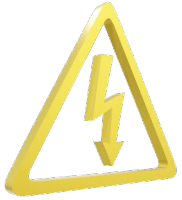
VOCATIONAL TRAINING AT HBF



POWER SYSTEM

AND

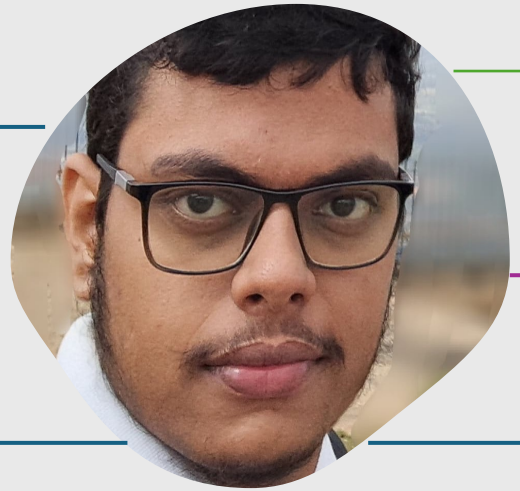
RELAY GRADING

Starting Date:06/06/2024
Ending Date:24/06/2024

About Me

HOBBIES

1.Follows International relations
2.Photography



PERSONAL PROFILE

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4.Matlab

EDUCATION

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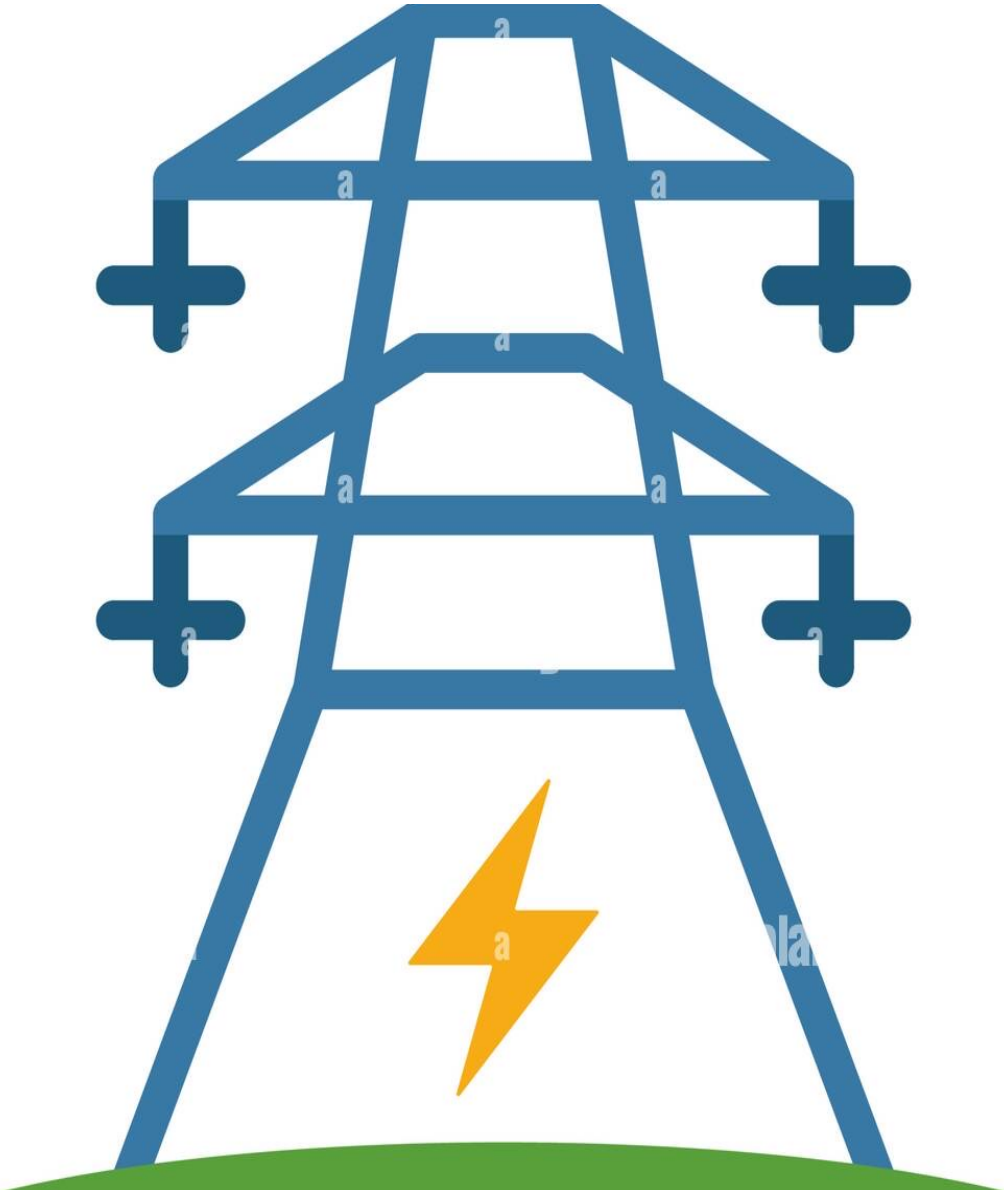
BRANCH: Electrical
Current Semester: 5th

