

رير عن تة

التدريب الميداني

الذي تم في الفترة من 27 / 8 / 2022 م وحتى 12 / 9 / 2022 م

فني

مصنع: حديد عز - السادات

مقدم من الطالب / اسلام سعيد سعد طه

المقيد بالفرقة الثانية بقسم الهندسة الكهربائية

في العام الدراسي 2021 م / 2022 م

Mansoura University

سبتمبر 2022 م



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

Index

Topic	Page
Thanks and appreciation	IV
figures list	V
Tables List	VII
Abbreviations List	VII
preface: The Objective of the training	1
Overview of the training	2
Ezz Steel Factory - Sadat	3
1 Components of electrical substation	4
1-1 Transformers	4



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

1-1-1 Transformers Cooling	5
1-1-2 Transformer characterization	6
1-2 Circuit Breakers	8
1-2-1 Types of Breakers used in industry	8
1-2-2 Breaker Components	10
1-2-3 connecting & disconnecting operations	11
1-3 power factor correction	12
1-4 electrical filters	12
1-5 thyristor	13
2 Electrical components of melt-shop	14
2-1 Electrical Arc Furnace	15
2-2 Switch Gears	18



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

2-3 furnace transformer connection	19
2-2-4 Instruments	20
3 Electrical equipment in rolling mill	21
3-1 11kv Switch gears	21
3-2 power transformers	23
3-3 DC motors	25
Engineering standards, safety, and risk management	27
Summary	29
References	30
Diagrams	31



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

Thanks and appreciation

Thanks to my parents, who have always supported me in all stages of my life in general and during my training, whether morally or financially. I also thank Prof. Mustafa Al-Shibiny - Professor of Electrical Machines and General Supervisor of Field Training at the College, strives throughout the semester to get us all possible opportunities in the best companies and Prof. Naji Al-Qalashey Head of the Electrical Engineering Department at the College of Electrical Engineering for all the guidance he gave us throughout the training period until writing the report.

I thank all university project engineers for all the information they provided us during training in university projects. I thank the management of Ezz Steel Company - Sadat for providing the great training opportunity that benefited me on the scientific and practical level, and I thank every engineer, manager, and worker I dealt with in the company for their beautiful cooperation and endeavor to provide their knowledge and assistance.

Finally, I would like to thank my friends in the training for their assistance in what I could not fully understand during the training, and their approach, which made the training environment a cooperative and beneficial environment instead of a competitive environment.



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

figures List

Figure	Description	Page
Figure (2-1)	circuit breaker Components	10
Figure (2-2)	connecting & disconnecting operations	11
Figure (2-3)	Processes in melt -shop	14
Figure (2-4)	EAF	15
Figure (2-5)	scrap buckets	16
Figure (2-6)	electrical view of furnace	17
Figure (2-7)	electrode	17
Figure (2-8)	switch gears	18
Figure (2-9)	power arc transformer	19
Figure (2-10)	some of the instrument used in the factory	20
Figure (2-11)	rolling mill factory	21
Figure (2-12)	rolling products	21
Figure (2-13)	Switch gears in rolling mill	22



جامعة المنيفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

Figure (2-14)	Switch gear protection	22
Figure (2-15)	rolling mill transformer components	23
Figure (2-16)	transformers connections	24
Figure (2-17)	motor components	25
Figure (2-18)	air flow switch & heat exchange thermal switch	26
Figure (2-19)	water flow switch	26
Figure (2-20)	warning and guidance signs everywhere	28
Figure (2-21)	Supplying protective safety clothes and equipment	28
Figure (2-22)	Single line diagram of EZZ steel factory	29
Figure (2-23)	Single line diagram of melt-shop	32
Figure (2-24)	Single line diagram of rolling mill 2	33
Figure (2-25)	single line diagram of factory utilities	34
Figure (2-26)	3d diagram of the furnace	35
Figure (2-27)	PLC (programmable logic control) system	36



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

Tables List

Table	Description	Page
Table (2-1)	Describes some characteristics, values, and units of a power transformer	7
Table (2-2)	Indicate the names of the components of the power transformer used in rolling mill	23
Table (2-3)	Indicate the names of the components of the DC motor used in rolling mill	25

Abbreviations List

Abbreviation	Word	Description
C.B	Circuit Breaker	A circuit breaker cuts off the electricity when the current exceeds the permissible limit
DRI	Direct Reduction Iron	Direct reduction iron is the iron produced after purification of iron ores in nature from impurities
EAF	Electrical Arc Furnace	Electric arc furnace is the main furnace for
LRF	Ladle Refining Furnace	Process iron to required temperature



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

Preface

Knowledge alone is not sufficient to form human thought, it must be accompanied by a practical application in which the person pours his theoretical knowledge to gain in return the skill and the impact of that knowledge on reality by employing the natural and mathematical sciences to benefit humanity in its daily life, it was important for every engineer to take every opportunity for practical participation. Initially, my training was at the Ezz Steel Factory in Sadat City, and the purpose of my choice was that the factory is like an integrated industrial facility. Besides it is a huge factory with a production capacity estimated at one million tons of rebar annually, it is also equipped with automatic packing equipment, Electricity sub-station, three water treatment units, two oxygen production units, and three automatic generators.

Then, I chose Menoufia University projects because it was a good opportunity to learn more About the light current and safety systems in the various university facilities.



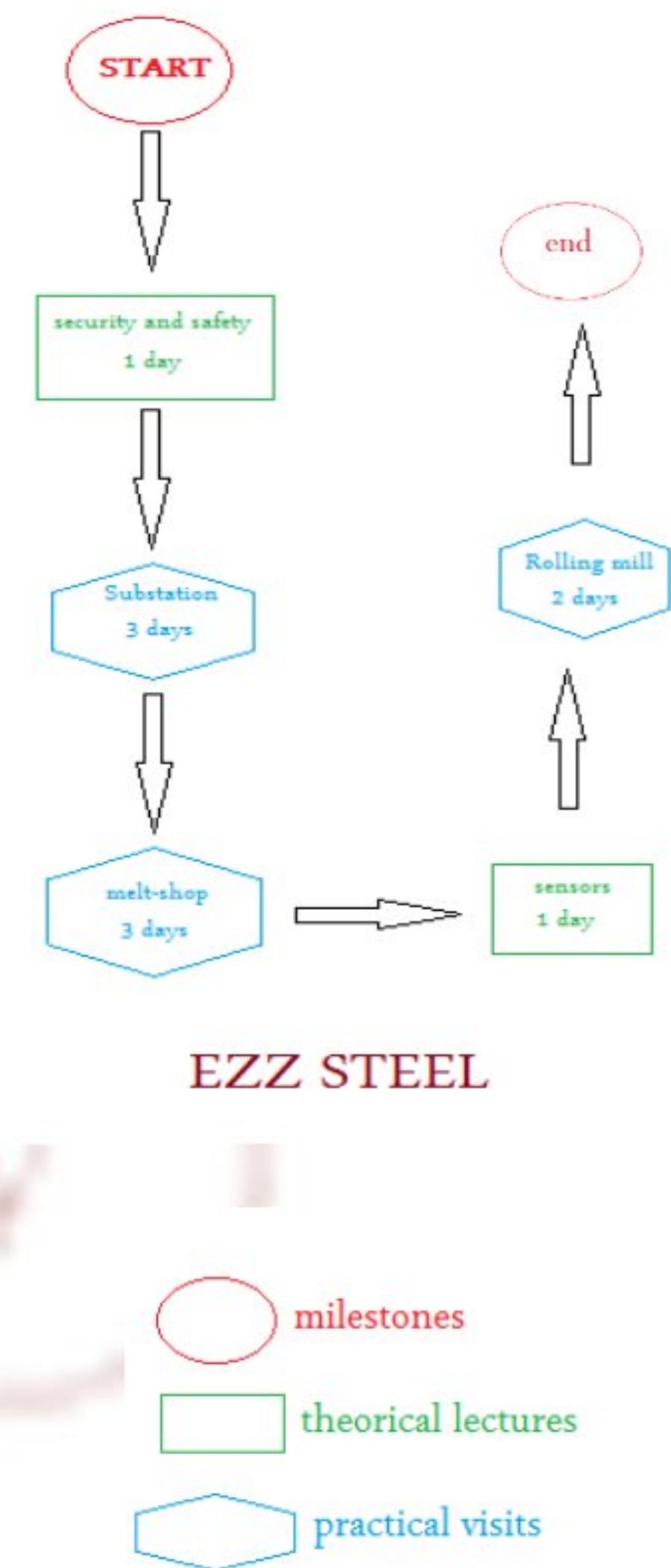
Training Overview

The field training took place during a cumulative fifteen days, during which was divided into:

1. The first day included an introductory lecture of the factory and industrial processes inside it, and lectures on the elements of engineering institutions and on the occupational safety and security. And lecture on maintenance management.

1. **The first phase:** included three days in the factory's electricity substation and the most important components in it

2. **The second phase:** included three days in melt-shop, knowing the processes of melting and formatting iron in billet molds ready for rolling and ended with a simple course on sensors.





Faculty of Engineering
كلية الهندسة



Ezz Steel -Sadat City



presenting
Islam Saeed Saad Taha



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

The production of Ezz steel-Sadat factory Is about million ton of construction iron per year, and it mainly consist of electrical substation, melt-shop, two rolling mill factories, water treatment station, utilities stations, billet yard, and scrap yard.

1 components of electrical substation

EZZ substation has two power transformers T1, T2, Static VAR compensator and series reactor.

- T1 is three phase 50HZ 220/30 KV 100/120MVA
- T2 is three phase 50HZ 220/11 KV 25/30 MVA
- Static VAR compensator 92 MVAR
- Series reactor with rated current 1800 A.

1-1 Transformers

The electrical transformer is the most expensive and the most important equipment in the electrical system. Its mission is to



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

change the values of voltage and current electromagnetically to suit the operating conditions of the equipment, region, or factory, while keeping the frequency and power values as constant as possible.

The station draws a voltage of 220 kv, then the transformers convert it to 11 kv to supply all components and facilities of the factory, and 30 kv for the furnaces.

1-1-1 Transformers Cooling

the heat formed through the transformer is produced electrical losses, and this loss reduces the efficiency of the transformer and withdraws additional power and increasing that heat will damage the transformer if it is left.

cooling material also acts as electrical insulators to isolate the transformer from the surroundings and to isolate the components of the transformer from each other. The materials used in the cooling are oil, air, and water, but the only direct cooling material is oil.



And types of cooling are:

(NONA: Natural Oil Natural Air cooling)

(NOFA: Natural Oil Forced Air cooling)

(FOFA: Forced Oil Forced Air cooling)

There is also (NOFW: natural oil forced water cooling) which uses both oil and water for cooling in special transforms

1-1-2 Transformer characterization

The characterization of the transformer is the main reference when using, buying, or connecting the transformer and includes:

- **Power:** Indicates the power of the transformer, which is apparent power due to the variance in power factor with different loads and it often written in range of values depending on type of cooling
- **Cooling method:** explained



جامعة المنوفية

كلية الهندسة بشبين الكوم

قسم الهندسة الكهربائية

برنامج هندسة القوى والآلات الكهربائية

- **Transfer ratio:** shows the ratio of the primary voltage to the output secondary voltage
- **Connection method:** written for example (DyN11), where the capital letter symbolize the method of connecting the primary, *which in this case is delta* and small letter symbolizes the method of connecting the secondary, *which in this case is star* and N symbolizes the *neutral*, which is **with star method only**. And the number refers to the angle between the primary and secondary wave as the angle with the clockwise between the hour hand and the minute hand-in this case- at 11 o'clock.
- **The insulator used in the cables:** (PVC- XLPE)

Table (1-1): characteristics of
power transformer

No.	Characteristic	Quantity
1	Apparent Power	150MVA
2	Frequency	50Hz
3	Nominal Voltage	400/63kV
4	Vector Group	YNynd11
5	Leakage Reactance	0.1373 PU
6	No-Load Loss	7.86e-4PU
7	Copper Loss	0.0018PU
8	Yoke Cross Section	4667 cm ²
9	Column Cross Section	8115 cm ²



1-2 Circuit Breakers

Circuit breakers provide effective and quick protection of the electrical circuit they open the circuit directly and stop the flow of the electrical current. The circuit breaker is distinguished from ordinary disconnect switches in that it is fed with an insulating material that speeds up the process of disconnection and connection and eliminates any sparks or heat. Finally, it does not depend on the presence of the human element always for its ability to disconnect the circuit if the current exceeds the permissible limit

1-2-1 Types of Circuit Breakers in industry

The type of circuit breakers depends on the type of insulator used:

- In the beginning, air pressure circuit breakers were made as when breaker switches on or off, instantaneous sparks occurred at a huge temperature, which cooled by the flow of Compress



جامعة المنوفية

كلية الهندسة بشبين الكوم

قسم الهندسة الكهربائية

برنامج هندسة القوى والآلات الكهربائية

air, but its disadvantage is the instability of the gas flow, it may be slow, late, or early this leads to rapid damage to the breaker

- Then, oil circuit breakers were used but they were leaking frequently and needed continuous oil change.
- Then, SF₆ gas circuit breakers were manufactured, which is a stable gas that does not decompose into its primary components and does not interact with the surrounding medium. electrical and thermal insulator.
- There are vacuum circuit breakers, which are distinguished by their long-life span of up to 30,000 separation operations.

