

RESEARCH & DEVELOPMENT

Empowered Committee on Research & Development

In pursuance of the decision of Government of India, an Empowered Committee has been set up on 24.2.1998 under the Chairmanship of Secretary to the Government of India Ministry of Steel with members from Department of Science & Technology Planning commission Department of Scientific & Industrial Research major products of steel Indian Institute of Technology Kharagpur, National Metallurgical Laboratory, Jamshedpur, Development Commissioner for Iron & Steel Kolkata and others with a view to providing overall direction to the total research effort on iron and steel in the country and approve specific research projects placed before it for funding fully or partially, from Steel Development Fund (SDF).

The terms of reference of the Empowered Committee cover the following aspects:

- Examination of all aspects of Science & Technology in the Iron & Steel Sector.
- Co-ordination of the on-going research programmes in the Iron and Steel sector (both in Public & private sectors) and monitoring their progress.
- Evaluation to decide upon the research proposals placed before it for fully or partly funding from the interest accruals of the Steel Development fund.
- Reviewing the progress of Science & Technology programmes of National importance in the Iron & Steel Industry.
- Advising Ministry of Steel on the policies and programmes which need to be pursued in developing domestic capabilities in scientific and technological research development of design engineering and research in the Iron & Steel processes and products.

Research and Technology Mission

According to the decision of Government of India a Research & Technology (R&T) Mission was to be formed by the Ministry of Steel to act as the secretariat of the Empowered Committee. However as per the subsequent decision of the Committee of Secretaries on downsizing/rightsizing of the Government the R&T Mission as originally proposed was not formed and the work has been entrusted to the Technical Wing Ministry of Steel. The Technical Wing processes the applications in consultation with experts in the field whenever necessary. At the instance of the Empowered Committee an Evaluation Group has been formed comprising of Industrial Adviser Ministry of Steel Adviser, Department of Scientific and Industrial Research and Adviser Technology Information Forecasting and Assessment Council (TIFAC), Department of Science & Technology to assist the Empowered Committee. On the recommendation of the Empowered Committee, Joint Plant Committee (JPS) releases funds and they also keep check on proper utilisation of funds.

Achievements:

Since 1998-99 the Empowered Committee (EC) has met, six times. The EC has approved as on 31.01.2002, 27 research projects from both public and private undertakings research laboratories educational and other promotional institutions. The research areas covered by these projects include mining and beneficiation of ores improvement of

productivity of plants and quality of products development of human resources reduction of costs etc, in Indian iron and steel plants. The total cost of these 27 projects is Rs. 181.53 crore. Out of which the SDF contribution is expected to be Rs.90.76 crore.

The amount released from SDF so far is as follows:

(Rs. In crore)		
Sl no	Year	R&D Projects
1.	1997-98	0.04000
2.	1998-99	1.29810
3.	1999-2000	32.57475
4.	2000-2001	16.75770
5.	2001-2002	8.21693
	Grand Total	58.88748

Status of these 27 projects are as follows:

No. of Projects completed :	3
No. of Projects stopped :	4
No. of Projects in progress :	20
Total	27

Research & Development activities by Iron and Steel producers

Iron and steel producers both in the public and private sector, continued to pursue their research and development activities to deal with their plant specific problems, assimilate and innovate newer technologies, utilise Indian minerals and raw materials in larger proportion reduce pollution conserve energy and reduce cost of production.

Total amount of maney spent in Research and Development by Iron and Steel plants and other related industries during last three years were as follows:-

(Rs. In crore)

		1999-2000	2000-2001	2001-02(upto sept 2001)
(a)	Public Sector			
	Steel Authority of India Ltd	44.46	51.83	25.70
	Rashtriya Ispat Nigam Ltd	2.50	2.50	1.20
	National Mineral Dev. Corpn	5.40	5.64	3.83
	Kudremukh Iron Ore Co. Ltd	2.30	4.20	0.50
	Manganese (Ore) India Ltd	0.77	0.74	0.22
	Sponge Iron India Ltd	0.06	--	--
	Bharat Refractories Ltd	0.81	0.21	--
	Sub Total (a)	56.30	65.12	31.45
(b)	Private Sector			
	Tata Iron & Steel Co Ltd	13.65	10.43	--
	Mukand Ltd	0.47	0.44	0.10
	Sunflag Iron & Steel Co. Ltd	0.31	--	--
	Usha Beltron Ltd	0.005	--	--
	Jindal Vijay Nagar Steel Ltd	0.12	3.00	--
	Ispat Industries Ltd	8.00	0.20	--
	Lloyds Steel Industries Ltd	0.15	--	--
	Jindal Steel & Power Ltd	0.38	1.86	--
	Sub Total (b)	23.085	15.93	0.10
	Grand Total (a+b)	79.385	81.05	31.55

STEEL AUTHORITY OF INDIA LTD.(SAIL)

Research & Development Centre of the company has undertaken 93 R&D projects during the current year (i.e.2001-2002) out of which 57 projects are to be completed during the year. These projects provide technological inputs to SAIL plants/units with thrust on cost reduction value addition quality improvement and development of new products. The Centre has filed 4 patents upto September 2001.