ABOUT TATA STEEL

Tata Steel Limited is an Indian multinational steel-making company, based in Jamshedpur, Jharkhand and headquartered in Mumbai, Maharashtra. It is a part of the TATA GROUP.
Formerly known as **Tata Iron and Steel Company Limited** (**TISCO**), Tata Steel is among the largest Steel producing companies in the world, with an annual crude steel capacity of 35 million tonnes. It is one of the world's most geographically diversified steel producers, with operations and commercial presence across the world. The group (excluding SEA operations) recorded a consolidated turnover of US$31 billion in the financial year ending 31 March 2023. It is the largest steel company in India (measured by domestic production) with an annual capacity of 21.6 million tonnes after Steel Authority of India Ltd. (SAIL).

Tata Steel is headquartered in Mumbai, Maharashtra, India, and has its marketing headquarters at the TATA Centre in Kolkata, West Bengal. It has a presence in around 50 countries with manufacturing operations in 26 countries including India, Malaysia, Vietnam, Thailand, UAE, Ivory Coast, Mozambique, South Africa, Australia, United Kingdom, The Netherlands, France and Canada.

POWER SYSTEM



An *electrical power system* is a network of interconnected electrical devices, which are used to generate, transmit, distribute and utilise the electrical power.

Overview Of Power System at H-Blast Furnace

- From Main Power Supply, Primary Buses (Bus A and Bus B which was coupled by a NO Bus Coupler) are energized.

- Each of BF-HV-MCC1, BF-HV-MCC2 and SH-HV-MCC further have 2 Buses each of which is energized by one incomer from each primary bus as shown in Fig 1.

- On next level, Each of BF-PCC1, BF-PCC2 and SH-PCC further have 2 Buses each of which is energized by one incomer from each buses of BF-HV-MCC1, BF-HV-MCC2 and SH-HV-MCC respectively, as shown in Fig 1.

- From PCC, Various Loads are Connected through local Busbars located at various load points.

