Report of the Working Group on Steel Industry for the Eleventh Five-Year Plan (2007-2012)

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PREFACE

Today, steel industry is on an upswing the world over. Indian steel making units, both in private and public sectors, remain upbeat about their improved volume of turnover, capacity utilization, sales and profit margins. A number of MOUs have been signed by major steel producers, both domestic and international, with the mineral rich states signifying possibilities of marked increase in both greenfield and brownfield production capacities. While private steel majors like Tata Steel have moved towards a globalised growth strategy based on mergers and foreign acquisitions, the public sector majors like Steel Authority of Il'}dia Limited (SAIL) or Rashtriya Ispat Nigam Limited (RINL) have eliminated huge accumulated losses and become commercially buoyant.

2. This turnaround is to some extent a result of favourable global market conditions created by a huge surge in steel production and consumption in China. But the stimulus has also been the demonstration effect of a booming economy. In fact, the resurgence of Indian steel industry has moved parallel to the post liberalization economic revival and the resultant buoyancy in sectors like construction, infrastructure, real estate and transport which account for most of the total steel usage in the country. An important potential area for steel usage resulting from economic growth and rising income levels is the household sector, specially rural households. However, unlike urban areas, in the rural areas concerted efforts would be required to convert this potential into actual consumption of steel and steel based products.

3. Despite the improved commercial viability and business optimism, one cannot ignore the fact that the sector continues to be plagued by a number of constraints. Some of these concerns may be common to other manufacturing sectors like need for supportive infrastructural facilities, adequate power/fuel, skilled personnel, modern testing and quality control equipment, product diversification, and marketing. There are, however, constraints which are specific to steel making. These are assured supply linkages to iron ore, coal and gas. Today criticality of these inputs constitutes one of the major areas of concern in steel making and specially for units without any captive

mines.

4. There are also issues requiring attention such as Research & Development for cost effective production techniques utilizing indigenous raw material, modernization and upgradation of technology particularly in small and medium scale secondary level units, provision of training facilities for manpower development, diversification of steel products and markets, building up a reformed and consolidated data base for the steel sector etc.

5. National Steel Policy (NSP) announced on 3rd November, 2005 aims at building a modern and efficient domestic steel industry of global standards with a capacity to cater to diversified product demand. To realize this goal in a largely market driven environment, the industry will have to ensure efficiency and productivity of each and every component of operations including management. Although an in-depth analysis of every aspect of steel making was beyond the Working Group's Terms of Reference, a conscious effort has been made to cover the critical issues and concerns of the industry and suggest remedial measures.

6. The Eleventh Plan period is going to be crucial for maintaining and also improving the performance of the steel industry. India has the potential to emerge as global player in steel making if its inherent advantages of availability of quality iron ore, cheap labour, technical manpower and growing domestic demand are properly leveraged.

7. I would like to thank all members of the Working Group for adjusting their busy time schedule to be present at the Group's deliberations and for providing valuable suggestions. I must place on record appreciation for the contribution made by both Sub Group-I and Sub Group-II in finalization of the recommendations. I would also like to thank the project team of Economic Research Unit (ERU) for their sincere involvement from conception to completion of the report.

I am sure the report will prove to be a valuable referral document on the performance and future prospects of the Indian Steel Industry.

(Raghaw **Sharan Pandey)**
Secretary, Ministry of Steel
& Chairman of the Working Group

New Delhi
4th December, 2006

INTRODUCTION

The Planning Commission vide its letter No. I&M 3(30)/2006 dated 22nd May, 2006 constituted the Working Group on Steel Industry for the Eleventh Five Year Plan (2007-2012) under the Chairmanship of Secretary, Ministry of Steel. The Composition and Terms of Reference of the Working Group is given at Annexure-1.

2. The first meeting of the Working Group was held on 9th June, 2006 in which it was decided that there was need for an indepth analysis of the issues relating to Steel Industry prior to framing a development strategy for 11th Plan. Accordingly, two Sub-Groups were set up – the Sub-group I on Demand and Supply of Steel under Shri Arun Kumar Rath, AS&FA, Ministry of Steel and the Sub-group II on Technological Issues under Shri George Elias, Joint Secretary, Ministry of Steel. The Composition and Terms of Reference of the two Sub-Groups are given at Annexure-2 to 2(iv).

3. Both Sub-group I & II submitted their reports by end of October, 2006 and their recommendations were considered by the Working Group in its second meeting held on 16th November, 2006. Based on the deliberations held on the recommendations, the report of the Working Group has been finalised.

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EXECUTIVE SUMMARY

The Working Group on the Steel Industry for Eleventh Five Year Plan (2007-12) was constituted by the Planning Commission with the objective of making a critical assessment of the performance of the Industry, examine major sectoral policy issues and concerns, estimate the potential demand and supply requirements during 11th Plan and to make policy recommendations for implementation. The major findings and observations of the Working Group are summarised as follows:-

(A) Overview of the Indian Steel Industry – Status, Performance and Emerging Trends

(i) The Indian steel industry is currently going through an expansionary phase backed by a liberalised policy environment. Prospects of domestic demand appear to be excellent driven by high investment rate, accelerated growth in the manufacturing industry and expansion in physical infrastructure creation.

(ii) The first four years of the Tenth Five Year Plan have seen robust growth of the steel industry with significant increases in both production and consumption. Crude steel production grew at the rate of 10.5% annually from 27.964 Million Tonnes in 2001-02 to 41.660 Million Tonnes in 2005-06. This growth was driven by both capacity expansion (from 34.172 Million Tonnes in 2001-02 to 45.693 Million Tonnes in 2005-06) and improved capacity utilization (from 82% in 2001-02 to 91% in 2005-06). Production of finished non-alloy steel grew at the annual rate of 9.8% from 30.635 Million Tonnes in 2001-02 to 44.544 Million Tonnes in 2005-06. Consumption of finished non-alloy steel also kept pace with production and grew at an annual rate of 9.3% from 27.43 Million Tonnes in 2001-02 to 39.19 Million Tonnes in 2005-06. The average increase in production during the 10th Plan was 3.5 Million Tonnes per annum as compared to just 1.6 Million Tonnes per annum during the 9th Plan (1997-2002). The growth in consumption was even more impressive with the annual growth rate more than doubling to 9.3 % in 10th Plan from just 4.4% in 9th Plan.

(iii) The post-deregulation period has seen significant changes in the structure of the Indian steel industry in terms of ownership. Capacity creation during the last decade after deregulation has taken place entirely at the behest of the private sector. As a result, there has been a noticeable shift towards the private sector both at the crude and finished steel stages. Private sector now accounts for 59% of total crude steel output compared to 37% in 1992-93 and 71% of total finished steel output compared to 67% in 1992-93.

(iv) Advent of new production technologies has brought about a significant change in the route-wise composition of the Indian steel industry. Capacities created in the aftermath of deregulation have been based on technologies as diverse as COREX (JSW Steel Ltd.), large-scale hybrid technologies combining Electric Steel making with BF hot metal with downstream rolling of flat products (Ispat Industries Ltd.) and large-scale integrated 'DRI-EAF-Flat products Rolling' capacities (Essar Steel Ltd.) etc. In the post deregulation years, the Secondary sector has doubled its contribution to crude steel production from 23% to 48% and for finished steel from 45% to 64% respectively.

(v) In the last five years the Indian Sponge Iron industry grew at an annual rate of 23.5%. Today, India has become the largest producer of sponge iron in the world with a total production of 12.6 Million Tonnes in 2005-06 as against 5.4 Million Tonnes in 2001-02. Expansion of this sector supplying a substitute for scrap, has been helped by limited scrap availability and resultant high prices with a rapid rise in production in the secondary sector. This growth Is the result of a remarkable expansion in the small-scale coal based units with short gestation period and low capital intensity – concentrated largely in the iron-rich states of Jharkhand, Orissa and Chhattisgarh. On the other hand, in the large-scale technologically sophisticated gas based sponge iron units production has remained stagnant.

(vi) During the first four years of the 10^{th} Plan, production of merchant Pig Iron remained at around 3-3.8 Million Tonnes till 2004-05. However, Pig Iron production has once again recorded a robust growth increasing 45% in a single year from 3.2 Million Tonnes in 2004-05 to 4.7 Million Tonnes in 2005-06. The noticeable trend with respect to this sector has been the gradual decline in the supply of merchant pig iron from the integrated Main Producers (e.g. SAIL and RINL) and the rise of the Secondary Sector Producers whose contribution increased from 64% in 2001-02 to nearly 79% in 2005-06. This trend is expected to continue in future as the Main Producers have not planned for significant increase in pig iron production.

(vii) Between 2001-02 and 2005-06, production of Special and Alloy steel has grown from 0.99 Million Tonnes to 2.28 Million Tonnes and consumption from 1.09 Million Tonnes to 2.25 Million Tonnes. Of the total output, Stainless Steel accounted for about 1.7 Million Tonnes in 2004-05. India is currently the 7^{th} largest producer of stainless steel in the world and has developed niche export markets in countries like China. The recent growth in this segment has been stimulated by use of stainless steel in sophisticated industrial applications and also in construction activities.

(viii) Performance of the domestic Ferro Alloy industry, although operating at 68% capacity utilisation, has been in line with the Indian and global steel industry. Production increased at a healthy annual average rate of 18.6% from 0.828 Million Tonnes in 2001-02 to 1.65 Million Tonnes in 2005-06. Export performance of this sector also remained robust with export share in production going up steadily from 18.4% to 27.6% in the last four years despite uncompetitive power rates. In the case of this industry, while Chrome Alloys dominated the export basket, imports have been mostly of Ferro Silicon.

(ix) The Indian Refractory industry caters to a wide range of end-using sectors such as steel, cement, non-ferrous metals, glass etc. Production in this sector recorded a double-digit growth of 12.3% annually in the first four years of the 10th Plan – increasing from 754.9 Thousand Tonnes to 1069.9 Thousand Tonnes between 2002-03 and 2005-06. However, there still exists, substantial unutilized capacity in this segment (utilization rate being 55% in 2004-05). The industry is constrained by long term deceleration in volume growth in demand because of improved technology and operating practices leading to increased refractory life cycle in critical areas of steel making which accounts for about 75% of the total Refractory consumption in India.

(x) Liberalization of the foreign trade regime has had a favourable effect on Indian exports. Exports have grown fast and at a rate exceeding 25% per annum between 1991-92 and 2002-03. Thereafter, till 2005-06 export levels stagnated at around 4-4.5 Million Tonnes per year. This period also coincided with a change in the country's export basket in favour of more value added and sophisticated products. The export destinations have also become diversified with the inclusion of new markets in Africa and the Middle East. On the other hand, imports followed a different growth path. In spite of progressive reduction in customs duty levels after deregulation, imports remained around 1-2 Million Tonnes per year till 2003-04 and rose rapidly in the last two fiscals. As a result, for a major part of the post deregulation years the country remained a net exporter of steel, even though the net export levels fluctuated between a low of 0.06 Million Tonne in 1996-97 to a high of 3.8 Million Tonnes in 2003-04.

(xi) It is important to note that there has been a change in the relative movements of exports and imports in the last 2-3 years. This period also saw very steep cut in customs duty rate on steel imports from 15% to 5% and within one single year (i.e., between February 2004 and August 2004). The reduction in import duty rates was undertaken to provide steel users easier access to global supplies and thereby stem the abnormal rise in domestic prices and also to avoid possibilities of a supply shortfall in the domestic market. Subsequently, i.e. in the last three years, imports of saleable steel more than doubled from 1.7 Million Tonnes in 2003-04 to 4.1 Million Tonnes in 2005-06. The surge in imports, however, has been accompanied by a decline in exports and also by falling net exports levels. These developments would imply that the rise in imports is, to a very large extent, the result of increased domestic demand and not of erosion in the competitiveness of Indian steel.

(xii) Another important outcome of globalisation has been the parallel movement in international and domestic prices – the difference between the two is largely dependent on the external value of the Rupee and the import duty rates. In other words, domestic prices are now being determined at the margin by international prices as expected in a free and open market situation. In fact, progressive reduction in custom duty rates has over the years reduced the margin between the landed cost of imports and the domestic market prices.

(xiii) Today world steel prices have become more volatile with sharp fluctuations within short time gaps. The differences between the contracted price and spot prices have also widened in the recent years. This is more apparent in the case of flat products, especially Hot Rolled flat products, as against the long products.

(xiv) This volatility has been reflected in the globalised Indian steel market as domestic prices in the de-regulated market tend to move in tandem with international prices. In reflection of the global situation, in the last three years, prices of both finished steel and those of its inputs such as iron ore and coal have also risen at a much faster rate and with a lot of volatility compared to the pre-deregulated era.

(xv) Overall, the net result of the changes in the prices of finished steel and its inputs has been quite positive for the financial health of the Indian steel industry. The restructuring efforts of the Government of India after opening up of the economy, i.e. between 1998 and 2001) and the favourable current domestic and international markets – have gone a long way in restoring the health of the Indian steel industry. The return on capital invested has improved significantly for both Public Sector and Private Sector players. Today, the Indian steel industry has both the potential and the creditworthiness to fund future plans of expansion through generation of internal resources and by directly raising capital from the market.

(B) Global Trends

(i) The world steel industry is currently going through an extraordinary phase of growth and all round prosperity, fuelled primarily by the frenetic pace of growth in consumption and production of steel in China. World crude steel production grew from 0.850 billion Tonnes in 2001 to approximately 1.13 billion Tonnes in 2004 – recording a growth of 7.5% per annum compared to a mere 2% annual growth recorded between 1995 and 2001.

(ii) The major trends observed in the structure of the world steel industry are:

- Continuous shift of the industry– both in terms of production and consumption– from the West towards the East;
- Ensuring control over raw materials has become a very important component of steel business strategy in the aftermath of tight supply conditions and inflated prices caused by China's entry into the raw materials market;

- Consolidation taking place through mergers and acquisitions, often across boundaries, as companies acquired downstream facilities for assured markets and upstream facilities for assured raw material/feed material supplies;
- Increased volatility of steel prices globally and widening of the gap between spot and contracted prices;
- Significant increase in the market valuation of the steel companies worldwide resulting from rising prices and successful cost reduction efforts.

(iii) Outlook for world steel market remains good for the coming next 2-3 years in the light of the expected robust global economic conditions. The short range forecast of steel consumption made by the International Iron & Steel Institute (IISI) estimates world steel demand to touch 1150 Million Tonnes in the calendar year 2007.

(iv) The greatest downside risks, however, may result from the possibility of a decline in the growth of domestic steel demand in China and the subsequent possibility of huge net exports from that country. Observers feel that any slowdown in the largely state-sponsored and highly steel-intensive 'Fixed Asset Investments' could create substantial over supply of steel within China with adverse impact on business globally.

(v) Further, potentially tight supply conditions of mined raw materials like coal and iron ore, shortage of international bulk carrying capacities and high transportation costs, possibilities of global destabilization through rising oil prices and high rates of inflation and interest in the developed world – also remain major causes of concern for the world steel industry including India.

(C) Outlook for Steel Demand and Supply

(a) Domestic Demand

(i) Demand for steel has been worked out on the basis of observed relationship between steel consumption and selected macro economic variables under four scenarios of GDP growth (i.e., of 7%, 8%, 8.5% and 9%) by 2011-12 as envisaged in the Draft Approach paper for the Eleventh Five Year Plan. In the 'Most Likely' scenario of 9.0% GDP growth, demand for steel works out to be 70 Million Tonnes by 2011-12. Therefore, it is envisaged that in the next five years, demand will grow at a considerably higher annual average rate of 10.2% as compared to around 7% growth achieved between 1991-92 and 2005-06.

(ii) The forecasts imply a higher rate of growth in demand for almost all steel categories in the next 5 years compared to that attained between 1991-92 and 2005-06. The highest double-digit growth rates have been visualised for Railway Material, Hot rolled flat products, Galvanised flat products and pipes.

(iii) Based on the observed annual rate of growth of 12% achieved during the last decade and the fact of a very low base level, apparent consumption of Special and Alloy steel is projected at around 3.5 -4.0 Million Tonnes, stainless steel at around 1.75 Million Tonnes by the year 2011-12.

(iv) Likely demand for pig iron is projected to lie in the range of 5.2 to 5.6 Million Tonnes by the year 2011-12.

(b) Export Demand

(i) India has necessary resources and capabilities to become a global supplier of quality steel. Also there exists ample market opportunities in the neighbouring regions of Asia, Africa and the Middle East. The policy framework while according top priority to meet domestic demand should also take into account the large export possibilities. Recognizing this potential, the National Steel Policy, 2005 has estimated an annual growth of around 13% in export of steel in the next decade and a half – a rate slightly higher than the achieved growth of around 11% during the post deregulation years.

(ii) Extrapolating this growth rate, the National Steel Policy projects an export ratio (i.e., percentage of production exported) in the range of 25-26% by 2019-20. Currently, India exports about 10% of its total finished steel production. Additionally, it exports semi-finished steel. In line with the achieved export ratio and the export possibilities indicated in the NSP, the milestone export ratio for the Eleventh Plan period is estimated to remain within a range of 12% - 15% of total production.

(iii) The large-scale capacity additions envisaged during the Eleventh Five Year Plan period confirm the possibility of achieving the targets set in the National Steel Policy, 2005.

(c) Demand and Supply Balance and Issues in Capacity Build-up

(i) In a deregulated environment, it is difficult to forecast capacity creation, especially in the private sector. Further, capacity creation is sensitive to unfolding market conditions – domestic as well as global. Based on information available from MOU documents, the crude steel supply by 2011-12 works out to be more than 100 Million Tonnes. However, the likely capacity to be realised by 2011-12 has been put at a lower figure of 80 Million Tonnes and that of finished steel at 77 Million Tonnes. These estimates have been worked out based on historical trends as well as an objective assessment of the following factors:

- Gestation period of large projects and the time required for obtaining statutory clearances
- Availability of key raw materials and infrastructural facilities

- Export/import possibilities and issues of competitiveness
- Movements in domestic demand
- Project cost, pricing of steel and raw material and issues of viability of individual projects

(ii) With the projected consumption of 70 Million Tonnes of non-alloy finished steel and corresponding production of 77 Million Tonnes by 2011-12, the steel industry appears to be well on its way to achieve targets set by National Steel Policy. This will be possible even after assuming an intermittent period of downturn, due to inherent cyclicity of steel business. However, if current momentum in steel demand and production is consistently maintained, the country may achieve the stipulated targets of NSP about 2 -3 years in advance. Estimated domestic supply and domestic demand for non-alloy finished steel in the terminal year of the 11th Five Year Plan is as given below:

Estimated Domestic Demand and Supply Balance in the Most Likely Scenario, 2011-12

(Million Tonnes)

Products	**2011-12**	
	Demand	**Supply**
Non-Flat	29.0	36.1
Flat	41.3	41.3
Total	70.3	77.4

(iii) In the last 15 years (i.e., 1991-92 to 2005-06) import of steel as a percentage of total consumption in India has varied between a high of 10% in 2005-06 and a low of 4.8% in 1998-99. Import of steel during the Eleventh Five Year Plan is forecast to be in the range of 3-7 Million Tonnes per year.

(iv) The estimated export ratio of 12%-15%, the projected production of 77.3 Million Tonnes and the likely import projection of 3-7 Million Tonnes per annum translate into export possibilities of 10–12 Million Tonnes per annum during the 11th Five Year Plan period. Therefore, projected production/supply during the Eleventh Five Year Plan appears to be adequate to take care of the export targets, albeit with some fluctuations between the two benchmark years. That is to say that the export possibilities and the import expectations along with expected domestic production would have enough leeway in the system to accommodate periodic spurts in domestic demand by 2011-12.

(D) Requirement of Raw Materials, Railway Services and Investments to Support Extra Production

(i) Based on the distribution of projected production of crude steel according to process routes and average norms of consumption route wise, estimates of total and additional requirement of raw materials have been worked out. However, in view of the fact that there exists large scope of improvement in operational efficiencies and also due to the fact that there are possibilities of changes in likely share of different routes, the estimates of input requirements are only indicative:

Estimated Requirement of Raw Materials and Other Inputs by 2011-12

Input Materials	Unit	Estimated Consumption 2005-06	Estimated Consumption 2011-12	Additional Requirement by 2011-12
Coking coal	Million Tonne	31.5	46.0	14.5
Non-coking Coal	Million Tonne	15.0	24.5	9.5
Coal Dust Injection	Million Tonne	Negligible	3.00	3.00
Iron Ore	Million Tonne	66.9	130	63.1
Scrap Steel	Million Tonne	10.2	18.0	7.8
Lime Stonne	Million Tonne	11	19.5	8.5
Dolomite	Million Tonne	4.0	7.4	3.4
Natural Gas	MCAL	10000	15000	5000
Ferro Alloys	Million Tonne	0.85	1.5	0.65

Power	MW	4120	7700	3580

(ii) On the basis of the present share of railways and roads in the movement of raw materials and finished/saleable steel, total traffic generated for the railways originating in the steel sector (excluding export of iron ore) is estimated at around 115 Billion Tonne-Kilometer by 2012.

(E) Issues in Technology and Research & Development

(i) BF-BOF based integrated steel plants with incorporations of latest technological innovations are expected to continue to be the main route of steel making throughout the world. While efforts are continuing to improve the already efficient blast furnace iron making process to the state of the art, it still has to depend on metallurgical coke for over 50% of the total fuel requirement. India has to depend mostly on import of coking coal. Moreover, the limited coking coal sources throughout the world are fast depleting. Therefore, globally and particularly for India, techno-economically viable alternative to blast furnace iron making has become imperative.

(ii) There are many technological developments, which have been commercialised abroad to reap the benefits in both equipments and processes. However, these are yet to be adopted widely in India. The Indian Steel Industry has to come forward and adopt these technologies on priority basis to make their products competitive internationally

(iii) India has a reserve of iron ore and non-coking coal. It has its own coal based DRI technology. Therefore, concerted efforts should be made to improve to coal based DRI technology and increase its production for use in electric steel making and an integrated policy formulation for development of this sector is necessary.

(F) Environmental Management and Pollution Control

(i) Environment protection in iron & steel plants is essentially linked to technology adopted for iron & steel making, starting from the raw material to finished steel stage, and efficient disposal/re-use of generated bye-products and waste. In this connection, bringing in zero waste and zero discharge concepts from the steel works are very relevant. This calls for an integrated approach at the production process and the environment surrounding the plant.

(ii) Despite significant progress, steel related environmental issues may continue to be the focus of policy debates, legislation and regulation. However, the vision of the industry should be to achieve further reduction in air and water emissions and discharges and generation of hazardous wastes as well as to develop/adopt designs and processes to avoid pollution rather than control and its treatment. Wastes, particularly solid wastes generated unavoidably, are to be converted into useful, value added by-products. In other words, “sustainable development” is to be practiced right from technology development and design stages. The challenge for steel in the new millennium is no longer to prove its capacity to create growth but to show that it is a material with a future resolutely adapted to the integrated concept of “sustainable development”. In future, it may be ensured that technologies, which are not “sustainable”, should not be adopted for either expansion of existing plants or creation of new capacities. Towards these objectives, initiatives both at the level of the entrepreneurs and Government by way of suitable intervention are necessary.

(G) Safety Measures

(i) The safety policy adopted in the Iron and Steel industry in India is comparable to the policy followed internationally. However, implementation and monitoring of these policy guidelines on the ground leave much to be desired. As a result, the number of accidents, casualties, disabilities, loss to plant and machinery and consequential loss of man-days and production is quite significant. It calls for an introspection and review of the whole situation.

(ii) It has been observed that adherence to safety measures and policy is lacking due to many factors, viz. indifference on the part of management and workers, financial problems, lack of awareness, complicated and slack legal machinery and lack of adequate statutory provisions.

(iii) Use of many out-dated technologies still prevalent in India exacerbates the hazards and risks in the plant.

(H) Issues in Competitiveness

(i) The Indian steel industry has a number of inherent advantages and can take pride in a few highly efficient and competitive firms in Steel manufacturing. However, there is substantial inter and intra sectoral divergence in the performance of the producers in terms of operational efficiency and cost of production. While there are positive factors benefiting the industry's performance, it remains equally constrained by a number of factors such as lack of availability of suitable raw materials, infrastructural inadequacy, high cost of capital and other structural impediments. The strengths, weaknesses and opportunities for the Indian steel industry have been identified as follows:

<u>Strengths:</u>

- Availability of iron ore and processed inputs like Sponge Iron
- Low wage rates
- Skilled manpower and managerial capability
- Ongoing modernization of existing/older plants and cutting edge technology in the new plants
- Regionally dispersed secondary steel makers to cater to local demand

Weaknesses:

- High cost of energy
- Poor infrastructure and high transaction costs
- Poor quality of domestic coking coal
- Relatively high cost of capital
- Rigid Labour Laws and their impact on productivity, costs and investments
- Dependence on imports for steel manufacturing equipments and technology
- Slow statutory clearance for development of mines
- Low R&D investments
- Low labour productivity
- Cost and time overrun in implementation of projects

Opportunities:

- Potentially huge domestic demand for steel-intensive social and economic infrastructure resulting from all round economic development and particularly because of anticipated growth in urbanisation
- Demographic conditions that favour Increasing demand for consumer durables
- Untapped rural market
- Increasing interest of domestic and overseas producers in capacity creation to serve the domestic and overseas markets

Threats:

- Slow growth in infrastructure development
- Possibilities of export growth from China
- Global economic slow down
- Unrestricted export of iron ore and other exhaustible mineral resources.

(I) Role of Government

(i) The Government has an important facilitating role in the development of the steel industry. As steel making is a highly capital intensive and complex process requiring large-scale investment, historically the industry has evolved with Government support. While direct Government involvement in steel making process may no longer be required, the State will have to provide the necessary policy support to the sector to achieve the objective of the National Steel Policy to make India a global Steel producer. Some of the important areas, where Government support is required, are - providing essential infrastructure facilities; assuring easy availability of critical inputs such as iron ore, coal, gas and power; provision of training facility for manpower development and creation of a consolidated and reliable data base for informed decision making by all stakeholders.

CHAPTER - I

PERFORMANCE, PRESENT STATUS AND GROWTH OF THE INDIAN STEEL INDUSTRY

1.1.0 Overview

1.1.1 Performance of the Indian economy in the last four years of the 10th Five Year Plan is an indication of its capability to grow at a fast pace on a sustained basis. The average growth rate in the 10th Five Year Plan has been estimated to be around 7.1% compared to 5.5% in the 9th Five Year Plan. The 7.1% average rate has been attained despite the very low growth rate of 3.8% recorded in the first year of the Plan. Exclusion of that year would raise the average growth in the past three years to 8.1% per year. Since 1950-51 - growth rates in real GDP exceeded 8% only in 5 years (i.e., 8.1% in 1967-68, 9% in 1975-76, 10.5% in 1988-89, 8.5% in 2003-04 and 8.4% in 2005-06) and two of these five were in last three years.

1.1.2 One of the most significant developments in this period has been the increase in investment rate. A pick-up in investment in the recent years has not only provided sustenance to industrial performance but has also strengthened the prospects of growth on a trajectory higher than that observed so far. The upward movement in Gross Domestic Capital Formation (GDCF) that started in 2002-03 had continued to recover till 2005-06. GDCF, as a proportion of GDP at current market prices, had declined from 26.0% in 1999-2000 to 23.0% in 2001-02 before the commencement of the industrial recovery in 2002-03. The ratio went up to 25.3% and 27.2% per cent in the two subsequent years and reached a high of 30.1% in 2004-05. Performance of the major macro economic indicators during the 10th Five Year Plan is shown in the **Table - 1.1**.

Table 1.1

Macro Economic Indicators for the Indian Economy, 2002-03 to 2005-06

(Percentage change over previous period)

Parameters	2002-03	2003-04	2004-05	2005-06
Gross Domestic Product at factor cost (at 1999-2000 prices)	3.8	8.5	7.5	8.1
Index of Industrial production	5.8	7.0	8.4	7.8
Whole-sale price index	6.5	4.6	5.1	4.1
Imports at current prices (In US $ million)	19.4	27.3	39.7	26.7
Exports at current prices (In US $ million)	20.3	21.1	26.2	18.9
Money Supply (M_3)	14.7	16.7	12.2	16.4
Sectoral Real Growth Rate (at 1999-2000 prices) Agriculture & Allied Industry Services	-6.9 7.0 7.3	10.0 7.6 8.2	0.7 8.6 9.9	2.3 9.0 9.8
Gross Domestic Savings as percentage of GDP	26.5	28.9	29.1	-
Gross Domestic Investment as percentage of GDP	25.3	27.2	30.1	-

Source: Economic Survey ,2005-06 and CSO

1.1.3 The pattern of economic growth witnessed in the last three years has been highly conducive to growth in the steel sector. The improved investment rates and the consequent step up in capital formation augur well for the steel industry that provides an essential intermediate for generating and sustaining growth in the brick-and-mortar commodity sectors of the economy. The Indian steel industry stands to benefit from the overall industrial recovery that started from the second quarter of 2002-03, which may be expected to continue. An acceleration in the growth of Industrial GDP (at factor cost at constant 1999-2000 prices) from 7% in 2002-03 to 7.6% and 8.6% in the subsequent two years, and an expected growth of around 9% in 2005-06 re-inforce the outlook of industrial resurgence in the coming few years.

1.1.4 Within the industrial sector, manufacturing growth has accelerated steadily from 7.1% in 2003-04 to 9.4% in 2005-06 with manufacture of capital goods registering a much faster double-digit growth. A faster growth of the capital goods sector within manufacturing indicates not only sustainability of the current rally in investment rates and possibility of accelerated future growth rates but also expanding demand for steel. Similarly, construction activities, which account for more than half of the current steel consumption in India, has been growing in double digits in each of the last three years at 10.9%, 12.5% and 12.1%, respectively. These sector level developments, if sustained, act as important enablers for growth in the steel sector.

1.2.0 Performance of Indian Steel Industry

1.2.1 Trends in Production and Consumption

1.2.1.1 The Indian steel industry in the last two decades of the controlled regime was plagued by low growth rates. A need was felt to break the vicious circle of low growth rate, shortages and structural inefficiencies. As a part of the general economic reforms programme, deregulation of the Indian steel industry was initiated in 1992. The new policy regime consisted of measures such as decontrol of price and distribution, de-licensing / de-reservation of capacity, progressive reduction of tariff barriers and removal of quantitative restrictions in international trade.

1.2.1.2 These policy measures set in motion a process of rejuvenation of this core industry, which during the 80s had shown signs of pervasive stagnation. In the 15 intervening years since deregulation, average yearly growth in production accelerated to 8.4% compared to 5.3%, recorded in the 80's. Similarly, the rate of increase in consumption of finished steel increased to 7.2% compared to 5.3% recorded in the decade preceding de-regulation **(Table – 1.2)**.

Table – 1.2

Comparative Rates of Growth in Production & Consumption of Finished Steel before and after Deregulation

Period	No. of Years	Production (Million Tonnes)	CAGR (%)	Consumption (Million Tonnes)	CAGR (%)
Decade preceding deregulation (1982-83 to 1991-92)	10	8.48 to 14.33	5.3	9.26 to 14.84	5.3
Entire Post De-regulation Period (1992-93 to 2005-06)	14	15.20 to 44.54	8.4	15.00 to 39.19	7.2
Eighth FYP (1992-93 to 1996-97)	5	15.20 to 22.72	9.7	15.00 to 22.13	8.3
Ninth FYP (1997-98 to 2001-02)	5	23.37 to 30.64	6.2	22.63 to 27.44	4.4
Tenth FYP till date (2002-03 to 2005-06)	4	33.67 to 44.54	9.8	28.90 to39.19	9.3

Source: Joint Plant Committee

1.2.1.3 The first four years of the 10^{th} Five Year Plan have seen robust growth of the steel industry with significant increase in both production and consumption. The average increase in production during the 10^{th} Five Year Plan was 3.5 Million Tonnes per annum compared to just 1.6 Million Tonnes per annum in the 9^{th} Five Year Plan. Performance of steel consumption was even more impressive with annual growth rate more than doubling to 9.3 % in the 10^{th} Plan compared to just 4.4% in 9^{th} Five Year Plan.

1.2.1.4 The relative average rates of growth in production and consumption for the four years, however, show significant yearly variation –

a) In the first two years of the Plan (2002-03 and 2003-04) production growth at 9.9% and 9.8% exceeded growth in consumption at 5.4%, and 7.8%, respectively.

b) This was reversed in the following two years (2004-05 and 2005-06) when consumption growth at 10.4% and 13.9% outstripped production growth at 8.4% and 11.2%, respectively.

1.2.1.5 The cyclicity of production and consumption of steel can be better understood if one considers a longer time series. Performance of the industry in the three consecutive Five Year Plans after deregulation (i.e., the 8th, 9th and the 10th Plans) clearly reflects this periodicity as shown in **Table 1.2** i.e.:

- The 8th Plan period (1992-93 to 1996-97) saw a high rate of annual growth in both production and consumption averaging at 9.7% and 8.3%, respectively.
- A pronounced slow down in steel business marked the 9th Plan period (1997-98 to 2001-02) when production growth decelerated to 6.2% per annum and consumption to a mere 4.4%.
- In the next phase, the industry started gathering steam from 2002-03 onwards and gearing for an expansionary phase. The first four years of the 10th Plan (i.e., 2002-03 to 2005-06) saw the industry turn around once again to record an average rate of growth of 9.8% in production and 9.3% in consumption.

(Details at **Annexure – 3**)

1.3.0 Analysis of Steel Production and Consumption

1.3.0.1 A detailed analysis of trends in production and consumption during the first four years of the 10th Plan, with necessary information and break-up in terms of crude steel/finished steel, producer-wise and category-wise production and consumption is as follows:

1.3.1 Crude Steel Production Source-wise, 2001-02 to 2005-06

1.3.1.1 Today, according to the estimates of the IISI, India is the 7th largest producer of crude steel in the world with a capacity of 45.69 Million TPA compared to 34.17 Million TPA in 2001-02 **(Table-1.3)**. Capacity utilization rates have also improved from 82% to 91% in this period. As a result, production of crude steel went up from 27.964 Million Tonnes in 2001-02 to 41.660 Million Tonnes in 2005-06 – representing a growth rate of 10.5% annually. Expansion in capacity and production has been in consonance with the expansionary phase in the general economy and the consequent accelerated growth in demand for steel by the user sectors and high prices of steel.

Table – 1.3

Overall Crude Steel Production, Capacity, Capacity Utilization, 2001-02 to 2005-06

Year	Capacity (Million Tonnes)	Production (Million Tonnes)	% Utilization
2001-02	34.172	27.964	82
2002-03	35.090	30.443	87
2003-04	39.383	34.248	87
2004-05	43.248	38.486	89
2005-06 (P)	45.693	41.660	91
CAGR	7.5%	10.5%	

Source: Joint Plant Committee, P=Provisional

1.3.1.2 Producer group wise data on production of crude steel for the last five years **(Table – 1.4)** show that the rate of growth has been higher for the Secondary producers led by the 'New Majors' as compared to the BF-BOF based Main producers. Consequently, the share of the Secondary Producers has increased from 36% in 2001-02 to 48% in 2005-06.

Table – 1.4

Producer Group-wise Production of Crude Steel, 2001-02 to 2005-06

PRODUCER	PRODUCTION OF CRUDE STEEL (Million Tonnes)				
	2001-02	**2002-03**	**2003-04**	**2004-05**	**2005-06 P**
SAIL	11.023	11.628	12.385	12.460	13.470
RINL	2.990	3.256	3.403	3.452	3.494
TATA STEEL	3.749	4.098	4.224	4.103	4.730
MAIN PRODUCERS TOTAL	**17.762**	**18.982**	**20.012**	**20.015**	**21.694**
EAF/COREX-BOF/MBF-EOF	5.904	6.711	8.238	10.229	11.273
INDUCTION FURNACE	4.298	4.750	5.998	8.242	8.693
SECONDARY PRODUCERS TOTAL	**10.202**	**11.461**	**14.236**	**18.471**	**19.966**
GRAND TOTAL	**27.964**	**30.443**	**34.248**	**38.486**	**41.660**

Source: Joint Plant Committee, P=provisional

1.3.2 Finished Steel Production Source-wise and Category-wise, 2002 to 2005-06

1.3.2.1 Total production of non-alloy finished steel in the country stood at 44.544 Million Tonnes in 2005-06 compared to 30.635 Million Tonnes in 2001-02 **(Table – 1.5).** This represents an annual growth rate of around 9.8%.

