

AW Interim Report

by Alexander Williams

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COLEG SIR-GÂR



PH Motor Monitoring System Upgrade

BSc(Hons) Electrical and Electronic Engineering

Major Project (PSDE6019) Interim Report

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Industry: Oil and Gas (downstream/ refining)

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1 | INTRODUCTION

The following project is based around the major project unit of the BSc (Hons) Electrical and Electronic Engineering degree at Coleg Sir-gâr, as well as a solution to a genuine concern at Pembroke refinery, where the author currently works.

The key word in the commitment to this project is **obsolescence**. The equipment which is being used as a part of a system to monitor the behavior of hydraulic systems on the refinery is becoming increasingly obsolete and a new solution is required as soon as possible. Many of the spare components are no longer available, where those which are still on the market are becoming increasingly exclusive and therefore costing much more.

The new system will monitor the hydraulic motors and provide information to the operator, similar to that before, although it will now be efficient and more importantly, it will be modern in respect to maintenance and acquiring spare components. The system is also responsible for the control of the equipment in relation to the process outlet temperature.

The importance of this project being conducted correctly, relates to reliability, efficiency of the plant and most importantly, safety aspects.

Good, clear introduction.

2 | BACKGROUND RESEARCH

2.1 | PROCESS THEORY AND SYSTEM

The Fluid Catalytic Cracking Unit (FCCU) is one of the most important plants in the integrated installation at Pembroke Refinery. Its main purpose is to produce additional and enhanced gasoline as demand is escalated. In brief, the main process within the FCCU uses a catalyst in the form of very fine particles which behave as a fluid when aerated with a vapour. There are 3 primary components in this cracking process. The units' vacuum gas oil feed interacts with the catalyst in the feed riser line or the **reactor** and the main reaction process occurs here in the presence of increased heat. During this process, the catalyst is progressively deactivated by the buildup of coke on its surface, where the **regenerator** is responsible for cleaning the catalyst from hydrocarbon and coke. The feed, from the reactor, of newly produced lighter products, is fed on to the **fractionator** to incur further molecular reduction.

(Rice, 1965)

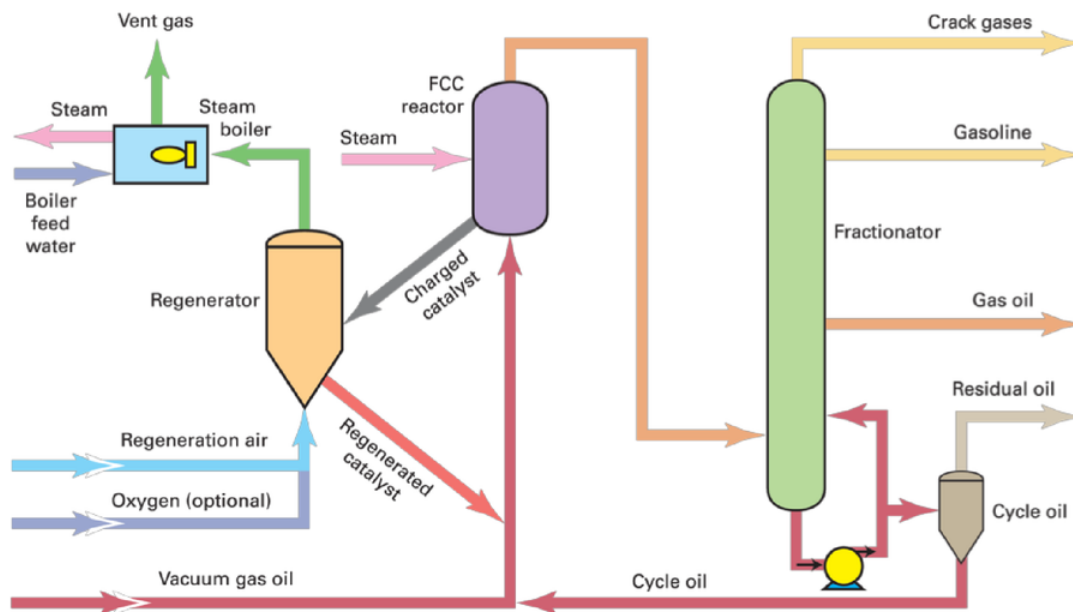


Figure 1 – Fluid Catalytic Cracking Unit Diagram (M. Heisel, 2009)

Important pieces of equipment utilized in the FCCU process (along with other parts of the refinery) are the hydraulic drives, which are used for temperature control through fin fans. Pumping high-pressured

hydraulic oil from the ground up to these fans, at different flow rates, allows for the control of the rate at which the fans will spin.

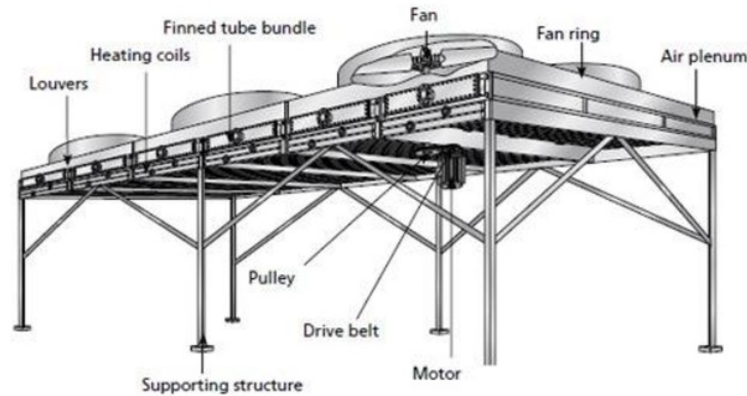


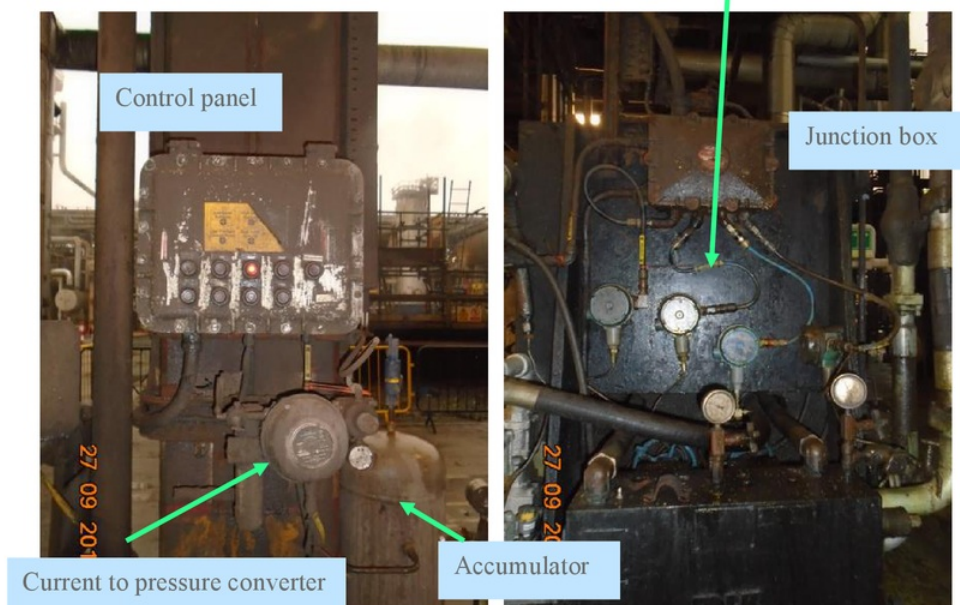
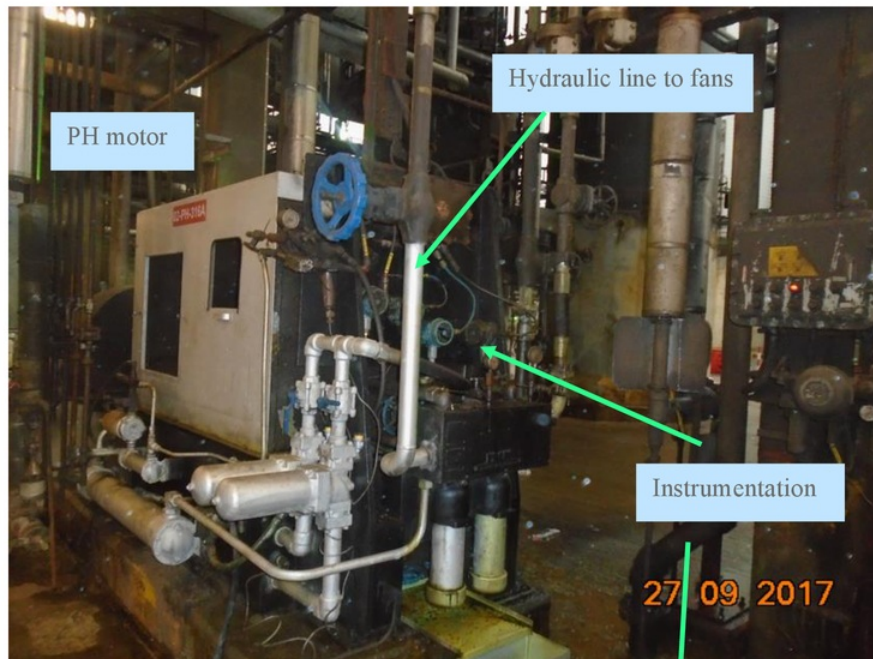
Figure 2 – Fin fan cooling system - (Inc., 2017)

