

SRU Jr. Officer Manual



SAIL REFRACTORY UNIT

BOKARO STEEL CITY

A glimpse of SAIL Refractory Unit:

SAIL Refractory Unit (SRU) is a unit of SAIL having four plants spread over Jharkhand and Chhattisgarh and caters to approximately 35% of the requirements of SAIL plants and units. The production capacity of the plants is dedicated to the different SAIL steel plants.

The Head Office of SRU is located at Bokaro Steel City and the location of its different refractory plants are as under:

1. SRU Bhandaridah Plant, P.O. Bhandaridah, Dist: Bokaro, Jharkhand.
2. SRU Ranchi Road, P.O. Marar, Dist: Ramgarh, Jharkhand.
3. SRU IFICO, P.O. Marar, Dist: Ramgarh, Jharkhand.
4. SRU Bhilai, P.O. Marauda, Dist: Durg, Chhattisgarh.

The plant wise manpower (as on 1st March 2022) in SRU is as under:

Sl.No.	Plant	Executive	Non-executive	Total
1.	SRU Bhandaridah	20	99	119
2.	SRU Ranchi Road	11	68	79
3.	SRU IFICO	21	136	157
4.	SRU Bhilai	30	56	86
5.	SRU Head Office	27	49	76
	TOTAL	109	408	517

Prior to its existence as a unit of SAIL, it was a public sector company under Ministry of Steel known as Bharat Refractories Limited.

The historical background of the company is that Bharat Refractories Limited was incorporated as a subsidiary company of Bokaro Steel Limited in 1972 with only one plant namely Bhandaridah Refractories Plant.

Upon restructuring of Public Sector Iron & Steel Industries in 1978, two other plants namely Ranchi Road Refractories Plant at Ramgarh which was under erstwhile Hindustan Steel Limited and Bhilai Refractories Plant which was under construction as captive unit of Bhilai Steel Plant were also transferred to the company. India Firebricks & Insulation Company Limited at Ramgarh which was a subsidiary company of SAIL was also transferred as a subsidiary company which later became a unit of Bharat Refractories Limited.

The ministry of corporate affairs vide gazette notification dated 28th July 2009 approved the merger of Bharat Refractories Limited with Steel Authority of India Limited (SAIL) and the company has acquired the status as a unit of SAIL.

Brief on commercial activities of the company:

Refractory is mainly used in industries that produce iron & steel, cement, glass, aluminum, ceramic, copper, fertilizer & petrochemicals and zinc & lead. SRU caters to refractory requirements of its sister plants.

This unit manufactures entire range of refractory products which is supplied in steel plants. The company also does application of its products in the steel plants on turn key basis with a guarantee of its quality and performance. Apart from the indigenous sources of raw materials, the unit imports raw material from countries like **Ireland, Australia, Turkey, South Africa etc.**

Products being manufactured in different plants are given below:

1. SRU Bhandaridah Plant:

- * Blast Furnace Tap hole Mass
- * Blast Furnace Trough Castables
- * Blast Furnace Trough Ramming Mass
- * Different types of Low Cement and Conventional Castables

2. SRU Ranchi Road Plant

- * Magnesia carbon bricks for LD converters & Steel Ladles & VAD ladles.
- * Magnesia carbon bricks for Arc furnace.
- * LD converters Tap hole mass.
- * Magnesite masses & basic masses.

3. SRU IFICO Plant:

- * Blast Furnace Main & Stove Bricks
- * Blast Furnace Tap hole Mullite Bricks
- * Fire clay & High Grog Bricks
- * High Alumina Brick in Dense and Super Dense Quality
- * Slide- Gate Refractories including SG plates, Wellblocks, nozzles.
- * Different types of Alumina based castables including conventional, low, ultra, Zero cement castable.
- * Zero Cement Castables & pre-cast Pre-fired Blocks
- * Fire Clay & High Alumina Mortar & Masses
- * Self flow castables.
- * Alumina, Magnesia spinel castable.

4. SRU Bhilai Plant:

- * Magnesite bricks.
- * Magnesite Chrome bricks.
- * Chrome magnesite Bricks.
- * LD converters gunning masses.
- * Magnesite mortars and masses.
- * All type of basic masses.
- * Magnesia carbon bricks for LD converters.
- * Magnesia carbon bricks for steel ladles.
- * Silica mortar.

SRU – BHANDARIDAH

The plant was designed to manufacture fireclay & high grog bricks. However, presently plant has diversified into manufacture of special castables and masses like BF trough mass and anhydrous tap hole mass. It also produces upto 42% Alumina bricks through tunnel kiln route. During year 2020-21 the production was 22112 Tons.

PRESENT PRODUCT-MIX AND SERVICES AND CUSTOMER BASE IS MENTIONED BELOW:

SL. NO	NAME OF THE PRODUCT AND SERVICES	CUSTOMER
1	SUPPLY OF MUDGAN MASS AND ITS APPLICATION (EXCL UNIT OPERATION S INVOLVED IN TAPPING LIKE PLUGGING, DRILLING ETC.	BSL (ALL FURNACES), BSP (ALL FURNACES EXCEPT UPCOMING BF 8), RSP (BF 4 AND I EXCEPT BF 5), DSP (ALL BFS) TATA STEEL (C,D & e BFS) AND VSP (A small percentage of our clay is mixed with the regular clay produced by VSP)
2	SUPPLY AND APPLICATION OF TROUGH RAMMING MASS	RSP BF4, DSP (Slag Runner), ISP (Application by customer) (and TATA Steel(For closing drain hole) (application by customer)
3	SUPPLY AND APPLICATION OF TROUGH CASTABLE (WEAR LINING CASTABLE)	BSL (C/H 5,6,7 AND8), BSP (4.1,5.1,6.2,7.1&7.2), DSP (2.1.3.1,3.2,4.1 and 4.2) AND RSP (hot metal runner and tilting runner of BF4)
4	SUPPLY AND APPLICATION OF CASTABLE FOR LADLE BACKUP AND TUNDISH BACK UP)	BSP AND BSL
5	SUPPLY OF CONVENTIONAL CASTABLE (HA 50 TO HA 90)	BSL, BSP, RSP AND ISP
6	SUPPLY OF MORTAR (WT2, BT 1 AND KYANITE MORTAR)	BSL AND BSP

The plant has 1(one) gas fired tunnel kiln for firing at ~1505°C suitable for high grog bricks. The fuel for firing is producer gas. Tunnel kiln can fire ~ 36 tons/day of bricks which translates into approximately 32 tons/day of saleable production. Maximum capacity of the plant for fired products works out to 11000 tons per year and 31600 tons of monolithic per year. However, the total production capacity has a limitation in Mill house. The existing crushing & grinding facility is limited to ~ 16000 tons/year on 2-shift working basis.

As on 01.03.2022, the plant has 20 executives and 99 non executives, the total being 119 employees at SRU Bhandaridah.

The manufacturing cost structure of the plant is that raw material constitutes ~ 52% of the product cost and fuel constitutes ~ 5%. The balance 43% cover fixed cost excluding interest and depreciation.

