



NORTH-WEST UNIVERSITY[®]
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
POTCHEFSTROOM CAMPUS

THRIP Project Report 1

Student Name: Vuyisani Magunjana

Study area/degree: NDip Electrical Engineering

Title on report: Bio-Diesel Project

Date: 02 Sep 2016

Gasification / biodiesel

Year 2

TP 13082831366

01 Jan 2016 – 31 Dec 2016

Faculty of Engineering

1. Table of Contents

1. Table of Contents	2
1. Introduction	3
1.1 Project Background	3
2. Student Activities	3
2.1 Research Activities	4
3. Conclusion	18

1. Introduction

1.1 PROJECT BACKGROUND

In 2013, iLive procured biodiesel technology in pursuit of its ambitions to produce 7 million litres of biodiesel per annum from used cooking oil (UCO). The technology is to be demonstrated by manufacturing 300,000 litres of biodiesel in compliance to SNAS1935 standards. After successful completion of phase 1 a ramp-up to 7million litres per annum will continue. The UCO is mainly supplied from restaurants and is collected by collection companies. By converting UCO into biodiesel, iLive will compliment South African's biodiesel and renewable and clean options, as well as ensuring restaurant wastes are treated indefinitely; preventing harmful secondary reuse of the wastes in the food market.

2. Student Activities

During the period as from 28 April 2016 to 02 Sep 2016 the following activities were completed:

- Building and Connection of Pipes
- Cables
- AC and DC Machines
- Protection System
- Switches and Circuit Breakers
- Testing and Fault Finding
- Drawings and Design

2.1 RESEARCH ACTIVITIES

Building and Connection of Pipes

During the training we were given an opportunity to study the designs and build what is required from the designs. Building the stands for the machines and other equipment in the plan was a good experience. Building supports for the tanks and motors we had to use more of our drawing and welding skills.

Connecting the steel and plastic pipes for the first time and making sure that there will be no leaks at the joints was not an easy task. But with the help of our supervisor and the engineers at the plant we managed to come up with strategies and simple ways of cutting and welding of the pipes.



Cables

During my training I learnt that, you never run power cables with data cables together in the same cable tray, because of interference due to the frequency which disturbs the signal you were supposed to get, hence it will give false signals.

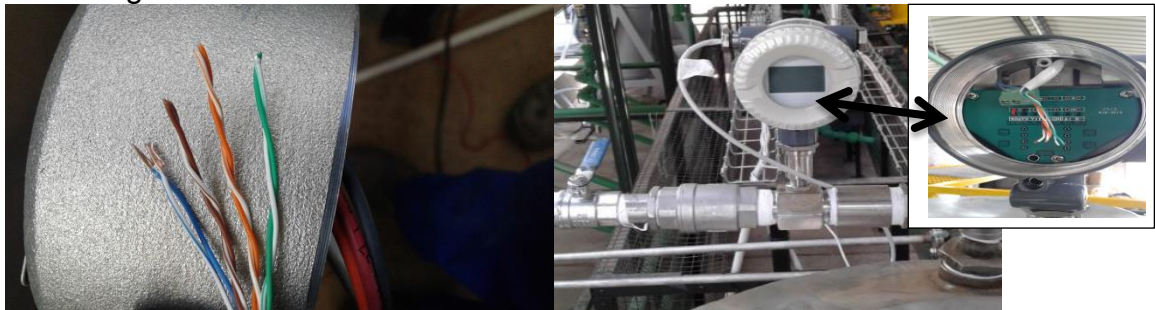
Types of cables used:

- Three-Phase Cables
- Single Phase Cables
- Data Cables

Four things that you consider when choosing the size of a cable

- Cables installation conditions and the load it will carry
- Continuous current rating of the cable
- Voltage Drop and short circuit consideration
- Earth fault loop impedance

A data cable is any media that allows baseband transmissions, binary 1 and 0. Examples are: Ethernet Cables (Cat5, Cat5e, Cat6, and Cat6a). We used these cables to send data or signal from the machines to the controls to receive data.



In the plant we used Ethernet cables to collect data from all the components in the plant. These cables go to different components in the plant, components like:

- Flow Metres
- Flow Switches
- Resistance Temperature Sensor
- Pumps and
- The Compressor

Cable Tray

Putting Cable tray for data cables from the control panel, controlled by the PLCs to collect data or read signals.