The benefit of using this type of air cooled heat exchange, is that the unrequired heat energy is rejected to the ambient air rather than to water, which is how shell and tube exchangers and cooling tower systems work. This fin fan method is then referred to as being 'green' in comparison, as they do not require the extensive amount of cooling water.

(Kolmetz, 2015)

control

Each of these 18 hydraulic units is controlling the process temperature for a wide variety of substances within the refinery. As seen in figure 3, the motor supplies the pressured oil up to a flow divider. This divider then splits the high pressured oil in to separate streams for anything up to 4 different fans. The substance entering the tubes is cooled by the air, where the cooler, process outlet temperature is measured and sent back to the control room as an analogue signal.



These figures should be numbered and explained further individually.

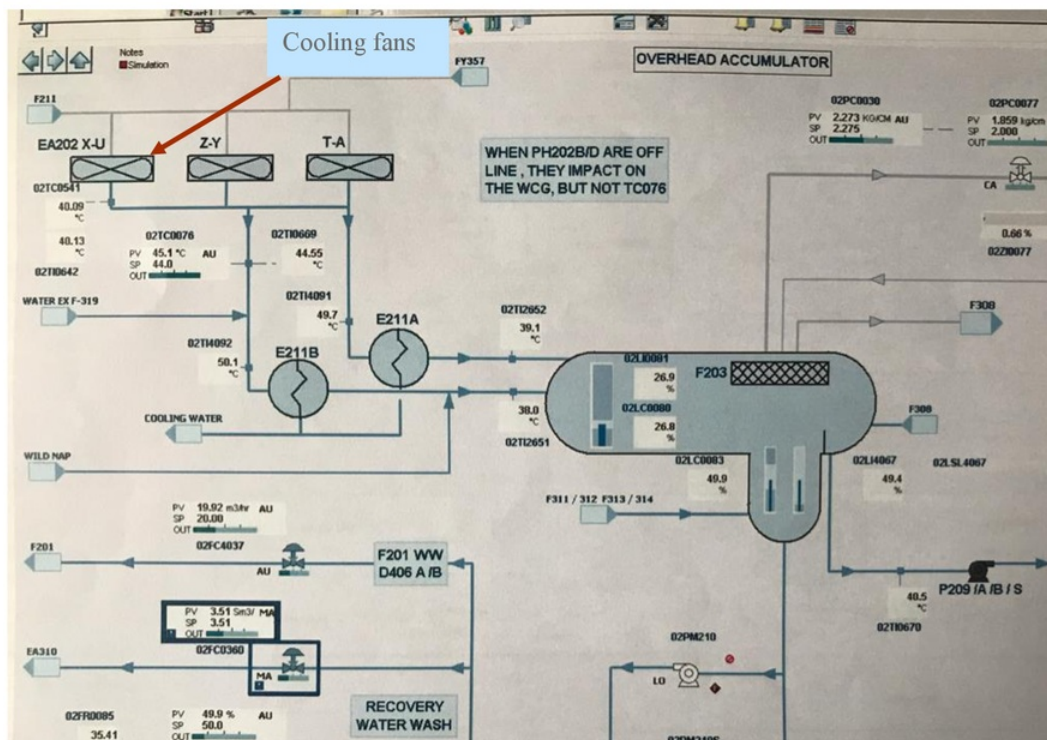


Figure 3 – Control panel screenshot

Why not Figure 3 shows...?

The above image conveys an example where the hydraulic drives and cooling fan systems are involved in the process. In this instance, hot vapour is coming off the top of the main fractionator column and consists of different substances including water, hydrogen sulfide, methane, ethane, propane, butane and more. This process is cooled through the process pipework and enters the drum as a method of separation. This cooling is important as it is very difficult to separate these products when they are in their purely gaseous form. As each of the substances has a different specific gravity, they will be separated in this drum, where the newly condensed water will sit at the bottom of the drum in the 'boot'. From here it is sent to be treated in a sour water stripper to remove contaminants with amine. The non-condensable substances will go over the top of the drum and are sent to a 'wet gas compressor', where they are squeezed and charged to a much higher pressure to ensure that they are used adequately. The methane and ethane are used as fuel gas and the propane and butane is sent to be used as olefins, where it is utilized in the alkylation unit.