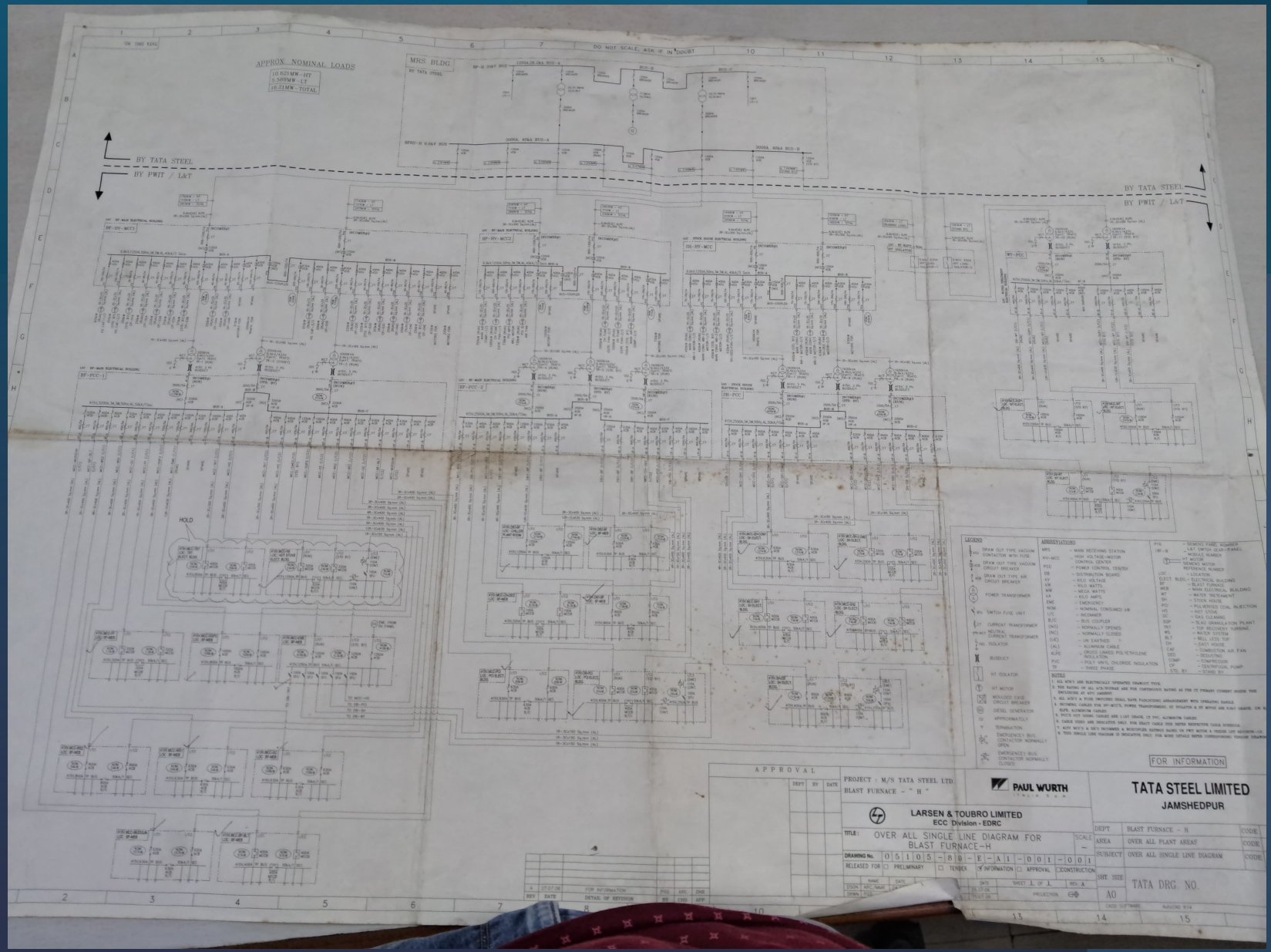
