik GmbH. Germany and our Promoter, Mr. B.G. Raghupathy, to produce and sell On-line Condenser Tube Cleaning Systems, Debris Filters and Rubber Cleaning Balls used in Thermal and Nuclear Power Plants. In 1993 Mr. B.G. Raghupathy and members of his family became the sole shareholders of the Company and began to expand our range of product and services range in the Power and Oil & Gas industries. On June 28, 2007 we changed our name from GEA Energy System (India) Limited, to **BGR Energy Systems Limited**.

BGR Energy carries on our business in two segments, the Supply of systems and Equipment and Turnkey Engineering project contracting.

In the Turnkey Engineering project contracting business, the company engineer, manufacture, procure, construct and commission projects in the Power and Oil & Gas sector, wherein we take Turnkey responsibility to supply of a range of equipment and services, including the civil works required for a project and other work as may be required under the contract for such project..

The company executes Turnkey Contracts to supply the Balance of Plant ("BOP") Equipment, Services and Civil works for Power Generation projects, in which we supply, from a single source, the Balance of the plant, i.e. items other than the Boiler, Turbine and Generator. Having successfully executed BOP contracts, we have begun to focus on Engineering, Procurement and Construction ("EPC") contracts, in which we Design, Engineer and Supply all of the equipment required for a Power Plant including the Boiler, Turbine and Generator and Civil works. We are currently executing BOP and EPC contracts tailored to customer demands. We also have an infrastructure business intended to provide construction services and technology oriented projects to the infrastructure sector. The company executes Turnkey Contracts to supply the Balance of Plant ("BOP") Equipment, Services and Civil works for Power Generation projects, in which we supply, from a single source, the Balance of the plant, i.e. items other than the Boiler, Turbine and

Generator. Having successfully executed BOP contracts, we have begun to focus on Engineering, Procurement and Construction ("EPC") contracts, in which we Design, Engineer and Supply all of the equipment required for a Power Plant including the Boiler, Turbine and Generator and Civil works. We are currently executing BOP and EPC contracts tailored to customer demands. We also have an infrastructure business intended to provide construction services and technology oriented projects to the infrastructure sector.

The Company consists of seven complementary businesses, including:

- **Power Projects business,** which provides turnkey EPC and BOP services for coal-based Thermal Power Plants and Gas-based Combined Cycle Power Plants typically over 100 megawatts ("MW"), and which completed its first contract in 2002,
- **Captive Power Projects** business, which provides Turnkey EPC and BOP services for power plants typically under 100 MW which began operating in 2006,
- **Oil and Gas Equipments business**, which designs and manufactures gas conditioning & metering skids, storage tanks, pipeline pig launching & receiving systems, gas processing complexes and gas compressor packages related to the oil and gas industry for companies in India and abroad, and which began operating in 2001,
- **Air Fin Coolers business,** which designs and manufactures Air Fin Coolers which cool process fluids and gases used in the refining, petrochemical, and oil and gas industries, and which began operating in 1994,
- **Environmental Engineering business**, which designs manufactures and provides Deaerators, Desalination plants, Water treatment plants and Effluent treatment plants, which have application in Power and Process plants and other Industrial plants, and which began operating in 1996,
- **Electrical Projects business**, which designs supplies Electrical systems and equipment such as Gas Insulated Switchgear (GIS) substations, Optical Fiber Power Ground Wires (OPGW), Extra High Voltage substations and Transmission Lines to Power Stations, Refineries and Petrochemical plants, and which began operating in 2003, and

- **Infrastructure business**, which is capable of building roads and industrial buildings, and which began operating in 2004.

2.2. MANAGEMENT:

BGR Energy Systems Ltd., is managed by an excellent team of path-breakers, chief among them being the **Chairman & Managing Director**, **B.G. Raghupathy**, he holds a Bachelor's degree in Chemistry from the University of Madras. Prior to founding our Company, he worked as a marketing executive specializing in the sale of industrial equipment, instruments and control systems. He subsequently served as the Chief Executive Officer of Introls, a company engaged in trading. He has over 33 years of experience in the fields of marketing, sales and management.

He is supported by technical and administrative people, experts in their own field, who together strive to maintain the highest quality quotient in all of BGR' products and services.

MEMBERS OF THE MANAGEMENT TEAM:

DIRECTORS:

1. S. Rathinam – Finance

2. V.R.Mahadevan –Technologies, HR & Infrastructure

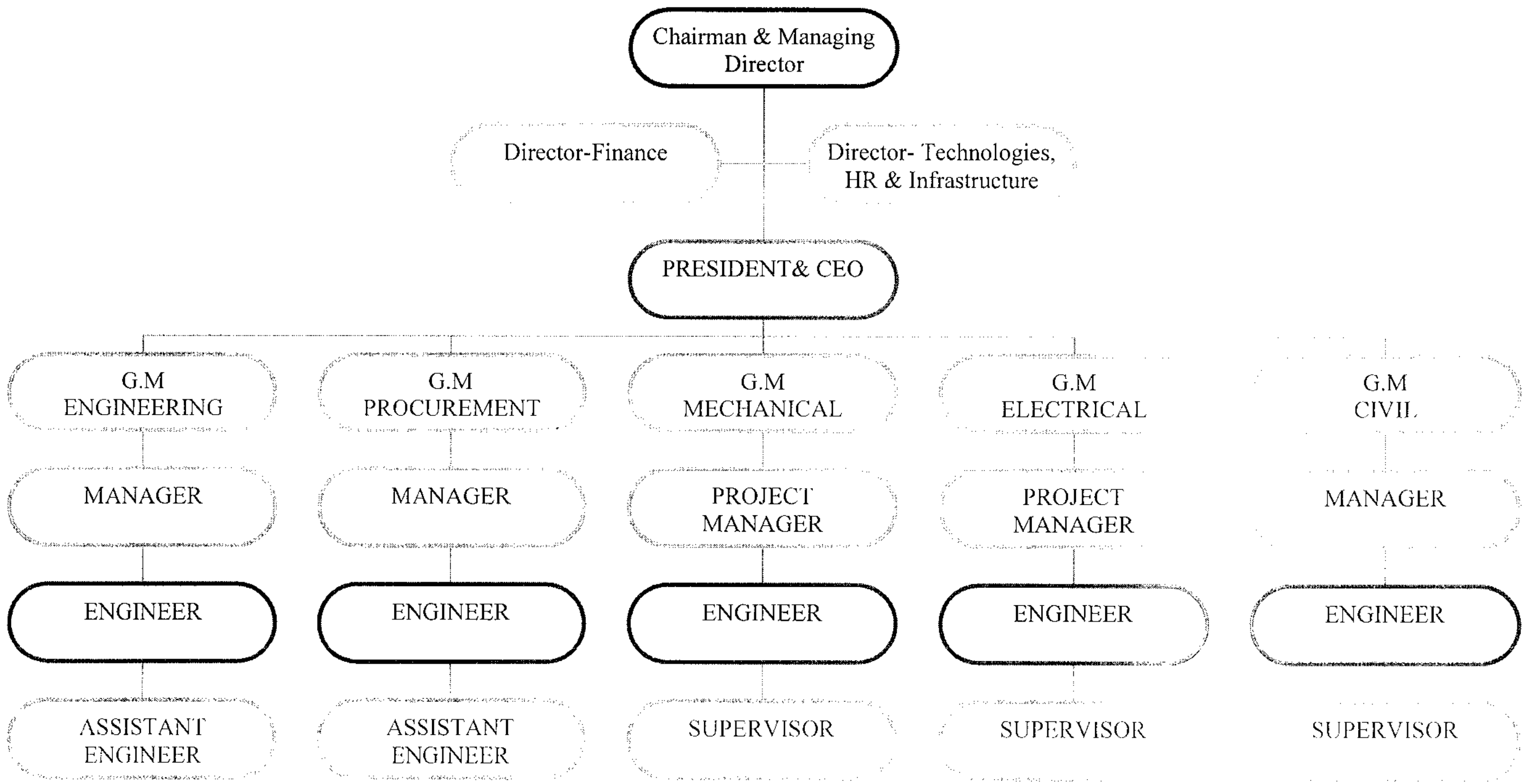
PRESIDENTS AND CEO'S:

1. Swaminathan – Power Projects Division
2. Major H.L. Khajuria – Major H.L. Khajuria
3. G. Suresh – Captive Power Division
4. V. Balakrishnan – Electrical Project Division
5. N. Murali – Oil & Gas Equipment Division
6. S.Ilanchezhiyan – Air Fin Cooler Division
7. R.Ramesh Kumar – President – Corporate & Secretary
8. P.R.Easwar Kumar – Chief Financial Officer
9. H. Venugopal – Executive Director
10. Krishna Kumar – Cuddalore Power Company Limited

BOARD OF DIRECTORS:

S.No	Name	Age	Designation
1	Mr.Heinrich Bohmer	71	Director
2	Mr.M.Gopalakrishna	68	Director
3	Mr. S.A.Bohra	62	Director
4	Mr.S.R Tagat	51	Director
5	Mrs Sasikala Raghupathy	51	Director
6	Mr.S.Rathinam	56	Director-Finance
7	Mr.V.R.Mahadevan	48	Whole Time Director
8	Mr.B.G.Raghupathy	54	Chairman & Managing Director

2.3. ORGANIZATION STRUCTURE OF POWER PROJECTS DIVISION:



2.4. PRODUCTS PROFILE:

The products that are manufactured by the company are illustrated as follows

- **ONLINE TUBE CLEANING SYSTEM:**

On Line Tube Cleaning System facilitates continuous cleaning of the Condenser Tubes up with the Plant in operation. Cleaning is accomplished by passing slightly oversized Sponge Rubber Balls though the condenser tubes.

- **DEBRIS SEPERATOR:**

The Debris Filter installed in the C.W. Inlet Line is an important secondary filtering equipment. The design and the internal construction of the Debris Filter is based on the Water flow, type, size and quantity of the Debris and the Cooling Water inlet Pressure. The Debris is collected at the inner surface of the screen, housed inside the filter.

The level of debris fouling on the filter screen is indicated by monitoring the Differential Pressure across the Screen. When it reaches a preset limit, the control system initiates the debris removal operation, till the screen is cleared off the debris.

Debris accumulated on the inside surface of the screen is sucked by the debris extraction assembly which routes the extracted debris into the Debris Discharge Pipe connected to the main condenser outlet pipe or drain.