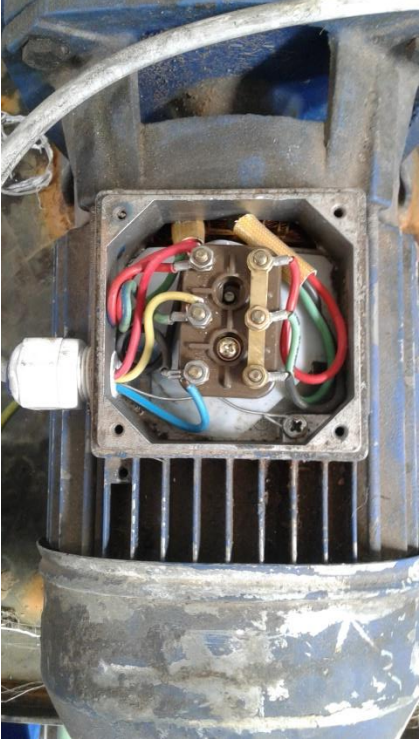
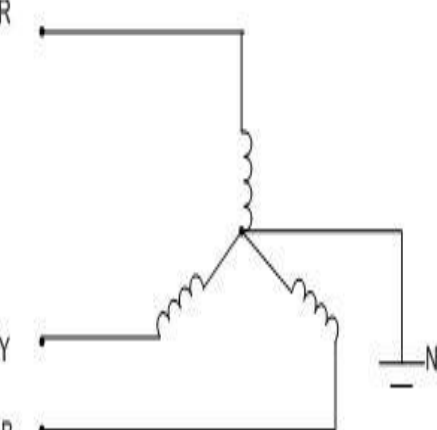
Cable tray for power cables from the control panel to the pumps and all other three-phase machines.


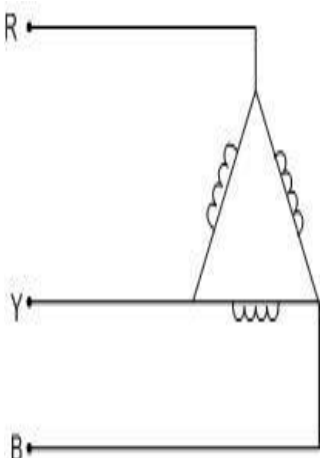
AC Machines: Synchronous and Induction

- Motors- Machines that convert electrical energy to mechanical energy
- Generators- Machines that convert mechanical energy to electrical energy
- Boiler – Machine that boils water, but in this case we boil water to get steam.

Motors

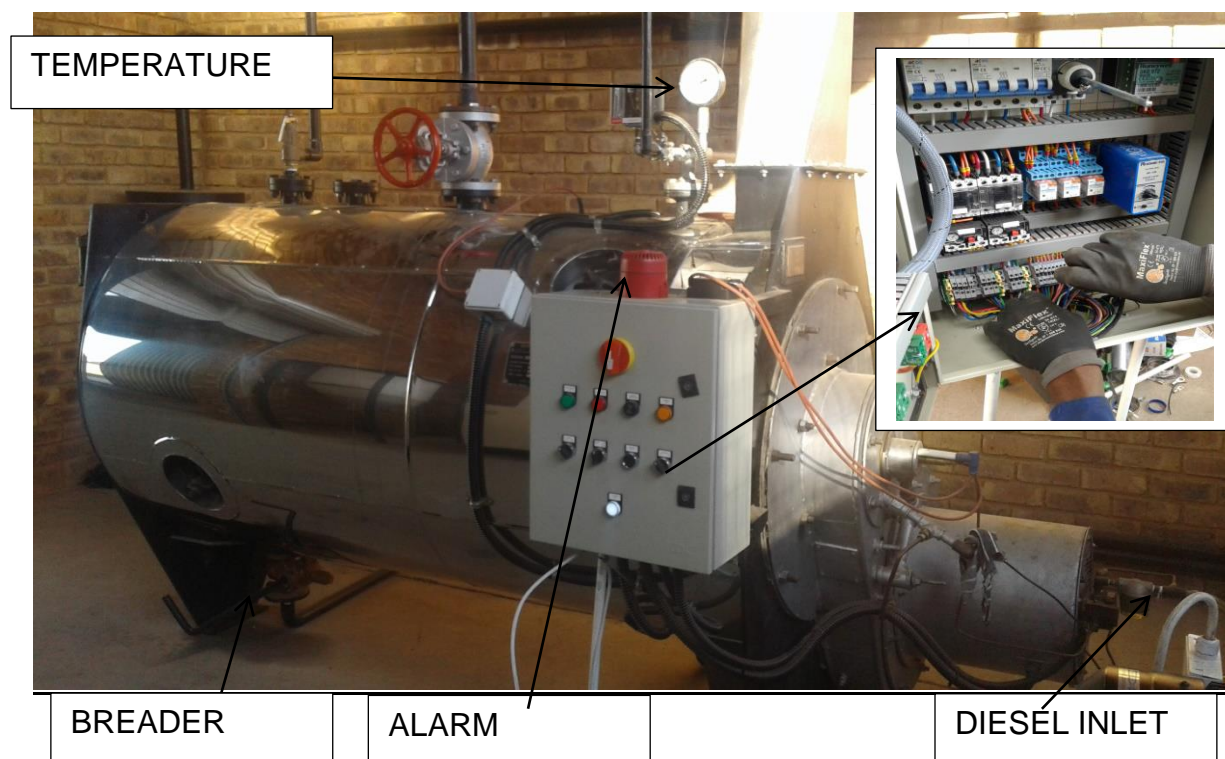
All the motors in the plant are three phase motors and they are connected to a three-phase balanced supply which drives the pump to pump the liquid. Motors are connected in star (Y) and Delta (Δ) configuration.

