

PSDE 5007

by Phillip Rowe

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Phillip Rowe

Electrical and electronic engineering

PSDE 5007

Individual project



Prifysgol Cymru

Y Drindod Dewi Sant

University of Wales

Trinity Saint David

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1. Project proposal

Company background

Tata steel was established in India in 1907 and then the first ever ingot of steel was made in Jamshedpur in India in 1912. In the year 1999 Corus was created via a merger of British steel and Koninklijke Hoogovens. Corus was then acquired by the Tata group in April 2007 and then joined the Tata steel firm which then made it one of the world's largest steelmakers which had a major presence in Europe and also Asia. Tata steel has a wide variety of steel making/rolling sites such as Port Talbot which is a steel making plant compared to Trostre which is a steel rolling site.

At Trostre the steel comes in as 20 ton coils and is rolled out, cleaned, stretched, annealed, tempered, inspected, coated and then either rolled into coils or sheared into desired lengths. Tata steel Trostre provides high quality steel for company's such as Heinz beans, jaguar land rover, Nissan and also Hyundai.

Summary of project

After a discussion with my shift craftsmen and also area engineers I have decided that my HNC project will be to upgrade and replace old start methods of the hydraulic and lubrication pumps on coil prep 3. The current method of starting the pumps is basic DOL starting. This currently takes up a lot of time due to the fact that the craftsmen have to go and do it manually as the crew are not allowed into the electrical sub room. The modification for this will be to rip of the old wiring which is not needed and replace it with PLC control and also a HMI screen in the crews pulpit so they can start the pumps saving craftsmen time. The reason for this project is because it will save vast amount of time once the lines have been down for maintenance. The start-up would usually take about an hour providing there are no faults. Moving forward the area engineer wants to modernise all of the line to make it easier to maintain and also fault find on, by modernising and keeping everything to one standard then it is much easier for craftsmen.

Timescale, budget and training

The project will be started on October the 9th 2017 and aimed completion will be April 25th 2018. The gannt chart will be used in order to track this and all progress will be tracked in log entries which will be produced each week. The budget for this project will be £10,000

Any help or training which will be needed will be discussed with the project mentor or the engineer of the area. Also further help manuals are available in electrical control rooms to aid any further help needed. Training will be provided for the production workers also for them to understand the new interface.

Testing procedures will consist of a series of live and dead tests. For example, by using Siemens S7 I will be able to physically see relays and switches energising and then by looking at pilot relays I will also be able to see that the hard wiring is good. Live tests will also be performed in order to check that the pilot relays are bringing in the main motor contactors.

<u>Student Signature</u>	Date:
<u>Lecturers Signature</u>	Date:
<u>Mentor Signature</u>	Date:

2. Background research

Coil prep 3

Coil prep 3 is an inspection line which checks the coils before they are loaded onto the coating lines. They are checking for any imperfections in the strip such as scratching, holes, discolouration and any other imperfection which the customer may not want. They can also trim the coil to a desired width which meets customer specification and also take spools off the coil. CP3 is a small line however it requires a lot of hydraulics and lubrication for the tasks it performs.

PLC/HMI – solution 1

A PLC(programmable logic controller) is something which can use inputs and outputs in order to control something. In this case an internal switch in the programming software can drive an output relay which can then start a pump. A PLC is today's modernised wiring, it takes away all the physical cables and replaces them with a computer program which will perform the same job. The only thing a PLC may need is inputs and outputs in order to perform a physical action. A HMI(Human machine interface) is basically a display screen which can also be programmed to start and stop pumps or maybe just used as a visual feedback for an actuator or sensor. The PLC that would be used would be a Siemens S7-1500 series which is the top of the range and most powerful PLC available in the Siemens series. Because the 1500 is such a good performance PLC it can handle vast amount of inputs and outputs and also has enormous amounts of processing power.

Relay logic – solution 2

Simple relay logic is making up of a switch or sensor in order to energise a coil of a relay which then will have auxiliary contacts on to drive outputs. Timers also would also be used to try and solve this problem, a timer is basically a relay however the outputs of that timer can either come on or off after a set amount of time so in this situation they would come on after 3 seconds.

Pic16F877 MICROCONTROLLER – solution 3

This is based on the PIC16F877 controller which is capable of performing the same task as the final chosen solution using an industry standard PLC.

