

King Fahd University of Petroleum & Minerals

Electrical Engineering Department

SUMMER TRAINING REPORT

SPCC

South Province Cement Company



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Date: 2010-10-12

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INTRODUCTION

This report will discuss the summer training program which has number of tasks that done through eight weeks in one of south province company. This company is Southern Province Cement Company (SPCC) which is divided into three main departments. These departments are Works Manager Department, Production Department and Maintenance Department.

Overview about Cement Contains

The cement Ingredients is containing 4 main types of raw material in addition of some additive materials like alkali. The Lime Stone, Sand Stone and Iron Ore will mix to each other through process step then we will get the Clinker. The Clinker, Gypsum and Alkali will mix to each other through process step then as result it will give the final cement product.

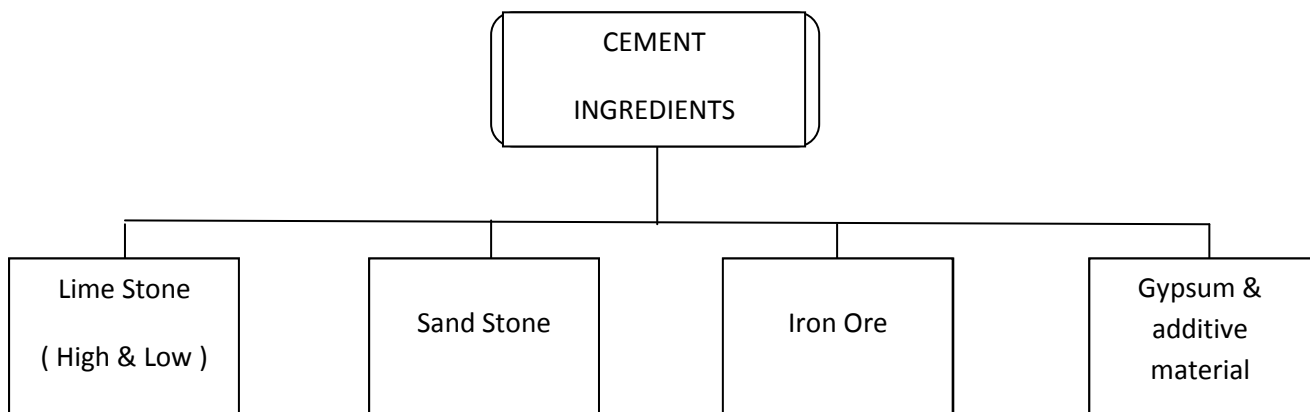


Figure 1: Cement Ingredients

PRODUCTION STEPS

Quarry

This place is the most important and most dangerous in the plant. It is important because it is the source of the main Raw Material which is Lime Stone either high lime or low lime. On the other hand, it is dangerous because of the explosive work to get those materials from the mountain. The control side of this part especially in High and Low Lime Reclaimers is using PLC Unite "S5 PLC".

Quality Control

In this department there are two types of machine that analyze the materials. Firstly, Gama Analyzer is analyze the lime stone and to find out the ratios of the elements. The idea of this machine is related to the electron of the element. Secondly, X-Ray instrument which control the Raw material. Also, there is some other equipment like small mills to prepare the sample which coming from the Raw Mills and Finish Mills. In addition, there is one system is used to call the sample from Mills. The type of this system is pneumatic system.

Crusher Area

There are six type of crusher depending on their specific work. The first type is Mobile Crusher that is moving from place to another according to the availability of needed source. The other type is locally crusher which consider as a multi step crusher as following:

- 1- Primary Crusher.
- 2- Secondary Crusher.
- 3- Sand stone Crusher.
- 4- Iron Ore Crusher.
- 5- Gypsum Crusher.

MOBILE CRUSHER

This crusher is receiving the raw material of lime stone through the apron feeder then the crushing process will takeover. Inside the mobile crusher rotor there are 12 rows in each row there are 7 hummers for crushing the huge rock to the required size. From the crusher to the plant the material is transferring through a long belt called "B1". This belt by three motors one in tail and two in head of belt.



Figure 2: Mobile Crusher

The Process of Mobile Crusher

Loading the track from the mountain → Apron Feeder → Vibrator → The Main Crusher Discharge Belt → A1A Belt → A1B Belt → A2 Belt → Surge Bin#1 → Long belt B1 → Surge Bin#2 → B2 Belt → B27 Belt → B127 Belt → B204 Gama → B30 Belt

How is Mobile Crusher working?

