A PROJECT REPORT ON

PLC A AND DRIVE SYSTEM AT FURNACE AT HSM

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ACKNOWLEDGMENT

The satisfaction and euphoria that accompany the successful completion of project would incomplete without the mention of people who made it possible.

I would like to take the opportunity to thank Mr**. Sandeep Dhir**, Chief of placement and training, SNTI who organized this summer training for me and gave me this golden opportunity to be a part of multinational company, **TATA STEEL**, as a vacation trainee.

My sincerest thanks must be extended to thank to my Project Mentor **Mr. Ajay Kumar**, (Senior Manager, Mills and Utilities Electrical Maintenance,(IEM), Hot strip Mill ,TATA STEEL ,Jamshedpur) who gave his valuable time and suggestions to me during this period and helped me a lot in understanding about PLC and Electrical drives and successfully completing this project.

I would also very grateful to **Mr. SaheedAlam** for his constructive suggestion, inspiration and guidance that is very helpful to us during the training periods.

We do how is specially and grateful thanks to all the technical staff of TATA STEEL for their co-operation who has helped us a lot during training.

Working in TATA Steel has been an enriching experience and I hope to utilize the knowledge I have gained here in the future.

SIGNATURE

CERTIFICATE

This is to certify that **G. SHUBHAM SREE** (SNTI No-VT 201912559) pursuing B.Tech from ITER , SOA UNIVERSITY has successfully completed the vocational training in our organization from 2nd July to 30th July 2019 on the project "**PLC AND DRIVE SYSTEM IN FURNACE SYSTEM AT HSM".** During her training tenure the organization , we found her hard working, sincere and diligent person and her behavior and conduct was excellent .We wish he all the best for her future.

SIGNATURE

SEAL

INDEX

PLANT OVERVIEW

Tata Steel Limited formerly known as Tata Iron and Steel Company Limited (TISCO) is an Indianmultinational steel-making company headquartered in Mumbai, Maharashtra, India, and a subsidiary of the TATA groups.

Tata Steel is one of the world's largest steel companies with a steel production capacity of approximately27.5 million tons per annum (MTPA) as on 31 March 2017. The company is a diversified steel producerwith major operations in India, Europe and South East Asia, and employs around 80,500 people. Its largestplant (10 MTPA capacities) is located in Jamshedpur, Jharkhand. The company has manufacturing units in26 countries and a commercial presence in over 50 countries. Tata Steel is the second largest steelproducer in Europe with a crude steel production capacity of over 12.1 million tons per annum.

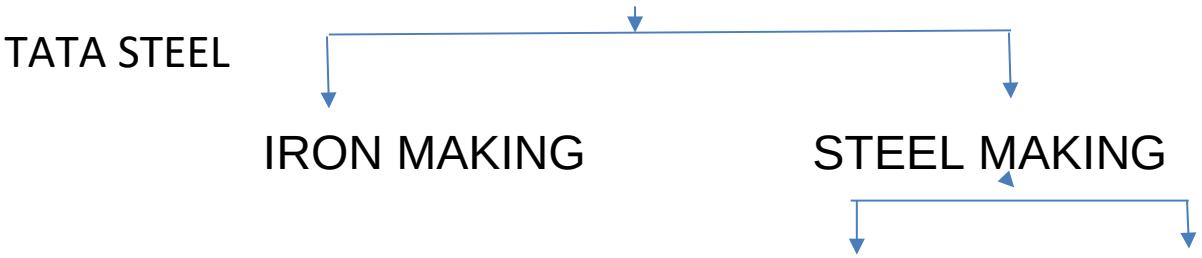
The company together with its subsidiaries, is engaged in the manufacture and sale of steel products inIndia and internationally. They offer hot and cold rolled coils and sheets, galvanized sheets, tubes, wire rods, construction bars and bearings. It is one of the few steel companies that are fully integrated - from miningto the manufacturing and marketing of finished products.

Tata Steel is also involves in prospecting, discovering, and mining iron ore, coal, Ferro alloys, and otherminerals; designing and manufacturing plants and equipment for steel, oil and natural gas, energy andpower, mining, railways, ports, aviation, and space industries; and agricultural implements. Further, theyoffers alumina, dolomite, and monolithic refractory, as well as silica refractory for coke ovens and the glassindustry; manufactures bricks; sponge iron lumps and fines; and rolls for applications in integrated steelplants, power plants, and government mint, as well as paper, textile, and food processing sectors.

Products:

Tata Steel's operations are grouped under six Strategic Business Units include Bearings Division, FerroAlloys and Minerals Division, Agric Division, Tata Growth Shop (TGS), Tubes Division and Wire Division.

They have introduced several branded steel products, including Tata Steelium (the world's first brandedCold RolledSteel), Tata Shaktee (Galvanized Corrugated Sheets), Tata Tiscon (rebars), Tata Pipes, TataBearings, Tata Structural, Tata Agrico (hand tools and implements) and Tata



Wiron (galvanized wireproducts).

LONG PRODUCT FLAT PRODUCT

The steel plant produces:

- Iron
- Soft iron
- Cast iron
- Alloy

They also produce:

- Locomotive parts
- Agricultural equipment
- Machinery, tinplate
- Cable and wire
- Rebars

Branded products and solutions like Pravesh Doors, Nest-in building structures

HOT STRIP MILL

The department of Hot Strip Mill (HSM) is responsible for hot rolling of slabs which are supplied from LD#2 slab caster. The slabs are first heated in the furnaces to the temperature around 1150 degree C. There are three furnaces out of which two are Mixed gas fired and one is BF gas fired. Mixed gas fired furnace are cuperative type and BF gas fired is regenerative type. On coming out from heating chamber slab goes through seven passes in the roughing mill. Roughing mill is thus seven pass reversible 4 hi mill. Sometimes to make mill faster 5 pass is also done. Then through coil box which coils and uncoils the strip ,sttrip goes to the finishing mill. Finishing mill has 6 stands F1 to F6. They are 6 hi irreversible mill.After F6 through the run-out tables strip goes to the down coiler. The runout table is the place where water is sprayed on the slabs for cooling and the rate at which water is sprayed is responsible for the metallurgical as well as the mechanical properties of the slabs. In HSM there are 2 Down Coilers, namely Down Coiler 1 (DC1) and Down Coiler 2 (DC2).

Input to HSM

LENGTH 5-12 m

WIDTH 900-1550 mm

THICKNESS 210 mm

Output of HSM

Width:- 900-1550 mm

Thickness- 1.2-12 mm

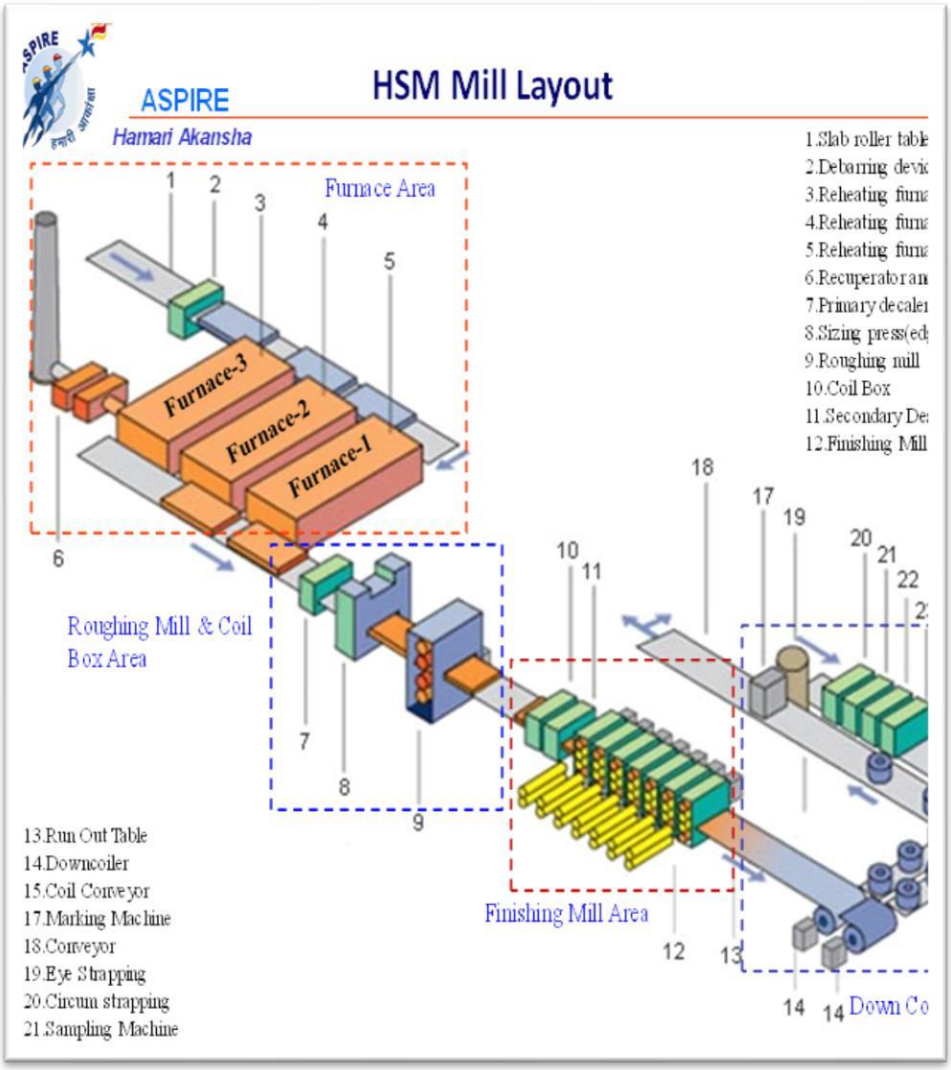
Weight: 28 Ton max.