Equipment-wise production capacity

<u>LIST OF EQUIPMENTS OF SRU BHANDARIDAH PLANT</u>				
A. <u>MASSES SECTION</u>				
SL.No.	Name of Equipment	Year of Installation	Quantity	Capacity
1	Muller Mixer -1	2001	01 No	1 MT
2	Muller Mixer -2	19(74-75)	01 NO	1MT
3	Muller Mixer -3	19(74-75)	01 NO	1MT
4	Muller Mixer-4	Feb.2012	01 NO	1MT
5	Auger Machine-1	2001	01 NO	3MT/Hour
6	Auger Machine-2	1980	01 NO	3MT/Hour
B. <u>(MILL HOUSE)</u>				
7	Jaw Crusher size: 20"x16"	1964	3 no.	5 to 6 MT per Hour
8	Jaw Crusher Size: 16"x10"	2010	2 no.	2 to 3 MT per Hour
9	Hammer Mill size: 500mm	1964	01 NO	2 MT per hour
10	Perforated Pan Mill	1964	1 no.	3 to 5 MT per hour
11	Impact Mill size: 1000 mm	2010	1 no.	2 to 3 MT per hour
12	Clay Disintegrator 1100mm	1980	1 no.	1.5 to 2.5 MT/ hour
13	Double Chamber Tube Mill Size: 6'x17'	1980	1 no.	2 to 3 MT per hour
C. <u>CASTABLE SECTION</u>				
14	Counter current Mixer	1980	2 no.	750 Kg. per batch
15	Counter current Mixer	2000	1 no.	750 Kg. per batch
D. <u>PILOT PLANT</u>				
16	Pulverisor 42"(Subhdra make)	2003	1 no.	1.5 to 2 MT/hour
17	Pulverisor 42"(Singhasini make)	1980	2 no.	1.5 to 2 Mt/hour
18	Pan Mill 6'	1980	1 no.	1 MT/hour
E. <u>GAS PLANT & T.K SECTION</u>				
19	Producer Gas Plant 2.6M	1980	2 no.	2500NM ³ /hour each at 500°C to 550°C at Pressure 60 to 100mm of H ₂ O

20	Tunnel Kiln To accommodate 47 cars. Produce gas fired. Firing Temperature 1450°C together with mechanical pusher, burner, blower, electrical equipments with Kiln cars.	1980	1 no.	Pushing Speed-09 Cars/day
21	Mechanical Pusher, Pushing force 100T at an speed of 1.5M/minute maximum travel 2.75M	1980	1 no.	100T at an speed of 1.5M/minute maximum travel
22	Radial Exhaust Fan Output 36000 M ³ /hour at 160mm H ₂ O at 20°C	1980	2 no.	36000 M ³ /hour at 160mm H ₂ O at 20°C
23	Electric Transfer Car for Kiln	1980	2 no.	16000 Kg.

F. WEIGHING SECTION

24	Electronic Weigh Bridge	2004	1 no.	60MT
25	Mechanical Weigh Bridge	1980	1 no.	30MT

G PRESS & COMPRESSOR SECTION

26	Hari F.S.P. 150T	1980	6 no.	2 cycles/minute
27	Deepak Hydraulic Press 150T	2002	2 no.	2 cycles/minute
28	MOSCO Hydraulic Press 150T	2004	1 no.	2 cycles/minute
29	Holman Air Compressor	1980	3 no.	305 Cu. Ft/minute at 100PSI

H GARAGE & D.G SECTION

30	Kirloskar make Genset	1980	3 no.	310KVA
31	Kirloskar make Genset	2006	1 no.	600 KVA
32	Pay Loader (TATA make) TWL-3036	2004	1 no.	Capacity rated (heaped) Cu.M-2 Capacity rated (struck) Cu.M-1.65
33	Pay Loader (BEML make) BL-200-1	2017	1 no.	

34	Forklift (VOLTAS make) DVX- 20 FC	2002	1 no.	2 MT
35	Forklift (VOLTAS make) DVX- 30 FC	2006	2 no.	3MT
36	Dumper(TATA make)	Two no are very old and one no is procured in year-2004.	3 no.	
37	Ambulance (TATA)	2013-2014	1 no.	

WORKSHOP

38	HMT make Lathe M/C Model:H-22	1980	1 no.	
39	HMT make Lathe M/C Model:NH-26	2004-05	1 no.	
40	HMT make Radial drilling M/C	1980	1 no.	
41	"Batliboy" make Shaper M/C	1980	1 no.	
42	"Cooper" make Shaper M/C	1980	1 no.	
43	HMT make Milling M/C	1980	1 no.	
44	Horizontal Surface Grinder	1980	2 no.	
45	Heat Treatment Furnace	1980	1 no.	

ELECTRICAL SECTION

46	Power Transformer Outdoor type	2007-08	2no.	3.5MVA
47	Power transformer Outdoor type	2009-10	2no.	1.5 MVA
50	Transformer	1981	1no.	1000KVA
51	Transformer	1980-81	1 no.	750 KVA
52	Transformer	1993-94	1 no.	800 KVA
53	Transformer	2003-04	3 no.	250 KVA
54	Transformer	2004-05	1 no.	150 KVA

SRU – Ranchi Road

The plant was originally designed to manufacture high alumina range of bricks based on sillimanite. However, it has been converted to manufacture magnesia carbon bricks only for converter and steel ladles including basic ramming and guniting masses. During the year 2020-21, the plant produced 7662 tons of magnesia carbon bricks including basic masses.

The plant has one modern Sacmi Press of 2500 tons which is suitable for making upto 1100 mm length converter bricks. The plant capacity is governed by the press capacity. Considering two shift working and 26 days working per month, the plant has a production potential of 900 tons/month i.e. 10800 tons/year.

The plant has 11 executives and 68 non executives, the total being 79 employees on its rolls as on 01.03.2022.

The manufacturing cost structure of the plant is that raw material constitutes ~ 70% of the product cost and fuel constitutes ~ 5%. The balance 25% covers fixed cost excluding interest and depreciation.

Capacity of different equipments at Plant II

SL. No.	Equipment Name	Year of Installation	Quantity	Capacity
Mill Section :				
1.	Ball Mill	1968-69	2	3 T/hr.
2.	Maxicon Mill	1968-89	1	2 T/hr.
3.	Tube Mill	2004	1	0.5 T/hr.
4.	Jaw Crusher	1988	1	4 T/hrs.