It is working in special way that starts from last part (B30 Belt) gradually to first part (Apron Feeder) and stop reversely from Apron Feeder to B30 Belt. This is happening to skip the problem of accumulating the material on the belt and inside the crusher which causing many problem. Also, if any part of the system is stop for any reason then all parts comes before this part will stop automatically and gradually one by one from last to first. For example, if A2 Belt is cut then the system stop starting from A1B then A1A then Discharging Belt then the main crusher then the vibrator and finally the Apron feeder. Other belt following belt A2 will not stop and it will continue work until transfer all material then stop. On the other hand, the system

does not start working again until it check all parts of system are ready to work otherwise it will not work. PLC S5 is doing these entire job including checking, starting and stopping. There are two special systems that controlling the tension of the belts according to the weather or the amount of material transferring by that belt. The system is chosen according to the length of the belt. If the belt is short, counter system will used which using weight to do the aim as shown in the figure. Motor system is using for long belt like B1 Belt.

Power Plant

This department is the main supply of power for all branches of the plant. The power is providing from main power plant to the substation and from the substation power will distribute to each area in the plant as shown in the figure. In the power plant there are 9 numbers of generators as below

- 1- 8 generators have capacity of 7.3 MW using relay system.
- 2- 1 generator have capacity of 10.9 MW using Siemens PLC system.



Figure 3: The Generators

On the other hand, It is easy to find out the pipe line which one for what, because each line have different color each color for different purpose as below

- 1- Blue color pipe line using for water.
- 2- Yellow color pipe line using for oil.
- 3- Brown color pipe line using for fuel.
- 4- White color pipe line using for Air.