PERMORMANCE PARAMETER

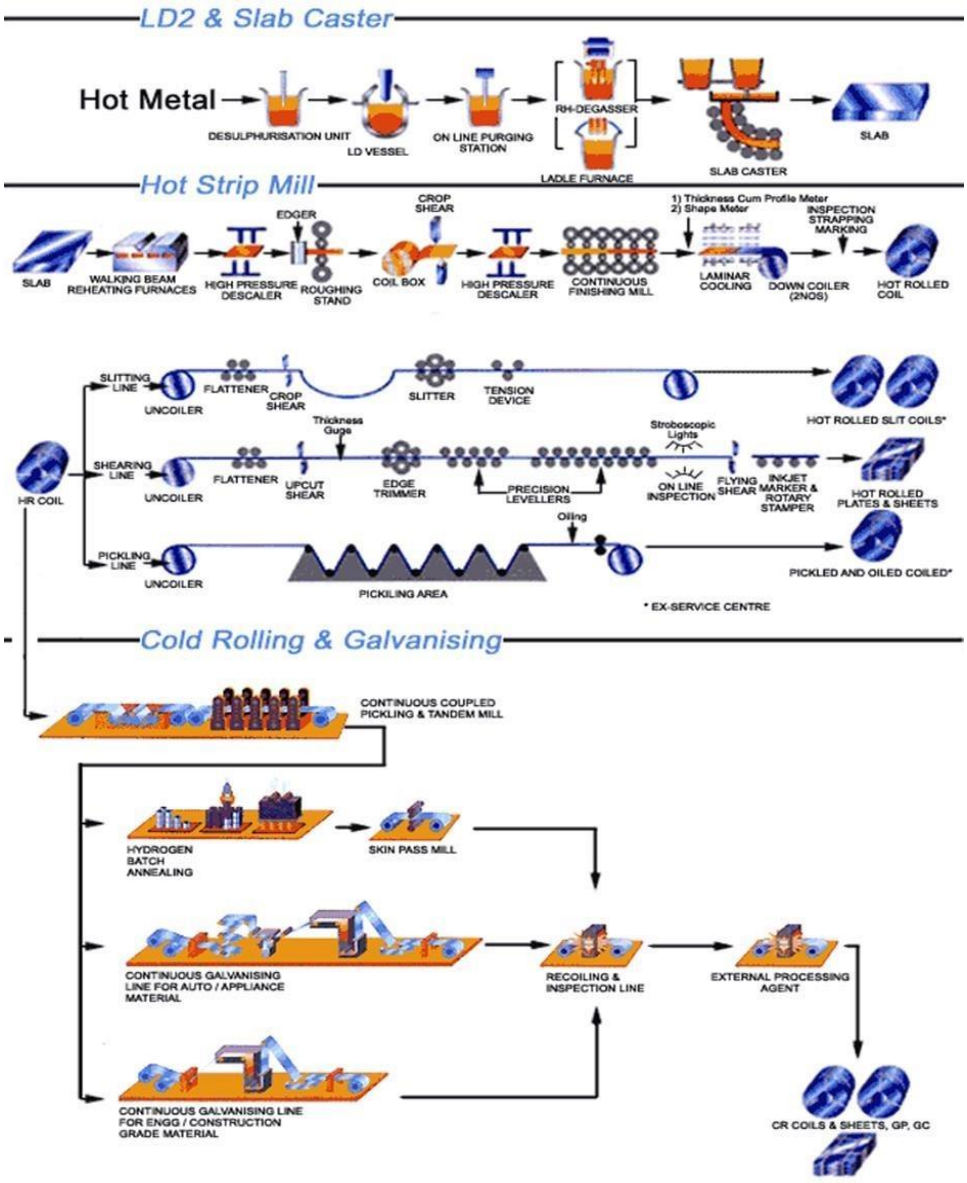
REFERENCE VALUE

Size of Slab(mm)	210*1050*10250
Material of slab	Carbon Steel
Charge temp.	20`c
Discharge temp.	1250`c
Access air	7
Fuel and it's CV	BFG 750 kcal/N CuM

HSM LAYOUT


ASPIRE
Hamari Akansha
HSM Mill Layout
Furnace Area
Furnace-3
Furnace-2
Furnace-1
Roughing Mill & Coil Box Area
Finishing Mill Area
Down Co
1.Slab roller table
2.Debarring devic
3.Reheating furna
4.Reheating furna
5.Reheating furna
6.Recuperator an
7.Primary descale
8.Sizing press(ed
9.Roughing mill
10.Coil Box
11.Secondary De
12.Finishing Mill
13.Run Out Table
14.Downcoiler
15.Coil Conveyor
17.Marking Machine
18.Conveyor
19.Eye Strapping
20.Circum strapping
21.Sampling Machine

PROCESS OF HSM



Furnace:-

Furnace is nothing but a walking beam type furnace. Slabs are received from LD#2 & Slab caster and arranged as per the schedule made by planning (FP). In starting the temperature of slabs are 200 degree C. Slabs are then charged in the two furance by using fuel which is a mixture ofcore iron and blast furnace gases and heatedup to1220 degree C. Slabs are kept in the furnace two hour and thirty minute.Furnace are divided in five different zone.

They are:-

a) Receprator Zone
b) Preheating Zone
c) Heating Zone
d) Per Soaking Zone
e) Soaking Zone

FUEL OF FURNACE

1. BFG

Calorific value	750*4.18kJ/Nm3
Normal consumption	110,000Nm3/h
Maximum flow	150,000m3/h
Pressure at Top	8~14KPa
Position of Top	E-15 column, NB 1800

2. MIXED GAS

Calorific value	2,500*4.18kJ/Nm3
Normal consumption	2,000Nm3/h
Maximum flow	2400m3/h
Pressure at Top	5~14KPa
Position of Top	Near E-15 column

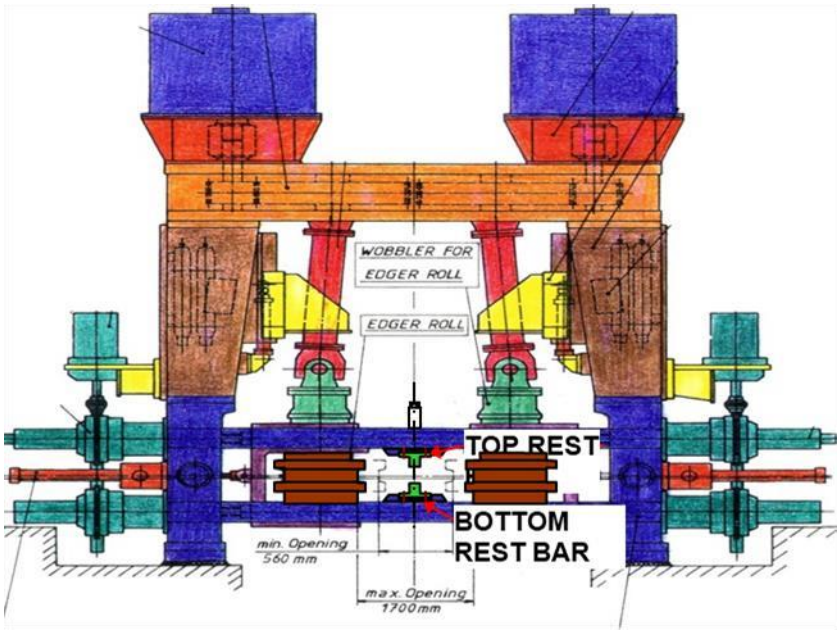
FURNACE DIMENSION

Overall length	44,300 mm
Width	12,070 mm
Height	1,460 mm
Depth	2,380 mm
CV	2500 Kcal/Nm3
Flow rate	42,000 Nm3/h
Temp.	Normal

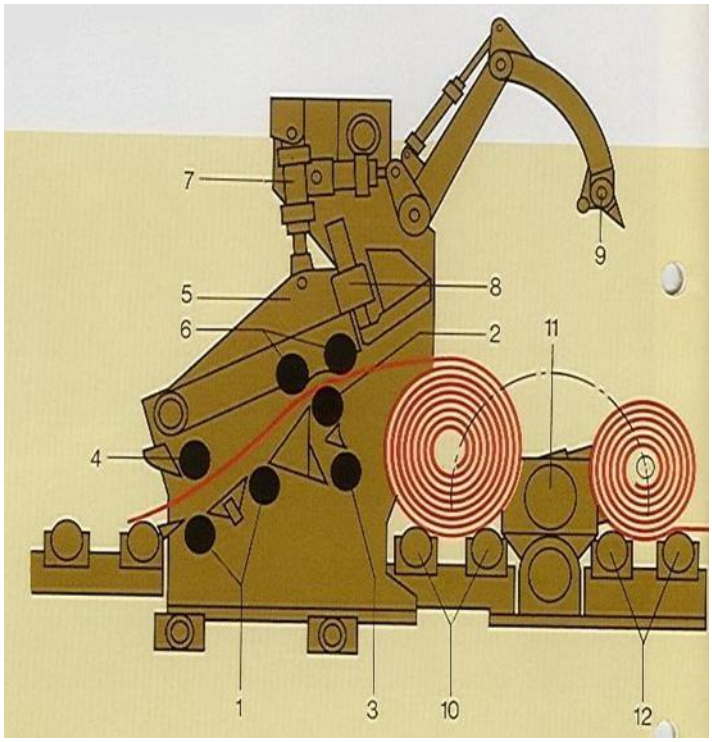
Pressure	400 mm w.c
Mixed gas	(CO+LD+BF+PROPANE

Primary descaling:-The oxide layers formed on the slabsduring heating is removed before rolling by the primary descaler.After exiting the reheat furnace, the slab passes through a descaling unit, an enclosure employing two pairs of spray headers that blast the intensely hot slab with 1,500 psi pressurized water to remove the 1/8-inch thick layer of oxidized iron that forms at the surface of the slab in the oxygen-rich atmosphere of the reheat furnace. Shortly after descaling, a (relatively) small 2-hi rolling mill called a scale breaker reduces the slab's thickness by about one inch to break up any scale that remains. Just before the next reduction pass is taken, 'sweep sprays' clean away any loosened scale that remains on the slab surfaces. The transfer bar will be descaled twice more during roughing, immediately prior to the third and to the last rolling operation, to remove the scale that has grown back over the three minutes or so that it spends in the roughing mill.