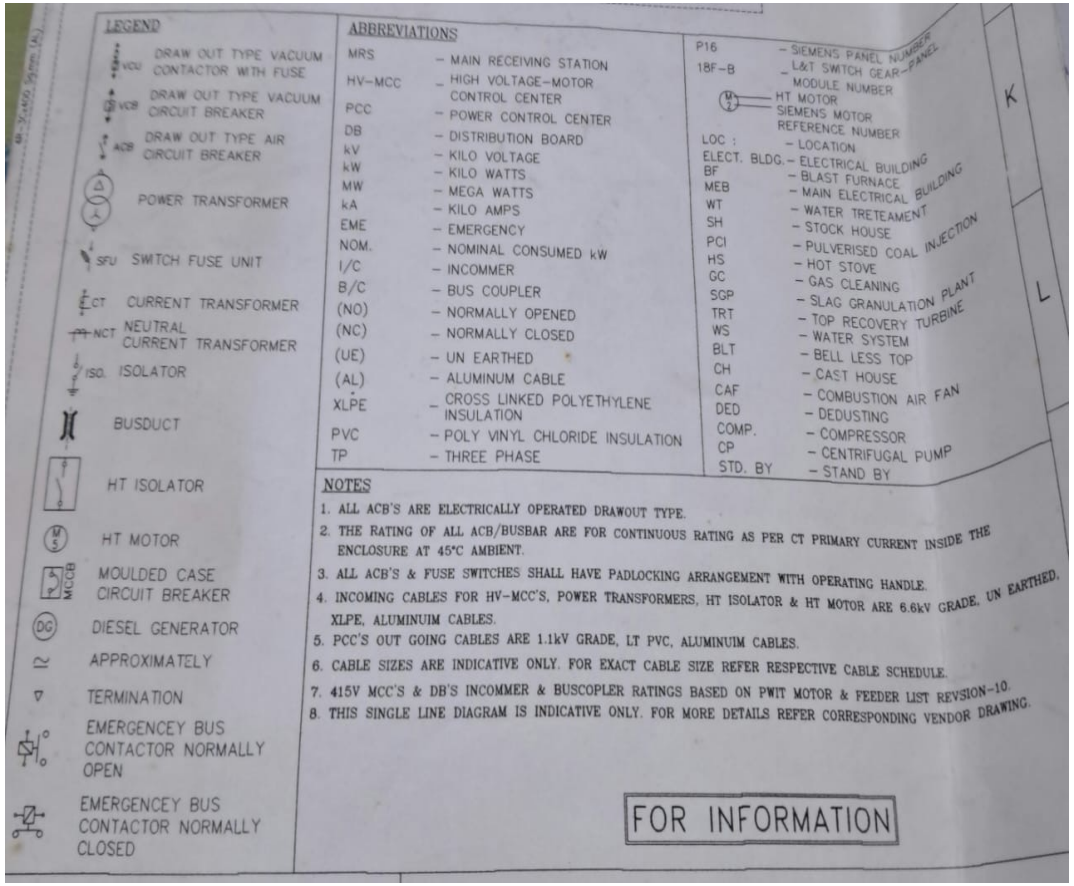