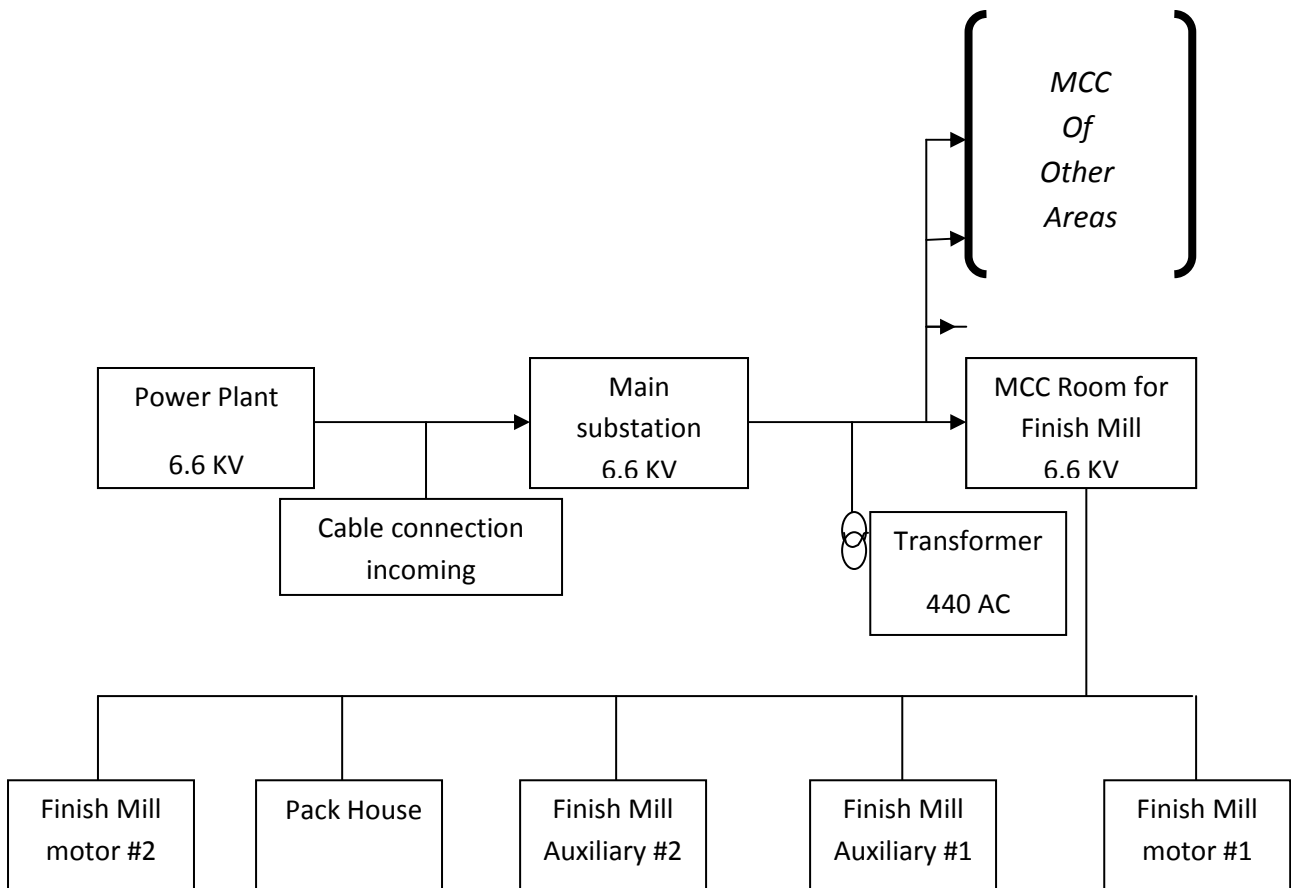


Figure 4: Power Distribution



Figure 5: MCC of Finish Mill

PROGRAMMABLE LOGIC CONTROLLER (PLC)

As we know since long time ago the people start thinking to find the best way that it can help them to control their projects and work. Then, they start using the ON/OFF contactor and day by day they find their need which is the PLC. The PLC started as simple control program then people started working in to improve their work. Finally, they came up with a step 5 PLC which has three different models (95u , 115u , 900) and it was the best in that time until step 7 comes up also with three different model (200,300,400). Nowadays, some companies are still using a step 5 like SPCC.

The Plants that used "S5 PLC" system in SPCC

- 1- High and Low Lime Reclaimers.
- 2- Mobile crusher.
- 3- Raw mills 1&2.
- 4- Kilns 1&2.
- 5- Finish mill.
- 6- Pack house.
- 7- Paper sacks.

In SPCC, there are three different PLC systems according to its producer company. These three producers are Siemens, Mitsubishi and Alum Bradley. Each one of these type has its special program and symbols as shown in the following table:

Type	Symbol		Refer to
SIEMENS	I	E	Input
	Q	A	Output
MITSUBISHI	X		Input
	Y		Output
ALUM BRADLEY	I		Input
	Q		Output

Table 1: Types of PLC's and their symbols.



Figure 6: PLC unit

Basic Information about PLC

PLC system contains three main units. Power supply is the first unit that provides power to other units. The second unit is the CPU unit which has all programs and consider as the brain of the all system. Then, the Input – Output unit (I \O) is the third unit and in this unit inputs is ordering like (I0.0,I0.1,... etc.) and output (Q0.0,Q0.1,...etc.) for Siemens. There is also a reserve power supply in case of a sudden stop of the power that make a lot of problem to the PLC system because it needs to stop gradually but not suddenly. Also, The PLC system is considered as operator for other machines and equipment that causes a lot of danger if it is stopped in wrong way like motors. In SPCC, they use Siemens MASTERGUARD PLC can deal with both type of signal either continuous or digital depending in the application itself. For example, continuous signal is used in temperature detectors because the temperature is considered as linear relation with continuous signal. There are three type of programming or sometimes called display Formats. These three display formats are explained as below:

1. Ladder Diagram (LAD) which consider as graphical representation of a program using the usual symbols. The symbols represent an interrogation of a voltage state (voltage present, voltage not present) of a sensor or a control element.
2. Control System Flowchart (CSF) is simply block diagram of the automation task using symbols for the individual functions.
3. Statement List (STL) is the program represented by a list of mnemonics.



Figure 7: Siemens MASTERGUARD

Notes

- In principle, the display formats can be intermingled on the PG. However, not all STL function can be converted into graphical forms CSF and LAD, all programs created in LAD or CSF can be converted into STL.
- The programming unit stores all programs in programmable controller's memory in machine code, regardless of the format that used to program.

PLC Programming

In SPCC, I learned how to program a PLC using SIMATIC manager software. I did some simple program and I interact with the block diagram and I got good experience in how to control huge number of motors and timers.