The rotation of the Flushing Assembly is facilitated by an Electric Gear drive mounted outside the Filter housing. The cleaning operation ceases once the screen is clean. The salient feature of the BGR filter is that at no time is there any significant reduction of water flow during the screen cleaning operation.

Many a times the extraction technique alone is inadequate to dislodge all the Debris from the screen. To effectively solve this problem the BGR Filter incorporates a special patented Rotating High Pressure Water Injecting Arm on the rear side of the screen.

- **SPONGE CLEANING BALLS:**

GEA BGR supplies a wide range of cleaning balls to suit every application. Sponge Rubber, High Temperature Balls, Abrasive Balls and Granulate Coated Balls.

GROUP COMPANIES:

- Cuddalore Power Company Limited
- Progen Systems and Technologies Ltd
- GEA Cooling Towers Technologies (India) Pvt Ltd

2.5. COMPETITIVE ADVANTAGE:

- Established in 1985 as joint venture with M/s.GEA Energietechnik GmbH, Germany.
- Leading supplier of Tube Cleaning System and Debris Filter on turnkey basis for Power and Desalination Plants worldwide
- Market Leader in India catering to 80,000 MW installed Power Plant Capacity
- Over 1000 systems operational Worldwide.
- Quality System to ISO 9001 :2000
- Installations in 33 Countries across 5 Continents.

CORE COMPETENCY:

- **INTELLECTUAL ASSET- POWER PLANT ENGINEERING & INTERFACING EXPERIENCE:**

  More than 750 man years of power plant engineering.
- **TURNKEY PROJECT DESIGN & EXECUTION CAPABILITY:**
  - Turnkey project design & execution capability
    - In house Design & Engineering Expertise for Civil & Structures, Mechanical, Electrical and C&I works
    - In house Design & Engineering of major system components: Chimney, Cooling towers, Coal handling Plant, WT Plant, OLTCS etc
    - Latest CAD tools & analytical software.
    - ERP compliant
  - Strong Project Management & Execution team.
  - Executing prestigious projects with unit sizes of 500 MW.

- **ALLIANCES:**

  BGR has strategic synergies with key world players in Power island equipments & poised to execute turnkey contracts for power plants with unit sizes up to 1000 MW using latest technologies.

- **TECHNOLOGY ORIENTED -EQUIPMENT, SYSTEMS AND SERVICES:**
  - BGR Energy has the unique capability of being able to source, from its own in-house divisions, almost the entire range of equipment and systems required for the Power plant.
  - Air Cooled Steam Condensers
    - Joint Venture with world leader GEA Energietecknik GmbH, Germany.
    - Supplied ACC for 155 MW CCPP in Vietnam.
    - Pioneer and Largest supplier of ACC in India.
  - Wet Cooling Towers

    Joint Venture with world leader GET, GmbH, Germany who have supplied Natural Draft Cooling Towers for 12 units of 500 MW and above (largest: 1350 MW)
  - On Load Condenser Tube Cleaning Systems
    - No 1 in India.
    - Over 500 systems commissioned.
    - >500 MW Project: More than Fifteen (15) nos. systems in India and fifteen (15) systems exported.
  - Water Treatment Plants (Desalination Plants, Condensate Polishing units))
  - Deaerators
    - No 1 in India.
    - Distinction of having supplied the LARGEST Deaerator in India to Nuclear Power Corp., Tarapur 2 x 500 MW Unit & 660 MW NTPC, Sipat Supercritical TPP.
  - Self Cleaning Strainers & Debris Filters
    - Over 330 DS/SCF supplied till date.
    - Supplied for more than fifteen (15) 500 MW units in India and five (5) units of 500 MW & above overseas, the largest being a 1350 MW Nuclear Plant

- Air Cooled Heat Exchangers & Aluminium Finned tubes.
    - No. 1 in India with 20% exports production
- High Frequency Resistance Welded Fin tubes.
- Gas Conditioning Skid, Group Gas Gathering Station, etc.
- Turbine Components etc. for Hydro Power Plants.
- Third Party Inspection Services and Management Certification.

- **MANUFACTURING FACILITIES:**

  No of Factories : 4 nos.

  Location : Chennai-Calcutta NH5 Highway (Near Chennai)

  Certification/Approvals: EIL, IBR, ISO 9001, ASME 'U' Stamp

  Area: Covered : 50,000 sq.ft.

  Covered Open: 18.5 Acres

2.6. DESCRIPTION OF FUNCTIONAL AREAS:

The major departments in power projects division are

- Procurement
- Mechanical
- Electrical/ C&I
- Civil works

The other departments such as HR, Finance, Marketing, EDP, etc are centrally managed by centrally by BGR Energy system at the H.O.

2.6.1. PROCUREMENT:

Procurement department is involved in the activities such as making estimations of projects, preparation for tenders, price negotiations, coordinating between marketing department to getting new orders.

2.6.2. MECHANICAL:

Mechanical department has the responsibility of designing, manufacturing, erection and commissioning of the following equipments of the power plant.

- Cooling Water System
- Water Treatment System
- Fuel / Material Handling System
- General Mechanical Systems.

It is the responsibility of the mechanical department that the equipments are erected in time and function properly. The mechanical department also has to synchronize equipments of BOP with main equipments for the power plant to be efficient.

2.6.3. ELECTRICAL / C&I:

Electrical / Controls & Instrumentation department is engaged in the activity of designing, manufacturing, erection and commissioning of equipments needed for BOP such as

- Switchyard
- Generator & Station Transformer
- LT Auxiliary and Distribution Transformer
- HT & LT Switchgear
- Busducts
- Interconnection HT & LT cabling
- DC System & UPS
- Lighting System
- Plant Communication System
- Earthing and lightning protection

These devices are needed to control various equipments of the power plant. These are designed with latest available technology to ensure safe operation of the power plant.

2.6.3. CIVIL WORKS:

The civil works department is engaged in the activity construction of all the buildings and structures of the power plant. Their activities are,

- Soil investigation.
- Complete Civil design and Engineering.
- Foundations for Turbine, Boiler, Air Cooled Condenser
- TG Building, Equipment Foundations and Plant Buildings

- Cooling Towers, Chimneys
- Reservoirs and Intake Systems
- Plant Civil Works, Roads, Trenches. Pipe racks, Culverts. etc.

These are the activities that are carried in various functional areas of the Power Projects Division. All the departments follow ISO standards while carrying out their activities.

Internal audits are conducted periodically to review their performance and adherence to the ISO norms

3. MACRO – MICRO ANALYSIS

CHAPTER 3

3. MACRO – MICRO ANALYSIS:

3.1. MACRO ANALYSIS:

GLOBAL OBSERVATIONS:

It is clear that all the scenarios involve a substantial increase in global energy supplies by 2050 on the order of a 100% increase. To achieve this, the WEC standard of keeping all energy options open and on the energy policy table continues to hold true. The energy mix of countries and regions will depend on individual resources and relationships, but all potential resources and trade opportunities need to be addressed against the WEC 3 A's.

It is also apparent that a substantial increase in global energy supplies will take time but can be accomplished in the timeframe of this study with cleaner technologies to underpin a low carbon economy. A low carbon economy does not mean taking fossil fuels off the policy table. It means increasing the efficient production and use of fossil fuels and managing the greenhouse gases which are generated by them.

80% of global population lives in developing areas. Of the 6.0 billion populations, in the OECD (Organization for Economic Co-operation and Development) countries the total number is approximately 1.2 billion – North America (0.4), Europe (0.6), Asia Pacific (0.2). In the non-OECD countries, the population is the balance 80% and i.e. 4.8 billion consisting of Asia Pacific (3.2), Russia-Caspian (0.3), Middle-East (0.2), Africa (0.8) and Latin America (0.4). By the year 2030, the global population is projected to be 8.0 billion rising at the rate of 0.9% per year and in the year 2030, the OECD countries would consist of North America (0.5), Europe (0.6) and Asia Pacific (0.2), the total being 1.3 from the present level of 1.2 billion. The balance 7.7 billion would be in non-OECD countries. Therefore, during the period 2005-2030, the population rise in the non-OECD countries would be higher than the population growth in the OECD countries. And, as a result, by the year 2030, the global population in the OECD countries would be a little more than 16% and the balance about 84% would in the non-OECD countries.

As regards energy consumption, 16% of the global population in the OECD countries would consume, by the year 2030, more than 40% of energy and the balance about 84% of the global population in the non-OECD areas would consume a little less than 60% of the total energy consumed in the world. No doubt, during the period 2005 to 2030, the rate of growth of energy consumption in the non-OECD countries would be higher than in OECD countries and would vary between 1.3% in the Russian-Caspian area to 3.2% in the Asia Pacific areas, as opposed to the rate of growth of energy consumption during this period in the OECD countries being in the range of 0.6% in North America to 0.9% in the Asia Pacific region. Still as mentioned earlier, by the year 2030, 16% of global population would consume as much as 40% of the energy and the balance 84% of the global population would consume less than 60% of energy. Providing access to adequate energy to their people is really a challenge for developing countries.

However, the global energy mix does not evolve in the same way under all scenarios. Important differences of degree and timing need to be understood. There is potential to offset the world's reliance on fossil fuels by an energy mix that uses more nuclear power with adequate waste management, additional hydro resources, and renewables including biomass and biofuels with an affordable, low carbon footprint. Key drivers in all scenarios regarding the potential evolution of the energy mix are efficiency gains from stronger standards for production and end-use choices and a value for carbon which is high enough to affect choices but low enough to avoid harmful costs to growing economies.

Figure shows result from the model of the normalized movement relative to 2005 for some key indicators that are used to frame the four scenarios:

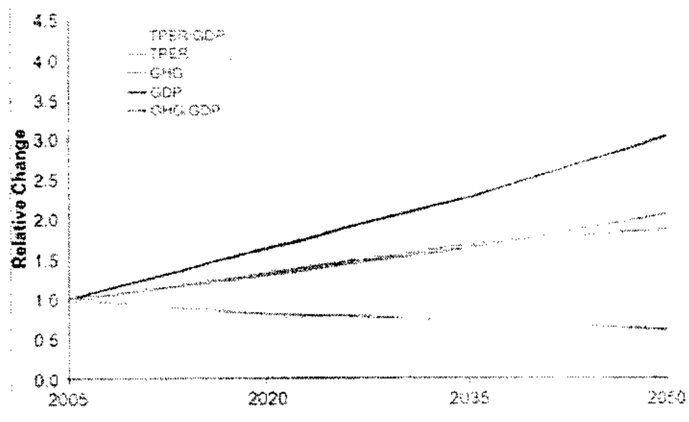


Fig 3.1 Relative change of Economic Factors

- Economic Activity (GDP)
- Energy Intensity (TPER/GDP)
- Total Primary Energy Requirement (TPER)
- Greenhouse Gas Emissions (GHG)
- Emissions Intensity (GHG/GDP)

ENERGY AND DEVELOPMENT – GROWTH RELATED ISSUES:

Economic growth is desirable for developing countries, and energy is essential for economic growth. However, the relationship between economic growth and increased energy demand is not always a straightforward linear one. For example, under present conditions, a 6 per cent increase in India's GDP would impose an increased demand of 9 per cent on its energy sector.