Type of Configuration	Picture	Symbol
<p>Star (Y): In star connection the starting or finishing ends of three coils are connected together to form the neutral point. A common wire is taken out from the neutral point.</p> <p>3-phase 4-wire system is derived from star connection s.</p> <p>Line current = Phase current</p> <p>$I_L = I_{ph}$; $V_L = \sqrt{3} V_{ph}$</p> <p>Total Power: $3(V_{ph})(I_{ph})\cos\phi$</p> <p>The speed of a star connected motors are slow as they receive $1/\sqrt{3}$. And the phase voltage is low by $1/\sqrt{3}$.</p>		

<p>Delta (Δ): The opposite ends of three coils are connected together. And three wires are taken out from the coil. No neutral point in delta.</p> <p>3-phase, 3-wire system is derived from Delta connection.</p> <p>$V_L = V_{ph}$, $I_L = \sqrt{3} I_{ph}$</p> <p>Total Power: $3(V_{ph})(I_{ph})\cos\phi$</p> <p>Speed of Δ motors are high because each phase gets the total line voltage</p>		
---	---	---

The motors are used to drive pumps to pump liquid from one tank to the other tank in the plant. Some of the pumps are used to mix the chemicals in the plant.

Boiler



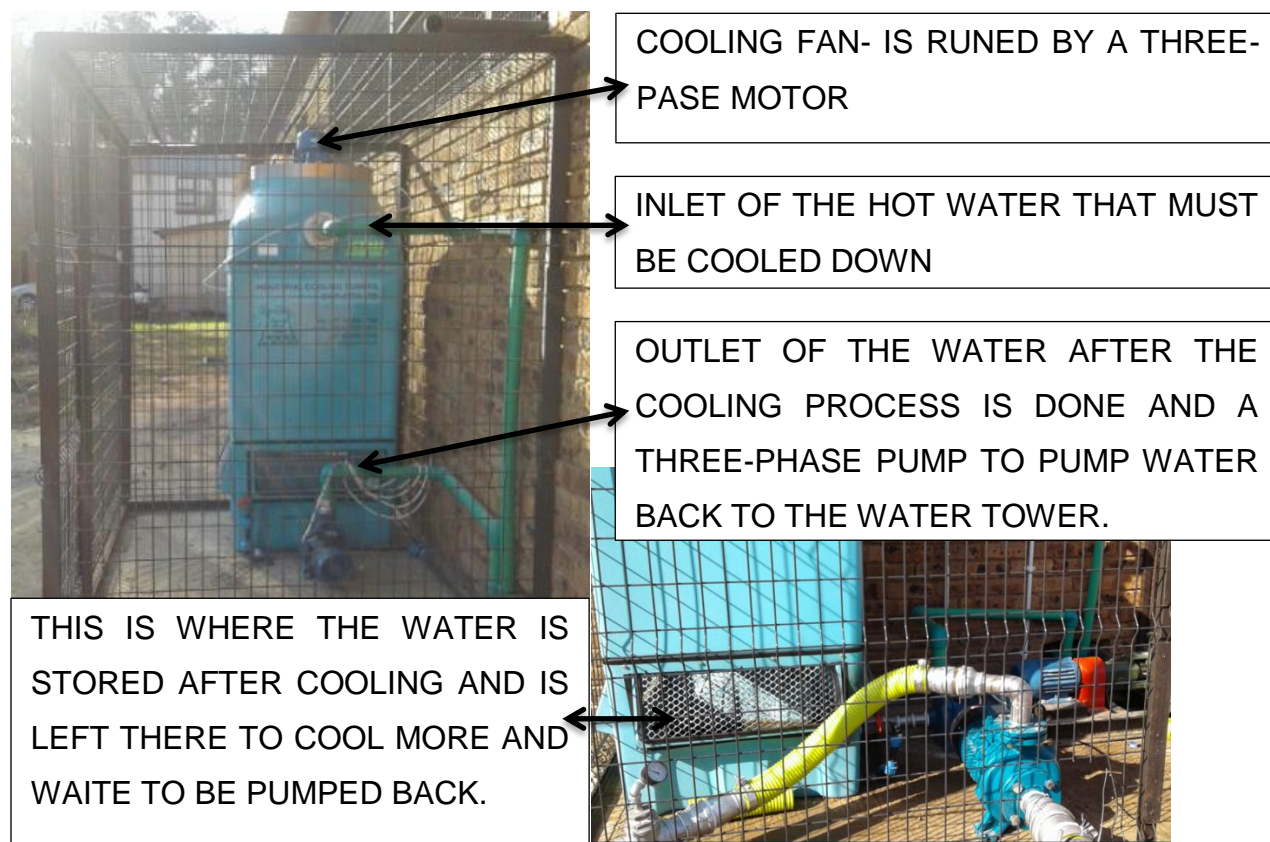
The boiler is used to boil the water and steam is trapped. The trapped steam is used to heat up flash evaporator FE 2-1 with the heat exchanger and chemicals in the reactors. The boiler uses fuel to operate (Diesel) and three-phase power for starting.

Water tower



The water is stored in this tank and pumped automatically out by a three-phase pump to the boiler when it's needed. This tank has a water gage and a sight glass that allows the operator to see the level of water at all times.