How to open and work with Engineering Station PLC Using SIMATEC

1. Open the engineering station PLC computer using the key.
2. After opening the computer select S5 from the tool bar.
3. After selecting S5 one page will come up with language selection. Press "E" from the keyboard for English language.
4. Now, PLC page will be shown and you can work offline mode as well as online depending in the programmer himself whether he want to apply the commands directly to the system or not. To set online or offline you should follow the steps as follow:

- Project → Load →D →Simatic →Jizan → then select the work direction that you need to work with and this will be the setup of page one.
- Project → setting → page2 → from page2 you can change the status to online.
- If page 2 is offline and you need to check one item →Editor → step5 block → in the program file →the dialog box will open then write the item PB number →press enter five times.
- If page 2 online and you need to check one item →Test → block status → the dialog box will open then write the item PB number press enter five times.

Steps to make a logic 1 or bypass:

- Press Edit from down tool bar or press F6 from the keyboard.
- To change the input status to logic 1, use the cursor key to bring the Edit box up to the input that you need to make logic 1.
- Now you can change the input to logic 1 by pressing "-" key from the keyboard. In step you have two choice as below:
 - You can change the input to logic 1 by writing command "F1.1". in this way you have to press "-" key one time only then write F1.1 then press enter then press "Ins" key then yes.
 - You can change the input to logic 1 by writing command "LOG1", in this way you have to press "-" key two times then write LOG1 then press "Enter" then press "Ins" key then yes.

Timers in the step 5 PLC:

- KT xxx.n
- xxx have value from 000 up to 999.
- n have value from 0 up to 3
 - K999.0 999/100
 - K999.1 999/10
 - K999.2 999/1
 - K999.3 999*10

Way of how to change the value of the timer in the PLC:

→ Edit → use the cursor key to bring the edit box to the timer value → do the changing → press enter.

Example of writing program using CSF which I did and checked by the SPCC supervisor:

Write a program that runs three motors as follow:

1. When start button is pressed motor 1 run.
2. After motor 1 run by 5 seconds motor 2 run.
3. After motor 2 run by 5 seconds motor 3 run.
4. When stop button is pressed motor 3 stop.
5. After motor 3 stop by 5 seconds motor 2 stop.
6. After motor 2 stop by 5 seconds motor 1 stop.