Table – 1.5

Growth in Production of Non-Alloy Finished Steel, 2001-02 to 2005-06

Year	**Production (Million Tonnes)**		
	Flat	**Non-Flat**	**Total**
2001-02	17.564	13.071	30.635
2002-03	19.743	13.928	33.671
2003-04	21.816	15.141	36.957
2004-05	24.175	15.880	40.055
2005-06(P)	26.763	17.781	44.544
CAGR			9.8%

Source: Joint Plant Committee, P = Provisional

1.3.2.2 Producer Group-wise production data on Non-Alloy Finished Steel reiterates the shift towards private sector seen earlier for crude steel production. Share of Secondary sector in total Non-alloy Finished Steel production has increased from 57% in 2001-02 to 64% in 2005-06 is given in **Table – 1.6.**

Table – 1.6

Producer Group-wise Production of Non-Alloy Finished Steel, 2001-02 to 2005-06

Year	Production of Finished Steel (Million Tonnes)		
	Main Producers	Secondary Producers	Total Production
2001-02 (%Share)	13.052	17.583 (57%)	30.635
2002-03 (%Share)	14.386	19.285 (57%)	33.671
2003-04 (%Share)	15.187	21.770 (59%)	36.957
2004-05 (%Share)	15.611	24.444 (61%)	40.055
2005-06 (P) (%Share)	16.211	28.333 (64%)	44.544

Source: Joint Plant Committee, P=Provisional

1.3.2.3 In gross terms, the share of flats in total steel production is 60% in 2005-06 compared to 57% in 2001-02. However, since subsequent processing of flat products into CR, GP/GC & pipes takes place partly in stand alone rolling mills, the actual share of flats may be lower to that extent. The detailed break up in terms of various categories and also flats and non-flats are given in **Table – 1.7.**

Table – 1.7

Category-wise Production of Finished Steel, 2001-02 to 2005-06

(Million Tonnes)

Categories	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06 (P)**
Bars & Rods	10.04	10.68	11.146	11.827	13.243
Structurals	2.33	2.37	3.066	3.046	3.525
Railway Materials	0.70	0.88	0.929	1.007	1.013
Total Non-Flat	**13.07**	**13.93**	**15.141**	**15.880**	**17.781**
Plates	1.87	1.832	2.182	2.575	2.974
HR Coils/Sheets/Skelp	7.86	9.254	10.136	10.884	11.813
CR Coils/Sheets	4.67	5.074	5.507	6.159	6.806
Galv Coils/Sheets	2.36	2.790	3.130	3.672	3.782
Electrical Steel	0.13	0.158	0.139	0.121	0.148
Tin Plates	0.14	0.148	0.165	0.176	0.182
Pipes	0.54	0.487	0.557	0.588	1.058
Total Flat	**17.56**	**19.743**	**21.816**	**24.175**	**26.763**
Total Finished Steel	**30.64**	**33.671**	**36.957**	**40.055**	**44.544**
Growth over previous year		9.9%	9.8%	8.4%	11.2%
CAGR (2001-02 to 2005-06)					9.8%

Source: Joint Plant Committee, P=Provisional

1.3.3 Special /Alloy and Stainless Steel Production & Consumption

1.3.3.1 Special and Alloy steel sector has registered much higher growth rates as compared to non-alloy finished steel. The 20% annual growth in the last 5 years is driven, to some extent, by a large number of emerging applications for such steels. But the high growth rate can also be partly attributed to the low base level production. The production and consumption of special and alloy steel have in fact more than doubled in a short span of five years **(Table-1.8).** In these five years production grew from 0.990 Million Tonnes to 2.278 Million Tonnes and consumption from 1.085 Million Tonnes to 2.248 Million Tonnes. Exports form about 14% of total production currently. The year-wise details of production, import, export and apparent consumption of special and alloy steel is given below:

Table – 1.8

Production and Consumption of Special/Alloy Steel (including Stainless Steel) 2001-02 to 2005-06

(Million Tonnes)

Year	Production	I/P	Import	Export	Variation in stocks	Apparent Consumption
01-02	0.990	0	0.102	0.005	0.002	1.085
02-03	1.636	0	0.153	0.011	-0.002	1.780
03-04	2.286	0.179	0.213	0.372	-0.002	1.950
04-05	2.271	0.133	0.184	0.324	0.010	1.988
05-06 (P)	2.278	0.150	0.455	0.323	0.012	2.248

Source: Joint Plant Committee; P=Provisional

1.3.3.2 Stainless Steel

1.3.3.2.1 India is the 7th largest consumer of stainless steel in the world with an apparent consumption of around 1.154 Million Tonnes, as of 2004-05. The consumption level is estimated to have risen by 10 per cent in 2005-06. However, Indian per capita consumption of 1.1 kg is far lower than that of China at 4.1 kgs and of developed countries in range of 15-20 kgs per annum. Therefore, there exists a large scope for increasing domestic consumption of stainless steel, especially as the usage in construction and other industrial applications is much lower in India as compared to international norms. Of late, this higher potential is getting translated into reality with an estimated average annual growth rate of 11% in consumption. The scope of higher usage in industrial applications and the construction segment can be gauged from the fact that in India, around 75% of total consumption is for kitchenware. Of the remaining 25%, an estimated 10% goes to the process industry, 2% to construction, 2% to transportation, 5% to engineering, 2% per cent to electromechanical/electronics industry and the residual 4% for miscellaneous applications.

1.3.3.2.2 The Indian stainless producers have been able to corner a niche market in the 200-series in countries like China and as a result exports to these countries have increased sharply. Exports of stainless steel stood at about 0.7 Million Tonnes in 2004-05 with imports estimated at about 0.091 Million Tonnes.

1.3.3.2.3 As per the latest available information, production of stainless steel was about 1.7 Million Tonnes in 2004-05. In India, bulk of the stainless steel output, that is about 80 per cent of the total, is produced in the form of flat products in the 200-series, as mentioned above, for manufacture of kitchenware. The level is estimated to have risen by about 10% in 2005-06. India has some of the necessary natural resources like manganese and chrome ore for production of stainless steel. However, high prices of nickel continue to be an area of concern. The high nickel prices have, in the recent years, resulted in higher market share for substitute grades like ferritic and chrome manganese stainless grade.

1.3.4 Production of Merchant Pig Iron, Sponge Iron, Ferro Alloy and Refractory, 2001-02 to 2005-06

1.3.4.1 Merchant Pig Iron

1.3.4.1.1 Production of Pig Iron in India has maintained steady growth in the last few years. The reported high figures in excess of 4 Million Tonnes going up to 5.29 Million Tonnes in 2001-02 and 2002-03 include some output of captive pig iron (hot metal) units, which did not find their way into the open market. The production figures in subsequent years dropped as one such big unit was merged with the mother steel-making unit. However, last year production of Pig Iron has once again recorded a robust growth – increasing 45% in a single year from 3.228 Million

Tonnes in 2004-05 to 4.695 Million Tonnes in 2005-06 **(Table–1.9)**. The share of Secondary Producers in total Pig Iron output has grown from 64% in 2001 to 79% in 2005-06. In the past, the bulk of pig iron used to be produced in the integrated mills. However, increasingly this is not being considered an economically acceptable business proposition and the integrated plants, barring RINL and SAIL, have literally stopped production of pig iron. Even at the SAIL plants and RINL, production levels have dropped significantly in the recent years. As things stand now, these plants do not envisage production of pig iron in future on a planned basis. Because of the growing demand for pig iron coupled with the reluctance and inability of the integrated plants to supply the material, the merchant pig iron units have grown at a rapid pace commanding a large share of the market now.

Table – 1.9

Production of Pig Iron in India, 2001-02 to 2005-06

Year	Main Producers (Million Tonnes)	Secondary Producers (Million Tonnes)	Total (Million Tonnes)
2001-02	1.016	3.055	4.071
2002-03	1.107	4.178	5.285
2003-04	0.966	2.798	3.764
2004-05	0.625	2.603	3.228
2005-06(P)	1.007	3.688	4.695

Source: Joint Plant Committee, P=Provisional

1.3.4.2 Sponge Iron

1.3.4.2.1 India is currently the largest producer of Sponge Iron in the world with a total production of 12.649 Million Tonnes in 2005-06 compared to 5.443 Million Tonnes in 2001-02. This quantum jump translates into a 23.5% per annum growth in the last five years **(Table – 1.10)**. This growth has come in terms of a remarkable expansion in the number of coal-based units that have started operating in the Eastern Region (West Bengal, Orissa and Jharkhand), Western Region (Chhatisgarh, Maharashtra, Goa) and in the Southern Region (Andhra Pradesh, Tamil Nadu, Karnataka). Gas based production has remained somewhat stagnant and confined to the existing three plants – Essar Steel, Vikram Ispat and Ispat Industries – all situated in the Western region. Triggered primarily by non-availability and high prices of scrap, rapid expansion of this sector has also been helped by the following factors – a vigorous growth in domestic steel production led by the Secondary Producers using Sponge Iron as feed material, relatively low cost of investment and short gestation period of the production units, clear cut technology, availability of mineral resources, cheap labour and technical expertise. The total number of units in the country at present is 218. There are over a hundred units in the process of being commissioned.

Table – 1.10

Production of Sponge Iron in India, 2001-02 to 2005-06

Year	Production (Million Tonnes)
2001-02	5.443
2002-03	6.908
2003-04	8.085
2004-05	10.296
2005-06 (P)	12.649

Source: Joint Plant Committee, P=Provisional

1.3.4.3 Ferro Alloy

1.3.4.3.1 Existing capacity of the Indian Ferro Alloy Industry is assessed to be 2.4 Million Tonnes per annum. The total capacity is distributed among different types of Ferro Alloys with Manganese Alloys accounting for the largest share at 1.4 Million Tonnes, followed by Chrome Alloys at around 0.80 Million Tonnes and Ferro Silicon at 0.25 Million Tonnes and Noble Ferro Alloys at 25 Thousand Tonnes per annum. India possesses reasonably large reserves of all basic raw materials needed for producing the bulk Ferro Alloys, namely Silicon, Manganese and

Chrome Alloys. Currently, the industry is operating at 68% of the installed capacity. Demand for Ferro Alloys is linked to the growth of steel production at home and abroad. The Indian Ferro Alloy industry has significant export capability. During the 10th Five Year Plan this segment of the Indian steel industry has grown in line with the growth in domestic and global steel industry. Production increased at a healthy average annual rate of 18.6% from 0.828 Million Tonnes in 2001-02 to 1.65 Million Tonnes in 2005-06. The overall production, import and export of different Ferro Alloys are as shown in **Table – 1.11** below.

<u>Table – 1.11</u>

Production, Export and Import of Ferro Alloys in India, 2001-02 to 2005-06

(Thousand Tonnes)

Production	2001-02	2002-03	2003-04	2004-05	2005-06
Ferro Manganese	206.6	236.7	248.4	270.2	273.0
Silico Manganese	235.7	304.2	380.3	498.1	596.4
Ferro Silicon	76.2	82.0	68.8	99.3	90.7
Ferro Chrome / Charge Chrome	302.1	380.5	525.8	595.0	662.3
Total Bulk Ferro Alloys **CAGR (%)**	**820.6**	**1003.4**	**1223.3**	**1462.6**	**1622.4** **18.6%**
Ferro Molybdenum	2.2	3.1	2.9	2.9	2.8
Ferro Silicon Magnesium	2.4	6.4	6.3	7.1	11.2
Ferro Aluminium	1.7	2.0	5.2	5.9	7.2
Others	0.9	1.3	1.2	1.5	1.8
Total Noble Ferro Alloy **CAGR (%)**	**7.2**	**12.8**	**15.6**	**17.4**	**23.0** **33.7%**
Total Ferro Alloys CAGR (%)	827.8	1016.2	1238.9	1480.0	1645.4 18.7%
Exports	152.3	182.6	253.8	389.3	453.6
Imports excluding Ferro Nickel	42.7	61.8	62.6	79.6	Na

Source: Indian Ferro Alloys Producers' Association (IFAPA)

1.3.4.3.2 In spite of the uncompetitive power rates in India, share of exports in total production of Ferro Alloys increased from 18.4% in 2001-02 to 27.6% in 2005-06. Bulk of the exports is accounted for by Charge Chrome/Ferro Chrome with their shares varying between 65% and 75% of total exports during normal years. In recent years, Silico Manganese exports have also grown significantly. The largest imports are on account of Ferro Silicon forming around 50% of all imports.

1.3.4.4 Refractory

1.3.4.4.1 The Indian Refractory industry caters to the requirements of major consuming industries like steel, cement, non-ferrous metals, glass, etc. About 75% of the total output of refractory materials is consumed by the steel industry. The industry also enjoys domestic raw materials base. India has substantial reserves of high quality fireclay and Dolomite, refractory grade Bauxite, natural Magnesite, Chromite, Zircon and Sillimanite. Some raw materials of high purity levels and with specific desired characteristics are being imported. The industry has over 80 units with a capacity of 1.65 Million Tonnes per annum. This industry is also faced with a low capacity utilization rate estimated at 55% by the end of 2004-05. Production of Refractory materials between 2002-03 and 2005-06 are shown in **Table – 1.12** below.

Table – 1.12

Production of Refractories, 2002-03 to 2005-06

(Thousand Tonnes)

Type	2002-03	2003-04	2004-05	2005-06
Fireclay Refractories	176.2	206.9	276.8	239.7
High Alumina Refractories	261.1	350.6	361.6	365.4
Silica Refractories	15.4	31.2	26.2	52.8
Basic Refractories	215.3	196.6	204.1	233.3
Special Products	24.3	28.7	27.7	34.1
Others (including monolithics)	62.6	73.7	149.0	144.7
Total Production **CAGR (%)**	**754.9**	**887.7**	**1045.4**	**1070.0** **12.3%**

Imports	**57.8**	**134.0**	**174.9**	**211.6**

Source: Indian Refractory Makers Association & Ministry of Commerce

1.3.4.4.2 Refractory production in India has increased at the double-digit rate of 12.3% annually between 2002-03 and 2005-06 but the industry still has substantial unutilized capacity in place. Steel accounts for 75% of the total consumption of Refractory in India. However, production and consumption of Refractory has not grown at the same pace as its major user industry because of increased refractory life cycle in the critical areas of steel making process. The saving in material consumption has been achieved by improving refractory quality, improved refractory maintenance technique and better operational practices. Apart from the problem of falling specific consumption in the user segments, this industry has also faced increased import competition in the last few years. Imports increased 3.7 times between 2002-03 and 2005-06 registering an annual growth of 54%.

1.3.5 Finished Steel Consumption, 2001-02 to 2005-06

1.3.5.1 Consumption of steel has recorded an average annual growth rate of 12.1% in the last three years of the current Plan period. This is the highest periodic average growth rate in consumption achieved in the three post deregulation Five Year Plans (i.e., the Eighth, Ninth and the current Tenth Five Year Plans). For the entire four years of the current plan, however, finished steel consumption increased at an average annual rate of 9.3% (i.e., between 2001-02 and 2005-06) with considerable inter year variations ranging between 5.4% at the least and 13.9% as the highest **(Table – 1.13).**

Table – 1.13

Category Wise Consumption of Finished Steel, 2001-02 to 2005-06

(Million tonnes)

Categories	2001-02	2002-03	2003-04	2004-05	2005-06P
Bars & Rods	9.68	10.34	10.71	11.74	13.30
Structurals	2.33	2.42	3.02	3.05	3.52
Railway Materials	0.71	0.88	0.93	1.01	1.00
Total Non-Flat	**12.72**	**13.64**	**14.66**	**15.80**	**17.82**
Plates	1.93	1.96	2.29	2.84	3.57
HR Coils/Sheets/Skelp	6.95	7.89	8.55	9.77	10.16
CR Coils/Sheets	3.10	3.21	3.02	3.15	3.99
Galv Coils/Sheets	1.75	1.27	1.69	1.93	2.05
Electrical Steel	0.18	0.19	0.18	0.22	0.34
Tin Plates	0.28	0.24	0.22	0.22	0.26
Pipes	0.52	0.50	0.55	0.47	1.00
Total Flat	**14.71**	**15.26**	**16.50**	**18.60**	**21.37**
Total Finished Steel	**27.43**	**28.90**	**31.16**	**34.40**	**39.19**
Growth over previous year		5.4%	7.8%	10.4%	13.9%
CAGR (2001-02 to 2005-06)					9.3%

Source: Joint Plant Committee, P=Provisional

1.3.5.2 The pronounced growth in consumption of steel in the last three years came on the back of high growth rates achieved in the major steel using sectors of the economy led by investment in infrastructure on one side and resurgence in consumer spending leading to high growth rates in the manufacturing activities. The upward movement in the related macro indicators reflects a period of heightened activities in these end-using sectors **(Table – 1.14**) in the last three years after a period of relative sluggishness.

<u>Table – 1.14</u>

Macro Indicators Impacting Steel Demand, 2004-05 and 2005-06

(Annual average rate of growth in percent)

	2003-04	2004-05	2005-06 (Apr-Dec)
GDP (at 1999-00 prices)	8.5	7.5	8.1
Capital Goods	13.6	13.9	15.7
Consumer Durables	11.6	14.3	13.6
M&E other than Transport	15.8	19.8	10.5
Transport Eqpt & Parts	17.0	4.1	12.5
Other Manufacturing	7.7	18.5	23.5

Source: Economic Survey 2005-06

1.3.5.3 There is a dichotomy so far as India's total steel consumption and per capita consumption of steel are concerned. While India has one of the largest total consumption of steel in the world, in terms of per capita consumption of steel, its position is near the bottom of the ladder. The low per capita consumption indicates low level of penetration of steel in the overall economic activities of the country. In particular, the low levels show lack of infrastructure in the economy, sluggish development of the commodity sectors and low standard of living of the population in general. This is also manifested in low GDP intensity of steel. Currently, India's per capita consumption is estimated at 33 kgs (2005) per year compared to 240 kgs in China. **Table 1.15** shows the relative position of India compared to other countries in terms of per capita consumption of steel.

<u>Table – 1.15</u>

Per Capita Consumption of Steel in Select Countries (in kgs per year 2005)

World	India	China	USA	Germany	Japan	Mexico	France	Russia
157	33	240	347	430	610	150	250	212

Source: IISI & UNDP

1.4.0 Structure of Production

1.4.1 Current Status

1.4.1.1 Structure of the Indian steel industry as of 2005-06 with its various segments can be described as below:

i) **The Main Producers**: In order to maintain homogeneity with past data, the old classification of Integrated Plants has been renamed **Main Producers**. This category includes the public sector plants of SAIL (including its subsidiaries - IISCO, Alloy Steel Plant, Salem and VISL), RINL and the lone private sector plant – TISCO. The Main Producers have a combined capacity of around 19 Million Tonnes per annum with current capacity utilization rates exceeding 100%.

ii) **Other Major Producers:** This category includes the integrated steel plants (other than Main Producers) with crude steel capacity 0.5 million and above – irrespective of technology route. The **Other Major Producers** comprising of ESSAR, ISPAT and JVSL are estimated to have a total of 8 Million Tonnes of crude steel capacity. However, the official estimates lie at about 5.8 Million Tonnes. These are primary steel makers with diverse technology routes such as DRI-EAF DRI/BF-EAF, COREX/BF- BOF etc.

iii) **Other Secondary Producers:** This category is comprised of the mini steel plants with Electric Arc Furnaces (EAF) and Induction Furnaces (IF) with capacity below 0.5 Million Tonnes. All EoF units also come under this category. Moreover, this category includes the stand -alone processors without backward integration of steel making. Re-rolling (RR) Units, Cold Rolling (CR) Units, GP/GC Sheets Units, Pig Iron & Sponge Iron Plants (other than those of main/major producers) fall under this category.

1.4.1.2 The last two categories, namely the '**Other Major Producers'** and the '**Other Secondary Producers'** together form the consolidated category of **'Secondary Producers'**. Distribution of capacity amongst these units is shown below **(Table – 1.16)**.

The **‘Other Secondary Producers’**, being mainly Mini Steel Plants and stand-alone processors, have been categorized into segments according to their items of production.

Table – 1.16

Structure of the Secondary Sector, 2005-06

New Majors & Other Secondary Producers: Capacity in Thousand Tonnes		
Industry Segments	**Working Units**	**Working Capacity**
Pig Iron	22	9332
Sponge Iron	218	18828
Electric Arc Furnace	37	8678
Induction Furnace	787	13222
Corex / MBF	3	2975
Re-rolling	1361	19558
HR Sheet / Coil	9	8445
Cold Rolling	55	6089
GP/GC Sheet	18	3533
Colour coated	4	400
Tin Plate	1	140

Source: Joint Plant Committee

1.4.1.3 The consolidated category of ‘Secondary Producers’ is highly heterogeneous in terms of scale of production/ capacity in place, technology in use, integration of production processes and vintage of the plants. Many of the segments included in the secondary sector - the Corex / MBF based units, the Pig Iron units, the Electric Arc Furnace units, the producers of HR sheets/coils, of Cold Rolled sheets/coils, GP/GC sheets and Colour Coated Sheets - fall into the category of medium to large units with some of them using the latest state-of-the-art technologies. On the other hand, the induction furnaces and coal based sponge iron units are largely small units. The small coal based sponge iron and the induction furnaces are unique in India and their continued growth poses some policy concerns. While the quality of their products and the adverse impact they are making on the environment are being debated, their existence is important at present considering the logistics, infrastructure and the geographical dispersion of the market. The emerging market forces will decide their future and since there is no overt policy support to such units, there is hardly anything the government can do at present to discourage their growth.

1.4.2 Changes in the structure of production

1.4.2.1 Share of Public and private sector: Post-deregulation period has seen significant changes in the structure of the Indian steel industry in terms of ownership. Capacity creation during the last decade after deregulation has taken place entirely at the behest of the private sector. As a result, there has been a noticeable shift towards the private sector both at the crude and finished steel stages. Private sector now accounts for 59% of crude steel compared to 37% in 1992-93 and 71% of finished steel output compared to 67% in 1992-93 **(Table – 1.17)**.

Table – 1.17

Contribution of Private Sector to Total Output of Finished and Crude Steel

Year	Share of Private sector in Total Production	
	Crude Steel	Finished Steel
1992-93	37%	67%
2000-01	49%	68%
2005-06 (P)	59%	71%

Source: Joint Plant Committee, P=Provisional

1.4.2.2 Share of Integrated and Secondary Sector: Advent of new technologies of production has brought about a significant change in the route-wise composition of the Indian steel industry as mentioned before. Capacities created in the aftermath of deregulation have been based on technologies as diverse as COREX (JSW), large-scale hybrid technologies combining Electric Steel making with BF hot metal with downstream rolling of flat products (Ispat Industries Ltd.) and large-scale integrated 'DRI-EAF-Flat products Rolling' capacities (Essar Steel Ltd.) etc. Noticeably absent have been the BF-BOF integrated mills with downstream rolling. The break-up of output between units operating on BF-BOF based routes and those using other routes for both crude and finished steel have also changed significantly with the Secondary sector doubling its contribution to crude steel production from 23% to 48% in the post deregulation years. For Finished steel the rise has been less dramatic from 45% to 64% in the same time period **(Table – 1.18).**

Table – 1.18

Contribution of Secondary Sector to Total Output

Year	Share of Secondary Sector in Total Output	
	Crude Steel	Finished Steel
1992-93	23%	45%
2001-02	36%	57%
2002-03	38%	57%
2003-04	42%	59%
2004-05	48%	61%
2005-06 (P)	48%	64%

Source: Joint Plant Committee, P=Provisional

1.5.0 Trends in International Trade in Steel, 1991-92 to 2005-06

1.5.1 Prior to deregulation imports of steel took place under a rigorously defined import plan designed to bridge the gap between domestic demand and domestic availability. The Indian steel industry remained protected from foreign competition by high import tariff rates and physical restrictions operating via canalization and import licensing. On the other hand, exports took place only on rare occasions when domestic demand fell short of production.

1.5.2 Deregulation brought about far-reaching changes in the international trading scene for the globally integrated Indian steel industry. Import duty rates have been progressively reduced from above 100% to 5% during the last 15 years. All quantitative controls on exports and imports stand withdrawn today. Protection from unfair import competition is currently being provided through the mechanism of Trade Actions (Anti-Dumping, Anti-Subsidy and Safeguard actions) as permitted under the WTO dispensation – of which India is a member. Most importantly, the 10th Five Year Plan period has witnessed one of the sharpest cuts in peak duty rates from around 25% to 5%. The government, however, maintains a higher import duty rate of 20 per cent on seconds and defective steel products. There is a system of floor prices too for such products to discourage their imports.

(Details of import duty changes are at **Annexure - 4**)

1.5.3 Liberalization of the foreign trade regime has had a favourable effect on Indian exports. Exports grew fast at a rate exceeding 25% per annum between 1991-92 and 2002-03. Thereafter, till 2005-06 export levels stagnated at around 4-4.5 Million Tonnes per year. During this period, the country's export basket also changed in favour of more value added and sophisticated products. The export destination also got widened with Indian steel reaching a very large number of countries in all the continents of the world.

1.5.4 Imports, on the other hand, followed a different growth path. Import of steel remained static around the pre-liberalization annual level of 1- 2 Million Tonnes per year till 2003-04 but increased dramatically between 2003-04 and 2005-06 doubling itself from 1.7 Million Tonnes to 4.1 Million Tonnes over just three years.

1.5.5 As a result, for a major part of the post deregulation years India enjoyed the status of a net exporter of steel, even though the net export levels varied widely between a low of 0.06 Million Tonne in 1996-97 to a high of 3.8 Million Tonnes in 2003-04 **(Table – 1.19)**.

1.5.6 Available data show an interesting correlation between the movements in net export levels and rate of growth in domestic consumption. Based on the associated movements, the data on import and export can be split into three distinct periods, namely,

The 8th Plan period (1992-93 to 1996-97) has been marked by high rates of growth in domestic consumption at around 8.3% per annum while net export levels remained depressed.

The 9th Plan period (1997-98 to 2001-02) has been marked by sluggish growth in domestic demand at around 4.4% while net export levels rose at a fast pace. The high net export level was maintained into the first year of the Tenth Plan period (i.e., 2002-03) with moderate consumption growth at 7% and net exports peaking at around 5 Million Tonnes.

The next three years of the 10th Plan period (2003-04 to 2005-06) have been marked by high growth rates in domestic consumption around 10% per annum. This period saw net export levels start its southward movement. As imports more than doubled and exports remained stagnant net export levels fell to the low levels of the early nineties at less than 1 Million Tonne.

1.5.7 The association noted between growth in domestic demand and relative movements in imports and exports (i.e., net exports) shows that the Indian steel industry has geared itself fully to operate in an open economy where exports and imports are seen to respond to increases or decreases in domestic demand driven by primarily market signals (i.e., relative domestic and international price and relative realization on domestic versus international sales) and appropriate fiscal adjustments (i.e., changes in tax rate The observed relative movements in exports and imports underpin the following important developments in the Indian steel industry:

a) Over the past 15 years the Indian steel industry has developed significant competitive strength, which enabled it to sell in the world market and to hold its own against imports in the domestic market.

b) Exports have become an integral part of the business strategy of the Indian steel producers, especially of the private players. It also implies that the level of exports in the globally integrated steel sector will be determined at the margin by relative realization of the producers in the domestic market vis-à-vis that in export destinations. While the PSUs are still committed to catering to the domestic market first, the private producers have utilized the opportunity offered by the opening up of the steel market.s, export reimbursements etc.) in a free market environment.

Table – 1.19

Import and Export of Non-Alloy Steel from India, 1991-92 to 2005-06

Year	Finished Carbon Steel (Million Tonnes)			Semis (Million Tonnes)		
	Import	Export	Net Export	Import	Export	Net Export
1991-92	0.970	0.368	(-) 0.602	0.027	0.005	(-) 0.022
(Eighth FYP) 1992-93	1.080	0.741	(-) 0.339	0.005	0.154	0.149
1993-94	1.063	1.020	(-) 0.043	0.091	0.585	0.494
1994-95	1.706	0.873	(-) 0.833	0.223	0.399	0.176
1995-96	1.536	1.275	(-) 0.261	0.298	0.391	0.093
1996-97	1.562	1.622	0.060	0.227	0.270	0.043
(Ninth FYP) 1997-98	1.588	1.880	0.292	0.219	0.483	0.264
1998-99	1.132	1.771	0.639	0.445	0.162	(-) 0.283
1999-00	1.600	2.670	1.070	0.545	0.301	(-) 0.244
2000-01	1.417	2.664	1.247	0.484	0.194	(-) 0.290
2001-02	1.271	2.704	1.433	0.212	0.281	0.069
(Tenth FYP) 2002-03	1.510	4.506	2.996	0.168	0.460	0.292
2003-04	1.540	4.835	3.295	0.147	0.684	0.537
2004-05	2.109	4.381	2.272	0.238	0.261	0.023
2005-06 (P)	3.850	4.478	0.628	0.372	0.388	0.016

Source: Joint Plant Committee, P=provisional

1.5.8 The experience of the last three Five Year Plans also underscores some important changes and new decision parameters in the evolving structure of the Indian steel industry that needs to be taken note of:

Firstly, decline in net export levels can be seen as a signal for the need to add to domestic supply through better capacity utilization and/or expansion of domestic capacity to meet rising domestic demand. For example, the sudden rise in imports accompanied by static export levels in the last 2 years had taken place not because of a fall in competitiveness of Indian steel but to fill the supply demand gap in the domestic market. In fact, exports of value-added products have increased in the last few years.

Secondly, the related movements in net exports and domestic consumption also underscore the strategic importance of building up export capabilities in the long run because such a strategy provides an important flexibility to the industry in terms of an extra window of demand when domestic demand is slack and as an additional source of domestic supply when domestic demand rises fast. Building up an export presence is of strategic importance to this industry where investments are lumpy.

1.5.9 The other important outcome of globalization has been the parallel movement in international and domestic prices – the margin between the two being determined by the external value of the Rupee and the import duty rates. In other words, domestic prices are now being determined at the margin by international prices as is expected in a free and open market situation. Progressive reduction in custom duty rates has over the years reduced the margin between the landed cost of imports and the domestic market prices. Under the current policy circumstances, vulnerability of the domestic suppliers from competing imports increases if the value of the Rupee appreciates or international prices fall sharply and vice versa.
(Relative movements in domestic and international prices of selected steel products are placed at **Annexure - 5**)

1.5.10 As it is not viable (technologically or economically on scale considerations) for any country at a given time period to produce domestically all the different grades of steel required by the downstream industries, some imports are bound to take place. However, under the current trade regime of low import duties and no physical controls, there is every possibility of imports taking place not only to bridge the gap between domestic availability and demand but also on price considerations as a substitute for dearer domestic supplies. Hence vulnerability of Indian domestic industry to cheap imports has increased manifold.

1.6.0 Trends in Domestic Market Price, 2003-04 to 2006-07

1.6.1 An important feature of post de-regulated era is that prices of both finished steel and its inputs have risen at a much faster rate and with a lot of volatility, compared to the past. This is especially true in the context of the period pertaining to the Tenth Plan. **Table – 1.20** below gives changes in WPI (with base year 1993-94 =100) for iron and steel and major inputs of steel production between 1995-96 and 2005-06.

Table – 1.20

Movement in Wholesale Price Index of Steel and its Inputs (1993-94=100)

Year	All Commodities	Iron & Steel	Iron Ore	Coking Coal	Non-Coking Coal
1995-96	121.6	116.6	74.2	106.2	106.1
1996-97	127.2	124.1	96.6	131.8	115.4
1997-98	132.8	129.8	88.1	151.1	139.3
1998-99	140.7	132.8	121.8	156.1	143
1999-2000	145.3	134.5	120.6	156.1	148.2
2000-01	155.7	136.8	122.4	158.9	156.7
2001-02	161.3	136.6	127	173.2	183.6
2002-03	166.8	143.5	127	173.2	183.6
2003-04	175.9	181.1	135.4	184.6	196.9
2004-05	187.3	232.9	448.3	227.2	225.6
2005-06	195.6	250.1	601.5	239	232.8

Source: Office of Economic Advisor, Ministry of Industry

1.6.2 Steel prices have seen an upsurge from the last quarter of FY2002. The upward momentum has been maintained throughout the 10th Five Year Plan period. The last two quarters of 2005 –06 **(Table – 1.21)** have seen some deceleration in the rate of price rise as compared to the base level average price prevailing in the 2nd Quarter of 2003-04. However, the opening quarter of 2006-07 has once again experienced sharp rise in domestic market prices. The indices are based on monthly spot market prices in Mumbai collected by the Joint Plant Committee. The prices are inclusive of transportation costs, excise duty and local sales tax.

1.6.3 Domestic price increases have been in tandem with the international price rise. The government, in a bid to curb domestic price rise and offer the user industries greater access to imported material, reduced customs duty rates sharply in quick succession in the course of the Tenth Five Year Plan – beginning with Mini

Budget of January 2004. Excise duty rates were also reduced as an interim measure for price management. However, upward pressure on prices has continued notwithstanding some relief towards the middle of the last fiscal **(Table – 1.21).**

Table – 1.21

Index of Quarterly Movement in Domestic Market Price for Select Categories in Mumbai Market, 2002-03 to 2006-07

Q2 (03-04)=100

Quarter	Wire Rods	HR Coils	GP Sheets
Q2- (03-04)	100.0	100.0	100.0
Q3- (03-04)	99.6	102.6	101.0
Q4- (03-04)	108.9	132.8	121.2
Q1- (04-05)	127.1	130.3	120.5
Q2- (04-05)	129.8	135.3	119.0
Q3- (04-05)	128.5	136.4	124.9
Q4- (04-05)	126.9	146.9	128.8
Q1- (05-06)	138.1	145.9	133.8
Q2- (05-06)	128.6	118.9	125.9
Q3- (05-06)	112.6	113.6	122.6
Q4- (05-06)	112.1	112.2	114.3
Q1- (06-07)	127.8	135.8	124.3

Source: Joint Plant Committee

1.6.4 The net result of the changes in the prices of finished steel and inputs has been quite positive for the financial health of the steel industry. The Indian steel industry, during the 9th Five Year Plan, suffered on account of poor profitability, cash crunch and in some cases inability to pay its dues to financial institutions. The Government of India and various financial institutions facilitated the process of business and financial restructuring in the steel sector. This strategy has paid rich dividends both to the Government as well as to the financial institutions. The return on capital employed, during the Tenth Five Year plan, has improved significantly, both in the public and private sector steel firms. Presently, the Indian steel industry is capable and credit worthy to fund future plans of expansion through internal resources and market borrowings.

1.7.0 Performance of Public Sector Undertakings during 10th Plan

1.7.1 The physical and financial performance of Public Sector units, in general have improved significantly in the first four years of the 10th Plan. However, the improvements were specially noteworthy with regard to financial performance. The profit before tax of PSU's have seen a sharp jump from a level of 562 crores in 2002-03 to 11382 crores in 2005-06. Some of loss making PSU's namely SAIL, MECON, HSCL and BRL have turned around during this period. The details of physical and financial performance of PSU's are shown in **Tables – 1.22 A & B** below:

Table – 1.22 A

Physical Performance of Public Sector Units

	Physical Performance				
		2002-03	**2003-04**	**2004-05**	**2005-06**
COMPNIES	**ITEM**	**Quantity**	**Quantity**	**Quantity**	**Quantity**
SAIL	(a) Hot metal ('000 Tonnes)	12908	13563	13203	14603
	(b) Crude Steel (Liquid Steel) ('000 Tonnes)	11628	12385	12460	13470
	© Finished Steel ('000 Tonnes)	8505	9014	9415	9612
	(d) Pig Iron ('000 Tonnes)	590	527	352	568
RINL	(a) Hot metal ('000 Tonnes)	3942	4055	3920	4153
	(b) Crude Steel (Liquid Steel) ('000 tonnes)	3256	3403	3452	3494
	© Finished Steel ('000 tonnes)	2652	2834	2904	2980
	(d) Pig Iron ('000 tonnes)	517	439	273	439
KIIOCL	Concentrate (million Tonnes)	5.532	5.090	4.350	3.300
	Pellets (Million Tonnes)	3.450	3.671	3.795	3.200

NMDC	Iron Ore production (Lakh tonnes)				
/	Bailadila-14/11c (Lakh tones)	64.62	66.41	70.76	69.00
	bailadila-5/deposit 10/11a (Lakh tones)	63.65	70.24	85.34	91.50
	Donimalai (Lakh tones)	41.45	42.94	51.33	39.50
MOIL	(a) Ferro Grade ('000 tonnes)	510	516	549	552
	(b) Dioxide ('000 tonnes)	25	27	40	40
	© LGHS Grade ('000 tonnes	127	144	204	204
	(d) others ('000 tonnes	52	112	150	89
	Electrolytic Manganese Dioxide (in Tonnes)	930	975	1123	1301
	Ferro Manganese (in Tonnes)	5996	10899	10325	6170
SIIL	(a)Sponge Iron ('000 Tonnes)	71,603	69,509	57,501	55,000
	(b) Power Generation (Lakh Kwh)	81	88	89	85
BRL	(Qty. in Tonnes)	35160	53116	65485	72199
MSTC	Import of materials & domestic marketing (Value Rs. Crores)	2041	3427	5382	4655
	Selling Agency (Value Rs. Crores)	628	738	1077	1250
FSNL	Recovery of Scrap (in lakh Tonnes)	16.29	16.29	21.74	20.00

Table – 1.22 B

Financial Performance of Public Sector units

(Rs. Crores)

		Profit / Loss (-) before Tax		
	2002-03	**2003-04**	**2004-05**	**2005-06**
Steel Authority of India Ltd. (SAIL)	-316.00	2628.00	9365.00	5708.00
Rashtriya Ispat Nigam Ltd. (RINL)	520.69	1547.19	2253.76	1889.51
Kudremukh Iron Ore Com. Ltd (KIOCL)	115.99	406.40	1111.91	548.10
National Mineral Dev. Corp. (NMDC)	420.18	616.02	1223.65	2883.82
Hundustan Steelworks Constr. Ltd. (HSCL)	-136.35	-88.50	-94.21	30.96
Metallurgical and Engineering Consultants India Ltd. (MECON)	-70.82	-10.72	10.73	37.33
Manganese Ore (India) Ltd. (MOIL)	27.83	45.29	202.27	169.00
Sponge Iron India Ltd. (SIIL)	6.98	20.53	14.24	5.66
Bharat Refractories Ltd. (BRL)	-31.26	-7.93	-2.98	-3.30
M S T C	16.73	33.70	64.77	85.70
Ferro Scrap Nigam Ltd. FCNL)	8.18	8.31	8.49	8.89

1.8.0 Conclusion

1.8.1 The macro economic indicators all signal a continuation of the growth momentum observed in the last three years. An upswing in economic activities stimulated by increased savings and investment appears to be already underway and is likely to continue for some years to come. To maintain the current impetus to economic growth, providing quality infrastructure through appropriate policy stimulus becomes the first and foremost priority for policy planners. India's growth prospects are intricately intertwined with the rapid development of physical infrastructure such as power, roads, ports and airports and efficient delivery of such services. Therein also lies the future of the Indian steel industry through its wide-ranging linkages with the brick-and-mortar commodity-intensive sectors of the economy.