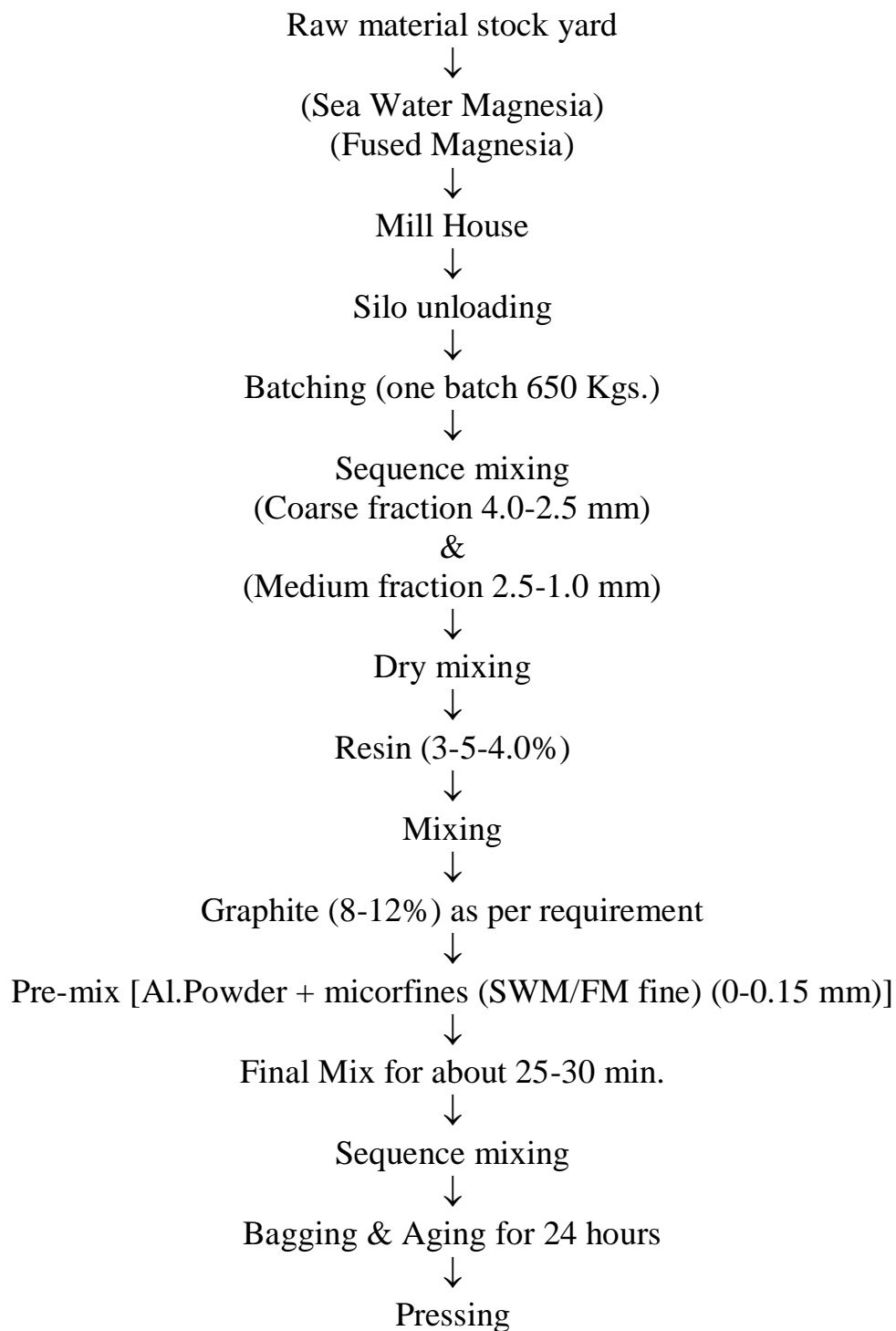
SL. No.	Equipment Name	Year of Installation	Quantity	Capacity
Mixing Section :				
1.	Eirich Mixer	1968-69	2	750 lit
2.	Hari Mixer	1991	1	750 lit
3.	Intensive Mixer	2003	1	750 lit
Press Section :				
1.	E.P. – 800 T	1986	1	3 T / Shift
2.	Sacmi – 2500 T	1999	1	10 T / Shift
3.	FSP	1994	1	2 T / Shift
Kiln Section				
1.	Chamber Kiln	1978	3 Nos.	120-130 T/Batch
Other Section				
1.	DG Set	1989/ 1990	2 Nos.	310 KVT each
2.	Fork Lifter	1988 /1988/ 1994 / 1996	4 Nos.	2 MT

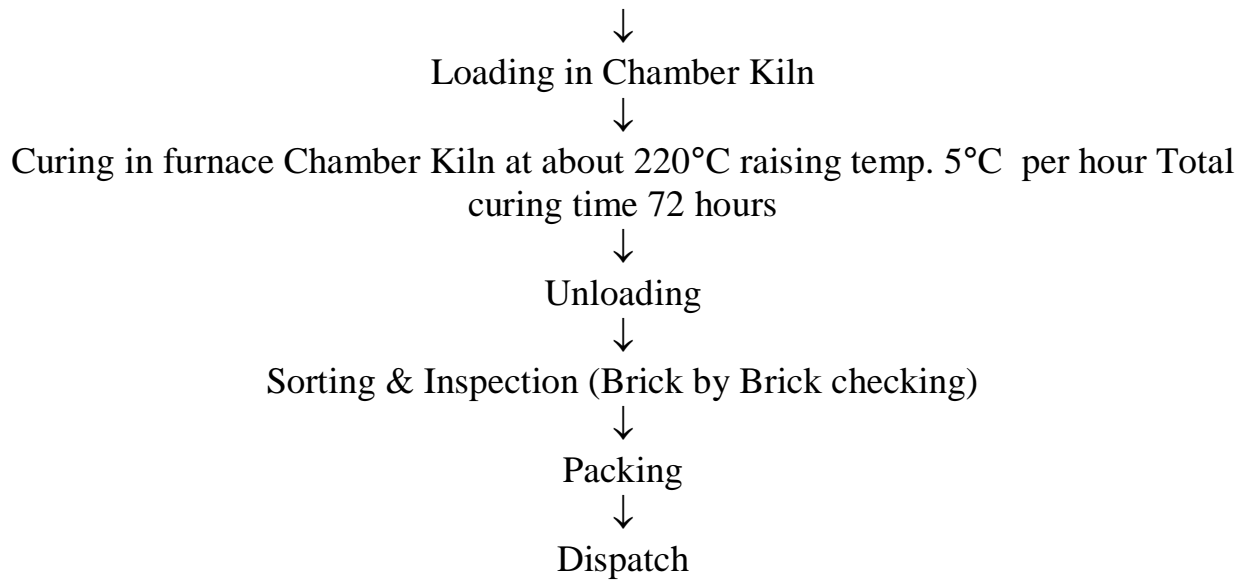
Capacity of different equipments at Plant I

SL. No.	Equipment Name	Year of Installation	Quantity	Capacity
1.	Eirich Mixer	1968-69	2 Nos.	750 / hr / Batch
2.	Mullar Mixer	1968-79	2 Nos.	