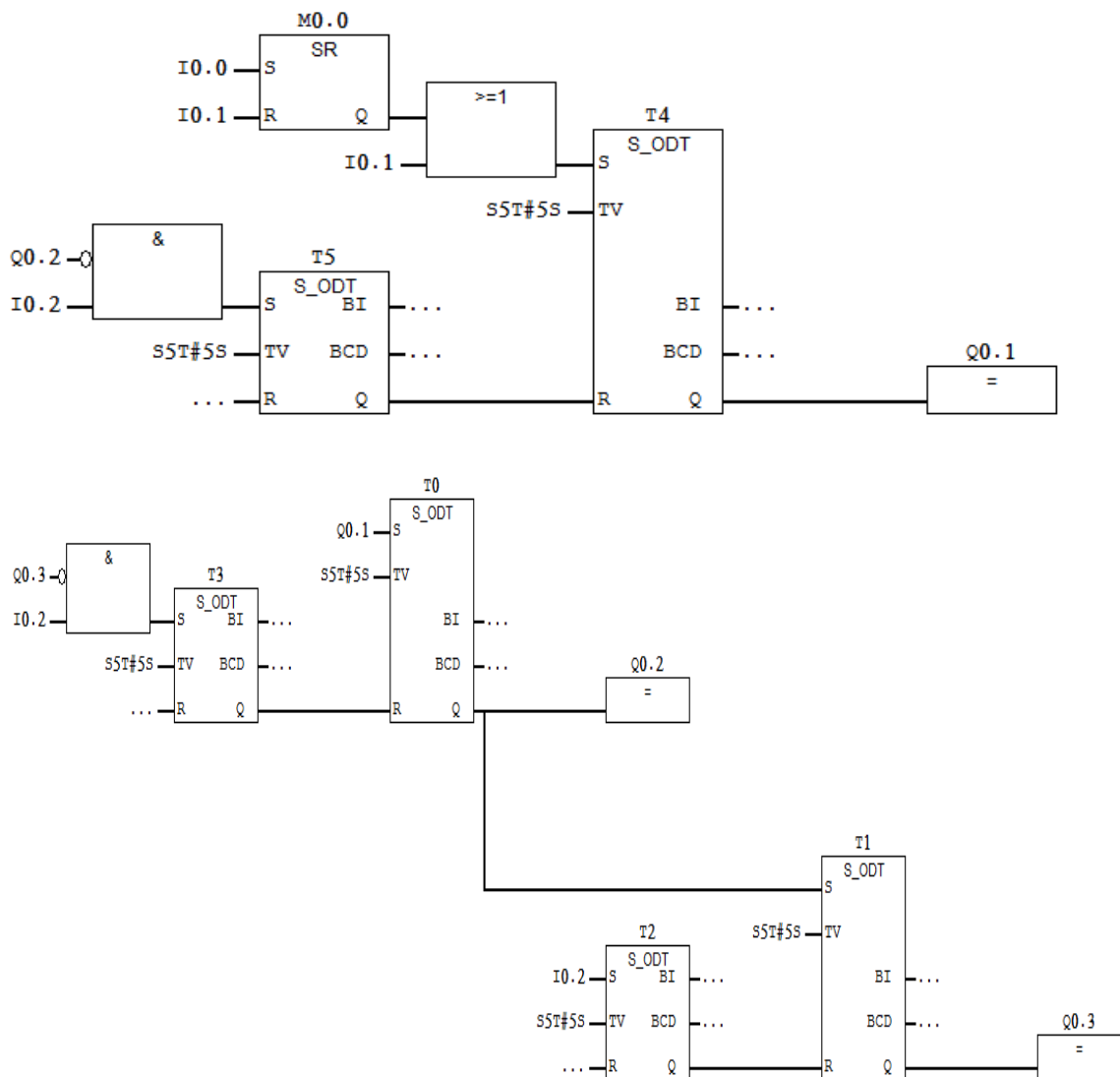


Figure 8: PLC Program using CSF

DETECTORS

There is many type of detector but I will concentrate in temperature sensors which I dealt with.

Thermocouple

A thermocouple is a device that is measuring temperature of any material. It is basically consists of two dissimilar materials that joined form junction which when heated produce thermoelectric voltage. This voltage indicates the temperature increases or decreases.



Figure 9: Thermocouple

How to Select Wire Calibration

Code	Wire Calibration
J	Iron Constantan
K	Chromel Alumel
T	Copper Constantan
E	Chromel Constantan
R	Plat. 13% Rhod. Plat.
S	Plat. 10% Rhod. Plat.
B	Plat. 30% Rhod. Plat. plat.6% Rhot

For duplex calibrations please indicate double letters, for example EE

Table 2: Wire calibration

Resistance Temperature Detectors (RTD's)

Resistance temperature detectors sense heat based on the principle that a change in temperature results in a corresponding change in the resistance of a wire. When a small excitation current is passed along the element, the voltage is then measured and converted to units of temperature.



Figure 10: RTD

Comparison of RTD's and Thermocouples

The advantages of using RTD's are numerous. They offer high accuracy, repeatability and stability. Another advantage is that cold junction compensation is unnecessary. Here is a brief summary of some of the advantages and disadvantage of both thermocouples and RTD's:

	Thermocouple	RTD's
Accuracy	Limits of error wider than RTD's	Limits of error much closer than thermocouples
Ruggedness	Excellent, will not affect life expectancy of the probe	Somewhat sensitive to strain, Vibration, shock and pressure
Temperature	-328 to 4200F -200 to 2315C	-50 to 1500F -45 to 593C
Response	Can be made small enough for millisecond response time	Slower , Thermal mass results in a response time of seconds or more
Sensitivity	Can be made tip sensitive	Cannot rapidly be made tip sensitive. Thermal mass prevents tip sensitive construction.
linearity	Non-linear	Linear over a wide operating range

Table 3: Comparison between thermocouple and RTD's

CONCLUSION

This period of summer training is very productive. Many things were learned in these 8 weeks taken in SPCC. In this conclusion, things were learned will be listed.

I learned how to deal with PLC system and many thing related to PLC. Also, I got a lot of information related to the sensors that used in SPCC and about some types of controller like PID controller. I learned about the power distribution in the plants. To sum up, I really concentrate on the control systems that used in SPCC.

**SOUTHERN PROVINCE CEMENT COMPANY
JAZAN CEMENT PLANT**
PROCESS FLOW SHEET