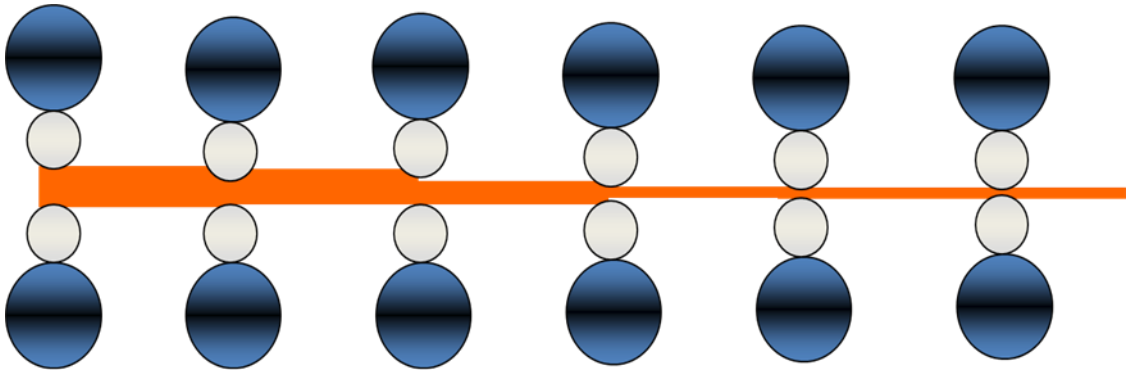
Roughing mill (RM) :- Slabs are reduced in thickness and width both, a pass schedule of 5,7 or 9 passes can be selected. A transfer bar of 20 to 40 mm thickness is produced here. Width of the strip is only controlled in RM.The roughing mill is made up of six independent rolling mill stands, the last four of which incorporate small vertical rolling mills called edgers. Slabs heated in the furnace until they glow bright orange-yellow are rolled through one stand at a time to produce so-called transfer bars suitable for finish rolling. High-pressure water-jet nozzles clean the oxidized iron, or scale, from the surface along the way. As the transfer bar exits the last roughing mill stand, the thickness of the leading edge of the bar is estimated. Similarly, a pyrometer measures the temperature profile of the bar from head to tail and a special camera photographs both ends. Depending on the gauge,width, and gradeofthe product to be rolled, the average temperature of the bar as it exits the last roughing mill normally ranges from 1900° to 2100° Fahrenheit. This data is collected in anticipation of finish rolling. Computers immediately begin calculating the speeds and gaps for threading the six finishing mills, which will roll the steel in tandem with one another. The workhorse roughing mill has 135" wide rolls for rolling 'broadside' (as the first roughing mill iscommonly called) to make a slab wider. A 6,500 hp motor drives 42"-diameter work-rolls through 28:1 gears to reduce the slab's thickness by as much as 2-½". The last four roughing mills each incorporate edgers for width control and roll the bar from five to six inches thick incrementally down to around an inch and a quarter, depending on the customer's ordered width, gauge, and steel grade. As mentioned previously, the third and fifth roughing mills each have high-pressure descaling headers operating at 1,500 psi. The individual roughing mills are spaced increasingly further apart to accommodate the lengthening of the transfer bars as they are rolled thinner and thinner.



Coil Box :- After rolling in the RM, a 30 mm transfer bar becomes about 80 – 90 m long. This is the intermediate product. It is coiled in a coil box to preserve the heat for rolling in finishing mill. After coiling it is immediately uncoiled for rolling in finishing mill after cutting the crop end in the rotary drum shear. After shearing it is again descaled in secondry descaler to clear oxide layers formed during rolling in RM.



Finishing Mill (FM) :- It is a 4 – high 6 stand continuous mill with 5 loopers in between. Any thickness between 1.6 and 12 mm can be rolled here. Dimensional tolerances are ensured by various close loop monitoring system like looper. AGC, Moniter etc.



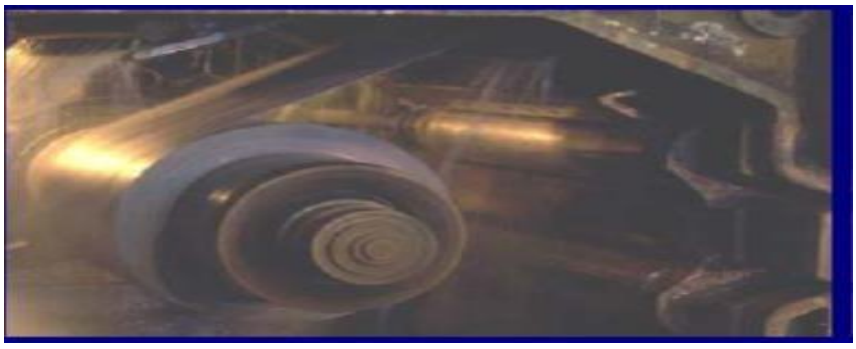
Out put thickness 1.6 mm to 16 mm

Measuring House :- All the quality parameters are measured here. It houses all the measuring instruments like IMS, IRM and width meter etc.

Run Out Tabel (ROT):- This is a 106-mtr long tabel with 20 top and 20 bottom laminar headers to cool down the strips to desired coiling temp. 5 different types of the cooling strategy can be selected. They are

- Near distributed
- Far distributed
- Near grouped
- Far grouped
- Random

Down coiler:-The long strip coming out of FM is coiled in two down coilers. A tension of 15 – 20 N/mm^2 is maintained to ensure a tight coil. Two gears are provided for rolling thin and thick Gauges.



operations:-

Sampling: A sample from the coil is taken to test the phisical properties.

Strapping: One cercumferential strapping and three-eye strapping are done to make sure that the wraps do not get losse during transportation.

Bronx Shearing Line: In addition to customers for hot rolled coils there is also demand for hot rolled sheets & plates in cut length from. To meet the requirement of this segment of the market the Bronx shearing line was commissioned in 1995 with a capacity of 0.3 mtpa of sheets and plates of the following dimensions.

Finishing

Thickness: 1.6 to 12mm

Width: 850 to 1550mm Length:

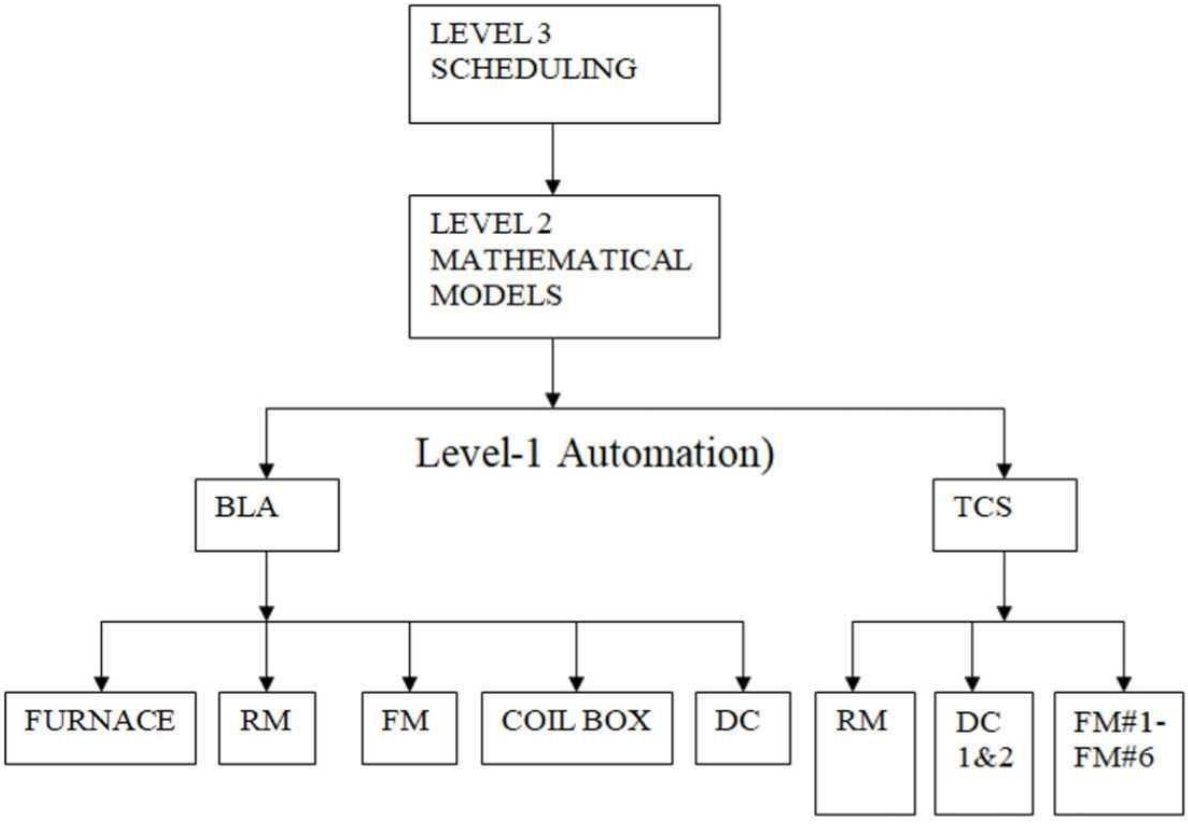
1.6 meter to 13 meter

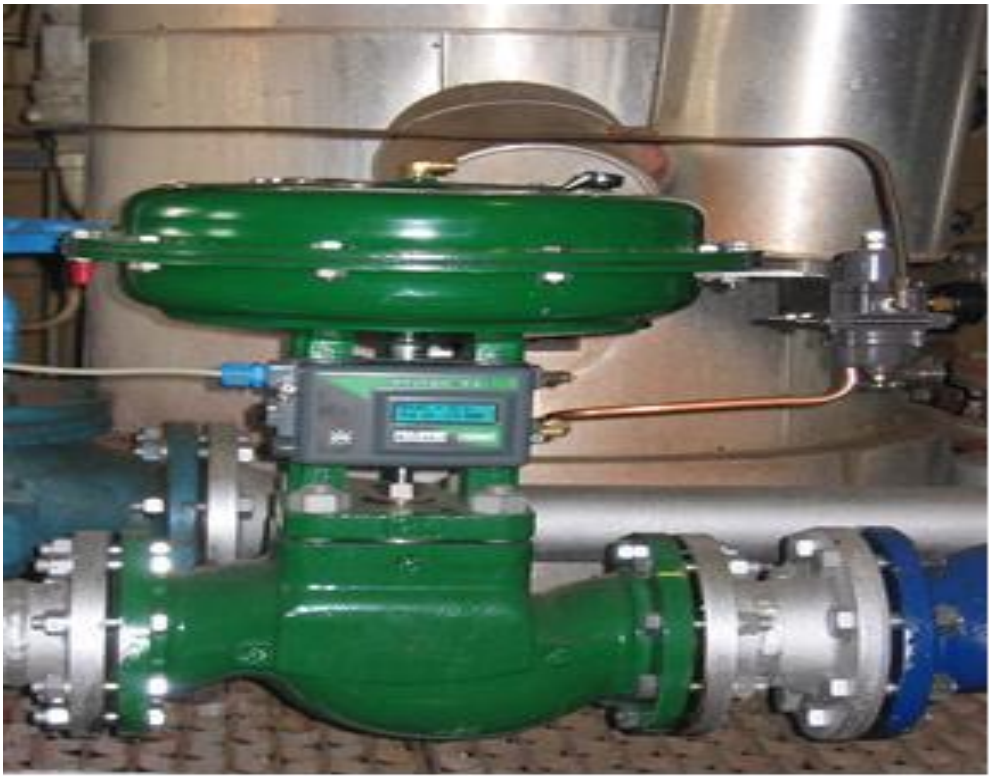
AUTOMATION SYSTEM

BLA system - BLA stands for Basic Level Automation. The BLA control system has been installed by ALSTOM USA. This system is responsible for speed referencing and controlling of the drives. Also it is responsible for control of roll change sequencing, screw down mechanism control and various other activities.