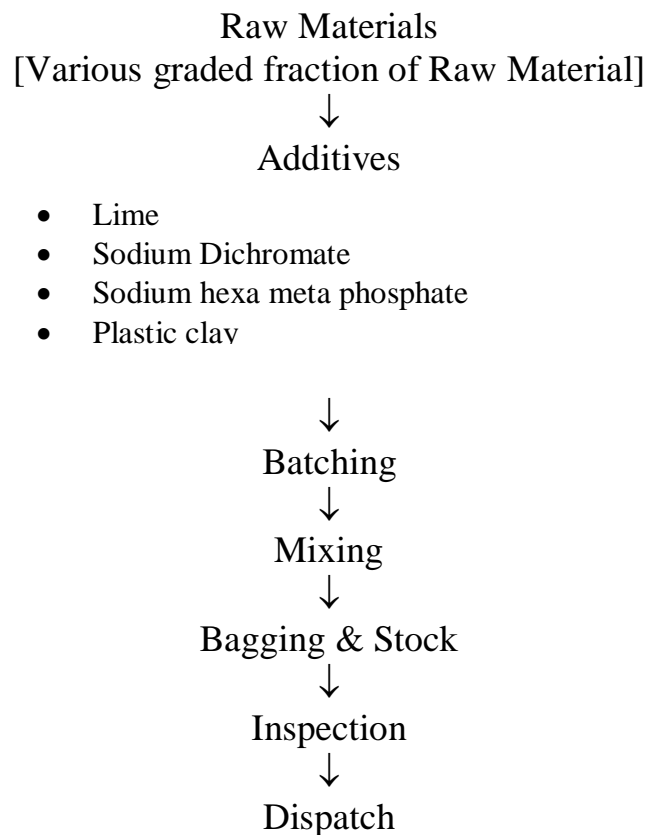
SRU – RANCHI ROAD

Process flow diagram of MCB





Process flow diagram of Masses



SRU- IFICO, RAMGARH

The Plant was designed to manufacture complete range of alumina silicate refractories (high grog, high alumina and super dense alumina bricks, etc.) and was recognized for manufacture of BF grade hearth bottom blocks. Presently plant is manufacturing high grog and high alumina bricks for BF quality, alumina carbon based slide gate plates. The plant also produces alumina based conventional castables, L.C.C., U.L.C.C., Z.C.C. and prefabricated shapes like block, housing block, inner nozzles etc. for steel teeming ladles. The production for the year 2020-21 was 28022 tons

The manufacturing facilities available with the plant are annexed.

The Plant has 2 tunnel kilns suitable for high temperature firing ~ 1550°C. The fuel for firing is producer gas with support of furnace oil. Each tunnel kiln can fire ~ 48 tons/ day of bricks which translates into approximately 40 tons per day of salable production.

The plant has 21 executives and 136 non executives as on 1.3.2022 with a total strength of 157 employees.

Manufacturing cost structure of the plant is that raw material constitutes ~ 44% of the product cost and fuel constitutes ~ 21%. Balance 35% covers fixed cost excluding interest and depreciation.

Production performance of IFICO

Year	Bricks	Mass	Total
2010-11	18719	8077	26796
2011-12	19346	11277	30623
2012-13	17362	8403	25765
2013-14	16308	9856	26164
2014-15	19860	11854	31714
2015-16	16558	10943	27501
2016-17	14046	10768	24814
2017-18	16112	9578	25690
2018-19	17527	10883	28410
2019-20	18439	9895	28334
2020-21	17691	10331	28022

PRODUCTS RANGE: 35-95% Al₂O₃ refractory, Zero Cement Castables(ZCC), Ultra Low Cement Castables(ULCC), Conventional castables, Slide gate plates & nozzles, Al₂O₃-MgO Spinel castables. Self flow castables, pre-fired pre-fabricated blocks.

CUSTOMERS: Bokaro Steel Ltd (BSL), Durgapur Steel Plant (DSP), Bhilai Steel Plant (BSP), Rourkela Steel Plant (RSP), Alloy Steel Plant (ASP), IISCO Steel Plant (ISP).

AREA OF APPLICATION: Blast furnace main & stove, coke oven, Steel Melting Shop (SMS), Reheating furnace, Rotary kiln for lime calcinations.

Equipment wise production capacity**A. Mill House**

Equipment	Capacity (MT/Day/Machine)
Two Ball Mills	15
Three Impact Mills	35
Two Pulverisers	15

B. Press

NAME OF THE PRESSES	SPECIFICATION	Production Capacity (MT/DAY)
1. Frictional Screw Press – 1	Capacity – 150 T	7.5
2. Frictional Screw Press – 2	Capacity – 150 T	7.5
3. Frictional Screw Press – 3	Capacity – 150 T	7.5
4. Frictional Screw Press – 4	Capacity – 400 T	7.5
5. Deepak Press – 1	Capacity – 150 T	6.5
6. Deepak Press – 2	Capacity – 150 T	6.5
7. Deepak Press – 3	Capacity – 150 T	6.5
8. Deepak Press – 4	Capacity – 150 T	6.5
9. Deepak Press- 5	Capacity – 150 T	6.5
10. Laeis Press - 1	Capacity – 630 T	19.5
11. Laeis Press –2	Capacity – 450T	16.5
12. Laeis Press -3	Capacity – 1260 T	30.0