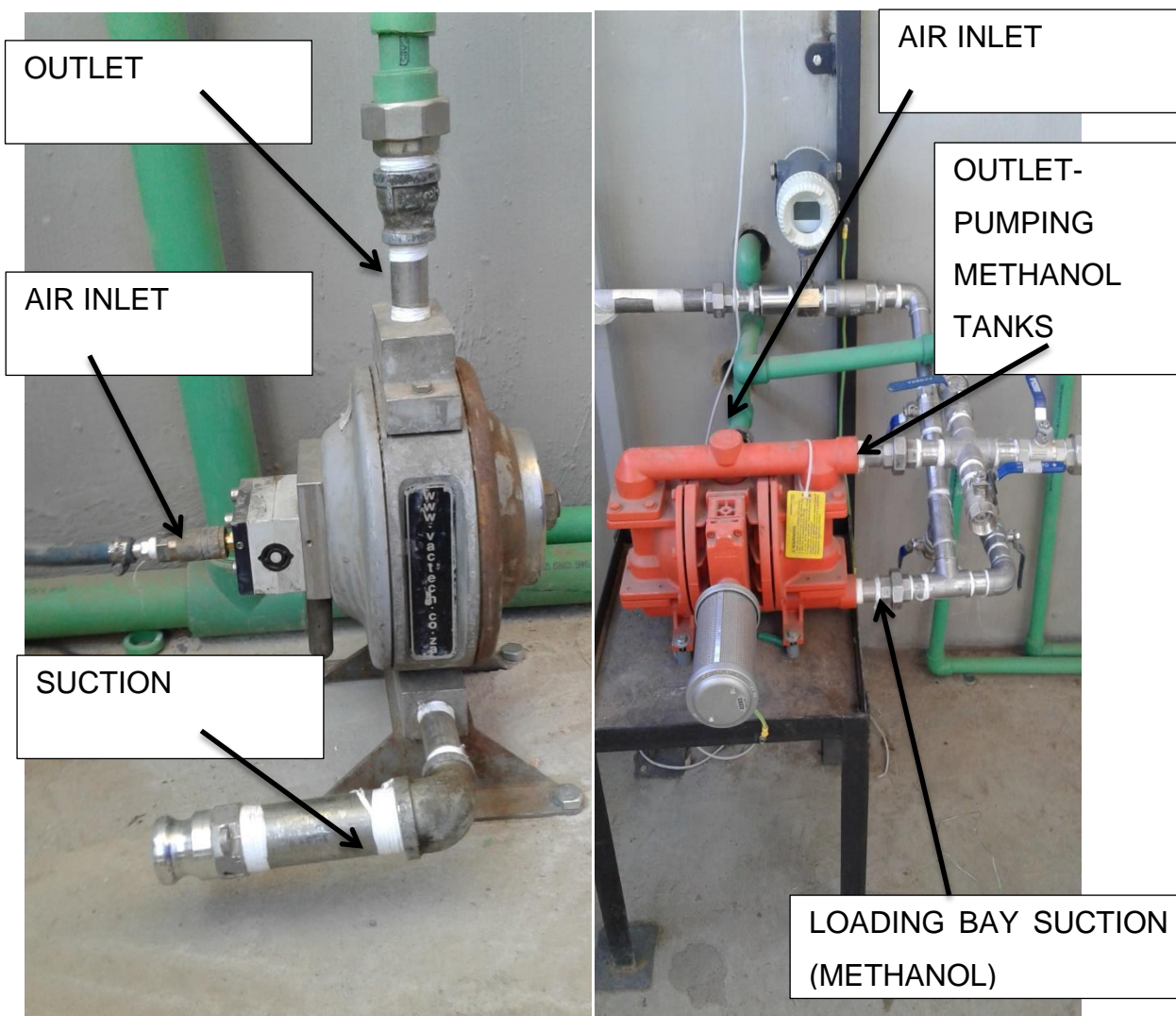
Industrial Cooling Tower



A cooling tower is a heat rejection device which rejects waste heat to the atmosphere through the cooling of water steam to a lower temperature. In this case the water is heated by the boiler and the heated water creates steam which is used to operate some of the components like, heating up FE 2-1 (Flash Evaporator) and the two reactor tanks. In the two reactor tanks the steam is used to heat up the methanol.

The cooling tower allows a small portion of water be cooled and pump it back to the water tank.

A 300LT three-phase compressor used to store air for the pneumatic pumps. The pumps are used to pump flammable chemicals like methanol in this case, into different tanks. This compressor supply air to three different pneumatic pumps at the plant; one at the loading bay, one next to control room to pump methanol to the mixing tank, and the last one is at the loading bay to collect methanol spillage during loading process.