In the factory, the last two types are used, and the SF₆ breaker is the most widely used



1-2-2 Circuit Breaker Components

The vacuum circuit breaker and the high voltage circuit breaker generally consist of six main components, as shown in Fig (2-1)

- 1) On Switch
- 2) Off Switch
- 3) Spring state.
- 4) Indicate breaker status (on/off)
- 5) Operation timer
- 6) Manual charge
- 7) key of disconnecting manual panel

Figure (2-1): circuit breaker Components





جامعة المنوفية

كلية الهندسة بشبين الكوم

قسم الهندسة الكهربائية

برنامج هندسة القوى والآلات الكهربائية

1-2-3 connecting & disconnecting operations

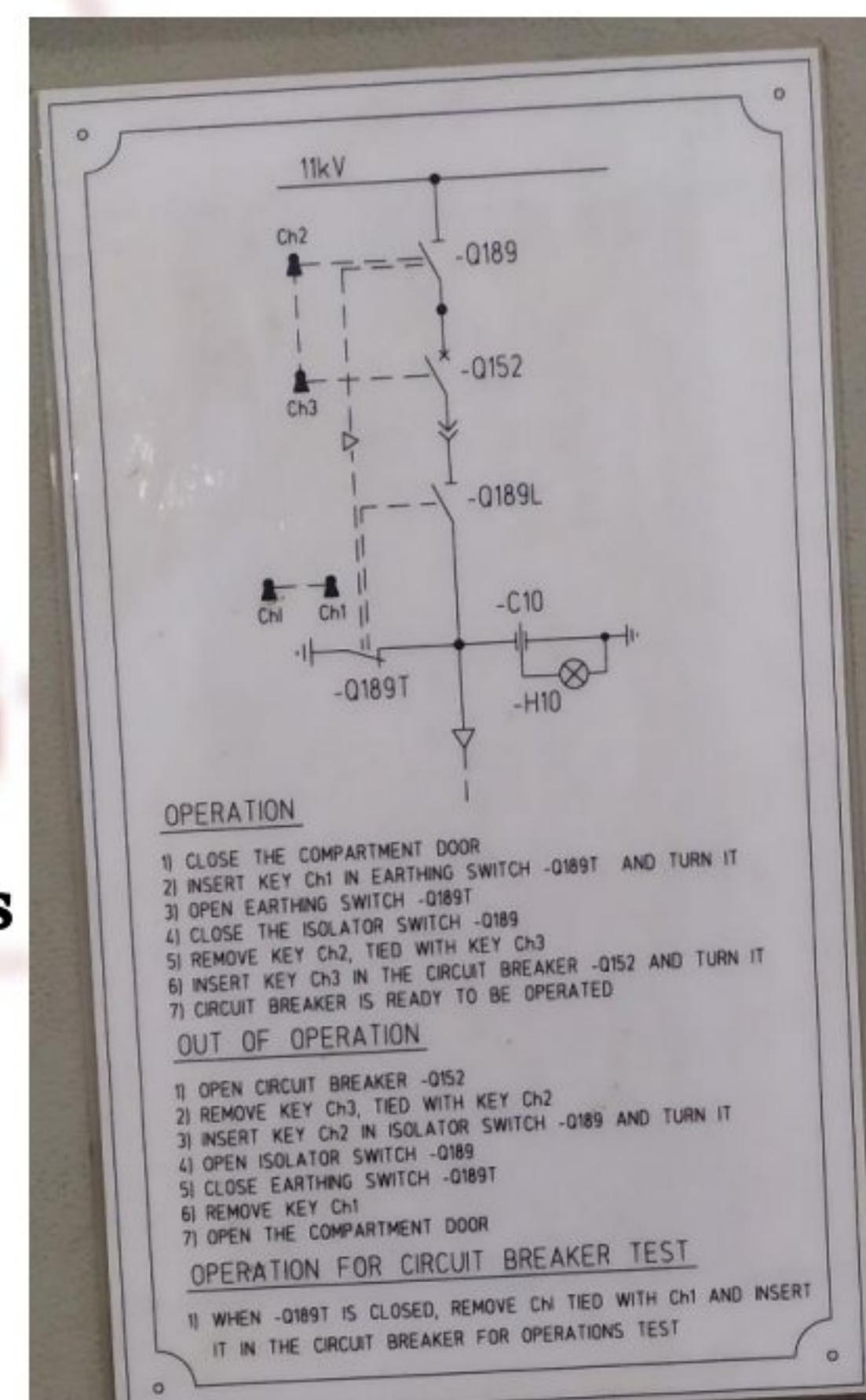
As shown in Figure (2-3), when connecting the breaker:

- 1- the earthing switch is opened ((-Q189T))
- 2- switch connected to ground is closed(-Q189L)
- 3- switch connected to busbar is closed (-Q189)
- 4- the breaker switch is closed (-Q152)

when disconnecting the switch:

- 1- the earthing switch is closed ((-Q189T))
- 2- switch connected to ground is opened(-Q189L)
- 3- switch connected to busbar is opened (-Q189)
- 4- the breaker switch is opened (-Q152)

Figure (2-2): connecting & disconnecting operations





1-3 power factor correction

Power factor is a measure of the efficiency of feeding power and the closer it is to 1 the better. During the transmission of electrical power throughout the factory, a reactive power arises that does not do any benefit in the system and thus consumes more energy for the same work, but also leads to an impact on the power of the unified network also formation of large sparks in many places in the Factory because of increased current. The power factor correction system is the elements of inductive and capacitive reactors that feed the power of the network in the factory and control its values by means of a thyristor so that it equals to the reactance in the network and fades away to get a power factor equal to approximately 1.

1-4 Electrical Filters

As a result of the large number of non-linear elements or power electronics, it produces unwanted waves that appear compounded on



جامعة المنوفية

كلية الهندسة بشبين الكوم

قسم الهندسة الكهربائية

برنامج هندسة القوى والآلات الكهربائية

the main electrical network wave and in multiple frequency, which leads to distortion of the basic wave and thus leads to thermal effects on transformers and insulators and strange behaviors for most elements of the network. This phenomenon is known as **harmonics**. This is overcome by using filter consisting of inductive and capacitive elements that allow the passage of waves of certain frequencies, which leads to smoothing the network wave.

1-5 thyristor.

It is semiconductor junction and can switch on and off very stable and the percentage of energy consumed is very small. It is used to control the switching speed in high-voltage transmission lines. The thyristor works, as it was clarified, to determine the values of inductive and capacitive reactors added to the network in the factory to correct power factor.



2 Electrical components of melt-shop

The melt-shop in Sadat City was designed and installed by Danieli in May 1998, and consisting of:

- 1- A 100-ton electric arc furnace
- 2- A 95-ton ladle furnace
- 3- A five-strand continuous billet caster
- 5- Material handling equipment.

auxiliary equipment including:

- A 120-MVA electric substation
- An electricity-powered plant for oxygen.

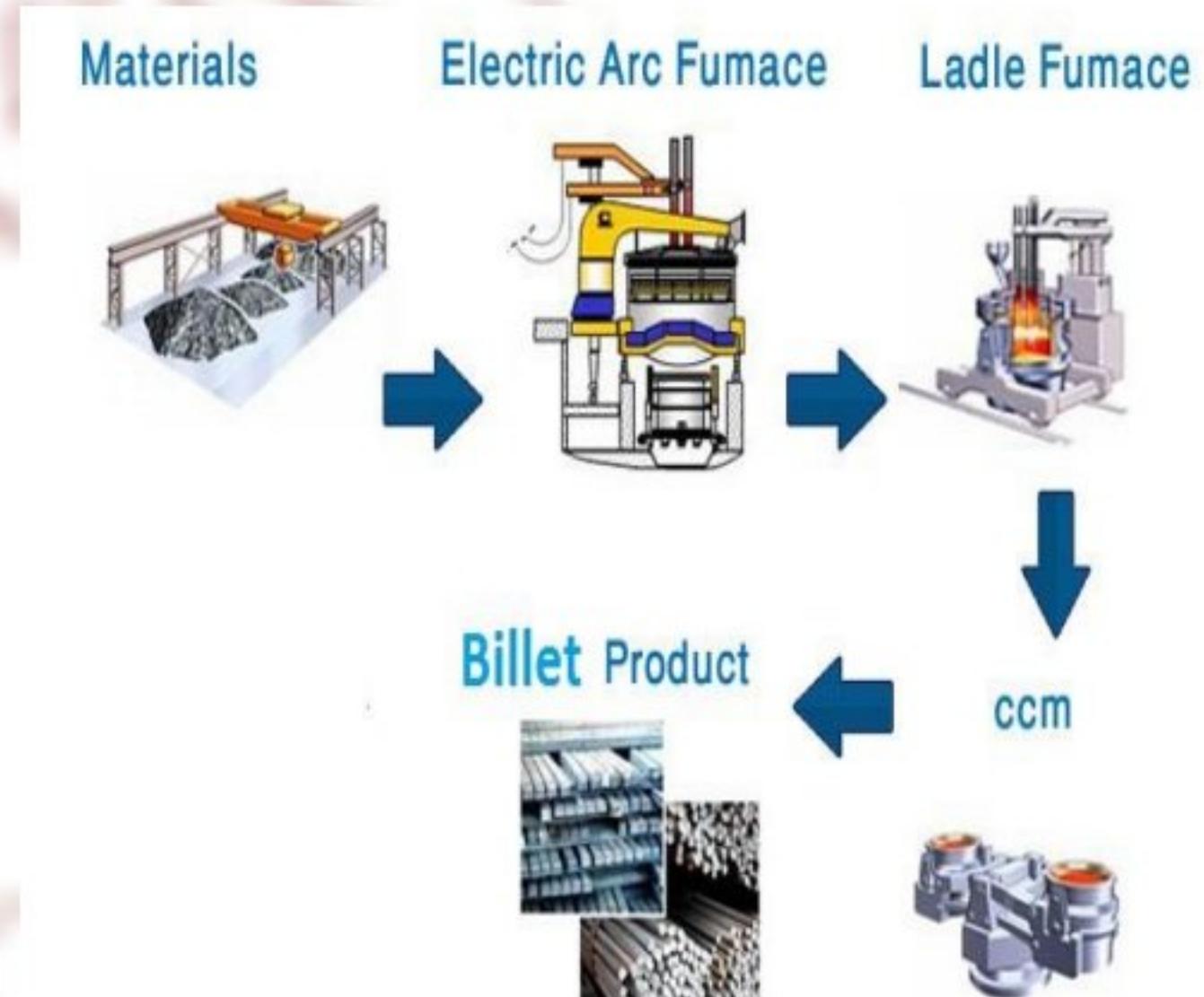


figure (2-3): Processes in melt -shop



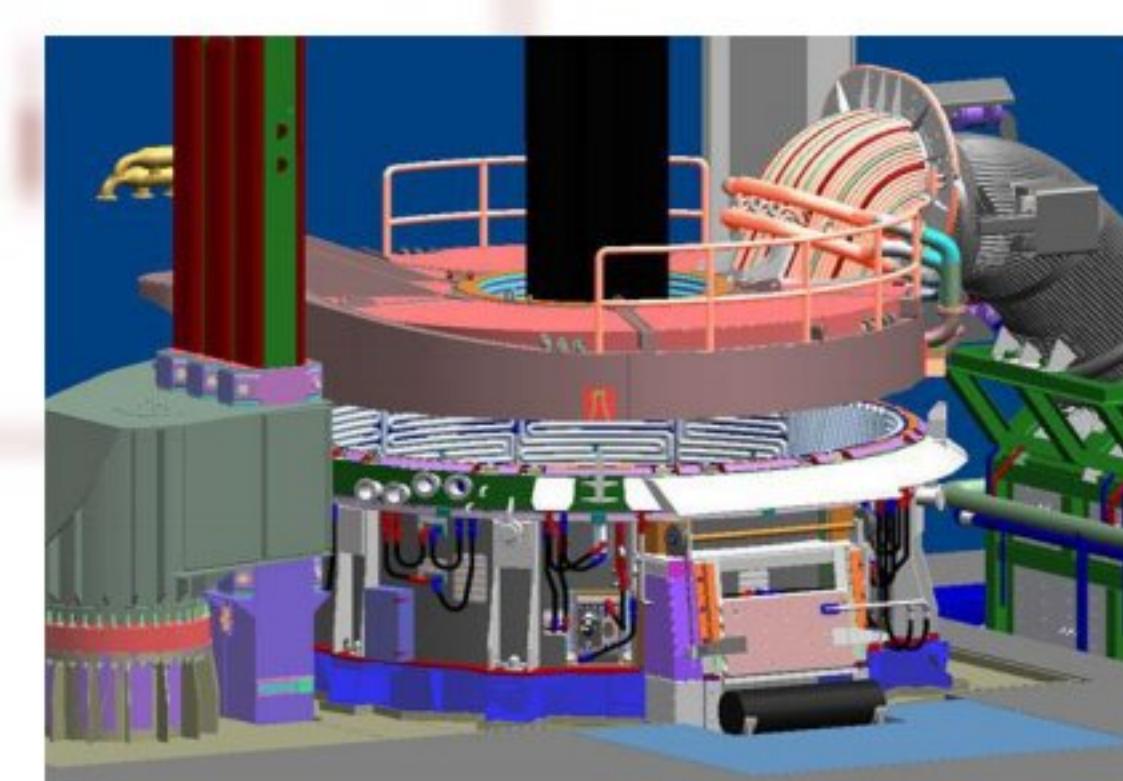
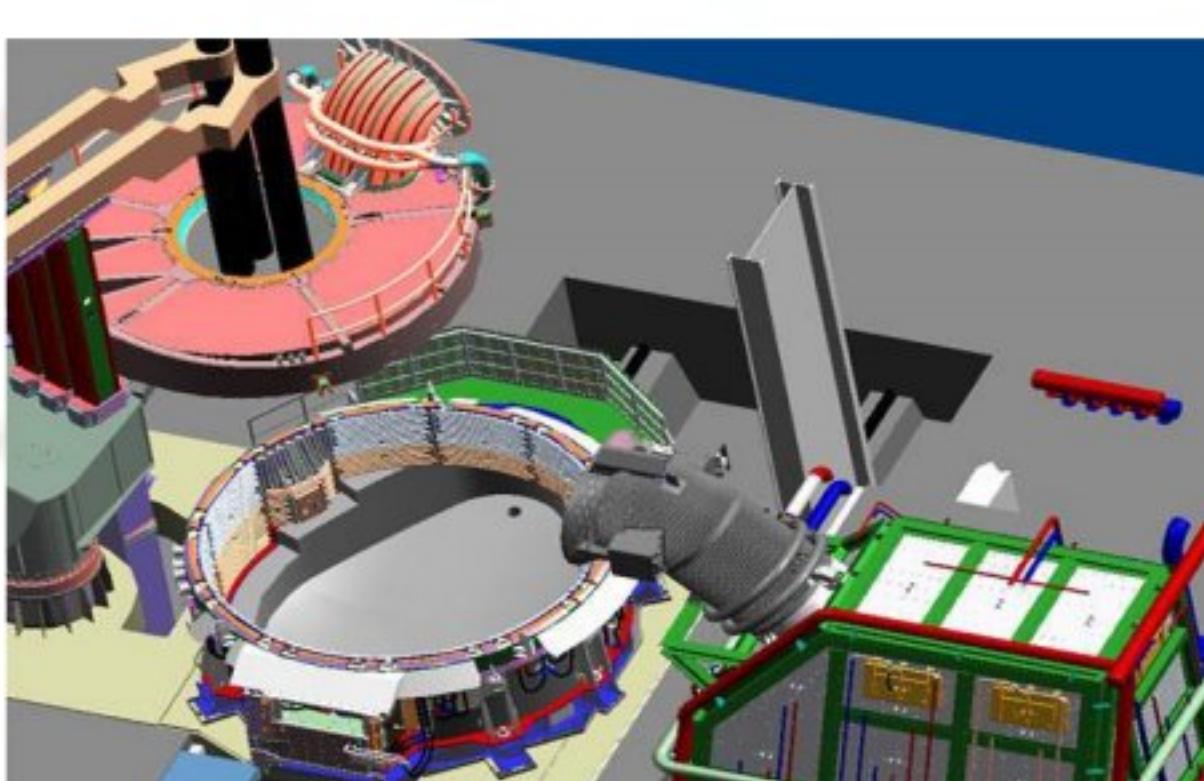
جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