TCS system –TCS stands for Technological Control System. The TCS system has been installed by SMS DEMAG Germany. This system is primarily responsible for all the hydraulic controls in the Roughing Mill, Finishing Mill from stand 1 to stand 6. Also it is responsible for the step control of down coiler 1 as well as down coiler 2.

Since there are two separate control platforms and both of them have separate network of devices for control, so a router is used for communication between the two separate control platform networks.





BASIC LEVEL AUTOMATION SYSTEM

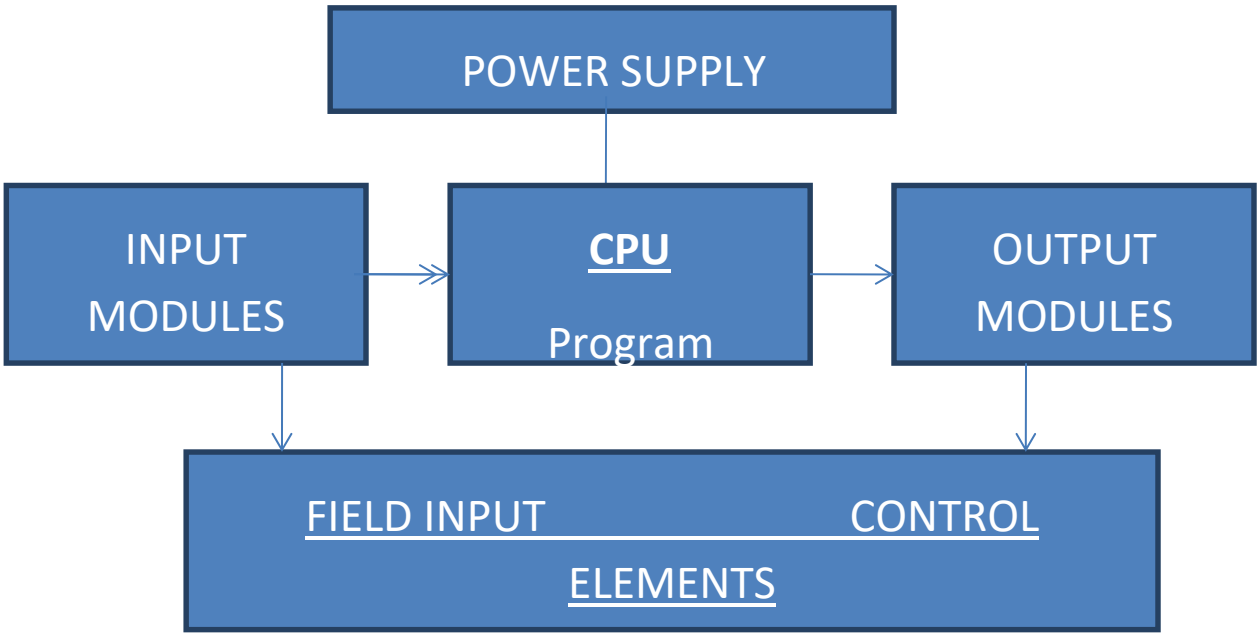
The Basic Level Automation System (BLA) present in HSM has been supplied by ALSTOM USA. The BLA system consists of High Performance controllers (HPC) which are actually PLCs responsible for controlling the entire operations of the mill.

COMPONENTS OF BLA SYSTEM:-

1. High Performance Controllers (HPC)
2. Power Electric Converter Regulator (PECR)
3. Mentor 2 Drives
4. ROT Unidrive
5. Remote I/Os
6. PLC (Programmable Logic Controller)
7. HMI (Human Machine Interface)

PROGRAMMABLE LOGIC CONTROLLER

A PROGRAMMABLE LOGIC CONTROLLER (PLC) is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices. Another advantage of a PLC system is that is modular.



Task performed by PLC:

- Scanning
- IO bus traffic control
- Device communication

PLC controllers are used for:

- Discrete or continuous control function
- Producing on/off voltage outputs
- Actuating elements such as motor & solenoid transferring and manufacturing

4.1 .PLC Development

1968 Programmable concept developed

1969 Hardware CPU controller, with logic instructions, 1 K of memory and 128 I/O points

Use of several (multi) processors within a

1974

PLC - timers and counters; arithmetic operations; 12 K of memory and 1024 I/O points

1976 Remote input/output systems introduced 1977

Microprocessors - based PLC introduced

1980

Intelligent I/O modules developed

Enhanced communications facilities

Enhanced software features (e.g. documentation)

Use of personal microcomputers as programming aids

1983 Low - cost small PLC's introduced

1985

Networking of all levels of PLC, computer and machine using SCADA software.

4.2. ADVANTAGES OF PLC

Programming the PLC is easier than wiring physical components; the only wiring required is that of connecting the I/O terminals.

The PLC can be reprogrammed using user-friendly programming devices. Controls must be physically rewired.

PLCs take up much less space.

Installation and maintenance of PLCs is easier, and with present day solid-state technology, reliability is greater.

Beyond a certain size and complexity of the process, a PLC-based system compare favorably with control panels.

Ability of PLCs to accept digital data in serial, parallel and network modes imply a drastic reduction in plant sensor and actuator wirings, since single cable runs to remote terminal I/O units can be made.

Special diagnostic and maintenance modes for quick troubleshooting and servicing, without disrupting plant operations.

4.3. LEADING BRANDS OF PLC

USA PLC	JAPAN	TAIWAN	CHINA	EUROPE
Rockwell	OMRAN	Delta	KincoDanielli	
Emerson	MITSUBISHI	FATEK	Inovance	ABB
Honeywell	G-FANUC			SIEMENS
	FUJI			

4.4. PLC SIZES

1) SMALL- covers units with up to 128 I/Ofs Memoriesupts 2 Kbytes.

These PLCS are capable of providing simple to advance level/ *os* machine control/.

2) MEDIUM-*hav*e up to 2048 I/O's

Memoriesup to 32 Kbytes.

Most commonly used PLC

3) LARGE- the most sophisticated units of the PLC family.

Haveupts 8192 *\/0's*

Memories up to 750 Kbytes.

Can control individual production processes and control the entire plant.

POWER SUPPLY: Provides the voltage needed to run the primary PLC components **I/O MODULES**: Provides signal conversion and isolation between the internal logic-level signalsinside the PLC and the field's high level signal.

PROCESSOR: Provides intelligence to command and govern the activities of the entire PLC systems.

PROGRAMMING DEVICE: used to enter the desired program that will determine the sequence of operation and control of process equipment or driven machine.Also known as:

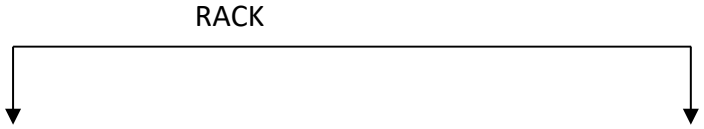
1. Industrial Terminal (Allen Bradley)
2. Program Development Terminal (General Electric)
3. Programming Panel (GouldModicon)
4. Programmer (SquareD)
5. Program Loader (Idec-Izumi)

6. Programming Console (Keyence / Omron)

4.5. HARDWARE OF PLC

CHASIS/RACK

- It is the component that holds everything together.
- It is the hardware which is configured first.
- Rack has cabinets for placing the modules.
- It comes in 2 series ,9 slots and 18 slots.



PASSIVE BACKPLANE	ACTIVE BACKPLANE
-Only 1slot	- Many slots
-no or very little additional circuitry in S7 400 plc	-necessary circuitry to - Control communication Between slots. -IN S7-400 PLC CPU can be Placed in central rack - USED

And universal rack.

POWER SUPPY MODULES

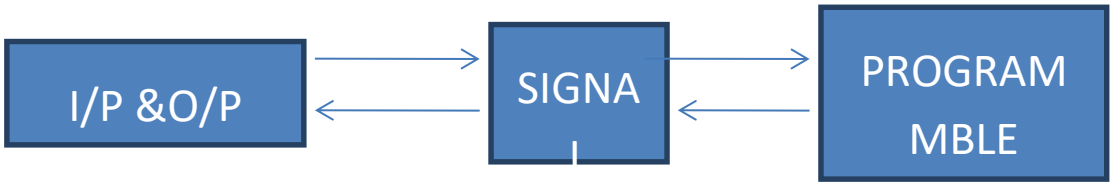
- POWER SUPPLY MODULES provide required level of regulated power supply to the different modules in the rack via system back plane bus.
- They donot provide load voltages for the signal modules.
- 220v AC UPS power supply is given to the power supply module of PLC. - It generates 5v/24v DC.

CPU MODULES

- The brain of the whole PLC is CPU MODULES. This module typically lives in the slot besides the power supply.
- The CPU has Different operating modes. - In programming mode it accepts the downloaded logic from a pc.
- Programming editing c an be done in this stop mode.
- The CPU is then placed in run mode so that it can execute the program & operate the process.
- Memory reset mode is used to reset the memory of CPU.