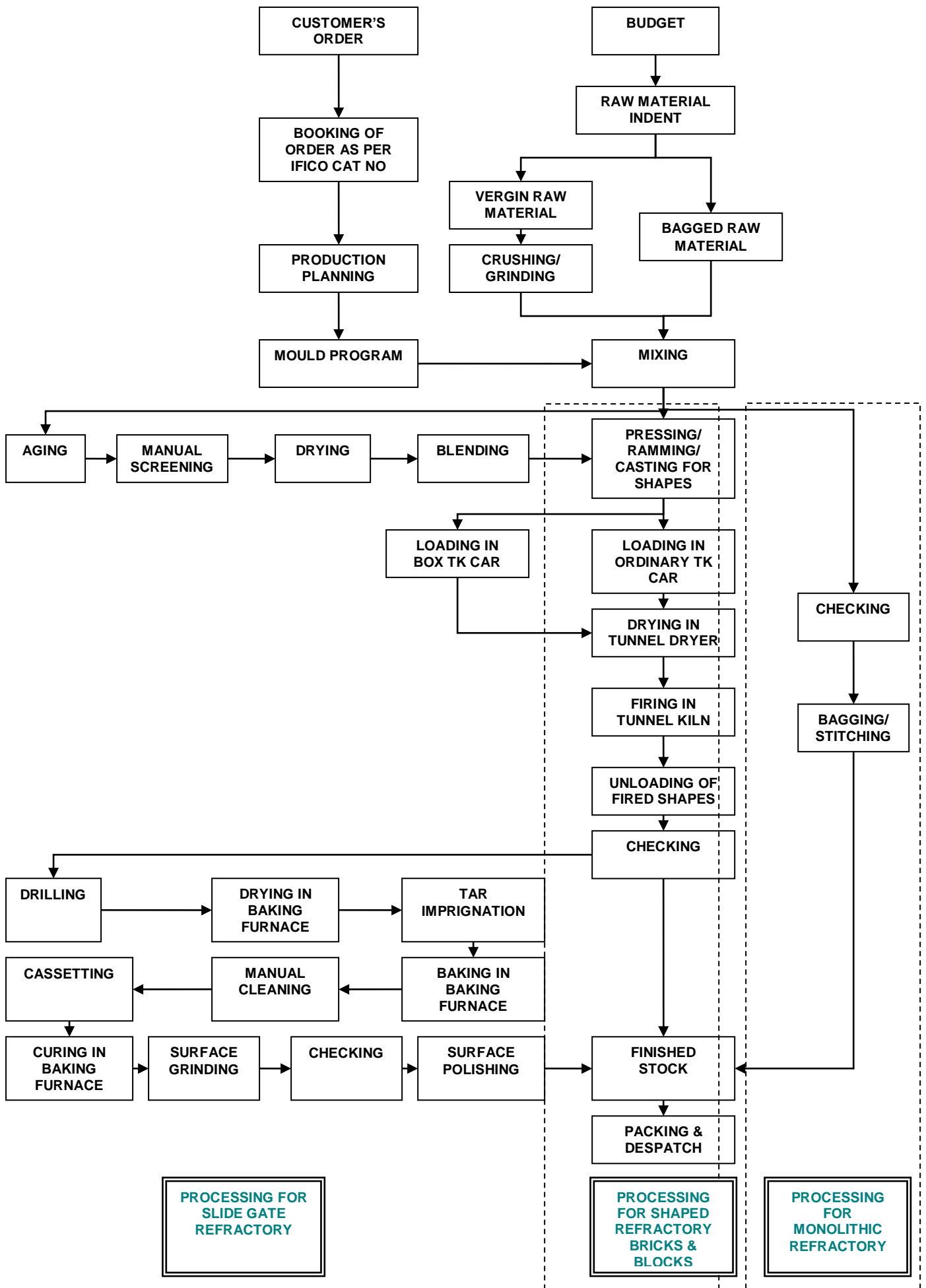
C. Tunnel Kiln & Producer Gas Plant

- Two Tunnel Kiln - Capacity 48 T/day Each
- Three Tunnel Drivers - Capacity 32 T/day Each
- Two Producer Gas Plant - 2450 NM³/hr.

D. Infrastructure for special Products

- Five counter current mixers – 250/300/300/500/750 kg/Batch
- One fluidized bed drier – 250 kg/Batch
- One tar impregnation plant – 1.5 MT/Batch
- Three electrically heated baking furnaces
- Four vibrating tables
- Three vertical rotary surface grinders
- One hydraulic cassetting machines
- One vertical drilling machines for refractory drilling

Process flow diagram of SRU IFICO



IFICO follows a Quality Policy for Customers' satisfaction

SRU-(BHILAI & IFICO)

QUALITY POLICY

BHILAI & IFICO PLANTS OF SAIL REFRACTORY UNIT, a fast moving growing manufacturer of refractory materials committed to meet customer's requirement and expectations consistently through meeting statutory & regulatory requirements.

To achieve this we must be committed for:

- **Ensuring effective & efficient students i.e. responsible and responsive to all stake holders, share holders, customers and employees with regard to satisfaction, quality & safety.**
- **Continually improving the processes, productivity & reducing impact on environment and improving customers' service.**
- **Providing a comfortable, clean, safe and efficient work for all employees.**
- **Continually improving the effectiveness of the quality management system.**
- **Providing a framework for establishing and reviewing measurable quality objectives & performance indicators at relevant functions and levels.**

DATE: 03.08.2011

EXECUTIVE DIRECTOR

Research & Control Laboratory

R&C Lab at SRU IFICO is recognized by DSIR, Govt. of India.

In main laboratory the following tests of different fire bricks and raw materials are performed to know and improve their properties and qualities.

PHYSICAL TESTS:

- Apparent Porosity (A.P).
- Bulk Density (B.D).
- Cold Crushing Strength (CCS).
- Water Absorption Test.
- Initial and Final setting time.

CHEMICAL ANALYSIS:

- By X-Ray Fluorescence (XRF).
- By Chemical methods.

THERMAL TESTS:

- Refractoriness Under Load (RUL).
- Permanent Linear Change (PLC).
- Hot Modulus of Rupture (HMOR).
- Pyrometric Cone Equivalent (PCE).

ANALYSIS OF COAL-TAR-PITCH:

- Determination of softening point.
- Determination of ash content (AC), volatile matter (VM), fixed carbon (FC):

IN PLANT LAB following tests are performed:

- Green B D
- Taper
- Sieve analysis

F C = 100 - VM - AC.

APPARENT POROSITY:

Apparent porosity is one of the important testing parameters. Apparent porosity is the percentage relationship between volume of the open pores space and the total volume of the sample. It is given by the relation as follows;

$$\text{Apparent porosity} = \frac{W-D}{W-S} \times 100$$

Where, W=saturated weight of the sample.

D= dry weight of the sample.

S=weight of the sample suspended in water.

BULK DENSITY:

This is also one of the important properties of refractory material. Bulk density is the weight per unit volume of the refractory including the volume of the open pores space. This factor is responsible for the overall weight coming upon the foundation of the refractory structure. It is one of the factors which limit the size of the furnace.

Bulk density of the refractory material is given as;

$$\text{Bulk density} = \frac{D}{W-S} \text{ (gm/cc).}$$

COLD CRUSHING STRENGTH:

Refractories must be able to withstand structural load coming over them. This is of particularly important in shaft type furnace or such parts of a furnace charge load is concentrated. Dense and fine grain refractories possess good crushing strength whereas porous and coarse grained refractories have poor crushing strength.

Cold crushing strength of a brick is carried out by placing a suitable refractory sample on a flat surface followed by application of a uniform load through a bearing block in a standard mechanical or hydraulic compression testing machine.

The load at which cracks appear in the refractory brick represents the CCS of the brick.

INITIAL & FINAL SETTING TIME: Initial and final setting time of refractory cements are determined by of *vicat* apparatus. Initial setting time should not less than 30mins and final setting time should not more than 600mins.

HOT MODULUS OF RUPTURE (HMOR):

The MOR shall be calculated from the following formula:

$$R=3Wl/2bh^2$$

Where, R=modulus of rupture in Kg/Cm²

W=load in Kg.

l =distance between the central lines of the lower bearing edges/span length in cm.

b =width of specimen in cm.

h =height of specimen in cm.

REFRACTORINESS UNDER LOAD (RUL):

Refractoriness under load is the softening temperature of the refractory under load condition corresponding to the breaking of the test specimen. The test specimen comprises a cylinder of size 50+ 0.5 mm height obtained after cutting, boring and grinding. The central portion of the refractory being tested with one of the original faces, forming one of the faces of the finished test specimen. The refractory must be free from crack and other macro defects.

Heating is done in a electrical furnace consisting of refractory tube. The specimen is positioned in the furnace between carbon and mullite rods with about 5mm carbon plate interposed between the test specimen and the rods. A load of 2kg/cm² is applied to the specimen, heating is then allowed at a rate of 15⁰C/min. up to 1000⁰C and a rate of 8⁰C/min. above 1000⁰C.

The change in the height of the specimen on heating is recorded against time scale to represent temperature deformation for the test. Temperature is measured with help of optical pyrometer.

PERMANENT LINEAR CHANGE (PLC):

This represents the permanent change of the refractory shapes undergone on heating, or after reheating under a given set of conditions. The specimen of size 5cm x 5cm x12.5cm is cut by cutting off wheel from a given refractory brick, ensuring that its structure does not get damaged. The volume of the specimen is determined and placed in a furnace at a temperature of 1600⁰C for a period of 120 minutes. After cooling, its volume is once again measured. The change in its linear volume gives its permanent linear change of the brick.

The PLC is calculated by knowing the following formula:

$$\text{Volume change (\%)} = \frac{\text{Final volume} - \text{Original volume}}{\text{Original volume}} \times 100$$

$$\text{Linear change (\%)} = \frac{\text{Final length} - \text{Original length}}{\text{Original length}} \times 100$$

PYROMETRIC CONE EQUIVALENT (PCE):

Refractoriness or PCE is a measure of fusibility of a material & it's a term which is used as an index of heat resisting property. Fusion point of refractory indicates temp at which it soften and the most common method is by comparing the bending characteristics of the samples with those of series of std. pyrometric cones(orton cone) of known fusion behavior, all run in the same furnace and the fusion temp value obtained is expressed by a number called PCE value.