Fig 1. Overall Single Line Diagram of Power system at H-Blast furnace.



There are many Electrical Components Through Out this Distribution System as shown aside.

There is a brief description of some of them:

1. Circuit Breaker: A **circuit breaker** is an electrical safety device designed to protect an electrical circuit from damage caused by current more than that which the equipment can safely carry (Overcurrent).

   There are various types of circuit breaker:

- VCU(Vacuum contractor units with fuse): Vacuum Contactors are designed and manufactured for frequent switching, especially considering safety and quality assurance. They are suitable for switching and controlling squirrel cage and slipring motors, medium voltage loads and resistance furnaces, and capacitors and transformers.

- VCB(Vacuum circuit Breaker): VCB circuit breakers are dependable current interruption components suitable for medium voltage switchgear. It can function seamlessly with minimum maintenance. A VCB circuit breaker is vital for reliable and safe power. They are exceptionally durable and appropriate for fault clearing.

- ACB(Air Circuit Breaker): Air Circuit Breaker (ACB) is an electrical device used to provide Overcurrent and short-circuit protection for electric circuits over 800 Amps to 10K Amps. These are usually used in low voltage applications below 450V.

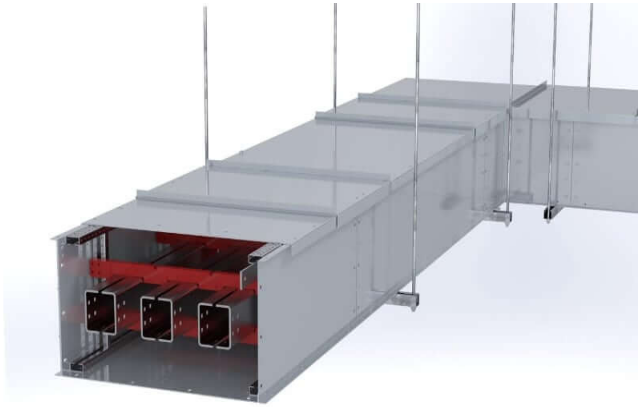
- MCCB(Moulded case Circuit Breaker):A moulded case circuit breaker (MCCB) is a type of electrical protection device that is used to protect the electrical circuit from excessive current, which can cause overload or short circuit. With a current rating of up to 2500A, MCCBs can be used for a wide range of voltages and frequencies with adjustable trip settings. These breakers are used instead of miniature circuit breakers (MCBs) in large scale PV systems for system isolation and protection purposes.

2. Power Transformer:Power transformers are electrical instruments used in transmitting electrical power from one circuit to another without changing the frequency. They operate by the principle of electromagnetic induction. They are used in transmitting electrical power between generators and distribution primary circuits. Power transformers are used to step up or step down the voltage in distribution networks. Since they have no rotating or moving parts, these instruments are considered static devices.

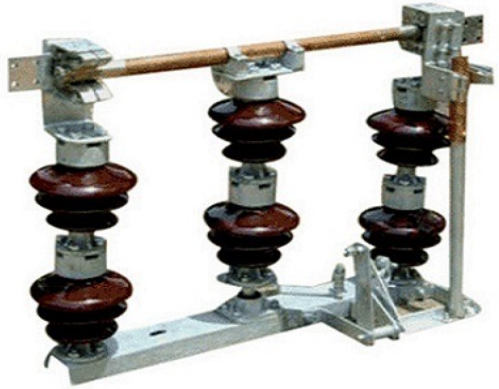
3. Current Transformer: Current transformers are the current-sensing units of the power system and are used at generating stations, electrical substations, and in industrial and commercial electric power distribution.
CT is a type of transformer that is used to reduce or multiply an AC. It produces a current in its secondary which is proportional to the current in its primary.

4. NCT(Neutral current Transformer):A neutral current transformer is used as earth fault protection to measure any fault current flowing through the neutral line from the wye neutral point of a transformer.

5. Busbars and Busducts: A Busduct also called busway typically uses sheet metal, welded metal or cast resin to contain and isolate Cu or Al busbars for the purpose of conducting a substantial current of electricity. It is an alternative means of conducting electricity to power cables or cable bus.

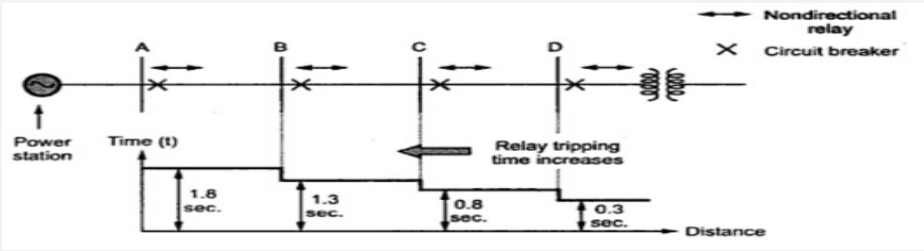


6.Isolators: Isolator is a manually operated mechanical switch that isolates the faulty section of substation. It is used to separate faulty section for repair from a healthy section to avoid the occurrence of severe faults. It is also called disconnector or disconnecting switch. There are different types of isolators used for different applications. They are single break, double break, bus isolator, and line isolator.



RELAY GRADING

Grading of over-current is the adjustment of the settings of the over-current relays to ensure discrimination and selectivity. Consider a radial feeder with multiple feeders in series. An over-current protection relay is installed at every breaker location. When a fault occurs at any given point, only the relay located closest to the fault should operate. This is known as grading.