SIGNAL MOSULES

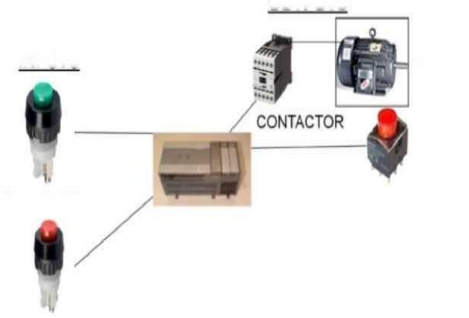
- It provides an interface for the field I/P and O/P devices to the programmable controller.



-
- Input : It carries the signal from the process box to the controller.
- They are 3 types–Digital input
- -analog input
- -variable frequency input

INPUTS are 3 types:

Digital input	Analog input	Variable Frequency
-Push button switch	-Thermocouple	-Encoder
-Selector switch	-Temp transmitter	-Flow meter
-Proximity Switch	-Pressure Transmitter	
- Strain gauge		



PUSH BUTTON SWTICH

A switch button or simply button is a simple switch

Mechanism for controlling some aspects of a machine

Oraprocess. Buttons are typically made out of

PLC hard material , usually plastic or metal. The surface is usually

flat or shaped to accommodate the human finger **push buttons**

or hand, sp as to be easily depressed or pushed .Buttons

Are most often biased switches, although many un-biased buttons still require a spring to return to their un-pushed state.

PROXIMITY SWITCHES

Proximity switches opens or closes an electrical circuit when they make contact with or come within a certain distance of an object. Proximity switches are most commonly used in manufacturing equipment, robotics, and security systems**.**

OUTPUTS

The O/P transmits the signal and displays the status of the status of the connected o/p points.

OUTPUT

Digital o/p	Analog o/p
-Lamp	-control valves
-Pilot light	-servo valves
- LED	-Proportional valve

- Solenoid valve -Drives - Contactor

Digital output

A discrete output is either in an *ON or* OFF condition. Solenoids, contactors coils, lampsare example *of* devices connected to the Discrete *os*diode outputs. Below, the lamp can iie turned *ON os* OFF by the PLC output d is connected to.

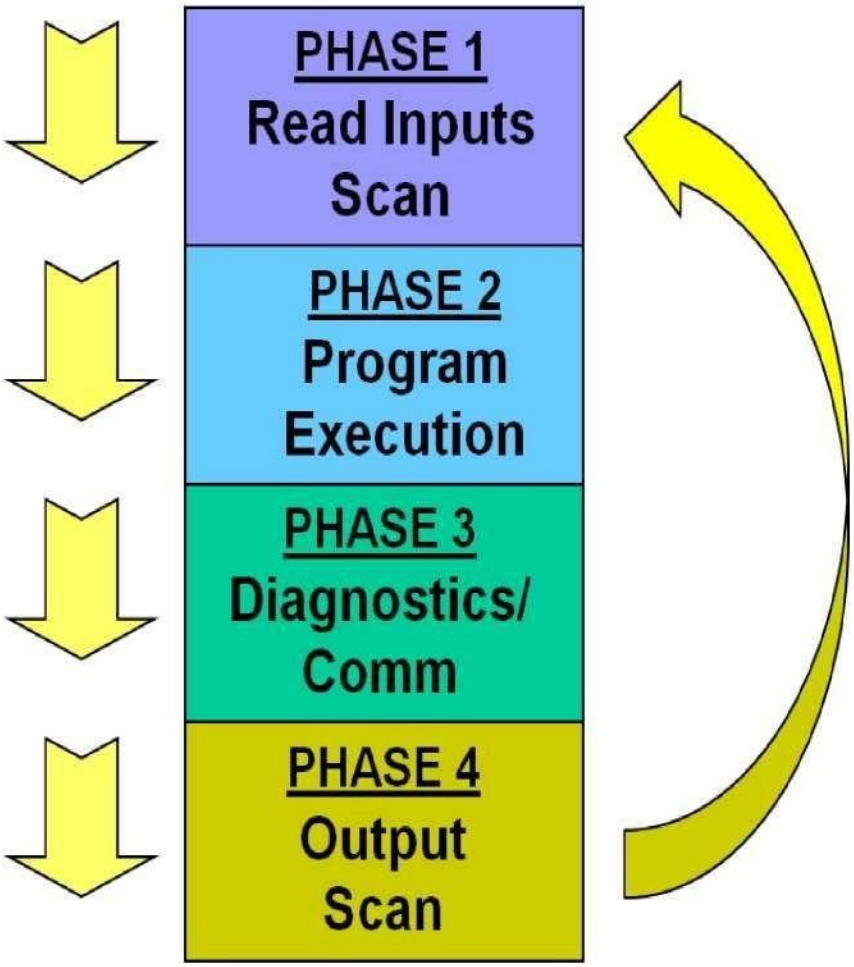
Analog Output

An analog output is an output signal that *has a* continuous signal. Typical outputs may vary from to 20mA, 4 to 20Ma or0to10V.

4.6. PLC OPERATION

Basic Function of a Typical PLCRead all field input devices via the input interfaces, execute the user program stored in application memory, then, based on whatever control scheme has been programmed by the user, turn the field output devices onor off, or perform whatever control is necessary for the process application. This process of sequentially reading the inputs, executing the program in memory, and updating theoutputs is known as scanning.

While the PLC is running, the scanning process includes the following four phases, which are repeatedcontinuously as individual cycles of operation.



HASE 1 – Input Status scan

A PLC scan cycle begins with the CPU reading the status of its inputs. PHASE 2– Logic Solve/Program Execution

The application program is executed using the status of the inputs PHASE 3– Logic Solve/Program Execution

Once the program is executed, the CPU performs diagnostics and communication tasks PHASE 4 - Output Status Scan

An output status scan is then performed, whereby the stored output values are sent to actuators and other field output devices. The cycle ends by updating the outputs.

As soon as Phase 4 is completed, the entire cycle begins again with Phase 1 input scan.

The time it takes to implement a scan cycle is called SCAN TIME. The scan time composed of the program scan time, which is the time required for solving the control program, and the I/O update time, or time required to read inputs and update outputs. The program scan time generally depends on the amount of memory taken by the control program and type of instructions used in the program. The time to make a single scan can vary from 1 ms to 100 ms.

4.7. PLC COMMUNICATION

Common Uses of PLC Communications Ports

- Changing resident PLC programs - uploading/downloading from a supervisory controller (Laptop *ot*desktop computer).
- Forcing I/O points and memory elements from *a* remote terminal.
- Linking *a* PLC into *a* control hierarchy containing several sizes *of* PLC and compute).
- Monitoring date *and* alarms, etc. via printers or Operotor Interface Units (Ol/s). **Serial Communications**

PLC communications facilities normal provide serial transmission of information.

Common Standards

RS 232

- Used in shoV-distcnce computer communications, with the majority of computer harOwaro and periiDherds.
- Has *a* maximum effective distance of approx. *30* m *ae O600* baud.

Local Area Network (LAN)

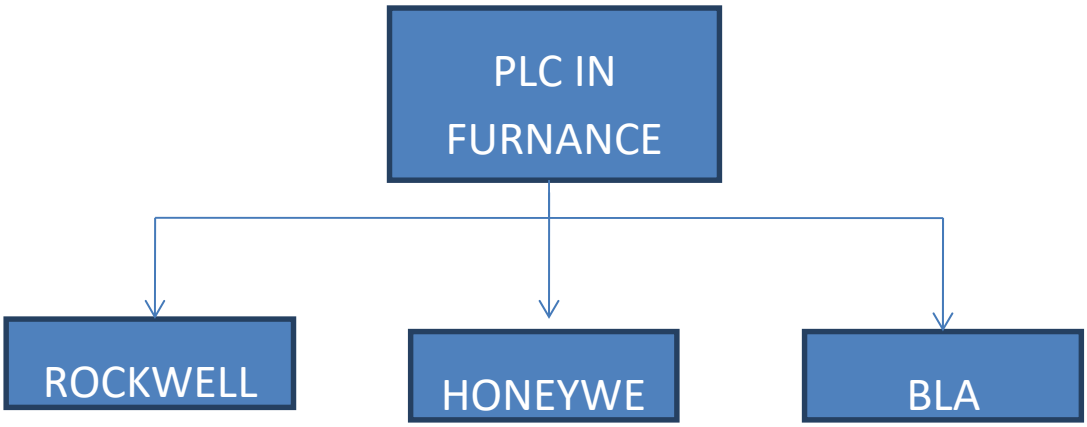
Local Area Network provides a physical link between all devices plus providing overall data exchange management or protocol, ensuring that each device can “talk” to other machines and understand data received from them.
LANs provide the common, high-speed data communications bus which interconnects any or all deviceswithin the local area.
LANs are commonly used in business applications to allow several users to share costly softwarepackages and peripheral equipment such as printers and hard disk storage. RS 422 / RS 485: Used for longer-distance links, often between several PCs in a distributed system. RS 485can have a maximum distance of about 1000 meters.

Examples of PLC Programming Software:

1. Allen-Bradley – Rockwell Software RSLogix500
2. Modicon - Modsoft
3. Omron - Syswin
4. GE-Fanuc Series 6 – LogicMaster6
5. Square D- Power Logic
6. Texas Instruments – Simatic

7. Telemecanique – Modicon TSX Micro

4.8. PLC IN FURNANACE AREA



FUNCTIONS -Hydraulics ON/OFF -Combustion control -charging

-Door operation (Heating of slabs) -Extractor

-Walking beam operation -Discharging Table -Charging table reference

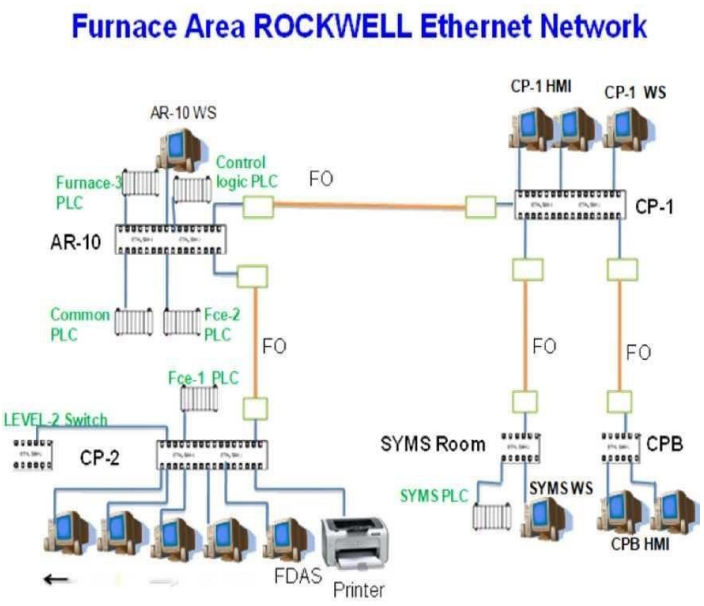
No. OF PLCPLC

ROCKWELL PLC	**HONEYWELL PLC**	**BLA**
-Furnace #1 PLC	-Furnace #1PLC	-Only one
- Furnace #2PLC	- Furnace #2PLC	
-Furnace #3 PLC	-Furnace #3 PLC	
-Common PLC		
-SYMS PLC		

This diagram can be used to understand the complete working of automation systems of HSM. Networkswitches are distributed all along special rooms like AR 1 0, AR 7 etc. The whole control is governed byoperators in various areas. Most of the operators operate from CP 2. This is a special control room locatedwithin HSM. As it is clear from diagram most operators are

present in CP 2 area. There are various types ofnetworkswitches with different types of data handling techniques.