1.9.0 The Global Steel Industry

1.9.1 Major Trends

1.9.1.1 The world steel industry is currently going through an extraordinary phase of growth and all round prosperity. The current expansionary phase has been fuelled by the frenetic pace of growth in consumption and production of steel in China. The new growth period for the world steel industry has been marked by a steep rise in steel production from the year 2000 onwards. World crude steel production grew from 0.850 Billion Tonnes in 2001 to approximately 1.13 Billion Tonnes in 2005 – recording a growth of 7.5% per annum compared to a mere 2% annual growth recorded between 1995 and 2001. China's steel production rose by more than 210 Million Tonnes since 2001 to reach a level of 349 Million Tonnes in 2005. This translates into an annual growth of around 26% during the five-year period. Today more than 30% of the global steel production is attributed to the Chinese economy.

1.9.1.2 The major trends observed currently in the structure of the global industry can be summarized as below:

a) There has been a continuous shift of the industry towards the East – both in terms of production and consumption.

b) Ensuring control of the producers over raw materials has become an important part of the overall business strategy. The extremely tight supply conditions and sky-rocketing of prices of iron ore and coking coal created by the entry of China in the global bulk material market has made the producers realize the importance of assured sources of raw materials.

c) Consolidation through mergers and acquisition has acquired a new meaning in the world steel industry today. Consolidations across boundaries are taking place in two major ways:

- Producers with crude steel capacities acquiring downstream facilities in search of new markets across the globe.
- Producers from steel active economies, especially those without adequate indigenous sources of raw materials, investing in upstream facilities to secure their raw material linkages.

d) There have been very sharp increases in prices of steel and its inputs in the last few years in response to expansion in Chinese demand. The world steel prices have become more volatile with sharp fluctuations within a few quarters. Also, the gap between the contracted price and spot prices has widened in the recent years. This characteristic is more apparent in the flat products market, especially of the Hot Rolled flat products, as compared to the long products.

e) The last five years have also seen a remarkable improvement in the fortunes of the world steel makers with a sharp rise in the profitability of their business despite sharp increase in input prices and global freight rates. This the combined outcome of:

- Vastly improved steel prices as a result of high growth in consumption led by Asia, on the one hand, and
- Cost containment and efficiency gains through better organizational, technological, managerial and financial discipline. As a result, there

has been a noticeable increase in the valuation of steel companies worldwide.

1.9.2 Short and Long Run Prospects

1.9.2.1 Outlook for world steel market remains good for the next 2-3 years as global economic conditions are also expected to be robust. The IISI in its short range forecast predicts world steel consumption to rise to 1.087 Billion Tonnes in 2006 and further to 1.150 Billion Tonnes in 2007 **(Table - 1.23).** Once again, China is seen to be leading the growth in world steel demand. The overall growth scenario has been further reinforced by economic resurgence in Europe and the USA – both regions with very high base level production and consumption.

Table 1.23

Short Range Forecast of Steel Consumption, 2006 and 2007

(Million Tonnes)

Regions	2005	2006	2007
EU-25	160	167 (4%)	169 (2%)
CIS & Other Europe	73	76 (5%)	79 (3%)
NAFTA	136	143 (5%)	145 (2%)
Central & South America	33	35 (8%)	38 (9%)
Africa	22	24 (8%)	25 (5%)
Middle East	35	38 (8%)	41 (8%)
China	315	356 (13%)	399 (12%)
Asia Pacific	240	249 (4%)	254 (2%)
Total World	1013	1087 (7%)	1150 (5.8%)

Source: International Iron and Steel Institute, BHP Billiton

1.9.2.2 The World Steel Dynamics (WSD) in its latest forecast for the next 15 years (June 2006) outlines the global steel outlook as below:

a) Global steel demand will grow at least at the rate of 3.1% per year till 2015,

b) Opening up of new mines all over the world would serve in curbing the extraordinary rise in prices of raw materials witnessed in the recent past. So far, soaring raw material prices have led to a spurt in proposed expansion of mining capacities the world over. An upward pressure on price of iron ore and coking coal will, however, continue in the medium run.

c) Technological revolution in steel making will continue in the next decade.

d) More consolidations will take place, especially in China. Such consolidation will be within China – amongst domestic players and outside China – with other global companies.

e) As demand for metallic rises, obsolete scrap prices will rise in periodic spikes.

f) In the net, steel producers' costs will not rise as sharply as has been witnessed in the recent past.

g) Over the next ten-year cycle, world export spot prices for steel products are expected to fare well in 7 years, at the most. This along with possible cost containment indicates continuance of the current favorable financial conditions of the steel makers for some more time to come.

h) A significant growth in steel financial transactions is foreseen as sellers, buyers and middlemen are able to hedge effectively the price risk through various price settlement mechanisms.

1.9.2.3 **The greatest downside risks**, however, emanate from the possibility of a deceleration in the growth of domestic steel demand in China and the subsequent net exports from that country. Observers feel that any slow down in the highly steel-intensive 'Fixed Asset Investments' in China taking place through massive state-sponsored investment in physical infrastructure would unleash substantial oversupply of steel within China. The possibility of Chinese supply depressing prices and profits globally is a risk worth noting. Apart from that the potentially tight supply condition of mined raw materials such as coking coal and iron ore, shortage of international bulk carrying capacities and high transportation costs and possibilities of destabilization through rising oil prices and high rates of inflation in the developed country markets- would remain as causes of concern for this cyclic industry.

CHAPTER – II

RAW MATERIAL & OTHER ISSUES IN COMPETITIVENESS

2.0 In global comparison of costs of production, the Indian steel plants occupy respectable positions as can be seen from the **Table 2.1**. The comparisons are for reference plants of other countries and for production of CR sheets. The competitive edge may be different for different products and even in the same line of production it may vary at different stages of production.

Table-2.1

Plant/Country Wise Indicative Cost of Production of Steel (CR Sheets)

(Reference Period June 2005)

Country/Plant	**Cost (in US $/Tonne)**
India - Bokaro	440
Tata Steel	354
Essar	446
Rourkela	465
Ispat	624
JSWL	524
Lloyds	585
USA	570
Japan	564
Germany	611
South Korea	494
Taiwan	468
Brazil	456
CIS	380
China	478

2.1 Competitive growth of the Indian steel industry, however, cannot be sustained unless there is competitive strength in terms of cost and operational efficiency, quality of products and business practices. The very fact that the presence of the Indian steel companies in the world market has risen sharply over the past one and a half decade with an expanding export basket including complex and technologically superior products, points to the improving competitiveness of the domestic industry in India. Indian steel products have been sold today in the most competitive markets of the advanced countries notwithstanding the numerous constraints, especially those arising out of poor infrastructure in India. On the other hand, despite the sharp improvement in the global presence of the Indian steel makers, the operational performance of most of the steel plants, small or big, has fallen short of the levels achieved by the international bests, barring a few exceptions like the facilities set up recently in either the old plants or in the new ones. Vast majority of plants including older and smaller steel units are characterized by lower returns on account of higher material and energy consumption, low labour productivity and limited expenditure on R&D. The comparative picture of efficiency levels of Indian and International plants are shown in **Annexure – 7.**

2.2 General issues in Raw materials

2.2.1 Steel industry development cannot take place in isolation and for that there will have to be creation of supportive infrastructure as mentioned above and also development of a sound and efficient raw material base. Since the competitive strength of the Indian steel industry is derived to a large extent from its raw materials base, unless there is integrated development of all the related sectors, the competitive position of the industry will be vastly eroded. Ensuring control over raw materials is becoming an important part of the overall business strategy and a necessity for sustainable growth. The extremely tight supply conditions and sky-rocketing of prices of iron ore and coking coal created by the entry of China in the global bulk material market has made the producers realize the importance of assured sources of raw materials.

2.2.2 It has been a matter of major policy debate whether the country should try to develop its resources like coal fully or instead import the same if supported by commercial merits. It is also a major policy issue whether the iron ore produced in the country, especially the high grade variety with higher ferrous content, should be retained for the use of the domestic iron and steel industry or used commercially to the extent possible by exploiting all possible export opportunities.

2.2.3 The requirement of major raw materials in the steel industry will depend not only on the industry's growth but also on the technology adopted for making the required steel. The choice of technology naturally will be guided by considerations of competitiveness. Competitiveness, in turn, will arise out of relative costs of raw materials and energy, labour, capital and more specifically on the entire logistics of movement of raw materials and finished products. Although in a market economy, there is no reason for any pre-determined policy intervention on matters related to technology choice, the government still will have to undertake certain policy measures to augment and ensure the best possible utilization of the country's natural resources like coal and iron ore which will, in turn, influence technology choice and investment decisions in the industry. It is necessary, in this context, to assess the position of a few major raw materials used in the steel industry.

2.3 Iron ore

2.3.1 India is being increasingly considered an attractive global alternative for creation of new steel capacities. Attractiveness of India as an investment destination emerges largely from the fact that our country has large reserves of iron ore, the basic raw material required for steel production. However, there is a need to retain and strengthen this competitive advantage as India faces a number of constraints in respect of other raw materials and infrastructure. Further, though the country has sufficient reserves of iron ore to meet the requirements of steel industry for short to medium term, the same is not true in the context of long-term requirements of the country.

2.3.2 Iron ore reserves and resources estimated on the UNFC basis as on 1.4.2005 are about 14630 million Tonnes of Haematite ore and about 10619 million Tonnes of magnetite ores. Almost the entire Magnetite resource is presently not available for extraction because of the ban imposed by the Supreme Court for reasons of environmental protection. Of the Haematite resource, only about 1 billion Tonnes are high quality reserves containing +65% Fe.

Grade-wise share of Reserves are:

(As on 1.4.2005)

Grade		Approx % share of recoverable reserve
High Grade	Fe + 65	18.6
Medium Grade	Fe 62-65	50.6
Low Grade	Fe -62	28.4
Others		2.4

2.3.3 Iron ore production in the country has been on the rise steadily since 2000-01. While domestic consumption exhibited significant growth, the bulk of the production increase seems to have been triggered by rising exports. Around 60 percent of the production of iron ore comes in the form of fines (including concentrates) during the course of mining operations itself. A further 5-6 per cent of the lump gets broken into fines in transit and handling. This creates a mismatch between demand and supply in the case of lumps and fines. The existing sintering and pelletisation capacity in the country is not sufficient to make full use of the fines and concentrates and therefore the bulk of it are exported.

2.3.4 In order to assure the availability of iron ore to domestic steel producers, India has adopted a policy of granting captive mines. The necessity of such a policy framework is even more important in the context of tight supplies and sharp volatility in prices of inputs. However, due to the existing allocation criterion based on considerations of value addition within state and other constraints, not all steel producers have got the facility of captive mines. Therefore, these plants are disadvantaged in comparison to plants with captive mines. This anomaly needs to be corrected as freight costs are also significant due to poor transport infrastructure.

2.3.5 The current cost advantage for steel plants with captive mines is due to the high prices of iron ore worldwide. The massive rise in demand for it, mainly from China, was largely unanticipated and the global iron ore industry was not prepared for such a rapid rise in its demand. Not only that mining capacity globally had to be raised, significant investments were to be made on infrastructure to make the iron ore move to the ports of the respective countries for export destinations. While the iron ore market is expected to remain tight at least for another 3-4 years, it is also believed that the current price levels are not sustainable in the long run and corrections will take place by the beginning of 2011. If the global iron ore prices fall, the competitive advantage for the Indian steel makers will also drop proportionately.

2.6.3 The iron ore advantage remains for Indian steel plants as long as there is sufficient iron ore available within the country, captive or otherwise. The steel industry has viewed that, given the steel output growth potential within the country and the mineable reserves plus remaining resources of iron ore, this will not last for more than 40 years (estimates vary from 20 to 40 years) if exports are to continue at the current or increased level and the full production potential of the industry is also to be met. The life will be shorter if the magnetite ores, not currently preferred by the Indian steel makers, are excluded. Further, the mining costs will rise incrementally in absolute terms at higher rate of exploitation taking away a part of the cost advantage that the Indian steel industry today enjoys. It is also being seen that the country's high quality reserves are limited as can be seen from **Table-**

2.2 below. Of the 7004.17 Million Tonnes of hematite reserves (as on 1.4.2005), only about 1304 Million Tonnes belong to 65% + (plus) Fe grade. Given the strong demand for these both from the domestic steel and DRI industries and for exports, these 65%+ reserves are expected to be depleted in less than 15 years.

Table – 2.2

IRON ORE AVAILABILITY- Haematite

As on 1.4.2005 Qty. in Million Tonnes

Grade	Reserves	Remaining Resources	Total
High Grade(Fe +65%)	1304.3	629.03	1933.33
Medium Grade(Fe 62-65%)	3544.03	3062.02	6606.05
Low Grade(Fe below 62%)	1989.75	1686.94	3676.69
Unclassified	159.23	743.67	902.90
Black Iron Ore	2.52	12.72	15.24
Others	1.62	5.05	6.67
Unclassified	1.98	0	1.98
Not-known	0.73	1486.79	1487.52
Grand Total	7004.17	7626.22	14630.39

(Source: Indian Bureau of Mines)

IRON ORE AVAILABILITY- Magnetite

As on 1.4.2005 Qty. in Million Tonnes

Grade	Reserves	Remaining Resources	Total
Metallurgical	687	2185.05	2185.74
Coal Washery	3.33	5.0	8.33
Foundry	0.46	0.3	0.76
Others	0.97	24.16	25.13
Unclassified	52.64	8060.34	8112.98
Not Known	0.43	286.12	286.55
Grand-Total	58.5	10560.98	10619.48

(Source: Indian Bureau of Mines)

2.3.7 On the question of supply of iron ore, it has also been seen that much of the iron ore reserves are in thick forest and ecologically sensitive areas. This may make their extraction difficult in the face of stringent forest and environment protection laws in the country. While alternative technologies are possible to execute mining in such areas, the initial costs of those may be very high and in the short term the steel industry may not be able to bear the burden of the same. They may, in fact, lose competitive strength given the future supply of iron ore at lower incremental costs.

2.3.8 The government will have to take major policy initiatives to see that the competitive strength of the Indian steel industry is maintained and that the steel industry can grow in the country to its full potential. In recent times, the government has set up two high level committees to look into various aspects of the mineral industries including iron ore, one under the chairmanship of Shri Dang, former Secretary (Mines) and the other under Shri Anwarul Hoda, member, Planning Commission. The Hoda Committee recommendations have been well discussed. The Committee although seeking liberal export of iron ore, has seen the need to conserve the high quality ores by adequate fiscal measures like imposition of an export tax. The Committee has also noted that the current royalty rates are very low at about Rs. 25-27 per Tonne and that they may be raised to a higher level by fixing them on an ad-valorem basis.

2.3.9 Bulk of the export of iron ore is in the form of fines (over 80% in 2004-05) for which adequate sintering or pelletization capacities do not exist in the country. Such capacity has to be built up through appropriate fiscal incentives. The steel makers will also have to take necessary initiatives to reduce lump ore consumption and change the iron ore consumption mix with adequate technological changes by higher utilization of fines through sintering. It will be necessary for the Indian steel producers to maker larger use of fines and concentrates instead of remaining over dependent on lumps. The current sinter and pellets usage in the Indian plants is lower than those in the best of the plants abroad. Higher sinter and pellets use will help the industry reduce costs as also make use of the fines generated in mining iron ore.

2.3.10 India has to keep its reserves for meeting its own requirements. India has the potential to become a global supplier of quality steel provided, it retains its competitive advantages. The investors both domestic and foreign have shown a great deal of interest in setting up large steel capacities in the coming years. The intended capacity is around 96 million Tonnes by 2011-12 and 208 million Tonnes by 2019-20. Though only a part of intended capacity will be converted into reality, the attractiveness of India as global production centre lies in expectations of easy availability of iron ore at affordable prices in the long run. In the absence of such a scenario, the investors may put up steel capacities in other parts of the world as dictated by cost-benefit analysis. The country may not like to lose this opportunity of high value addition within the country by exporting large quantities of iron ore at an increasing rate. Further, at such high rates of export of iron ore, our resources will be exhausted much earlier and India will have to import large quantities of iron ore to meet the domestic demand for steel. It may be mentioned here that if India attains a similar stage of development as today's China, our iron ore requirement will be around 580 million Tonnes per annum. India's current consumption of steel is at an abysmally low level and it should not be used as benchmark for deciding sufficiency of our iron ore resources.

2.4 Coking Coal

2.4.1 Coal is one of the most important raw materials for the steel industry. The blast furnace based steel plants use coking coal while the non-coking coal or natural gas is used for DRI production. Sized non-coking coal is used in the Corex plants.

2.4.2 Unlike Iron ore, the coking coal position for the Indian steel industry is rather depressing with none of the segments feeling comfortable with the current or future supply position of coal. Even the projections made by several expert bodies indicate a huge shortfall of both coking and non-coking coal.

2.4.3 Although the country has a very large reserve of coking coal, the quality of the same is poor due to very high ash content. The ash content of delivered washed coal from Coal India (or own) falls in the range of 19-20 percent for SAIL plants compared to 9-10 per cent in the case of imported coking coal. Coking coal factor has several implications on the Indian steel industry.

2.4.4 One, pure short supply has led to increased and near total continuous dependence on imports creating supply uncertainties unless long term or evergreen contracts are signed with the major coal companies in the world.

2.4.5 Two, the highly Oligopolistic global market has pushed the pricing power in favour of the suppliers of coal. This means, the steel industry remains unfavourably positioned in coal price negotiations.

2.4.6 Three, the coking coal prices on the global market (hard coking coal of Australian origin) have increased substantially over time, from about $48 per tonne on fob basis in 2003 to $59 per tonne in 2004 to $125 per tonne in 2005 and $115 per tonne in 2006. While there were genuine shortages of the same on account of immediate capacity and infrastructure constraints, the prices are not likely to soften significantly in the near term despite the investments being undertaken to raise both mining and infrastructure capacities.

2.4.7 Four, increased imports will lead to increased pressure on the ports and the railway network connecting the ports to the plants. Unless sufficient investments are made in such infrastructure, the effective costs of importing coking coal in large quantities will be a concern.

2.4.8 While in the context of global competition, most of the steel majors will face an identical cost situation in respect of coking coal, the Indian situation remains complicated by the fact that some of the plants are located away from the ports and moving these materials from ports to the plants will remain an expensive proposition. Also, with the plants yet to reach the international best norms in coking coal consumption, the impact of high cost coking coal will be further magnified. Although the steel producers have now planned to use coke-substituting materials like pulverized coal or coal dust (CDI/PCI), which will significantly cut the specific consumption of coke in the blast furnaces, it will call for substantial investment.

2.5 Non-coking Coal

2.5.1 The country has large reserves of non-coking coal, and technologies based on non-coking coal may be cost competitive in comparison to those based on coking coal. This has been reflected in rapid growth of coal based sponge iron units in the country in the recent years especially in states of Orissa and Jharkhand. In fact most of the incremental capacity in sponge iron sector in the recent past has been through coal-based units. This is due to the fact that the gas-based units have been facing twin pressures of availability and pricing. Besides SI sector, COREX route of hot metal production can use non-coking coal. However, the requirements of COREX process are very stringent in terms of size and other parameters like ash content and the only plant in the country based on COREX process is using imported coal.

2.5.2 As mentioned earlier, the country has sufficient resource base of non-coking coal with proven reserves of 79 billion Tonnes as on 1.1.2006. The reserves of non-coking coal are 83% of total reserves of coal in the country. However, it may be mentioned that SI sector is not getting appropriate supplies of non-coking coal especially in terms of quality. The SI industry requires ‘B’ and ‘C’ grades of non-coking coal, while it is meeting its requirements through inferior ‘D’, ‘E’ and ‘F’ grades. Such a mismatch in quality is not in consistent with optimum utilization of facilities as well as required quality of final product.

2.5.3 The country will need approximately 25 million Tonnes of non-coking coal to meet the requirements of the Sponge Iron sector by 2011-12. In view of this, an enabling policy environment facilitating increased priority and allocation of captive mining is needed. The National Steel policy had recommended a number of measures to increase the supply of Sponge Iron grade non-coking coal. These measures include:

- First priority in the allocation of higher grades of non-coking coals below 12 percent ash content to Sponge Iron and Steel industry
- Public Private Partnership for increased investments in coal mining
- Greater flexibilities in sale of surplus coal generated in captive mines
- Allocation of mining blocs to consortia of small users/producers of Sponge Iron

There is a need for heavy investments in the coal sector, and opening up of this sector will be a necessity in order to meet the growing requirements of various sectors both in terms of quantity as well as quality.

2.6 Raw Materials for Ferro-alloy Industry

2.6.1 In addition to coal and iron ore, the steel industry development will lead to incremental demand for other processed inputs like ferro-alloys. The ferro-alloys industry has registered strong growth in the past few years on the back of strong demand from the rapidly growing steel sector. The current capacity has been estimated at 2.4 million Tonnes while the production of bulk ferro-alloys reported for the year 2005-06 was 1.62 million Tonnes. The important minerals required by the ferro alloy industry are manganese ore and chrome ore. The facts and figures with respect to these minerals are placed at **Annexure – 6**.

2.6.2 It has been mentioned earlier that the industry continues to have large underutilized capacity despite reasonably fast growth in the last four years triggered by rising steel production. Moreover, the industry's growth has been hampered by cheaper imports. The Ferro Alloy industry requires cheap electricity, which is scarce in the country and especially in the mineral rich states where the basic minerals are found. Policies by some state governments requiring value addition in downstream industrial projects within the state as a condition for granting a mineral concessions are detrimental to the exploitation and extraction of these minerals by the industry.

2.6.3 The existing limit of export of chrome ore fines / lumps is 4 lakh Tonnes per annum. The export of beneficiated chrome ore is free but canalized. As per UNFC system as on 1.4.200 total resources of chromite in India are 179 Million Tonnes comprising 47 Million Tonnes (26 per cent) of reserves. Considering the reserve position an Expert group constituted by the Ministry of Steel headed by Sri R. K. Dang had concluded that the reserves would last for 20 years given the existing Alloy and Stainless Steel capacity. The expert group has recommended beneficiation of low-grade ores to improve mineral content. In respect of chrome ore, which is scarce in the country, it has recommended a ban on export of raw ore. It has also recommended export of concentrates produced by beneficiation of low grade chrome ore feed below 38% Cr_2O_3 to be permitted through MMTC; only from and to the extent of, existing or approved capacity of beneficiation plants. Considering the resource position, it is essential to conserve an important raw material like Chrome for value-addition in the country.

2.7 Power

2.7.1 Cost of electricity in India is among the highest in the world and on top of that the supply and quality remain uncertain. This has slowed down the progress of the electric steel making in the country. The future, however, looks brighter with several power generating projects under active planning and implementation.

2.7.2 While the problems related to availability and pricing of electricity are well known, the steel industry will have to take steps to reduce energy consumption and adopt those technologies that are less dependent on electrical energy till the time ongoing reforms in that sector bring out results.

2.8 Labour Costs

2.8.1 The other major source of cost competitive strength for Indian steel makers is derived from low wage costs. This is typically a developing nation syndrome, but has further been helped by abundance of workers at the right age group. However, labour productivity has not been the same across the steel plants in the country. While the new generation plants have been able to achieve internationally comparable productivity levels, the older plants are faced with a large and to some extent a redundant work force involved in a wide range of peripheral activities like civic maintenance and providing education and health facilities not strictly related to plant operation. These companies are currently involved in wide ranging efforts to reduce their excess or redundant manpower by offering early separation or through voluntary retirement programmes. Although the success of these programmes has been seen in the significantly reduced manpower and corresponding gain in labour productivity in the plants, such exercises have also put a heavy burden on the finances of the steel companies. While in the short run such companies face a biting financial pain, the expected long-term gains far outweigh the short-term problems.

2.8.2 Lower productivity has robbed the steel plants of much of the advantages of low wage rates. If the wage rates continue to rise, especially in the public sector, without proportionate rise in productivity, these companies will not only lose out internationally in terms of cost but also to those domestic companies who have managed their employment levels and productivity much better within the country itself. It is also pertinent to note that there is an urgent need for the Indian steel makers to invest in human resource development through training. It is also important that the government initiates measures along with the private sector to develop a strong educational and human resource development base with technical and engineering institutes suitable for the iron and steel industries.

2.8.3 While assessing the competitive strength of the Indian steel industry, it will be in order to bring up the differences between the new generation and the older plants, some aspects of which have already been discussed above. The new generation plants are located either on the coast on close to the ports. They have smaller work force and have derived the full advantage of lower wage rates. They, however, have suffered from their high material and financial costs. Only after a series of financial restructuring that some of the major steel companies in the private sector are back on the growth path. The natural gas based plants like Essar Steel and Ispat industries have suffered from the rising costs and uncertain supplies of natural gas.

2.8.4 The other smaller steel making and rolling units have to go a long way to achieve global competitiveness in operational performance in terms of energy and raw materials consumption. The specific advantages of these units are fundamentally derived from their low capital costs, proximity to markets and flexibility of operation.

2.9.0 Other Costs

2.9.0.1 Among the external conditions that have affected the performance and cost competitive position of the Indian steel industry, the high costs related to finance and infrastructure are the most significant ones.

2.9.1 Capital Costs

2.9.1.1 High capital costs have been a major hurdle in the Indian steel industry's growth plans. While the interest rate depends on a host of factors in the domestic and international capital markets as also on policy decisions of the government, the industry should take adequate measures to neutralize this disadvantage. Judicious capital investment and making the most of the capital assets to gain labour productivity, material and energy saving and quality improvement of products is by far the most important areas that the industry has to focus on. By now, it has been fairly well known that companies that made the right kind of capital investment and managed their projects well are the winners and are making profits even in the most troubled times. POSCO, TISCO and Arcelor- Mittal

Steel are examples for the industry. Capital investment after the completion of the project - on maintenance of assets, modernization of facilities and overall resource development - is equally important.

2.9.2 Infrastructure

2.9.2.1 The most important externality that affects the costs of production and sales is the availability of infrastructure. Poor physical infrastructure for transportation hits the steel makers both while carrying raw materials, machines etc. and in moving its finished goods for sale. The quality of infrastructure available to the steel industry even to undertake its day-to-day operations is grossly insufficient. It has resulted in high costs at every stage of its business.

2.10.2 It has been reported that it costs more to transport a tonne of steel from Visakhapatnam to Delhi or from Jamshedpur to Mumbai than from Mumbai to Rotterdam or Visakhapatnam to China. In addition, low turn around time for ships at Indian ports makes shipping in and out of India relatively more expensive. Internal transportation by railways or roads is more expensive in India than in most other major steel producing countries.

2.10.3 It is expected that much of the current bottlenecks the steel industry is facing today may be expected to be removed over time. But, what is important here, in the context of the steel industry, is to identify those specific areas of infrastructure needs that will help the steel industry more comprehensively and directly. For example, expansion and modernization of the ports at Haldia and Paradeep will directly help the steel plants in the eastern part of the country. This will facilitate easier and low cost transportation of imported coking coal, limestonne etc. and for exports of steel.

CHAPTER – III

TECHNOLOGICAL ISSUES

3.1.0 Introduction

3.1.1 The genesis of the Indian iron and steel industry dates back to 1875, with the setting up of the first coke based commercial blast furnace by the Bengal Iron Works at Kulti, West Bengal. The first integrated steel plant Tata Iron & Steel Co Ltd.(TISCO), now re-named as Tata Steel Ltd. was set up in 1907 at Jamshedpur in the private sector. At the time of independence in 1947, the country had three integrated steel plants (TISCO, IISCO, VISL) and a few Electric Arc Furnace based plants. From the mid 50s to the early 70s, the Government set up large integrated steel plants in the public sector at Bhilai, Durgapur, Rourkela and Bokaro. Some of these plants were equipped with the state-of-art technologies of their respective eras, like LD steel making at Rourkela. Further expansion of a green-field site, in the public sector took place in Visakhapatnam in 90s.

3.1.2. The 90s were a very tumultuous time for the Indian economy. 1992 saw India take its first step towards economic liberalization, in which endeavour, the steel sector has been a pioneer. Steel production and consumption, which were earlier controlled by the Government were liberalized. The opening up of the economy witnessed the entry of several large integrated steel plants in private sector (Essar, Ispat, Jindal etc.). The country experienced rapid growth in steel making capacity. In 1990-91 the Indian steel industry had a production capacity of 21 million tonnes of crude steel which rose to 45 million tones in 2005-06. India was the eighth largest steel producing nation in the world with a crude steel output of 38.1 million tones in 2005. Today India produces steel of international standards in almost all grades / varieties and has been exporting to various countries. The challenges of the future, especially with 7.3% annual growth (CAGR) in production of steel as targeted in the National Steel Policy, can be squarely faced if the country takes recourse to development of indigenous technology and selection and assimilation of proven and emerging technologies that would make it cost and energy efficient. This has to be backed up with R&D and conducive Government policies for the Indian steel industry.

3.2.0 Process Routes Of Production of Iron & Steel

3.2.1 The Indian Iron and Steel Industry has grown over the last five decades adopting a mix of old and new technologies over the years and the current routes of production covers the conventional Blast Furnace technology, electric arc Furnace technology, Corex Furnace and other state-of-the-art technologies like DC Arc Furnace, Con-Arc Furnace and Thin Slab Casting and Direct Rolling etc. Briefly, the gist of technological routes for production of iron & steel adopted in the country are given below :

i) Coke Oven - Blast Furnace (BF) -Basic Oxygen Furnace (BOF) /Twin Hearth Furnace(THF) using Coking Coal and Iron Ore (Lumps/Sinters) as basic inputs for production of steel flat & long products.

ii) COREX – Basic Oxygen Furnace (BOF) using non-coking coal and iron ore (lumps/pellets) as basic inputs for production of steel flat product.

iii) Direct Reduced Iron (DRI) – Electric Arc Furnace (EAF)/Electric Induction Furnaces (EIF) using Natural Gas/Non coking Coal and iron ore (lumps/pellets) as basic inputs for steel production.

iv) Direct Reduced Iron (DRI) / Blast Furnace (BF) – Electric Arc Furnace (EAF) using iron ore, DRI and coke as basic inputs for steel production where in hot metal from BF is used as partial substitute of DRI (40-50%) for optimizing power/electrode consumption and tap-to-tap time.

v) Mini Blast Furnace (MBF) – Energy Optimising Furnace (EOF) using coke and iron ore lumps and scrap as basic inputs for steel production.

vi) Stand alone Electric Arc Furnaces using steel scrap and purchased sponge iron as basic inputs mainly for production of steel semis & long products.

vii) Stand alone Electric Induction Furnaces using steel scrap and sponge iron as basic inputs mainly for production of steel semis & long products.

viii) Stand alone Mini Blast Furnaces using mostly iron ore lumps and coke as basic inputs for pig iron production.

ix) Stand alone Gas/Coal DRI Furnaces using iron ore lumps/pellets and Natural Gas/ Non Coking Coal as basic inputs for production of Direct Reduced Iron (Sponge iron).

x) Stand alone Rolling /Processing Mills using purchased/imported semis as basic inputs for production of long & flat rolled steel products including coated sheet products.

3.3.0 Present Technology Profile

3.3.1 The old/ outdated technologies together with the indigenously available raw material of poor quality, particularly coking coal, made Indian steel production more cost intensive and therefore, uncompetitive over the years. The need was, therefore, felt for continuous modernization and up-gradation of our steel plants. As a result, several production units have been modernized over the years and others are in the process of modernization and expansion.

3.3.2 The Industry has been gradually adjusting to the changed economic scenario by adopting technological up-gradation along with safer and promising technologies, energy optimization, environment management & pollution control, etc. Improved manufacturing practices, cost, quality, design and technological innovations have become distinct determinants for international competitiveness. New plants set up in 90s have adopted newer and modern technologies like COREX iron making, DC Arc Furnace, Con-arc Furnace, Thin Slab Caster etc.

3.3.3 The salient features of the present technological profile of the Indian Iron & Steel Industry, sector wise, are given below:

i) Coke Making:

Till recently, most of the coke ovens in the country which were captive to the integrated plants, comprised of the conventional top charged, low height batteries with bi-product recovery plants, The scenario has changed with the adoption of several newer technological innovations like Stamp Charging & Partial Briquetting of Coal Charge, Selective Crushing of coal, 7 M tall ovens, Coke Dry Quenching etc. In the quest of low capacity ovens to suit specific requirements of the user industry and also to ensure cleaner environment, several Non-Recovery Coke Ovens have now been set up in the country mostly using imported coking coal. Some of these ovens are also equipped with modern technological innovations like the vibro-stamp charging and co-generation of power. These have helped to reduce emission of pollution as normally associated with the conventional by-product coke ovens. These have also enabled to generate electricity by harnessing the waste heat from the exit gases.

ii) BF Iron Making:

In India, there are 39 large and medium sized blast furnaces, 25 with SAIL(530 M^3 to 2000 M^3 useful volume), 2 with RINL (3200 M^3 each) , 7 with Tata Steel (600 to 2640 M^3), 1 with Ispat Industries (2580 M^3), 1 with NINL (1915 M^3), 1 with Jayaswal Neco (650M^3) and 2 with JSW (1250M^3 &1650 M^3). Further, a 2000 m^3 BF is planned to be installed at RSP, Rourkela and deliberations are on for installing a big size (3200 M^3 min.) BF at BSP, Bhilai. A 4000 M^3 BF is likely to be introduced at IISCo, Burnpur. Another large BF of ≥ 4000 m^3 is expected to be added at JSW shortly.

In the post liberalized period, a large number of mini blast furnaces (175 M^3—350/402 M^3), adopting MECON, Tata Korf or Chinese technology, have been set up for production of pig iron/hot metal. Today, there are over 30 such operating units and several are under planning and implementation stage. In addition, a few tiny Blast Furnaces (50 M^3) have been set up recently.

The technology adopted in most of the older BFs in the country is old & outdated and operating with poor techno-economic parameters. In recent years, the trend towards higher blast furnace productivity, operating efficiency and campaign life as well as quest for alternate and cheaper fuel has been influenced by a greater understanding of what is happening inside the blast furnace. Following the benefits experienced from the Paul Wurth Bell-Less Top and the growth of automation systems and knowledge gathered from a range of probes and sensors, together with the introduction of other new technologies; a program of improvements to existing BF equipment and associated facilities have consolidated the reliability of the process.

Several blast furnaces have been renovated/ upgraded and equipped with some of the latest technological innovations such as Bell-Less Top charging, Coal Dust Injection Oxygen enrichment, High Top Pressure etc. There has also been more emphasis on the use of prepared/ sintered burden in the blast furnace and currently, 70-75% sinter is used in the blast furnace. As a result of these measures and the adoption of several other modern features viz. automation, control etc. there has been substantial improvement in the techno-economic parameters of Indian Blast Furnaces.

iii) DRI Making:

Government of India took special initiative in the 70s to develop and establish the coal based sponge iron technology using indigenously available natural resources as a substitute for steel melting scrap. With this initiative by the

Government, coal based technology has come up to age and Sponge Iron India Ltd (SIIL) technology has been adopted by a large number of units. Three gas based units have also been set up,

Today, there are 180 units in operation with a total installed capacity of 17 Million Tonnes. This includes three gas-based plants, one of them also adopting the latest and largest Mega module. Reportedly, 200 more units are in various stages of planning, construction and installation. In 2005, India produced approx 12 Million Tonnes of sponge iron and maintained its position of being the largest producer in the world. It is also the largest producer of coal based sponge iron in the world.

iv) Steel Making:

a) Basic Oxygen Furnace (BOF) Steel Making

The profile of the Indian steel making process technologies have also undergone a sea change from the domination of Open Hearth Furnaces to the Basic Oxygen Furnaces (BOF) in the Integrated Steel Plants. All the conventional Open Hearth Furnaces have since been phased out and the last in the queue are the Twin Hearth Furnaces in two plants. As a result, today, Basic Oxygen Process route (52.5%) and Electric Furnace route (45%) accounts for over 97 % steel production in the country and the contribution of other route (Twin Hearth Furnace) is negligible at 2.5% only. Further, some of the BOFs are being equipped with the latest technological innovations like concurrent top and bottom blowing practices, modern automation & control facilities including dynamic charge control and better shop floor practices. These have led to higher productivity and lesser consumptions of costly inputs and refractories.

b) Electric Arc Furnace (EAF) steel making

There are two large capacity plants and 36 mini plants. Though the two plants adopt several modern technological innovations, most of the mini plants are yet to adopt such modern technologies. Most of these plants are equipped with 20-50 tonne furnaces with very high consumption of electricity and electrode.

Nevertheless, the technological profile of the industry has been improving. A few units have set up blast furnaces for production of hot metal for use in EAF thereby utilizing the chemical/sensible heat of the hot metal resulting in very low power/electrode consumption. Most of the plants are equipped with common modern gadgets like water cooled wall, water cooled roof, oxygen injection, foamy slag practice, ladle furnace, eccentric bottom tapping, cored wire injection etc. leading to achieving improvements in terms of higher productivity, lower consumption of electricity, electrode, refractory etc. One of the most significant achievements of the EAF sector is their output of tailor made, high quality alloy/special steel. Today's customers like the auto sector, railways, defence etc require steel of stringent quality and composition. The EAF sector with modern technologies is able to meet such requirements.

c) Electric Induction Furnace (EIF) steel making :

India is the largest user of induction furnaces, both for production of ingot steel and steel castings. Today, there are around 720 operating Induction Furnace units producing over 8.5 million tonnes steel through this route. This process route is now being used in several Asian countries like Bangladesh, Pakistan, Indonesia, Turkey and some African countries.