TRENDS IN NEED FOR ENERGY:

- **INCREMENTAL WORLD PRIMARY ENERGY DEMAND:**

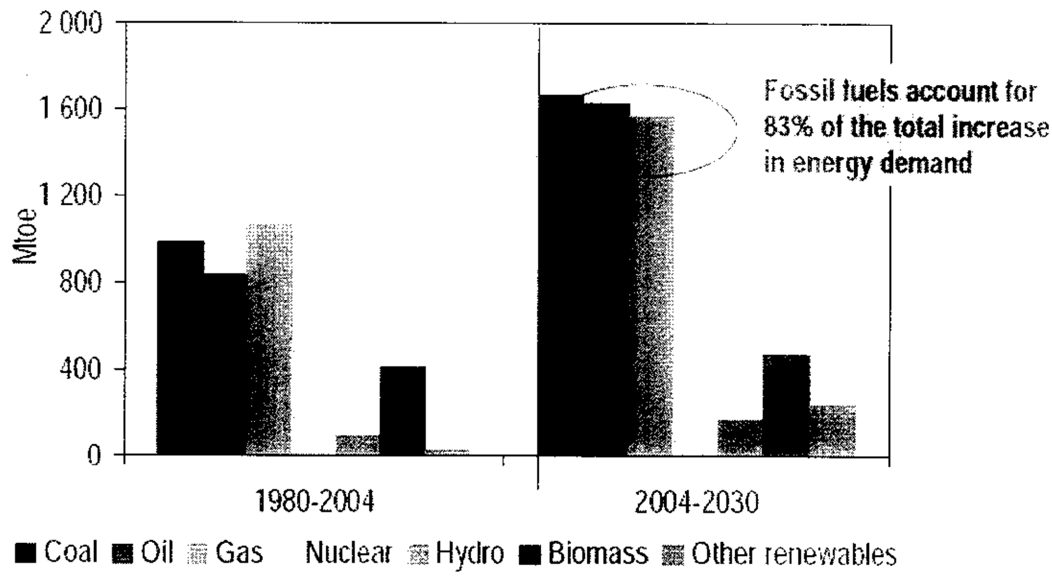


Fig 3.2. Incremental World Primary Energy Demand

Source: INTERNATIONAL ENERGY AGENCY

- **WORLD ELECTRICITY DEMAND BY REGION**

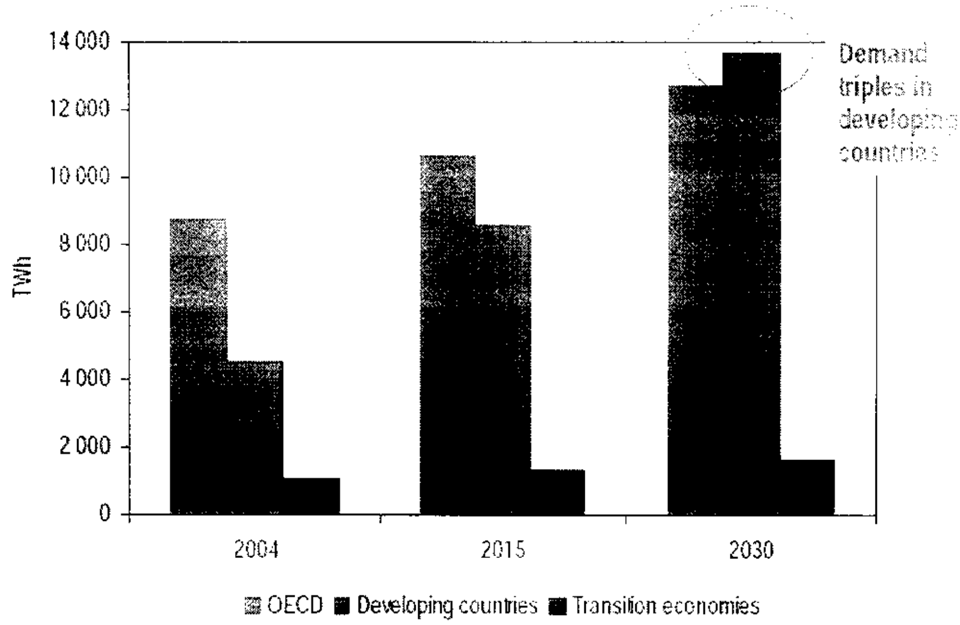


Fig 3.3 World Electricity Demand By Region

Source: INTERNATIONAL ENERGY AGENCY

- **WORLD INCREMENTAL ELECTRICITY GENERATION BY FUEL**

Most of the additional demand for electricity is expected to be met by coal, which remains the world's largest source of electricity to 2030.

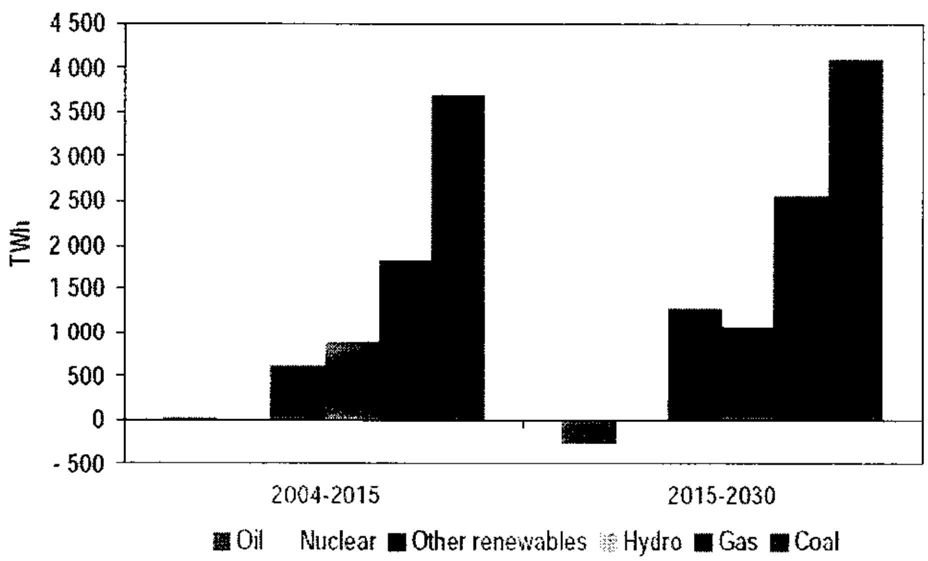


Fig 3.4. World Incremental Electricity Generation by Fuel

Source: INTERNATIONAL ENERGY AGENCY

- **INVESTMENTS NEEDED FOR ENERGY WORLDWIDE:**

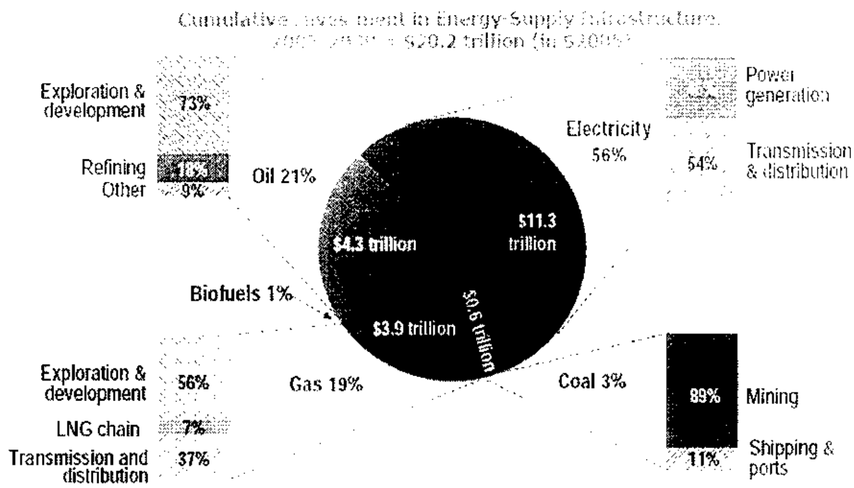


Fig 3.5. Investments Needed For Energy Worldwide

Source: INTERNATIONAL ENERGY AGENCY

- **Cumulative Power-Sector Investment by Region, 2005 – 2030:**

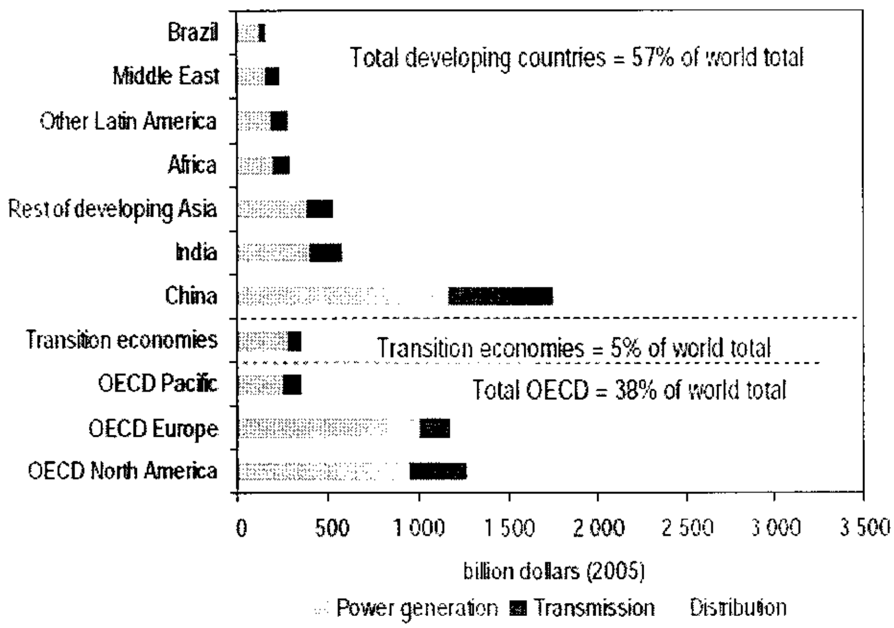


Fig 3.6. Cumulative power-sector investment by region, 2005 – 2030

Source: INTERNATIONAL ENERGY AGENCY

INDIAN ELECTRICITY SCENARIO:

India is one of the countries where the present level of energy consumption, by world standards, is very low. The estimate of annual energy consumption in India is about 330 Million Tones Oil Equivalent (MTOE) for the year 2004. Accordingly, the per capita consumption of energy is about 305 Kilogram Oil Equivalent (KGOE). As compared to this, the energy consumption in some of the other countries is of the order of over 4050 for Japan, over 4275 for South Korea, about 1200 for China, about 7850 for USA, about 4670 for OECD countries and the world average is about 1690.