There are different types of grading. They are

1) Current Grading
2) Time grading
3) Current-Time Grading

1.Current Grading

Current Grading refers to the discrimination achieved by reducing the current setting as we move towards the power source. This ensures that the relay closest to the fault trips first. Here, The Short Pick-up Current For the Lower relays Must be Lower Than the higher relays which are closer to power source. The downside of this arrangement is that the fault current does not always vary with the location. Hence, it is not possible to accurately discriminate between the relays.

2.Time Grading

Time Grading refers to the discrimination achieved by varying the time delay for the different relays. In this method, the relay farthest from the source has the shortest time delay and the time delay increases as we move towards the source. That is, the source breaker will have the highest time delay. This will work in systems where the fault current is uniform across the system. However, this type of grading will not be sufficient in systems where the fault current varies with the location of the fault.

3.Time-Current Grading System

The Time current grading system is the most widely used method of Grading. This method uses a combination of Time and Current grading to achieve discrimination. In this method, the time setting varies with the fault current. A severe fault will have a shorter time delay while the delay will be more for a mild fault. The **times of operation** associated with zones are different: zone 1(Lowest level , nearest to fault) operation is instantaneous, zone 2 is delayed to allow zone 1 relays to operate first, and zone 3 times allow the corresponding relays closer to the fault to operate first in either the zone 1 or zone 2. With this time-step approach selected for different zones of protection, the relays closest to the fault are allowed to operate first. If they fail to operate, the relays located at the remote terminals, that "see" the same fault in zone 2, will still disconnect the failed component. If zone 2 relay operation fails, relays located further away from the faulted line will operate next with the zone 3 settings.

- **Selection of Current Setting**

The current setting is determined by first calculating the current during a fault. This is done by a procedure called the fault level calculation. The current during a fault will depend on the number of power of upstream power sources. Thus, the fault current at minimum generation and the fault current at maximum generation should be calculated. A three-phase fault during maximum generation will cause maximum fault current while a fault between two phases during minimum generation will result in minimum fault current.

Each section of the distribution should serve as a backup for the immediate section downstream. The setting such that the relay operates for a fault at the adjoining section during minimum generation. The current setting is lowest at the feeder farther from the source and increases towards the source.

Types Of Fault

- **Ground faults and Short Circuit Faults**:Short circuits and ground faults both involve hot wires but differ in how the wires touch. In a short circuit, the hot and neutral wires touch, while in a ground fault, the hot wire touches the ground. Both short circuits and ground faults will result in blown fuses and circuit or circuit breakers, respectively.

Short Circuit	**Ground Fault**
Hot and neutral wires touch	Hot wire touches ground
Blown fuse or circuit	Blown fuses or circuit breaker
Causes sparks or smoke	Alerts GFCI outlets
Caused by loose connections in fuse box or touching wires	Caused by damaged wiring or overload

- **Overload current:**In an electric power system, overcurrent or excess current is a situation where a larger than intended electric current exists through a conductor, leading to excessive generation of heat, and the risk of fire or damage to equipment. Possible causes for overcurrent include Short Circuits, excessive load, incorrect design, an arc faults, or a ground faults. Fuses, circuit breakers and current limiters are commonly used overcurrent protection (OCP) mechanisms to control the risks. Circuit breakers, relays, and fuses protect circuit wiring from damage caused by overcurrent.