In Induction Furnaces, there are technological limitations to refine the steel to produce stringent quality steel with low sulphur, low phosphorous and low inclusions as per national/international standards. The problem is more stringent with those who do not get good quality shredded scrap and use DRI. Some of the units have recently set up captive DRI facilities also in view of limited availability of shredded scrap. Most of Induction Furnace units are engaged in production of mild steel ingots/billets and long products for mass consumption. Some are also producing stainless steel patta/patras for utensils. The units are also dependent on State Electricity Boards (SEBs) for electricity, which is costly in most of the states. This makes them uncompetitive in the market. As a result, the production capacity of this industry remains under utilized/ under reported.

v) Secondary Refining

Adoption of Secondary Refining practices in Indian Steel Industry, in general, is limited. Some of the integrated/composite plants have recently set up these technologies to enable them to produce quality steel for specific end use applications. Most of the EAF based mini-steel plants have also adopted Secondary Refining facilities to enable them to produce alloy/ stainless/special steel economically. A few EIF units have also set up Ladle Furnaces to partially refine the steel produced. However, in other mini steel plants, adoption of these technologies is insignificant and hence their contribution to the production of alloy/special steel is very limited.

vi) Continuous Casting

In the areas of conversion of liquid steel to solid/ crude steel also, there has been a remarkable change from the old/outdated ingot-casting route to the modern continuous casting route. This change is visible not only in the large plants but also in the mini steel plants. Today, in India approx. 66% steel is produced through the Continuous Casting route.

vii) Rolling & Finishing Mills

Significant developments have been made in the rolling and finishing lines. The major thrust areas are increased yield, reduced energy consumption and production of high strength steel with superior surface finish and dimensional accuracy.

Barring the old low capacity mills, with obsolete technologies, most of the later generation mills are with modern technologies. In the Hot Rolling of Flat products, there are semi-continuous and continuous mills as well as Steckel Mills with modern automation and control systems. The technology profile in the cold rolling sector has also improved significantly from the conventional 2Hi/4Hi Mills to the modern 4-Hi/6-Hi Mills with conventional crown, high crown and continuous variable crown as well as Sendzimir Mills specially for stainless steel products. There has also been significant improvement in the allied sectors like pickling and annealing.

In the processing sector also, there has been remarkable changes with the advent of large number of galvansing and colour coating lines to produce value added products. Besides, a galvalume line has also been set up.

3.4.0 Assessment of the Current Status Of Technology

3.4.1 Though some of the Indian Steel plants have been assessed to be the lowest cost steel producer having some of the best operating practices in the world, a cursory examination of the present status of technology would show that the technological performance of Indian Steel Plants in terms of specific consumption of raw material/ consumables, specific energy/power consumption, environmental and pollution norms and cleanliness of steel is significantly lower than those in the advanced countries. For example;

- India still produces 34% steel through ingot casting route, which is obsolete in advanced countries.
- BF productivity in the majority of the furnaces vary in the range of 1.5—2+ $T/M^3/D$ as compared to the international modern plants achieving over 2.5-3+ Kg/THM using auxiliary fuel injection and oxygen enrichment extensively.
- Coke rate in Indian Blast Furnaces is 450- 600+ kg/thm which is higher than the international norm of 350-400 kg/thm.
- Energy consumption is 6.45-8.5 G. Cal/tcs in India as compared to 4.5-5 G. Cal/tcs abroad.
- Only approximately 25% of India's steel is secondary refined.
- Indian Plants produce 1.5 -2 times more slag and dust, 2 times more GHGs and upto 4-5 times more waste gases compared to those in the developed countries.

- In most of the plants use of advanced instrumentation and automation is meagre.

3.4.2 The benefits on account of indigenously available low cost of primary raw materials (iron ore) have been gradually eroding over the years. Similarly, benefits on account of low cost labour is also eroding. Therefore, more and more stress is required on technological aspects to reduce cost of production, improve quality and produce new and value added products which are needed by the customers.

3.4.3 The inferior performance of the Indian Steel Plants using conventional processes is mainly due to poor quality of raw material/inputs, obsolete technology, inefficient use of technology, mismatch between the imported technology and the indigenous situation and technological indiscipline. Though the new plants compare favorably in many parameters, they also lack good norms of performance and quality in their products.

3.4.4 However, in some areas, Indian plants have become world leaders on account of incorporation of appropriate technology as well as the development of indigenous technology. Today India is the largest producer of DRI in the world. Some companies in India are acknowledged as global leaders in the application of the following technologies: coal and gas based DRI; hot charging of DRI in Electric Arc Furnace, flexible Con-arc furnace, alternate route of iron making like COREX and thin slab casting and direct rolling.

3.4.5 The status of performance of the Indian Steel Plants of India vis-à-vis their counterparts in respect of certain key parameters, sector-wise, are given in Annexure-I. This shows that in terms of performance of technological parameters, in a number of areas, Indian plants are at a lower standing than their international counterparts for reasons as mentioned above. At the same time, some of the parameters, though limited, reveal high standards of performance of Indian industry.

Therefore, a suitable programme of action needs to be drawn to bring the Indian steel industry in a leading role.

3.5.0 Programme of Action

3.5.1 Challenges before the Indian Steel industry

Inferior performance of conventional integrated steel plants is mainly due to constraints in indigenously available raw material, prevalence of obsolete technology, technological indiscipline, and lack of R&D to overcome the technological gaps.

Though, the BF-BOF as well as DRI-EAF/EIF routes of production are well established, there is serious mismatch between the indigenous availability of raw material vis-à-vis the techno-economic requirements of these processes. Quantity of Indian iron ore though considered adequate to sustain the growth and development of steel sector, there are areas of concern in terms of qualities particularly, high alumina content and also high alumina-silica ratio and high alkali loading in inputs which very adversely affect the operation & productivity of BF, quality of hot metal and cost of production. Indian coals (both coking and non-coking) are of very inferior quality which significantly influence the productivity, efficiency of iron making processes and quality of hot metal/steel produced. This necessitates import of large quantity of coking coal. Technological solutions of these problems are considered essential and need to be explored considering the prevailing and rising prices of these good inputs.

Similarly, the DRI and Electric furnace sector is constrained by insufficient indigenous availability of high grade of iron ore and steel melting scrap. DRI units based on natural gas are loosing competitiveness due to rising prices of natural gas. Quality and availability of non coking coal for coal based units is also not satisfactory. These also require immediate technological solutions.

Besides, poor and costlier infrastructure like power, rail/ road transportation and communication, poor reliability are also areas of concern for the Indian steel industry. These factors, no doubt, affect the scope of technology selection, adoption and utilization.

Lastly, global competitiveness is a major challenge which essentially directs the emphasis towards input & product quality, cost competitiveness and customer satisfaction.

3.5.2 Strategies to overcome the Challenges

To beat the above challenges, the Indian steel industry has to improve upon the technological and economic parameters of the existing plants – in all areas starting from raw material to the finished product– through modernization / renovation to adopt modern, energy efficient & cost effective technologies and modern shop floor practices. This should also take into account the adoption of the modern, state-of-art technologies and innovations as well as the emerging technologies. In this context, alternative iron making technologies having larger flexibility to use indigenously available resources like non-coking coal, low grade iron ore, iron ore fines and coal of inferior grade appear quite relevant. Most of these technologies are yet to be proven commercially and therefore, they need to be adopted after judicious techno-economic evaluation.

The strategy to tackle the problem may include;

i) Improvement in quality of raw materials by

- Outsourcing
- Installation of additional beneficiation/ processing facilities.
- Research & Development.

ii) Incremental improvement in performance of existing plants by

- Reduction in specific consumption of raw materials

- Increase in productivity, reduction in processing time and change in processing practices.
- Reduction in consumption of energy and harnessing of waste energy.
- Effective utilization of manpower to the maximum extent possible
- Recycling and utilization of wastes
- Introduction of automation in all the areas of plant operation
- Development of human resources
- Introduction of safer operation practices

iii) Introduction of better and value added products by Research & Development.

iv) Improvement in design and machine building capability.

v) Introduction of new technologies.

vi) Government support in extending financial incentives for R&D activities by individual companies

3.6.0 Assessment of Promising and Emerging Technologies:

3.6.1 A large number of new technologies are presently available in the world particularly in the developed countries. These technologies are classified according to the technical areas viz. iron ore and coal processing. beneficiation, agglomeration, direct reduction, smelting reduction, coke oven and bye-products, blast furnace, basic oxygen furnace, electric furnace, induction furnace, secondary refining, rolling etc. details of which are given in Annexure- II. Some of these technologies though introduced in India by some units, others are yet to be explored / introduced; and yet some are still under development. The relevance of these technologies with regard to the basic technologies and their feasibility for introduction / adoption in the Indian scenario are discussed in the following paragraphs :

3.6.2. Beneficiation of Raw Materials

3.6.2.1 Presently, most of the steel plants are required to wash and beneficiate their primary raw materials – iron ore, coal, lime stone etc. but adoption of the modern beneficiation techniques has been very limited. For example, coking coal is washed to bring down the ash content to around 17% ash and there is absence of suitable technology with Coal India Ltd for washing these coals below 17% ash level with reasonably higher yield. As a result more than 50% coking coal is to be imported for blending purposes. Tata Steel has developed superior beneficiation technology and are producing 14% ash coal with good yield. Similarly, coal based DRI industry is forced to utilize the high ash (25-40%) indigenously available non-coking coal. The volatile matter in this coal is also higher than the desired limits and fixed carbon is lower than the desired limit. Hence they are limited to be used even in the alternate iron making technology like the COREX.

3.6.2.2 Therefore, beneficiation of indigenously available natural resources have to be taken up on priority as a National Policy and suitable technologies have to be developed and adopted to address the perennial problems of indigenously available raw materials particularly iron ore and coal. Preferential removal of alumina from High Aumina Indian ores, through suitable beneficiation processes has to be addressed in light of the rising cost of iron ore. Beneficiation of banded hematite quartzite (BHQ) is also a techno economic challenge before the industry to enhance substantially our iron ore resource base.

3.6.2.3 In India, the iron ore processing circuit comprises two/three stage crushing, wet/dry screening followed by processing in a mechanical classifier to produce iron ore lump (10-40 mm) and sinter grade fines (- 10 mm). In some mines the slime (-0.2 mm) generated during the process is treated in a cyclone or magnetic separator to recover enriched iron fines thereby reducing slime generation.

3.6.2.4 Most of the mines are having hematite iron ore and the cut off grade of run-of-mines is in the range 60-62% Fe, depending upon the iron ore reserve quality. Iron ore with less than 60% Fe are discarded as overburden or waste and are dumped. Processing facilities to process low grade hematite ore is not available in India, which results in reduction in mine life.

3.6.2.5 Indian iron ore processing technology have technological gaps with respect to processing low-grade iron ores which are abundantly available in the country. The challenge is to beneficiate these iron ores to improve their iron content to more than 65% Fe by development of relevant method of beneficiation to reduce the slime generation and to achieve reasonably high yield through recovery of iron values. Incorporation of new technology would result in production of concentrate besides iron ore lump and fines. Concentrate would be a good feed material for pellet making.

3.6.2.6 New technologies will involve use of modern crushers, Batac Jigs, Hydrocylones, Wet high intensity magnetic separators (WHIMS), spirals and flotation to produce iron ore lump of size 8-30 mm, Sinter fines (- 8 mm) and high grade concentrate (-0.15 mm). Attempts have to be made to beneficiate low grade dumped iron ores and slimes deposited at tailing ponds and use intense beneficiation circuits with a view to improve quality of product and also minimize slime loss.

3.6.2.7 The beneficiation of coal and coal fines is another area of challenge which could be addressed by using flotex density separator which is a recent development for implementation and need to be explored for adoption in Indian scenario extensively.

3.6.2.8 Attention is also required to utilize the low volatile medium coking coal available abundantly in the country by adopting suitable washing/ beneficiation techniques and coke making technologies.

3.6.2.9 Both magnesite and bauxite along with graphite are used for manufacture of certain high quality refractories. Though magnesite and bauxite are available in India much of the country's requirement is made through import (magnesite 90%; bauxite 70%). The prime reason for import is inadequate beneficiation with attendant lower quality. The quality of graphite required for carbon bearing refractory is over 97% carbon. Indigenous graphite is not beneficiated beyond 94% carbon, which restricts its use. There has to be a thrust in the development of beneficiation technology as well as incentive for using Indian raw material

3.6.2.10 In view of increasing production of special grade steel of high quality, there is considerable demand of Ferro-alloys like Ferro-Manganese (FeMn), Silica-Manganese (SiMn) of appropriate quality. Quality issues faced are in terms of residuals. One of the issues requires attention is beneficiation of manganese ore for production of low phosphorous Ferro-manganese. Need exists towards development of suitable technology for the production of extra low phosphorous FeMn(< 0.2% P) for wide range of low carbon grades of steel by reducing phosphorous content of manganese ores.

3.6.2.11 Ferro-chrome is produced from chromites ore containing 45-50% Cr_2O_3. Ores containing < 30% Cr_2O_3, which are of sizable amount, friable and fines in nature, are generally not used for the production of FeCr. Suitable beneficiation methodology needs to be evolved so as to make effective use of this lean material.

3.6.3.0 Coke Making

3.6.3.1 In the Coke making area, though several plants have adopted some of the modern technological innovations viz. pre and post carbonization techniques, more emphasis is needed to adopt these technologies by all the plants to enable economic production of coke using inferior coal in an environment friendly manner.

Stamp Charging as well as Partial Briquetting offer significant improvement in productivity and quality of coke, even with relatively inferior coal. These need to be widely introduced particularly to address the problem of scarce and precious coking coal. In the Indian context the third generation and large scale technology of Non-Recovery Coke Oven Batteries and On-line heating control of coke ovens need to be further developed and fostered.

3.6.3.2 Non-recovery ovens

Non Recovery Coke Ovens are characterized by lower investment cost and more environment friendliness. These are particularly useful in smaller scale of operations and could be adopted to meet the gap in metallurgical coke requirement in the country. Pioneered by Sesa Kembla Ltd, in India, this technology is gaining importance in the country and there is wider scope for its adaptation and development. Similar technology is being used extensively in China for large scale merchant coke production for iron & steel industries. A large plant based on Chinese technology ≥ 1 million tonne per annum with 60 MW power is being constructed by Tatas at Haldia. JSW Steel Limited have also installed a non – recovery type coke oven.

In this technology, carbonization is done under negative pressure and the volatiles are completely combusted. There is no chemical bye-product processing involved – no wastewater, no tar sludge disposal problem - very low emission and no hazardous waste generation.

The above distinct advantages together with low capital cost make non-recovery ovens with and without heat recovery technology a promising alternative in the Indian context, particularly, for a Greenfield plant. It is reported that using 100% imported coal (upto 20-25% Soft/Inferior variety in the blend) coke of Micum 5-6 and with good CSR about 64-65 with no or minimum environmental pollution can be obtained. However, for integrated steel plant space, logistics, machineries and gas balance etc. are the major factors that are to be addressed before adoption of such non-recovery ovens in an integrated steel plant.

3.6.3.3 On-line heating control technology for coke ovens

In today's scenario, Level-II computerized controlled battery heating and automation system is essential for all the coke ovens to improve coke quality and reduce energy consumption in coke making. This also facilitates adherence to pollution control norms besides reducing coke rate in Blast Furnace.

The technology is available with only a few select countries : CETCO, Netherlands, CODECO, Germany, Rautarukki, Finland and Amano, Japan. This technology has also been developed in-house by RDCIS, SAIL for optimization of heat consumption during coal carbonization and has been implemented in BSP, SAIL and DSP, SAIL.

3.6.3.4 Widening of coal base for coke making

On long term perspective, we need to consider development of innovative coke making process aiming at widening the choice of coal resources, increase productivity, reduce environmental pollution and energy consumption in the line of SCOPE-21 technology.

3.6.4 Sintering and Agglomeration

3.6.4.1 Like the beneficiation of iron ore and coal, agglomeration of ore/ coal fines has also to be addressed on priority in all the iron & steel plants as a National Policy to reduce dependence on lumpy ore and to avail associated techno-economic benefits.

3.6.4.2 Since most of the iron ore fines are combination of hematite-goethite and hematite-limonite, the sintering plant performance will be affected due to high fusibility and high porosity of iron ore fines. New technology has to be developed to reduce the porosity of iron ore fines and fusibility characteristics by preheating of iron ore fines and granulation (new granule design).

3.6.4.3 Pellet sintering technology, which combines pelletisation and sintering process holds promise to take care of the availability of finer grade iron ore fines.

3.6.4.4 Today, available technologies for production of pellets are essentially in large scale of the order of millions of tonnes. On the other hand, the need of the hour is to have cost effective small capacity pellet plants of the order of lakhs of tonnes, based on the Chinese model to utilize fine iron ore which are being exported at present. This would also prove to be a boon for coal based DRI plants which are dependent on lumpy iron ore. This problem needs to be addressed on priority.

3.6.4.5 Further, a number of energy saving technologies namely, increased use of multi slit burners, "proper MgO addition' etc. are available which have to be introduced in the existing sinter plants to make them more energy efficient. Similarly, measures available for increase in production and productivity from existing facilities viz. use of super fines in sinter mix (e.g. HPS process), vibrating granulation equipment, high agitating mixture, extension of grate width, modern high pressure sintering, increased bed height/width and suction etc. have to be introduced selectively. Energy conservation & reduction and Emission Control in Sinter Plant are challenging tasks and modern energy conservation & pollution control needs to be considered on priority.

3.6.5 BF Iron Making

3.6.5.1 Blast furnace, by far, has proved to be the most efficient, techno-economic and the predominant route followed all over the world for liquid iron production. It is also expected that this route of iron making will play its dominant role in the years to come though in percentage terms its share may reduce over the years. Technological innovations continue and will continue to make the BF iron making process state-of-the-art to enhance the techno-economic advantages of the route. However, its dependence on metallurgical coke for at least 50% of the total fuel requirement cannot be ruled out. This is a challenging area particularly because of limited coking coal reserves throughout the world.

3.6.5.2 Different technological innovations that need to be considered under Indian conditions to improve the productivity and quality of hot metal and to reduce the consumption of fuel are elaborated hereunder:

Process improvements : Introduction of Cu- staves, silicon carbide or other improved refractory system in high heat load areas, revamping/conveyorisation of stock house and screening efficiency of ore, sinter and coke, strengthening stoves capacity, increasing blast volume and flow rate, increasing oxygen enrichment of blast (upto at least 5%), hot blast temperatures of at-least 1100^0 C, application of close circuit water for better cooling efficiency, increasing the inner useful volume (by 150-200 M^3), introduction of alternate fuel injection in blast furnaces, augmentation of cast house facilities including powerful mud gun and drilling machines and installation of latest instrumentation, automation and control systems for improved process control will have to be given immediate importance.

Increased use of prepared burden : Prepared burden (sinter, pellets, DRI and other metallics) has to be increased to the extent of 80-90% , if not more, to achieve consistent quality of hot metal and better performance efficiency of furnaces.

High level of alternate fuels injection : In order to drastically reduce coke rate, incorporation of technologies for injecting pulverized/ granulated coal (+ 200 kg/thm), oil (100 kg/thm), Natural gas (100 kg/thm) and waste plastics granules have to be seriously considered.

Cost reduction measures : Technologies e.g. Top Gas Recovery Turbine, use of waste heat stove gas for preheating of gas, high efficiency stoves etc. need to be evaluated and introduced in existing and new blast furnaces.

Increase in campaign life : Introduction of various measures like copper staves, Silicon carbide and monolithic linings in stack and bosh, closed circuit demineralized water and provisions for regular monitoring of heat flux all along the furnace height and cross-section, use of titanium bearing material as a regular hearth protection measure etc. will have significant impact in extending campaign life of furnaces.

Application of sophisticated probes and computerised expert system : Extensive use of probes (under and overburden probes, vertical probes etc), models and computerized Expert system for process analysis, control and optimisation are very important tools for bringing about quantum jump in productivity levels of Indian blast furnaces.

Efficient casting practice: This can be attempted through up-gradation of cast house equipment, clay mass and liquid disposal system. Incorporation of powerful mud gun and drilling machines are important and need to be considered for incorporation.

3.6.6 Direct Reduction and Smelting Reduction

3.6.6.1 To reduce the dependence on precious and scarce coke in conventional BF iron making process, development of techno-economically viable alternative to BF iron making has become imperative globally and particularly, for India since availability of coking coal is very limited. This constraint has proved to be the main driving force for development of alternative iron making technologies using mainly non-coking coal. In this context, Direct Reduction Processes and Smelting Reduction Technologies are considered very relevant.

3.6.6.2 An integrated policy for promotion and growth of sponge iron industry in India, particularly, the coal based sponge iron industry in an environment friendly manner by installation of adequate pollution control equipment is important. This may encompass development/ adoption of technologies for washing/ beneficiation of non-coking coal to the required ash level, augmenting pellet making capacity utilizing fine ores, gasification of coal for supporting development of gas based plants and extensive use of middlings for generation of power. Maximum importance may, however, need to be given to production of sponge iron at competitive rates, utilization of indigenously available iron ore fines directly and production of high carbon sponge iron.

3.6.6.3 Coal gasification for DRI production

A revolutionary and challenging new alternative likely to be suitable under Indian conditions is non-coking coal gasification by the well established coal gasification (Lurgi Technology) and use of the synthesis gas thus generated (in lieu of natural gas) as the reductant in vertical Shaft Furnace to produce gas based DRI.

Jindal Steel and Power Ltd. is coming up with this revolutionary technology for production of DRI at its Greenfield steel project in Angul, Orissa. Coal to be used for gasification will be from indigenous sources (coal with 40-45% ash washed to suitable quality). The middling generated will be used for power generation. Iron ore fines after required washing and suitably blending with high iron containing blue dust will be used to produce DR grade pellets. These pellets along with ore lump at suitable ratio will be used in vertical shaft DRI unit to produce gas based DRI, which in turn will be used in EAF to produce steel.

Several Smelting Reduction technologies have been developed over the years and several are under development. Details of these technologies are given in Annexure-III. These processes are known for their eco-friendliness and use of non-coking coal directly as reducing agent and energy source. These technologies appear to fulfill the requirement of "sustainable development", i.e. environmental control, pollution control and safety all integrated parts of the technologies and do without coke making or separate agglomeration facilities. Therefore, the relevance of these technologies has to be carefully assessed for compatibility in the Indian context.

The promising alternative technologies which have been commercialized or are in the process of commercialization and which appear relevant for the time frame of the 11th and 12th Five year Plan are COREX, FINEX, HISMELT, FASTMET/FASTMELT and ITmk3 .

a) COREX Process

Out of the several Smelting Reduction processes, only the COREX process has so far been commercially exploited successfully. 4 No. of COREX C-2000 modules are under operation at JSW Steel in Karnataka (2 nos.), Pohang Works of POSCO, Korea (1 no.), and Saldanha Steel Ltd. in South Africa (1 no.) and are producing ≥ 5 MTPA quality hot metal consistently. Essar Steel Ltd. is in the process of setting up a ˜1 MTPA COREX Plant in their Hazira Works.

Though it is claimed that this route is best suited for cost effective production of liquid iron using non-coking coal in an environment friendly manner, reservations exist on account of high capital investment, use of agglomerated burden (pellets), requirement of stringent quality non-coking coal not available in India, high cost of oxygen plant and power plant. These tend to restrict further installation of more such units. JSW Steel Ltd. has gone in for a small blast furnace (0.8 MTPA), instead of adding another COREX unit, along with 1 MTPA non-recovery battery with co-generation power plant (60 MW) primarily for specific energy cost and gas balance optimization.

The success of COREX process seem to lie on the effective and economical utilization of the large amount of surplus high calorific value off gas, viz. for power generation, DRI production etc. Further improvement of COREX process for making it more raw material friendly through use of coke, medium volatile coal, use of fines and waste materials is being pursued. The future adoption of this technology would depend on techno-economic considerations vis-à-vis other SR processes particularly the FINEX and HISMELT processes.

b) FINEX process

The limitations of the COREX process with respect to use of iron ore fines directly has led to development of FINEX process at Pohang, POSCO. The process has been successfully demonstrated at 2000 TPD level producing hot metal consistently. A 1.5 MTPA commercial plant is expecting commercial production by end of 2006, in Pohang, South Korea.

The unique feature of Finex process, is the direct use of iron ore fines and non coking coal to make liquid iron. However, the Melter Gasifier, which melts the reduced iron as well as generates the gas for use in the fluidized beds –appears to need inputs largely in lumpy form requiring compaction of reduced ore at the high operating temperature and reducing atmosphere. While it has been possible to avoid use of coke in Melter gasifier like that in Corex plant, the process needs either lumpy coal or coal briquettes. Briquetting calls for use of binders and suitable processing technology to get strength levels of coke. The Finex plant at Pohang reportedly use coal injection thereby lowering need of high strength briquettes. Similarly, the reduced iron to be charged in the melter gasifier is also in the form of lump/ briquettes. Thus, while need for agglomeration(pelletising) of ore and use of coke are avoided, these are functionally substituted by alternative, major processing steps requiring substantial additional cost apart from operating and maintenance difficulties. Further, like Corex gas, Finex gas is also of high calorific value and needs to be utilized gainfully to make the process economically viable.

The above technological issues and techno-economics at commercial scale plant of 1.5 MTPA would judge the commercial viability of the process route. If these turn out to be feasible and viable at commercial scale; Finex technology may emerge as a leading iron making technology that will contribute to the sustainable growth to the Steel Industry. It is reported that adoption of this process is also being considered for POSCO's venture in Orissa.

c) HISMELT process

This process differs from Corex or Finex in that it makes direct use of iron ore and coal fines in a single step reactor. The salient feature of the process is that it involves moderate to high degree, 70% and above, post combustion. The in-bath gas generated during the reactions is post combusted to around 50% above the bath and the heat energy of the post combustion is transferred back to the main process through the liquid fountain of molten iron bath, instead of recovering it as export gas to be used for other applications like in Corex process. This reduces the coal and oxygen requirement of the process. Another distinguishing feature of the process is oxidation level of the slag bath- with 5% FeO in slag- which helps in portioning of a large part of the phosphorous to slag. Further, silicon is practically absent, making the hot metal an ideal feed for BOF. Further, The technology is at demonstration stage and could be commercially exploited using quality and enriched raw material fines.

The HISMELT technology is in the process of commercialization and the first plant of 0.8 MTPA has been commissioned in 2005 at Kwinana, Western Australia. The Plant had a major shut down in February, 2006 for modification. Since its restart in March, 2006, the Plant has achieved a production rate of about 60% of its capacity. The hot metal produced has low phosphorus (less than 0.05%) and very low silicon (less than 0.05%). There are further plans to scale up the size (internal diameters) of the Smelting Reduction vessel from 6m to 8m for achieving a production of 2 MTPA from this single module. Based on the preliminary assessment, it appears that HISMELT is a potential replacement for the Blast Furnace Iron making process and is positioned to become one of the important technologies of choice for future iron making requirement.

Out of the two promising smelting reduction processes for iron making i.e. FINEX and HISMELT, it is to be noted that though both the processes have been demonstrated successfully at the demonstration plant level, relative merits and demerits of the two processes could be better visualized upon commercial success of the two processes on higher scale of operation which is expected by the end of 2006.

d) FASTMET/FASTMELT process

This process envisages reduction of ore-coal composite pellets in rotary hearth furnace (RHF). Various carbon sources such coal, coke breeze and carbon bearing waste can be used as a reductant in this process. The DRI product with high degree of metallization can be charged in conventional iron & steel making furnaces or can be smelted in Electric Iron Furnace (EIF) to produce hot metal directly from the Hot DRI adopting the FASTMELT Process. This process may be attractive for small to medium iron producing units.

The process was successfully demonstrated by MIDREX Corporation, USA jointly with Kobe Steel Ltd., Japan and subsequently, a demonstration plant was set up at Kobe Steel Ltd's Kakogawa Works. MIDREX Corporation is currently marketing the FASTMET process for mill waste oxides. Two commercial FASTMET units have been installed at Kobe Steel and Nippon Steel. Iron Dynamics, a subsidiary of Steel Dynamics currently operates a rotary hearth furnace to produce 85% reduced iron pellets which are subsequently melted in a sub-merged arc furnace to produce hot metal for use in a EAF shop. However, the total energy efficiency of this process is not very high as compared with the blast furnace or other coal based technologies for production of iron. The techno-economics of this process in Indian condition will have to be judged after an in-depth study of the process vis-à-vis other established process for production of DRI or Hot Metal.

e) ITmk3 Process

Developed by Kobe Steel, Japan, the process uses a rotary hearth furnace to turn green dry pellets made from low grade iron ore fines and pulverised coal into solid iron nuggets of superior quality(97% Fe) to DRI but similar quality to pig iron, suitable for use in EAF, BOF and foundry applications. The process is unique in that nearly all of the chemical energy of the fuel used is consumed and no gas credit is exported from the system. It is claimed that the process is more energy efficient (consuming 30% less energy compared to BF-BOF route), more environment friendly with 40% less emissions and involves less capital and operating cost, which make the process attractive for consideration for steel plants in the small and medium sector.

A pilot plant of 25000tpa capacity set up by Mesabi Nuggets is operating in Minnesota, USA. The start up of the first commercial plant or the Large Scale Demonstration Plant (LSDP) of capacity 500000tpa is tentatively planned for the third quarter, 2007.

3.6.7 BOF Steel Making

3.6.7.1 In India, BF-BOF is the widely used and stabilized main/-line steel making technology wherein a mix of old and new/modern BOF furnaces (LD converters) are in operation. The new furnaces are equipped with several modern technological innovations and also the current shop floor practices and compares reasonably well with the furnaces elsewhere in the world. However, many other furnaces, particularly, the older versions are still operating at much lower efficiency. Therefore, these furnaces need to be modernized/ renovated and fitted with modern innovations to make steel production internationally competitive.

3.6.7.2 BOF lining life and corresponding converter availability and cost of steel making is another area of thrust. JSW Steel Ltd. has established lining life ≥12000, which is equivalent to good international practice. Other steel plants should take this as a challenge. Pre-treatment of Hot Metal, Dynamic Control of BOF process, Slag Splashing are some of the modern technological practices which need to be extensively used in the existing or new set up. Process development for handling and utilization of slag and sludge in steel making process should be given adequate attention. Some details on dynamic BOF process control and zero waste BOF steel making are mentioned below:

a) Dynamic BOF process control

Dynamic BOF process control (level II) is practiced in most advanced steel plants abroad. BOF steelmaking is in operation in India for quite some time. But most of these resorts to computerized static charge control only. Significant techno-economic advantage can be obtained by resorting to dynamic process control system.

Dynamic control of the blowing through off gas analysis has helped to achieve consistent and reproducible turn down condition by way of high percentage hitting of carbon and temperature (more than 90%) simultaneously. Use of optical sensors and lasers is on the verge of being utilized for measurement and control.

Such system is planned to be installed in SMS-II at BSL, SAIL. Additionally, SAIL has launched a programme for indigenous development of such system in association with IIT, Kanpur for implementation in SMS-II of RSP, SAIL. Some of the other plants are also planning to adopt these systems in the immediate near future.

b) Zero waste BOF steel making

Different wastes are generated in a BOF Shop. These are: slag, sludge (130 – 150 kg/tcs) and Gas (90 – 100 Nm^3/tcs). These are generated mainly during BOF blowing but are also produced during other SMS operation e.g. hot metal desulphurization, Secondary Refining and Continuous Casting.

Worldwide attention is being focused towards reducing these generation and utilize them gainfully so that wastes become valuable materials.

Besides efforts to reduce waste generation, many processes are being mastered to use the generated solid/liquid wastes viz. PRIMUS, OXYCUP, ZEWA etc. Industry wide effort to adopt/develop suitable waste recycling process would entail value generation and lessen land fill load for the industry.

3.6.8 Electric Steel Making

3.6.8.1 EAF Steel making:

In the electric arc furnace sector, there is a wide variation in the technological profile of the Indian plants. While a few plants are world class, others still suffer with technological obsolescence. State-of-the-art technologies like UHP furnaces, Door-jet burners with super sonic oxygen lances for enhanced oxygen injection, Utilisation of waste heat for scrap pre heating (like those used in Finger shaft furnace, Eco-arc furnace) and the like are known for substantial reduced electricity (approx 150 kwh) and electrode consumption (approx 1 kg) and need to be adopted. These technologies along with other modern features may be considered on priority in order to reduce consumption of electricity, electrodes and refractories and thereby make electric steel making internationally competitive.

The use of hot metal in electric furnaces and hot charging of DRI are particularly relevant to improve productivity of EAFs and to reduce power & electrode consumption. In Indian condition where scrap & power availability is limited and cost is prohibitive, use of chemical energy of hot metal in EAF is particularly recommended as a futuristic technology with definite return as already proven at Usha Martin plant at Jamshedpur. Effective steps may be taken towards partial substitution of scrap/DRI by hot metal where ever feasible, both in the short term and long term perspective.

To ensure availability of good quality domestic scrap for the electric furnace industry, it is necessary to have scrap processing facilities in the country. It is suggested that MSTC LTD which has vast experience in handling of scrap is made the nodal agency for scrap procurement and processing.

3.6.8.2 Induction Furnace Steel Making

The induction furnace industry and technology profile are undergoing changes in view of substantial increase of main line steel production units. The industry is expected to exist in India due to its geography to meet local requirements, though with a new face. It has been already mooted by many units that stand alone small units may not survive and should either become large units or have forward or backward integration. Ten tonne and above per charge induction furnace are going in for forward integration with rolling mill. In many states, medium scale sponge iron units have installed IFs which use energy generated from the waste heat of sponge iron plant. There are bigger units having 2.0 lakh tonne per annum capacity using sponge iron and induction furnaces with secondary refining to produce mild steel. Unit capacity of IFs have also increased to over 25 tonnes and India is the pioneer in such technologies. Such initiatives are needed for others to survive in the future.

However, technological bottlenecks remains and efforts are absolutely necessary on the part of Industry and Government to address the problem by suitable technological interventions. Ways and means need to be evolved to refine the steel inside the furnace adopting basic/neutral lining or outside the furnace (LRF), essentially to reduce harmful elements like sulphur, phosphorous, inclusions, slag entrapments etc and thereby make clean steel of national /international quality. This must be given top priority to ensure availability of standard quality steel from this sector.

3.6.9 Secondary Refining and Continuous Casting

3.6.9.1 In view of increasing demand of quality steel by the consumers, it is apparent that the steel industry needs to pay more attention towards secondary refining and also continuous casting to improve quality of steel and also to reduce energy consumption and increase yield and thereby produce steel at reduced cost.

3.6.9.2 In this area also there are several well established technologies viz. RH / RH-OB process, CAS-OB process, LF/ AOD / VOD / VAD / VD/ processes and techniques like Hydrogen Censors, which may be utilized for improving the quality of steel to produce value added products required by the modern consuming sectors.

3.6.9.3 In the continuous casting area, there have been considerable developments in the conventional casting technologies over and above the development of thin slab casters. Uses of robots for tundish lining, use of EMS, Level – II automation / computerization, automated system for slag detection and slag carryover control from ladle to tundish, hot charging are some of the promising technologies and need to be adopted. In order to reduce energy costs and improve surface quality, near net shape casting is expected to have wide application and potential in India.

3.6.9.10 Besides the above, modern technological developments like electro-magnetic stirring, electro-magnetic brake ring in moulds etc lead to improved productivity, defect free steel production and reduction in production cost justifying immediate attention of the industry.

3.6.10 Near-net-shape casting

3.6.10.1 The present trend is to cast a profile, which is very near to the final product in size and shape. Casting of thin slab, beam blank, thin strip and wire rod belong to this category. The main advantages are substantial energy saving and yield improvement through minimization of subsequent processing. Technology for casting of thin slab or beam blank is today well established on a commercial scale. Both have a large potential for India.

3.6.10.2 Thin slab caster along with on-line rolling has been implemented at Ispat India. BSL, SAIL and BSP, SAIL will have this technology shortly. JSPL has commissioned one beam-blank caster, and BSP, SAIL has plan to implement the same in future.

3.6.10.3 Casting of thin strip or wire rod has just started getting implemented in a few steel making units in the world. It would take some time before its commercial viability gets established.

3.6.10.4 The technology of continuous casting of wire rod is presently being developed by Arcelor group and is essentially in pilot scale level. In future when the technology is upscaled to commercial level, the following advantages are expected to accrue:

- Possible to cast ϕ 15.0 mm rods
- Coils can be fed directly to wire rod mill
- Higher yield and low cost of production

3.6.11 Rolling Technology

The technological area of rolling assumes importance for the steel industry as it directly impacts the acceptance of products in the market and augments customer confidence. Though recent advancements in rolling technology are getting incorporated in the Indian steel industry, some of the existing mills require up-gradation and incorporation of state-of-art technologies listed in Annexure-II. In today's context, rolling technology must aim at quality product at lowest cost of conversion to suit the users in the engineering sector. In this context, processes like thermo-mechanical treatment and on-line accelerated cooling for rolled products; post- finishing block namely flexible reducing /sizing to roll all finished rods sizes from a common family of inputs produced by intermediate mill or the finishing block have immense value. These lead to improvement in product quality, reduction in production cost, delivery time etc. Further on-line shape measurement, ultrasound testing etc in rolled products is of vital importance to bring in definite improvement in yield of prime quality products.