- A water treatment plant for direct and indirect cooling and water softening,
- Fume collection plants for pollution control,
- A scrap receiving yard for storing and sorting scrap
- Static VAR compensation units to prevent chargebacks and damage to the national electricity network.

2-1 Electrical Arc Furnace (EAF)



Figure (2-4): EAF





جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

First, the scrap is transported through huge buckets provided with:

- 2 AC derived motors for car movements
- 2 limit switches for car position
- Weighing system
- Giant display

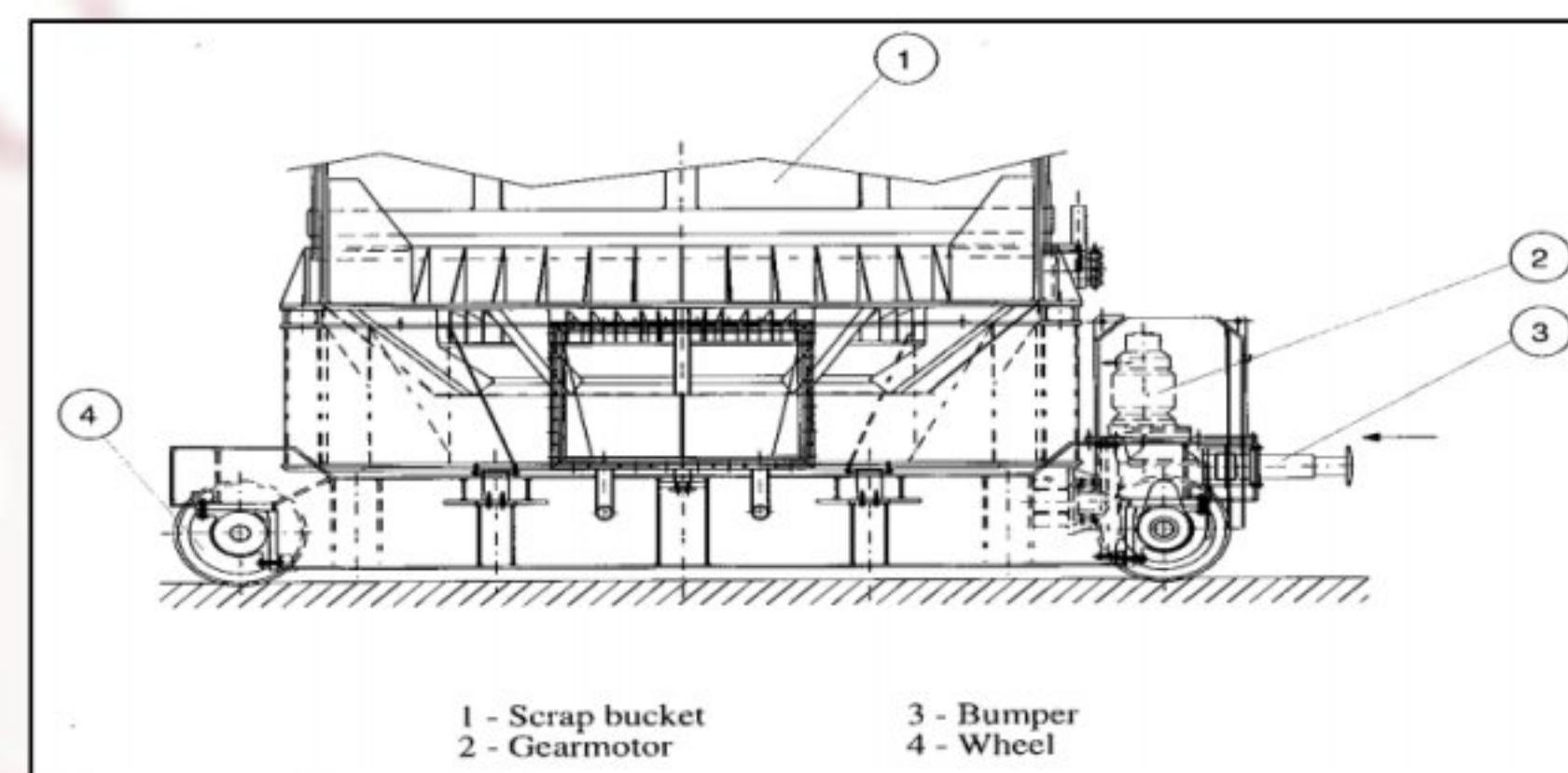


Figure (2-5): scrap buckets

Voltage is first transformed from 220KV to about 30 KV. The EAF transformer is then transforming it to 1034 V on the secondary side with currents of about 60 KA in a three-phase circuit with 50 HZ.

In the furnace, a giant electric arc passes between electrodes through the scrap, voltage and current are regulated to reach melting point, and the arc is created in three directions mutually exclusive of each other at an angle of 120 degrees between each of them in what is known as hot spots. Figure (2-6) illustrates the electrical view of the furnace and Figure (2-7) shows the shape of



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

the electrode

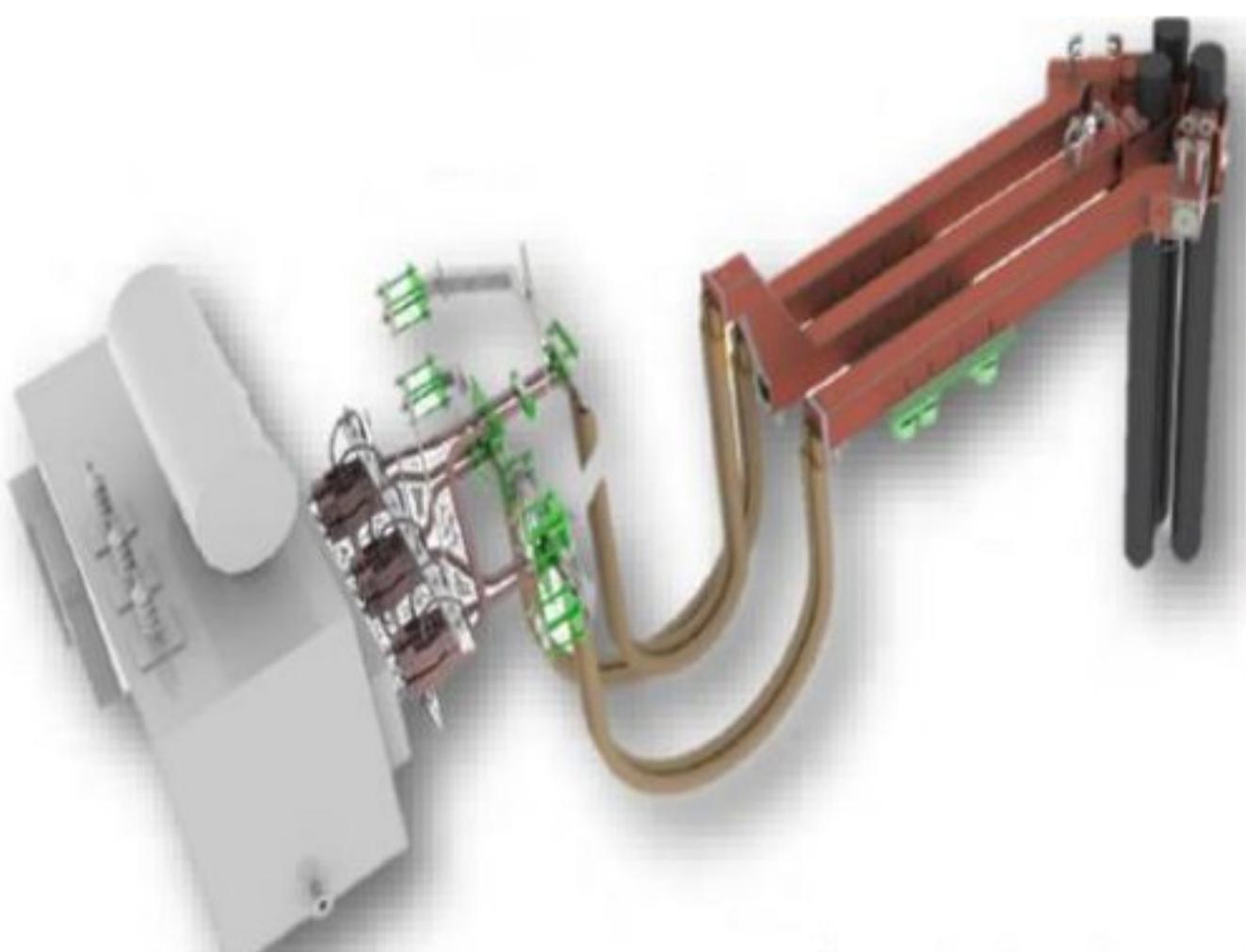


figure (2-6): electrical view of furnace



figure (2-7): electrode

The furnace shell, the furnace roof, the electrical parts (Delta closer, power cables and the conductive arms) and the transformer are provided with indirect cooling water supplied from Water treatment plant with specific flow and pressure.

The automation PLC control the correct operation for the furnace and reads all flows, pressures and temperatures generate the correct signal (alarm or trip) depending on the pre-defined setting.



The main objective from the LRF process is to treat the heat in the ladle till the desired chemical composition and temperature are achieved.

2-2 switch gear

melt-shop uses medium voltage switch gears that mainly consists of Vacuum circuit breaker with 30.000 operating cycles and uses for:

- 1- Protection of transformer (protection relay) Measuring of primary values
- 2- Disconnecting and grounding of high voltage line for maintenance purpose.

Figure (2-8): switch gears





2-3 furnace transformer connection

- 1- Bus bar system and water-cooled cables
- 2- Disconnector: must provide a visual disconnection. (IEC 60519-4)
- 3- Surge arrestor: protect electrical equipment from over-voltage transients caused by external or internal events
- 4- RC-protection: Must be provided for switching arc Furnace transformers to limit over voltages.
- 5- Flexible connection to transformer
- 6- Power arc transformer (special transformer)
- 7- On-Load tap changer (OLTC)
- 8- Redundant heat exchanger (oil & water)

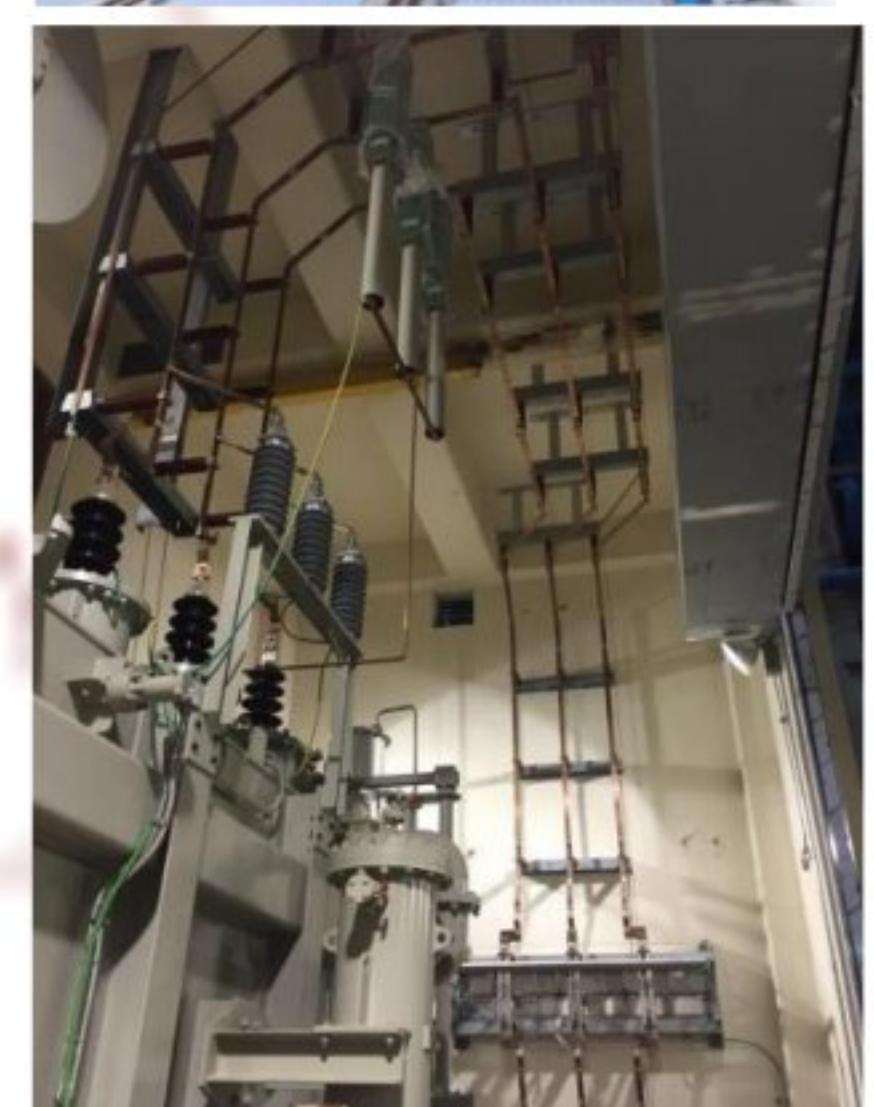


Figure (2-9): power arc transformer



2-4 Instruments

Used to monitor and control the process to take an accurate decision during automatic control and divided into:

Analog sensors: flow meters/ pressure transmitter/ temperature sensor/ speed sensors/ level transmitters/ weighting system.