In so far as electricity consumption is concerned, India has reached a level of about 600-kilowatt hour (kwh) per head per year. The comparable figures for Japan are about 7,800, for South Korea about 7,000, for China about 1380, for USA about 13,000, for OECD countries about 8050 and world average are about 2430. Thus, both in terms of per capita energy consumption and in terms of per capita electricity consumption, India is far behind many countries, and as a matter of fact, behind even the world average. Therefore, to improve the standards of living of Indian people and to let them enjoy the benefit of economic development, it is imperative that both energy consumption and electricity consumption level is enhanced. India is targeting a growth rate of 9 – 10%, having already reached a level of almost 8%. To sustain the double-digit growth rate for next 10-15 years, it would be essential that the level of energy availability and consumption, and electricity consumption in particular, is enhanced substantially.

On the supply side, the mis-match between demand and supply is so large that India can ill-afford to choose one option in preference to the other. For several years, in fact may be for next few decades, India would need to exploit all possible options to create reasonably large capacity base on the energy side. It needs to expand manifold the coal production, extract through all possible means, the oil and gas reserves, wherever possible, resort to import of coal, acquire coal and gas reserves abroad, will need to continue substantial dependence on import of oil, and exploit fully the large hydro electric potential which is of the order of over 1,50,000 MW. Only about 32,000 MW i.e. about 20% of the hydroelectric potential has been exploited so far. Increase in the capacity base of power generation through dependence on the coal reserves of the country, which are of the order of 200 billion tones is inevitable. Nuclear programme has proved to be effective and successful.

Energy Source	Demand	Supply	Gap/Shortage
Electricity (Jan 2006) (In Million KWh)	5,21,872	4,80,242	(41,630)
Oil (In MMT)	128	33*	(95)
Gas (In Mmscmd)	162.03	81.17	(80.86)
Coal (In MT)	415 MT	378.6	(36.4)

Table 3.1. Sources of Energy, Demand, Supply and Gap

Source(s): Ministry of Power; Economic Survey 2005-06 & Planning Commission KWh –Kilowatt hours, MMT –Million Metric Tonnes, MCM –Million Cubic Meter, MT –Million Tonnes; Mmscmd-Million standard cubic meter per day.

The growth of the economy, calls for a matching rate in infra-structure facilities. The growth rate of demand for power in developing countries is generally higher than that of Gross Domestic Product (GDP). In India, the elasticity ratio was 3.06 in the first Plan and peaked at 5.11 during third plan come down to 1.65 in the Eighties. For the Nineties, a ratio of around 1.5 is projected.

Therefore, in order to support a rate of growth of GDP of around 7 percent per annum, the rate of growth of power supply needs to be over 10 percent annually.

Power Sector, hitherto, had been funded mainly through budgetary support and external borrowings. But given the budgetary support limitation, due to growing demands from other sectors, particularly social sector and the severe borrowing constraints, a new financing strategy was required. This had been recognized by the Government as reflected in the new policy enunciated in 1991, allowing private enterprise a larger role in the power sector.

GROWTH IN ELECTRICITY GENERATION:

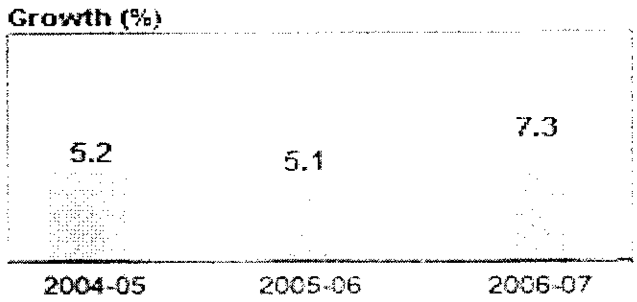


Fig 3.7. Growth in Electricity Generation

PER CAPITA CONSUMPTION OF ELECTRICITY:

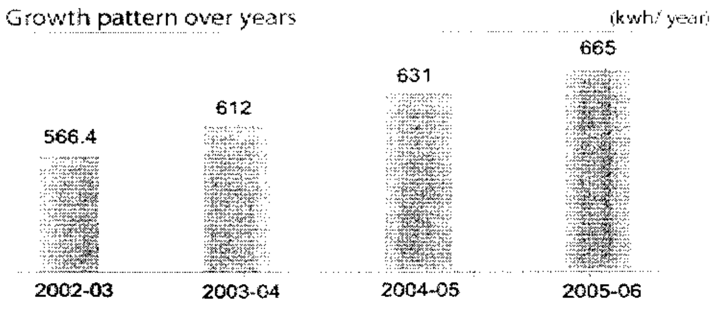
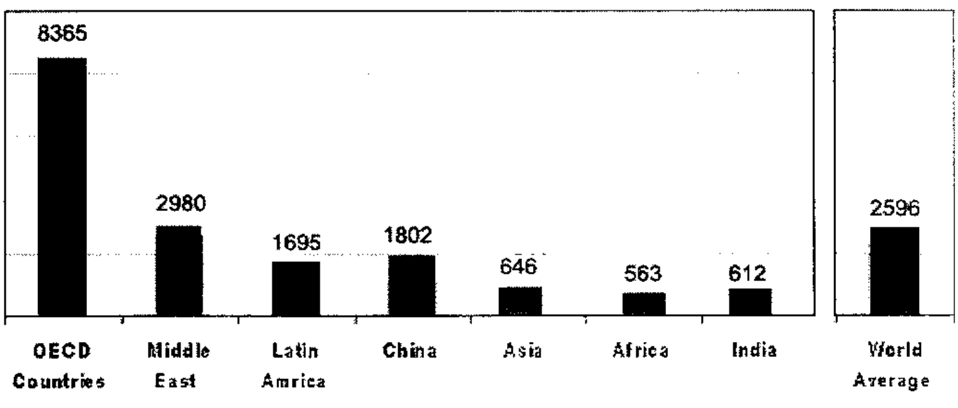


Fig 3.8. Per Capita Consumption of Electricity

Source: Ministry of Power

COMPARATIVE PER CAPITA CONSUMPTION OF ELECTRICITY (Kwh):



Source : Key World Energy Statistics (2007)

Fig 3.9. Comparative per Capita Consumption of Electricity (kwh)

CUMULATIVE GROWTH IN TRANSMISSION SECTOR AND PROGRAMME FOR 11th PLAN					
	Unit	At the end of VIII Plan ie March 1997	At the end of IX Plan ie March 2002	At the end of X Plan ie March 2007	At the end of XI Plan ie March 2012
TRANSMISSION LINES					
		VIII Plan	**IX Plan**	**X Plan**	**XI Plan**
765 kV	ckm	409	971	1704	7132
HVDC +/- 500kV	ckm	3138	3138	58728	11078
HVDC 200kV Monopole	ckm	0	162	162	162
400kV	ckm	36142	49378	75772	125000
230kV/220kV	ckm	79601	96993	114629	150000
Total Transmission Line	**ckm**	**119290**	**150642**	**198089**	**293372**
SUBSTATIONS					
		VIII Plan	**IX Plan**	**X Plan**	**XI Plan**
HVDC BTB	MW	1500	2000	3000	3000
HVDC Bipole+Monopole	MW	1500	3200	5200	11200
Total-HVDC Terminal Capacity	**MW**	**3000**	**5200**	**8200**	**14200**
765kV	MVA	0	0	2000	53000
400kV	MVA	40865	60380	92942	145000
230/220kV	MVA	84177	116363	156497	230000

Table 3.2. Cummulative Growth in Transmission Sector and Programme for 11th Plan

Source : Ministry of Power

MICRO- ANALYSIS:

Since the company is in a developing and booming Indian economy it has good opportunities to grow. The company has many orders for its future to run the business successfully. Some of the orders in hand are

- BGR Energy Electrical Projects Division received an order from Nuclear Power Corporation of India (NPCIL) A/c Bharatiya Nabhikiya Vidyut Nigam Limited (BHAVINI), Kalpakkam for turnkey execution of Medium Voltage Power Distribution System valuing Rs.24 Crores.
- Chief Minister Ms.Vasundra Raje dedicated 330 MW Dholpur Combined Cycle Power Plant, Rajasthan to the Nation. BGR Energy executed the Balance of Plant for the project.
- BGR Energy has received a Letter of Intent from Konaseema Gas Power Limited for Balance of Plant contract for 820 MW Combined Cycle Power Plant at Konaseema.
- BGR Energy has received Licence from Kingdom of Bahrain to set up manufacturing facility in Bahrain. Bahrain International Investment Park (BIIP) has given its approval of allotment of land.
- BGR Energy Electrical Project Division has received a contract from Tamil Nadu Electricity Board (TNEB) for Design, Engineering, Manufacture, Supply, Erection, Testing & Commissioning of OPGW Cables and OLTEs with associated equipments and System Integration for establishing Optic Fibre Backbone for TNEB on Turnkey basis, valued at Rs. 19.74 Crores.
- BGR Energy has secured a contract for supply of Balance of Plant (BoP) equipment and Civil Works for 1 x 500 MW Khapharkheda Thermal Power Station of Maharashtra Generation Co. Ltd.(MAHAGENCO) for Rs. 998 Crores.

4. DATA ANALYSIS & INTERPRETATION

CHAPTER 4

4. ANALYSIS AND INTERPRETATION:

4.1. DETERMINATION OF MATERIAL UTILIZATION RATES IN VARIOUS METHODS:

The table below shows material utilization rate when different nesting methods are followed. Material utilization is determined by the left out scrap in manual nesting, burnt out waste is not considered and hence it is not accurate. Material utilization rate is obtained as output when nesting softwares are used. It has accuracy up to two decimal places.