Pneumatic Pumps to pump methanol.

Installing Panel For PLC's



MAIN CIRCUIT BREAKER

MAIN PLC

A STEP DOWN POWER
SUPPLY, 220v AC TO 24v
DC.THIS 24v IS USED TO

220v AC INPUT
PLUS
GROUND/EARTH

24v DC OUPUT
TO SUPPLY THE
PLCs

Back-Up Generator



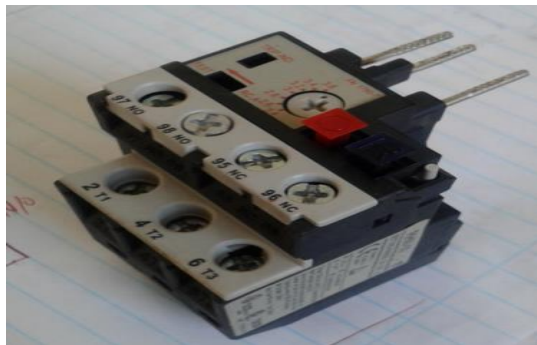
This is a standby generator or a back-up electrical system that operates automatically and manually. Within seconds of power drop or if the municipality power is gone, the generator will automatically sense the power outage and start up automatically.

If the power supplied by the municipality is not balanced, the generator can be started manually or it can start automatically to balance the power that you supply to your load. This generator used fuel (Diesel) to operate. It has two 12v batteries connect in series to form a 24v DC to start up the machine.