Digital sensors: position sensors (limit switch/ proximity, encoder), pressure switch, flow switch, level switch.

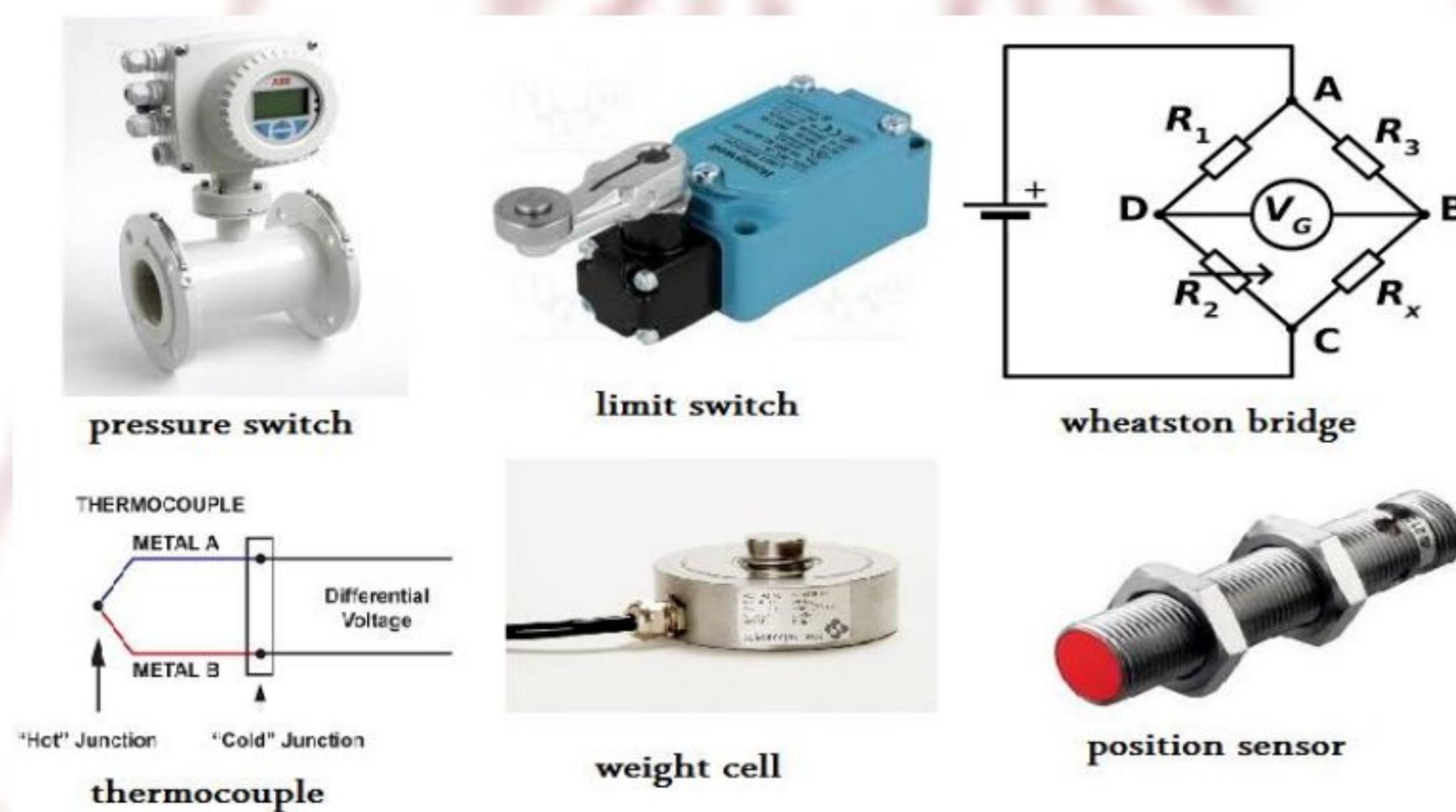


Figure (2-10): some of the instrument used in the factory



3 Electrical equipment in rolling mill

After the iron is melted and formed into billets, it is then reheated to the point of redness and then rolled in form of construction rods.

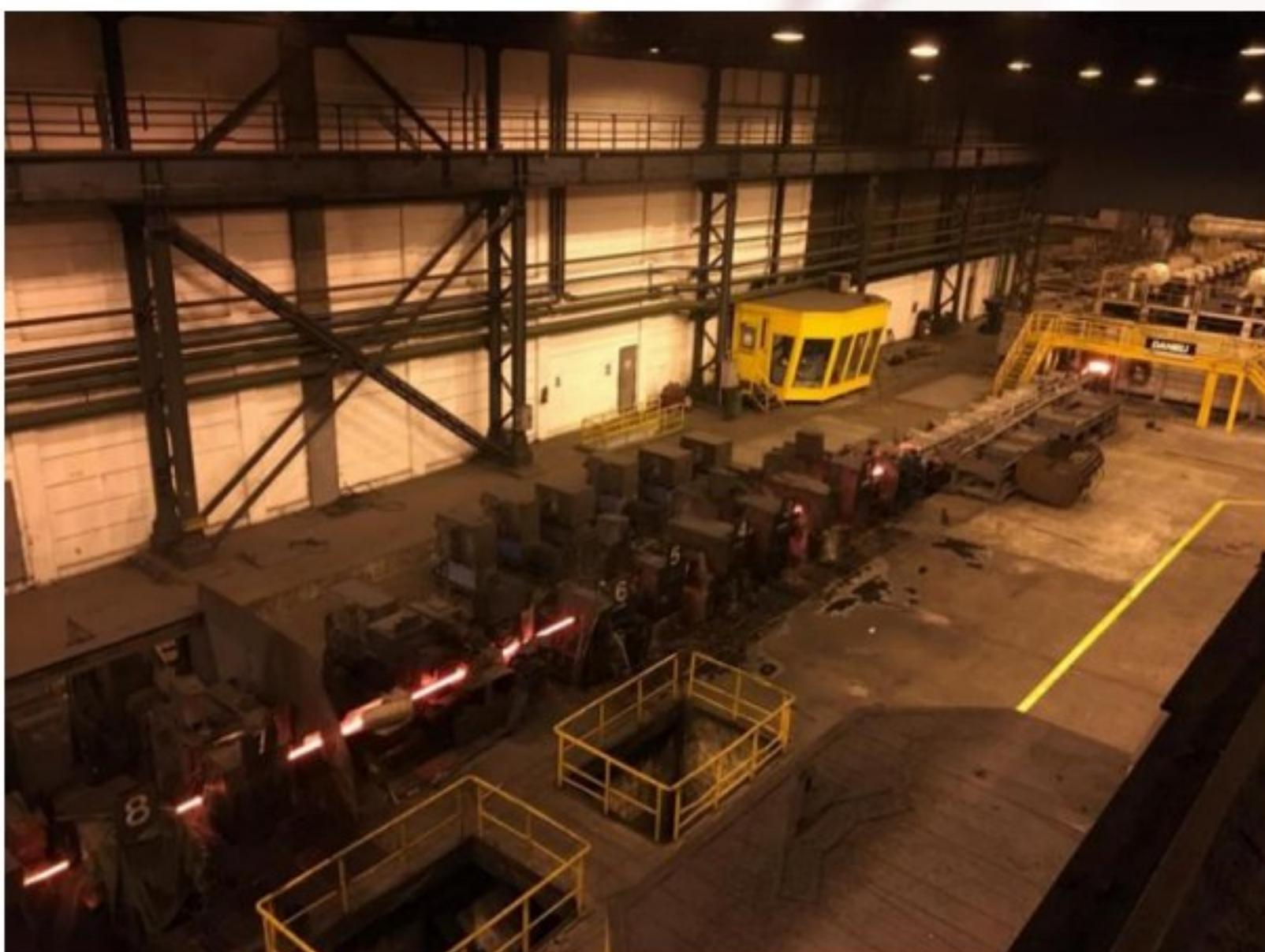


Figure (2-11): rolling mill factory

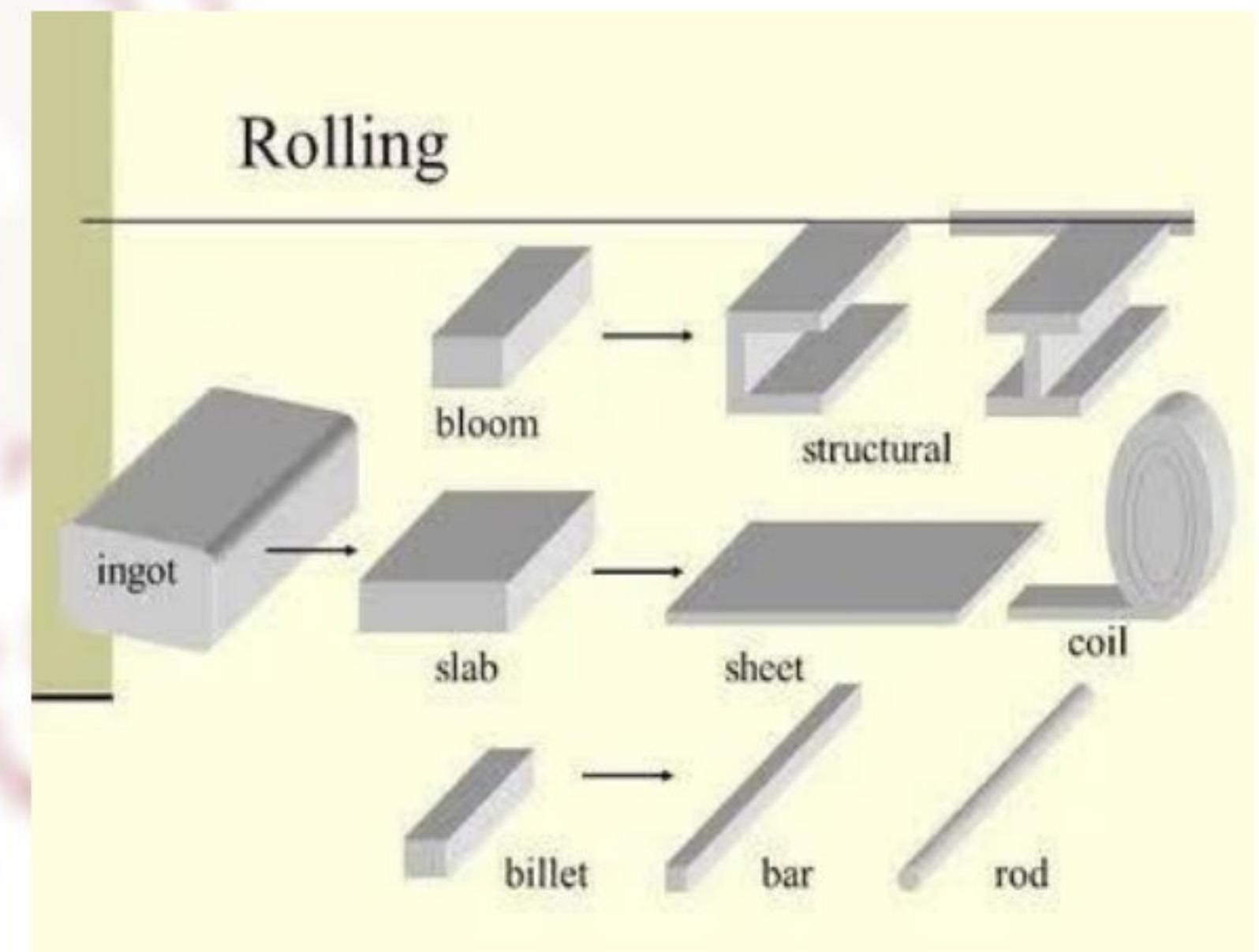


figure (2-12): rolling products

3-1 11kv switch gears

Take power from 11kv line into Power transformers with switch gear for each transformer. It uses SF6 gas for spark suppression