TABLE 4.1
MATERIAL UTILIZATION RATE OF MANUAL, MOST 2D & PLUS 2D NESTING

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
1	GID-064-ST-DWG-F01	83	90.29	7.29	89.94	6.94
2	GID-064-ST-DWG-F02	84	92.82	8.82	92.13	8.13
3	GID-064-ST-DWG-F03	87	95.66	8.66	95.16	8.16
4	GID-064-ST-DWG-F04	82	90.38	8.38	89.62	7.62
5	GID-064-ST-DWG-F05	87	92.76	5.76	92.27	5.27
6	GID-064-ST-DWG-F06	84	91.45	7.45	90.87	6.87
7	GID-064-ST-DWG-F07	81	89.72	8.72	89.25	8.25
8	GID-064-ST-DWG-F08	85	93.98	8.98	93.64	8.64
9	GID-064-ST-DWG-F09	86	92.18	6.18	92.22	6.22
10	GID-064-ST-DWG-F10	83	91.27	8.27	90.82	7.82
11	GID-064-ST-DWG-F11	85	93.82	8.82	93.36	8.36
12	GID-064-ST-DWG-F12	84	93.83	9.83	93.31	9.31
13	GID-064-ST-DWG-F13	90	95.63	5.63	95.17	5.17
14	GID-064-ST-DWG-F3001	84	90.36	6.36	89.78	5.78
15	GID-064-ST-DWG-F3002	83	89.26	6.26	88.81	5.81
16	GID-064-ST-DWG-F3003	82	90.83	8.83	90.84	8.84
17	GID-064-ST-DWG-F3004	86	93.81	7.81	93.27	7.27
18	GID-064-ST-DWG-F3005	87	95.29	8.29	94.73	7.73

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
19	GID-064-ST-DWG-F3006	86	93.83	7.83	93.16	7.16
20	GID-064-ST-DWG-F3007	89	94.27	5.27	93.73	4.73
21	GID-064-ST-DWG-F3008	86	91.49	5.49	90.76	4.76
22	GID-064-ST-DWG-F3009	83	94.00	11.00	93.68	10.68
23	GID-064-ST-DWG-F3010	88	91.03	3.03	91.14	3.14
24	GID-064-ST-DWG-F3011	84	90.73	6.73	90.26	6.26
25	GID-064-ST-DWG-F3012	82	92.62	10.62	92.47	10.47
26	GID-064-ST-DWG-F3013	86	93.82	7.82	93.37	7.37
27	GID-064-ST-DWG-F3014	83	92.16	9.16	91.23	8.23
28	GID-064-ST-DWG-F3015	84	93.61	9.61	92.96	8.96
29	GID-064-ST-DWG-F3016	86	94.18	8.18	93.98	7.98
30	GID-064-ST-DWG-F3017	91	92.17	1.17	92.24	1.24
31	GID-064-ST-DWG-F3018	86	90.15	4.15	90.02	4.02
32	GID-064-ST-DWG-F3019	83	89.72	6.72	89.36	6.36
33	GID-064-ST-DWG-F3020	88	92.84	4.84	92.34	4.34
34	GID-064-ST-DWG-F3021	86	91.38	5.38	91.17	5.17
35	GID-064-ST-DWG-F3022	88	93.62	5.62	93.26	5.26
36	GID-064-ST-DWG-F3023	87	91.87	4.87	91.28	4.28
37	GID-064-ST-DWG-F3024	81	89.06	8.06	88.63	7.63
38	GID-064-ST-DWG-F3025	84	91.26	7.26	91.11	7.11
39	GID-064-ST-DWG-F3026	84	92.17	8.17	91.78	7.78
40	GID-064-ST-DWG-F3027	83	91.26	8.26	90.88	7.88

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material. accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
41	GID-064-ST-DWG-F3028	84	91.83	7.83	91.34	7.34
42	GID-064-ST-DWG-F3029	85	94.19	9.19	93.84	8.84
43	GID-064-ST-DWG-F3030	91	89.82	-1.18	92.03	1.03
44	GID-064-ST-DWG-F3031	83	93.64	10.64	93.53	10.53
45	GID-064-ST-DWG-F3032	89	93.14	4.14	92.85	3.85
46	GID-064-ST-DWG-F3033	86	92.52	6.52	92.14	6.14
47	GID-064-ST-DWG-F3034	88	93.73	5.73	93.14	5.14
48	GID-064-ST-DWG-F3035	82	90.62	8.62	90.46	8.46
49	GID-064-ST-DWG-F3036	83	90.91	7.91	90.74	7.74
50	GID-064-ST-DWG-F3037	85	92.83	7.83	92.37	7.37
51	GID-064-ST-DWG-F3038	87	94.19	7.19	94.03	7.03
52	GID-064-ST-DWG-F3039	87	93.99	6.99	93.73	6.73
53	GID-064-ST-DWG-F3040	85	90.28	5.28	89.83	4.83
54	GID-064-ST-DWG-F3041	90	91.48	1.48	91.73	1.73
55	GID-064-ST-DWG-F3042	86	92.61	6.61	92.17	6.17
56	GID-064-ST-DWG-F3043	83	90.72	7.72	90.14	7.14
57	GID-064-ST-DWG-F3044	86	93.62	7.62	93.23	7.23
58	GID-064-ST-DWG-F3045	84	91.27	7.27	90.73	6.73
59	GID-064-ST-DWG-F3046	83	91.10	8.1	90.78	7.78
60	GID-064-ST-DWG-F3047	87	93.56	6.56	93.14	6.14
61	GID-064-ST-DWG-F3048	86	92.89	6.89	92.43	6.43
62	GID-064-ST-DWG-F3049	83	90.15	7.15	90.04	7.04

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
63	GID-064-ST-DWG-F3050	87	92.19	5.19	91.84	4.84
64	GID-064-ST-DWG-F3051 SHT 1 OF 2	86	91.73	5.73	91.63	5.63
65	GID-064-ST-DWG-F3051 SHT 2 OF 2	83	90.25	7.25	90.38	7.38
66	GID-064-ST-DWG-F3052 SHT 1 OF 2	88	94.19	6.19	93.76	5.76
67	GID-064-ST-DWG-F3052 SHT 2 OF 2	88	92.73	4.73	92.37	4.37
68	GID-064-ST-DWG-F3053	82	89.16	7.16	88.76	6.76
69	GID-064-ST-DWG-F3054	84	89.05	5.05	88.86	4.86
70	GID-064-ST-DWG-F3055	80	90.73	10.73	90.36	10.36
71	GID-064-ST-DWG-F3056	86	92.05	6.05	91.73	5.73
72	GID-064-ST-DWG-F3057	83	89.29	6.29	89.16	6.16
73	GID-064-ST-DWG-F3058	84	92.48	8.48	91.89	7.89
74	GID-064-ST-DWG-F3059	81	89.73	8.73	89.14	8.14
75	GID-064-ST-DWG-F3060	86	92.82	6.82	92.25	6.25
76	GID-064-ST-DWG-F3061	87	93.81	6.81	93.14	6.14
77	GID-064-ST-DWG-F3062	82	90.18	8.18	90.63	8.63
78	GID-064-ST-DWG-F3063	91	93.81	2.81	93.16	2.16
79	GID-064-ST-DWG-F3064	84	89.72	5.72	89.27	5.27
80	GID-064-ST-DWG-F3065	88	89.38	1.38	89.63	1.63

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
81	GID-064-ST-DWG-F3066	83	90.82	7.82	90.26	7.26
82	GID-064-ST-DWG-F3067	85	93.72	8.72	93.17	8.17
83	GID-064-ST-DWG-F3068	80	88.29	8.29	87.86	7.86
84	GID-064-ST-DWG-F3069	90	92.93	2.93	92.81	2.81
85	GID-064-ST-DWG-F3070	84	90.81	6.81	90.27	6.27
86	GID-064-ST-DWG-F3071	86	92.71	6.71	92.38	6.38
87	GID-064-ST-DWG-F3072	86	91.39	5.39	90.97	4.97
88	GID-064-ST-DWG-F3073	84	90.05	6.05	89.73	5.73
89	GID-064-ST-DWG-F3074	89	94.82	5.82	94.39	5.39
90	GID-064-ST-DWG-F3075	86	91.73	5.73	91.34	5.34
91	GID-064-ST-DWG-F3076	84	88.47	4.47	88.17	4.17
92	GID-064-ST-DWG-F3077	82	87.38	5.38	86.83	4.83
93	GID-064-ST-DWG-F3078	88	90.08	2.08	90.13	2.13
94	GID-064-ST-DWG-F3079	80	89.94	9.94	89.24	9.24
95	GID-064-ST-DWG-F3080	79	91.30	12.3	91.16	12.16
96	GID-064-ST-DWG-F3081	83	90.18	7.18	89.85	6.85
97	GID-064-ST-DWG-F3082	84	90.73	6.73	90.38	6.38
98	GID-064-ST-DWG-F3083	88	94.73	6.73	94.27	6.27
99	GID-064-ST-DWG-F3084	85	92.54	7.54	91.06	6.06
100	GID-064-ST-DWG-F3085	87	92.48	5.48	92.02	5.02
101	GID-064-ST-DWG-F3086	84	91.38	7.38	90.86	6.86
102	GID-064-ST-DWG-F3087	79	85.69	6.69	85.23	6.23

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material. accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
103	GID-064-ST-DWG-F3088	86	92.48	6.48	92.07	6.07
104	GID-064-ST-DWG-F3089	87	93.93	6.93	93.38	6.38
105	GID-064-ST-DWG-F3090	83	90.26	7.26	89.94	6.94
106	GID-064-ST-DWG-F3091	81	89.44	8.44	88.87	7.87
107	GID-064-ST-DWG-F3092	88	93.72	5.72	93.48	5.48
108	GID-064-ST-DWG-F3093	83	90.87	7.87	90.34	7.34
109	GID-064-ST-DWG-F3094	91	97.19	6.19	96.83	5.83
110	GID-064-ST-DWG-F3095	84	92.49	8.49	91.92	7.92
111	GID-064-ST-DWG-F3096	86	91.28	5.28	91.16	5.16
112	GID-064-ST-DWG-F3097	85	93.08	8.08	93.13	8.13
113	GID-064-ST-DWG-F3098	80	89.92	9.92	89.53	9.53
114	GID-064-ST-DWG-F3099	84	91.37	7.37	90.93	6.93
115	GID-064-ST-DWG-F3100	92	95.19	3.19	95.1	3.1
116	GID-064-ST-DWG-F3101	86	94.46	8.46	93.97	7.97
117	GID-064-ST-DWG-F3102	83	91.70	8.70	91.28	8.28
118	GID-064-ST-DWG-F3103	88	93.07	5.07	92.97	4.97
119	GID-064-ST-DWG-F3104	86	91.58	5.58	91.24	5.24
120	GID-064-ST-DWG-F3105	84	90.73	6.73	89.95	5.95
121	GID-064-ST-DWG-F3106	92	96.43	4.43	96.18	4.18
122	GID-064-ST-DWG-F3107	80	88.49	8.49	87.99	7.99
123	GID-064-ST-DWG-F3108	87	89.08	2.08	89.1	2.1
124	GID-064-ST-DWG-F3109	91	95.19	4.19	94.87	3.87