Some std. pyrometriccones(ASTM) are as follows:

Cone no.(ASTM)	Fusion point(⁰ C)
20	1564
23	1605
26	1621
27	1640
28	1646
29	1659
30	1665
31	1683
31.5	1699
32	1717
32.5	1724
33	1743
34	1763

CHEMICAL ANALYSIS BY X-RAY FLUORESCENCE (XRF) :

- Each element has electronic orbitals of characteristic energy.
- X-rays expel tightly held electrons *from* inner orbital.
- Electrons from higher orbital fall into the lower orbital.
- Energy equals to difference of the respective orbitals released in a form of fluorescent radiation of characteristic wave length.

$$\lambda = hc/E.$$

Infrastructure at R&C Lab:

- ❖ Digital Electronic Balance
- ❖ Hot MOR Tester
- ❖ PLC Furnace
- ❖ Digital Viscometer
- ❖ De-ioniser
- ❖ Planetary Mixer(Imported)
- ❖ Dryer
- ❖ ED-XRF(Imported)
- ❖ RUL Testing M/c
- ❖ PCE Testing M/c
- ❖ Electro-magnetic Vibrating Table
- ❖ CCS Testing M/c

Pilot Plant Facility:

- ❖ Jaw Crusher
- ❖ Roll Crusher
- ❖ Ball Mill
- ❖ Pan Mill
- ❖ Mixer
- ❖ Press
- ❖ Brick Cutting M/c
- ❖ Drilling M/c

SAIL REFRACTORY UNIT - BHILAI

This plant was established in 1976-80 and was originally designed for a production of 1,10,000 tons/year as per break-up given below:

- | | |
|--|-----------------|
| • Basic Bricks | 30000 tons/year |
| • Silica Bricks | 20000 tons/year |
| • Fireclay/High grog/High Alumina bricks | 60000 tons/year |

However, for various reasons the plant was never completely operational and the Fireclay/High grog/High Alumina brick manufacturing line was never made operational, since inception. During 2020-21 the production was 24481.019 tons comprising of the following products:

- Basic Bricks (MCH, CHM & MGT)
- Mag-Carb. Bricks, AMC Brick (Alumina Magnesia carbon)
- LD Gunning Mass
- Dry Ramming Mass
- Magnesite & other products
- Products filler / Nozzle filling compound, Chrome Mag, Mag chrome & Magnesia Mortar, Silica Mortar.

The manufacturing process flow comprises of Mill House, Batching & Weighing, Mixing, Pressing and Firing Facilities.

The available infrastructure of the various shops along with capacity & annual production potential is also annexed..

The capacity of Basic Bricks is defined by the firing facilities (i.e. Tunnel Kilns). The Tunnel Kiln has an output of 75 tons / day and based on 340 working days /year, capacity works out to 25,500 tons / year.

The equipments in the originally designed High Alumina line is now being utilized for manufacture Mag-Carbon bricks & various kinds of masses. For Mag-Carbon Bricks, the capacity is defined by the pressing facilities and is 14,500 tons / year.

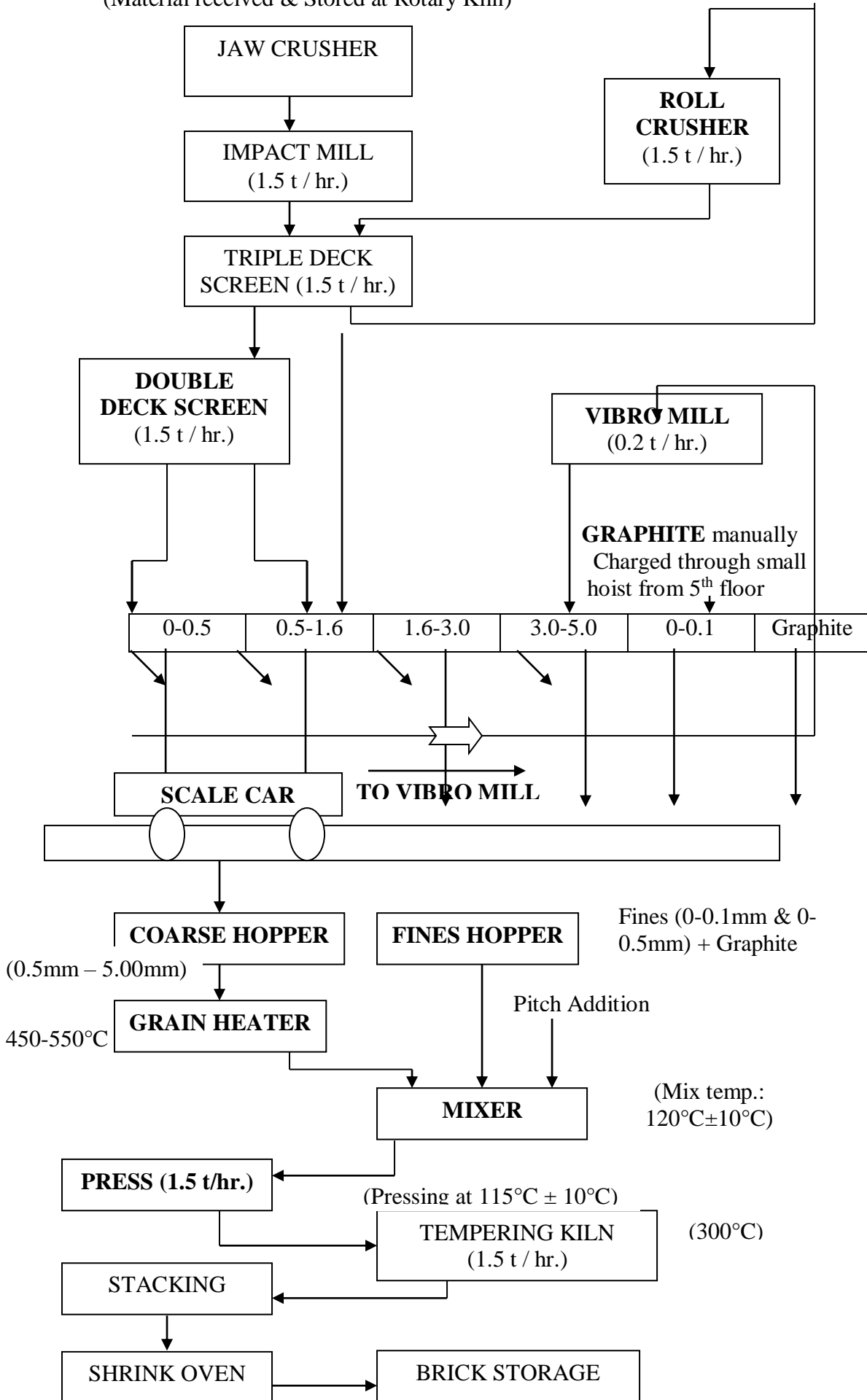
As on 1st of March, 2022, there are 30 executives and 56 non-executives, the total being 86 employees.