Figure (2-13): Switch gears



Protections in switch gear:

- 1- over voltage protection relay
- 2- under voltage protection relay
- 3- short circuit protection relay
- 4- earth fault protection
- 5- over current protection

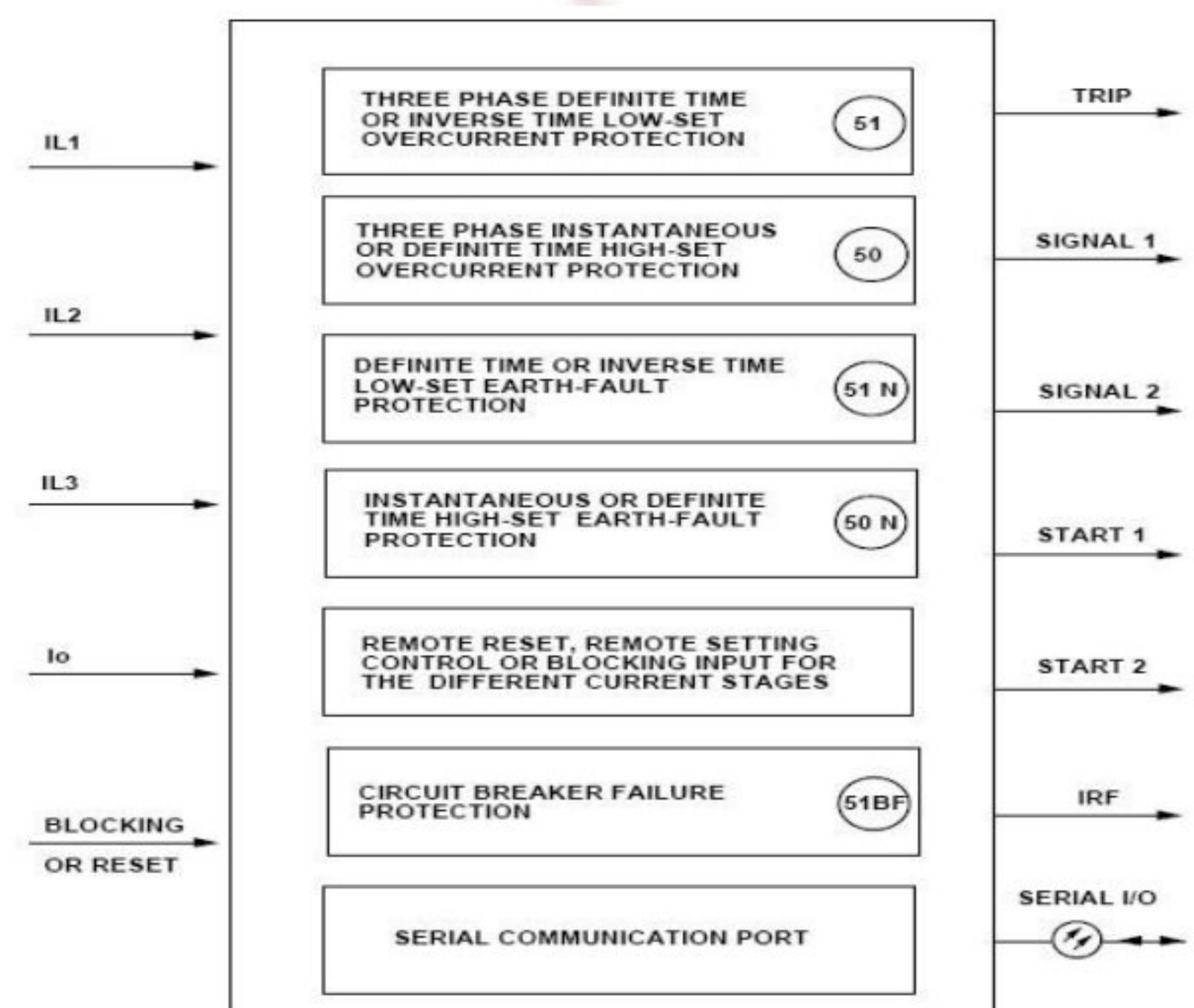


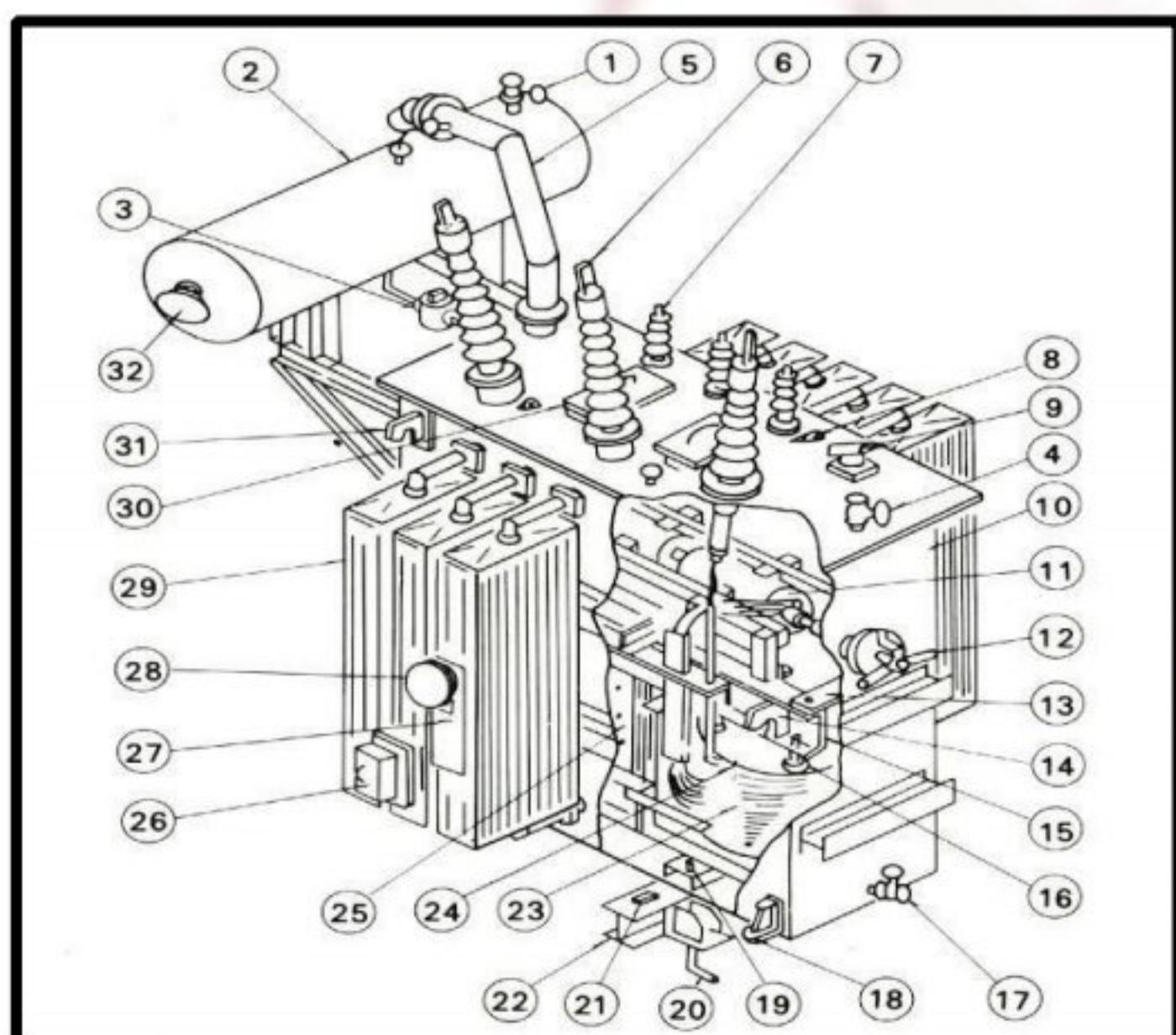
Figure (2-13): Switch gear protection



3-2 power transformers

There are 8 power transformers in rolling mill 2 with ratio 11kv/620v AC and rated power between 2MV and 2.5MV.

Components:



1.	Oil filter valve	17.	Oil drain valve
2.	Conservator	18.	Jacking boss
3.	Buchholz relay	19.	Stopper
4.	Oil filter valve	20.	Foundation bolt
5.	Pressure-relief vent	21.	Grounding terminal
6.	High-voltage bushing	22.	Skid base
7.	Low-voltage bushing	23.	Coil
8.	Suspension lug	24.	Coil pressure plate
9.	B C T Terminal	25.	Core
10.	Tank	26.	Terminal box for protective devices
11.	De-energized tap changer	27.	Rating plate
12.	Tap changer handle	28.	Dial thermometer
13.	Fastener for core and coil	29.	Radiator
14.	Lifting hook for core and coil	30.	Manhole
15.	End frame	31.	Lifting hook
16.	Coil pressure bolt	32.	Dial type oil level gauge.

Figure (2-14): trans components

table (2-2): components names

Transformer protection sensors:

1. Maximum oil temperature:



جامعة المنوفية

كلية الهندسة بشبين الكوم

قسم الهندسة الكهربائية

برنامج هندسة القوى والألات الكهربائية

2. Min oil level



3. Max oil level

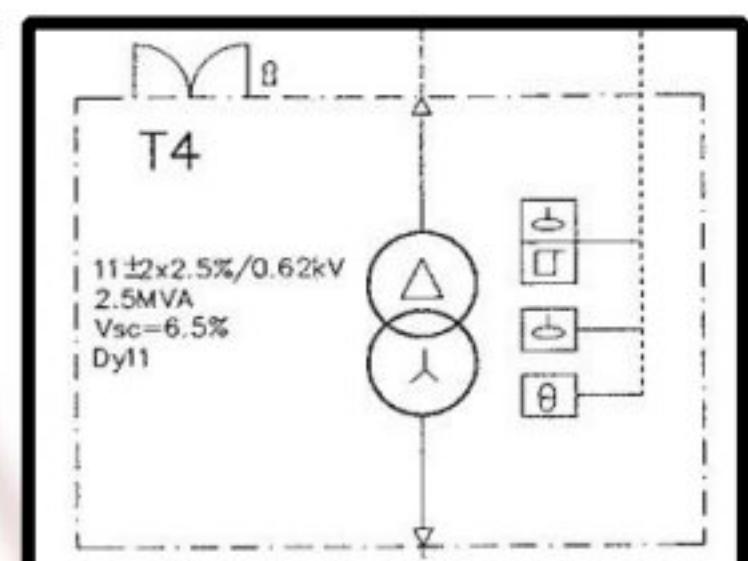
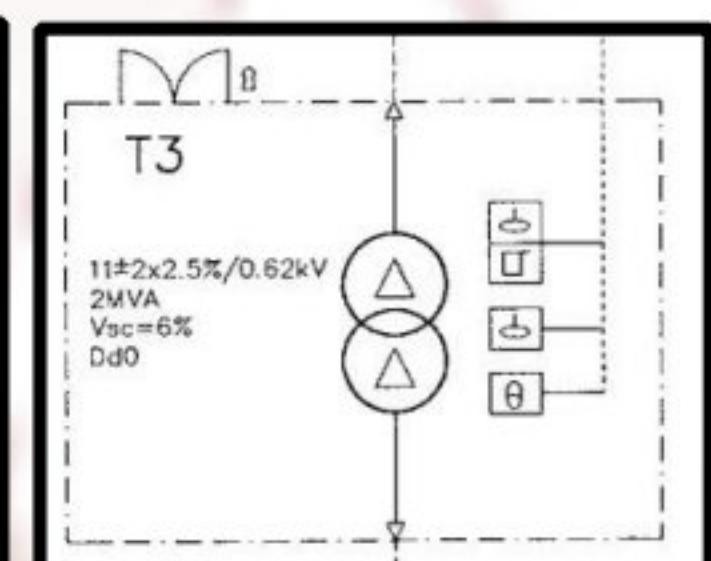
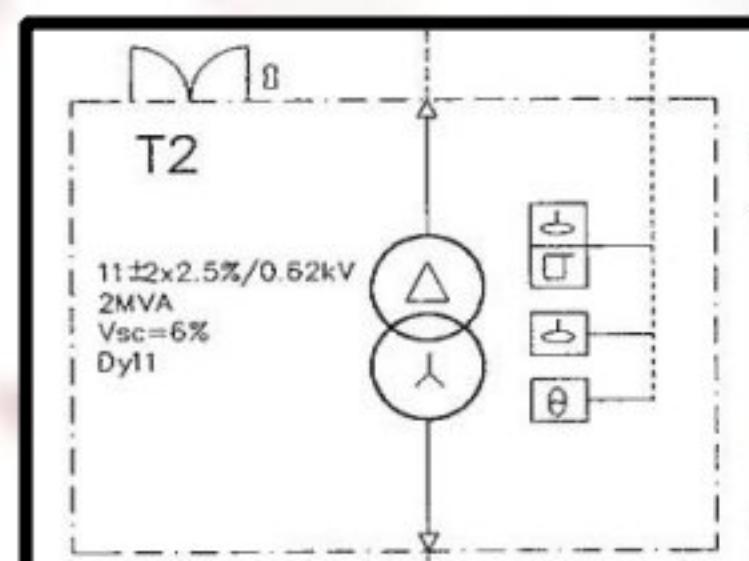
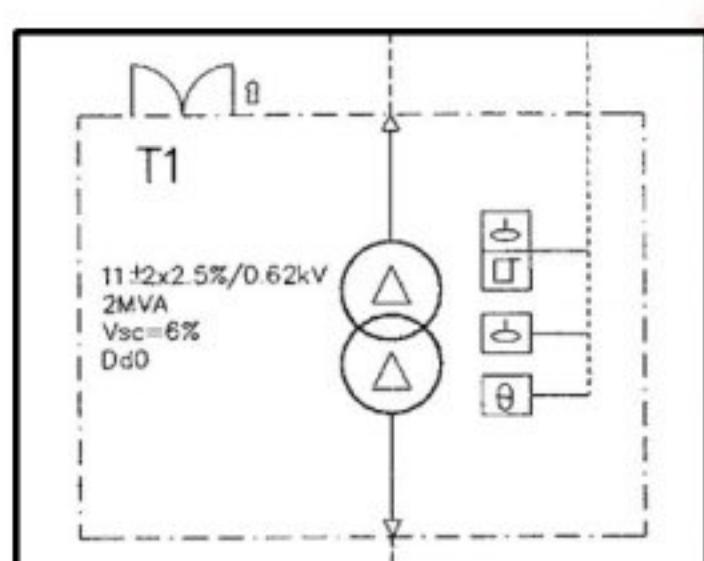