Examples Of Relays

1.Microprocessor Based- SR21i:

Salient Features

- Self-powered & True RMS sensing
- Inbuilt Zone Selective Interlocking (ZSI)
- Provision for Self-diagnostic test(without tripping the breaker)
- True Hot & Cold characteristics & switchable Thermal Memory
- Multi-state LED to indicate
  - Power ON condition
  - Test mode
- Individual fault annunciation through LEDs
- Provision for AN1 module for remote fault indication through LEDs with changeover contact for each kind of fault
- Direct tripping of breaker-reliable tripping with minimum time delay
- Test kit available for testing the release (SRT-2)
- Realistic hot and cold curves which take into account integrated heating effect
- Conformance to EMI/EMC standards

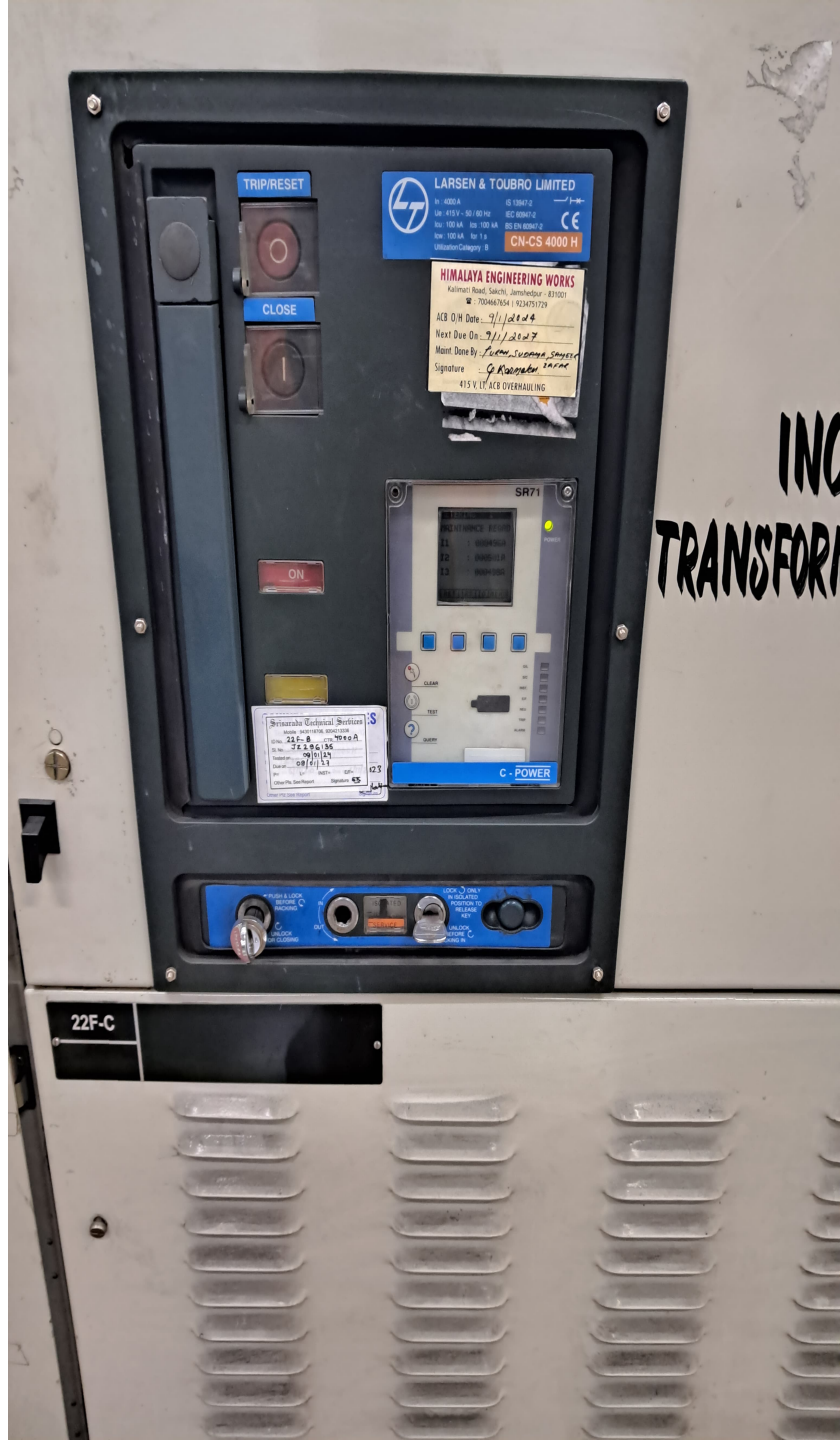
Type of Protection	Setting Range	
	Pick-up Current	Time Delay
Overload (Phase)	Ir - 0.5 to 1.0 times In Steps : 0.50, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.9, 0.95, 1.00	0.2 to 30 sec. at 6 times Ir Steps : 0.2, 0.5, 1, 1.5, 2, 3.5, 6, 12, 17, 30 Sec
Short-Circuit	2 to 10 times In Steps : 2, 3, 4, 5, 6, 7, 8, 9, 10	20 ms to 600 ms Steps : 20, 60, 100, 160, 200, 260, 300, 400, 500, 600 ms
Instantaneous	2 to 16 times In Steps : 2, 3, 4, 6, 8, 10, 12, 14, 16, OFF	-
Earth Fault*	0.2 to 0.6 times In Steps : 0.2, 0.3, 0.4, 0.5, 0.6	100 to 400 ms Steps : 100, 200, 300, 400 ms & OFF