1. Earlier in HSM there was only Furnace 1 .So PLC structure was designed accordingly keeping in mind onlyFurnace #1 . But due to increased production the need was felt to introduce furnace #2 and then at lastFurnace #3. This made automation of HSM very complex. However it is much better and advanced thanolder times due to advent of new and very fast types of data handling and data transfer. As for example wemay consider the



use of Data highway (DH) as one of the most primitive ways of data handling usedearlier(Although it is used till date, but rarely mainly due to its slow speed which is really a big disadvantage
in today's challenging economic environment). Now a day's Ethernet data cables are used which have amuch higher speed and can handle much more data than that of other earlier devices used in Data communication.

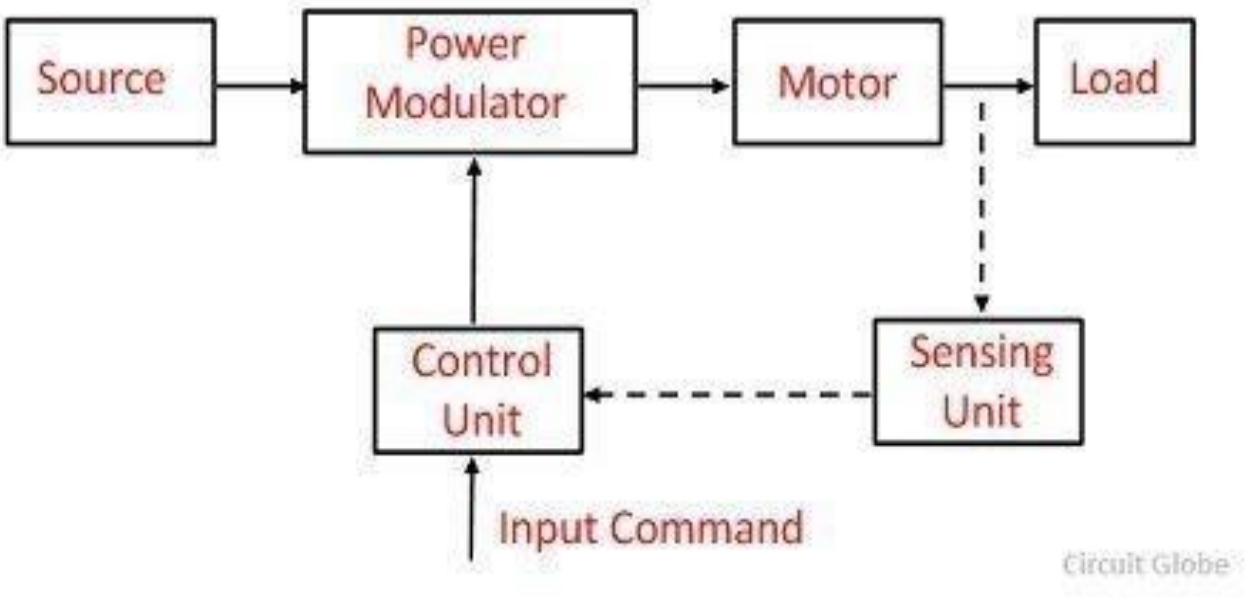
DRIVE SYSTEM

Nowadays, modern power electronics and drives are used in electrical as well as mechanical industry. The power converter or power modulator circuits are used with electrical motor drives, providing either DC or AC outputs, and working from either a DC (battery) supply or from the conventional AC supply. Here we will highlight the most important aspects which are common to all types of drive converters. Although there are many different types of converters, all except very low-power ones are based on some form of electronic switching. The need to adopt a switching strategy is emphasized in the Wrist example, where the consequences are explored in some depth. We will see that switching is essential in order to achieve high-efficiency power conversion, but that the resulting waveforms are inevitably less than ideal from the point of view of the motor. The thyristor DC drive remains an important speedcontrolled industrial drive, especially where higher maintenance cost associated with the DC motor brushes (c.f. induction motor) is tolerable. The controlled (thyristor) rectifier provides a low-impedance adjustable DC voltage for the motor armature, thereby providing speed control.

5.1. ELECTRICAL DRIVES AND THEIR BLOCK DIAGRAM

An electrical drive system has the following components

1. Electrical machines and loads
2. Motor
3. Power modulator
4. Sources
5. Control unit
6. Sensing unit



[*BLOCK DIAGRAM OF DRIVE SYSTEM*]

Types of Power Modulators

In the electric drive system, the power modulators can be any one of the following:

1. Controlled rectifiers (AC to DC converters)

2.Inverters (DC to AC converters)

3. AC voltage controllers (AC to AC converter)

4. DC choppers (DC to DC converters)

5. Cycloconverters (frequency conversion)

Electrical Sources

Very low power drives are generally fed from single-phase sources. Rest of the drives are powered from a three-phase source. Low and medium power motors are fed from a 400 V supply. For higher ratings, motors may be rated at 3.3 kV, 6.6 kV, and 11 kV. Some drives are powered from the battery.

Control Unit

Control unit for a power modulator is provided in the control unit. It matches the motor and power converter to meet the load requirements.

Sensing Unit

1. Speed sensing: Speed can be sensed by using a tachometer. Wind speed can be sensed by anemometer similarly both speed and velocity can be measured by the speedometer.
2. Torque sensing: Magnetoelastic torque sensor is used in-vehicles applications on race cars, automobile, and aircraft.

3. Position sensing: Motion can be sensed through GPS, vibrometer, and rotary encoder.
4. Current sensing and Voltage sensing from lines or from motor terminals. 5. Temperature sensing: Thermistor is a device which is used for temperature measurement.

5. 2.CLASSIFICATION OF ELECTRICAL DRIVES:

Generally classified into 3 categories:

I. Group drive

II. Individual Drive III. Multimotor Drive

Group Drive :

If several group of mechanisms or machines are organized on one shaft and driven or actuated by one motor, the system is called a group drive or shaft drive.

Advantage : Most

Economical

Disadvantage:

1. Any Fault that occurs in the driving motor renders all the driving equipment idle.

2. Efficiency low because of losses occurring in the energy transmitting mechanisms (Power loss)

3. Not safe to operate.

4. Noise level at the working spot is high.

5. Flexibility.

Single motor drives a no of machines through belt form common shaft.***Individual Drive:***

1. If a single motor is used to drive or actuate a given mechanism and it does all the jobs connected with this load , the drive is called individual drive.

2. All the operations connected with operating a lathe may be performed by a single motor.

3. Each motor is driven by its own separated motor with the help of gears , pulleys etc.

Disadvantage:

Power loss occurs.

Multi Motor Drive:

· Each operation of the mechanism is taken care of by a separate drive motor.

· The System contains several individual drives each of which is used to operate its own mechanism.

. Separate motors are provided for actuating different parts of the driven mechanism.

Advantage :

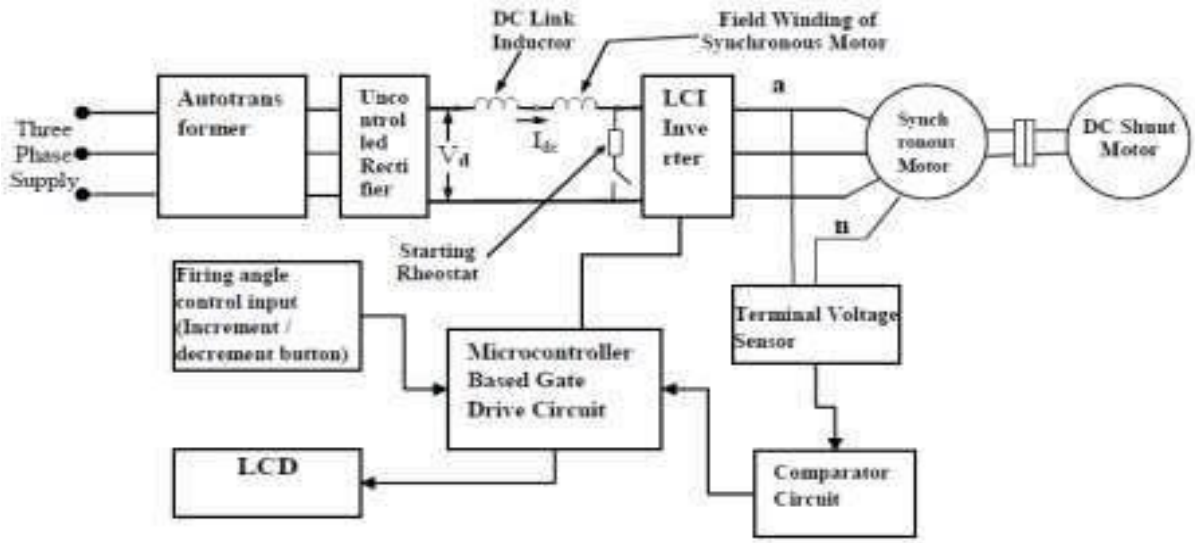
1. Each Machine is driven by a separated motor it can be run and stopped as desired.
2. Machines not required can be shut down and also replaced with a minimum of dislocation.
3. There is a flexibility in the installation of different machine's.
4. In the case of motor fault, only its connected machine will stop where as others will continue working undisturbed.
5. Absence of belts and line shafts greatly reduces the risk of a accidents to the operating personnel.