Specific Areas in which R&D Activities were Carried Out by the Company :

- Quality Improvement
- Yield/Productivity Improvement
- Energy Conservation
- New Technology/Product Development
- Waste Management/Pollution control

Benefits Derived as a Result of R&D Efforts Quality Improvement

- 2 Cr-1Mo low alloy steel conforming to T22/f22 grade specifications is widely used for various power plant components such as super heaters reheaters and pipelines of turbine etc. This type of steel produced at VISL was characterised for creep stress properties and it was found that this grade can meet the long-term tests of 10,000 and 30,000 hrs. to qualify for the central boiler board requirements for certification.
- Mill set up system for continuous hot mills was developed at RDCIS and tried out at the 6-stand continuous mill, BSL. Suitable speed correction mechanism was evolved to assimilate the shock of the impact when the rolling stock entered the stand. This leads to increase in roll life. For mitigating the inevitable temperature variations across the rolling stock, a temperature compensator was designed to provide feed forward online speed changes for ensuring smooth rolling in all finishing stands.
- Introduction of modified coolant system at TCMI, CRM, BSL, has resulted in reducing temperature difference between centre to edge of the roll from 7-8 to 3-4° c; premature roll spalling by 50%; specific roll consumption by 30% and specific oil consumption by 10%. The above measures have improved strip shape as well as surface quality of strips.
- A number of annealing cycles were designed in an attempt to find the optimum cycle, which results in an attractive combination of mechanical and formability properties of an extra deep drawing quality steel. It was found that the cycle which involved an intermediate anneal at 600° C followed by soaking at 700° C resulted in the best combination of mechanical and formability properties. It was also found that the heating upto 600° C has to be done at a rate of 50° C /hr while the heating from 600° C to 700° C needs to be done at a marginally lower rate.
- The oxygen and nitrogen mapping in LCAK steels has shown a total content of ~ 80 ppm in the final product of SMS II, BSL. To control nitrogen < 50 ppm and total oxygen < 40 ppm various measures were adopted; viz. improved oxygen purity (from 99.0 to 99.4%), restricted slag carry over (from 12 to <8 kg/t) reduction in BOF tap temperature (from 1660 C to 1645°C), installation of on-line argon purging at tapping pit reduction in aluminium consumption from 2.67 to 2.1 kg/t and modified slag chemistry at LF with

enhanced shrouding system at CC. With these measures nitrogen and total oxygen content in final product was restricted to < 42 ppm and < 45 ppm respectively.

- ASP produces ball bearing steel with Ti content less than 30 ppm. However, in as many as in 45% of heats, Ti exceeds this limit. In order to assess the sources of Ti in steel a study was undertaken to investigate Ti during steel making process. Based on the finding of the study suitable measures for controlling Ti have been formulated.

Yield/productivity improvement

- A new width measuring system has been developed and commissioned for roughing stand of plate mill Bhilai Steel plant to ensure measuring tolerance band within ± 10 mm for all sizes of plates. This will improve the yield by 0.5 to 0.8%.
- A contact lens has been designed and installed in extremely difficult site condition for cross trolley mechanism of ore bridge crane nos. 2,4 and 5 at Bhilai Steel Plant. This system has potential to increase the frequency of hoisting/dehoisting resulting in increase in charging rate of blast furnace and sintering plant.

New Technologies/Product development

- Technology of ilmenite sand injection through tuyers of BF no. 7 at Bhilai Steel Plant was successfully tried to check BF hearth erosion.
- One Ti bearing heat with reduced Mn was produced and processed.

Expenditure on R&D during last three years

(Rs. In crore)

Year	SAIL's turnover	R&D expenditure	R&D expenditure % of Turnover
1999-2000	16250	44.46	0.27
2000-2001	16233	51.83	0.32
2001-2002 (Upto Sept)	6977	25.70	0.37

RASHTRIYA ISPAT NIGAM LIMITED (RINL)

The Research and Development efforts of RINL are directed towards trouble shooting process improvement and product development. These are effected by carrying out small but decisive changes or additions in the technologies to derive benefits of enhanced efficiency cost reduction and improved product quality.