* In 3 phase, 4 wire system, Neutral CT is required for earth fault protection.

2. Microprocessor-based, Communication-capable- SR71

Salient Features

- True RMS sensing
- Offers comprehensive protection for overload, short-circuit, instantaneous, earth fault and neutral overload
- High resolution backlit LCD display
- Intelligent Pre-trip alarm to prevent system shutdown
- Password protected settings and commands
- MODBUS RTU protocol with intrinsic RS 485 port
- LED indication for POWER ON, different faults and Pre-trip alarm
- 2 sets of storable protection settings
- Last 5 trips & 128 Event records with time & date stamping
- 3 programmable contacts-1 for micro controller failure, 2 for basic fault annunciation
- 4 relay contacts for indication of exceeding maximum demand, Pre-trip alarm and control on breaker (closing and opening)
- Rating-plug for precise protection at lower load currents
- Auto-doubling features to prevent nuisance tripping
- Selectable I^2t based current for short-time and earth fault zones
- Thermal reflectivity enables faster tripping on recurrent overloads
- Inbuilt Zone Selective Interlocking
- Provision for Self-diagnostic test
- Conformance to EMI/EMC standards



Questions and Doubts which arises ?

1.Why are both incomers come to MCC or PCC from two different Buses? Why not from Same bus?

Ans: Because to ensure the reliability of the system. During any fault in anyone of the section, we did not loose the entire circuit.

2.Why Short circuit current rating > Overload current rating > Ground fault current rating ?

Ans: Path of least resistance: In a short circuit fault, the fault current flows through a direct path with very low impedance, typically through a metallic conductor. This low-impedance path offers little resistance to the flow of current, resulting in a high magnitude of current. In contrast, an earth-fault current must flow through the earth or other grounding system, which generally has higher impedance compared to a direct metallic path. As a result, the earth-fault current is usually lower than a short circuit current with Overload current in between.

3.If current surges originates from the source when fault occurs, then upper zone circuit breakers or their corresponding relays would detect fault first, then why Practically it is said that relay just above the fault would detect the fault first?

Ans: Since short pickup current for lower relays are much lower than higher ones, Therefore relative increase of surge current with respect to rating current of lower relays is very much higher, therefore it is said that their Probability of detecting fault first is higher.

4.If there is a current surge in all the 3 faults Short circuit fault, Overload current and Ground fault, Then How protection system (Relays) Knows that which type of fault is this?

Ans: In Ground fault or SC fault the current in the 3-phase become unbalanced or current in neutral wire increases to significant amount. But current increase in case of short circuit fault is much higher than ground fault. Whereas in case of overload fault the 3-phase system remains balanced and current in neutral wire remains negligible.

COMPLETED UNDER GUINDANCE OF

Nishant Kumar sir

GUIDE NAME

THANKS