Besides the above, there are mill/process specific technologies, which are relevant in the Indian context and need quick assessment and implementation. These are highlighted hereunder:

3.6.11.1 Hot strip rolling

a) Hot charging of slabs

Slabs from continuous caster to reheating furnace are being transported through wagons and charged in the furnace after 24 – 72 hours as per the production plan of hot strip mills. In this process large amount of heat energy is lost to the atmosphere. It is, therefore, important to charge slabs in hot condition in reheating furnace in the temperature range of 500-900^{0}C. This process will not only decrease the energy consumption in reheating furnace, but also will increase the metallurgical properties of the product. Hot charging is being practiced in some plants in India and is being planned in some other plants.

b) Compact Strip Processing (CSP)

The process involves casting of near-net-shape thin slabs (40-70 mm), temperature homogenisation of hot charged thin slabs in reheating furnace (with swivel ferry), rolling of thin slabs in 5-7 mill stands and defined cooling and coiling of hot strips. Compared to the conventional process of hot strip production, the CSP technology has definite advantages in terms of lesser investment for setting up of new plant (40-60%), low production cost of hot rolled steel strips (40-50%), reduced energy consumption (50%), production of thinner strips up to 1.0 mm (potential of rolling 0.7-0.8 mm), etc. All types of products from low/medium carbon to ferritic/austenitic stainless steel and CRGO steel can be processed through this technology. CSP technology was developed first by SMS, Demag and introduced in Nucor Steel in 1989. CSP technology has been incorporated in Ispat Industries Ltd. in their Dolvi Plant in Maharashtra. In view of the known techno-economic benefits, this process is considered attractive to be adopted after due deliberation in terms of capacity proposed, specific product-mix and cost of production vis-à-vis the conventional mills at a particular location.

c) On-line surface inspection system for hot rolled flat products

Surface quality is an important parameter in defining the steel strip quality. Spotting tiny surface flaws on a steel strip as it speeds along the processing line is not an easy task, but it is an essential one. Marks and defects as small as a few millimeters in length can cause problems further down the line, particularly for the automotive industry, which requires a defect-free finish on the surface of the steel sheet used in car panel production.

The surface inspection system is among the most challenging machine-vision applications to design and operate. High-speed surface inspection system is required to detect the surface defects and classify them on-line. At present, there is no such inspection system existing in any Indian steel industry. The imported systems are very costly and adaptability with Indian working condition is poor due to lack of detail hardware and software information. Suitable technology, appropriately modified, have to be in position in Hot Strip Mills to avoid materials having surface defects.

d) Online microstructure control through modeling in HR coils

Presently hot rolled coils get diverted subsequent to mechanical tests undertaken. The mechanical properties are primarily dependant upon the final grain size of the steel. On-line microstructure model calculates the grain size of steel during the rolling process and takes corrective actions on-line to achieve the desired mechanical properties. The techniques for model development employ empirical relations, FEM, ANN etc. This technology is relatively new which is yet to be established internationally.

3.6.11.2 Plate rolling

a) Plan view rolling

During initial passes of plate rolling, it has been found that the plates are not perfectly rectangular. In some cases there is less material in corners (called barrel shaped plates) and in some other cases there is more material in corner (called ears or tongue). A slab with a small width being rolled to a plate with a large width produces a plate with a barrel-shape. A slab with a short length being rolled to a plate with a longer length produces a plate with ears. In order to avoid defects on the finished plate due to non-rectangularity, different roll gaps are set at the ends than the middle portion of slab. This technology will be introduced in Plate Mill, BSP, SAIL shortly.

b) Intelligent mill set up for achieving narrow tolerance

Customer demands close thickness tolerance along the plate length. It is difficult to achieve this demand in mills where mechanical screw down system is in place. Therefore, a hydraulic automatic gauge control (HAGC) system which uses both feedback and feed-forward predictive control loops can be used to achieve a lower gauge tolerance (+0.3 mm, -0.2 mm). The feed forward loop uses data of the variation of temperature along slab length and takes corrective action at appropriate time. RDCIS, SAIL is developing such an intelligent control system which will be used in Plate Mill, BSP, SAIL or any other Plate Mill in the country.

3.6.11.3 Cold Rolling and Coating

a) Continuous-continuous cold rolling mill

In continuous rolling, pickling line is coupled with tandem cold mill to provide continuous flow of metal through the mill. It thus eliminates the normal delays due to coil change over. With moderate acceleration and deceleration during coil change over, the mill can run nearly at constant speed and tension. This improves gauge accuracy and yield of CR coils becomes almost 100%. The mill capacity is also increased by about 25%. Most of the major steel producers of world have adopted this technology. Some of them are Dongbu steel, NKK, ILVA, Sidmar, Sollac, Jenn An CRM, Tata Steel, etc.

b) Galvannealing in HDGL

Galvanneal is a hot dip coated steel sheet in which zinc coating is changed into a zinc-iron alloy coating for improved paintability. This is done in hot dip process where zinc-coated strips coming out from the zinc bath is immediately subjected to heat treatment. Due to this zinc is alloyed with iron and becomes a zinc-iron alloy coating. Compared to the shiny bright surface appearance of conventional hot dip galvanized strips, galvanneal sheets have dull/grey matte appearance, which is excellent for painting. Extra smooth galvanneal sheets, produced through temper rolling, are used in exposed automobile applications. The zinc-iron coating is harder and brittle compared to the conventional zinc coating.

Due to this it is more resistant to scratches during handling, however, there is tendency for powdering during difficult forming operations. Galvanneal process should therefore be controlled suitably to avoid powdering phenomena. This technology has been adopted at Tata Steel and is planned for incorporation at BSL, SAIL. Others may follow suit.

c) Zinc-aluminium Alloy Coated Steel Sheets in HDGL

Zinc-aluminium Alloy Coated Steel Sheets (normally known as Galvaume, zincalume etc.) is a hot dip coated steel sheet in which instead of zinc, an alloy of aluminium-zinc-silicon is applied on steel sheets in a manner similar to hot dip galvanizing process. The product is known for its high temperature resistance and input paintability. One unit has recently started production of this sheet in India. In view of established demand in domestic market and abroad, there appears to be a promising future for this product.

d) Colour Coating

The technology is well established in India. Originally, there were two units and now there are half a dozen units. In view of the techno-economic advantages and the aesthetic appeal of various types of finish of colour coated sheets, there is a promising market for this product and a few more units are already planning/ implementing fresh capacities for this product.

3.6.11.4 Bar and rod mills

a) Stelmor controlled cooling system

With high speed of rolling, control of the metallurgical properties are done by Stelmor controlled cooling system. As rod rings overlap on conveyor, density of material vary along the width of the conveyor and, therefore, the cooling rates are varied by Stelmor process to achieve uniform metallurgical and mechanical properties though out the coil. This is achieved by distribution of cooling air across the width of the conveyor and blowing more air at the edges than in the center. Conveyor processing directly effects as rolled properties and indirectly effects properties of products, which are heat treated after rolling.

b) No twist mill

No twist mill (NTM) provides wire rod mills with the capability for producing precision tolerance bar products with enhanced mechanical properties. NTM provides a mill with low temperature rolling capability. NTM has proven to be capable of sustained, reliable operation at speeds upto 120 m/s. In addition to high speeds, the mills also have the ability for higher loads and capability to roll wide range of grades from carbon steels to difficult heat resistant alloys.

c) Endless rod rolling

Endless rolling involves rolling directly from billet or caster to rod continuously. Endless rolling is presently used in rod, bar and section mills worldwide and allow the operating mill to fully realize the benefits of lower manufacturing costs, increased production, improved yield and a flexible coil weight. In wire rod mills it is necessary to complement the endless bar rolling system (EBROS) technology with technologies for temperature control, size control and coil weight optimization for its better utilisation. This technology is likely to be incorporated in the new bar and rod mills at DSP, SAIL & BSP, SAIL.

3.6.11.5 Rail mill

a) Universal rolling of rails

Universal rolling consists of universal stands followed by edger stands. There are different configurations by combination of universal and edger stand. In Universal rolling reductions are applied from all four directions, while controlling the thickness of the web, foot and the head. Edger stands are required to control the edges of two halves i.e. the total width and also the shape of the head flanks and the fishing flanks width and the shape of the head flanks. In conventional rolling since lower forging effect is obtained in rail head and base due to which deformation is in one direction, crack formation and propagation is encountered.

Universal rolling of rails results in improved surface quality, full section forging by direct pressure, lower roll consumption, and improved mill productivity. Dimension tolerances are also improved using universal rolling.

b) Head hardening of rails

Increase in axle load and traffic speed induces a greater performance demand of the rails. Normal C-Mn rails have limitation in performance in such severe condition. To cater the demands of Indian Railways, head hardening of rails is necessary. A suitable method to produce head hardened rails offline/online has to be developed to cater the demands of Indian Railways.

3.7.0 Design, Engineering and Manufacture of Steel Plant Equipments

3.7.1 In view of massive capacity additions anticipated in the near future, capacity in project execution activities viz. design , engineering, equipment manufacturing, construction, erection and availability of machine and other infrastructure are to be strengthened in the country.

3.7.2 In order to overcome short comings in the areas of technology, much of the knowledge gained through research and development has to be upgraded and implemented by acquiring appropriate skills for design and manufacture of process equipments.

3.7.3 Indian steel plants waste a lot of energy. These may be harnessed by suitably indigenously designed equipments for generate power and also to obtain benefits under Clean Development Mechanism (CDM). Indigenous development and manufacture of energy saving equipment & systems need to be initiated.

3.7.4 With automation performance of plants may be enhanced. Indigenous development of automation system should be encouraged.

3.7.5 Advanced study centres may be set up at some institutes in association with consulting houses and industrial undertakings in the public and private sector.

3.8.0 Policy Orientation for Development / Adoption of Relevant Technologies.

3.8.1 According to the new industrial policy import of technology is freely permissible up to certain limits in iron & steel sector. Foreign Direct Investment is also allowed upto 100% in the iron steel sector. Import of equipments/capital goods whether new or second hand is also freely permissible. Entrepreneurs are free to adopt the modern or relevant technologies as per their commercial judgments and discretion. Further, Govt. of India has also allowed concessional rates of customs duty on imported equipment for research and development.

3.8.2 The most important area of positive Government intervention would be in the sphere of R&D. Government aided programmes of pooling and sponsoring available talent and expertise in the country can result in development of technologies which are in consonance with local resource endowments. Large R&D projects, for developing breakthrough technologies, need to be coordinated and facilitated by the Government. Details of the R&D Scheme and initiatives required thereof are covered in the following Chapter “R&D and Technological Interventions”.

3.9.0 Policy/Incentives for Technology Upgradation

3.9.1 Cost of up-gradation of technology in steel sector in general is very high and it has not been possible to invest fund by the Indian steel plants. This is particularly true for the EAF based mini steel plants. The globalization and International competition has led to the closure of a large number of EAF based steel plants with outdated technologies and higher consumption/ cost of inputs. Nevertheless, the EAF sector contribute significantly in the overall production of steel in the country, particularly, in production of high value added alloy and special steel catering to niche market. To minimize the gap in technological profile of these plants vis-à-vis their counterparts abroad, it would be desirable to extend a helping hand by Government by setting up a Technology Up-gradation Fund Scheme (TUFS) which should cover modern, state-of-the-art technologies to ensure not only higher productivity but also reduce cost and reduced emissions.

3.9.2 The Sub-Group has noted that several economic Ministries in the Government of India operate Technology Upgradation Fund Schemes. In the Ministry of Textile, there is a Scheme to enable Indian Textile Industry to become internationally competitive by way of technological upgradation. One important benefit under the scheme is reimbursement of 5% interest, i.e. $1/3^{rd}$ of the prevailing lending rate in 1999 when the Scheme was announced. Alternatively, small scale textile/ jute industry can avail 15% credit linked capital subsidy. Technology levels are benchmarked in terms of specified machinery for each sector of the textile industry. There are specific lists showing the type of machinery which will be eligible for getting benefits under the TUFS. The scheme is administered by the Office of the Textile Commissioner, Mumbai. The benefits are provided to the industry through designated nodal agencies. Monitoring and review of the scheme is done through two committees. The industry overwhelmingly taken benefit of the Scheme.

3.9.3 A similar scheme is also operated in Ministry of SSI which is known Schemes of Small Industries Development Organisation (SIDO). This credit linked capital subsidy scheme aims at facilitating technology upgradation by providing 15% capital subsidy to SSI units. This is limited to a loan amount of Rs.100 lakhs . SIDO also operates cluster development programmes for promoting technology upgradation. The Scheme also covers re-rolling/ pencil ingot making industries in the small scale sector.

3.9.4 Ministry of Food Processing Industry has also been operating several plan schemes for technology upgradation/ modernization/ establishment of food processing industry, under which assistance in the form of grant subject to 25% of the cost of plant and machinery and technical civil works subject to a maximum of Rs.50 lakhs in General Areas and 33.33% but upto Rs.75 lakhs in Difficult Areas.

3.9.5 The Report of the Expert Committee on ‘Integrated Energy Policy” of Planning Commission has also recommended for creation of National Energy Fund to finance Energy R&D which inter alia include technology upgradation to also reduce energy and reduce GHG emissions.

3.9.6 The Sub-Group recommends that a Technology Up-gradation Fund may be evolved for assisting small and medium scale iron & steel plants in the country including the refractory and ferro alloys sector on similar lines. The Sub-Group also recommends that a Task Force comprising of representatives from Ministry of Steel, EAF, EIF, Refractory, Ferro Alloys and Re-rolling Mill Units may be constituted to work out the scope of the Scheme, eligibility, type of machineries/ equipment, procedure/ modalities etc. to manage and operate the Scheme in line with similar other Schemes under the Government of India. However, pending the same, a token provision of Rs. 10 crore or so may be provided in the 11th Five Year Plan.

3.10.0 Manpower Development

3.10.1 There is a dearth of quality manpower who are interested in iron and steel making. On the other hand, because of massive expansion in the Indian steel industry, there is an growing demand for them. Today, metallurgical engineers from reputed institutions tend to be going for software jobs because of attractive salaries and perks resulting in non-availability of the brain not only for taking up production but for taking up higher studies to support research and development in the industry, academic institutions or laboratories. This is a very disturbing trend and need to be reversed by suitable measures by the industry as well as by the Government. Appropriate environment needs to be created by way of Public Private Partnership to encourage qualified metallurgical engineers to pursue their career in steel industry and associated R&D.

3.10.2 State-of-the-art education centers for higher studies (M,Tech, Ph.Ds) need to be set up/revived at institutes of higher learning to attract and retain engineers in the study of metallurgy and other conventional engineering subjects.

3.10.3 To overcome the present problem it may be considered to start Chairs of Professors of iron & steel making in IITs, NITs & IISc. Besides usual pay and allowances as per norms of the institute, these professors may be given yearly grant which could be used for consumables/contingencies/travel/pay for project assistants etc. They may be given a one time grant for purchase of equipments.

3.10.4 One of the ways to motivate students to join research in iron and steel is to encourage them to attend international seminars abroad. The expenses for these activities should be borne by Govt. under certain earmarked schemes or by the steel plants themselves.

3.10.5 Professors of iron & steel making can send their students abroad for a short duration and any student whose paper has been accepted in any international conference related to iron & steel making may be considered eligible for getting the grant to attend the seminar.

CHAPTER - IV

R&D AND TECHNOLOGICAL INTERVENTIONS

4.1.0 Present Status

4.1.1 Research & Development in iron and steel sector in India is carried out mainly by the iron and steel plants themselves, National Research Laboratories, Academic Institutions etc. Though, marginal improvements in various areas of Iron & Steel technology have been realised, in overall terms, the initiatives can be considered to be meagre. There is very little concern and achievement on basic research and development of indigenous technology to address the typical problems of the industry. Most of the technologies have been purchased where in there have been consistent adaptation and absorption problems, thereby leaving missing links in between.

4.1.2 In Indian iron & steel industry, R&D is limited to a few companies viz. SAIL and Tata Steel and the other large or medium steel plants hardly under take R&D and invest money in an organized manner on iron and steel research in the pursuit of development of relevant technologies. Even in the companies pursuing R&D, the actual R&D expenditure is very low, 0.15-0.2% of the sales turn over, which is approximately 1/10th of the R&D expenditure by some of the steel plants in advanced countries. This scenario needs to be reversed in the interest of the country.

4.2.0 Government Initiatives

4.2.1 R&D under the Empowered Committee Mechanism

4.2.1.1 To supplement the above R&D activities by the steel plants & research laboratories & academic institutions, Government of India decided to invest up to Rs. 150 crore per year from the interest proceeds of Steel Development Fund (SDF). Accordingly, Ministry of Steel has constituted an Empowered

Committee (EC) under the chairmanship of Secretary (Steel) with the representatives of major steel producers and other experts in the field.

4.2.1.2 The EC, since inception, has approved 44 research projects costing Rs. 292 crore including SDF component of Rs. 168 crore. Of this, 21 research projects have been completed yielding benefits to the iron and steel industries in the areas of iron & steel making, up-gradation of raw material, product development, increase in productivity, improvement of quality, reduction in energy consumption etc.

4.2.2 R&D under Steel Research and Development Mission (SRDM)

4.2.2.1 Though the Government had approved an outlay of Rs.150 crore per annum which was subsequently reduced to Rs.60 crore for R&D in iron and steel sector, actual investment remained very low mainly because of non receipt of sufficient number of good research proposals from the industry / institutions / research laboratories. This shows a lack of awareness and intent in R&D, at least by some companies and certain segments of the industry and institutions.

4.2.2.2 Ministry of Steel reviewed the position and after wide ranging brain storming and consultations with the scientists, technologists and industrialists, a task force was set up to review the existing institutional infrastructure, identify gaps, assess present and the future needs of the industry and to suggest a blue print for pursuing innovative / path breaking technologies.

4.2.2.3 The Task Force recommended setting up a **Virtual Centre** to revitalize the existing R&D centres, augmenting human R&D infrastructure through focused projects and programmes and thereby encourage R&D in iron and steel sector solving various problems confronting the industry. Accordingly, a Virtual Centre has been incorporated as a registered society at Hyderabad. The affairs of the society are to be governed and driven entirely by a Governing Council comprising of eminent scientists, technologists and professionals. A director will manage the day to day affairs of the virtual centre. Besides the director, there will be engineers and scientists for taking up specific R&D projects. The Empowered Committee in the Ministry of Steel has approved this project and sanctioned Rs.50 crore as an initial corpus to sustain R&D projects and Rs.15 crore to meet the initial establishment and running cost for the first three years upon which the centre is expected to be self-reliant. Follow up action in this regard is being taken towards actual setting of the centre at Hyderabad.

4.3.0 Action Plan & Thrust Areas on R&D

4.3.1 The low priority to indigenous R&D has given rise to adoption of imported technologies that are more relevant to the conditions prevailing in the developed world and not to the Indian conditions. For example, resource position of indigenous raw materials requires development of relevant technologies, which can use indigenously available coking & non-coking coals and iron ore. However, lack of innovation and adaptation to Indian conditions is resulting in large-scale import of coking coal and low performance in iron making. Aggressive R&D efforts would, therefore, be required to create manufacturing capability for production of iron & steel of international quality at competitive cost using the indigenous resources in an environment friendly manner. This is what has also been emphasized in the National Steel Policy.

4.3.2 The National Steel Policy has emphasized the need for aggressive R&D efforts to step up India's R&D expenditure and also to create state-of-the-art manufacturing capability based on indigenous resources. This should be a priority area for all the steel companies in the country for sustainable development of iron & steel industry in India. It is also necessary that the Government should create appropriate environment to encourage individual steel companies to invest in R&D by way of suitable policy measures/ incentives.

4.3.3 The Government while expressing its concern over very low R&D expenditure has urged upon the Indian iron & steel industry to step up their R&D

initiative and enhance their R&D expenditure to at-least 2% of their turn over by 2019-20. With this objective in view, the Indian steel fraternity, particularly the large steel companies must address the problem more seriously and endeavour to increase expenditure on R&D including new process/product development to at-least 1% of their turn over, by the terminal years of the 11th Five years Plan period.

4.3.4 Under Section 35 of IT Act, any expenditure (revenue and capital) on scientific research is eligible for deduction upto 125% from the total taxable income of the company, thereby giving relief in income tax for encouraging R&D. This provision however, at present, is only upto FY 2006-07. The Sub-Group recommends that not only this provision should be continued in the future, at least for the iron & steel sector, but also the benefit should be enhanced to at least 150% of the total expenditure on R&D. Further, companies as they spend more on R&D, beyond 0.5% of sales turnover, should receive additional tax benefits (i.e. beyond 150%) which should increase exponentially with further increased R&D investment, say beyond 1% of sales turnover.

4.3.5 Government is expected to enhance its contribution to fostering basic and applied research within the existing frame work of the Empowered Committee including the specially created vehicle i.e Steel Research & Development Mission (SRDM) which is expected to be launched soon.

4.3.6 Though the choice of technology will be largely determined by the entrepreneurs based on techno-economic considerations, the Government would encourage/facilitate development and adoption of such technologies which are relevant to natural resource endowment of the country, which minimize damage to the environment, optimize resource utilization, facilitate achievement of global standards of productivity and efficiency and development of front end and strategic steel based materials.

4.3.7 Towards these objectives, prime areas of focus areas should be to improve the quality of basic input/ raw materials and develop/adopt suitable beneficiation technologies to suit Indian conditions. These would include lower grade iron ores (Fe content $\leq$ 55%), high ash coking / non-coking coals and raw materials for refractory (magnesite, bauxite and graphite) and Ferro-alloys. From environmental view point, recovery of iron values from slime followed by pelletisation should also be a thrust area. Technologies which have an impact in reducing carbon dioxide emission will also be important. The Indian steel industry has to move towards achieving zero waste generation by ensuring proper and complete management of wastes (liquid, solid and gas). For cost competitiveness, the industry has to concentrate on developing energy efficient technologies and processes. Technologies have to be developed for production of clean steel, which will enable processing and manufacture of special grades of steel for the Indian and global markets.

4.3.8 In view of increasing production of special grades of steel of very stringent quality, there is considerable demand on ferro-alloys of appropriate quality, particularly, very low residual ferro-alloys. One of the issues which require immediate attention is beneficiation of manganese ore for production of low phosphorous ferro-manganese. There is also need towards development of suitable technology for production of extra low phosphorous Ferro manganese for wide range of low carbon grades of steel by reducing phosphorous content of manganese ores. Similarly, suitable beneficiation methodology needs to be evolved to make effective use of low grade, friable Chromites ore (less than 30% Cr_2O_3) fines, which are available in sizable quantity in India. Besides, production of ferro-alloys using alternate technologies viz. smelting reduction of Manganese Ore, solid state reduction of Chromites ore fines/concentrates in fluidised bed reactor using natural gas seem to have promising feature in view of rising electricity price and attempt may be made to develop such technologies.

4.3.9 Some of the important and priority areas were R&D efforts should be directed are given hereunder:

a) Beneficiation of low grade iron ore (from 55% to 65% Fe for hematite and from 35% to 64% for magnetite and banded hematite quartzite [BHQ])

b) Beneficiation of high ash coking coal (from 25+% to <15% ash)

c) Beneficiation of raw materials required for refractories- magnesite, bauxite and graphite

d) Pelletisation technology for Indian iron ore fines/ concentrates

e) Coal based fluidized bed technology of iron making using non-coking coals

f) Effluent control in coke ovens through bio-chemical / microbial treatments

g) Technology for injection of natural gas, Coal Bed Methane (CBM) in blast furnace and improving rate of PCI in blast furnace.

h) Development of technology for ultra low carbon dioxide steel making

i) Improving lining life of BOF process to 15000-20000 heats

j) Computational fluid dynamic studies for production of clean steels in ladle furnace and RH-OB

k) Waste recycling and utilisation

l) Continuous casting technology of thick plates (>60 mm)

m) Reduction of power consumption in EAF to 300 KWh/tcs

n) Development of ultra high strength steel with good formability

o) Development of ultra fine grained steel plates/ coils/ rods (YS: 800-1000 MPa)

p) Development of steel foam

q) Development of relevant Mathematical modeling and simulation in process metallurgy.

4.3.10 R &D Centre in western / south – west region :

4.3.10.1 Traditionally, the steel industry was concentrated in eastern zone of the country. In the liberalized environment, it has spread all over the country. Large steel plants have come up in western and southern regions. Steel Research & Development Mission (SRDM) has been set up at Hyderabad. There is, therefore, a need to create adequate steel research facility in the western region. Government should encourage the industries and academic institutions in this region to come forward to set up an adequate R&D facility jointly as a Society.

CHAPTER – V

ENVIRONMENT MANAGEMENT AND POLLUTION CONTROL

5.1.0 Introduction

5.1.1 Steel by itself is one of the most eco-friendly of all materials, yet invented by Man. Steel making, unfortunately is beset with severe environmental ramifications. This is because steel production involves various processes that result in extensive consumption of natural resources and energy whose impacts to environment are inevitable. With improved technology and operational practices, however, a substantial part of the environmental issues can be addressed to, as achieved in advance steel making countries like Japan, Germany, South Korea and the United States. In India most of the causes of higher pollution are attributed to usage of old technologies besides inherent raw material constraints.

5.1.2 The global movement for environment protection commenced with the Stockholm Declaration in 1972. Subsequent to the above declaration various participating countries including India, started framing legislation in the field of environment protection and various laws and regulations continue to be promulgated even today. Gearing up to the changed scenario, during the late 1980s and early 90s, steel industry reciprocated to the mandate and the National Task Force (NTF) for steel industry on Environment was constituted by MoEF in 1989, which hastened the process of identification of critical areas.

5.1.3 By 90s, when the significance of environmental protection and the concept of sustainable development was perceived and understood by steel makers, several modernization/ up-gradation schemes were initiated by the industry to optimize the raw material consumption, minimize pollution generation and energy consumption.

5.2.0 Role of Legislation

5.2.1 With the environmental laws becoming progressively stricter and with the all-round rise in awareness, it has become essential to make the process of iron and steel making more eco-friendly. Several regulations have been introduced in the recent past covering Hazardous Wastes, Coke Ovens, Ozone Depleting Substances (ODS) etc. The voluntary initiative with the Ministry (MOEF) for Corporate Responsibility for Environmental Protection (CREP) has further propelled the steel industry to formulate a number of ameliorative measures.

5.3.0 Energy Conservation

5.3.1 Energy is an important facet of environment management. Steel making is essentially an energy intensive process. Depending upon the technology and the quality of the raw materials used, integrated steel plants in India consume energy to the tune of almost 6.45- 8.5 Giga.Cal which is much higher than the world norm of 4.5-5 Giga.Cal per tonne of Crude Steel. Steel makers are therefore, continuously striving to bring down the energy consumption through use of various energy saving and conservation technologies in the process for making and shaping of steel.

5.3.2 Energy conservation practices across the industry to-day, such as the re-use of internally generated fuel gases (by-product gases) to reduce overall energy consumption in the integrated route, using waste gas in the Electric Arc Furnace (EAF) route, help to ensure that energy use is minimized. However it may be noted that with the quality of raw materials available in India, it will be technically futile to emulate energy consumption pattern of Japan or South Korea with economic viability. Presently amongst the integrated plants, RINL's achievement of 6.45 gcal/tcs is noteworthy. The Sub-Group is of the view that an achievement of 5.5-6.0 gcal/tcs specific energy consumption with existing sources / quality of raw materials (even considering present pattern of imported coal usage) will be a significant milestone for the integrated plants and may be pursued for the timeframe of the 11th Five Year Plan.

5.4.0 Green House Gas (GAG) Emissions

5.4.1 With the Kyoto Protocol entering into force in early 2005, GAG Emissions and climate change continue to be significant environmental issues for the steel industry, particularly because steel is the 3rd largest contributor of GAGs in India . The industry continues to adopt innovative solutions that reduce GHG emissions over the life-cycle of steel products, such as automobiles using high strength, light-weight steel, which reduce fuel consumption and hence CO_2 emissions during the use-life phase significantly. Commercially viable use of renewable energy is still in theory but definitely has exciting prospects, particularly the use of hydrogen as reducing agent, as substitute for coke. None the less Indian steel plants, at an average of 2.7 tonne, emit more than twice the amount of Carbon dioxide per tonne of crude steel than a Japanese or German plant, which can be reduced to less than 1.5-1.8 tonnes of CO_2 /tcs by appropriate energy conservation measures and pollution control measures. Similarly, the SOx and NOx generations are much higher which needs to be brought down by adopting suitable desulpherisation of fuel gases and efficient combustion system. The Sub-Group recommends reduction of CO_2 to a level of less than 1.5 and SOx and NOx to a level of below 1kg/tonne of crude steel by the end of 11th Five Year Plan.

5.5.0 Material Efficiency

5.5.1 The steel industry continues to demonstrate resourcefulness in its utilization of raw materials and waste minimization. Improved efficiency in the use of resources, results in the direct reduction of energy consumption and CO_2 emissions. In not too distant past, Indian integrated steel plants were generating equivalent tonnage of waste for every tonne of steel produced, and 85% were Blast Furnace and Steel Melting slag. With the use of better quality of raw materials namely imported coal and beneficiated ore and flux, the generation of slag have been reduced to less than half of the steel produced. However, even this is not very satisfactory and considering the huge quantity of steel out put envisaged under the 11th Five Year Plan, slag disposal should continue to occupy significant attention.

5.5.2 While cement companies shall remain an important outlet for the blast furnace granulated slag, increased recycling of BOF slag through sintering-BF route shall be emphasized upon. Besides commercial avenues like road making, use as Rail Track Ballast etc will have to be augmented as being done in other steel making countries. Other wastes like sludges and dusts can also be recycled through comprehensive agglomeration technology (like rotary hearth pelletisation) for which technology transfer under suitable MOU or Partnership with advanced steel making countries may be organized.

5.5.3 Steel Plants are also source of hazardous wastes which are covered under statutes and strict surveillance of the Environment Protection Agencies.

5.5.4 With the projected level of steel production by the end of 11th Five Year Plan, the estimated Dust Emissions is expected to be enormous, over 500 tonnes per day. Necessary action needs to be initiated to bring down the dust emission level to at least 1kg/ tonne of crude steel by installing high efficiency fabric filter and /or ESPs.

5.5.5 The steel plants need to comply with the relevant rules and guidelines through appropriate technologies and practices like recycling, protective burial, incineration etc. Technology input from advanced steel makers will be of great help.

5.6.0 Recyclability of Steel

5.6.1 Steel is 100% recyclable, and because it maintains its properties through successive product cycles without a loss of quality, it can be recycled unlimited number of times. It is easy to handle and separate from other materials in the recycling stream because of its natural magnetic properties and enjoys high recycling rates throughout the world. Recycling in the steel industry covers a much broader spectrum. Not only steel, the whole production process is optimized to reuse and recycle energy, process gases, water, steam, dust, slag and many other by-products, with potential of 100 % recycling for some of the elements. Recycling steel is environmentally friendly since a significant component of energy consumption in absence of coke ovens-blast furnace route(responsible for 65 to 70% of energy consumption) is directly avoided in steel making. Besides, environmental degradation associated with mining operations (mainly iron ore) is also avoided. Recyclability of steel however depends on availability of used steel itself. This is greatly related to the degree of consumption of steel in the country, which is again influenced by strength of economy of the country. In a developed country having a “cruising economy” with high per capita steel consumption , like Japan or the USA, recycling is of high degree at 60 to 70%. India, like China, shall have to depend on iron ore sources for the foreseeable future.

5.7.0 Environment Management System (EMS)

5.7.1 Effective environment management continues to play a key role in the efforts of steel industry to operate in a sustainable manner. Several steel manufacturers are embracing the Environmental Management System enthusiastically, to continually improve their environmental performance and to increase their operating efficiencies with concomitant economic advantages. Some of the more progressive steel manufacturers in the country are adopting integrated management systems encompassing Quality (ISO 9001), Environment (ISO 14001), Safety and Occupational Health (OSHAS 18000), and Social Accounting (SA 8000) and are leveraging multiple benefits.

5.8.0 Technology Initiatives

5.8.1 With the introduction of new laws in the recent past like, Management and Handling of Hazardous Wastes, New Emission standards for Coke Ovens and

MoEF guidelines for Corporate Responsibility for Environmental Protection (CREP) etc., the steel industry has formulated a number of mitigative actions.

5.8.2 Some of the technology initiatives taken up by the steel industries for environment protection include:

- Study on Clean Technology Development
- Clean Development Mechanism (CDM)
- Phasing out of Ozone Depleting Substances (ODS)
- Environmental accounting
- Carbon accounting
- Life Cycle Analysis (LCA)
- Greenery development
- Eco-restoration of degraded land

5.8.3 The salient initiatives in different production & technological areas are as follows:

Coke Oven

- Incorporation of new series of leak proof doors
- Coke Dry Quenching and recovery of sensible heat
- New coke oven machines like single spot pusher car, guide car, charging and quenching car
- Continuous stack monitoring system
- Computerized Combustion Control System (CCCS)
- Computerized coal blending system
- De-sulphurisation of coke oven gas
- Coal moisture control
- New Coke Oven battery with all modern facilities
- Non recovery type Coke Oven battery

Sinter Plant

- Steam injection in sinter cooler bed
- Modification of burners in Sinter Plant
- Replacement of multi cyclones with ESPs
- Recovery and usage of waste heat
- Installation of on-line stack monitoring system

Blast Furnace

- Incorporation of Coal Dust Injection (CDI) system
- Installation of Coal Tar Injection (CTI) system
- Cast House Slag Granulation plant
- Secondary emission control system in Cast House
- New Gas Cleaning Plant (GCP)
- Top gas Recovery Turbine (TRT)
- Dry fog dust suppression system in stock house
- Use of Tar free runner linings
- External combustion stoves

Steel Melting Shop

- LD/EAF gas recovery system
- Secondary emission control system
- Dust extraction in EAF & Mixer shop and recycling
- Augmentation of SMS along with waste water treatment facilities
- COREX – DRI process for steel making

Rolling Mills

- Modification of pickling lines
- Replacement of HCl regeneration unit
- Introduction of continuous Caster replacing conventional Ingot casting

- Modernization of Re-heating furnaces through the use of regenerative burners.

5.8.4 Installation of pollution control counter measures cost nearly 15% of the capital cost of the overall project.

5.9.0 Action Plan

5.9.1 The clean technology initiatives, some of which have been referred to above, would need be adopted by all the steel makers across the industry. Strict adherence to Standard Operating Practices (SOPs) and Standard Maintenance Practices (SMPs) is the basic tool for a clean environment to work in. Apart from this, implementation of structured Environment Management System (EMS) linked to ISO 14001 : 2004 is essential. A few plants have already been certified and others should follow. Similarly, other environmental initiatives like replacement of Ozone Depletion Substances (ODS), Clean Development Mechanism (CDM) and Life Cycle Analysis (LCA) should also be earnestly followed by all steel plants in the country.

5.9.2 One very important area where concerted effort by the steel industry may be directed during the 11th Five Year is propagation for the use of steel for eco –efficient applications. A task force with representatives Ministries of Steel, Non-conventional Energy and Building and Works and Steel Industry may look into the aspects of use of steel for constructing wind mill towers (a 60 metre tower would 100 tonnes steel), construction of Eco-Efficient buildings based on LCA studies, development of Ultra Light Steel for Automotive Bodies(ULSAB),etc.

5.10.0 Conclusion

5.10.1 The 11TH Five Year Plan (and beyond) for the steel industry must envisage growth within the frame work of Sustainable Development which means valuing the interdependence of environmental, social and economic aspects in all decision making. Steel is valued and would continue to be valued as a cornerstone for development and economic growth of a nation. This is more so for a country like India which need sharp increase of its per capita steel consumption. What is crucial is that this development must keep in view country's requirement, eco-efficiency, social responsibility, conduct business in high ethical standard and transparency in communications.

5.10.2 The importance of clean environment and sustainable development may not be over emphasized for social and economic development of the country. Towards this objective, the existing plant must carry out life cycle inventory analysis of the existing operation to compare with the benchmarks attain by similar operating units and the Greenfield Plants must adopt clean technology with emission loads comparable to the good plants elsewhere. Since the cost of pollution control measures, energy conversation and energy saving measures is expected to be very high, Government may consider suitable incentives in the form of capital subsidy or reimbursement of interest on term loan taken for the purpose. Such incentives may also be extended in the form of reduced exemption/ reduction of customs duty on imported equipments/ facilities.

CHAPTER – VI

SAFETY MEASURES IN STEEL INDUSTRY

6.1.0 Introduction

Steel Industry no doubt, poses one of the most difficult challenges in the area of safety, health and environment when compared to many other industries due to complex nature of its operation and maintenance activities and wide range of hazards associated with them. Despite tremendous technological progress, the questions of safety culture and safety at work still are serious problems. In this crucial juncture maintaining of high standards of health, safety and environment in Steel Industry is of paramount importance.

6.2.0 Identification of Hazards & Control Strategies

6.2.1 The whole process of production of iron and steel right from the raw material to the finished products is ridden with many inherent hazards and risks. Hazards are also associated with the very nature of the shape and size of operation, reactors and machines. There are physical hazards (noise, vibration, heat and coal stress, radiation, chemical hazards (inhalable gases/ wapour/dust/fumes, asbestos, insulation wools etc.), safety hazards (limited space, electrical/ mechanical/ hydraulic/pneumatic sources of energy, machineries prone to accident including cranes and hoist, falling weights and dangerous objects, slips, trips and falls) etc.

6.3.0 Present Safety Status

6.3.1 A unique feature of safety management in steel industry is that a bipartite forum named Joint Committee on Safety, Health and Environment in Steel Industry (JCSSI) was formed 33 years back in 1973 at national level having representatives from Central Trade Unions & Indian Steel Manufacturers like SAIL, Tata Steel, RINL, Essar Steel, Ispat Industries, NINL besides, MECON, Dastur & HSCL.

