

1102216

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Submission date: 22-Dec-2023 08:33PM (UTC+0000)

Submission ID: 220159598

File name: 3005_Seans_Parry_1102216_182120_1651579558.pdf (852.45K)

Word count: 8806

Character count: 47894

Course: BSc (Hons) Electrical and Electronic Engineering
Module: SGEL6000 Independent Project
Assignment: 1. Project Definition, Research and Quality Planning
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University number: 1102216
Date submitted: 22/12/2023
Word count: 3794

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A good summary but there should be less emphasis on what's in the report, and more on the project itself.

1. Executive Summary *You explain the reason for each section instead of telling your reader what's in them.*

The assignment consists firstly, of a project proposal. The project proposal states that the project was carried out in the working steel industry. It addresses the water ingress problem that is currently flooding cable tunnels, budgeting and expenditure. Secondly, a log book. The log book records the achievements throughout the life cycle of the project. Thirdly, the project background and problem definition and constraints. The background of the project sets it in context and gives an understanding as to why the project is being undertaken. *your reader will know the purpose of this section but needs to know here what it is.* The purpose of the problem definition is to explain the issues that exist that require this project to be undertaken. *here, you should have stated the problem* Many constraints were addressed and consideration was given to Ethical Engineering, Legal/Commercial and Sustainability. Fourthly, a function design specification was created to identify the project outcomes, the measurable performance parameters and features. This will determine whether the project was successful or not. Fifthly, a test plan was generated based on the FDS to plan a test procedure carried out at the end of the implementation phase to prove the outcomes of the project have been met together with its performance criteria, known as FAT. Sixthly, three solutions were considered to rectify the water problem, these were a radar sensor to monitor the water level, an ultrasonic sensor for continuous level measurement and float switch to stop and start motor pumps to drain the water away. A comparison was made and the chosen solution was the radar level sensor to monitor the water level. Finally, the project planning, work breakdown structure and management techniques were addressed. Here the design was broken down into implementation stages using a WBS. From this a Gantt chart was created to monitor the progress of the project together with a costing spreadsheet. The project will be completed by the 11/04/2024.

2. Introduction

The aims and objectives of the report is to identify the problem within the company and design an engineering project to rectify the problem. To achieve this objective, the problem must be identified along with any constraints which may hinder the completion of the project. The aim of the report is to identify the project outcomes or deliverables. The report will address what needs to be carried out in the project along with a testing sequence to determine whether the project has met the desired outcomes or not. The aim of the report is to show a great extent of research into various possible solutions which could potentially rectify the problem in the work place. This broadens the approach to the problem. The report will then analyse all the technical data and specifications of all three solutions to provide the best possible solution to the problem. The report will generate costing spreadsheets and scoring sheets to aid in the overall decision and direct to the best possible solution. The aim of the report is to break the project down and provide a graphical work breakdown structure, showing what needs to be done in the project and when. To provide a Gantt chart to monitor the project at each stage. The report will then provide recommendations as to how the project can be improved for future use. The aim and objective of the report is to highlight and address each of these fundamental points to come to an acceptable, efficient and sustainable solution to the work based problem and how it is going to be done. The report will then show the reader in stages as to how the project will be achieved and how it will rectify the given problem.

3. Project Background and Problem Definition and Constraints

Background *Why are there no photos or diagrams?*

The project was based in the basic oxygen steel making plant located in the steel industry. The development of the project will, again be utilised and developed within the work place on equipment already installed. Plant suffers greatly from water ingress, which in turn causes great damage. The current method has no means of detecting water level, only when the water becomes visible from above and at that point it is too late as the water would have already damaged components. This makes the cable tunnelling project imperative and a good project to reduce downtime and cost.

What is the plant made up of?
The aim of this project is to decrease plant downtime and save money, thus making plant more efficient and cost effective. Water has been entering the cable tunnels and damaging cables and load cells. The damage is costing the company approximately forty thousand pounds a year to keep replacing cables and load cells. In order to change these components plant has to either be placed on stop or production speed must decrease. As a result the company is losing money to allow time for the components to be changed. To install a level transmitter to monitor the level of water and then pump it away when the water level becomes too high is a cheap solution to this problem. This then is the justification for the project. The water level must be monitored to minimise and even eliminate water damage.