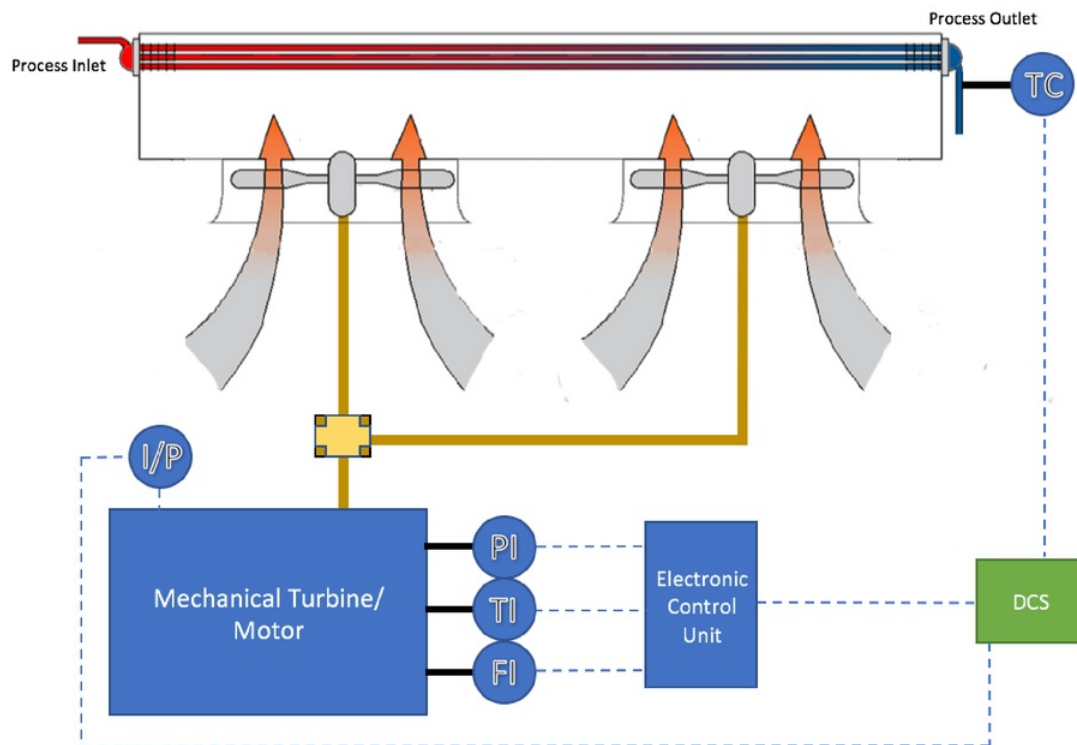


Figure 4 – System Diagram

Key

I/P = Current to Pressure Converter

PI = Pressure Indicator

FI = Flow Indicator

DCS = Distributed Control System

TI = Temperature Indicator

TC = Temperature Controller

This flow of hydraulic oil is relative to the temperature measurement of the process which is being cooled. This is achieved with a closed loop feedback system (see figure 4), which delivers the measured temperature and compares it with the desired set point. This new value (dependent on the error between the set point and the process variable) is presented to the controller and will generate a change in the output signal to the 'current to pressure' converter.

This converter interprets the 4-20mA signal and will transfer it in to a 3-15psi output signal to a pneumatic controller, where a moving arm alters the position of a valve which allows steam to the turbine. The more steam that is allowed in to the turbine, the faster it will spin and increase the flow of hydraulic oil to the rotating fans above.

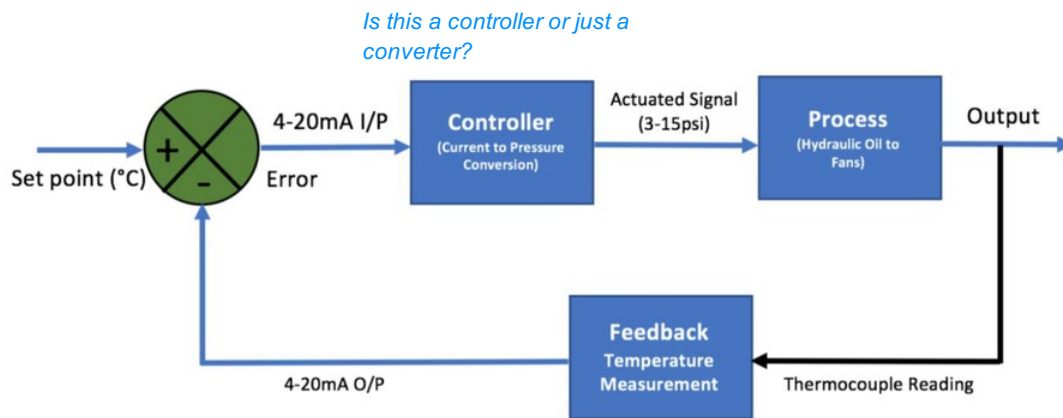


Figure 5 – Closed Loop Feedback System

They have independent alarm systems which are fed back to the control system on a single (digital) transmission loop, providing a common alarm for that particular drive. This alarm output, as well as the instrumentation inputs are controlled via an electronic system, local to each of the units.

2.2 PROBLEM ANALYSIS

These monitoring units are aged, unreliable and they are becoming vastly obsolete. They house a series of 4 alarm/ relay cards and a flasher card in each unit, which are supplied with 110V AC. The instrumentation on the hydraulic drive is fed to this enclosure and then fed to the control room via the digital signal. The parts for these units are becoming less available and cost around £1000 per card, where several cards are replaced each month due to their unreliability. It is also noted that this price for spare components will only increase as time goes on.

This system is monitoring the behavior of the PH unit output as well as providing those all-important alarms to signify that there is an impending issue with the equipment. Solving the issue with these existing units and with a potential upgrade will increase reliability and immensely reduce the maintenance requirements in respect to the instrumentation and possibly the mechanical systems.

Very good background information related to the project problem.

2.3 | SOLUTIONS

2.3.1 | Solution 1

There are 18 hydraulic drives currently in use on the plant, each with their own alarm arrangement. One solution would be to replace them with a PLC and a HMI unit, which would be housed in the appropriately IP rated, hazardous area approved enclosure, along with the relating circuitry/ wiring etc. An element of programming would be involved as the HMI would be designed to display each of the various level, pressure and temperature instrumentation alarms. The signal delivered back to the control room system would be a single, common alarm. This alarm would then prompt the control operator to ask the respective field operator to go and check the new local HMI screen which would give the appropriate description, allowing a solution to be obtained.

The resources will typically consist of the desired hardware for the solution to be achieved. This may include but not be restricted to:

- A PLC
- A HMI
- Power supplies
- Measuring devices/ transducers (pressure, flow, temperature and level)
- Galvanic isolation barriers
- Adequate enclosure for the hazardous area

Cost range estimation: £8000 - £10000

2.3.2 | Solution 2

Another solution would be to install a wireless router which could be mounted at an elevated position such as the control room. This would facilitate the application of wireless technology as a form of process measurement on the PH units. Wireless instrumentation could be mounted appropriately on the unit and the monitored signals transmitted wirelessly to the router and consequently the distributed control system for the control operator to view. For the more remote units, repeaters could be utilized

to enhance the transmissions for the required distance although the network can also be 'self-organised' and engage nearby instrumentation to achieve this.

The following resources would be required:

- Wireless instrumentation
- Wireless router
- DCS interface requirements

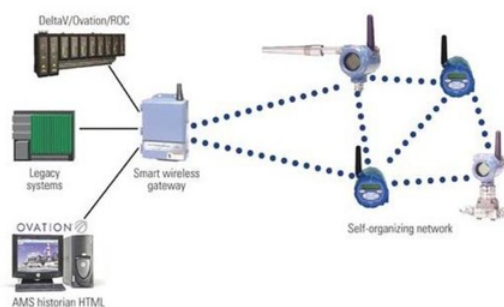


Figure 6 – Rosemount Wireless Installation Example (Rosemount, 2017)

Cost range estimation: £10000 - £18000

This solution would also require a control unit!

2.3.3 | Solution 3

Another solution would be to utilise a series of relays and trip amps which could be housed within a similar enclosure as that mentioned in solution one. This would eliminate the dependence on the electronics, such as a PLC. A hardware based controller could be used as a method of automatic control for the process temperature. Typical resource requirements will include the following:

- Relays
- Trip amplifier
- Hardware controller
- Measuring devices/ transducers (pressure, flow, temperature and level)

- Galvanic isolation barriers
- Adequate enclosure for the hazardous area

Cost estimation: £6000 - £8000

2.3.4 | Solution Analysis

	Solution 1	Solution 2	Solution 3
Labour Costs	Medium	Low	Medium
System Costs	Medium	High	Medium
Time Commitment	High	Low	High
Reliability	High	High	Medium
Maintenance Simplicity	Medium	Medium	Low

Figure 7 – Table of Comparison One

Some of the physical resource requirements may already be held at the dedicated stores at the refinery, where the majority of the equipment will require purchasing from the respective manufacturers or suppliers.