Protection Systems

Protection system is to isolate a faulty section of electrical power system from rest of the live system so that the rest portion can function without any server damage due to fault current.

Over Load Protective Relay



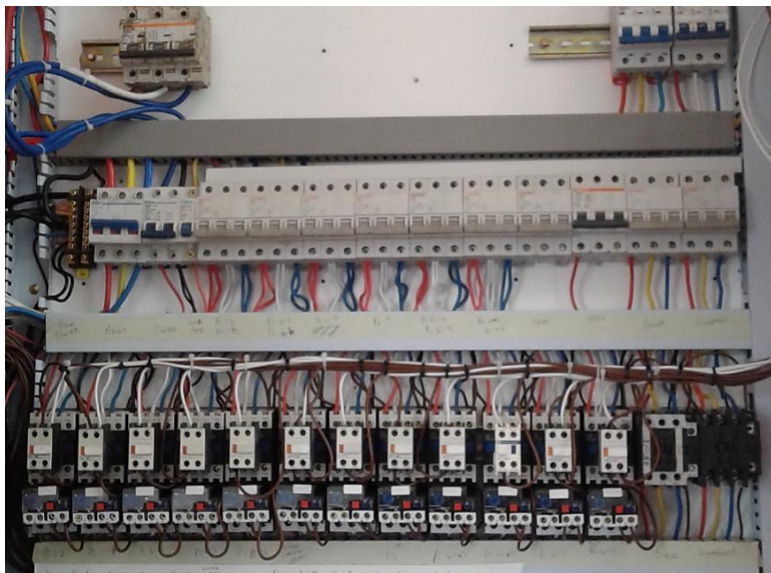
THIS IS THE OVERLOAD RELAY USED IN THE PLANT TO PROTECT THE MACHINES FROM BURNING AND BEING DAMAGED FROM THE SHORT-CIRCUIT OVER LOAD THAT WILL BE HAPPENING AT THAT POINT.

Fuse



THIS IS A SAFETY DEVICE CONSISTING OF A TRIP OF WIRE THAT MELTS AND BREAKS AN ELECTRIC CIRCUIT IF THE CURRENT EXCEEDS A SAFE LEVEL.
IT PROTECTS THE CIRCUIT FROM BURNING.

Switches and Circuit Breaker



What is a circuit breaker?

- A circuit breaker is an automatic operated electrical switch design to protect an electrical circuit from damage caused by overload or short circuit.

What is its function?

- Its basic function is to interrupt current flow after protective relays detect a fault. Unlike a fuse, which operate once and then must be replaced
- A circuit breaker can be reset manually or automatically to resume normal operation.

How do they differ?

- They are made in varying sizes, from small devices that protect an individual household appliance up to large switchgear designed to protect high voltage circuit feeding an entire city.

Operation

- All circuit breakers have common features in their operation, but they differ when it comes to the voltage, current rating and type of the circuit breaker.
- The circuit breaker must detect a fault condition in common mains and low voltage circuit breaker.
- Circuit breakers for large currents or high voltages are arranged with a protective relay to sense a fault condition and to operate the trip opening mechanism.
- There is a trip solenoid that releases the latch is usually energized by a separate power source. And some circuit breakers are self-contained with current transformers, protective relays, and an internal control power source.
- Once a fault is detected, the circuit breaker contacts must open to interrupt the circuit. This is done using mechanically stored energy contained within the breaker, such as a spring or compressed.
- Circuit breakers may also use the higher current caused by the fault to operate the contacts.
- Circuit breakers must allow the current to pass through without over

Switches



Three-phase isolators used to switch on and switch of the power at the pumps. There is an Isolator for each pump.



Temperature Sensor, This tool will read the temperature and send the signal inside and the heating steam will be stopped and there will be no steam coming in to the reactor.

Testing and Fault Finding

Fault finding is when there a fault in the system and you troubleshoot by using testing tools like multi-meter to find the fault.