6.3.2 With a view to inculcate safety consciousness, JCSSI organises seminars, workshops, training programme, safety competition like poster designs, calendar designs and essays for the employees of its member organizations. It has also brought education materials like manuals, booklets, DO's and DONT's etc. JCSSI with the co-operation and support of Trade Union representatives formulates policies and guidelines for its member plants. Implementation of these guidelines is monitored through two sub-committees on Plant Safety & Construction Safety.

6.3.3 There is still a lot more to be done in next five years in safety area since we are still far away from creating an environment free from accident, which is the goal set by International Iron & steel Institute. This is borne out of the statistics on accidents occurring in Indian Steel Industry in last five years as shown below:

<table>
<tr><td>Company</td><td>2001</td><td>2002</td><td>2003</td><td>2004</td><td>2005</td></tr>
<tr><td>SAIL(9 plants)</td><td>18</td><td>27</td><td>30</td><td>20</td><td>25</td></tr>
<tr><td>TISCO</td><td>8</td><td>12</td><td>10</td><td>6</td><td>5</td></tr>
<tr><td>RINL</td><td>3</td><td>0</td><td>5</td><td>0</td><td>5</td></tr>
<tr><td>NINL</td><td colspan="3">Not Available</td><td>3</td><td>1</td></tr>
<tr><td>Essar Steel</td><td colspan="4" rowspan="2">Not Available</td><td>3</td></tr>
<tr><td>Ispat</td><td>0</td></tr>
</table>

6.4.0 Present Safety Efforts /Activities

6.4.1 Since major causes of accidents are unsafe behavior & unsafe acts, preventive measures like safety training, Safety audits, safety inspections, safety awareness generation etc. are being undertaken on regular basis. Safety performance is reviewed at highest level by Chairman / Managing Directors and Safety Advisory Board consisting of Directors and Chief Executives.

6.4.2 Some of the salient safety activities undertaken/being undertaken in Indian steel industry include:

i) A Joint Committee on Safety occupational health and environment under the Ministry of Steel provides guidelines for safety aspects presented which are:

a) Review of safety performance of the steel plants in India.

b) To create safety awareness among persons working in the various steel plants through imparting training, conducting workshop, seminars etc.

c) Publishing the collected safety related data from various steel plants such as major accidents, fatal accidents, safety measure adopted for improvement in plant safety, innovation and development mode etc.

d) Conducting a workshop on safety ensuring participation of both executive and worker's representative from various trade unions to understand the safety and health problem faced by workers in various steel plants. Outcome of discussion is documented and circulated to all members as well as to Management for necessary action.

e) Conducting safety auditing & risk grading in various steel plants.

ii) Dedicated safety department in all the steel plants to take care the safety aspects.

a) Celebration of National safety day, Safety weeks through essay writing, slogans, Safety quiz etc. among employees and their wards / children.

b) Conducting workshop highlighting one field of safety viz., Road safety, Gas safety & electrical safety etc. area-wise.

c) To carry out interval inspection safety audit, shop-wise to assess the safety measures – status.

d) To create safety awareness among personnel working in plant towards the use of safety appliances viz., safety shoes, safety goggles, gloves, apron etc.

e) Formulation of plant safety policies.

f) Recording of accidents, fatal accidents and preparation report for the management suggesting remedial measures.

g) Reporting of the incidence of non-compliance to plant safety rule by individual / shop to management.

iii) Compliance to state Factory Act, with respect to safe distances between units, service facilities etc. and other clauses.

iv) Adherence to National Electricity Rule, Petroleum Act, Pressure Vessel Act etc. while locating the unit / facility.

v) Conducting internal and external safety audit.

vi) Written policies for work permit.

vii) Use of safety appliances viz., Breathing apparatus, fire suit, portable hazardous gas monitors, siren / warning system and personal perfective equipment (PPE).

viii) Use of fire fighting measures for various plant facilities as per guidelines of Indian Standards, Tariff Advisory Committee and National Fire Protection Association, USA.

ix) Dedicated fire station along with staff and vehicle / equipments to fight any out break of fire round the clock.

x) Gas monitoring system to check that release of harmful gases to atmosphere are controlled.

xi) Some of the steel plant are also conducting scientific study like Hazard & Operability (HAZOP) study and analysis of risk/accidents and determining the causes and taking remedial actions to prevent their reoccurrence.

xii) Compliance to road & rail safety, electrical safety, gas safety, contractor's labour safety, occupational health safety etc.

xiii) Hot line communication system between plant unit and fire department.

xiv) Emergency preparedness plant.

xv) House keeping.

xvi) Safety monitoring activities such as safety protocol, work permit, height pass for working at height, round the clock surveillance and safety monitoring during capital repair, major shut down, gas shut-down and compliance clauses of Factory Act etc.

xvii) OHSAS – 18001 Implementation: In some of the steel plants to improve occupational health and safety performance implementation of OHSAS – 18001 standards has been initiated.

xviii) Preparation of on site disaster Management Plant and conducting Mock Drills on identified thrust areas to ensure effective implementation of the Plan, if need arises.

6.5.0 Thrust in next Five Years

6.5.1 There is still a lot more to be done in future in safety area since India is still far off from the objective of accident free steel. Some of the suggested measures are given below:

a. Accreditation of all plants under OSHAS: 18000:

All the Steel plants will have to cover themselves under OSHAS Certification within the next five years.

b. User-friendly PPEs and modern safety gadgets have to be used by all employees including employees of contractors in future. The clause for compulsory use of modern PPEs & safety gadgets like fire retardant dress, flash arrester in gas welding sets etc. will be incorporated in every contract including project contracts in future.

c. Intensification of area specific workshops.

d. Safety has to be integrated with operation and maintenance of steel plants. All equipment will have integrity to ensure maximum reliability through safety interlocks, pre-startup safety checkups etc. Design of equipment, processes and procedures will be such that exposures to hazards are minimized.

e. During modernization/expansion, safety has to be essentially in-built into new technologies and associated equipment and plant layouts. Automatic fire fighting systems like automatic sprinklers will be installed during modernization.

f. New safety management technologies like automatic hazard identification and mitigation systems have to be installed in hazardous areas.

g. Up-gradation of occupational Health Centers with modern facilities like rescue vans etc.

h. A culture of safety needs to be cultivated and assistance of JCSSI has to be taken in this effort. Modern audio-visual aids will be used for effective safety communications. Wider cross sections of society will be involved through mass contact exercises.

i. The latest and most modern safety management systems need to be incorporated by all the steel plants in the country, if necessary, with the help of Consultants. Introduction of Information Technology and automation in the steel sector, which have direct bearing in reducing accidents, is considered relevant and may be adopted by the steel plants.

j. Safety aspects in Secondary Steel making sector i.e. Induction Furnace, Sponge Iron, mini steel (EAF), re-rollers etc. is the most unorganized and a lot more needs to be done through assistance from CII, ICC, FICCI, National Safety Council etc

k. Safety of workers engaged by contractors to be dealt at par with regular employees. Contractor safety rating system based on safety performance of the contractor is to be started.

l. Measuring and combating of high noise and vibration from operational areas to check hearing impairment.

m. Safety audit to be implemented in organized and unorganized sectors of steel making

CHAPTER - VII

DEMAND AND SUPPLY PROJECTIONS FOR THE ELEVENTH FIVE YEAR PLAN PERIOD AND REQUIREMENT OF CRITICAL INPUTS

7.1.0 Aggregative Models of Demand Forecasting- Estimation of GDP Elasticity of Steel Demand

7.1.1 At the aggregate level, growth in total finished steel consumption will depend upon the rate of growth in GDP and the estimated 'GDP-elasticity of steel demand' (i.e., observed response of steel consumption to changes in GDP/relationship between steel demand and GDP calculated on the basis of past time-series data). GDP-elasticity, in its turn, is determined primarily by the following structural factors:

- Rate of investment/capital formation
- Structure of the economy, particularly, the share of steel intensive manufacturing activities and their growth
- Technological factors (e.g., norms of production, considerations of material conservation, possibilities of inter-material substitution etc.) guiding usage of steel per unit of production/activity in the end-using sectors.

7.1.2 Value of the estimated 'GDP elasticity of steel demand' is seen to change over time with shifts in the structural parameters listed above. For example, in India, the GDP elasticity of steel demand had been estimated to be close to 1.33 for time-series spanning the seventies and the eighties. However, this value has come down progressively to about 0.9 for the period between 1990-91 and 2002-03. The reduction took place primarily because of the following reasons:

- Share of manufacturing sector in total GDP has gone down continuously over the last three decades and today stands at just about 26%. This reduction has been the sharpest during the last decade when the Services sector grew to be the largest contributor to the National Income – accounting for more than 50% share;

- The rate of investment in the economy also came down and stagnated at about 24-25% of the GDP for several years till 2002-03, compared to nearly 40% in many of the South East Asian economies including China.
- Miniaturization and dematerialization of steel-using products leading to lower specific consumption of steel in downstream activities and substitution of steel by competing materials in some critical areas.

7.1.3 Inclusion of data for the last three years has, however, resulted in an improvement in the estimated value of GDP-elasticity of steel demand to around 1.1 from 0.9 calculated for 1991-92 to 2005-06. This improvement is the result of a marked a shift in the movement of some of the macro variables known to impact demand for steel such as -

- An increase in the savings and investment rate from 25-26% to around 30% in the course of one single year;
- A sustained acceleration in the growth of the industrial sector and the manufacturing activities registering double-digit growth rates for three years in succession and manufacturing activities achieving the highest 10 year growth rate of 11.2% in Q1 of 2006-07;
- Increased investment in steel-intensive physical infrastructure;

7.2.0 Disaggregated Demand Forecast – Category Wise Forecast of Finished Steel Demand

7.2.1 Projection of total Finished Steel Demand by the aggregative technique discussed above is a good indicator of the overall growth of the steel industry derived from broad-based economic performance indicated by the GDP growth rate. However, the sub-group felt that an aggregative model using the omnibus macro-indicator of GDP as the only explanatory variable might not be able to capture the impact of the changing structure of the economy over time and also of the shifting patterns of steel usage in specific end-using segment. It was suggested that a disaggregated model be developed where demand for the different product categories are estimated separately based on specific sector level indicators of demand for enhancing the accuracy and reliability of the forecasts. Use of a disaggregated model will be especially relevant under the prevailing circumstances where the structure of the economy and major steel using activities are slated to change substantially over the medium term – both in terms of future growth and in terms of technology and norms of material use. At the operational level, it will lead to greater utility and reliability for economic decision-making and policy formulations (such as those relating to investment, capacity creation etc.) aimed specifically at different product groups of steel with diverse applications in different sectors of the economy.

7.2.2 Therefore, demand for steel has been forecasted, based on an econometric model for product wise demand forecast developed by ERU/JPC and modified by the members of the Sub-group. The disaggregated model estimates separate demand equations for each product category by relating its consumption to movements in its principal end-using segments. Each end-using segment, in turn, is represented by an appropriate sector-level macro indicator/variable. Since each steel product has multiple uses, simultaneous movements in more than one end using economic sectors will determine its total demand. Aggregated product-specific activity indices have, thus, been constructed for each steel category by taking the weighted average of all the macro indicators selected as explanatory variables representing its relevant end-using segments. The weights are the estimated sectoral shares/steel flows in total consumption of the steel product. Ten activity indices have thus been calculated for the ten broad product categories of finished steel.

7.2.3 Apparent consumption levels of each product category (Production+Imports-Exports), serving as a proxy for demand, have then been regressed upon the consolidated activity index pertaining to that product. For each of the 10 product categories, demand equations have been fitted and coefficients of elasticity estimated based on a data set spanning 15 years from1991-92 to 2004-05. These estimated coefficients along with the projected values of the macro indicators have been used to derive demand for steel in each category. In all eight macro indicators have been chosen to reflect activity levels in the major end-using sectors of different categories of finished steel. These are –

Gross Fixed Capital Formation in Construction and in Machinery & Equipment, Private Final Consumption Expenditure,

IIP for capital Goods and Transport Equipment,

Outlay in Power Sector (at constant price),

Outlay in Railway (at constant price), and

Consumption of Petroleum Goods.

7.2.4 Total finished steel demand is then arrived at by aggregating the product wise demand, taking care to avoid double counting.

7.2.5 To have a forecasting framework consistent with the overall GDP growth rates envisaged in the Eleventh Plan, coefficients of elasticity of each macro indicator/variable with respect to GDP/IIP have been first estimated using data for comparable time period (i.e., 1991-92 to 2004-05). The future levels of all such macro indicators (forecasts for 2007-08 and 2011-12) for the purpose of predicting steel demand have been derived on the basis of these estimated coefficients. The basic GDP scenarios have been those considered in the Draft Eleventh Five Year Plan **(Table 7.1)** ranging between 7% and 9% with 9% as the most likely case.

Table 7.1

The Different GDP Growth Scenarios Considered for Forecasting Category-wise Steel Demand during the 11th Plan, 2007-08 to 2011-12

	Scenario 1	Scenario 2	Scenario 3	Scenario 4 (The Most Likely Scenario)
GDP	7%	8%	8.5%	9.0%
IIP	8.6%	9.9%	9.9%	11.2%

7.2.6 Category wise forecast for Finished Steel is presented below **(Table 7.2).**

Table 7.2

Category-wise Forecast of Finished Steel Demand for 2007-08 and 2011-2012

(Mn. T)

Sl No.	Product	2005-06	2007-08		2011-2012	
		Actual	Range	Most Likely Scenario (GDP grows at 9% pa)	Range	Base case
1.	Bars & Rods	13.30	15.90 – 16.11	16.11	21.18 – 22.10	22.10
2.	Structurals	3.52	3.84 – 3.90	3.90	4.62 – 4.74	4.74
3.	Railway Materials	1.00	1.85 – 1.87	1.87	2.12 – 2.18	2.18
4.	*Total Non-Flat (1 to 3)*	17.82	21.59 – 21.88	21.88	27.92 – 29.02	29.02
5.	Plates	3.57	3.96 – 4.00	4.00	4.70 – 4.80	4.80
6.	Hot-Rolled Coils/Sheet/Skelp	10.16	14.20 – 14.68	14.68	21.19 – 22.82	22.82
7.	Cold-Rolled Coils/Sheet	3.99	4.74 – 4.80	4.80	5.86 – 6.10	6.10
8.	Galvanized Coils/Sheet	2.05	2.60 – 2.75	2.75	4.00 – 4.50	4.50
9.	Electrical Steel Sheet	0.34	0.38	0.38	0.38 – 0.46	0.46
10.	Tin Plates/Tin Free Steel	0.26	0.28	0.28	0.30	0.30
11.	Pipes	0.99	1.40 to 1.50	1.50	2.13 – 2.34	2.34
12.	*Total Flat (5 to 11)*	21.37	27.56 – 28.40	28.40	38.56 – 41.32	41.32
13.	Total Finished Steel (4+12)	39.19	49.15 – 50.28	50.28	66.48 – 70.34	70.34

7.2.7 For Hot rolled and cold rolled flat products with extensive downstream applications, it is necessary to have an estimate of the gross consumption inclusive of downstream requirements. The gross estimates are necessary for realistic assessment of the total HR capacity/production needed to support downstream applications. The forecasts for gross HR and CR materials are placed below (**Table 7.3**).

Table 7.3

Forecast of Gross Consumption of HR and CR for 2007-08 and 2011-12

(Mn T)

Gross Categories	2005-06	2007-08		2011-12	
		Range	Most Likely	Range	Base Case
Hot rolled Flat Products	16.14	21.00 – 21.60	21.60	30.00 – 32.00	32.00
Cold Rolled Flat Products	7.10	8.60 – 9.00	9.00	12.35 – 13.50	13.50

7.2.8 The forecasts presented above imply a higher rate of growth in demand for almost all steel categories in the next 5 years compared to that attained between 1991-92 and 2005-06 (**Table 7.4**). The highest double-digit growth rates have been visualized for Railway Material, Hot rolled flat products, Galvanized flat products and pipes.

<u>Table 7.4</u>

Comparative Growth Rates of Non-Alloy Finished Steel Consumption – Achieved versus Projected

(Per cent per annum)

Products	CAGR (1991-92 to 2005-06)	CAGR (2005-06 to 2011-12)
Bars & Rods	6.2	8.8
Structurals	5.2	5.1
Railway Materials	3.1	13.8
Total Non-Flat	5.5	8.5
Plates	5.7	5.0
Hot Rolled Coils/Sheets/Skelp	11.2	14.4
Cold Rolled Coils/Sheets	5.7	7.3
Galvanized Coils/Sheets	10.6	14.0
Electrical Steel Sheets	5.2	1.6
Tin Plates/Tin Free Steel	Negligible	1.7
Pipes	15.0	15.2
Total Flat	8.5	11.6
Total Finished Steel	7.0	10.2

Further Details are provided in **Annexure – 10.**

7.2.9 Based on the observed annual rate of growth of 12% achieved during the last decade and the fact of a very low base level, apparent consumption of special and alloy steel is projected at around 3.5 -4.0 Million Tonnes, stainless steel at around 1.75 million Tonnes and for pig iron at around 5.20 to 5.55 million Tonnes (**Table – 7.4.1**) by the year 2011-12.

Table 7.4.1

Likely Demand of Alloy Steel, Stainless Steel and Pig Iron

(Million Tonnes)

	2005-06 (Actual)	2007-08 (Range)	2011-12 (Range)
Alloy Steel	2.27	2.85 – 2.90	3.5 – 4.00
Stainless Steel	1.00	1.25	1.75
Pig Iron	3.10	3.85 – 3.95	5.20 – 5.55

7.3.0 Projections of Supply and Availability

7.3.1 Projected Supply of Crude and Finished Steel during 11th Five Year Plan

7.3.1.1 The Indian steel industry, in response to the growing domestic demand and export prospects, has planned to add fresh capacities both brown-field and green-field. The Public sector units, namely SAIL and RINL, are planning to increase production of crude steel from a level of 17 Million TPA in 2005-06 to 30 Million TPA by 2011-12. The private sector players, both domestic and overseas, have announced massive addition to the existing capacities, especially in the iron rich states of Orissa, Jharkhand and Chattisgarh. In a liberalized scenario it is difficult to predict the likely realization of these plans, especially in the context of volatile steel prices. In view of this the Sub-Group has taken into account the assessment of various factors, namely:

- Time required to obtain statutory clearances,
- Gestation period of integrated projects,
- Projected category wise demand by 2011-12 and over the medium term, and
- Prospects of exports from India.

7.3.2 The basic assumptions for availability projections are discussed in the following paragraphs.

a) Broad process routes taken into account include Oxygen Route and Electric Furnace Route, which cover most of the existing (crude) steel producing units existing in the country. As not much detailed information about process routes are available for the new units, they may be considered as a mix of EAF and Oxygen Routes as existing today.

b) The assumptions for different groups of steel producers can be detailed as below:

Main Producers: The projections are based on current performances of each in 2005-06 and the likely outcome of the expansion projects as they materialize subject to emerging market conditions.

COREX/BF-BOF: Only JSW Steel falls in this category and the projections include similar bases as above, given that in the coming years the BF-BOF unit will gain prominence.

MBF-EOF: Projections are based on last three years performance.

EAF Units: This category includes ESSAR Steel, Ispat Industries, JSPL along with other small to medium scale units. Given the heterogeneous composition of the category and its present performance trends, an overall growth rate of 8% has been assumed for the period.

Induction Furnace Units: For this category given its present performance trends and likely future growth in its raw materials availability (Sponge Iron Particularly) an overall growth rate of 5% has been assumed;

New Units proposed: Based on information available from MOU documents, 39 units are found to have made some progress in varying degrees in implementation, spread over the states of Chattisgarh, Jharkhand and Orissa. Total likely capacity coming up is 20 Million Tonnes. Commissioning in this case also faces the constraints/conditions of similar nature as the others (extent varies only) along with fluctuations of market conditions and for the initial years of operation, capacity utilization of 60% is adopted. This yields a gross production from new projects as 12 Million Tonnes.

7.3.3 A caveat is in order at this juncture. All the assumptions are made with respect to prevailing conditions in the market (including the raw material scenario), the indications therein and announcements of new projects as of now and are liable to change with unfolding of market conditions – domestic as well as global. Also one needs to consider the fact that the market can absorb additional production in periodic trenches and infrastructure development will also come in phases.

7.3.4 Given that the present analysis focuses on deriving the likely indigenous crude steel production by 2011-12, the current exercise takes into account the likely sources along with the process routes to be followed. Incorporating the impact of present market situation and the proposed year wise phasing of expansion plans, the exercise estimates year wise projection of domestic crude steel production for the entire Eleventh Five Year Plan. It is estimated that crude steel production will increase from 42 Million Tonnes currently to 80 Million Tonnes in 2011-12 (**Table 7.5**) recording a growth rate of 11.3% per annum. Moreover, it is also expected that around 55% i.e., 44 Million Tonnes out of 80 Million Tonnes, of the supply in 2011-12 would emanate from the Oxygen Route.

Table 7.5

Likely Scenario of Crude Steel Production by 2011-12

(Million Tonnes)

Process Routes	2005-06	2007-08	2011-12
Oxygen route (BF-BOF, Corex-BOF, MBF-EOF)	25.0	27.8	44.4
Electric Furnace route (EAF, IF)	17.0	18.6	23.8
New Units (Unspecified)	Nil	4.0	12.0
Grand Total	42.0	50.4	80.2

7.3.5 Year wise crude steel production estimates are shown in **Table 7.6** below.

Table 7.6

Estimation of Crude Steel Supply during the 11th Five Year Plan

Crude Steel Production Projections

(Million Tonnes)

PRODUCER/ROUTE	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
A) OXYGEN ROUTE							
1. SAIL (incl VISL) *	13.33	14.18	14.87	15.81	15.93	19.48	21.53
2. RINL	3.5	3.7	3.8	4.2	5.3	6.6	7.6
3. TSL	4.73	5	5	6	7	8	9
4 JINDAL:							
a) COREX-BOF	1.5	1.5	1.5	1.5	1.5	1.5	1.5
b) BF-BOF	0.8	1.5	2	2.2	3	3.5	4
5. MBF-EOF	0.6	0.6	0.6	0.7	0.7	0.8	0.8
A) TOTAL OXYGEN ROUTE	**24.46**	**26.48**	**27.77**	**30.41**	**33.43**	**39.88**	**44.43**
B) ELECTRIC FURNACE (EF) ROUTE							
1. SAIL (ASP & SSP)	0.14	0.18	0.18	0.18	0.65	0.65	0.65
2. Other EAF UNITS	8.33	8.72	9.42	10.12	10.45	11.25	12.15
Induction Furnace Units	8.31	8.5	9	9.5	10	10.5	11
B) TOTAL EF ROUTE	**16.78**	**17.4**	**18.6**	**19.8**	**21.1**	**22.4**	**23.8**
C) TOTAL NEW UNITS PROPOSED	**-**	**2**	**4**	**6**	**8**	**10**	**12**
D) GRAND TOTAL=A+B+C	**41.24**	**45.88**	**50.37**	**56.21**	**62.53**	**72.28**	**80.23**
**** SAIL Total including Oxygen and EF Route***	*13.47*	*14.36*	*15.05*	*15.99*	*16.58*	*20.13*	***22.18***

Note:

1. The projections are based as per the information submitted in writing to the Working Group by the October, 2006. Subsequent revisions amount to around 1 million tonne additional capacity (RINL + others).
2. Jindal's BF-BOF is assumed to gain prominence in coming years.
3. For EAF UNITS, assumed annual growth = 6%; for IF units, 5%
4. For New Plants: No details available as to adoption of process route. A mix of (A) and (B) may be assumed.
   Only new players, as available in list of MOU signed with state govt, are considered.
5. All TOTAL figures are rounded off.

7.3.6 Corresponding to the projected crude steel production, likely availability of re-rollable scrap and estimates of downstream processing capacities in place, total Finished Steel availability has been estimated to go up be around 47 Million Tonnes in 2007-08 and 77.4 Million Tonnes by 2011-12 (**Table - 7.7**)

<u>Table 7.7</u>

Likely Scenario of Finished Steel Availability by 2011- 12

(Million Tonnes)

Products	**2007-08**	**2011-12**
Bars & Rods	15.8	26.2
Structurals	4.3	8.6
Rails & Railway Materials	1.0	1.3
Total Non-Flat	21.1	36.1
Plates	2.5	4.0
Hot-Rolled Coils/Sheet/Skelp	12.3	21.6
Cold-Rolled Coils/Sheet	4.8	5.5
Galvanized Coils/Sheet	4.6	7.5
Electrical Steel Sheet	0.2	0.3
Tin Plates/Tin Free Steel	0.3	0.5
Pipes	0.9	1.9
Total Flat	25.6	41.3
Total Finished Steel	46.7	77.4

7.4.0 Comparison of Projected Supply and Demand in the Eleventh Plan Period

7.4.1 The above analysis suggests that the country is unlikely to face serious shortages of crude/finished steel for domestic consumption over the period under consideration, that is up to the terminal year of 2011-12. During 2007-08, conditions of domestic production of finished steel appear to be a little tight under the current assumptions of low capacity utilization in some of the sub-sectors made in the supply projection exercises. However, it is expected that a fuller and better utilization of the existing capacity, especially in the secondary sector will take care of periodic tightness in supply in the very short run. At the overall level, the projected production will also be able accommodate possible exports from India. However, for certain categories such as Hot –Rolled Coils and sheets/Plates and Electrical Steel Sheet there may be some deficit of domestic supply primarily due to quality mismatch. The expected outlay on the dedicated freight Corridor in railways may lead to some shortage of supply, given the current production intentions. However, it may be noted that category wise gaps may not be a cause of worry in the medium term (i.e., 6 years) as the producers have the time and the technological flexibility needed to align their rolling plan and facilities to market conditions.

7.5.0 Estimation of Export Possibilities and Likely Overall Availability

7.5.1 Exports in the pre-deregulated era were largely determined by surpluses of supply over domestic consumption. At present, steel producers are free to determine the level of exports for maximization of profits. The level of exports in an open economy will be determined at the margin by relative realization of the producers in the domestic market vis-à-vis realization in export destinations. Apart from dedicated export capacities, it implies that a relatively strong domestic market and prices relative to overseas markets should discourage exports and vice versa. Therefore, for a country like India with a growing industrial economy and rising infrastructure investment where demand and price of steel are likely to remain firm for some more time to come, projection of exports will be determined largely by the capacities in place and realized domestic demand at any point in time.

7.5.2 In the National Steel Policy an export ratio of 25-26% (i.e., percentage of production exported) in 2019-20 was estimated keeping in view the annual growth rate of about 11% in exports achieved by the Indian steel industry in the post-deregulation period. This ratio was also in line with the global export ratio of above 30% recorded today. Currently, India exports about 10% of its total finished steel production. Additionally, it exports semi-finished steel. In line with the achieved export growth in the last decade and a half and the target of steel production set in the NSP, the milestone export ratio for the Eleventh Plan period is estimated to lie within a range of 12% - 15% of total production.

7.5.3 While talking about the likely export levels it needs to be underscored that even in a deregulated market situation the government has the responsibility of ensuring sufficient supply of steel for downstream activities within the country for continued economic growth. Therefore, in certain situations the government may discourage exports through reduction of export incentives or alternatively by imposing export duties. Therefore, export targets are liable to be affected by these periodic policy decisions.

7.5.4 Import duties have been progressively reduced from a peak level of 20% to 5% during the 10th Five Year Plan. Protection from unfair import competition is being provided through the mechanism of Trade Actions (Anti-Dumping, Anti-Subsidy and Safeguard actions) as permitted under the WTO dispensation – of which India is a member. It is expected that the same import policy will continue in the next five years especially in view of the fact that a low import duty rate regime assumes greater relevance as an instrument for overall price management in the context of a growing domestic steel market with upward pressure on market prices. In the last 15 years (i.e., 1991-92 to 2005-06) import of steel as a percentage of total consumption in India has varied between a high of 10% in 2005-06 and a low of 4.8% in 1998-99.Import of steel during the Eleventh Five Year Plan is forecast to be in the range of 3-7 Million Tonnes per year.

7.5.5 The expected export ratio of 12%-15% and the likely import projection of 3-7 Million Tonnes per annum translate into export possibilities of 10–14 million Tonnes per annum during the 11th Five Year Plan period. The likely scenario of domestic demand and availability including export and import possibilities by the end of the 11th Five Year Plan would emerge as below:

Table 7.8

Likely Demand and Availability of Finished Steel 2011-12

(Million Tonnes)

	Production	Import	Export	Domestic Demand
2011-12	72-78	3-7	10-14	65-71

7.5.6 Projected production/supply during the Eleventh Five Year Plan appears to be adequate to take care of the export targets, albeit with some fluctuations between the two benchmark years. That is to say that the export targets set and the import expectations along with expected domestic production would have enough leeway in the system to accommodate periodic spurts in domestic demand by 2011-12.

7.6.0 Requirement of Critical Inputs and Supporting Facilities Needed for the Envisaged Expansion of Production

7.6.1 Estimated Requirement of Raw Materials and other Inputs till 2011-12

7.6.1.1 Based on the distribution of projected production of crude steel according to process routes and average norms of consumption route wise, estimates of total and additional requirement of raw materials have been worked out (**Table 7.9**). However, in view of the fact that there exists large scope of improvement in operational efficiencies and also due the fact that there are possibilities of changes in likely share of different routes, the estimates of input requirements are only indicative:

Table 7.9

Estimated Requirement of Raw Materials and Other Inputs by 2011-12*

Input Materials	Unit	Estimated Consumption 2005-06	Estimated Consumption 2011-12	Additional Requirement by 2011-12
Coking coal	Million Tonne	31.5	46.0	14.5
Non-coking Coal	Million Tonne	15.0	24.5	9.5
Coal Dust Injection	Million Tonne	Negligible	3.00	3.00
Iron Ore	Million Tonne	66.9	130	63.1
Scrap Steel	Million Tonne	10.2	18.0	7.8
Lime Stonne	Million Tonne	11	19.5	8.5
Dolomite	Million Tonne	4.0	7.4	3.4
Natural Gas	MCAL	10000	15000	5000
Ferro Alloys	Million Tonne	0.85	1.5	0.65
Power	MW	4120	7700	3580

* Excludes requirements of ferro alloy industry.

7.6.2.0 Estimated Modal Distribution of Traffic between Rail and Road by 2011-12

7.6.2.1 It is estimated that every Tonne of steel production involves transportation of 4 Tonnes of material. The envisaged addition of 39 Million Tonnes of steel annually implies 150-156 Million Tonnes of additional traffic. In a globally integrated economy, minimization of the overall cost of transportation becomes an important instrument of maintaining the competitive edge in both the domestic and overseas markets. The inland transportation considered here are the – railways and road.

7.6.2.2 The railways transport iron ore, coal and other bulky input materials from mines and ports to the plants, and steel to ports and consuming centres. However, over the last decade railways has been consistently losing traffic originating in the steel sector to the roads. In a period of ten years, the share of railways in transporting finished steel had declined from 71.9 percent in 1991-92 to 34.4 percent in 2001-02. The decline has been largely on account of railway's competitive weakness in the face of challenges from other modes of transport like roads, pipeline and coastal shipping. Replacement of the 'equalized railway freight' by 'freight ceilings' is also partly responsible for the modal switch. In the last two years, however, the share of railways has recovered to some extent.

7.6.2.3 On the basis of the present share of railways and roads in the movement of raw materials and finished/saleable steel, the expected scenario by 2011-12 appears to be as follows:

<u>Table 7.10</u>

Modal Distribution of Traffic, 2003-04 and 2011-12

Expected traffic originating in the steel sector to be handled by the railways (mT)				
	2003-04		2011-12	
	Railways	Road	Railways	Road
Raw Materials*	75	33	161	70
Finished Steel	11	25	26	51
Total	86	58	187	121

* *Excludes traffic due to export of iron ore.*

7.6.2.4 Based on the average lead distance over which the freight needs to transported for raw material for steel making and finished products it is estimated that the total traffic generated for railways originating due to the iron and steel industry would be around 115 billion Tonne kilometer by 2012. The total traffic for railways including export of iron ore will, however, be higher. This estimate, however, may change somewhat depending on the exact location of the new (green-field) plants and mines coming up in the next two decades.

7.6.3.0 Investment in Complementary Sectors

7.6.3.1 The investments required in the Mining and power sectors are placed below (**Table 7.11**).

Table 7.11

Investments Required in Complementary Sectors

	Mining		Power
	Iron Ore	Coal*	
Investment (Rs Crore)	11,800	2700	12,500

* Major requirement of coking coal will be met through imports

7.6.3.2 Railways, road and other infrastructure have multiple users. Therefore, it is not possible to allocate investments cost due to the iron and steel sector separately.

CHAPTER – VIII
RECOMMENDATIONS

8.1.0 Introduction

8.1.1 Steel Industry has an important role to play in the development of any economy. The sector's sustained growth, therefore, is one of the important prerequisites for attaining the level of GDP growth envisaged in the 11^{th} Plan. The sectors growth during the 11^{th} Plan, however, is going to be largely driven by market forces in a deregulated economic environment.

8.1.2 While the industry's future prospects may be determined by market forces, the Government will continue to play a pro-active role especially in areas where the actual achievements fall short of expectations. At the same time there is also a need to exploit the industry's growth potential fully. The ongoing processes of global relocation and world-wide restructuring have clearly shown that the focus of the industry will gradually shift to those countries which have raw materials, low cost labour and technical manpower, high potential of technology absorption and a rapidly growing domestic market as well as proximity to other growing markets. India has the potential to emerge as a global player during the Eleventh Plan period, if the inherent advantages like availability of quality iron ore, cheap labour, technical manpower and growing domestic demand are leveraged properly. Its capability has already been demonstrated in the last decade and a half when it improved its position from the 11^{th} place in 1991 to become the 7^{th} largest producer of steel globally in 2005. As the 11^{th} Plan period is going to be crucial for not only maintaining but also improving the overall momentum of growth in this sector and this for a conducive policy environment.

8.1.3 The supportive measures to be provided by the government to strengthen the steel industry include the following:

a) Providing an enabling policy framework that supports easy availability of critical inputs;

b) Developing infrastructure, institutionalizing research and supporting market promotion efforts;

c) Monitoring market developments for any distortions / failures and taking corrective actions;

d) Ensuring easy availability of steel for downstream industrial activities, as well as for meeting the needs of the community at large, especially for rural population by extending the distribution network to rural and remote areas;

e) Supporting efforts of the producers for product diversification / development of new products for emerging areas of application such as automobiles etc.;

e) Ensuring production of quality steel in accordance with the laid down specifications and standards for protecting the interests of the consumers.

f) Encouraging the growth of financial instruments, which provide protection to consumers against market volatility; and

g) Supporting an efficient system of collection, analysis and dissemination of basic information for informed decision making by all stakeholders; and,

h) Above all, playing the role of a watch dog of all aspects of the industry's performance namely production, consumption, pricing, export, import and distribution net work;

8.2.0 Area Specific Recommendations

8.2.1 Based on the observations and findings of the 11th Plan Working Group on Steel and in keeping with the spirit and objectives of the National Steel Policy, 2005, to make India globally competitive not only in terms of cost, quality and product mix but also in terms of global benchmarks of efficiency and productivity, recommendations are made to deal with specific areas of concern. The major recommendations are discussed in the following section.

8.2.2 Demand side management

8.2.2.1 One of the major concerns for all stakeholders is the prevailing low per capita consumption of steel in India. While per capita consumption is expected to improve with increasing income levels, urbanization and development of infrastructure, conscious efforts are required to stimulate domestic demand and create incremental consumption possibilities. The latent possibilities of increasing steel demand can be translated into reality by:

I) Conscious promotion of steel usage by the producers of steel and the Institute of Steel Development and Growth (INSDAG) amongst architects, engineers, students and other technology practitioners and users of steel;

II) Encouraging use of steel in bridges, crash barriers, and flyovers, industrial and other buildings and large-scale construction in general;

III) Developing new grades and products for expanding the basket for steel applications;

iv) Improving steel availability and affordability

8.2.2.2 The real challenge however lies in addressing disparities in steel consumption across different states and regions and also between urban and rural areas. There is a need to strengthen the efforts under various initiatives like Bharat Nirman programme, National Rural Employment Guarantee act etc. These programmes will address the problems of poor infrastructure and low income levels prevailing in rural areas. At the same time specific strategies are needed to make available steel products required for household construction and for agricultural/agro-industries at affordable prices. In the 11th plan, there is a need to impart greater thrust on opening new block level rural stock points to increase availability of steel in all parts of the country.

8.2.3 Supply side management

8.2.3.1 Raw Materials

8.2.3.1.1 The deregulated steel industry has effectively dealt with the problem of shortages though at higher equilibrium of prices. While planning for the 11th Five Year Plan, it is necessary to fully take into account the growing needs of steel for downstream economic activities. Though efforts will be made to fulfill domestic needs with priority, it is equally important to exploit emerging export opportunities. In view of this, availability of key inputs should be planned to meet the growing domestic and export demand of steel in the 11th Plan.

8.2.3.1.2 To ease the availability of critical raw materials like iron ore and coal, it is desirable that necessary changes in legal, policy and institutional set up are effected with priority. At the same time, adoption of new technologies can play a far greater role by improving material efficiencies and also by making it possible to use indigenously available resources.

8.2.4 Iron Ore

8.2.4.1 The issue of conservation of iron ore for domestic use vis-à-vis exports was examined by a High Power Committee of Secretaries. As the Committee could not reach a consensus on the controversial issue, the matter has been referred to the Cabinet for examination. While framing any policy on export of raw materials long term requirements of steel industry may have to be considered keeping in view the fact that not only are the reserves of high-grade ore limited but the available reserves are also not optimally/fully exploited by the steel industry because of the following factors:

a) Large reserves of iron ore are in deep forests and in ecologically sensitive areas, where full-scale mining may be discouraged for fear of environmental degradation.

b) Some of the richest mines are also located in tribal belts where mining may lead to widespread displacement and impoverishment of indigenous population especially, those dependent on forest resources and this restricts mining operations.