Solution 1		Solution 2		Solution 3	
Advantages	Disadvantages	Advantages	Disadvantages	Advantages	Disadvantages
Most likely to be completed within the academic based time frame. Potentially cost effective as an entirety.	Requires extensive research and time consumption in respect to hazardous area equipment and ratings. Software can be very expensive.	Very low labour and installation costs with a significantly reduced time exhaustion. High reliability <i>This solution is not complete!</i>	Can be a very expensive system to initially install. A new technology may incur future training costs.	Lower complexity and will be moderately easy to implement. Little to no training required to maintain the equipment.	Mechanically moving parts of the relays meaning more potential to go wrong. Can be maintenance labour extensive. Will take up more space at the motor location.

Figure 8 – Table of Comparison Two

Good comparisons made.

2.3.5 | Chosen Solution



After deliberation, **solution 1** has been chosen for the project. There were several methods and various discussions involved in choosing this solution. Three important aspects to consider include that which are displayed in the triangle of objectives, introduced by Dr Martin Barnes in the 1980s. It is an understanding by the project manager/author, that within the project, these 3 objectives of quality, cost and time are interrelated and that greater emphasis is placed on achieving one or two of these objectives is commonly made at the expense of one of the others.

In the instance of choosing this solution out of the 3 potentials, time is a considerable factor as the project runs in conjunction with the academic time requirements. The cost of the project is constrained to the company budget, whilst the quality cannot typically be divested as the system must comply with the specification. (Lock, 2007)

In regards to performance, this solution will be the most reliable and maintenance should be easily conducted on the system as required. It will also have a realistic cost in respect to both components and labour. It is also the most realistic and practical for an industrial upgrade project. Although relay based system work very well and were a chosen method in the past, they can have various issues and by using a PLC, they can be avoided.

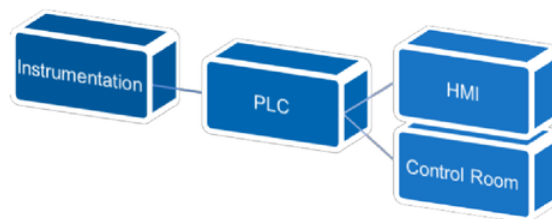


Figure 10 – System Flow Diagram

Very good analysis of 3 solutions with well reasoned choice as to which solution to take forward

3 | SPECIFICATION

3.1 | PERFORMANCE REQUIREMENTS

3.1.1 | The system must continuously monitor the process variables relating to the PH motor. This includes the following:

- Hydraulic reservoir temperature; range = 0-150°C
- Hydraulic oil pressure; range = 0-4000psi
- Hydraulic charge pump pressure; range = 0-300psi
- Gear oil temperature; range = 0-150°C

3.1.2 | The system must control the temperature of the cooling fans in a continuous, closed loop format. This must be achieved with the following parameters:

- Range = 0-80°C
- Accuracy = $\pm 3\%$

3.1.3 | The system must alarm on the control system in the event of the following:

- High oil pressure, with a set point of 2200psi rising
- High reservoir temperature, with a set point of 65°C rising
- Low charge pump pressure, with a set point of 100psi falling
- High Gear oil temperature, with a set point of 82°C rising
- Power supply failure alarm
- Transmitter line fault

3.1.4 | The system must run continuously and should only be isolated under a fault condition in which the system must be off for maintenance purposes.

3.1.5 | The system must be powered with 24VDC or 110VAC.

Which? Not a clear specification!

3.1.6 | The system will be in service until it no longer operates or becomes obsolete, with an estimation of at least 20+ years.

3.1.7 | Any instrumentation loops must conform to the minimum standard of intrinsic safety. The use of Zener barriers or signal isolators (galvanic or opto-isolation) is mandatory.

3.2 | SAFETY AND RELIABILITY REQUIREMENTS

3.2.1 | The product will be exposed to a potential hazardous environment (including gases and hydrocarbon) based within the tier 1 COMAH site. Specific regulations apply and should be adhered to for the equipment to be legally used in the proposed location.

3.2.2 | The system must have an operator to machine interface for the effective running of the equipment, which includes a visual indication of the variables.

3.2.3 | Externally, the operating temperature value (under running or fault condition) of the system will not exceed the rating of the area in correspondence with ATEX regulations. Internally, the operating temperature will depend on the components.

3.2.4 | The system must have a reserve power supply in the event that the first supply should fail

3.2.5 | The following regulations must be adhered to:

- Directive 99/92/EC – ATEX 137
- Directive 94/9/EC – ATEX 95
- The Dangerous Substances and Explosive Atmospheres Regulations, 2002 (DSEAR)
- The Control of Major Accident Hazards (COMAH) Regulations 2015
- BS EN 61508 Functional Safety of electrical/ electronic/ programmable electronic safety related systems
- The health and safety at work act 1974
- The Electricity at Work Regulations 1989

3.2.6 | The system must comply with company policies and a management of change must exist in the system for the system to be used.

3.2.7 | The system must be fully tested and have correct functionality before being commissioned.

3.3 | APPEARANCE

3.3.1 | The equipment must be labelled adequately so that the operations and maintenance personnel can identify that it is the correct asset that they are operating/ maintaining. The asset number will relate to each hydraulic motor i.e. 02-PH-201.

3.4 | MAINTENANCE

3.4.1 | The system must be easily maintained by the instrumentation and control department, where spares must also be available if required. This maintenance will be conducted internally, within the refinery.

3.4.2 | The system must have a form of maintenance mode in which the controller can be placed in to a manual form of control and safely be worked on without affecting the process.

3.5 | ENVIRONMENT

3.5.1 | The operating of the equipment should have no impact on its surroundings and any other equipment within the vicinity.

3.6 | QUALITY

3.6.1 | All manufacturing components must comply with site standards and have the relevant quality markings i.e. CE marking.

Very detailed specification given.

4 | PLANNING AND PROCEDURES

4.1 | CONDUCTING THE PROJECT

The project will be conducted primarily within the following areas:

- Pembroke refinery – this is where the system will be fabricated and will eventually be installed.
- Coleg Sir-gâr – these workshop sessions are used to liaise with the lecturers for their professional opinions and to carry out related research.

The planning and implementation for this project has been, and will be based around the following project management structure.



Initially the project was carefully examined as to whether it would; (a) satisfy the requirements of the major project syllabus of the university and (b) benefit the organization. As it goes, it is known that the premise of this project is a serious ongoing worry and a solution is highly desirable. This can be seen in the solution analysis in the first chapters.

Once the solution had been determined, the planning could begin. This included outlining the work that will be required to meet the specification and cater for the companies needs, calculating a budget for these requirements and determining the resources. Some of these planning techniques can be seen below in the form of a structured task breakdown and a progress chart. The project could then be executed with the commencing of work and acknowledging responsibilities. This includes the design of the logic which will interpret the mechanical motors behavior via the instrumentation, as well as the physical build of the equipment.

From now on, it is just as important to monitor this progress and recognize how it compares to the proposed plan, as the project now resides in the ‘control’ stage. Considering that there is a deadline involved, it may be necessary to adjust schedules and do what is required to maintain on schedule. Once all task of the project have been completed and the organization and the university lecturers are satisfied,

a closing evaluation can be made to highlight the project success. This is important to learn from the project history and utilize any positives for future project management activities.

Consideration towards the health and safety of individuals involved in the project as well as those in the vicinity is imperative. There are certain regulations that are followed day to day at the refinery and will specifically apply to this project as well. These include The Health and Safety at Work Act 1974 and the Management of Health and Safety at Work Regulations 1999. Both of which are government legislation and need to be followed by law. This involves conducting the work for the project in a manner that remains safe to both the author and those around. It also means using PPE and equipment provided by the employer and following their appropriate codes of conduct.

Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) and ATEX directives also play an important part in the safety of this project, considering the explosive nature of the refineries atmosphere. This means that classifications will need to be enforced for some of the equipment which is relevant to the type of EX atmosphere and is partly based on the time in which an explosive substance may be present in the atmosphere. This information can be found by researching the appropriate drawings. Intrinsically rated equipment is also required under these regulations.

As far as company policy is concerned, it is a requirement to be professional and competent to work on site. Continuous development and adequate training is provided regularly to ensure this. It is also a requirement that all work on site is carried out in conjunction with a risk assessed permit to work. The purpose of which is to illustrate the area of work and equipment, whilst also conveying the potential hazards and if any additional control measures are required to reduce the risk. (Executive, 1974)

[in section 4.2](#)

A risk assessment has been conducted, which can be seen below, and will be periodically reviewed throughout the project lifespan.

4.2 RISK ASSESSMENT

General risk assessment

Advice on hazards, risks and risk assessment is available from the Company and H&S Advisers.

Location

Instrumentation Workshop

Activity

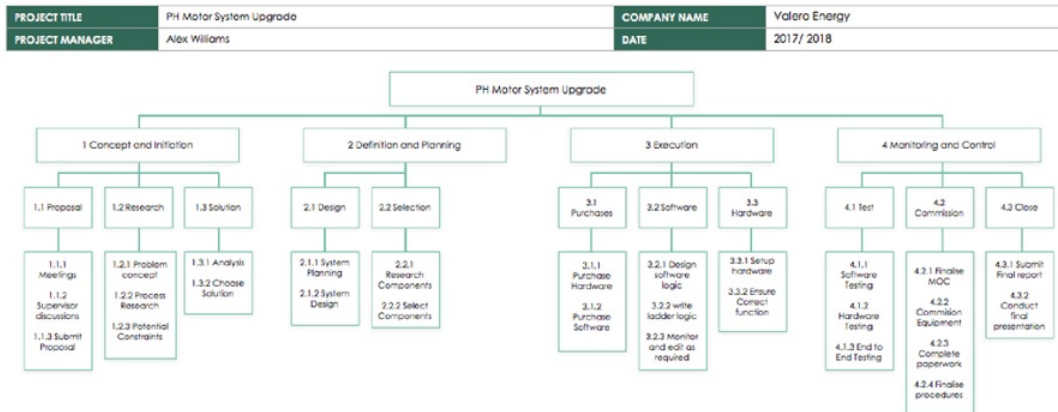
Installation of new project to upgrade PH motor systems.

Assessor

Alex Williams

Hazard	Possible effects/harm	Risk rating H, M, L	Detail existing controls	Detail further action required to reduce risk	Revised risk rating H, M, L
Something with the potential to harm: hazards listed should be all those present before controls are in place.	Where a group of people may be affected differently, for example young people or expectant mothers, identify the separate effects/harm and risk rating.		Provide details of control measures already in place. If measures are detailed in other documents, state where.	Note the action required, responsible person.	
Working with electricity and electrically powered equipment.	Electrocution to anyone working near the items including burns and respiratory issues.	H	Any rules put in place by the site, HSE guidance and ensuring adequate training competency by the operator.	Provide toolbox talks and regular refresher information/ training. To be conducted by safety personnel.	M
Working with hand tools and metal equipment.	Cuts and abrasions to skin leading to potential infections.	M	Company PPE policies and ensuring competency in employees.	Provide administration controls such as signage to enforce the correct PPE for activities.	M
Poor housekeeping	Objects left unattended and mess around the floor areas increases the risk of slips trips and falls.	L	Enforcement of good housekeeping policies.	Create rota to ensure that the workshop is cleaned at regular intervals.	L
Loud noises	Causing damage to hearing and temporary hearing loss.	M	Employee competency and training. Electronic measuring device in the workshop to demonstrate the current noise level.	Ensure adequate signage and regular toolbox talks to reiterate the dangers of loud equipment.	L

4.3 | WORK BREAKDOWN STRUCTURE



Good, detailed WBS clearly showing work required but not listed as a Table or a Figure.

4.4 | GANTT CHART

The images below present a Gantt chart that was initially produced as timed guideline for the project, based upon the work breakdown structure that was initially established.

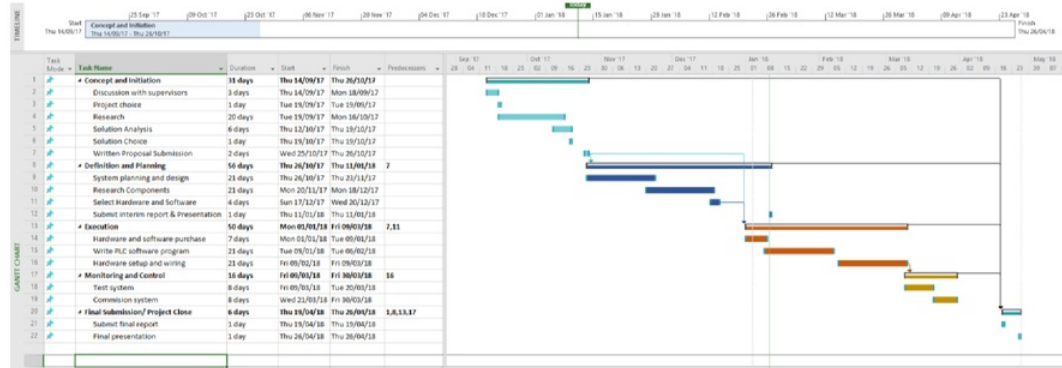


Figure 11 – Gantt chart

Task Mode	Task Name	Duration	Start	Finish	Predecessors
1	Concept and Initiation	31 days	Thu 14/09/17	Thu 26/10/17	
2	Discussion with supervisors	3 days	Thu 14/09/17	Mon 18/09/17	
3	Project choice	1 day	Tue 19/09/17	Tue 19/09/17	
4	Research	20 days	Tue 19/09/17	Mon 16/10/17	
5	Solution Analysis	6 days	Thu 12/10/17	Thu 19/10/17	
6	Solution Choice	1 day	Thu 19/10/17	Thu 19/10/17	
7	Written Proposal Submission	2 days	Wed 25/10/17	Thu 26/10/17	
8	Definition and Planning	56 days	Thu 26/10/17	Thu 11/01/18	7
9	System planning and design	21 days	Thu 26/10/17	Thu 23/11/17	
10	Research Components	21 days	Mon 20/11/17	Mon 18/12/17	
11	Select Hardware and Software	4 days	Sun 17/12/17	Wed 20/12/17	
12	Submit interim report & presentation	1 day	Thu 11/01/18	Thu 11/01/18	
13	Execution	50 days	Mon 01/01/18	Fri 09/03/18	7,11
14	Hardware and software purchase	7 days	Mon 01/01/18	Tue 09/01/18	
15	Write PLC software program	21 days	Tue 09/01/18	Tue 06/02/18	
16	Hardware setup and wiring	21 days	Fri 09/02/18	Fri 09/03/18	
17	Monitoring and Control	16 days	Fri 09/03/18	Fri 30/03/18	16
18	Test system	8 days	Fri 09/03/18	Tue 20/03/18	
19	Commission system	8 days	Wed 21/03/18	Fri 30/03/18	
20	Final Submission/ Project Close	6 days	Thu 19/04/18	Thu 26/04/18	1,8,13,17
21	Submit final report	1 day	Thu 19/04/18	Thu 19/04/18	
22	Final presentation	1 day	Thu 26/04/18	Thu 26/04/18	

Figure 12 – Gantt chart breakdown close up

4.5 | MANAGEMENT OF CHANGE (MOC)

A management of change has been initiated which is a requirement for the system to be installed on the plant. It will require the assessment of risk and any effects that may be caused in its lifetime. This process should hopefully be complete within the coming months.