Pump 1 switched on with pump 2 switched off

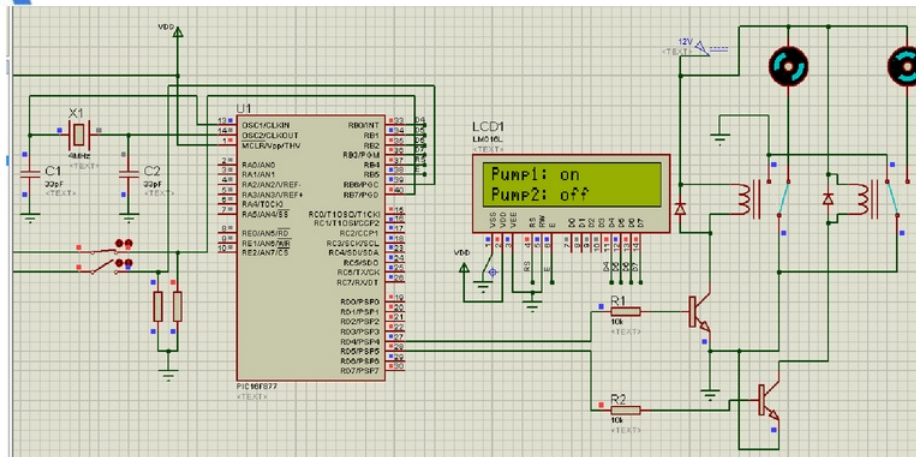


Figure 1

The image in figure 1 shows the operation of the two pumps where pump 1 is switched on and pump 2 off as indicated by the message in the LCD display. The display is the feedback for the pump conditions. The system operates on the condition that only one pump is on at any given time.

The circuit consists of the 16f877 microprocessor that has 2 input select switches for pump selection. The output consists of two 12V relays which are switched using a transistor interface. The output relays coils are energised by a permanent 12V supply with a controlled ground from the microprocessor output.

Pump 2 switched on with pump 1 switched off

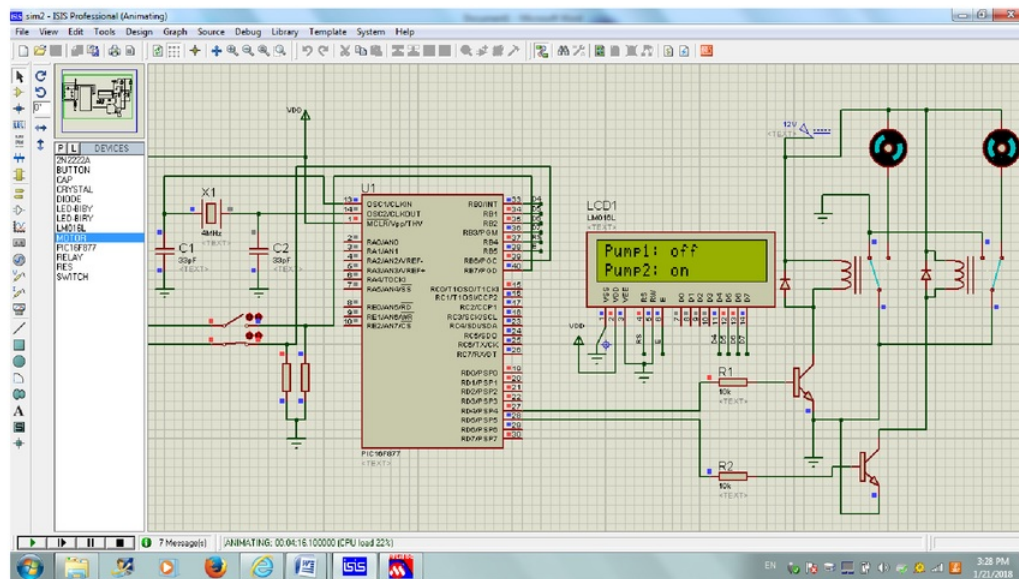


Figure 2

The image in figure 2 shows the operation of the two pumps where pump 2 is switched on and pump 1 off as indicated by the message in the LCD display. The display feedback indicates the pump conditions.

Testing was carried out to test the functionality of the circuit meets the specification. The following results were observed.

Test No	Switch 1	Switch 2	Pump 1	Pump 2	Pass / Fail
1	off	off	off	off	pass
2	on	off	on	off	pass
3	off	on	off	on	pass

Table 1

Table 1 shows the results of running the CAD software and operating the circuit conditions. This is indicated by the feedback messages from the LCD display which alters its condition when each pump condition changes.

In this CAD design the pumps are indicated by animated motors which run when the required conditions are applied from the microprocessor.

The relays provide the necessary interface requirements for the motors. The control for the microprocessor is a C program which has been developed for this circuit.

The circuit has been designed using Proteus CAD software which enables the design and run functionality of the circuit. The C program can be downloaded into the PIC within Proteus and run. The microprocessor will behave according to the program instructions.