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
125	GID-064-ST-DWG-F3110	85	92.43	7.43	91.83	6.83
126	GID-064-ST-DWG-F3111	85	94.57	9.57	94.15	9.15
127	GID-064-ST-DWG-F3112	85	91.27	6.27	90.63	5.63
128	GID-064-ST-DWG-F3113	86	90.58	4.58	89.86	3.86
129	GID-064-ST-DWG-F3114	83	89.19	6.19	88.73	5.73
130	GID-064-ST-DWG-F3115	83	92.73	9.73	92.14	9.14
131	GID-064-ST-DWG-F3116	86	93.28	7.28	92.74	6.74
132	GID-064-ST-DWG-F3117	86	90.49	4.49	89.85	3.85
133	GID-064-ST-DWG-F3118	82	91.18	9.18	90.47	8.47
134	GID-064-ST-DWG-F3119	80	89.77	9.77	89.27	9.27
135	GID-064-ST-DWG-F3120	84	91.73	7.73	91.17	7.17
136	GID-064-ST-DWG-F3121	81	94.18	13.18	93.43	12.43
137	GID-064-ST-DWG-F3122	89	92.48	3.48	92.52	3.52
138	GID-064-ST-DWG-F3123	80	88.18	8.18	87.63	7.63
139	GID-064-ST-DWG-F3124	84	92.76	8.76	92.25	8.25
140	GID-064-ST-DWG-F3125	79	93.61	14.61	90.84	11.84
141	GID-064-ST-DWG-F3126	85	91.40	6.4	90.93	5.93
142	GID-064-ST-DWG-F3127	83	89.02	6.02	88.37	5.37
143	GID-064-ST-DWG-F3128	86	90.37	4.37	89.84	3.84
144	GID-064-ST-DWG-F3129	82	90.43	8.43	90.13	8.13
145	GID-064-ST-DWG-F3130	84	91.27	7.27	90.84	6.84
146	GID-064-ST-DWG-F3131	90	94.73	4.73	94.26	4.26

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
147	GID-064-ST-DWG-F3132	86	93.48	7.48	93.13	7.13
148	GID-064-ST-DWG-F3133	83	89.24	6.24	88.83	5.83
149	GID-064-ST-DWG-F3134	82	86.46	4.46	85.79	3.79
150	GID-064-ST-DWG-F3135	84	91.59	7.59	91.19	7.19
151	GID-064-ST-DWG-F3136	86	92.19	6.19	91.64	5.64
152	GID-064-ST-DWG-F3137	85	90.46	5.46	89.91	4.91
153	GID-064-ST-DWG-F3138	87	92.37	5.37	91.83	4.83
154	GID-064-ST-DWG-F3139	80	89.67	9.67	89.17	9.17
155	GID-064-ST-DWG-F3140	84	91.18	7.18	90.38	6.38
156	GID-064-ST-DWG-F3141	80	89.15	9.15	88.39	8.39
157	GID-064-ST-DWG-F3142	88	92.73	4.73	92.27	4.27
158	GID-064-ST-DWG-F3143	86	90.37	4.37	89.83	3.83
159	GID-064-ST-DWG-F3144	84	90.94	6.94	90.17	6.17
160	GID-064-ST-DWG-F3145	86	93.19	7.19	92.38	6.38
161	GID-064-ST-DWG-F3146	83	89.73	6.73	89.15	6.15
162	GID-064-ST-DWG-F3147	85	92.11	7.11	91.39	6.39
163	GID-064-ST-DWG-F3148	84	90.35	6.35	89.84	5.84
164	GID-064-ST-DWG-F3149	83	91.77	8.77	91.36	8.36
165	GID-064-ST-DWG-F3150	88	94.34	6.34	93.97	5.97
166	GID-064-ST-DWG-F3151	84	88.19	4.19	87.48	3.48
167	GID-064-ST-DWG-F3152	86	91.73	5.73	91.39	5.39
168	GID-064-ST-DWG-F3153	91	93.00	2.00	93.34	2.34

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
169	GID-064-ST-DWG-F3154	88	92.37	4.37	91.68	3.68
170	GID-064-ST-DWG-F3155	91	94.27	3.27	93.97	2.97
171	GID-064-ST-DWG-F3156	87	92.74	5.74	92.16	5.16
172	GID-064-ST-DWG-F3157	81	90.82	9.82	90.27	9.27
173	GID-064-ST-DWG-F3158	82	89.18	7.18	88.74	6.74
174	GID-064-ST-DWG-F3159	86	93.68	7.68	93.24	7.24
175	GID-064-ST-DWG-F3160	83	90.47	7.47	89.92	6.92
176	GID-064-ST-DWG-F3161	83	91.88	8.88	91.27	8.27
177	GID-064-ST-DWG-F3162	83	90.09	7.09	89.48	6.48
178	GID-064-ST-DWG-F3163	79	87.27	8.27	86.38	7.38
179	GID-064-ST-DWG-F3164	85	92.38	7.38	91.84	6.84
180	GID-064-ST-DWG-F3165	90	93.93	3.93	93.24	3.24
181	GID-064-ST-DWG-F3166	86	92.49	6.49	91.78	5.78
182	GID-064-ST-DWG-F3167	83	91.51	8.51	91.35	8.35
183	GID-064-ST-DWG-F3168	80	90.29	10.29	88.38	8.38
184	GID-064-ST-DWG-F3169	89	93.81	4.81	93.24	4.24
185	GID-064-ST-DWG-F3170	82	90.36	8.36	89.36	7.36
186	GID-064-ST-DWG-F3171	84	92.04	8.04	91.41	7.41
187	GID-064-ST-DWG-F3172	86	93.43	7.43	92.92	6.92
188	GID-064-ST-DWG-F3173	76	89.49	13.49	87.63	11.63
189	GID-064-ST-DWG-F3174	84	90.14	6.14	89.38	5.38
190	GID-064-ST-DWG-F3175	83	91.43	8.43	90.27	7.27

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
191	GID-064-ST-DWG-F3176	86	93.47	7.47	92.38	6.38
192	GID-064-ST-DWG-F3177	78	88.11	10.11	87.04	9.04
193	GID-064-ST-DWG-F3178	87	93.68	6.68	93.12	6.12
194	GID-064-ST-DWG-F3179	81	90.73	9.73	89.12	8.12
195	GID-064-ST-DWG-F3180	90	94.47	4.47	94.11	4.11
196	GID-064-ST-DWG-F3181	79	90.04	11.04	89.62	10.62
197	GID-064-ST-DWG-F3182	83	89.16	6.16	88.32	5.32
198	GID-064-ST-DWG-F3183	82	90.55	8.55	89.83	7.83
199	GID-064-ST-DWG-F3184	85	91.04	6.04	90.16	5.16
200	GID-064-ST-DWG-F3185	82	90.37	8.37	89.24	7.24
201	GID-064-ST-DWG-F3186	84	92.76	8.76	91.15	7.15
202	GID-064-ST-DWG-F3187	82	89.09	7.09	88.41	6.41
203	GID-064-ST-DWG-F3188	85	90.17	5.17	89.82	4.82
204	GID-064-ST-DWG-F3189	88	95.79	7.79	95.37	7.37
205	GID-064-ST-DWG-F3190	83	90.94	7.94	90.12	7.12
206	GID-064-ST-DWG-F3191	79	90.38	11.38	88.24	9.24
207	GID-064-ST-DWG-F3192	91	95.24	4.24	94.13	3.13
208	GID-064-ST-DWG-F3193	84	89.09	5.09	88.41	4.41
209	GID-064-ST-DWG-F3194	80	90.89	10.89	89.68	9.68
210	GID-064-ST-DWG-F3195	77	91.67	14.67	88.84	11.84
211	GID-064-ST-DWG-F3196	87	92.46	5.46	91.73	4.73
212	GID-064-ST-DWG-F3197	83	90.43	7.43	89.27	6.27

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
213	GID-064-ST-DWG-F3198	88	93.78	5.78	92.96	4.96
214	GID-064-ST-DWG-F3199	84	89.22	5.22	88.63	4.63
215	GID-064-ST-DWG-F3200	89	91.01	2.01	92.73	3.73
216	GID-064-ST-DWG-F3201	85	90.47	5.47	89.72	4.72
217	GID-064-ST-DWG-F3202	83	88.29	5.29	87.17	4.17
218	GID-064-ST-DWG-F3203	86	91.34	5.34	90.86	4.86
219	GID-064-ST-DWG-F3204	84	90.71	6.71	90.14	6.14
220	GID-064-ST-DWG-F3205	81	92.53	11.53	84.83	3.83
221	GID-064-ST-DWG-F3206	83	88.19	5.19	87.18	4.18
222	GID-064-ST-DWG-F3207	88	91.64	3.64	88.53	0.53
223	GID-064-ST-DWG-F3208	85	89.21	4.21	88.16	3.16
224	GID-064-ST-DWG-F3209	82	88.91	6.91	88.16	6.16
225	GID-064-ST-DWG-F3210	84	90.17	6.17	89.38	5.38
226	GID-064-ST-DWG-F3211	80	93.56	13.56	91.73	11.73
227	GID-064-ST-DWG-F3212	86	90.08	4.08	89.63	3.63
228	GID-064-ST-DWG-F3213	91	93.89	2.89	93.49	2.49
229	GID-064-ST-DWG-F3214	87	92.57	5.57	92.11	5.11
230	GID-064-ST-DWG-F3215	79	88.21	9.21	86.84	7.84
231	GID-064-ST-DWG-F3216	80	91.43	11.43	90.32	10.32
232	GID-064-ST-DWG-F3217	83	90.73	7.73	90.27	7.27
233	GID-064-ST-DWG-F3218	86	89.87	3.87	89.14	3.14
234	GID-064-ST-DWG-F3219	83	90.18	7.18	89.36	6.36