Disadvantage:

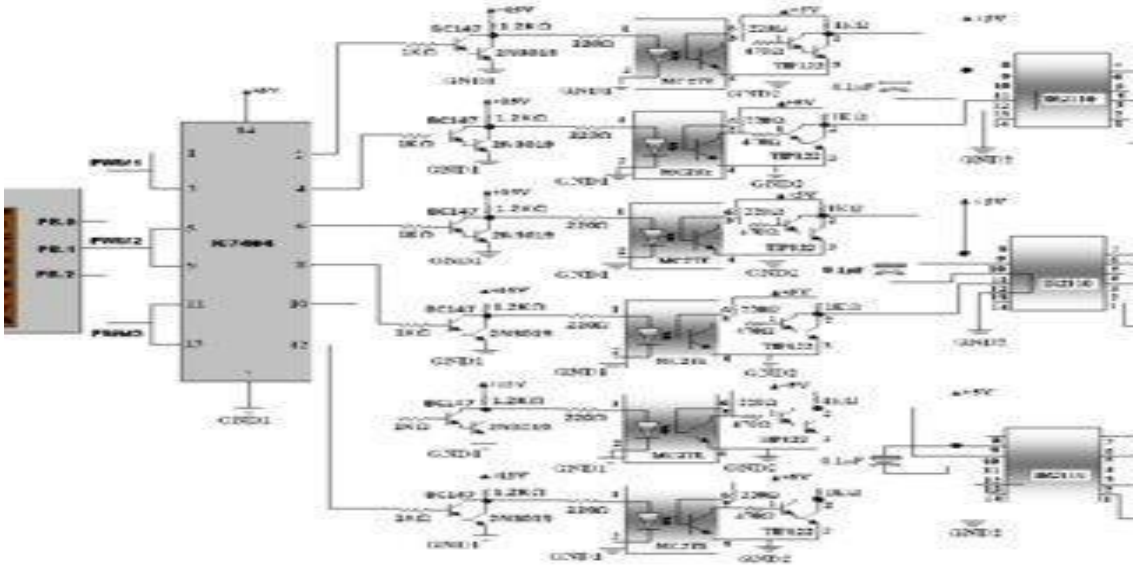
Initial high cost.

5.3. MICROPROCESSOR BASED ELECTRICAL DRIVES

Microprocessor and microcontroller based electrical drives are DC motor drives, inductionmotor drives and traction motor drives. A microprocessor based control system can also be built where a phase controlled rectifiersupplies a DC motor.



[*MICROCONTROLLER BASED DC DRIVES*]



[*MICROCONTROLLER BASED AC DRIVES*]

In general, the main task of the electrical drive is the motion control of mechanisms. An electrical drive is an automatic control system with a number of feedbacks where different automatic control principles, such as error driven feedback control, model-basedcontrol, logical binary control, or fuzzy logic control methods, are used. Depending on a particular technical solution and selected control principle, different sensors for measuring of currents, voltages, velocity, acceleration, torque, etc., in an electrical drive are used. Another information, like

pressure signal for controlling pumps and compressors, air humidity and/or temperature signal for controlling of fans, etc., is also necessary.

5.4 APPLICATIONS OF ELECTRICAL DRIVES

Electric drives are used in boats,

1. traction systems,

2. lifts, cranes, electric car, etc.

3. They have flexible control characteristics. The steady state and dynamic characteristics of electric drives can be shaped to satisfy the load requirements.

4. They are available in wide range of torque, speed, and power.

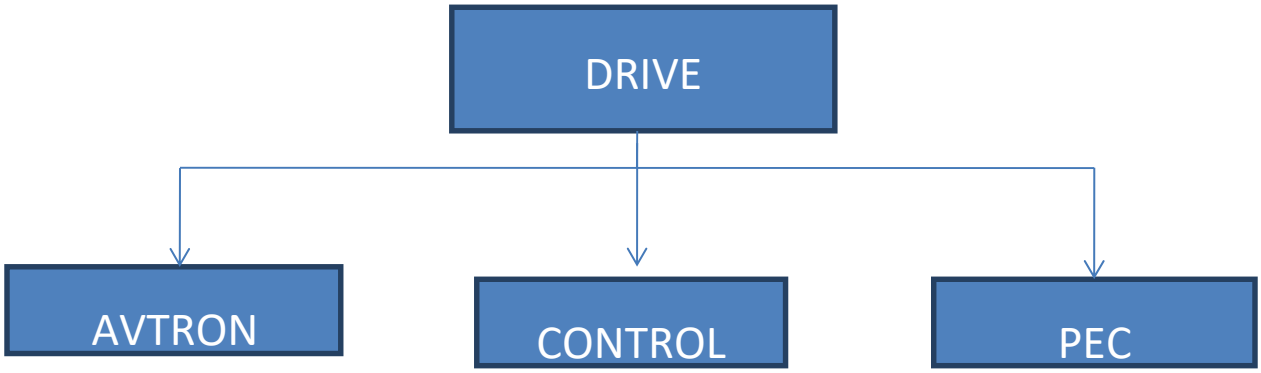
5. They can be started instantly and can immediately be fully loaded.

6. They can operate in all the four quadrants of the speed-torque plane.
7. They are adaptable to almost any operating conditions such as explosive and radioactive environments.

6.ADVANTAGES OF ELECTRICAL DRIVES:

- Cost is too low as compared to another system of the drive.
- The system is more simple and clean.
- The control is very easy and smooth.
- Flexible in the layout.
- Facility for remote control.
- Transmission of power from one place to other can be done with the help of cables instead of long shafts, etc.
- Its maintenance cost is quite low.

• It can be started at any time without delay.



-Slab charging

-slab charging table

-Slab charge

-slab extractor

-Slab discharging

-F1DT&F2DT

(Furnace #1&#2

Discharge table)

5.4.Mentor MP

25A to 7400A Two or four quadrant operation (regenerative)

24V - 480V / 500V - 575V / 500V - 690V

Mentor MP brings DC drive technology up to date, enabling existing and new DC motors to provide economic and productive service. DC drive technology remains cost effective, efficient and is relatively simple to implement. For new applications DC drive provides many advantages, especially for regenerative and high power applications.

FEATURES:

Greater motor field control

- Built in field controller as standard
- Gives excellent field control for the majority of DC motors

- Reduces the need for external components

Enhanced field control with FXMP25

- The FXMP25 may be controlled digitally by using a standard RJ45 connection, allowing set-up by standard drive parameters.The FXMP25 can also function in standalone mode using its integrated keypad and display.

Enhanced system design

- The heatsink cooling fans are intelligently controlled and only run when required, thus increasing reliability and reducing maintenance
- Eighteen different option modules allow customisation of the drive, including fieldbus, Ethernet, I/O, extra feedback devices and motion controllers.
- The drive system designer is able to embed automation and motion control within the drive, eliminating communications delays that reduce performance.

Fast set-up, configuration and monitoring

- Quick and easy to set-up
- Can be configured using optional removable keypads
- Advanced autotune features help you get the best performance from your machine
- PC software and Smartcard tools for rapid commissioning
- Intelligent networked system with CTNet
- Program inbuilt controller with SyPTLite
- Develop tailored solutions for applications modules with SyPTPro
- Option modules for all common Industrial Ethernet, fieldbus networks **Ease of migration**

- Mentor MP has been designed so existing Mentor II customers can easily migrate to the new platform
- All power terminal locations and mounting points have been retained
- Mentor MP has a much smaller frame size than the 900 A Mentor II with paralleling options to offer high power density
- CT Soft has a built in migration wizard to assist with the transfer of drive parameters and programs
- Smaller cable requirements make connections within the cubical easier. Construction of a custom-made bus-bar is not required

Motor Field Control

- Built in field controller as standard in every Mentor MP • Gives excellent field control for the majority of DC motors.
- Reduces the need for external components

5.5.PEC DRIVE :

In HSM all main mill drives are controlled using PEC drives.

We have 29 PEC drives.

Drive can be broken into 3 main components:

1. **PEC REGULATOR**:

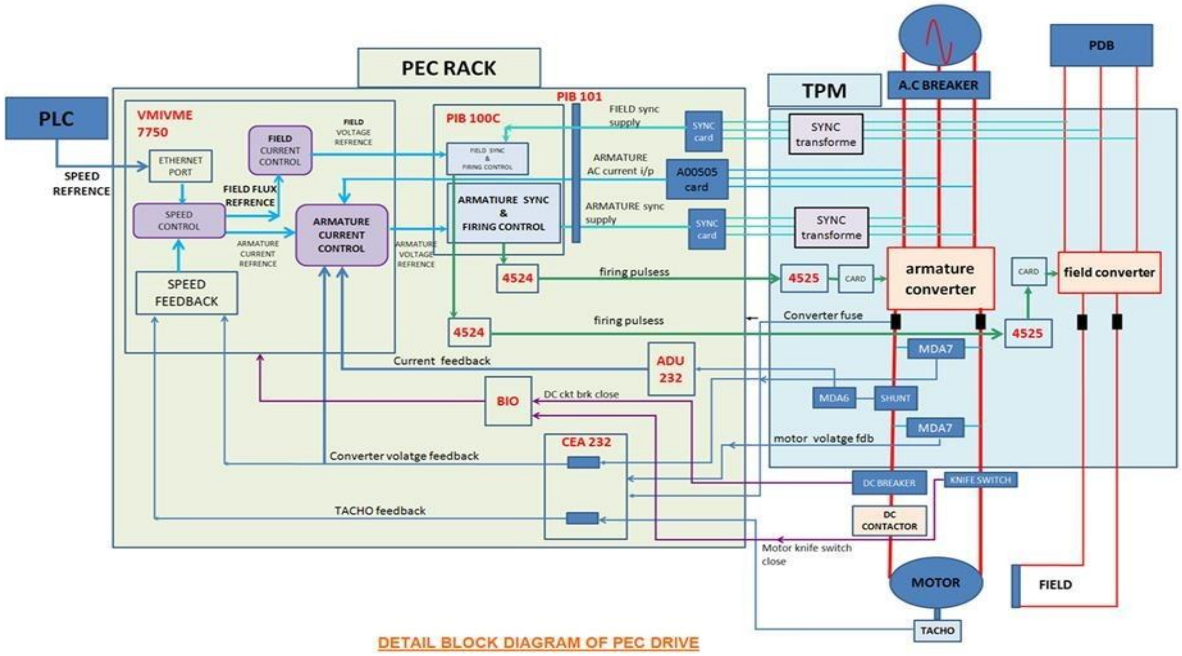
It houses PEC rack (the controller), finder relays, MCB's and relays. Main function of the controller is to receive both, the speed reference as well as the speed & current feedback and then according to the demand it generates the firing angle. Firing pulse is then converted to the light signal by 4524 card for sending it to the TPM panel.