8.2.4.2 Need for conservation of iron ore resources for domestic use may also be argued on the basis of the necessity to increase per capita consumption of steel in India from the current low levels. Per capita consumption of steel indicates the state of economic development of a country in terms of the economic and social infrastructure available to support its overall production systems and ultimately the level of living of its people. Since India with its burgeoning population needs steel in huge quantities in the next few decades to catch up with the world average level of consumption, the basic raw material iron ore becomes central to all policy formulations relating to this sector. While Indian steel industry suffers on account of various factors mentioned in the report, it has the advantage of indigenous availability of iron ore. This advantage needs to be further built upon. The experience of China with regard to paucity of iron ore in the last half decade is a pointer to this direction.

8.2.4.3 Considerations of higher value addition and employment in the economy, especially in the commodity sectors (including the employment-intensive manufacturing, construction and other secondary/industrial activities), should also be taken into account. In view of the above factors, a judicious balance between exports and domestic supply of iron ore need to be maintained. Pending large-scale discoveries, there is a need to consider measures such as gradual reduction in export of iron ore/export duty to meet the requirements of steel industry with priority.

8.2.4.4 At the same time the following measures need to be taken to ensure the easy availability of iron ore and other important minerals:

- Exploration of minerals needs to be accorded highest priority with necessary incentivisation and by removing various legal / procedural constraints.
- Environment and forest clearance for mining leases should be granted within a pre-specified time frame.
- A transparent set of policy rules that addresses the issue of compensation and makes the affected/displaced persons beneficiaries of the mining projects is to be framed.
- Scientific mining and economies of scale are to be encouraged for which a minimum economic size for iron ore mines may be prescribed.
- Beneficiation of iron ore and coal needs to be taken up as a priority to increase the size of reserves suitable for requirements of steel industry. Adoption of relevant technology in these areas needs to be encouraged through suitable fiscal incentives.
- Sintering and pelletisation activities need to be encouraged for domestic usage of iron ore fines for which fiscal incentives may be considered. Steel plants having captive iron ore leases should ideally use all their iron ore fines and exports/domestic sale of lump/fines be discouraged.
- Existing steel plants without captive mines have serious disadvantage vis-à-vis those with captive mines and there is a need to accord high priority in allocation of captive mines to these units.
- The insistence by state governments for value addition within the state may be justified on grounds of local development. However, at times it discourages investment as different resources may be dispersed amongst different states. In view of this, a consensual approach that maximizes national interests may be worked out.

8.2.5 Coking/Non-Coking Coal

8.2.5.1 The globalised Indian steel industry has the advantage of procuring quality raw materials from overseas sources to maximize operational efficiencies. This is especially relevant to the requirements of coking coal, where indigenously available coals need to be blended with imported coal to make these suitable for metallurgical operations. However, a steel industry over-dependent on imports, may suffer on account of disruptions in supplies and also loss of competitiveness in certain situations of escalating input prices. Therefore, there is a need to intensify efforts to acquire mines overseas to protect against poor availability and rising prices of purchased inputs. The Indian steel industry should enter into long term/evergreen contracts with major coal companies in the world. Further, alternative technologies like injection of PCI, coal tar etc. into blast furnaces need to be fully explored to reduce dependence on imported coking coal.

8.2.5.2 In the long term, there is a need to adopt and encourage technologies, which can make use of indigenously available raw materials like non-coking coal and iron ore of low grade / fines. Moreover, to facilitate higher production of sponge iron, there is also an urgent need to earmark certain categories of reserves of iron ore and coal exclusively for this sector. In this context, it is desirable to reclassify coal categories, especially non-coking coal, in accordance to their use for metallurgical and non-metallurgical purposes.

8.2.5.3 At the same time, there is a need to denationalize the coal sector to attract private investment. Coal pricing and marketing also need to be modernized. The e-auction route will help in transparency and also to move towards rational coal pricing.

8.2.6 **Ferro-alloy** is an essential input for steel making. The basic raw materials needed for this industry, especially chrome and high quality manganese ore, are in short supply. It is therefore necessary to give thrust to exploration activities of these minerals. In the intervening period, these ores should be conserved for domestic use pending large-scale discoveries. Further, in view of the surplus domestic capacity, the industry needs to be exempted from the ongoing fiscal rationalization processes aimed at rectifying the inverted import duty structure vis-à-vis the steel industry for the time being.

8.2.7 Infrastructure

8.2.7.1 The infrastructure for steel sector needs to be essentially provided by the Government as it may not be feasible to develop required infrastructure by steel companies due to the large size of the investments involved, on one hand and the imperatives of maintaining essential cash flows by the companies, on the other. However, the scarcity of public resources has already made many steel companies go for captive power plants, jetties, roads and even railways. While some such investments by the large steel companies will be unavoidable, the burden of infrastructure development totally should not fall on the steel companies. On the other hand, some companies will be willing for public private partnerships (PPPs) especially in certain critical areas for reasons of avoiding uncertainties and reducing long-term costs. There is a need to fully utilize existing policy framework of Public-Private Partnerships (PPPs) for the benefit of all stake-holders.

8.2.7.2 Power: Power is an essential input for all segments of steel industry especially for secondary producers and for Ferro-alloys segment. The capacity build up in power sector during the 10th Five Year Plan is likely to be much below the targets. This had an adverse impact on the effective utilization of the existing steel capacity. Further, high rates of power have eroded the competitiveness of steel sector. Though there is a need to deepen the reform process in power sector, it is essential that capacity build up through captive power plants is accorded high priority by increasing incentives/tax breaks and by removing various procedural constraints. This is a necessity especially for power intensive segments of steel industry. Smaller players may be encouraged to pool their efforts as a consortium for carrying out such activities.

8.2.7.3 Railways: The steel industry needs more effective railway network in the areas where plants and mines are located. It is not merely the connectivity, but the overall quality of the service that matters the most. A reliable, efficient and low cost railway movement is the need of the hour and it will help the Indian steel companies to win export share by becoming competitive. It will also help in reducing delivery costs of steel, which are very high due to geographical spread of our country. The Railways need to augment capacity at an accelerated pace. The implementation of dedicated freight corridors will be a step towards cost effective transportation. Further, there is a need to take a major initiative in shifting to PPPs for building rail infrastructure. Rationalization of freight rates for steel and its raw materials will facilitate inter modal shift.

8.2.7.4 Ports & Coastal Shipping: There is a need to develop in the 11th plan, ports and related infrastructure of international standards in turn around time and clearing of cargoes. Since public resources may be inadequate to augment capacities, it is necessary to lay down the framework for private sector participation in a clear manner. Further, there is an immediate need to develop a deep-sea port for handling large sized vessels. Greater thrust is also required to develop adequate rail-road connectivity. For some steel plants, it makes an economic sense to move steel and raw materials along the coast. Coastal shipping may, therefore, need to be developed and encouraged to the extent possible. It will help decongest the major ports, railways as well as roads.

8.2.7.5 **Highways:** While NHDP programme has been able to develop highways of international standards, adequate attention has not been paid to roadways, which are under state governments. What will be of larger relevance for a bulk product like steel is well built expressways and good roads in and around the steel plants and mines. Since steel has to be carried to far-flung areas, it is essential to accord priority to integrated development of road networks including State highways and district roads. In order to improve the availability of steel in rural areas, there is a need to give greater thrust to rural roads under PMGSY. In addition to these measures in different sectors, development of Inland waterways should be explored more seriously.

8.2.8 New Investments

8.2.8.1 The country would need an investment in the range of Rs.1 lakh to 1.2 lakh crore in creation of additional steel capacities by 2011-12. Related areas like mining and power will require an additional investment of Rs.25 to 30 thousand crores. While supply of finances for steel projects has to be decided by banks and FI's on merits of the individual projects, sufficient liquidity needs to be injected into the financial system at macro-level to ensure the kind of capacity build-up envisaged in the steel sector in the 11th plan. Further, there is a need to retain flexibilities in the financial system to encourage innovation. There are many areas of technology development and adoption, which can be risky but also highly rewarding. Venture capitalism needs to be promoted at a greater pace for early adoption of emerging technologies.

8.2.8.2 However, there is a need to exercise caution while planning for future capacities. The intended capacity of around 100 Million Tonnes is higher than domestic demand. Though only a part of the intended capacity will be realized as shown by past experience, it is necessary to adopt a strategy of gradual build-up of capacity through a number of phases or modules so as to avoid a situation of oversupply and financial problems.

8.2.8.3 At the same time a growing economy cannot plan for lower capacity where there exist substantial opportunities to add to per capita consumption. In such a scenario, it is necessary to actively monitor the capacity build up both in India and abroad so that investment decisions are taken optimally.

8.2.8.4 Foreign direct investment is expected to supplement the resource requirement of a growing steel industry. Additionally, FDI is expected to bring along world-class technologies with modern management culture. The demonstration effects on Indian steel firms can be highly rewarding in the long run. However, there is a need to develop transparent policies before according various linkages to domestic and foreign companies.

8.2.8.5 The country is capable of attracting much higher investments in steel sector both through foreign and domestic investors. A key issue in this context is to impart greater flexibilities in some of the labour laws. There is a need to consider appropriate amendments in Industrial Dispute Act to provide flexibilities to steel companies to compete in the international markets. The advantage of lower wage rate in India coupled with these flexibilities can greatly enhance the competitive advantage of Indian Steel companies.

8.2.8.6 While any concessions/tax-breaks for any particular state/region is desirable in the context of balanced regional growth, the policy framework should also take into account the possibilities of a mere relocation of the existing facilities from the border districts of one state to another - rather than creation of fresh capacities.

8.2.9 Issues in Technology and R&D

8.2.9.1 Competitiveness of the steel industry can only be ensured and sustained through consistent improvements in parameters of technical efficiency. There are many areas where the Indian Steel Industry is lagging behind, though there are some bright spots where the industry has been able to take leading role. The problems are mainly related to obsolescence of technology adopted and lack of timely modernization / renovation, quality of raw material and other inputs, inefficient shop floor practices, lack of automation and R&D intervention. Concerted effort s with well thought out programme of action are, therefore, necessary to bring the Indian Steel Industry at par with their counterparts abroad. The specific areas requiring immediate attention have been outlined in detail in the report. Briefly these include areas of process improvement, automation, use of inferior raw materials, beneficiation, energy conservation and use of waste materials. While for some of these problems, the industry is in search of innovative and cost effective solutions, there exist proven technologies in certain other areas. These technologies/practices have been already operating successfully abroad and need to be adopted and assimilated by the Indian industry at an accelerated pace.

8.2.9.2 While adoption of proven technologies may result into immediate gains, there is a need to encourage those technologies, which though are not commercially proved but are consistent with resource endowment of our country. In this context, it is worthwhile to explore a few promising alternate iron making (SR) technologies being tried on pilot plant or demonstration stages. The salient features of these processes are direct use of non-coking coal and iron ore fines, thereby completely bypassing coke oven, sinter/pellet plant and of course coking coal. These technologies are particularly relevant in India in view of indigenously available resources of high ash coal and also abundant iron ore fines. Processes such as FINEX, HISMELT, FASTMET, ITmk3, etc. appear promising and relevant in the Indian context and need to be assessed for their future adoption based on their commercial success. Such technologies fulfill the requirements of “sustainable development”, i.e., environmental control; pollution control and safety are all integral part of these technologies and do without coke making or separate agglomeration facilities.

8.2.9.3 Another interesting new alternative likely to be suitable under Indian conditions is non-coking coal gasification based on Lurgi technology and use of the gas thus generated in gas based direct reduction process. Though, such technologies are not expected to make a sizeable contribution in total iron/hot metal production in the country during the next five years, it is necessary that some of these technologies should be in place during the period so that they contribute considerably to hot metal production for the following five-year period.

8.2.9.4 While significant progress has been achieved by domestic manufactures of capital goods and equipments in acquiring newer capabilities, the progress in developing steel equipments have been relatively slow. A significant portion of steel projects is still imported leading to high project costs. It is essential to acquire capability for designing of plant and equipments based on R&D results. The academic institutions, researchers and consulting houses need to develop programmes and work in close coordination for this. However, in the intervening period it is desirable to allow liberal import of new and second hand plants and equipments to facilitate capacity build up.

8.2.9.5 Attaining indigenous capability for undertaking automation of various processes and developing various design parameters, would be equally important to cut down costs and become globally competitive.

8.2.9.6 Indian steel plants waste a lot of energy in its steel making process. There is a good scope to harness these energies by generating power or using hot gases as alternative heating medium. Industry and consulting houses may be encouraged to design and install such facilities to utilize waste energy. The benefits under clean development mechanism (CDM) may be aggressively obtained by the industry.

8.2.9.7 The Government needs to directly support those research and development (R&D) activities, which are consistent with the national priorities such as conserving the environment and non-renewable resources. Direct financial support may also be essential for basic and applied research for development of breakthrough technologies using indigenously available raw materials. Some other areas of importance, which may need direct support are development of technologies, in particular, for exploitation of magnetite ore reserves and for use of low grade iron ore (55% - 62% Fe for hematite and 35% Fe for magnetite ore) and high ash coking coal (25+% ash) – either directly or by developing relevant beneficiation & agglomeration techniques. There are many other grey areas requiring R&D intervention as listed in the report under relevant chapter. To carry out these activities, it is desirable to expedite the setting up of an R&D Mission in order to provide accelerated thrust on R&D and thereby improve the competitiveness of the industry.

8.2.9.8 To enhance the in-house R&D activities by the industry, it is essential to extend the tax benefits available under Section 35 of IT ACT beyond March'2007. Further, there is a need to enhance the limit of income tax rebate of 125% of R&D expenses to at least 150%. The 11th Plan through various incentives should aim to accelerate the R&D expenditure in iron & steel sector to at-least 1% of total sales.

8.2.9.9 Government's positive intervention is required in collaboration with the industry in setting up state-of-art education centers for development of manpower to sustain the growth and development of the iron and steel industry and R&D required thereof. This particularly requires attracting metallurgical engineers to work in iron & steel industry and/or to pursue higher studies viz. M Tech, PhD etc to support the faculty base in academic institutions and also R&D in the industry. Similarly, there is a need to train and attract talent to the mining sector associated with the iron and steel industry. This is all the more necessary in view of the low productivity in the Indian mining sector compared to international standards and also for adoption and assimilation of the new generation technologies in mining.

8.2.9.10 There is a need to give immediate attention to availability of quality raw materials for EF steel making. While significant progress has been made in the development of Sponge Iron industry, the country lacks concerted efforts with regard to melting scrap. In this context, it would be desirable to set up a nodal agency for scrap procurement and processing.

8.2.9.11 Steel industry, which was earlier concentrated in the eastern region, has spread all over the country after deregulation. In order to address R&D needs of western and southern regions it is necessary to set up a large R&D centre in the western region of the country.

8.3.0 Environmental Management & Pollution Control

8.3.1 Environment protection in iron & steel plants is essentially linked to the technology adopted for iron & steel making, starting from the raw material to finished steel stage, and finally to the efficient disposal/re-use of generated bye-products and waste. Therefore, effective management of environment calls for an integrated approach covering the production process as also the environment surrounding the plant. In this connection, the industry and government should aim at zero waste /zero discharge.

8.3.2 Wastes, particularly solid wastes generated unavoidably, are to be converted into useful, value added by-products. In other words, “sustainable development” is to be practiced right from technology development and design stages. The challenge for steel in the new millennium is no longer to prove its capacity to act as an engine of growth but also to show that it is a material of the future resolutely adapted to the integrated concept of “sustainable development”. In future, it may be ensured that technologies, which are not “sustainable”, are not adopted for either expansion of existing plants or creation of new capacities. Towards these objectives, initiatives both at the level of the entrepreneurs and Government by way of suitable intervention are necessary.

8.3.3 Policy Measures and technologies, which need special mention for development and adoption are:

- To adhere to the Corporate Responsibility on Environmental Protection guidelines as circulated by CPCB.
- To have a breakthrough in iron making technologies thereby eliminating coke ovens and agglomeration plants.
- To adopt dry coke quenching in existing plants by studying its feasibility and installing only dry coke quenching in new plants.
- To reuse sludge after sludge treatment by removing moisture, etc.
- To reuse more steel melting slag by accelerating R&D in line with experience of internationally reputed companies in Japan, USA, etc.

- To reuse oily mill scale after incineration and, if possible, recovery of energy there from. The associated technology is to be either imported or developed through indigenous R & D.
- To encourage energy conservation by adopting following measures:

  --Installing BF top gas turbines

  --Improving efficiency of regenerative burners in reheating furnaces.

  --Extraction of heat from sinter cooler waste gas.

  --Installation of more vapour absorption refrigeration systems by utilizing waste heat of furnaces.

  --To reduce sulphur content of coke oven gas before reuse.

  --Install on-line monitors for ambient air/ water/ effluent pollution level hooked up to control rooms.

  --To improve participation in Clean Development Mechanism projects.

8.4.0 Safety Measures

8.4.1 For improvement in the overall safety situation in the Iron & Steel industries in India following remedial measures are suggested.

i. The government has to play the primary role of tightening the legal system so that any instance of violation of safety policy, whether by public sector or private sector, does not go unpenalised. The system of factory inspectorate, safety officers and legal framework has to be refurbished accordingly. There should be up-gradation in legal provisions to take care of changes in technologies / work environment so that loopholes are plugged as far as possible.

ii. OHS Management system as per ILO guidelines and OHSAS 18001 should be adopted in all plants.

iii. Technological Improvement:

   In India many outdated technologies, viz., twin hearth furnace, ingot making etc. are still being practiced in some steel plants. These processes are hazardous to personnel working there and it is required to phase these out immediately to improve safety in such plants. Apart from this, new technological development as described elsewhere in this document will also facilitate attainment of safe work environment.

iv. Fire modeling and hazard risk analysis should be done in all plants for better assessment of inherent risk/ hazard:

8.4.2 The latest techniques in safety management including use of latest software programmes may be used to carry out the fire modeling and hazard risk analysis. Above technique is done to obtain quantitative data regarding risk, loss of life/property and also investment to be made in installation of these safety system / equipment.

8.5.0 Price Stability

8.5.1 Integration with global economy, may at times lead to sharp rise and volatility of steel prices. While a part of this volatility may be unavoidable, hedging mechanism should be available for consumers to increase stability of business. A beginning in this respect has already been made in the various stock exchanges like Multi Commodity Exchange (MCX) and National Commodity Exchange (NCDEX). This is in accordance to the recommendations adopted in the National Steel Policy, 2005.

8.5.2 However, there is a need to spread awareness of these instruments and also to increase trading volumes under such arrangements. Also an appropriate regulatory mechanism is to be developed to avoid any manipulative practices.

8.5.3 At the same time, there is a need to bail out the small-scale industries through assistance to Small Scale Industries Corporations (SSIC's) as interim relief measures during periods of extreme price volatility and sharp escalations.

8.5.4 Also the producers need to be made aware of the fact that continuous increase in the prices of steel products may be counter productive to long term growth and objectives of the companies.

8.6.0 Institutional Framework for collection of data and dissemination of Information

8.6.1 There is an urgent need of reforms in the existing institutional mechanism for collection, validation, analysis and dissemination of data / information. Collection of data has become far more complex with deregulation of the Indian steel industry, especially information on capacity and production. Necessary legal provisions / institutional framework are required to ensure building up of a reliable and effective data base to facilitate informed decision making by all the stake-holders – the policy makers, the firms, the financial institutions and also the consumers. The existing institutions, namely, the Joint Plant Committee (JPC) and the Economic Research Unit (ERU) may be strengthened for this purpose.

8.6.2 Further, the existing institutions e.g., Joint Plant Committee (JPC), Economic Research Unit (ERU), Institute for Steel Development & Growth (INSDAG), National Institute of Secondary Steel Technology (NISST) and the Biju Patnaik National Steel Institute (BPNSI), need to be reoriented to be consistent with the changing realities of globalization. In this context, setting up of a multi-disciplinary organization along the lines of the International Iron & Steel Institute (IISI) in this country may also be considered.

8.7.0 Plan Assistance / Allocations for the Steel Industry

8.7.1 Presently there are no Plan schemes/ programmes being implemented by the Ministry of Steel. However, there are a number of projects and schemes being implemented by various Public Sector Undertakings (PSUs) under the Ministry, which are funded from internal resources. An elaborate review mechanism for evaluation and assessment of these major plan schemes/projects of the PSUs already exists. Based on the evaluation of the projects their continuation in the 11th Plan may be decided. A decision has been taken by the Ministry to quantify deliverables under the approved and ongoing projects with a total outlay of more than **Rs 50 Crore** and above (See **Annexure 11**).

8.7.2 Scheme for Resource Development Fund for Iron and Steel industry

8.7.2.1 The Indian steel industry is poised for a quantum jump in the near future. Achieving the target of steel production of 110 Million Tonnes by 2019 - 2020, as per the National Steel Policy 2005, would require an additional workforce of 220,000 even after accounting for the expected productivity improvements. The real challenge, however, lies in imparting new competencies and capabilities to the workforce in tune with changes in technology and the emerging needs of globalisation. The profile of the required human resources will have a larger share of skilled and semi-skilled work force. There is a need to evolve an effective institutional mechanism to create a large pool of skilled human resources. Therefore, it is imperative to have a dedicated centralised fund to undertake the financial requirement of the institutes set up/being set up.

8.7.2.2 It is also desirable that measures are taken by the ministry towards fostering long-term consumption and growth of the steel industry. For this purpose, public awareness of various usages of steel is to be created by holding workshops and advertisement campaigns. It is, therefore, proposed to have a dedicated plan fund **of Rs. 25 crores for the 11th Five Year Plan** in the Ministry of Steel towards grant for development of human resources for iron and steel and for ad campaigns for promotion of steel usage. The fund will be used for providing grants to these institutes and may be termed as “Resource Development Fund for Iron and Steel industry”.

8.7.3 Technology Up gradation Fund Scheme (TUFS) for the Small and Medium Enterprises (SME) sector

8.7.3.1 Cost of up gradation of technology in the steel sector in general is very high and it has not been possible for the plants to invest funds in these areas. This has resulted in technological obsolescence leading to higher consumption of inputs, higher energy consumption, lower environment friendliness, lower productivity and higher cost of production. This is particularly relevant for the small and medium sector steel plants adopting electric furnaces for production of crude steel. The iron & steel is a investment intensive industry and the requirement of funds for technological up gradation is high. It is, therefore, recommended that TUFS is set up during the 11th Five Year Plan to extend financial support to the aforesaid sector to upgrade the technological profile of these plants. Similar schemes are already functioning under Government of India for Textile, Small Scale, and Food Processing industries.

8.7.3.2 The Working Group recommends that a Task Force comprising of representatives of EAF & IF based steel producers, Ferro Alloys & Refractory producers and re-rolling mills may be constituted to work out the details of the scheme and year wise fund requirement etc. However, pending the above, the Working Group recommends that a token provision for **Rs. 10 crore** may be made for disbursement by Ministry of Steel out of its annual budget during the 11th Five Year Plan.

8.7.4 Other Proposals for Plan Assistance

a) Hindustan Steelwork Construction Limited (HSCL)

A proposal has been moved for revival and restructuring of HSCL a public sector undertaking under the Ministry of Steel. The proposal is presently under consideration of the Bureau of Restructuring for Public sector Enterprises (BRPSE).

Apart from the proposed revival packages, an additional plan outlay will amounting to **Rs 35 Crore** will be required by the company towards rehabilitation and repair of the plant and machineries, in view of their expanding business in various diverse specialisations.

b) Metallurgical and Engineering Consultants India Limited (MECON)

During the 11th Plan MECON may also require plan assistance to the tune of **Rs.93 crore** (Rs.30 crore as fresh equity and Rs.63 crore by way of preference share capital) for implementation of its restructuring proposals. The proposal is currently under active consideration of the Government.

c) Bharat Refractories Limited (BRL)

BRL would be requiring assistance for implementation of their Continuous casting Project (CCP), R&D activities and for Addition, Maintenance & replacement (AMR) scheme. Accordingly, a budgetary support of **Rs 54 Crores** is being proposed for BRL for the 11th Plan.

List of Tables

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Annexure – 1

No.I&M-3(30)/2006

Government of India

Planning Commission

(Industry Division)

Yojana Bhavan, Sansad Marg

New Delhi the 22nd May, 2006

ORDER

Subject: Constitution of a Working Group on Steel Industry for Eleventh Five Year Plan (2007-2010)

In the context of formulation of the Eleventh Five Year Plan (2007-2012), it has been decided to set up a Working Group on Steel. The Terms of Reference and Composition of the Working Group will be as follows:

I. Terms of Reference

a) To review the performance and present status and growth of domestic Iron & Steel Industry keeping in view the emerging trends, strength and weakness and changing economic scenario in the country.

ii) To recommend measures for making the Indian Steel Industry internationally competitive in terms of quality and cost of production along with measures for achieving the same.

iii) To review productivity issues and economics of the steel production in 'Secondary Steel Sector' including mini steel plants and sponge iron and to recommend measures to make it less susceptible to downturn in industry.

iv) To assess the relevance of new and emerging technologies for iron and steel production in the Indian context and make recommendations for introduction of promising technologies both in Public and Private Sector.

v) To assess the requirements of physical inputs, as well as investments in the complementary sectors like mining, power, transport, refractories etc. during the period. Extent of financial participation by Steel Industry in creation of railway infrastructure as envisaged in National Steel Policy 2005.

vi) To assess the requirement of coking coal, likely supplies from indigenous sources and the quantum of imports, year wise up to 2011 - 2012.

vii) To suggest a policy framework for achieving the targets including increased output from green field projects and existing main producers through expansion, modernization and diversification.

viii) To recommend a policy for production, imports and export ferro-alloys e.g. ferro-manganese, ferro-silicon, ferro-chrome, etc. keeping in view of the availability from domestic sources and estimated demand for these items up to 2011-12.

ix) To review the present status and future prospects of manufacture and supply of important inputs and raw materials by indigenous producers.

x) To review the technological trends in steel production and to suggest policy measures and institutional mechanism to promote R & D in the steel industry.

xi) To review broadly the status of environment protection pollution control and safety measures and suggest measures for improvement.

xii) To assess the manpower development need of the industry and to recommend the strategy to meet the same. To assess the level of direct as well as indirect employment generation during 2007-2012 in iron and steel industry if the projected level of investment fructify.

xiii) To recommend such other measures as the Working Group may consider relevant.

II. Composition of the Working Group

1.	Secretary, Ministry of Steel	Chairman
2.	Secretary, Department of Public Enterprises	Member
3.	Chairman, Central Electricity Authority Sewa Bhawan, R.K.Puram, New Delhi	Member
4.	Adviser to Deputy Chairman, Planning Commission	Member
5.	AS & FA, Ministry of Steel	Member
6.	Pr. Adviser (PP Division), Planning Commissioner	Member
7.	Adviser (Energy), Planning Commission	Member
8.	Adviser (Minerals), Planning Commission	Member
9.	Adviser (I&VSE), Planning Commission	Member
10.	Joint Secretary, Ministry of Steel	Member
11.	Economic Adviser, Ministry of Steel	Member-Secretary
12.	Industrial Adviser, Ministry of Steel	Member
13.	Representative of Ministry of Coal (not below the rank of Joint Secretary)	Member
14.	Representative of Department of Commerce (not below the rank of Joint Secretary)	Member
15.	Executive Director, Traffic Transportation (M&S), Railway Board, Rail Bhavan, New Delhi	Member
16.	Secretary (Industry), State Government of Orissa	Member
17.	Secretary (Industry), State Government of Chattisgarh	Member
18.	Secretary (Industry), State Government of Jhakhand	Member
19.	Secretary (Industry), State Government of West Bengal	Member

20.	Secretary (Industry), State Government of Andhra Pradesh	Member
21.	Chairman, Steel Authority of India Ltd. Ispat Bhawan, Lodi Road, New Delhi –110 003	Member
22.	CMD, Visakhapatnam Steel Plant, Visakhapatnam	Member
23.	Managing Director, TISCO, Jamshedpur	Member
24.	CMD, National Mineral Development Corporation Ltd. Khanij Bhavan, Masab Tank, Hyderabad – 500 028	Member
25.	Director (R&D), RDCI&S, SAIL P.O. Doranda, Ranchi-834 002	Member
26.	CMD, MECON Ltd., Ranchi	Member
27.	Chairman, Sponge Iron Manujacturers Association 1501, Hemkunt Tower, 98, Nehru Place, New Delhi- 110 019	Member
28.	President, Steel Furance Association of India 3 D Vandhna, 11, Tolstory Mard, New Delhi – 110 001	Member
29.	President, Alloy Steel Producers Association of India 24, Mahatma D, Ground Floor, A M Marg, Prabhadevi Mumbai 400 025	Member
30.	Senior Consultant, National Council of Applied Economic Research (NCAER), Parisila Bhawan, 11, Indraprastha Estate, New Delhi – 110 002	Member
31.	Chief Economist, ERU, Joint Plant Committee (JPC) Ispat Niketan, 52/1A Ballygunge Circular Raod, Kolkata 700 019	Member
32.	Shri. B.D. Jethra, former Adviser (I&M), Planning Commission, A303-A, Sushant Lok-I, Gurgaon-122022	Member
33.	Dr. Ramprasad Sengupta Centre for Economic Studies and Planning, Jawaharlal Nehru University, New Delhi	Member
34.	Shri M.L. Majumdar, former Adviser, Planning Commission	Member

B-301, Harmony Apartments, Plot No6-B, Sector 23,
Dwarka, New Delhi – 110 075

2. The Chairman of the Working Group may include additional Terms(s) of Reference in consultation with Member (Industry), Planning Commission, who is Chairman of the concerned Steering Committee.

3. The Chairman of the Working Group may co-opt any other Experts as Members of the Working Group.

4. The Working Group will submit its report within three months of the date of this order to the Chairman of the Steering Committee on Industry. The Working Group will be serviced by Ministry of Steel.

5. The expenditure of TA/DA of official members in connection with the meetings of the Working Group will be borne by their parent Department/Ministry to which the official belongs as per the rules of entitlement applicable to them. The non-official members of the Working Group will be entitled to TA/DA as permissible to grade I officers of the Government of India under SR190(a) and this expenditure will be borne by the Planning Commission.

Shri Sudhir Kumar, Senior Research Officer (Engg.), Planning Commission, New Delhi (Room No.334, Yojana Bhavan – Tel : 011 – 23096690 Ex.2332) will act as Nodal Officer for this Working Group and any further Query/ communication in this regard may be made with the Nodal Officer.

(K.K. Chhabra)
Under Secretary to the Govt. of India

To

Chairman and all the Members (including Member Secretary) of the Working Group.

Copy to

1. PSs to DCH/MOS (Planning)/Members/Member-Secretary, Planning Commission
2. All Principal Advisers/Advisers/HODs in Planning Commission
3. Prime Minister's Office, South Block, New Delhi
4. Cabinet Secretariat, Rashtrapati Bhavan, New Delhi
5. Information Officer, Planning Commission
6. Joint Secretary (Administration), Ministry of Steel
7. Controller of Accounts, Ministry of Steel

(K.K. Chhabra)
Under Secretary to the Govt. of India

Annexure – 2

The Planning Commission, Government of India vide its order No. I&M-3(30)/2006 dated 22nd May, 2006 appointed a Working Group under the Chairmanship of Secretary, Ministry of Steel to draw a road map for Iron & Steel industry in India for the 11th Five Year Plan (2007-2012). The Working Group in its 1st meeting held on 9th June, 2006 decided to constitute two subgroups for preparation of the report.

Composition of the Sub-Group-II

2.1 The Member Secretary, Working Group vide Order No. BGT-1(1)/2006 dated 16th June, 2006 constituted the Subgroup – II on Technological Issues under the Chairmanship of Shri G. Elias, Joint Secretary, Ministry of Steel and the composition of Sub-group was as follows:

i)	Shri G. Elias, Joint Secretary, Ministry of Steel	.. Chairman
ii)	Shri S.S. Saha, Industrial Adviser, Ministry of Steel	Convenor
iii)	Shri K.K. Khanna, Director (Technical), SAIL	Member
iv)	Shri B.D. Jethra, Former Adviser (I&M), Planning Commission	Member
v)	CMD, MECON Limited	Member
vi)	Shri S.K. Saluja, Manager (Technical), ERU	Member
vii)	Shri B.D. Ghosh, JIA, Ministry of Steel	Member
viii)	Shri Sudhir Kumar, Sr. Research Officer (Engg.), Planning Commission.	Member
ix)	Shri Arun Kumar Singh, Secretary (Industries), Govt. of Jharkhand,	Member
x)	Shri Hem Pande, Adviser (Industry), Govt. of West Bengal	Member
xi)	Shri N.C. Mathur, Chairman, SFAI,	Member

xii) Shri R.P. Varshney, ED, AIIFI, Member

xiii) Shri Suketu Shah, Chairman, ASPA Member

xiv) Shri A. Prasad, Chief Regulatory Affairs, Tata Steel Member

xv) Representative of M.N. Dastur & Company Member

xvi) Shri V. Ramachandran, Vice President, Essar Steel Ltd, Member

xvii) Representative of Jindal Steels & Power Limited Member

xviii) Representative of JSW Steel Limited Member

xix) Representative of Bhushan Steel & Strips Ltd Member

2.2 The Chairman of the Sub-group felt that views of the suggestions of some eminent technologists / organizations may be important for meaningful deliberation and decision and accordingly the following persons / organizations are co-opted as members of the sub-group :

i) Dr. S.K. Gupta, Consultant. Member

ii) Dr. Sanak Mishra, Chief Executive Officer, Mittal Steel (Jharkhand), Member

iii) Shri V.K. Mittal, Managing Director, Ispat Industries Ltd, Member

iv) Mr. S.M. Doh, Chief Representative, POSCO, Member
(Representative of POSCO did not participate in any deliberation.)

3.0 Terms of Reference

3.1 The terms of reference for the Sub-group is as follows :

I. To asses the relevance of new and emerging technologies for iron & steel production in the Indian context and make recommendations for introduction of promising technologies both in Public and Private sectors.

II. To review the status of the present technologists as well as emerging technologies, R&D work carried out by the steel industry and assess the present and future level of expenditure to improve the competitiveness of Indian Iron & Steel industry.

III. To review the status of environment protection, pollution control & safety measures and suggests measures for improvement.

3.2 The sub-group was to submit its report by 10th July, 2006.

Annexure - 3

Annual Growth in Production & Consumption of Non-Alloy Finished Steel

	Production (Million Tonnes)	Rate of Growth over Prev. Year (%age over prev yr)	Consumption (Million Tonnes)	Rate of Growth over Prev. year (%age over prev year)
1991-92	14.331		14.836	
1992-93	15.204	6.09	15.003	1.13
1993-94	15.199	-0.03	15.323	2.13
1994-95	17.821	17.25	18.661	21.78
1995-96	21.403	20.10	21.299	14.14
1996-97	22.72	6.15	22.128	3.89
1997-98	23.372	2.87	22.634	2.29
1998-99	23.824	1.93	23.546	4.03
1999-00	27.173	14.06	25.092	6.57
2000-01	29.267	7.71	26.526	5.71
2001-02	30.635	4.67	27.438	3.44
2002-03	33.671	9.91	28.897	5.32
2003-04	36.957	9.76	31.169	7.86
2004-05	40.055	8.38	34.389	10.33
2005-06	42.737	6.70	39.190	13.96

Annexure - 4

Changes in Customs Duty on Steel Items

(Percentage)

	1993-94	1996-97	1999-00	2002-03	2003-04	Jan '04	Feb '04	2004-05 (8.7.04)	20.8.04	2005-06	2006-07
Structurals / Wire Rods	85	30	35	30	25	20	15	10	5	5	5
Plates / HR Sheets	75	30	35	30	25	20	15	10	5	5	5
CR Coil	75	30	35	25	25	20	15	10	5	5	5
CR Sheet	75	30	35	25	25	20	15	10	5	5	5
HR Coils	50	25	25	25	25	20	15	10	5	5	5
GP/GC	85	30	35	30	25	20	15	10	5	5	5
Semis	30	20	25	25	25	20	15	10	5	5	5
Pig Iron	20	20	15	15	15	15	5	5	5	5	5

Annexure : 5

Relative movements of steel prices - Imported vs Domestic

(June 2003=100)

Period	HR COIL imported	HR COIL domestic	Wire Rod imported	Wire Rod domestic
June,03	100.00	100.00	100.00	100.00
July,03	98.15	104.00	100.00	104.97
Aug,03	105.56	119.00	100.00	120.42
Sept,03	105.56	105.00	100.00	109.95
Oct,03	105.56	105.00	100.00	112.57
Nov,03	107.41	111.00	100.00	115.18
Dec,03	109.26	118.50	100.00	125.65
Jan,04	122.22	130.00	100.00	131.94
Feb,04	155.56	150.00	154.84	139.79
Mar,04	177.78	150.00	177.42	139.79
Aprl,04	177.78	149.00	161.29	145.03
May,04	207.41	150.00	148.39	149.21
June,04	207.41	137.50	141.94	130.89
July,04	207.41	154.00	141.94	159.69
Aug,04	214.81	150.00	141.94	148.69
Sept,04	214.81	149.00	161.29	127.75
Oct,04	214.81	154.00	177.42	146.60
Nov,04	214.81	156.00	170.97	138.74
Dec,04	214.81	154.00	154.84	133.51
Jan,05	211.11	165.00	154.84	145.55
Feb,05	211.11	167.50	151.61	141.36
Mar,05	211.11	177.00	148.39	147.91
Aprl,05	192.59	185.00	141.94	151.83
May,05	192.59	170.00	135.48	130.89
June,05	166.67	160.00	135.48	125.65
July,05	144.44	141.00	135.48	124.08
Aug,05	138.89	140.50	135.48	133.51
Sept,05	133.33	133.50	135.48	139.27
Oct,05	133.33	131.50	135.48	125.65
Nov,05	133.33	130.00	135.48	125.65
Dec,05	133.33	125.00	135.48	122.51
Jan,06	133.33	130.00	138.71	129.84
Feb,06	133.33	127.50	135.48	133.51
Mar,06	159.26	138.00	158.06	138.74
Aprl,06	159.26	155.00	158.06	147.12
May,06	159.26	156.00	158.06	141.88
June,06	159.26	158.00	161.29	133.51
July,06	177.78	167.50	158.06	141.36
Aug,06	177.78	164.00	158.06	137.70

Raw Materials for Ferro Alloy Industry

Manganese

Manganese in alloy forms is an essential input in steel making. It improves strength, toughness, hardness and workability of steel. Manganese is introduced in steel generally in the form of iron-manganese alloys, ferro manganese and silico manganese. There is no satisfactory substitute for it in the making of steel in which it is present in percentage varying from 0.5 to 0.95 i.e. 5.5 kg to 6.5 kg in every tonne of steel made.