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material. accuracy is ± 2%

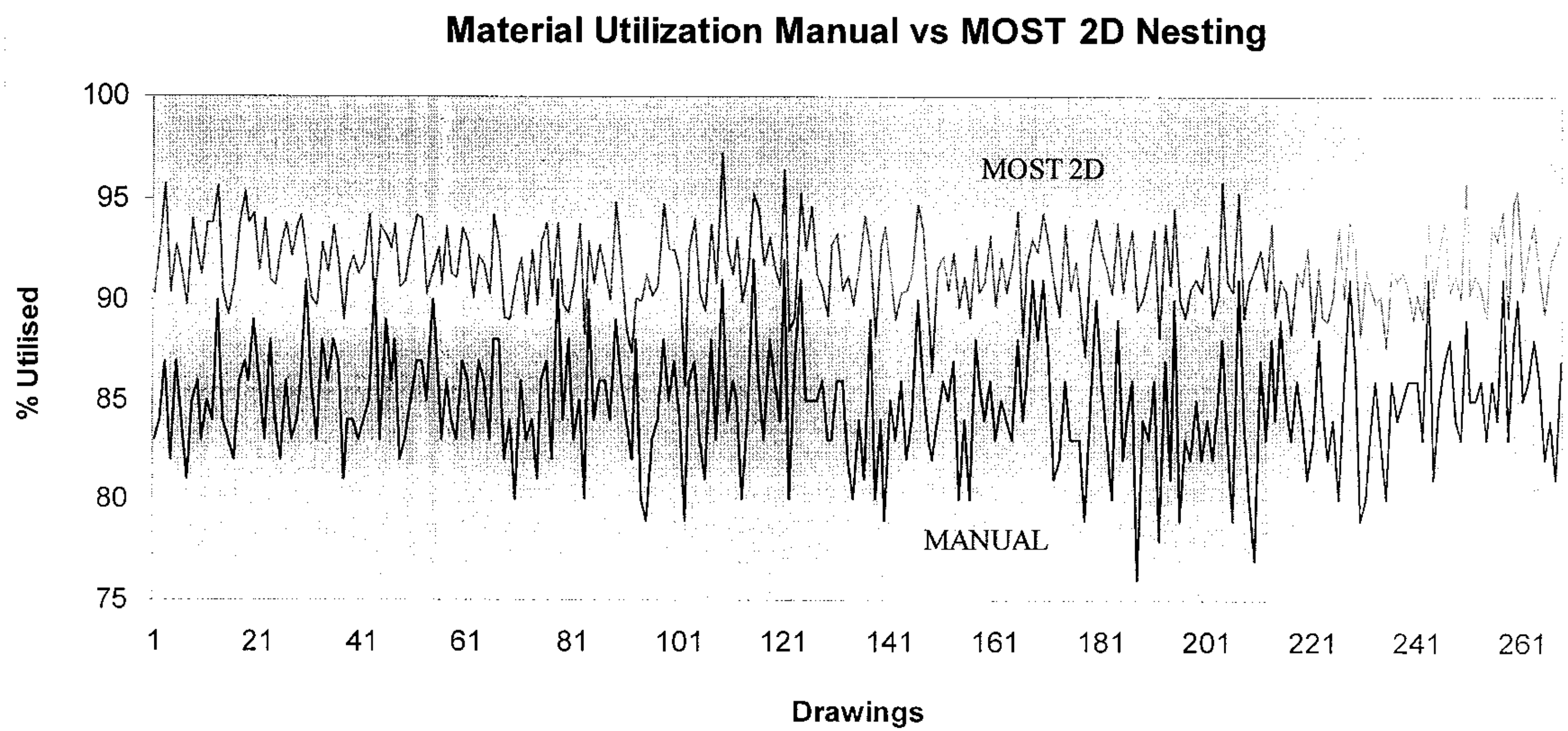
S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
235	GID-064-ST-DWG-F3220	80	87.69	7.69	86.94	6.94
236	GID-064-ST-DWG-F3221	86	91.47	5.47	91.13	5.13
237	GID-064-ST-DWG-F3222	84	90.89	6.89	90.19	6.19
238	GID-064-ST-DWG-F3223	85	91.35	6.35	90.84	5.84
239	GID-064-ST-DWG-F3224	86	90.57	4.57	90.62	4.62
240	GID-064-ST-DWG-F3225	86	89.04	3.04	89.73	3.73
241	GID-064-ST-DWG-F3226	86	90.25	4.25	89.74	3.74
242	GID-064-ST-DWG-F3227	83	89.15	6.15	88.73	5.73
243	GID-064-ST-DWG-F3228	91	93.79	2.79	93.16	2.16
244	GID-064-ST-DWG-F3229	81	90.24	9.24	88.73	7.73
245	GID-064-ST-DWG-F3230	85	92.43	7.43	91.83	6.83
246	GID-064-ST-DWG-F3231	87	93.91	6.91	93.14	6.14
247	GID-064-ST-DWG-F3232	88	90.37	2.37	89.83	1.83
248	GID-064-ST-DWG-F3233	84	91.15	7.15	90.63	6.63
249	GID-064-ST-DWG-F3234	83	90.12	7.12	89.48	6.48
250	GID-064-ST-DWG-F3235	89	95.76	6.76	95.17	6.17
251	GID-064-ST-DWG-F3236	85	90.27	5.27	89.74	4.74
252	GID-064-ST-DWG-F3237	85	91.19	6.19	90.62	5.62
253	GID-064-ST-DWG-F3238	86	90.54	4.54	89.96	3.96
254	GID-064-ST-DWG-F3239	83	89.13	6.13	88.48	5.48
255	GID-064-ST-DWG-F3240	86	93.67	7.67	92.84	6.84
256	GID-064-ST-DWG-F3241	84	92.94	8.94	91.38	7.38

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

S.No	DRAWING NUMBER	MANUAL NESTING % of Utilization *	MOST 2D NESTING % of Utilization	~ b/w MOST 2D & Manual in %	PLUS 2D NESTING % of Utilization	~ b/w PLUS 2D & Manual in %
257	GID-064-ST-DWG-F3242	91	94.37	3.37	94.58	3.58
258	GID-064-ST-DWG-F3243	83	89.16	6.16	88.39	5.39
259	GID-064-ST-DWG-F3244	88	94.75	6.75	94.21	6.21
260	GID-064-ST-DWG-F3245	90	95.34	5.34	94.62	4.62
261	GID-064-ST-DWG-F3246	85	90.43	5.43	89.72	4.72
262	GID-064-ST-DWG-F3247	86	92.34	6.34	91.37	5.37
263	GID-064-ST-DWG-F3248	88	93.79	5.79	92.96	4.96
264	GID-064-ST-DWG-F3249	86	91.48	5.48	90.61	4.61
265	GID-064-ST-DWG-F3250	82	89.31	7.31	88.24	6.24
266	GID-064-ST-DWG-F3251	84	91.72	7.72	90.31	6.31
267	GID-064-ST-DWG-F3252	81	92.49	11.49	90.36	9.36
268	GID-064-ST-DWG-F3253	87	93.27	6.27	92.36	5.36
	AVERAGE	84.77	91.61	6.84	91.03	6.26

* utilization rate is calculated by weighing the scrap left after cutting does not include the exact burnt out material, accuracy is ± 2%

FIGURE 4.1


Material Utilization Manual vs MOST 2D Nesting
100
95
90
85
80
75
% Utilised
MOST 2D
MANUAL
1
21
41
61
81
101
121
141
161
181
201
221
241
261
Drawings

MARKING CHARGES:

It is the cost involved to do nesting operation manually. It is charged as cost per metric tonne of material. The marking cost decreases as the plate thickness increases. this is due do the reduction in area of plate per metric tonne of material.

TABLE 4.2

DETAILS OF MARKING CHARGES

Plate thickness (mm)	Marking cost/metric tonne (INR)
8 - 18	800
20 - 32	700
36 - 45	600
> 45	500

COST REDUCTION DUE TO MARKING CHARGES:

When nesting operations are done using nesting softwares, marking cost can be avoided. This is calculated by multiplying material used with marking cost per metric tonne.

TABLE 4.3

CALCULATION OF MARKING COST

Plate thickness (mm)	Metric Tonnes used	Marking cost/metric tonne (INR)	Marking cost (INR)
8 - 18	1135	800	9,08,000
20 - 32	2460	700	17,22,000
36 - 45	2711	600	16,26,600
		Total marking cost	INR 42,56,600

COST REDUCTION IN MARKING CHARGES = INR 42,56,600

CALCULATION OF COST REDUCTION DUE TO MATERIAL REDUCTION BY USING MOST 2D:

Total material used = 6304 Metric tonnes

Cost/metric tonne = INR 36000/metric tonne as on Dec 2007

Total material cost = 6304 x 36,000 = INR 22,69,44,000

for STG building

Increase in utilization = 6.5%[7] for error correction

Material saved = 6304 x 6.5% = 410 metric tonnes

Cost reduction = 410 x 36000 = INR 1,47,60,000.

TOTAL COST REDUCTION ACHIEVED BY USING MOST 2D:

Total cost advantage includes cost reduction due marking charges and increase in material utilization.

Total cost reduction = 1,47,60,000 + 42,56,600 = INR 1,90,16,600

CALCULATION OF COST REDUCTION DUE TO MATERIAL REDUCTION BY USING PLUS 2D:

Total material used = 6304 Metric tonnes

Cost/metric tonne = Rs.36000/metric tonne as on Dec 2007

Increase in utilization =6%[8] for error correction

Material saved = 6304 x 6% = 378 metric tonnes

Cost reduction = 378 x 36000 = INR 1,36,08,000

TOTAL COST REDUCTION ACHIEVED BY USING PLUS 2D:

Total cost reduction = 1,36,08,000 + 42,56,600 = INR 1,78,64,600

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[7] 6.84% rounded to 6.5% for error correction

[8] 6.26% rounded to 6% for error correction

COST ADVANTAGE OF MOST 2D OVER PLUS 2D:

Cost advantage is calculated by taking into consideration the difference in initial cost of the software and cost reduction achieved by each of the software.

Cost of MOST 2D Lite	= USD 1000	= INR 40,000[9]
Cost of PLUS 2D Sheet metal	= € 1300	= INR 81,900[10]

Cost advantage of MOST 2D over PLUS 2D in terms of initial cost = INR 41,900.