Some of the Research & Development activities completed during 2000-2001 and the first half of 2001-02 are brought out below:

- Development of corrosion resistant steel
- Study of effect of operating conditions and brick properties on wear rate of refractory lining in BOF
- BF hearth protection by Ti-bearing material
- Development of bottom ramming mass for converter
- Development of process parameters for the production of 20MnCr5 grade steel and spring steel for applications in the Railways
- Selection of Lance parameters for stabilising of blowing
- Process development for lowering specific consumption of hot metal in converter during shortage of hot metal
- Study of various factors affecting coke rate at BF

Apart from the above certain product development & technology upgradation initiatives were taken during the year. The new products developed were consolidated and further development of new products was undertaken in association with Rolling Mills and Marketing departments. The details of the New products and New sections developed during the year are given below:

New Products Developed

- Corrosion resistant Rebars
- ST 52.3 (DIN 17100) Rounds in Bar Mill
- 16 MnCr5 & 20MnCr5 Billets
- SAE 1541 & IS:2879 Wire Rods
- 40Cr4 Billets for forging
- ASTM 60 M

New Sections produced

- 16,5,20,64,34 & 36 mm Rounds in Bar Mill
- 71,77 & 80 mm Rounds in MMSM

Expenditure on R&D during last 3 years

(Rs. In crore)

Year	Turnover	R&D Expenditure	R&D Expenditure % of Turnover
1999-2000	2974	2.5	0.08
2000-01	3436	2.5	0.07
Apr. to Sept 2001	1802	1.2	0.06

MANGANESE ORE (INDIA) LIMITED (MOIL)

Objectives and thrust area

The R&D efforts in MOIL have mainly been directed in the following areas:

- 1) Beneficiation studies for upgradaton of Dongri Buzurg fines and Balaghat ROM
- ii) Rock mechanics studies at the under ground mines for design of stopping parameters and support systems.
- iii) Experimentation with mechanical handling of ROM in stopes at Balaghat Mine.
- iv) Diamond drilling to locate new manganese bearing areas and to prove further reserves in the existing areas.

Expenditure on R&D during last 3 years

(Rs. In crore)

Year	Turnover	R&D Expenditure	R&D Expenditure % of Turnover
1999-2000	134.11	0.77	0.57
2000-01	165.22	0.74	0.45
2001-02(up to Sept)	72.12	0.22	0.30

MECON Ltd.

1. R&D Achievements

New Processes :

Project entitled "Studies on production of alloyed pig iron and low alloy steel/stainless steel using chromite overburden" is an on going R&D project jointly funded by Ministry of Mines, M/o Science and Technology and MECON. Result obtained till date in pilot scale is extremely encouraging large scale testing is in progress. This is a process developmental project and the estimated cost of the project is Rs 120 lakhs.

Products:

Following products are developed in-house; prototypes made; filed tested and commercialized successfully. They were the first of their kind to be developed in India.

- Laser Line Indicator System. Two systems have been installed at the Plate Mill of Bhilai Steel Plant in 2000.

Following sponsored projects are completed to the full satisfaction of the respective sponsoring authorities.

- Thermoelectric Cooling Garment for Tank Crew. A DRDO sponsored project. Final tests of the prototype were successfully conducted inside MBT Arjun Tank at CVRDE, Avadi, Chennai in October 2000.

A software development project entitled "Development of Expert System for on-line Application for Continuously Cast Products" has successfully been completed in the year 2001. The project was partially funded by Ministry of Steel from Steel Development Fund.

In the category of **special project**, MECON has recently completed a project entitled 'Setting up of Geotechnical Centrifuge Facility at IIT, Bombay,*

*It is a National Facility and first of its kind in India, having capacity of 125-g tonne devoted for geotechnical studies. Many innovative design concepts have been incorporated in the system by MECON. The project is funded by DST, DRDO & MHRD.