On an average 70% of manganese ore is consumed by the Ferro Alloy industry and 26% of manganese ore is used directly by the Iron & Steel industry. The direct use of manganese ore in Iron & Steel industry is on a declining trend whereas its use in ferro alloy industry is increasing. In the ferro alloy industry, on an average 86% of ferro manganese and 95% of silico manganese produced is consumed by the Iron & Steel industry.

Manganese Ore

The world reserve base of manganese ore is as below:

(Unit in '000 Tonnes)

Country	Reserve Base
World	50,00,000
Australia	82,000
Brazil	51,000
China	1,00,000
Gabon	1,60,000
India	33,000
Mexico	9,000
South Africa	40,00,000
Ukrain	5,20,000
Other Countries	Small

Source: IBM (Indian Mineral Year Book, 2005)

Indian Reserves: As per Indian Mineral Year Book, 2005, the total resources of manganese ore are placed at 295 million Tonnes. Out of these, 104 million Tonnes are categorized as reserves and the balance 191 million Tonnes in the remaining resource category. Out of total reserves at 104 million Tonnes, about 49 million Tonnes are proved reserves and the remaining 55 million Tonnes are under probable category.

The major reserves in the country are of blast furnace grade. The reserves of ferro manganese grade are very limited to about 9.2% of the total reserves.

All India Reserves/Resources of managanese ore as on 1.4.2000 is as below:

(In ‘000 Tonnes)

			Total
Reserves	Proved STD 111	48791	104541
	Probable STD 121	7057	
	STD 122	48693	
Remaining resources	Pre feasibility STD 221 SRD 222	 3201 12707	
	Measured STD 331	639	190523
	Indicated STD 332	3455	
	Inferred STD 333	168298	
	Reconnaissance STD 334	2224	
		Total Resources	295063

Source: IBM (Indian Mineral year Book 2005)

Production and Despatches:

Production of manganese ore during 2005-2006 is estimated at 2.28 million Tonnes as compared to 2.38 million Tonnes of the previous year. Orissa, maharashtra, Madhya Pradesh and Karnataka are the principal producing states together accounting for 95% of the total production of manganese ore during the period of 2005-2006.

Details of production and dispatches of manganese ore from the year 2002-03 to 2005-2006 are given below:

(Quantity in million Tonnes)

Year/Period	Production		Despatches		
	Quantity	Value (Rs. Crores)	Total	For Internal Consumption	For Exports
2002-2003	1.66	239.10	1.58	1.46	0.12
2003-2004	1.78	279.31	1.71	1.53	0.18
2004-2005 (P)	2.38	374.84	1.98	1.80	0.18
2005-2006 (E)	2.28	520.06	1.75	1.60	0.15

= Provisional

(E) = Estimated

Source: Indian Bureau of Mines, Nagpur.

Chromium

Chromite is the only commercial source of Chromium. The main use of chromite is in metallurgical industry especially in the manufacturing of ferro chrome, silico chrome and charge chrome which in turn, are used as addictives in making stainless stel and special alloy steel. Ferro alloys are the essential ingredients for the production of high quality special alloy steel as well as mild steel. Another measure use of chromite is in production of refractory bricks due to its high melting point, moderate thermal expansion and resistance to acids and alkalis. It is used in the form of chrome magnesite bricks or in the open hearth electric furnace, cement kilns, glass furnaces and processing industries for non ferrous metals and foundries. Chrome is also used in leather processing and chemical industries.

On an average, 92% of Chrome ore is consumed by the ferro alloy industry and 90% of ferro chrome is consumed by the steel industry.

Chrome Ore

World Reserve Base (in ‘000 Tonnes)

Country	Reserve Base
World	1,800,000
US	7,000
India	57,000
Kazakhstan	470,000
South Africa	200,000
Other Countries	1,100,000

Source: IBM (Indian Mineral Year Book, 2005)

Indian Reserves: As per UNFC system, total resources of chromite in the country as on 1.4.2000 are 179 million Tonnes, comprising 47 million Tonnes reserves (26%) and 132 million Tonnes remaining resources 74%). More than 97% reserves / resources of chromite are located in Orissa, mostly in the Sukinda valley in Cuttack and Jajpur districts. Minor deposits are scattered over Jharkhand, Maharashtra, Tamil Nadu, Andhra Pradesh and Manipur.

All India Reserves / Resources of Managanese Ore as on 1.4.2000

In '000 Tonnes

			Total
Reserves	Proved STD 111	28752	46663
	Probable STD 121	151	
	STD 122	17759	
Remaining resources	Pre feasibility STD 221 SRD 222	 3072 4968	
	Measured STD 331	1966	132057
	Indicated STD 332	32065	
	Inferred	47110	
	Reconnaissance STD 334	42876	
		Total Resources	178720

Source: IBM (Indian Mineral Year Book, 2005)

Production and Despatches:

Production of chrome ore in 2005-2006 is estimated at 3.546 million Tonnes as against 3.640 million Tonnes in 2004-2005. Orissa continues to be the major producing state accounting for 3.510 million Tonnes (99%) during 2005-06.

Production and dispatches of Chrome ore from the year 2002-03 to 2005-2006 are given below:

(Quantity in million Tonnes)

Year/Period	Production		Despatches		
	Quantity	Value (Rs. Crores)	Total	For Internal Consumption	For Exports
2002-2003	3.06	467.25	2.27	1.083	1.192
2003-2004	2.90	432.12	2.92	1.821	1.101
2004-2005 (P)	3.64	676.25	2.99	1.900	1.099
2005-2006 (E)	3.54	1060.99	2.73	1.601	1.131

= Provisional

(E) = Estimated

Annexure –7

PERFORMANCE STATUS OF INDIAN IRON & STEEL PLANT VIS-À-VIS THE INTERNATIONAL PLANTS

A. Integrated Steel Plants

Parameter	Indian	International
Sinter Plant ($t/m^2/hr$)	1.2-1.5	>1.8
Blast Furnace ($t/m^3/day$)	1.3 -2.2	2.5-3.5
Coke Rate(Kg/THM)	450- 610+	350-400
Steel Making (blows/year/working convertor)	4000-4500	6000-10,000+
BOF Lining Life (No. of Heats)	2000-10000 +	5000-10000 +
Continuous Casting (metres /minute)	1.0-1.9 (Slab) 3.0-3.5 (Billet) 0.5-0.9 (Bloom)	1.4-2.5 (Slab) 3.0-4.7 (Billet) 0.5-1.0 (Bloom)
Rolling Mills		
i) Hot Strip Mill		
Mill utilization (%)	70-78	85-90
Yield from Slab(%)	96.3-97.6	98.5
ii) Cold Rolling Mill		
Mill utilization (%)	56-64	90
Yield (%)	92.7-94.3	95+
Specific Energy consumption (Gcal/tcs)	6.45-8.5+	4.5-5.5
CO^2 Emissions (Kg/tcs)	2600-3300	1200-1800
Steel Cleanliness (S,P,O,N) (ppm)	S: 10-100 ppm P: 50-200 ppm O: 10-50 ppm N: 30-60 ppm	S: 5-150 ppm P:10-150 ppm O: 5-40 ppm N: 10-40 ppm

B. Electric Arc Furnace Units

Parameter	Indian	International
Furnaces size, tonne	20-50/200	100-250
Specific transformer capacity, MVA/t	0.3-0.8	0.8-1.2
Oxygen consumption, NM^3/t	5-40	30-45
Tap to tap time, minutes	90-240	60-90
Specific productivity, t/hour/ MVA	0.5-0.7	0.8-1.1
Power consumption, KWh/t	300-700	150-350
Electrode consumption, Kg/t	2.5-6	1-2.5
CO^2 Emissions (kg/tcs)	600-900	105-350

C. Direct Reduced Iron/ Sponge Iron Plants

Parameter	Indian	International
COAL BASED		
Module Size, Mt/ year	0.015-0.15	0.15
Net Coal Consumption, t/t DRI (~25% Ash)	0.75-1.1	0.75-0.85
S, P in DRI,%	S: 0.02 P: 0.07-0.08	S: 0.01-0.02 P: 0.06
Ore type	Lump	Lump & Pellets
Usage in EAF, %	20-80	50-100
C_{FIX} / FC_T ratio	0.45-0.50	0.45-0.50
GAS BASED		
Module Size, Mt/ year	0.75-1.2	0.75-1.2
Nat. gas consumption, Nm^3/t	295-315	275-300
Ore type	Lump (60%) + Pellets(40%)	Lump (30%) Pellets (70%)
Fe, in ore, %	65%	~ 65%
Metallization, %S	90-92 S: 0.01-0.03%	90-92 S: 0.005-0.01%

Annexure-8

LIST OF PROMISING TECHNOLOGIES IN IRON & STEEL

Sl.No.	Name of Technology	Reasons for adoption
A.	**Iron-ore area**	
1.	Installations of high efficiency crushers	Decreases size fluctuation of iron ore lump, lowers energy consumption in sizing operation
2.	Fine ore beneficiation using magnetic separation	Beneficiation of slime: mineral conservation and ecological preservation.
3.	Floatex density separator	Beneficiation of fines/ slime fluctuation in feed rate and grain size: do not affect quality of output, applicable in coal washing also.
4.	Lamella thickeners and clarifiers	Beneficiation of fines including slimes, lowers capital and space requirement easy maintenance.
B.	**Technologies in Coke Oven and By-Products area**	
1	Stamp charging	Substitutes prime coking coal: improve coke quality and BF productivity: lower pollution.
2	High capacity coke oven	Lowers number of units and manpower : better coke quality: lowers pollution.
3	Improved design and construction features of coke oven machine and other equipment	Better performance: less manpower and improved pollution control.
4	Computerised heating control and automation.	Accurate positioning of oven machines increased battery life, improved coke quality, lowers requirement of pollution control measures, etc.
5	Improved coke quenching system.	Better efficiency: lowers water consumption: long life of warf and coke conveyors, etc.
6	Coke dry cooling	Better coke quality: lowers environmental pollution: possibility of power generation and heat recovery.
7	Pollution control technologies in coke ovens.	Improves emission control: coke quality and efficiency of coke ovens.
8	Regeneration of acid from acid sludge.	Eliminates disposal problems of hazardous acid sludge: regenerated acid can be used in ammonium sulphate plant.
9	Laser based spotting / positioning system for coke oven service machines.	Increases productivity due to rapid and accurate alignment of servicing machine
10	Desulphurization of coke oven gas.	Yield sulphur of extremely good quality.
C	**Sintering**	
1	Processes to use super-fines in sinter-mix like (HPS) process, vibration granulation equipment, high agitating mixture, etc.	Decreases AL_2 O_3 content, fuel rate; improves granulometry; improves productivity of machine.
2	Extension of grate width	Increases productivity / production.
3	Waste heat recovery from sinter cooler	Energy recovery; reduces cost of production.
4	Pollution control measures, like, EOS, AIRFINE, Sulfex process, etc	Lowers pollution level; reduces fuel consumption, etc.
5	Use of Mg silicate in sinter-mix	Decreases alkali loading in BF; improves sinter reducibility.
6	Improvement in sinter feeding system	Increases bed permeability; yield and productivity.
7	High pressure sintering process	Can use high amount of super fines: improves sinter quality : improves productivity, etc.

8	Increase in bed height and suction in sinter machine	Improvement in productivity and sinter quality.
D	**Blast Furnace area**	
1	Coal dust injection with oxygen enrichment	Replaces BF coke: by non coking coal : decreases production cost.
2	Use of silicon carbide refractories in blast furnace.	Improves furnace lining life leading to higher furnace availability.
3	Copper stave cooling system	Improves furnace cooling efficiency , increases service life.
4	Improvement in operation and control system by incorporating cast house expert system, laser radar system, on-line detection of tuyer leakage, etc.	Stabilises the furnace operation leading to improved operating efficiency.
5	Dry slag granulation system	Lowers environmental pollution : reduces water consumption etc.
6	Post treatment of hot metal	Improves steelmaking efficiency: yield etc.
7	Coke-ore mixed layer charging	Lowers consumption of sized BF coke : improves productivity
8	Remotely operated gunning system	Reduces the capital repair time.
E.	**Direct Reduction area**	
1	APEX iron carbide process	Substitute process for production of iron carbide: flexibility in choice of fuel: lowers specific energy consumption: reduces operating cost as separate natural gas reformer is not required.
2	Transportation of hot sponge iron (Hytemp process)	Facilitates hot DRI/HBI transportation and charging in EAF: reduces electricity consumption in EAF steelmaking.
3	Production of iron carbide	Suitable in regions where natural gas is abundantly available: an alternative iron bearing material which substitutes use of imported scrap.
4	FIOR process and FINMET process	Uses low cost iron ore fines to produce premium iron product stable DR briquettes which can be stored and transported as a merchant product.
F.	**Basic oxygen furnace area**	
1	Monitoring of BOF lining wear	Helps ion controlling wear by identifying weak spots: optimizes lining method and application of suitable brick quality and improves refractory yield.
2	Slag splashing in BOF converter	It improves lining life' thereby improves productivity of the furnace and decreases operating cost.
3	System for measuring the end point chemical analysis by drop in sensors	It eliminates waiting period of converter due to quick chemical analysis of liquid steel.
4	Adoption of computerised process control system in BOF operation.	
5		Improves end point corrections, reblowing and coolant additions which in turn improves production efficiency, steel yield and refractory life
6	HI-VAP BOF spray cooling system	This technology has been successfully demonstrated in few select BOF converters abroad; It facilitates successful cooling of the BOF vessel shell and trunion thereby increases campaign life.
7	Use of BOF slag for ironmaking	Utilizes waste material for reuse in ironmaking, reduces slag disposal problems.
8	Adoption of new suspension system for BOF vessels.	This new and improved type of suspension system could be adopted in future plants based on economics.
9	Recycling of converter dust	The pilot plant study made needs to be kept under

	/ sludge	watch for future applications.
G.	**Electric Arc Furnace area**	
1	Twin vessel mono-power system	Increases productivity due to reduced power off time.
2	Scrap preheating systems	Preheating of scrap lowers the requirement of electric power reduces melting time; reduces dust generation etc.
3	Hot metal usage in EAF	Reduces power and electrode consumption ; lowers tap to tap time, reduces dependency on scrap etc.
4	Post combustion in EAF	Lowers overall electrical energy consumption, decreases heat load in the off gas system, etc.
5	Adoption of DC arc furnace	Lowers electrode consumption, requires lower grid strength, etc.
6	Cooling system for electrodes and furnace roof	Lowers electrode consumption in EAF, maximizes shell life and minimizes down time for repair.
7	Recycling of EAF dust	Re-utilizes hazardous waste; lowers power consumption and dependency on steel scrap; improves steel yield, etc
H	**Secondary refining area**	
1	RH/RH-OB process	It is a fast refining process, capable of processing large number of heats / day ; produces ultra low carbon and very low hydrogen steels; suitable for large capacity integrated steel plants.
2.	CAS-OB process	Process is simple in design and operation; suitable for medium to large capacity plants; facilitates production of special steel grades at shorter treatment times.
3.	MRP converter process	Utilizes low grade charge material; consumes less energy; low operating cost; suitable for mini steel plant / foundries for producing variety of steel grades.
4.	AOD converter process	Most prevalent stainless steelmaking process; suitable for mass production of stainless steel; can be retrofitted in existing mini steels.
I.	**Continuous Casting area**	
1	Tundish lining using remotely operated industrial robot system	It is a modern cost efficient, low labour intensive, pollution free system; remotely operated tundish lining has been proven on an industrial scale with low maintenance requirement.
2	Use of Electro Magnetic Stirring on solidification of strand	Improves internal quality of cast billets; can be retrofitted in existing billet casters.
3.	Tundish metallurgy	Improves steel quality and lowers strand breakouts.
4.	Level-II Automation	Facilitates scheduling of casting process: display data histograms: improves maintenance of equipment and quality of product.
5.	Automation and process control	Facilitates smooth and trouble free operation of CC machine.
6.	Hot/direct charging of strands in rolling mill	Conserves energy and improves mill productivity.
7.	Thin slab casting, beam blank and HCC technology.	Energy efficient processes: lower capital and production costs: improves productivity.
8.	Moulds for high speed casting	Improves casting speed thereby cater productivity.
9.	Application of Electro Magnetic Brake Ring (EMBR) in moulds	Reduces turbulence and vortex formation at the meniscus level: facilitates floatation of inclusions to the mould slag level: reduces mould powder entrapment.
10.	Thin strip casting	Demonstrated successfully by various process of commercialization: an economical route for production of flat rolled products.
J	**Rolling mill (Flat) area**	
1	Automatic width control	AWC system controls the steel width and hence

	(AWC) in hot strip mill	improves the yield from mill.
2	Hydrochloric acid regeneration plant with spray roaster process	Allows complete recovery of HCI acid for reuse in pickling: pollution due to acid fumes is reduced.
3	On-line accelerated controlled cooling of plates	Allows leaner chemistry to attain the same strength level and improves weldability.
4	Zinc alloy electro-plating	Lighter coating weight, better weldability and paintability.
5	Thermo-mechanical controlled processing	Leaner chemistry due to micro-alloying: adequate strength and good weldability achievable.
6	CVC control in finishing mills of HSM	Good strip flatness and surface quality.
7	Profile and automatic shape control of CR strips	Ensures good strip flatness and surface quality.
8	Continuous annealing line for sheet gauge material	Reduces processing time and produces cleaner, flatter surface.
9	Automatic surface inspection of strip on delivery side of mill and other processing and finishing lines.	A quality assurance measure which detects, classifies and provides information for eliminating defects.
10	Recrystallisation controlled rolling.	Can be adopted in existing plate mills having low roll separating force for producing stronger plates.
11	Hydraulic automatic gauge control in plate mill	Improves gauge tolerance and reduces gauge rejections, thereby, improving the yield.
12	On-line ultrasonic testing of plates	A quality assurance scheme which can test plates at a speed matching that of the line: has low setting up time when plate size is changed.
13	Bite and back rolling method for slabbing mill yield improvement	Improves slab yield by 3.5 to 4%.
14	High convective 100% hydrogen batch annealing	Lowers energy consumption, uniform cooling rates are achieved.
15	Laser based line projection system for shear blade alignment	Increases production rate, avoids accidents.
K	**Rolling mill (Non-Flat) area**	
1	Use of 3 roll block stand as intermediate finishing blocks in wire rod mills.	Allows free size rolling without changing of passes or stands.
2	In-line heat treatment of wire rods	Low installation cost: low production cost: short delivery time: no further off line heat treatment.
3	Temperature controlled rolling of round bars and wire rods	improves mechanical properties saving of subsequent heat treatment processes.
4	Thermo-mechanical treatment , on-line accelerated cooling, Post-finishing Block & FRS (Flexible Reducing & Sizing)	These enable to roll all finished rod sizes from a common family of feed sizes produced by intermediate mill leading to improvement of quality, reduction in cost etc.
5	High speed discharge of bars and rods in straight length	Small diameter plain rounds and bars can be discharged to cooling bed at a much faster rate without loss of production.
6	On-line gauge control of long products	Non contact gauging system can measure and display major dimension of section: measurements are unaffected by bar twist.
7	Use of carbide rolls for bar and rod mill	Improves quality and tolerance of rolled products; improves mill utilisation and availability.
8	Predictive maintenance for No-twist block in wire rod mill using vibration monitoring	Reduces cost of repairs and lowers unplanned down time.
9	Energy conservation in rolling mills (hot charging/ direct rolling)	The main advantage is the saving of energy besides reduction of scale loss.

10	On-line gauge control of long products (laser based or camera based)	Permits on-line measurement of products besides improving yield and reducing post operation maintenance.
11	Momentless straightening of rails	Reduces straightening forces and decreases rail cross section distortion.
	In-line heat Hardening of rails	High and uniform hardness and high depth of hardness could be achieved when compared to off-line system.

Annexure - 9

SMELTING REDUCTION (SR) PROCESSES

Sl. No.	Process Name/ Developer(s)/ Promoter	Basic Process Features	Status/ Remarks
1.	COREX (earlier KR Process): Voest Alpine, Austria	Pre-reduction (+90%) of iron ore lumps (8-20mm)/ pellets in a Shaft Furnace using off-gas (part) from the Melter Gasifier. Melting of hot pre-reduced iron in Melter Gasifier using sized coal (non-coking coal, 5-40mm, FC: +50%) and injected oxygen.	Four modules are in operation. Process is extremelty sentive to size/ quality of iron ore and coal. Viability depends on gainful utilization of off-gas and cost of power/ oxygen
2.	ROMELT (earlier FLPR-Ferrous Liquid Phase Reduction): Moscow State Institute of Steel and Alloys (MISA) and Novolipetsk Steel Works, Russia	A single stage process with high degree of post-combustion . Iron Ore (any type e.g. lumps/ pellets/ fines etc.) and lumpy/ fine coal (low ash and low VM) are reacted in a Rectangular horizontal smelting reactor where oxygen and air are blown through two rows of side lances/ tuyers.	A 0.3 LTPA pilot plant worked in Russia. No commercial plant till date. Simpler equipment design, less captive intensive, less restriction in size/ quality of ore and coal. But high consumption of oxygen/ power.
3.	HISMELT Corporation Pty. Ltd. (A Member of the Rio-Tinto Group), Australia	A two stage process with high degree of post-combustion. Pre-reduction of ore fines upto FeO stage in circulating fluidized bed using off-gas from Smelter Reduction Vessel (SRV) . Smelting in SRV with bottom injected coal and natural gas where pre-heated air used for coal gasification.	0.8MTPA demonstration plant commissioned in Australia. Iron Ore and Coal Fines can be used, though use of slimes is yet to be established. Off-gas has significant thermal and chemical energy and its effective utilization is must for viability. Also an oxygen intensive process.
4.	FINEX: Voest Alpine and Research Institute of Industrial Science and Technology, Korea Posco, Korea	Two stage production process. Pre-reduction in series of fluidized bed reactors followed by compacting into briquettes; coal fines also used as briquettes. Smelting of hot pre-reduced briquettes in Smelter-Gasifier using oxygen and coal briquettes.	Based on success of 2000 TPD demonstration plant, a 1.5 MTPA commercial plant is under construction and is scheduled to be begin full scale operation by end of 2006.
5.	FASTMELT: Midrex, USA and	Two stage smelting - Pre-reduction i.e. DRI	Two commercial FASTMET plants set up

	Kobe Steel, Japan	production in RHF (FASTMET) using coal, coke breeze and carbon bearing waste and melting in Electric Iron Furnace (EIF) to produce hot metal directly from Hot DRI.	in Japan to produce DRI, one producing hot metal using EIF. Poor energy efficiency and viability for large scale hot metal production yet to be established.
6.	AUSMELT (AUSIRON): Limited, Australia.	Single stage process working under negative pressure using Oxygen and coal fines blown through top lance(s) into a liquid metal bath in a converter type furnace.	A 0.5 LTPA demonstration plant set up in Australia. No commercial plant. High ash low CV coal and iron ore fines including various iron bearing material may be used. Flexibility operation, can be quickly stopped and quickly re-established.
7.	COMBISMELT: LURGI, Germany and Mannesmann Demag, Germany	Pre-reduction in rotary kiln using coal	Smelting and final reduction in EAF.
8.	AISI Process: American Iron and Steel Institute and HYL, Mexico.	Pre-reduction in shaft furnace using smelter off-gas upto FeO Stage. Molten iron bath reactor using coal and oxygen with post-combustion and provision for direct steelmaking.	Can use lump ore or pellets and low ash coal. An oxygen intensive process. Only a 8 TPH pilot plant set up in USA.
9..	ITmk3: Kobe Steel, Japan and Midrex, USA	A three stage process i.e. a pr-heater, a fluid bed pre-heater, a fluid bed pre-reduction furnace and a reduction furnace. Fine ore pre-heated at 600 DC in pre-heater, reduced to 27% at 780 DC in pre- reduction furnace and melted in reduction furnace.	Fine/ powder ore and coal can be used. Operation flexibility with provision for stopping and restarting operations easily. Established only in pilot plant stage and break through to depend on actual commercial success.
10.	TECNORED: CAEMI, Brazil	Coal, ore, green pellets and briquettes reduced in a specially designed low shaft furnace. Melting in shaft furnace	Strictly speaking, not a DR or SR process but a combination of pelletisation and modified BF. Can use ore fines/ lumps and coal fines, no oxygen required. No commercial plant established.
11.	PLASMA-SMELT: SKF Steel, Sweden	Pre-reduction in fluidized bed in two stages using gas from plasma furnace. Smelting in plasma furnace.	No commercial plant

Annexure 10

Projection of Category Wise demand for Finished Steel for 2007-08 and 2011-2012 under Different scenarios

(Thousand Tonnes)

Scenario 1: 7% Growth in GDP			Scenario 2: 8% Growth in GDP		
Products	**2007-08**	**2011-2012**	**Products**	**2007-08**	**2011-2012**
Bars and Rods	15889	21180	Bars and Rods	16002	21640
Structurals	3844	4619	Structurals	3860	4684
Railway Material	1850	2120	Railway Material	1855	2150
TOTAL NON-FLAT	**21583**	**27919**	**TOTAL NON-FLAT**	**21717**	**28474**
Plates	3963	4697	Plates	3974	4749
Hot Rolled Coils/Sheets/Skelp	14204	21187	Hot Rolled Coils/Sheets/Skelp	14427	22004
Cold Rolled Coils/Sheets	4744	5864	Cold Rolled Coils/Sheets	4771	5051
Galvanized Coils/Sheets	2620	4010	Galvanized Coils/Sheets	2650	5245
Electrical Steel Sheet	380	380	Electrical Steel Sheet	380	390
Tinplates/Tin Free Steel	280	300	Tinplates/Tin Free Steel	280	300
Pipes	1400	2130	Pipes	1406	1320
TOTAL FLAT	**27591**	**38568**	**TOTAL FLAT**	**27888**	**39059**
TOTAL FINISHED STEEL	**49174**	**66487**	**TOTAL FINISHED STEEL**	**49605**	**67533**

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Annexure 10 …..contd.

Projection of Category Wise demand for Finished Steel for 2007-08 and 2011-2012 under Different scenarios

(Thousand Tonnes)

Scenario 3: 8.5% Growth in GDP			**Scenario 4: 9% Growth in GDP**		
Products	**2007-08**	**2011-2012**	**Products**	**2007-08**	**2011-2012**
Bars and Rods	16052	21847	Bars and Rods	16114	22107
Structurals	3868	4714	Structurals	3900	4750
Railway Material	1866	2160	Railway Material	1870	2180
TOTAL NON-FLAT	**21786**	**28721**	**TOTAL NON-FLAT**	**21884**	**29037**
Plates	3978	4767	Plates	4000	4802
Hot Rolled Coils/Sheets/Skelp	14538	22384	Hot Rolled Coils/Sheets/Skelp	14676	22823
Cold Rolled Coils/Sheets	4779	6004	Cold Rolled Coils/Sheets	4800	6085
Galvanized Coils/Sheets	2700	4040	Galvanized Coils/Sheets	2750	4500
Electrical Steel Sheet	380	400	Electrical Steel Sheet	400	460
Tinplates/Tin Free Steel	280	300	Tinplates/Tin Free Steel	280	300
Pipes	1424	2292	Pipes	1500	2340
TOTAL FLAT	**28079**	**40187**	**TOTAL FLAT**	**28406**	**41310**
TOTAL FINISHED STEEL	**49865**	**68908**	**TOTAL FINISHED STEEL**	**50290**	**70347**

ANNEXURE -11

Statement of Outlays and Outcomes/Targets of Major ongoing/sanctioned Schemes (estimated/sanctioned cost>Rs.50 crore) in Outcome Budget 2006-07 of Ministry of Steel

(Rs. in crore)

No	Name of PSUs and Schemes	Objective/ Outcome	Estimated/ sanctioned cost	Outlay 2006-07	Quantifiable Deliverables/ Physical Outputs	Projected Outcomes	Processes/ Timelines	Remarks/ Risk Factors
1	2	3	4	5	6	7	8	9
A.	**Steel Authority of India Limited**							
	Bhilai Steel Plant							
1	Revamping of B-Strand of Wire Rod Mill	To facilitate production of Wire Rods of TMT grade and smaller section with improved quality	74.66	25.00	Facilitate production Wire Rods of TMT grade and smaller section in 5.5 to 7.0 mm.	Wire Rods of TMT grade and smaller section in 5.5 to 7.00 mm	Aug'06	-
2	Rebuilding of Coke Oven Battey-5	To improve production and to achieve latest pollution norms of MOEF	219.04	85.00	--	--	Jun'07	-
3	Hydraulic Automatic Gauge Control & Plan View Rolling in Plate Mill	To achieve closer thickness tolerance requirement of customers, less crop cutting & side trimming and improvement in the yield of plates	64.10	25.10	--	--	Aug'06	-
4	Technological Upgradation of BF-7	To increase the useful volume and productivity	170.41	59.00	Useful volume will increase from 2000 m3 to 2214 m3 and productivity from 1.75t/m3/day to 2.0t/m3/day	Useful volume 2214M3 Productivity 2.0t/m3/day	Aug'06	-
5	Installation of new Slab Caster, RH Degasser and Ladle Furnace	To produce value added/special quality of steel to augment capabilities to produce high quality plates and rails conforming to specifications for Indian Railways	520.76	135.00	Additional casting 0.165 mtpa. API X65/X70 grade-3,00,000T	Additional Cast Slab and API X-65/X-70 grade steel	Sept'07	-
6	Hot Metal desulphurization in SMS	To facilitate production of low sulphur steel to meet demand for high quality steel, particularly for application in off-shore, transport and structural sectors	86.23	86.23	Reduction in sulphur level in Hot Metal from 0.1% to 0.01%	De-suphurised hot metal	Aug'07	-
	Durgapur Steel plant							
7	Bloom Caster with associated facilities	To improve the yield & quality of steel and to reduce energy consumption	271.41	110.00	Production of Cast Bloom-0.85 MTPA	Cast bloom	Dec'06	-
8	Coal Dust Injection in BF-3&4	Technical necessity for reduction in coke rate and improvement of the furnace productivity	74.22	74.22	Replacement of coke with pulverized coal on 1:1 basis. Coal injection rate in Blast Furnace at 120 Kg/thm.	Reduced coke rate	Aug'07	-

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	Bokaro Steel Plant							
9	Rebuilding of Coke Oven Battery-5	To improve production and to achieve latest pollution norms of MOEF	198.84	57.10	-	-	Jan'07	-
10	Modification/revamping of Maewest Block System and Housing Machining in Hot Strip Mill	To improve overall quality as well as production of hot strips and to ensure smooth functioning of Hot Strip Mill	91.86	43.36	-	-	Jun'07	-
	Rourkela Steel Plant							
11	Rebuilding of Coke Oven Battery-1	To improve production and to achieve latest pollution norms of MOEF	112.39	49.34	-	-	Sep'06	-
	Alloy Steels Plant							
12	Argon Oxygen Decarburisation (AOD) & Electric Arc Furnace	To facilitate production of various grades of stainless steel	54.16	17.00	Production of 120,000t of stainless steel per year	Additional stainless steel	Jun'06	-
B.	**Rashtriya Ispat Nigam limited**							
13	Coke Oven Battery No. 4 Phase-I	To meet the Coke requirements & gas balance, it is essential to have a replacement battery to maintain hot metal & liquid steel production at current levels even during capital repairs of other three coke oven batteries	303.0	122.16	To produce 0.75 MT of Coke	Increase in BF Coke production increased in recovery of by-products	Dec'06	Delay in supply of mechanical items as per delivery schedules to match with erection requirement
14	Expansion to 6.5 MTPA Hot metal	To increase the plant capacity	8692.00	901.00	Additional production facilities at an estimated cost of Rs. 8692 crore	Increased production enhancing the production of liquid steel to 6.3 MTPA from existing 3.5 MTPA of liquid steel	36/48 months in phases from Nov'05	Government of India approved the proposal on 28.10.05. Price escalation of plant and machinery leading to increase in the capital cost. Time overrun leading to cost overrun. fluctuations in the market prices raw material prices dumping of steel by other countries. Competition from re-rolling mills and domestic players
15	Air Separation Plant	Additional facility to meet shortfall of Argon for combined blowing process. Oxygen produced is used in BF	96.00	60.00	600 ton capacity at an estimated cost of Rs. 95. crore	Increased production of liquid steel in SMS and Hot metal in BF	18 months from approval of Board of Directors	Proposal is under consideration of Board of Directors

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16	Pulverised Coal Injection	Injection system for reduction in consumption of expensive BF coke with less expensive pulverized coal	181.00	100.00	Increased production of hot metal. To reduce cost of production of hot metal	To enhance present capacity of hot metal by 0.5 MT	18 months from approval of Government of India	Proposal submitted to Government of India in Feb'05. Approval is awaited.
17	Acquisition of iron ore Mine & coking coal mines	To achieve self-reliance for raw material	600.00	60.00	RINL/VSP does not have captive sources for cooking coking coal/iron ore and outlay included to acquire mines	Better availability of Iron Ore/Coking Coal and reduction in dependability on out side sources to insulate against fluctuations in prices	For Coal block allotted CMDPI, Ranchi, being appointed as consultants. For overseas, (Coal) agencies/ consultants appointment being processed.	Persuading State Governments for iron ore.
18	BF-1 Cat-I Repair	To increase the life of the furnace	50.00	50.00	Strengthening the furnace structurally and at other levels to sustain high levels of fuel injection and production	Increase in life of furnace	2007-08	-
19	AMR Schemes	To maintain good health of plant	377.59	100.00	To maintain good health of the equipment by carrying out periodical capital repair, maintenance of all major production units	To sustain the current levels of production/productivity in the context of the ageing of the plant	Continuous	-
C.	**Kudremukh Iron Ore Company Ltd.**							
20	Construction of bulk material handling facilities for receipt of iron ore by rail *	Facilities have to be developed for handling of bulk material for receipt of iron ore by rail at Mangalore. This would involve installation of wagon tipplers, underground hoppers, conveyor system, silos, control room etc.	137.00	70.00	--	-	M/s. MECON have been awarded the engineering consultancy on total responsibility basis. Tendering work is in progress.	-
21	Other Mine development	The object is to explore the possibility of setting up of new mines, in view of the restriction imposed by the Hon'ble Supreme Court.	170.00	70.00	--	-	MOU has been entered into with SAIL for formation of Jt. Venture company for mining and related activities to develop and work on Taldih along with Barsua and Kalta.	-

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22	Development of permanent railway siding at M'lore	Presently, iron ore requirement for pellet is being met in house i.e. from Kudremukh through slurry pipe. Consequent to H'ble Supreme Court's decision to stop mining activities in Kudremukh w.e.f. 31.12.05, it has become necessary to procure iron ore from outside. The iron ore proposed to be brought from Bellary-Hospet area will have to be moved by rail. This would entail arrival of larger quantity of railway rakes at Mangalore. To handle these rakes, exclusively for KIOCL pellet plant a permanent railway siding has to be developed	50.00	15.00	Tendering process has been initiated. A temporary railway siding has been proposed during 2005-06 at NMPT. Permanent railway siding is envisaged to reduce the pollution as the number of rakes to be handled in the future will be very high	-	-	-
23	Formation of Jt. Venture with M/s IDCOL	Proposal is to revive M/s. IDCOL, Orissa	50.00	20.00	SBI caps had been appointed for carrying out evaluation. SBI caps have submitted their final business evaluation report together with a draft MOU to be entered into between KIOCL and M/s. IDCOL. Same has been forwarded to M/s. IDCOL.	-	-	-
D.	**National Mineral Developmnet Corporation**							
24	Bailadila Deposit –11B	To increase production of Iron Ore	295.89	10.00	Phase-I capacity of 3MTPA	Phase-I capacity of 3MTPA	Oct'2009	Environmental clearance
25	NMDC Iron & Steel Plant (NISP)	To establish iron & steel plant utilising slimes generated from Bailadila Mines	298.68	2.00	To establish iron and steel plant of 0.30 MT per annum capacity	To establish iron and steel plant of 0.30 MT per annum capacity	Finalisation of global tender Decision on technology by 31.3.2006	-
26	Kumaraswamy Iron Ore Project	To increase of production of Iron Ore	296.03	9.50	Phase-I capacity of 3MTPA	Phase-I capacity of 3MTPA	Dec'2009	Delay in forest clearance
E.	**Hindustan Steelworks Construction Ltd.**							
27	Interest subsidy on term loan taken for VRS	To rationalize manpower through VRS	59.19	59.19 **(Non-Plan)**	To reduce the employees strength to 1200	To make the company more cost effective	By end of 2006-07	-