4. Buchloz alarm

Figure (2-15): oil level sensor

5. Buchloz trip

Transformers connections:



T1 feeds stands 1,2,3,4

T2 -> stands 5,6,7

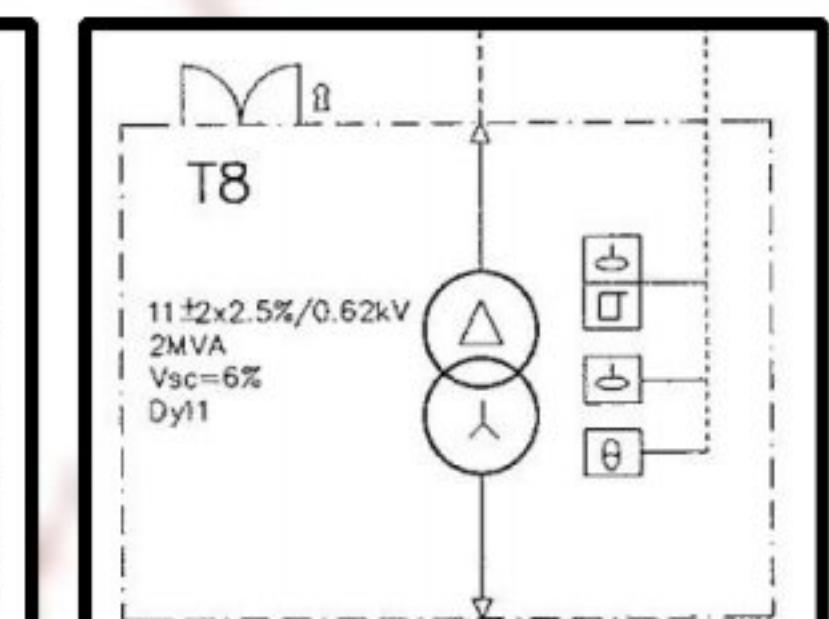
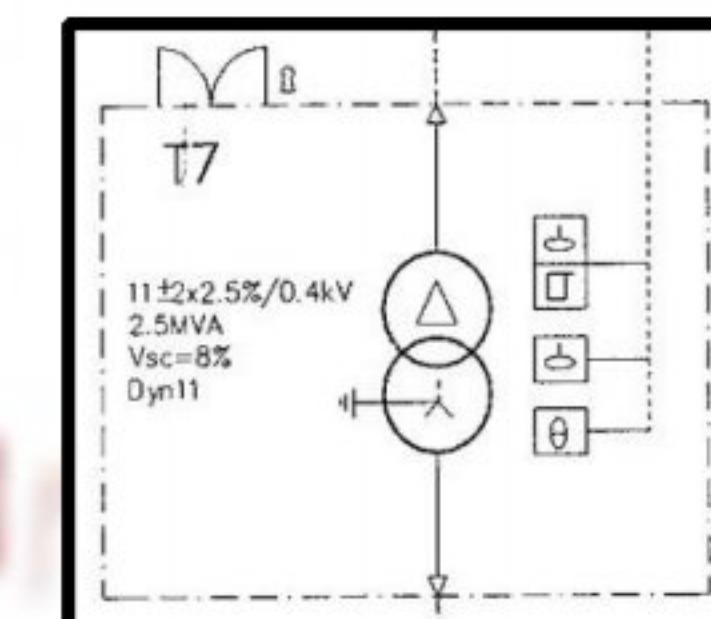
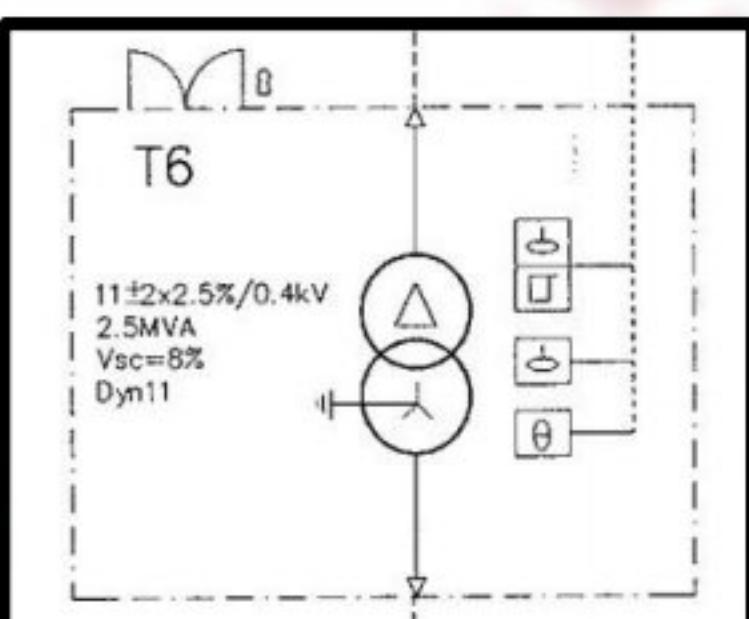
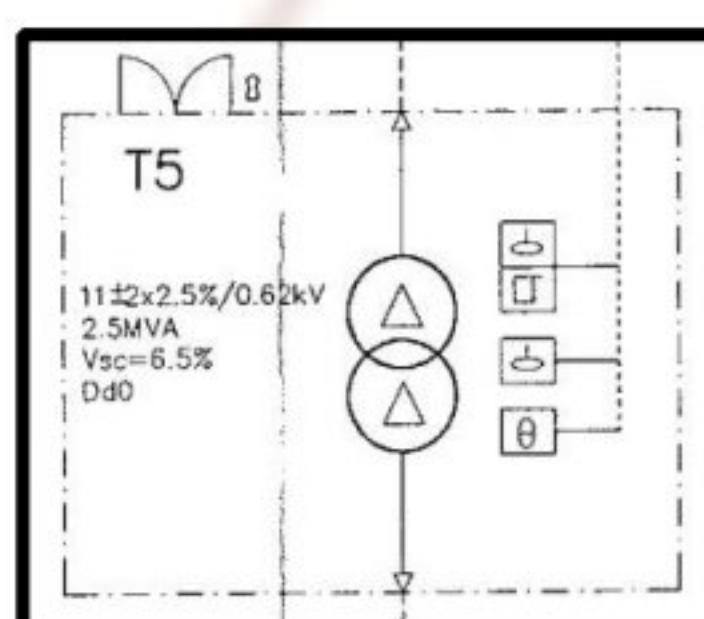
T3 -> stands 8,9,10

T4 -> stands 11,12,13

&shear 1

&shear 2

&shear 3



T5 feeds stands 14,15,16

T6

T7

T8 -> stands 17,18

figure (2-16): transformers connections



3-3 DC motors

DC motors is the main electrical machine in mill line

Components:

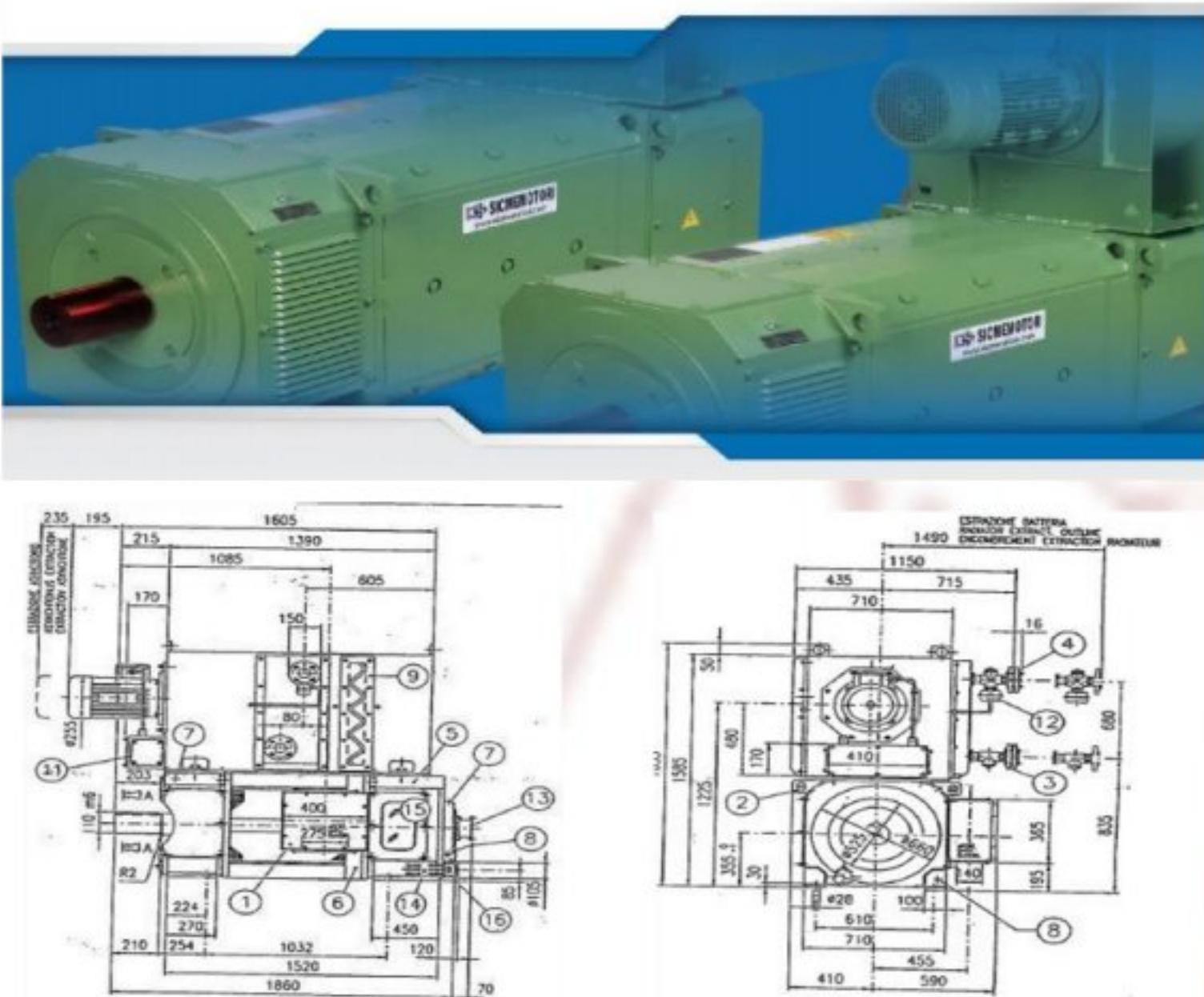


Figure (2-17): motor components

1-Terminal box	9-Filter
2-Lifting lug	-
3-Water inlet	11-Terminal box heat exchange
4-Water outlet	12-Water flow switch
5-Commutator end	13-Tacho provision type red 444 R
6-Grounding bolt	14-Space heater
7-Grease cup	-
8-Grease relief	16-Terminal box space heater

table (2-3): components names

DC motor protection sensor:

- 1- Air flow/pressure switch: detect that the air coming from cooling fan with a suitable pressure
- 2- Heat exchange thermal switch: detect cooling air temperature



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

3- Water flow switch: detect the cooling water flow inside heat exchanger device

4- Motor over peep switch: protect the motor from high values of RPM and used as interlock to stop motor at high-speed value



Figure (2-18): air flow switch & heat exchange thermal switch



Figure (2-19): water flow switch



Engineering standards, safety, and risk management

If the rules of safety and risk management is important at any engineering facility, then at Heavy industries facility like ezz steel it is critical as any mistake can cost the person his life and some of these rules (for students):

- Participation is always in a team and no student goes away from his team for any reason
- Students must have a supervising engineer, and no action is taken without his consent
- Wear all the protective clothing and equipment provided by the factory for students
- Pay attention to the warning signs and stay away from prohibited areas
- Not to deal with any working equipment of heavy material



figure (2-20): warning and guidance signs everywhere



Figure (2-21): Supplying protective safety clothes and equipment



Summary

By that point, my training has completed in two weeks and in 3 different factories and two yards, during that time I have learnt:

- 1) How to read and analyze single line diagram for industrial places and the nameplates of different machines
- 2) Observance of occupational safety and security standards and executing them for safe training environments
- 3) In addition to learning many technical and scientific topics, I also learned some administrative topics, such as how the industrial corporation is formed and how factories complement each other, which ensures an efficient industrial process.
- 4) I learned how team spirit can make training easier, more enjoyable and beneficial for everyone. as Every student in the training had a role to help his friends with, which made the training process one of the best possible.