Before Starting:

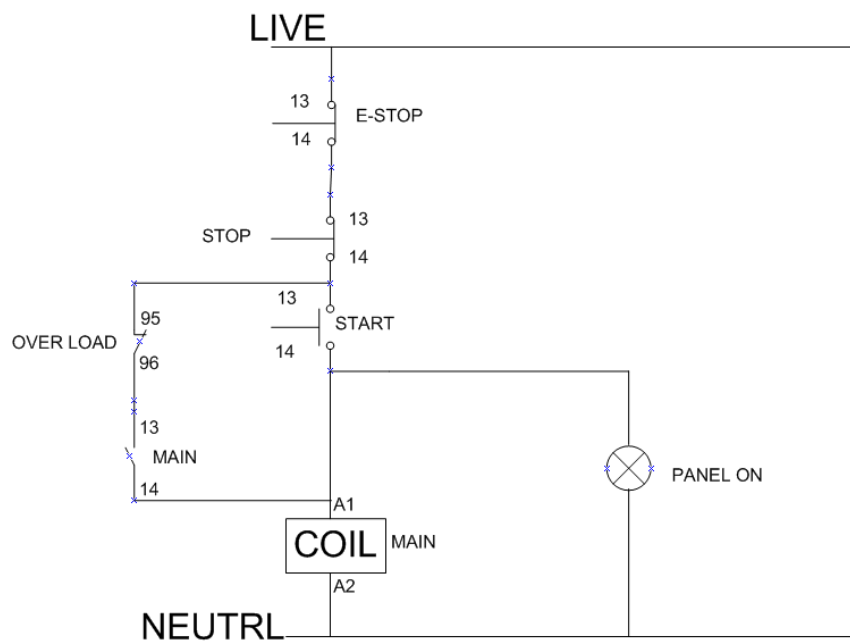
- Test Equipment
- Multi-meter
- Know how to use safety
- Working Order(No flat Batteries)
- Proper probes / clips
- Know how to use the tools

Steps in Fault Finding:

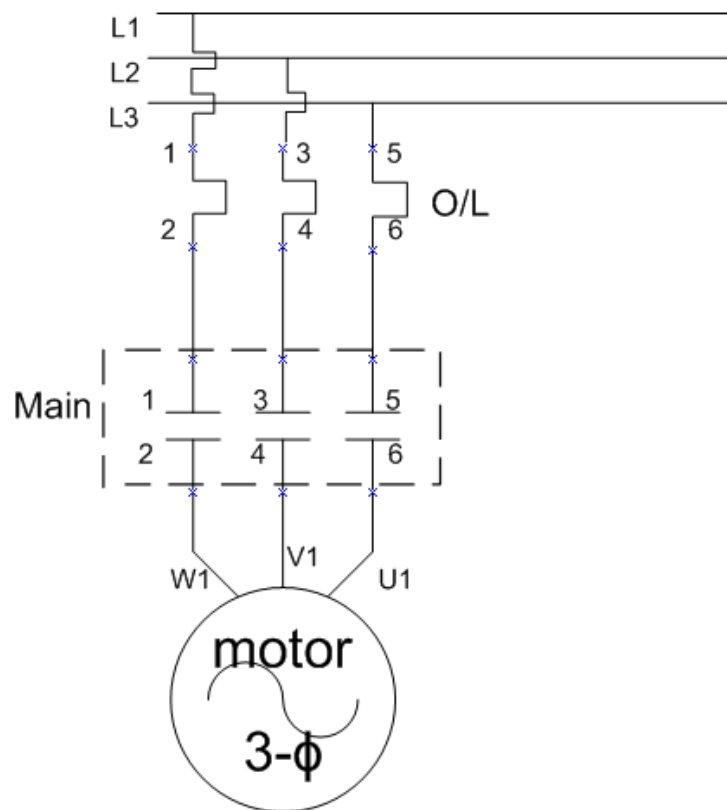
- Identify the fault module/stage
- Identify the fault component
- Analyse the failure
- Redesign if necessary
- Replace faulty component
- Test to specification
- Document

Drawings and Design

Control Circuit



Power Circuit



3. Conclusion

The experiential leaning that I had at iLive Sustainable Development Holdings (Pty) Ltd was really helpful. Working for a company on a big project like this was a great experience. I gained a lot of experience and I learnt so many things like, connecting heavy machines like a Back-Up generator, motors and all other components. Now I know how to connect and how to choose your size cables according to the ratings of the equipment.

I experienced a lot as I was help by a qualified Engineer to connect all the components. Now I can work on my own and design on my own, and I can also be able to work with a team. I learnt that as an Engineer you need to teach yourself complete all your given tasks on time. Work against deadlines and make sure that your work is neat and safe, so that it does not bring harm to the environment or people around it.