4.6 | BUDGETING

The following table is a list of the primary costing for the project, the majority of which has already been ordered and received.

Item	Serial No.	Product Code	Price
AB Micrologix 1400 PLC	1766-L32BXB	714-0108	£630.00
AB PLC Expanded I/O	1762-IF4	698-7679	£278.00
AB Panelview	2711R-T10T	893-7783	£1260.00
AB RSLogix 500 Software	9324-RL0300ENM	698-7464	£1650.00
Phoenix Contact 24V Supply	2866763	540-769	£197.22
Phoenix Contact Diode Module	2320160	739-7893	£113.24

Figure 13 – Table of costings

4.7 | CONTINGENCIES

Provided that the project remains on schedule and the required amount of work can be completed as per the timing charts, the project should hopefully be fully constructed, implemented and commissioned.

If for some reason there are complications with the enclosure and the fabrication time (in relation to the academic year), then the system can still be built. This can be achieved on a backboard with the components mounted as they would be within the enclosure. This means that full testing can be accomplished with software and hardware, where it can then be installed within the enclosure when it arrives and the management of change has been completed.

Good to see contingencies noted.

5 | PROJECT PROGRESS AND TESTING

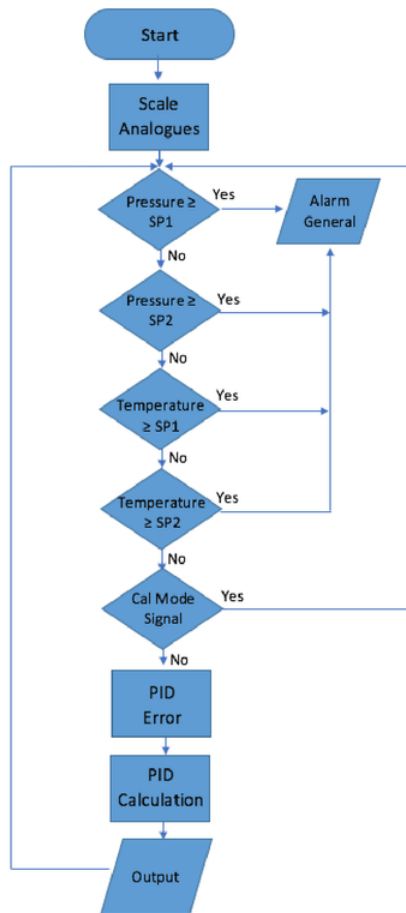


Figure 14 – Flow chart for programming purposes

Most of the required hardware has been ordered and received in the recent weeks. This includes the power supplies, diode pack and the PLC itself. The Allen Bradley Micrologix 1400 series was chosen as the primary control unit. The main reason behind this manufacturer is that it is generally a site-specific brand, meaning that the maintenance technicians have experience in working with the hardware/ software for Rockwell. The 1400 series as a specific model has been chosen due to its size within the enclosure and its functionality in relation to the system requirements.

The flow chart to the left has been created in order to assist the design process of the PLC program.

The following images provide a sample of the software logic that has been achieved to date. In the first image, the ‘first pass’ is introduced in order to arrange the analogue in signals. This allows their ranges to be allocated to the 4096 bits of the PLC. These values are as follows.

Tx Asset Number	Input Value	PLC Value	Alarm Set Point	Dead band Value
02-PT-1195	0-4000psi	0-4095	2200psi	2195psi
02-PT-1196	0-300psi	0-4095	100psi	99psi
02-TT-1194	0-150°C	0-4095	65°C	64°C
02-TT-1197	0-150°C	0-4095	82°C	79°C

Figure 15 – Table of PLC values

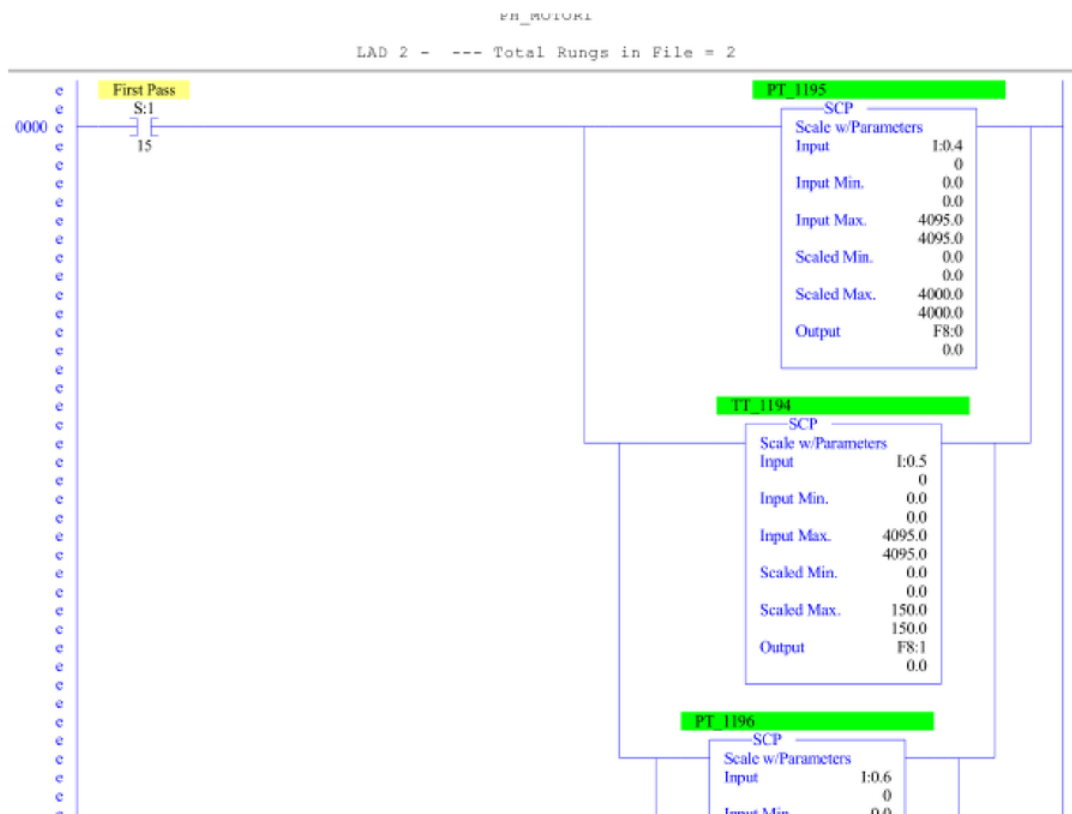


Figure 16 – Ladder logic first pass

The next image has been segregated to a different page in the programme so that it can be easily accessed throughout. It consists of the set point values for the alarm limits and uses comparison elements for inputs. When the set point is reached, the output B3:0 is latched, where the OR logic based rung below it, is a method of providing a form of dead band which prevents the system from continuously coming in and out of alarm, if the process measurement is hovering around this value.