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

References

- 1) Dr. Mahmoud EL-Gilany (2020) “Electrical power Engineering” (N1)
- 2) EZZ STEEL SADAT CITY: EFFICIENT REBAR MANUFACTURING. Accessed August 25, 2022, from <https://bit.ly/3Rm1QJs>
- 3) Ezz Steel Company, “trainee Guide - melt-shop” (N1) ‘Ezz Steel Academy’
- 4) Ezz Steel Company, (2021) “Sensors” (N1) ‘Ezz Steel Academy’
- 5) Ezz Steel Company, (2021) “Ezz Rolling Mill 2” (N1) ‘Ezz Steel Academy’



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

Diagrams

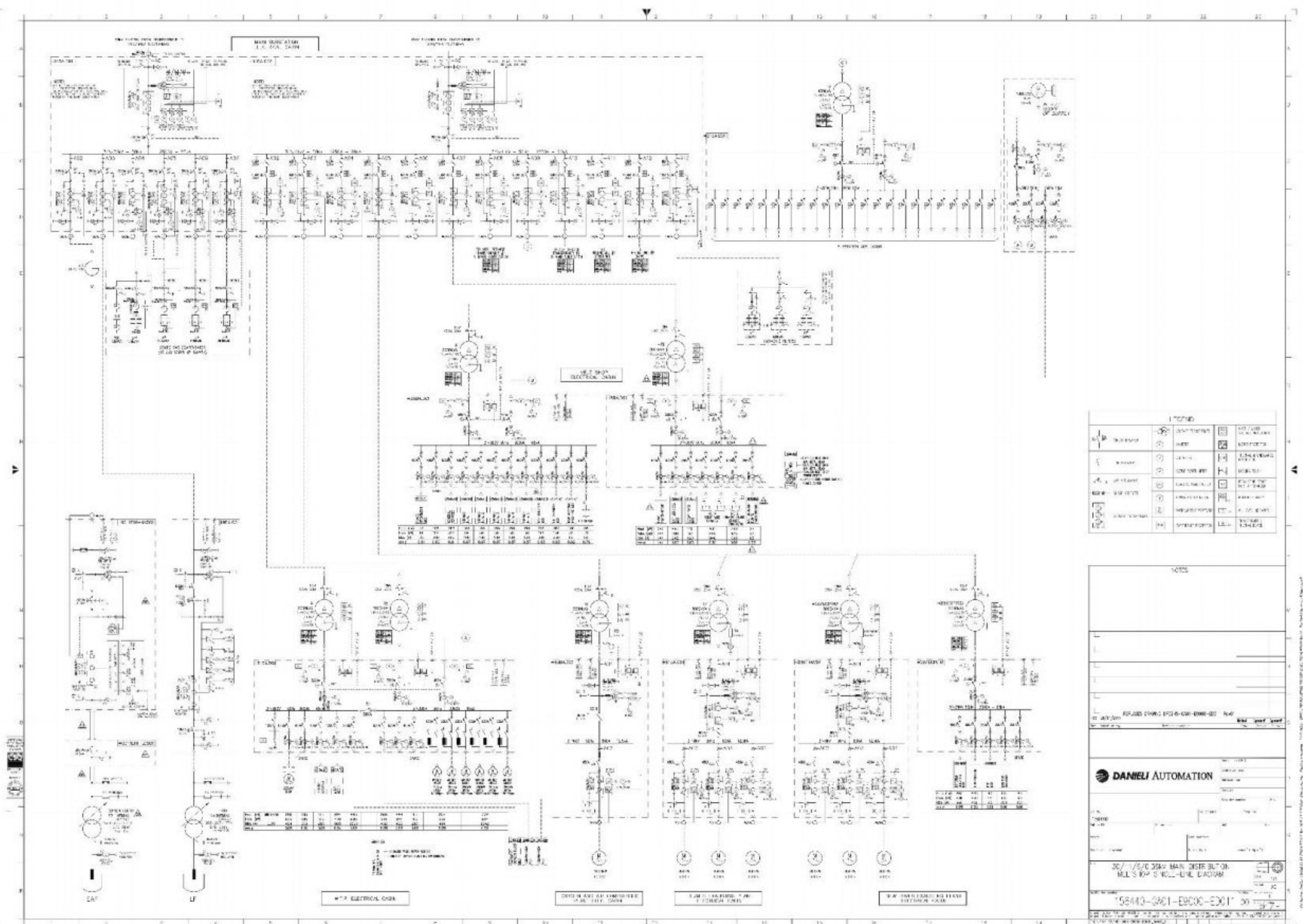
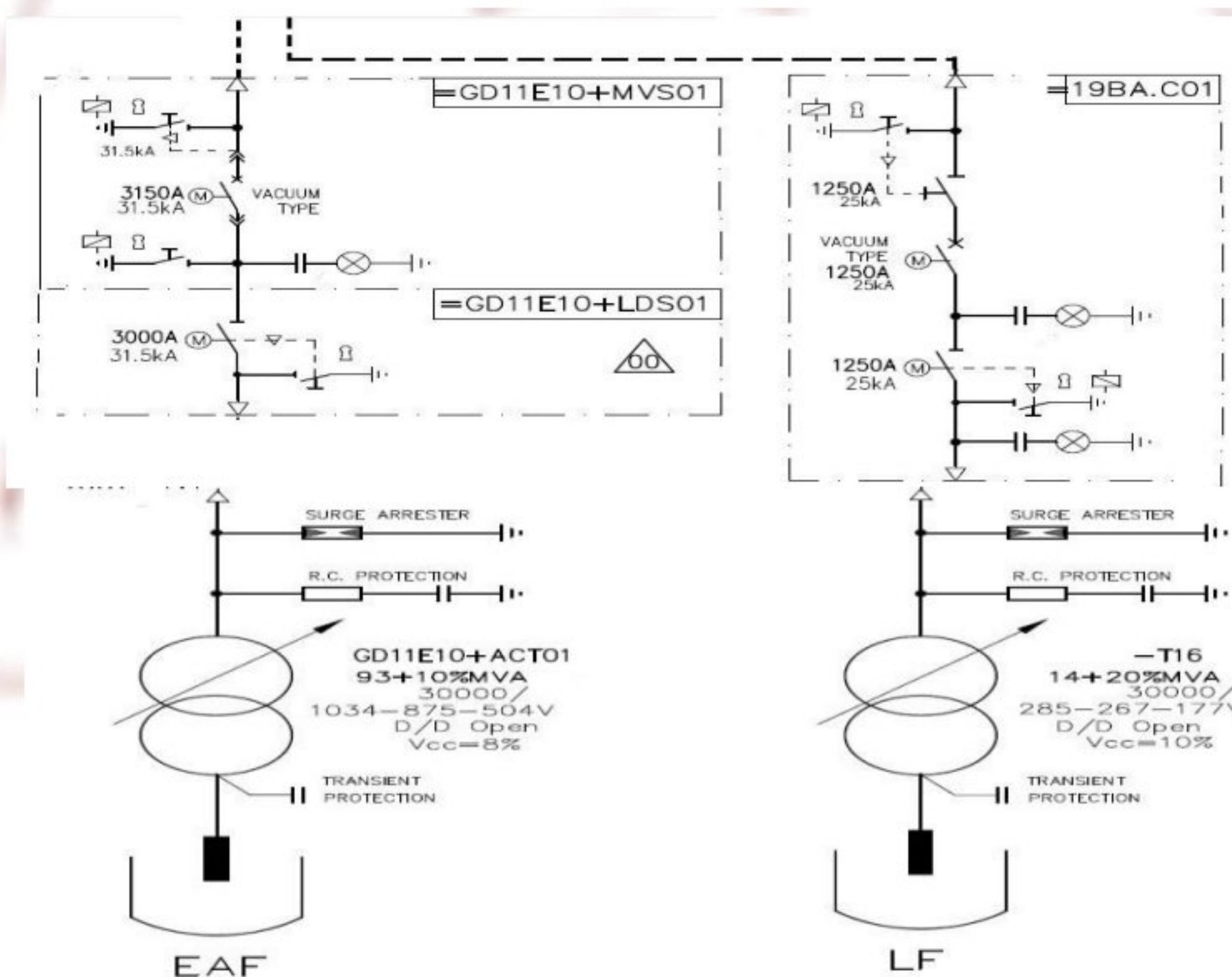
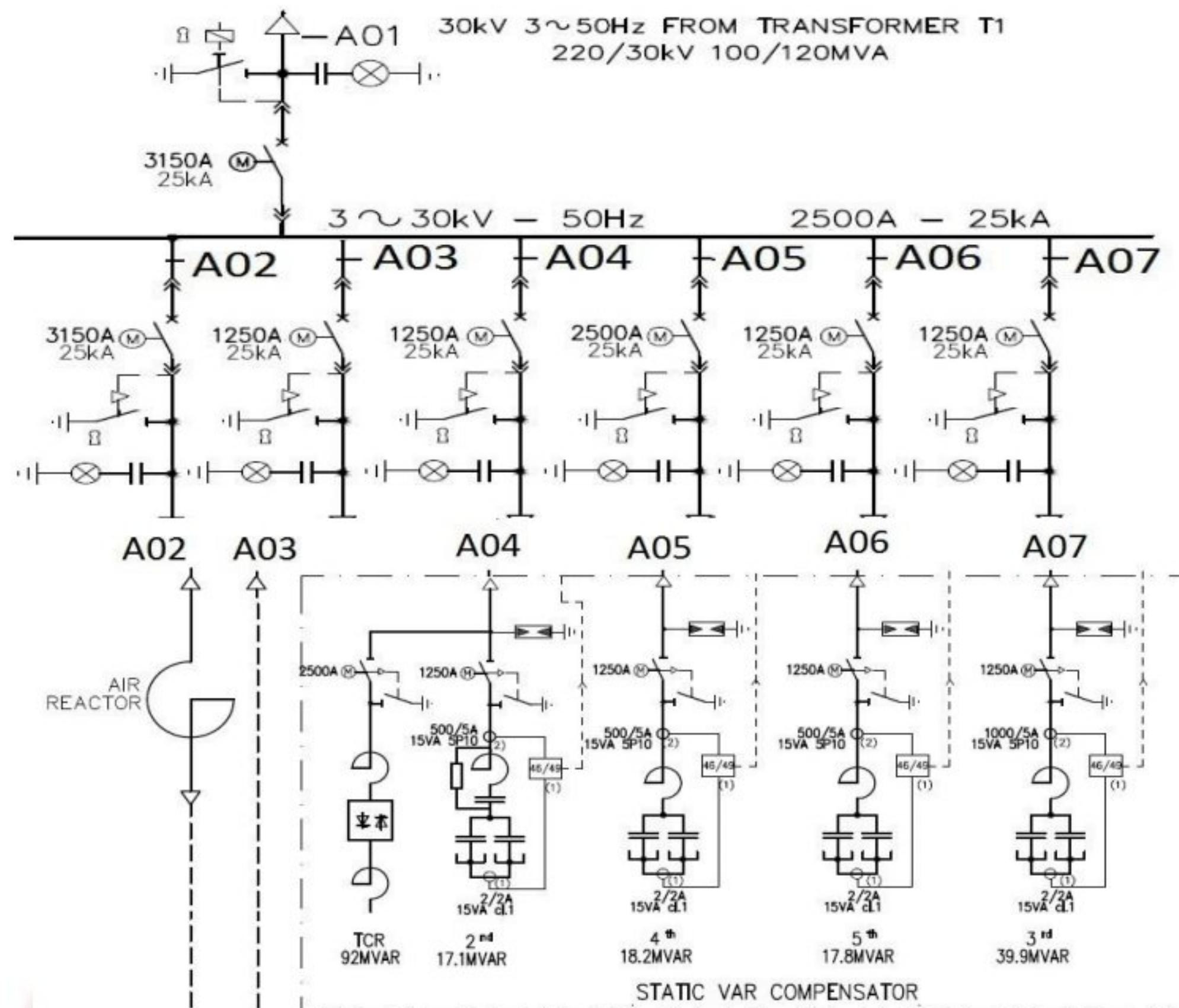


Figure (2-22): Single line diagram of EZZ steel factory



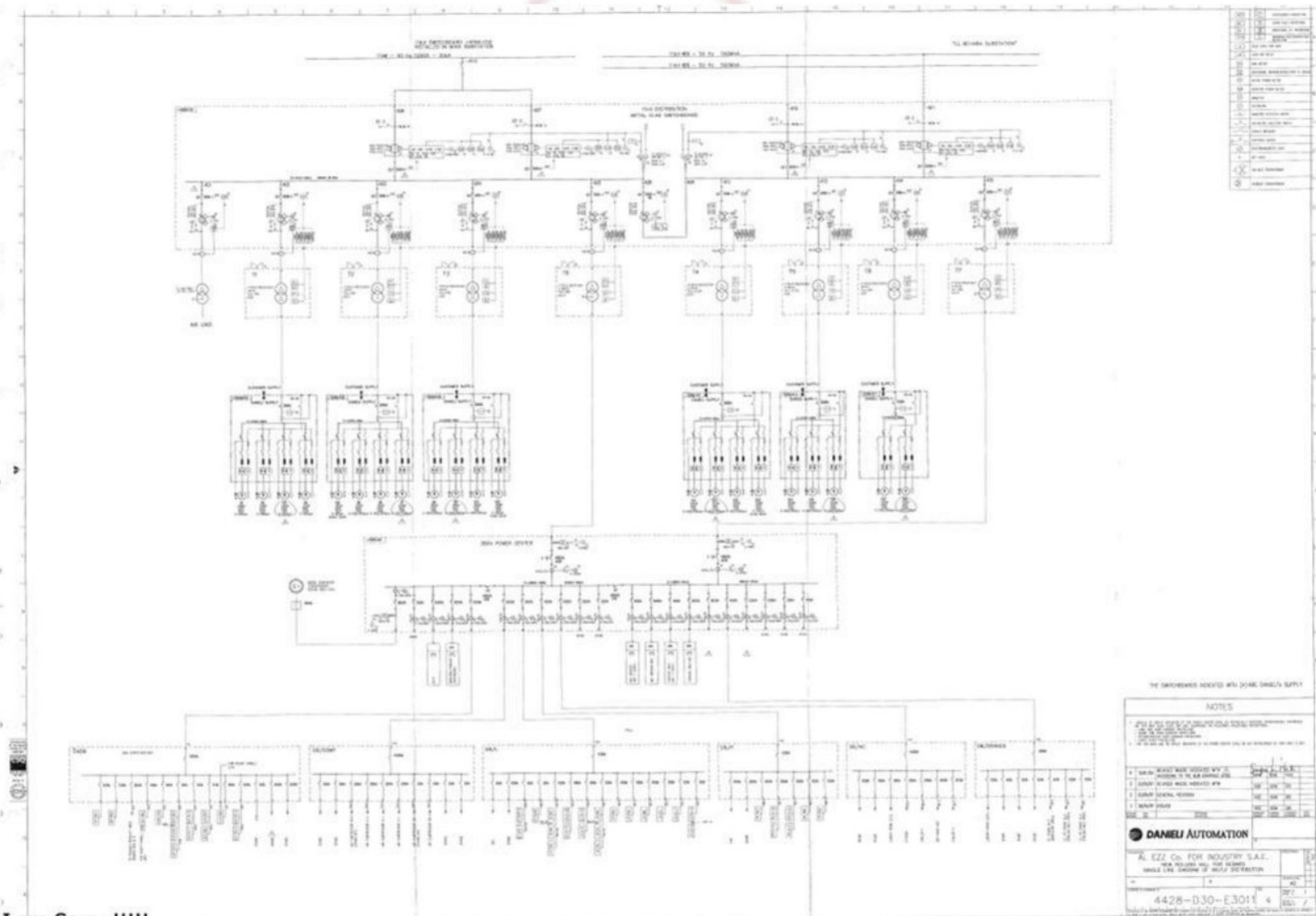
جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية





جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

Figure (2-23): Single line diagram of melt-shop



I am Sorry !!!!!