EXPENDITURE ON R&D DURING LAST 3 YEARS

(Rs. in crore)

Year	MECON'S Turnover	R&D Expenditure	R&D Expenditure % of Turnover
1999-2000	235.03	0.34	0.14
2000-01	--	0.76	--
2001-02 (UP TO Sept)	--	--	--

NATIONAL MINERAL DEVELOPMENT CORPORATION (NMDC)

Thrust areas

R&D Centre activities are planned to achieve optimum utilisation of mineral resources, development of value added products from mine waste, development of technology in the field of Mineral Beneficiation, Agglomeration of Ore fines. Design of bulk material handling system and pipeline system for transportation of ore slurries. Characterisation, quality evaluation, Mineralogical and Petrography studies of gold bearing rock samples of Madagascar/Tanzania Gold deposits. Besides the centre also takes up assignments sponsored by other agencies in Public and Private sector to utilise its spare capacities and time and to generate funds to meet part of its annual revenue expenditure.

Highlights of R&D activities

A. New technology/process

Bulk production of Fluffy Silica from Kimberlite Waste at pilot plant completed.

B. Utilisation of Mine Waste

1. Production of power ferrite powder from UPFO. Power ferrite sintering trials were conducted at CEL, Delhi and at NMDC, NPD laboratory. It has been found that initial permeability values are on lower side and are having wide variations.
2. Production of Carbon free sponge iron powder and development of value added products thereof.

About 2 tonnes of carbon free sponge iron powder has been produced. One set of full density components has been prepared for application as soft magnetic

materials and magnetic characteristics of these components are being evaluated. Friction material components i.e. break pads have been developed and their friction properties are being evaluated.

C. Income from product sales/consultancy work in R&D areas

(Rs. in crore)

Sl No.	Nature of income	1999-2000	2000-01	2001-02 (up to Sep)
1.	Product sales (Ferrite Powder/ Ferric Oxide)	86.74	20.70	2.5
2.	Consultancy/sponsored assignments	9.42	12.43	7.1

Total value of jobs on hand : Rs 52 lakh.

D. Expenditure on R&D during last 3 years

(Rs. in crore)

Year	Turnover	R&D Expenditure	R&D Expenditure % of Turnover
1999-2000	786.15	5.40	0.69%
2000-01	1015.04	5.64	0.56%
2001-02 (Ending 30 th Sept)*	481.44	3.83	0.80%

* Figures are provisional

KUDREMU KH IRON ORE COMPANY LIMITED (KIOCL)

Thrust areas

R&D activities at KIOCL are directed towards quality improvement through process development/modifications to suit multiproduct needs and to modify Process Flow Chart to cater to the present run of mine ore characteristics.

Achievements

R&D activities undertaken at KIOCL include implementation of new technology/processes like column flotation and high rate thickner for reduction of silica in final product to enable value addition and ensure better quality pellets. By introduction of these techniques the concentrate quality has shown improvement with a higher Fe and reduction in silica in the product.

Expenditure on R&D during last 3 years

(Rs. in crore)

Year	Turnover	R&D Expenditure	R&D Expenditure % of Turnover
1999-2000	620.79	2.30	0.37
2000-01	583.03	4.20	0.73
Apr. to Sept 2001	326.19	0.50	0.15

SPONGE IRON INDIA LIMITED (SIIL)

The main thrust areas in R&D activities include improvement in the existing process for effective operation of the plant and to reduce cost of the product. During the year iron ore from various regions of Andhra Pradesh and Karnataka were tried. This has helped to identify iron ore from Chitradurg region of Karnataka. Regular ore of this ore has yielded good techno-economic advantages. Besides, iron ore fines in sizes 3 to 5 mm which were earlier being treated as wastes could be recycled into the kiln through R&D work.

BHARAT REFRACTORIES LTD. (BRL)

During the year 2001-02, in-house R&D was carried out in respect of the following areas: -

- Resin bounded tap hole clay.
- Carbon paste for Blast Furnace hearth.
- Alumina Magnesia carbon bricks for steel ladles
- Impact pad for tundish
- Improving the quality of MCB using Novolac Resin
- Silicon carbide based fine grained castable for buyers of Blast Furnace.

Most of the above products are developed and commercialised which, in turn, resulted in an upward thrust towards the performance of the Company.

The revenue and capital expenditure on R&D during 2000-01 was Rs.21.08 lakhs and Rs.0.33 lakh respectively.

MAHARASHTRA ELECTROSMELT LTD. (MEL)

Achievements

Trials were conducted to manufacture low carbon ferro manganese by alumino thermic process. The process was developed successfully during the month of September, 2001

TATA IRON & STEEL COMPANY LIMITED (TISCO)

The objectives of TISCO's R&D division are as follows:-

- Creating a world class knowledge-base and enabling the company to become the supplier of the most sought after deliverables.
- Providing effective back-up to the company in utilizing the facilities & raw material resources optimally, for remaining ahead of competition.
- Developing cost-effective and environmental-friendly new products & processes.
- Ensuring satisfaction of R&D's customers by providing quality services.
- Scaling newer height of excellence in innovative research by promoting a learning satisfied and motivated human asset.