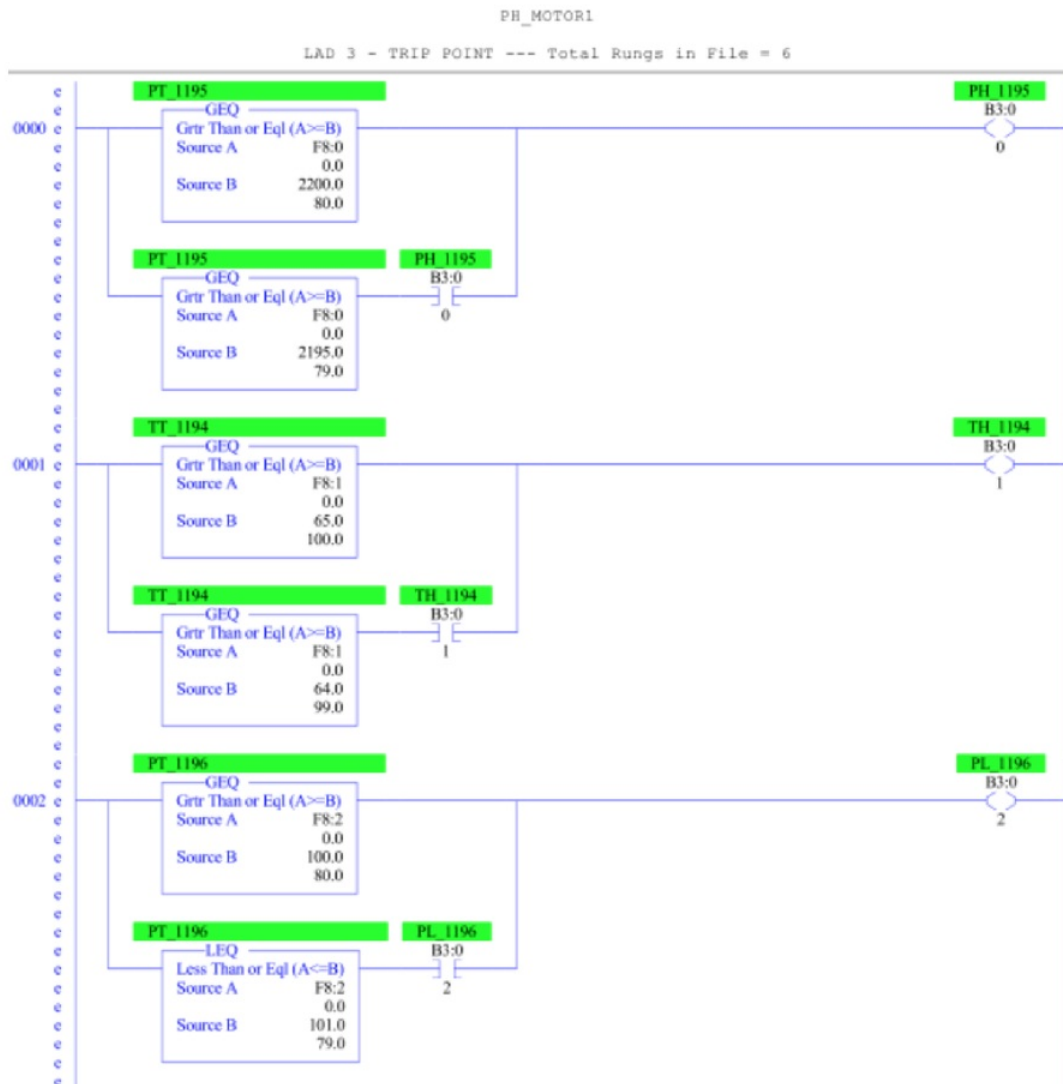


Figure 17 – Ladder logic input set point values

The third ladder logic image below shows the instrumentation outputs from the set points and that, in the OR series that they are set up, the alarm output will initiate if 1 or more of these contacts is closed.

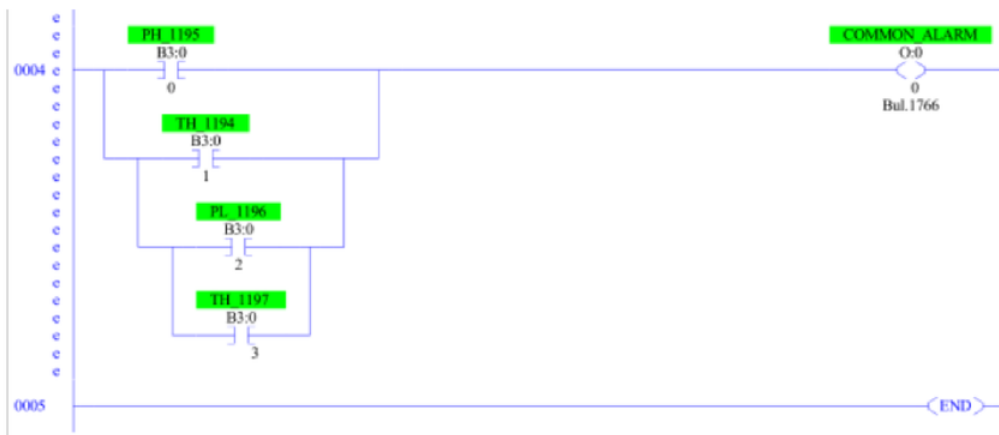


Figure 18 – Ladder logic outputs to common alarm signal

In order to test the system so far, a current source (mA) has been connected to the analogue inputs of the PLC to ensure that the correct input signal will correlate to the required output signal. This means that the set points of the various alarms could be checked. To achieve this, take 02-PT-1196 as an example;

$$4\text{-}20\text{mA} = 0\text{-}300\text{psi}$$

$$\text{Therefore, } \frac{16(\text{span})}{300} = 0.05333$$

$$0.05333 \times 100(\text{psi}) = 5.333 + 4 (\text{mA at zero}) = \underline{9.333\text{mA}}$$

The results were as follows:

Tx Asset Number	Alarm Set Point	Input Value (mA)	PLC Value
02-PT-1195	2200psi	12.80	2252
02-PT-1196	100psi	9.333	1365
02-TT-1194	65°C	10.933	1775
02-TT-1197	82°C	12.75	2239

Figure 19 – Table of results for mA/ PLC bits testing

As for the hardware circuit construction, the following design has been produced as a proposed layout.