C program for pump switching

```
#include <pic.h>
#include "LCD.h"

void DisplayPump1(int line);
void DisplayPump2(int line);
//Function prototypes

void DisplayState(int line);

void Delay(int t);
//Function prototype

int state=0, i, j, pump1, pump2;
//global variables

//////////////////////////////////////
void main(void)
{
    TRISA = 0xFF;
    TRISB = 0xC0;
    TRISC = 0x00;
    TRISD = 0x00;
    ADCON1= 0x07;

    LCD_Startup();

    while(1)
    {

        if (RB7==1) {
            pump1 = 1;

        }
        else{
            pump1 = 0;

        }

    }

}
```

```

if (RB6==1) {                                     //settings for feedback message pump2
    pump2 = 1;

    }

    else{
        pump2 = 0;

    }

DisplayPump2(1);                                  // displays the state
on line 1 of LCD
DisplayPump1(0);

switch(state)                                     //set state for pumps
{
    case 0:
        if (RB7 == 1)                             //set pump1 on
        {
            RD4 = 0;
            RB6 = 0;
        }
        else{                                     //pump1 off
            RD4 = 1;

        }

        if (RB6 == 1)                             //pump2 on
        {
            RD5 = 0;
            RB7 = 0;
        }
        else{                                     //pump2 off
            RD5 = 1;

        }

        break;                                    //This breaks out from each case
    }
}

////////////////////////////////Function prototype for delay////////////////////////////////

void Delay(int t)
{
    for(i=0;i<t;i++) // Outer loop
    {
        for(j=0;j<50;j++); // inner loop

    }
}

```

```
////////////////////////////////Funtion prototype to display the state////////////////////////////////
```

```
void DisplayState(int line)
{
    char state_string[10] = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
    state_string[0] = 'S';
    state_string[1] = 't';
    state_string[2] = 'a';
    state_string[3] = 't';
    state_string[4] = 'e';
    state_string[5] = ':';
    state_string[6] = ' ';
    state_string[7] = (char) state + 48;
    state_string[8] = 0;

    DisplayString(line, state_string);
}

void DisplayPump1(int line)
{
    char pump_string[11] = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
    if(pump1==0)
    {
        pump_string[0] = 'P';
        pump_string[1] = 'u';
        pump_string[2] = 'm';
        pump_string[3] = 'p';
        pump_string[4] = '1';
        pump_string[5] = ':';
        //pump_string[6] = (char) pump + 48;
        pump_string[6] = ' ';
        pump_string[7] = 'o';
        pump_string[8] = 'f';
        pump_string[9] = 'f';
        pump_string[10] = 0;
    }

    if(pump1==1)
    {
        pump_string[0] = 'P';
        pump_string[1] = 'u';
        pump_string[2] = 'm';
        pump_string[3] = 'p';
        pump_string[4] = '1';
        pump_string[5] = ':';
        //pump_string[6] = (char) pump + 48;
```

```
pump_string[6] = ' ';
pump_string[7] = 'o';
pump_string[8] = 'n';
pump_string[9] = ' ';
pump_string[10] = 0;

}

    DisplayString(line, pump_string);
}

void DisplayPump2(int line)
{

    char pump_string[11] = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
    if(pump2==0)
    {
        pump_string[0] = 'P';
        pump_string[1] = 'u';
        pump_string[2] = 'm';
        pump_string[3] = 'p';
        pump_string[4] = '2';
        pump_string[5] = ':';
        //pump_string[6] = (char) pump + 48;
        pump_string[6] = ' ';
        pump_string[7] = 'o';
        pump_string[8] = 'f';
        pump_string[9] = 'f';
        pump_string[10] = 0;
    }

    if(pump2==1)
    {
        pump_string[0] = 'P';
        pump_string[1] = 'u';
        pump_string[2] = 'm';
        pump_string[3] = 'p';
        pump_string[4] = '2';
        pump_string[5] = ':';
        //pump_string[6] = (char) pump + 48;
        pump_string[6] = ' ';
        pump_string[7] = 'o';
        pump_string[8] = 'n';
        pump_string[9] = ' ';
        pump_string[10] = 0;
    }
}
```

```
    DisplayString(line, pump_string);  
}
```

The program shown consists of function calls which are called from the main program loop. The conditioning is provided by the 'if else' statements and the LCD functions are provided via inheritance using 'Header' files. The function prototypes provide the arrays that enable the data to be displayed on the LCD.

The program is commented to help understand the sequence operation and conditioning. The ascii table values are used to print characters on the LCD.

3. Testing plan and procedure

The testing for this project will be simple in order to test the hard wiring modifications a multimeter will be used in order to check for continuity between any modified wires and then in order to test the PLC program side of things I will be running live tests with the monitoring mode enabled in order to see coils and switches energising and being switched. In the event of there being a fault then fault finding procedures will be applied in order to find the fault.