2. **TPM (Thyristor Power Module):**

It houses mainly converter unit (armature thyristors & field thyristors), sync transformer, suppressor circuit, firing board (4525) & measuring units (MDA6 & MDA7). Here, 4525 receives the firing pulse signal & covert it back to electrical signal. This pulse is use to fire the thyristors. Thus the AC power is now been converted to DC power.

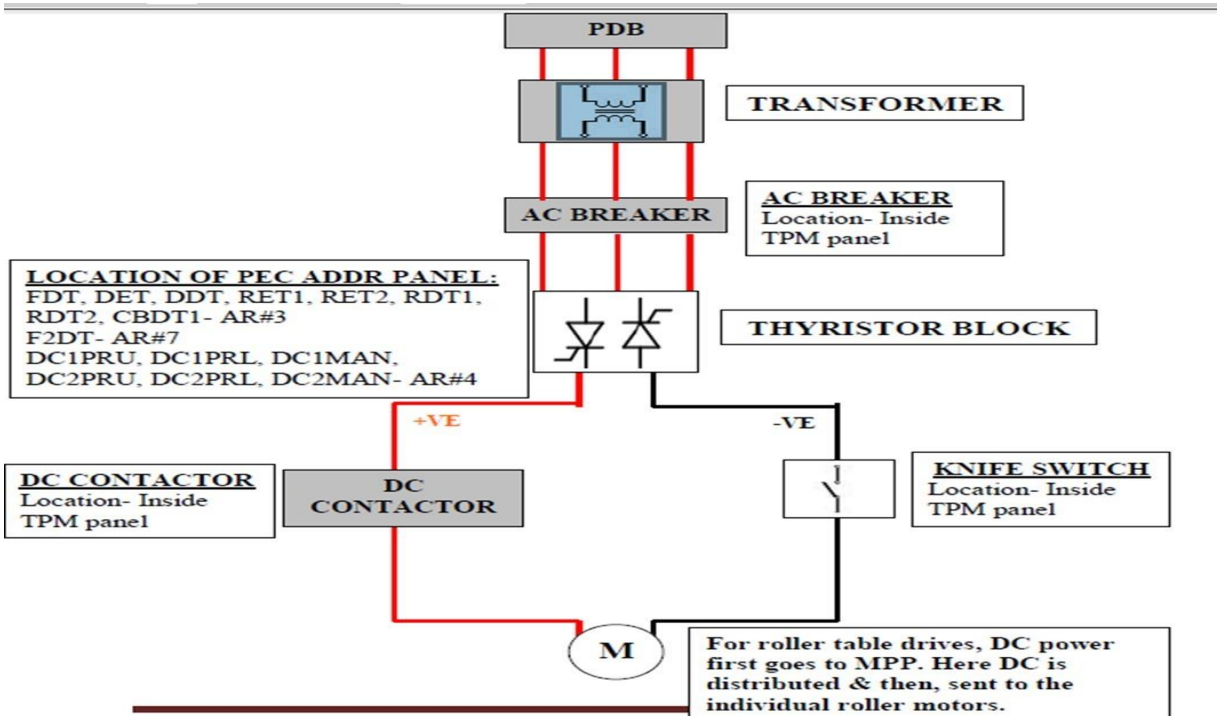
3. **MOTOR:**

Finally the DC voltage goes to the DC motor. Tacho is connected to the shaft of the motor for providing the speed feedback. MDA 6 is used for current feedback & MDA 7 is used for voltage feedback.



DETAIL BLOCK DIAGRAM OF PEC DRIVE

BASIC POWER FLOW DIAGRAM FOR SMALL DRIVES (PEC ADDR) IN HSM:



The above schematic diagram shows the circuit diagram of small drives.The power entering the transformer is 33kv from the substation which comes to the PDB(power distribution).The 3 phase supply is then stepped down to 1000 V through the step down transformer. Further the voltage goes

through the AC BREAKER which is used for the protection and isolation of the circuit.The dual convertor converts AC current to DC current.The two converters are connected in opposite direction one being forward biased and other reverse biased. The forward biased convertor facilitates the motion of motor in forward direction and the reverse biased convertor facilitates the direction of motor in reverse direction. The positive of the convertor goes to the DC CONTACTOR which is used as a protection device and used for the electrical isolation of circuit.the positive goes to the manually operated knife switch it is also a safety device and it provides manual isolation . Both the positive and negative terminal goes to the motor and the motor thereby starts running.

5.6.PRESENCE & CLASSIFICATION OF DRIVES in HSM

FURNACE ENTRY SIDE DRIVES	**DRIVE TYPE**	**RATINGS**
Slab receiving table	MENT	550A
Furnace approach table	MENT	550A
Furnace 2 approach charging table 1	MENT	210A
Furnace 2 approach charging table 2	MENT	210A
Furnace connecting table	MENT	210A
Furnace 1 approach charging table 1	MENT	420A
Furnace 1 approach charging table 1	MENT	420A
Furnace 2 left slab charger	MENT	213A
Furnace 2 right slab charger	MENT	213A
Furnace 1 left slab charger	MENT	420A
Furnace 2 right slab charger	MENT	420A
FURNACE DELIVERY SIDE DRIVES		
Slab reject table	PEC	532A

Furnace 2 delay table	PEC	1537A
Furnace 1 delay table	PEC	1537A
Descalar entry table	PEC	806A
Furnace 2 left slab extractor	MENT	213A
Furnace 2 right slab extractor	MENT	213A
Furnace 1 left slab extractor	MENT	420A
Furnace 1 right slab extractor	MENT	420A
ROUGHING MILL DRIVES		
Descalar delivery table	PEC	750A
Roughing Mill entry table 1	PEC	545A
Roughing Mill entry table 2	PEC	1000A
Roughing Mill entry feed roll	MENT	420A
Edger operator side	PEC	2318A

Edger drive side	PEC	2318A
Edger adjust	PEC	533A
Roughing Mill upper	PEC	2418A
Roughing Mill lower	PEC	2418A
Roughing Mill screw down	PEC	533A
Roughing Mill exit feed roll	MENT	420A
Roughing Mill delivery table 1	PEC	1000A
Roughing Mill delivery table 2	PEC	545A
Coil box delay table 1	PEC	820A
Coil box delay table 2	MENT	900A

Coil box delay table 3	MENT	900A
Coil box entry roll	MENT	210A
Coil box deflector roll	MENT	210A
Coil box top bending roll	MENT	825A
Coil box lower bending roll	MENT	825A
Coil box bending roll gap adjust	MENT	112.5A
Coil box Cradle Roll 1	MENT	825A
Coil box Cradle Roll 2	MENT	420A
Coil box pinch roll upper	MENT	630A
Coil box pinch roll lower	MENT	630A
Crop shear measuring roll	MENT	37.5A
Crop shear entry table	MENT	630A
FINISHING MILL		
Scale breaker upper pinch roll	MENT	630A
Scale breaker lower pinch roll	MENT	630A
Descalar pinch roll	MENT	200A
Finishing mill 1	PEC	2760A
Finishing mill 2	PEC	2760A
Finishing mill 3	PEC	2760A
Finishing mill 4	PEC	2760A
Finishing mill 5	PEC	2760A
Finishing mill 6	PEC	2760A
Down Coiler 1 wrapper roll 1	MENT	320A
Down Coiler 1 wrapper roll 2	MENT	320A

Down Coiler 1 wrapper roll 3	MENT	320A
Down Coiler 1 mandrel	PEC	640A
Down Coiler 1 pinch roll upper	PEC	568A
Down Coiler 1 pinch roll lower	PEC	568A
Down Coiler 2 wrapper roll 1	MENT	320A
Down Coiler 2 wrapper roll 2	MENT	320A
Down Coiler 2 wrapper roll 3	MENT	320A
Down Coiler 2 mandrel	PEC	640A
Down Coiler 2 pinch roll upper	PEC	530A
Down Coiler 2 pinch roll lower	PEC	530A

Mentor Drive Ratings	**No of Drives**
M210	**10**
M420	**22**
M550	**2**
M825	**3**
M900	**2**
Total	**39**

Function of PLC and Drives.

Function	PLC	Drives
Slab movement on charging table	Rockwell – Commech PLC, SYMS PLC BLA – FA Controller	Autrom DC Drive Control Technique DC Drive
Slab charging inside furnace	BLA – FA Controller	Control Technique Drive
Slab Discharging from furnace	BLA – FA Controller	Control Technique Drive
Slab movement on discharge table	BLA – FA Controller	Control Technique Drive ALSTOM(PEC)
Walking beam movement (inside furnace)	Rockwell PLC	NO DRIVES
Door operation	Rockwell PLC	NO DRIVES
Furnace hydraulics control	Rockwell PLC	NO DRIVES
Slab heating inside furnace	Honeywell \ TDC 3000 Experion C300	NO DRIVES

CONCLUSION:

I, G. SHUBHAM SREE would like to conclude by saying that completion of this project was an extremely enriching and informative experience. This project has been a great source of knowledge for me throughout the training period. It is my pleasure to have spent an amazing one month in one of the leading and best steel manufacturing industry. I got the opportunity to learn something which I hadn't come across during my educational career so far.

The HSM department plays a crucial role in the steel making process at TATA STEEL. Each process is controlled by the automation system designed especially for the machineries in the HSM. There are unique programs written for each machinery which is transferred from different PLCs and DRIVES through Ethernet Global Data (EGD) and TCP/IP.

Apart from all this, there are so many protocols involved to keep the work on the right track and there are no rooms for errors in any of these protocols, as even the slightest of carelessness could lead to losses worth billions of money. So, highly qualified teams in all the departments make sure that everything works out by proper rules and regulations of the company and hence shutdowns are avoided.