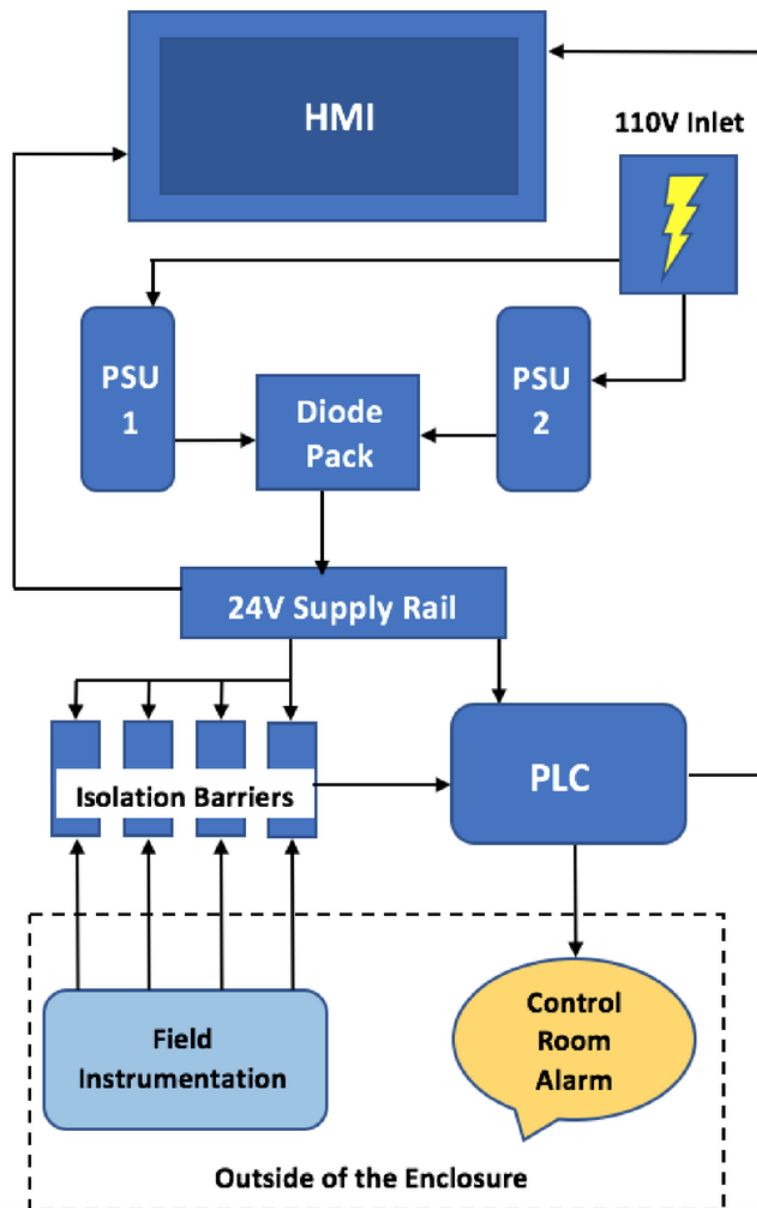


Figure 20 – System Architecture Plan

Very good detail on work carried out to date with good analysis of flow chart and understanding of PLC program design.

6 | CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the project now has some good momentum (currently in the execution stage), which should help ensure that the final goal is achieved within the time frame. Referring to the design specification, there are some aspects that have already been achieved, including the software program. This involves some of the analogue loops which are part of the monitoring system, which can be seen in the evidence conveyed in the progress and testing chapter previously. This is also the case for the digital output alarm that will be sent to the control operator during the breach of these measured input set point values.

The system is powered initially by 110VAC and then stepped down to 24VDC for the electronic equipment as itemized in the design specification. All of the components that are being used for this project are CE marked, which again, is a condition of the specification.

Going forward, the system hardware will be set up accordingly and tested as required. As per the specification, signal isolators (galvanic method) have been received ready for the system to achieve the required intrinsic safety at its location in the plant. Whilst on this subject, the instrumentation which has been acquired, conforms with the regulations stated in the specification (ATEX, DSEAR, COMAH) and will have sufficient protection to be used externally on the system.

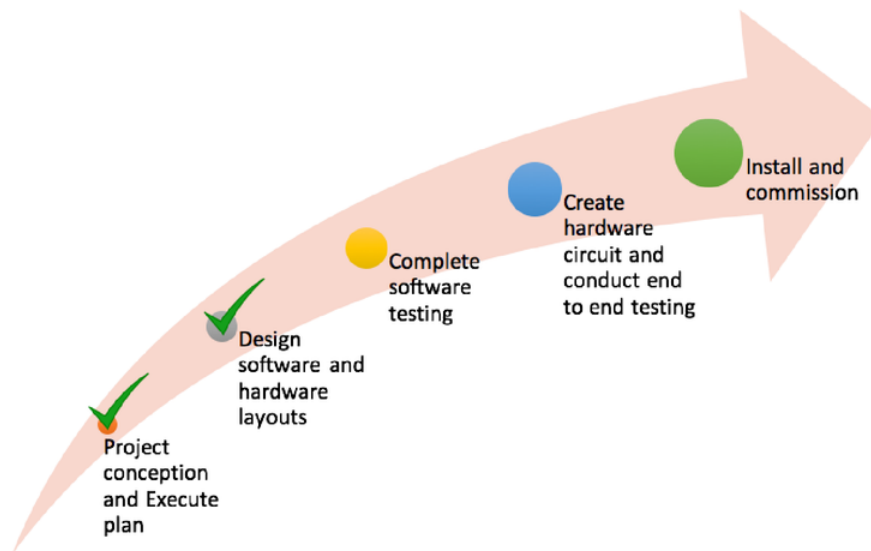


Figure 21 – Project progress and remaining requirements

A working procedure will need to be written in order for the equipment to be tested by the maintenance department periodically as set by the company. This will be achieved in the coming months. A management of change will also be completed so that the system can be installed out on plant. This process will be started immediately as it can be take months to complete, considering the various personnel that are involved.

Provided that there are no unforeseen issues that arise from now until the project close stage, this project will be completed within the given time frame.

Good analysis of the work carried out to date and work left to do. Some reflection noted.

7 | WORKS CITED

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Good, varied referencing cited correctly using the Harvard system

AW Interim Report

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

66/100

PAGE 1

PAGE 2

PAGE 3

PAGE 4

Text Comment. Good, clear introduction.

PAGE 5

PAGE 6

Text Comment. control

PAGE 7

Text Comment. These figures shold be numbered and explained further individually.

PAGE 8

Text Comment. Why not Figure 3 shows...?

PAGE 9

PAGE 10

Text Comment. Is this a controller or just a converter?

Text Comment. Very good background information related to the project problem.

PAGE 11

PAGE 12

Text Comment. This solution would also require a contro unit!

Text Comment. This solution is not complete!

Text Comment. Good comparisons made.

Text Comment. with whom?

Text Comment. Very good analysis of 3 solutions with well reasoned choice as to which solution to take forward

Text Comment. Which? Not a clear specification!

Text Comment. Very detailed specification given.

Text Comment. in section 4.2

Text Comment. Good, detailed WBS clearly showing work required but not listed as a Table or a Figure.

Text Comment. Good to see contingencies noted.

Text Comment. Very good detail on work carried out to date with good analysis of flow chart and understanding of PLC program design.

PAGE 28

PAGE 29

Text Comment. Good analysis of the work carried out to date and work left to do. Some reflection noted.

PAGE 30

Text Comment. Good, varied referencing cited correctly using the Harvard system

GRADING FORM: CSG-RUBIC

ALEXANDER WILLIAMS

66

RESEARCH-INFORMED LITERATURE



Introduction (3/5): Good, clear introduction.
Background Research (3/4): : Interesting explanation with helpful diagrams to set the project in context. However, there are many industry-specific terms that need explaining and further labels needed on your diagrams. Perhaps a glossary of terms could be added to the report. Harvard Referencing (3/4): Very wide range of sources listed and cited correctly. Literature Review (4/7): Briefly outlined. Solution 2 however, does not have any explanation about the control aspect of the project.

13

KNOWLEDGE AND UNDERSTANDING

WBS (7/10): Good; a brief explanation could be



added. Specification (7/10): Good but more accuracy information would help together with actual temperature set point. Gantt Chart (7/10): Contains some detail with an explanation of contingency. (could have been added to the chart)

21

ANALYSIS



Analysis of test results (6/10): Good understanding given of the design of the flow chart and appropriate PLC program. Conclusions (6/10): Good, general conclusion showing work completed to date.

12

PRACTICAL APPLICATION AND DEP.



Progress to date (3/5): Some lines of code written and some tests carried out. Presentation of test results (4/5): Well-presented with flow chart.

7

SKILLS FOR PROFESSIONAL PRAC.



Recommendations (6/10): Some reflection shown in conclusion and good realization as to what is left to do. Report Quality (7/10): Generally well written and presented. However, all photos and diagrams should have figures numbered and be referred to in the text by their number not their location.

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