4. Specification

The problem with the current starting method is that it takes up time which can be saved and the line is in need of an upgrade. The start buttons for the pumps are all in the electrical sub room which only authorised personnel are allowed to go into. So say if the electrician responsible for coil prep 3 is busy and coil prep 3 pumps need starting then this can cause a delay so by giving the crew the power to start the pumps is a lot more convenient and also more cost effective.

Project spec

The project must:

- Start all the pumps individually and have HMI display when running.
- PLC and HMI communication to display overload trips.
- Pilot relays to actually start the pumps from the HMI.
- Selector switches for standby and main pumps.

Electrical specification

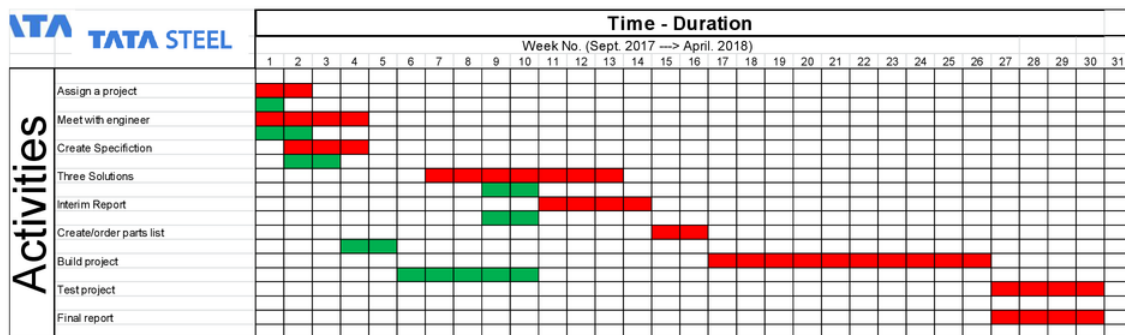
The electrical requirements for this project are:

- PLC and HMI communication.
- PLC program controlling the pumps.
- HMI screen for crew to turn pumps on/off.
- Follow the 17th edition wiring regulations and Tata internal regulations

All the electrical installation must be up to a good standard meaning all cables are secured and also all panel cables are ferruled and also crimped.

5. Project plan

In order to keep track of the timing in this project a Gantt chart will be created and an index will be used in order to plan what should be done when and if the time plan is being met or not. If it is not met then it will be displayed on the Gantt chart.



6. Discussion and conclusions

For this project there has to be 3 solutions in which the problem can be solved. These will be discussed giving the advantages and disadvantages of doing each method.

Method 1

PLC and HMI screen to energise pilot relays to start the pumps. This method will require a PLC with I/O units and also a panel with pilot relays in order to start the pumps. This method is modifying the current wiring taking out what is not needed and replacing physical start with an interface one on the HMI screen.

Advantages:

- Solves the problem and allows crew control.
- Easier to fault find on.
- More modern and will take up less space.
- Provides feedback if pumps are on.

Disadvantages

- Slightly expensive.
- Need a portable programmer to write PLC program.

Although this method may have a slight expense this method is the one which is the easiest to fault find on, easy to install and has the best timescale for the volume of work. Therefore this is the method that will be used.

Method 2

This method would be hard wiring start/stop buttons into their desks in their pulpit. Although there are already start/stop buttons existing due to the fact the crew cannot access the control room they are in there is still an issue so wiring buttons to their desks is a suitable solution.

Advantages:

- Provides easy starting method.
- Not much can go wrong with them.

Disadvantages:

- Very expensive.
- Not easy to get multiple cables to pulpit.
- Takes up too much space.
- Very time consuming

Although this is a good idea this is old technology and doesn't live up to current days development. Also the amount of time and money it would take in order to make this happen just wouldn't have the same return as method 1.

Method 3

The final method is to use the micro controller in order to perform the required tasks however although the microcontroller is quite cheap and easy to install the industry/site standard is more aimed towards PLC's and HMI screens so due to this this method is out of the question.

FINAL GRADE

GENERAL COMMENTS

Instructor

49/100

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GRADING FORM: CSG-RUBIC

PHILLIP ROWE

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RESEARCH-INFORMED LITERATURE



Background research is good, but no refs. 8/25

8/25

KNOWLEDGE AND UNDERSTANDING



Proposal is good. - 6/10 Spec is good. 3/5 Design requirements needs work and needs to be in a separate section. - 4./10

13/25

ANALYSIS



Testing needs more attention and best use tables method. - 5.5/10 Conclusion is reasonable but needs to improve and use of relevant sources will improve this area for final report. 6.5/10

12/20

PRACTICAL APPLICATION AND DEP.



Gant chart is good. 3/5 Quality is ok. 3/5

6/10

SKILLS FOR PROFESSIONAL PRAC.



Reasonable report and presentation. 10/20

10/20