Difference in cost reduction by increase material utilization b/w two softwares	= 1,47,60,000 - 1,36,08,000
	= INR 11,52,000
Total cost advantage of MOST 2D over PLUS 2D	= 41,900 + 11,52,000
	= INR 11,93,900.

INTERPRETATION:

The **table 4.1** clearly shows that material utilization rate when nesting softwares are used is higher than when done manually. But the difference is marginal when efficiency of manual nesting is high.

The maximum difference between MOST 2D and manual nesting is 14.67% and minimum difference is -1.18%. The average difference between MOST 2D and manual nesting is 6.84% for all 268 items of STG building. In some cases manual nesting has been more efficient than that of the software.

The maximum difference between PLUS 2D and manual nesting is 12.43% and minimum difference is 0.53%. The average difference between PLUS 2D and manual nesting is 6.26% for all 268 items of STG building. It can be seen that the nesting done by using PLUS 2D was always greater than manual nesting.

Marking charges when nesting operations are done manually is INR 42,56,600. Total cost of material used for the STG building is 6304 metric tonnes which costs INR 22,69,44,000. When MOST 2D software is used about 6.5% of this cost is be reduced

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[9] Exchange rate of USD against INR is taken as 1$ = Rs 40.
[10] Exchange rate of Euro against INR is taken as 1€ = Rs 62

i.e., INR 1,47,60,000 can be saved by reducing wastage of around 410 metric tonnes of material.

When PLUS 2D software is used about 6% of this cost is be reduced i.e., INR 1,36,08,000 can be saved by reducing wastage of around 378 metric tonnes of material.

The difference in cost reduction by improved material utilization by using MOST 2D is INR 11,52,000 more than is achieved using PLUS 2D.

Initial investment required to buy MOST 2D is INR 41,900 less than that is required to buy PLUS 2D. Total cost advantage of using MOST 2D is INR 11,93,900.

INFERENCE:

The material utilization rate in manual nesting is only around 85% and material wastage is about 15%, because when nesting is done manually only one shape is taken at a time and arranged one by one to fill the entire area. It is taken as the optimal nesting and cutting process is started without arriving at an optimal nest, so there is a less chance for a best optimal solution. It happens to be a chance of luck that a best optimal solution is arrived for some drawings. This some times has more utilization rate than using software or is only marginally less.

The material utilization rate of both the softwares is around 92% and wastage in only about 9%. It has greater efficiency because they consider all the shapes at time for creating a nest. So, they have optimal nesting solution.

Better efficiency can be achieved even in manual nesting process by following trial and error method of nesting until an optimal nest is arrived. But it is a time consuming process and requires more analytical skill to work on arithmetical algorithms available to optimize the nest.

When the nesting tools are used, the labour charges involved in the name of marking charges can be saved.

MOST 2D nesting software is the most optimal software because it both efficient and cheaper than PLUS 2D.

5.CONCLUSION

CHAPTER 5

5.1. FINDINGS:

1. Material utilization rate has increased by 6.5% when MOST 2D software is used compared with manual nesting i.e., utilization rate has gone up from around 85% to 91.5%.
2. Wastage of 410 metric tonnes of material could have been minimized out of 6304 metric tonnes used for the STG building.
3. Cost reduction in terms of waste minimization by increase in material utilization would be INR 1,47,60,000 where the total cost of the project is INR 22,69,44,000.
4. Cost reduction in terms of labour cost for carrying out manual nesting operations is INR 42,56,600.
5. Cost reduction that can be achieved by using MOST 2D is INR 1,90,16,600.
6. MOST 2D is efficient than PLUS 2D by about 0.5%. The increase in utilization by 0.5% has a cost reduction of INR 11,52,000.
7. MOST 2D is also cheaper than PLUS 2D by INR 41,900 at current exchange rates. So the total cost advantage over PLUS 2D is INR 11,93,900.
8. Total cost advantage of using MOST 2D is INR 11,90,16,600.

5.2. SUGGESTIONS:

1. The company can buy MOST 2D software and train its employees to use it so that they can work efficiently.
2. The company can go in for CNC gas cutting machines which will further enhance the efficiency of cutting process.
3. CNC program codes can be generated using MOST 2D, hence this feature of the software can also be used.

5.3. CONCLUSION:

In the field of manufacturing, waste minimization has become an important factor and many companies are exploring ways to minimize various forms of waste generated during production process because this waste adds to the cost of the product, and the companies loose their competitive advantage. New techniques have to be adopted by the organizations to stay competitive.

BGR Energy Systems Limited was taken as a sample and its fabrication operations were studied to determine it efficiency. The study which was based on the fabrication reports of STG building i.e., material utilization rate and labour charge involved when nesting is done manually was used. It was then compared with reports generated using nesting softwares.

Based on analysis and subsequent findings it is concluded that manual operations are efficent but improvements can be made if nesting softwares are used and cost reduction can be achieved with minimal investment.

APPENDIX

IT CONTAINS THE REPORTS THAT CAN ARE GENERATED BY MOST 2D SOFTWARE.

Job File: H:\project\cutting plan\Cutting plan - New\Bhagwti\CP 23.job

Monday, April 07, 2008

Total Shapes Remaining: 0

Total Number of Stocks Consumed: 1

Total Consumption of Cutting Agent 1: 10.266 M3

Total Consumption of Cutting Agent 2: 1.027 M3

Total Operation Time: 324 minutes

Total Cost: 93087.05 in local currency

Note: For safety, always cross-check the estimates presented here.

Production Order No.: Date: April 07. 2008

Stock Name: fresh stock 1 Revision No.: 0 Item Code:

Stock Size: 12505 x 2505 x 12.000 Material: MS

Stock Area SqM	Item Area SqM	Scrap Area SqM	Consumed Area SqM	% Utilization	Rtn. Balance Area SqM
31.3250	26.0610	0.4289	26.4899	[illegible]	4.8352

Recommanded Operating Data

Nozzle Type	Cutting Speed	Oxy / N2 Pressure	Acetylene Pressure	Oxy / N2 Consumed	Acetylene Consumed
1	600.0 MMPM	3 unit	0 unit	10 unit	1 unit

Length of Cut: 184.793 M , 63 pierces Cutting Time (Minutes): 324

Cutting Machine: ____________________ Code Details: ____________________

Cut By	Date1	Cut Date	Return Balance Date
	__ / __ / 20__	__ / __ / 20__	__ / __ / 20__

Prepared By: ____________________

Remarks

Shapename	Project	Dimension	Quantity	Area SqM	Perimtr
12x350x1460		1460.00 x 350.00	51	26.06	184722.00

BGR ENERGY SYSTEMS (Fab-shop)

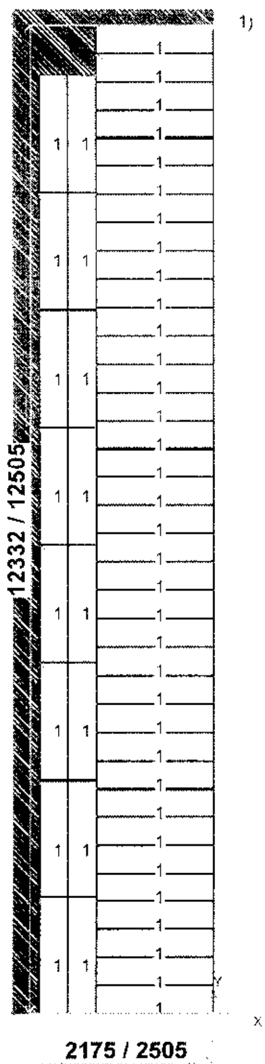
STOCK: fresh stock 1   Production Order No.:   Date: April 07, 2008

Matl: MS   Thk: 12.0 MM   Size: 12505x2505 MM   Offcut: 12.5x2.5 M

Stock Wt.: 2951 kg   Used Wt.: 2495 kg   Balance: 455 kg   Util: 98.4 %

Kerf: 1.00 MM   Speed: 600.00 MM per Minute

=> MS / 12.00 , %% = 83.20 , FREQ=1 , LEN=184722.00 , PRC=51 , [illegible]



1) 12x350x1460 # 51

Heat no.:   Material on hand: Req. #   PRP #

Drawn: Checked: Inspection:

Target Date: Priority #   Layout # 1   Revn #

Job File: H:\project\cutting plan\Cutting plan - New\Bhagwti\CP 23.job   Layout 1 of 1

BIBLIOGRAPHY

BIBLIOGRAPHY

BOOKS:

1. Pradeep Chaturvedi and N.K.Tewari, 'Modern Trends in Manufacturing Technology', The Instituition of Engineers (India), 1998.
2. Groover, 'Automation, Production Systems and Computer Integrated Manufacturing' 2nd Edition, Tata McGrawhill.
3. P.N.Rao, 'Manufacturing Technology – Foundry, Forming & Welding', 2nd Edition, Tata McGrawhill.
4. Dennis W.Mc Leavey, 'Production Planning & Inventory Control', 2nd Edition, Prentice Hall of India Pvt Ltd.

JOURNALS:

- Scott Grindstaff, 'Improving with Efficiency Nesting Software', by SigmaTEK Corp., Cincinnati, OH: Penton's Welding Magazine – January 2004.
- Patrick Waurzyniak, 'Buying CAD/CAM Software', Manufacturing Engineering - December 2004 Vol. 133 No. 6.
- Patrick Waurzyniak, 'Buying CAD/CAM Software', Manufacturing Engineering - December 2007 Vol. 139 No. 6.
- David R. DeLalio, 'Capacity Evaluation And Cost Optimization For Sheet Metal Punching', Department of Mechanical Engineering and Institute of Systems Research, University of Maryland, Master of Science, Thesis 1998.
- Ghosh Diptesh, Das Shubhabrata, 'Analysis of the Behaviour of Optimal Solutions to Combinatorial Optimization Problems When Element Costs Vary': IIM, Ahmedabad – 2004.
- Wang Hu, Li Enying, G. Y. Li and Z. H. Zhong, 'Optimization of sheet metal forming processes by the use of space mapping based metamodeling method', M.O.E., Hunan University, Changsha, China; Journal - The International Journal of Advanced Manufacturing Technology, Publisher - Springer London, November 2007 Vol. s00170-007-1253-z

WEB SITES:

www.weldingmag.com

www.sme.org

www.manufacturingtalk.com

www.isr.umd.edu

www.springerlink.com

www.wikipedia.org