Figure (2-24): Single line diagram of rolling mill 2



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

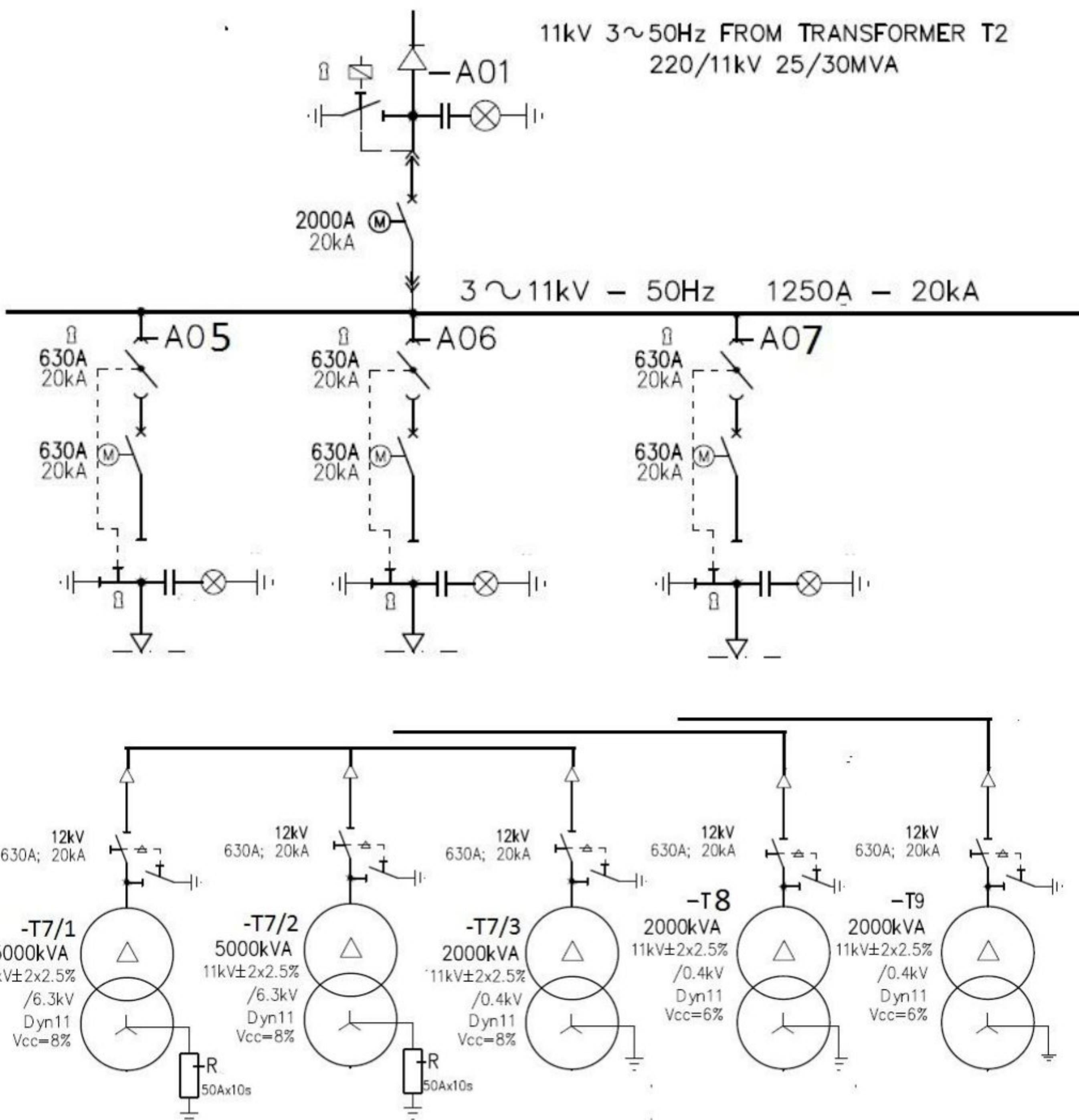


Figure (2-25): single line diagram of factory utilities



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

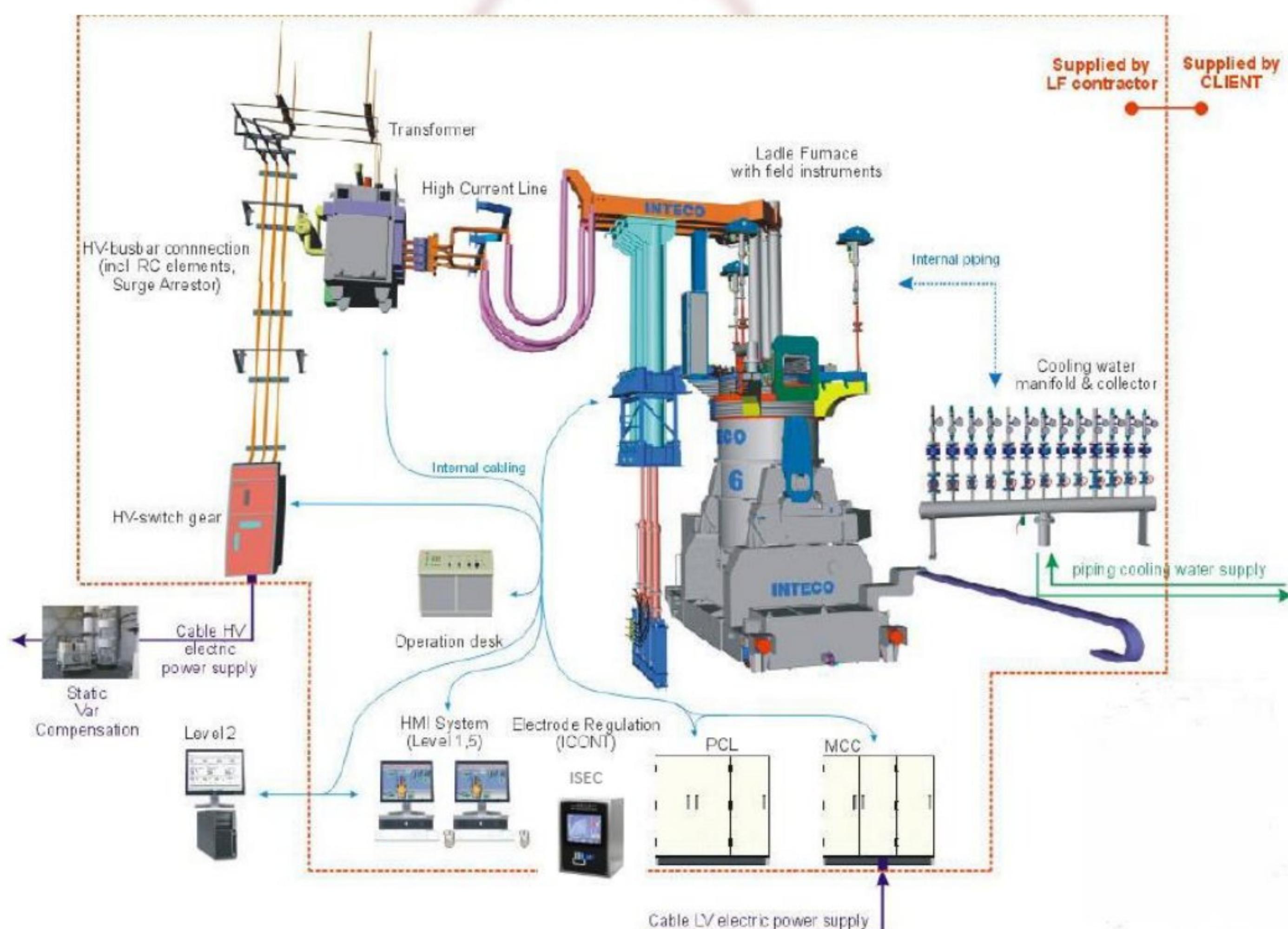


Figure (2-26): 3d diagram of arc furnace



جامعة المنوفية
كلية الهندسة بشبين الكوم
قسم الهندسة الكهربائية
برنامج هندسة القوى والآلات الكهربائية

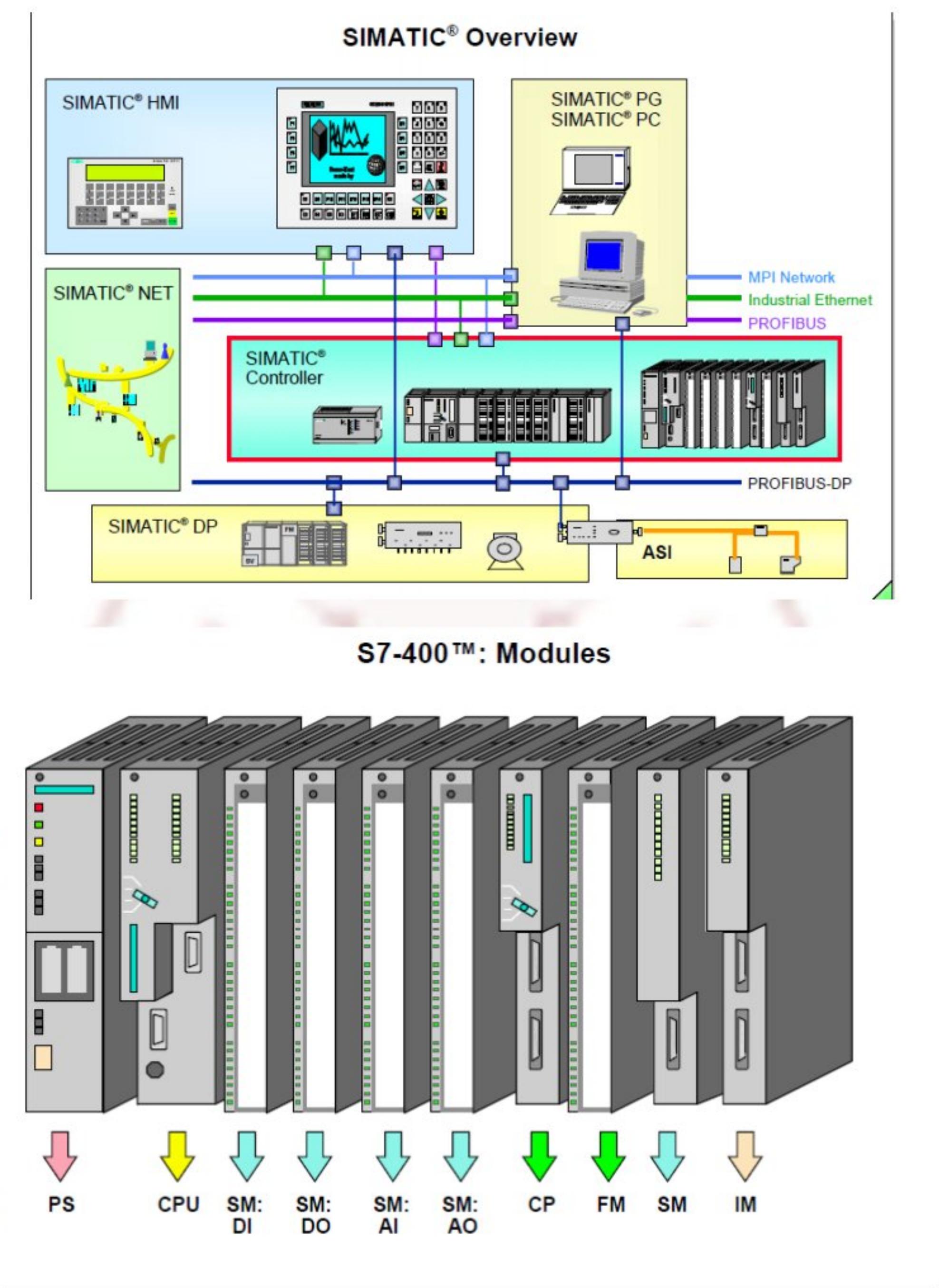


Figure (2-27): PLC (programmable logic control) system