The plant works on two shift basis, except for firing area which has three shift working. The manufacturing cost structure of the shop is that variable cost constitutes ~70%, of which raw material constitutes ~ 53%. The balance 30% covers fixed cost, excluding interest and depreciation.

SRU Bhilai will be supplying refractory materials to new SMS-3 of BSP for which three shift working will be introduced soon in all areas.

PROCESS FLOW CHART

(Material received & Stored at Rotary Kiln)



AVAILABLE INFRASTRUCTURE

SHOP – I A (Basic Burnt)

Crushing & Grinding

<u>Equipment</u>	:	<u>Nos.</u>	<u>Capacity</u>	<u>Annual Production</u>
Jaw Crusher	:	1 No.	25 MT / Shift	15000 T
Impeller Breaker	:	3 Nos.	30 MT / Shift	54000 MT
Tube Mill	:	2 Nos.	10 MT / Shift	12000 MT

Crushing & Grinding Capacity :-

Coarse	:	27000 MT
Fines	:	12000 MT
Total	:	39000 MT

Mixing

Heavy Mixer	:	2 Nos.	24 MT / Shift	28800 MT
-------------	---	--------	---------------	----------

PRESSING

Horn-800 T	:	2 Nos.	7 MT / Shift	8400 MT
Horn 1600 T	:	1 No.	7 MT / Shift	4200 MT
Laeis-320 S	:	1 No.	4 MT / Shift	2400 MT
Laeis-1250	:	1 No.	4 MT / Shift	4800 MT
Laeis-1600	:	1 No.	4 MT / Shift	8400 MT
TOTAL				<u>28200 MT</u>
Saleable :				25500 MT

SHOP – I B (Silica Brick Production)

Crushing & Grinding

<u>Equipment</u>	:	<u>Nos.</u>	<u>Capacity</u>	<u>Annual Production</u>
Jaw Crusher	:	2 No.	20 MT / Shift	24000 MT
Impeller Breaker	:	2 Nos.	15 MT / Shift	18000 MT
Cone Crusher	:	2 Nos.	15 MT / Shift	18000 MT
Tube Mill	:	1 No.	10 MT / Shift	6000 MT

Crushing & Grinding Capacity :-

Coarse	:	36000 MT
Fines	:	6000 MT
Total	:	42000 MT

Mixing

Heavy Mixer	:	2 Nos.	14 MT / Shift	16800 MT
Light Mixer	:	1 No.	10 MT / Shift	<u>3000 MT</u>
			Total	<u>19800 MT</u>

PRESSING

FSP	:	11 Nos.	2.25 MT / Shift	115000 MT
Deepak	:	2 Nos.	2.00 MT / Shift	<u>2400 MT</u>
			TOTAL	<u>17400 MT</u>
			Saleable :	7200 MT

SHOP – II (Mag – Carbon Brick & Various Masses)**Crushing & Grinding**

<u>Equipment</u>	:	<u>Nos.</u>	<u>Capacity</u>	<u>Annual Production</u>
Jaw Crusher	:	2 No.	25 MT / Shift	30000 MT
Impeller Breaker	:	4 Nos.	30 MT / Shift	54000 MT
Tube Mill	:	2 Nos.	10 MT / Shift	12000 MT

Crushing & grinding capacity:

Coarse	:	54000 MT
Fines	:	<u>12000 MT</u>
Total	:	<u>66000 MT</u>

Mixing

Heavy Mixer	:	1 Nos.	24 MT / Shift	14400 MT
Light Mixer (For Masses)	:	3 No.	10 MT / Shift	<u>18000 MT</u>
			Total	<u>32400 MT</u>

PRESSING

LAEIS - 800	:	1 No.	8 MT / Shift	4800 MT
LAEIS – 400R	:	3 Nos.	5.5 MT / Shift	<u>9900 MT</u>
FSP – 150 T	:	2 Nos.	Total	<u>14700 MT</u>
			Saleable Mag. Carbon	: 14500 MT
			Saleable Masses	: 12800 MT

Kiln capacity:

Facilities	No.	Capacity
Tunnel Kiln (Shop – 1A)	1 No.	75 MT / Day
Tunnel Kiln (Shop – II)	3 Mos.	-
Chamber Kiln	2 Nos.	28 - 30 MT / Day
Curing Furnace	1 No.	35 – 40 MT / Day
Curing Furnace	1 No.	15 – 20 MT / Day
Driers Chamber	3 Nos.	15 – 20 MT / DAY
Producer Gas Plant	1 No.	Around 3000 Nm ³ / Hr.
Rotary Kiln Complex	1 No.	196 MT of lime / Day

STEEL AUTHORITY OF INDIA LIMITED
SAIL REFRACTORY UNIT

Balance Sheet

	As at 31st March				
	2017	2018	2019	2020	2021
					(` in crore)
EQUITY AND LIABILITIES					
Shareholders' funds					
(a) Share capital	-	-	-	-	-
(b) Other Equity	103.52	145.77	197.34	238.66	19.51
(c) Money received against share warrants					
Share application money pending allotment	-	-	-	-	-
Non-current liabilities					
(a) Long-term borrowings	-	-	-	0.07	0.04
(b) Deferred tax liabilities (Net)	-	-	-	-	-
(c) Other Long term liabilities	3.27	3.36	3.85	2.61	2.50
(d) Long-term provisions	48.31	36.61	40.49	38.82	36.42
Current liabilities					
(a) Short-term borrowings	0.01	-0.28	-0.30	0.00	0.00
(b) Trade payables	35.63	42.49	82.09	68.57	77.02
(c) Other current liabilities	56.39	51.92	68.14	75.31	75.91
(d) Short-term provisions	25.59	20.41	18.52	18.91	18.37
Inter Unit Current Account	365.45	288.23	406.06	485.21	00.00
TOTAL	638.15	588.51	816.19	928.16	229.77
ASSETS					
Non-current assets					
(a) Fixed assets					
(i) Tangible assets	22.66	20.84	20.95	23.33	23.08

(ii) Intangible assets	0.06	0.36	0.36	0.36	0.15
(iii) Capital work-in-progress	2.45	3.26	0.89	0.18	0.04
(b) Non-current investments	-	-	-	-	-
(c) Long-term loans and advances	0.43	0.43	0.32	0.46	0.48
(d) Other non-current assets	1.03	0.43	0.69	2.00	2.02
Current assets					
(a) Inventories	138.51	106.17	172.68	280.50	187.94
(b) Trade receivables	2.42	2.75	1.55	2.28	0.63
(c) Cash and Bank Balances	0.23	0.24	0.26	0.28	0.28
(d) Short-term loans and advances	1.31	1.36	1.07	1.24	0.92
(e) Other current assets	17.59	8.38	26.28	18.36	14.23
Inter Unit Current Account	451.46	444.29	591.14	599.17	00.00
TOTAL	638.15	588.51	816.19	928.16	229.77