Achievements during April-September 2001

Process Development

- A 3-D mathematical model has been made to analyse the flow pattern within SEN. To eliminate the stagnation zone and thereby reduce clogging tendency the SEN bottom is redesigned for trial.
- Blast furnace hot metal dephosphorisation has been assessed for implementation in the plant.
- An optimum TBM tuyeres location for new vessel bottom at LDI has been suggested to the plant based on the water model study carried out at R&D
- Water model study carried out for 1500 mm mould using 00 and 150 downward submerged entry nozzle (SEN) established the superiority of 150.
- Improving the life of RH snorkels by injecting gas from the upleg and downleg was evaluated through modeling injection of gas from the downleg snorkel was not recommended.
- Kinetic equations for recrystallisation and precipitation during Hot Rolling of IF steel have been developed and are integrated with offline simulator which will be useful to simulate the rolling loads in the HSM.
- The annealing parameters have been optimised for production of ULC/LC Si free Electrical Steel which would reduce processing cost at the customers' end.
- Alternative material to Hadfield Mn-steel used in the cone crusher of the jiggling plant has been developed and plant trial is in progress.

Expenditure on R&D during last 2 year:-

(Rs. in crore)

Year	Turnover	R&D Expenditure	R&D Expenditure % of Turnover
1999-2000	6825	13.65	0.20
2000-01	8023	10.43	0.13

ESSAR STEEL LTD.

Specific areas in which R&D activities have been carried out by the company are as follows:-

- Online Super data: Online process monitoring software 'Super Data' developed to monitor the process considering all plant modifications.
- Product fines feeding : System developed to feed the product fines and convert it into briquettes, which has higher sales realisation.
- Modification in the Blower Filter done to save energy.
- Trial was done by decoupling the motor of Bag Filter's centrifugal fan to get the natural draft utilising the pressure of the kiln.
- Necessary interlocking provided to avoid unnecessary running of equipment.
- Design and installation of Supersonic Oxygen Lancing system in all three Electric Arc Furnaces.

MUKUND LTD.

Achievements during 2000-01

- Parameters for desired metallurgical structure in ball bearing grades were identified and controlled for improved quality and performance for customer satisfaction.
- Specific process parameters were determined and modified for achieving enhanced quality and lowering costs in martensitic stainless steels.
- Successfully recertified in August 2001 by National Accreditation Board for Testing and Calibration Laboratories (NABL) New Delhi for additional 3 years.

Expenditure on R&D during last 3 years:

(Rs. in crore)

Year	Turnover	R&D Expenditure	R&D Expenditure % of Turnover
1999-2000	844.79	0.47	0.05
2000-01	823.84	0.44	0.05
Apr. to Sept 2001	--	0.10	--

SUNFLAG IRON & STEEL COMPANY LIMITED

With a view to develop alloy steel for critical applications actions have been taken to install and commission vacuum degassing unit for refining steel.

Besides, the existing caster has been revamped to cast slabs and rectangles of higher dimensions.

UNIVERSAL FERRO & ALLIED CHEMICALS LIMITED

Thrust areas

- Use of hard lump along with briquettes made with quick lime instead of hydrated lime.
- Utilisation of excess heat generated in the furnace by recirculating the total generated remelts.
- Use of paste lined ladles and dressing of metal casting pans
- Incorporation of anti friction bearings to briquetting press.

Achievements

- Computerised electrode control system for submerged electric arc furnaces to save power consumption and optimise production of ferro alloys was installed.
- Reduction in sulphur content in high carbon ferro chrome.
- Better chromium recovery and metal yield.
- Skulling of metal in the ladles is arrested and recovery of pure metal without any offgrade generation has been made possible.

JINDAL STEEL & POWER LIMITED

Achievements

- Development of steel rounds for seamless pipe application continuous casting slabs for boiler application /HT applications.
- Reduction of ash content down to 27% on dry basis in coal washery and enhancement of coal washery capacity to 250 tonnes/hr. Moisture in washed coal has been reduced to 16%.
- Inspection and quality management system of the company has been granted recognition of IBR as a well known steel maker for manufacture of boiler quality steel slabs, rounds and blooms under provision of IBR, 1915.

Expenditure on R&D during last 2 years:-

(Rs. in crore)

Year	R&D Expenditure	R&D Expenditure % of Turnover
1999-2000	0.38	0.11
2000-01	1.86	0.32