STEEL AUTHORITY OF INDIA LIMITED
SAIL REFRACTORY UNIT
PRODUCTION & PROFITABILITY OF SRU during last 5 years

	2016-17	2017-18	2018-19	2019-20	2020-21
PRODUCTION: (Qty In Tons)					
MCB	19825	18799	22977	26552	21714
Basic	10835	13278	12045	6705	5530
Silica	2351	2070	2168	1003	0
HA	14046	16111	17528	18441	17691
Mass	39967	38249	40674	40570	37763
Total	87023	88507	95392	93271	82697
Dispatch (Qty In Tons)	87514	87439	95617	86870	85285
Statement of Profit & Loss for the Financial Year					
					(' in crore)
Particulars	2016-17	2017-18	2018-19	2019-20	2020-21
<u>Income</u>					
Revenue from Operations	11.81	11.31	8.33	12.85	12.36
Other Income	3.67	4.98	1.87	2.55	3.89
Stock transfer to other units	479.02	449.69	579.06	571.35	532.68
Total Revenue	494.50	465.98	589.26	586.75	548.93
<u>Expenditure</u>					
Cost of materials consumed	255.97	250.04	376.75	439.70	320.39
Purchase of stock in trade	0.04	0.35	0.00	0.00	0.00
Changes in inventories of finished goods, work in progress and stock in trade	-3.21	15.30	(4.21)	(55.19)	41.55
Employee Benefits expense	80.28	66.98	68.57	61.99	74.28

	Interest & Finance Costs	0.94	0.27	0.11	0.16	0.00
	Depreciation and Amortization expense	2.42	2.85	3.72	2.65	2.32
	Consumption of Stores & Spares Parts	3.30	5.37	4.89	6.12	3.83
	Power and Fuel	26.52	26.44	25.88	22.89	18.74
	Repair & Maintenance	8.19	9.16	10.10	14.14	16.49
	Freight outward	7.00	6.90	7.15	6.75	6.33
	Excise Duty on IPT / internal consumption	53.47	12.38	0.00	0.00	0.00
	Other expenses	32.24	35.73	45.41	38.80	39.62
	Exceptional Items	1.13	1.59	0.18	0.00	0.00
	Total Exp	474.71	433.36	538.55	538.01	523.55
	Profit Before Tax	19.79	32.62	50.71	48.74	25.38

Welfare facilities in SRU

Medical treatment facilities

SAIL Refractory Unit provides comprehensive free medical facilities to its employees and their dependent family members. It runs small dispensary in each of its four plants to provide primary health care and also has tie-up with the neighboring hospitals of SAIL and Coal India for the patients who require prolonged treatment. In addition the company also refers chronically sick patients requiring specialized treatment to premier medical institutions of the country as per SAIL Medical Treatment Rules.

Housing

SRU has its own township in three of its units sufficient for providing accommodation to its employees on nominal rent.

At its unit Bhilai and Head Office at Bokaro, SRU shares the housing facility of the respective steel plants.

Educational facilities

SRU provides subsidized educational facility to dependents of its employees. At Bokaro and Bhilai, the company shares the educational facility of the SAIL steel plants. At its unit at Bhandaridah, for the benefit of employees' wards a School is running in collaboration with DAV education trust.

Market complex

Each plant township has been provided with a market complex which has been let out to people who run shops to make available the items of daily requirement to the employees. The company also runs a consumer cooperative shops which sends domestic items on no profit basis. Other facilities like bank are also available in the market centre.

Group Savings Linked Insurance Scheme

The company has taken a Master Insurance Policy from Life Insurance Corporation of India for its employees. The employees have option to contribute as per the rates prescribed for each group (cluster of grades).

The minimum contribution per month is Rs.50/- and maximum is Rs.120/- for the insurance coverage. 35% of this amount goes for risk coverage and 65% is deposited as a savings account which earns interest at prevailing market rates. In event of death while in service, the insured amount which is Rs.1000/- per rupee is paid to the dependant of the deceased employee. This means that the employee who was contributing Rs.50/- per month, his dependants gets

Rs.50,000/- and the one contributing Rs.120/- per month, his dependents gets Rs.1,20,000/- in event of death of the employee.

In case the employee completes his service and retires on attaining the age of superannuation, the 65% amount which was preserved as savings account along with interest is paid to the employee.

Corporate Social Responsibility

As a part of its responsibility towards society the company extends its educational facility to the non employees of the area where its plant is situated and there by benefits the local children and youth in getting quality education. In emergency situations medical health care of primary nature is also extended to the local inhabitants in case of accidents snake bites etc. The company has also constructed roads and a primary health centre in a village near Bhandaridah Plant which has been helpful in connecting the remote villages with the highway. The primary health centre has been handed over to state government who have posted medical staff to run the centre.



Sample Question Paper

1. How many manufacturing units are under SRU.
2. What products mainly manufactures SRU – BHRP?
3. SRU – Ranchi Road Plant caters to the demand of Mag Carbon Bricks for _____.
4. SRU – BHILAI mainly manufactures _____.
5. SRU – IFICO caters to the demands of _____ zone and _____ zone.
6. Primary crushing of raw material is done by _____.
7. Secondary crushing of raw material is being made by _____.
8. Grinding of raw material is made through _____.
9. Products of SRU – BHRP are _____.
10. Products of SRU BHILAI are _____.
11. Mullite Bricks are used in _____.
12. Mudgun mass is applied in Blast Furnace _____.
13. Main raw material used for SRU – BHRP are _____.
14. What is the full form of SWM, DBM & F.M?
15. Source of Graphite are _____.
16. For silica bricks main raw material is _____.
17. Basic bricks are used for lining of _____.
18. Reheating furnaces are lined with _____.
19. In Blast furnace main _____ bricks are used.
20. Blast furnace stove are lined with _____ bricks.
21. What is the full form of F.S.P for refractory bricks manufacturing unit?
22. Maximum capacity press in SRU is of _____ tons capacity.
23. What is the full form of T.K. & C. Kiln?
24. In SRU silica bricks are fired in _____.
25. What is the full form of P.G.P.?
26. How many types of Basic bricks are produced at SRU?
27. What does MCH bricks stands for?
28. MGT bricks means _____.
29. Main raw materials for CHM bricks are _____.
30. Slide gate bricks is produced at _____.

31. SRU – RRRP cures _____ tone of Mag. Carbon bricks/ batch of furnace.
32. In SRU – RRRP bricks are cured in_____.
33. Fuels used for curing of Mag. Carbon brick is SRU – RRRP is_____.
34. Fuel used for firing chamber kiln is _____.
35. Fuel used for firing tunnel kiln at SRU – IFICO plant is _____.
36. Side gate used in steel ladels is of _____ model.
37. The cost of Graphite of 94% Carbon per tone is_____.
38. The cost per tone of resin used for Mag. Carbon bricks is_____.
39. Mudgun mass manufactured in SRU – BHRP is of_____ bonded & _____ bonded.
40. Producer gas is poisonous due to presence of_____ gas
41. Green bricks coming from press should be free from _____ and _____.
42. Green bricks should be of no_____ to avoid problem during firing.
43. What is the full form of R.U.L., P.C.E. & C.C.S.?
44. Total Revenue of SRU in 2020-21 was Rs. -----
45. Employee benefit expenses in SRU in 2020-21 was Rs. -----
46. Total production of masses in 2019-20 was -----Tons.
47. Total dispatch of products in 2020-21 was -----Tons.
48. A public school in Bhandaridah unit is running in association with -----.
49. Power and fuel expenses in SRU in 2020-21 was Rs-----
50. Under the GSLI scheme in SRU the percentage contribution for risk coverage is -----%.