the background is meant to set the scene for the problem definition, you should have explained the basic oxygen process and what the cable tunnels feed rather than explaining the problem which belongs in the next section

this paragraph contains a lot of repetition

Problem definition

Due to the vast size and length of the plant much ^{Spelling} cabling is required to supply electricity to the high level of operating equipment on site. Being such a large site this has meant that cable tunnelling has been used and implemented to run large cables across site to various substations and contactor rooms. These are all necessary to supply the equipment with the low and high voltages which is necessary for plant operation. Due to the age, general wear and tear and many harsh weather conditions that plant has suffered with over the years, the cable tunnels have begun to fill with water. Water, of course is a major hazard to electrical equipment and so this water level must be monitored and controlled to ensure safe operation of plant equipment. This is the problem that is currently being outlined and this is the problem which the project is going to address. The project will involve monitoring and controlling the water level to reduce the risks and hazards that this could potentially have on the electrical cables. The current hazards and risks are very high. Water ingress can cause cables to short circuit, which will then cause the large breakers to trip and prevent operation of plant equipment. The water can also cause corrosion if it remains for a long period of time. This will then mean that cables will have to be replaced. The impact that this will have on plant will be great. There will be serious consequences to this such as, the cost implications of replacing and installing the new cables. The other consequence is that it will render plant inoperable until the work can be completed. This will affect plant dramatically and will reduce production. Due to the many problems and consequences, this project is crucial to prevent these disasters from occurring. There is no system ^{repetition} currently in place to monitor the water level and so this is one of the main reasons for this project.

Constraints

There are many constraints to consider for such as ethical constraints due to regulations. The 'company shall strive to provide a safe, healthy, clean and ergonomic working environment for its people. It shall prevent the wasteful use of natural resources and be committed to improving the environment, particularly with regard to the emission of greenhouse gases, and shall endeavour to offset the effect of climate change in all spheres of its activities. The company, in the process of production and sale of its products and services, shall strive for economic, social and environmental sustainability', (Company, 2008).

This appears to be a quotation. It should be in double quote marks and begin with The company states that " "

Incorrectly cited, this is not the Harvard Method

Incorrectly cited, this is not the Harvard Method

The industrial code of conduct states 'to strive to provide a safe, healthy and ~~clean~~ working environment for employees and all workers, (Chandrasekaran, 2017). The ~~companies~~ code of conduct stipulates that ^{use double " marks} 'all employees have a personal responsibility to help preserve the human rights of everyone at work and in the wider community', (Company, 2023). All employees, including full-time directors and the chief executive, shall exhibit culturally appropriate deportment in the countries they operate in, and deal on behalf of the company with professionalism, honesty, integrity, while conforming to high moral and ethical standards. Such conduct shall be fair and transparent and be perceived to be so by third parties. Every employee of the company shall preserve the human rights of every individual and the community, and shall strive to honour commitments. Every employee shall be responsible for the implementation of and compliance with the Code in their environment.

Spelling

The company states that 'it thrives in a culture of respect, inclusion and diversity. Conscious efforts are made to build an equitable environment and a diverse leadership team. The company has across the globe teams that have a healthy mix of not just gender and age, but also culture, ethnicity and a myriad of other aspects. Their Diversity and Inclusion initiative established in 2015 for Indian operations, is a driver towards this goal. It defines the path the company has taken to build a people-oriented culture that both celebrates and encourages diversity and inclusion', (Company, 2023).

There are too many quotations. It would be better to read them and put in your own words.

'Social responsibilities empowers employees to leverage the corporate resources at their disposal to do good', (Murphy, 2022). 'User needs involve tasks that need to be completed, how to complete them, anything that hinders the tasks from being completed and solutions to the problems', (Nikolaieva, 2023). The customer needs are 'price, quality, choice and convenience', (BBC, 2023). Business needs are 'what resources or methods organisations require to reach their business goal. It can be identified through analysis and critical thinking', (Indeed, 2023).

The company's code of practice for the environment is to 'respect the environment, working with customers and suppliers to improve the environmental profile of their products over their full life cycle', (Europe, 2019). Regarding societal, the company states, the 'Code of Conduct outlines their commitment to each of their stakeholders, including, the communities in which they operate, and is their guiding light when they are faced with business dilemmas that leave them at ethical crossroads', (Group, 2017).

Incorrectly cited, this is not the Harvard Method

Amongst all the constraints there are additional risks such as current economic climate. 'The UK economy is experiencing renewed signs of stress. While worries about a deep recession have largely gone, the prospects of high interests rates and low productivity are expected to hold back growth. The UK *no need to explain this term* over water in the second half of 2023', (KPMG, 2023). 'Global growth will fall to 2.9% in 2023, but rise to 3.1% in 2024', (Fund, 2023). Brexit is an additional risk, 'every industry is affected by Brexit due to the potential economic impacts such as reduced investment, recession and manpower issues', (WLG, 2023). Additional risks such as delivery times, availability of components and equipment, cost of components and installation, training on new equipment, standardising equipment and maintenance will all have an effect on the overall completion of the project.

There are legal and commercial responsibilities of employers and employees in the workplace in accordance with the Health and Safety Work Acts 1974. Any management of change process covers any change to an installation or process does not breach Health and Safety regulations or environmental risks. Any change to the project must be evaluated for acceptable levels of risk to all persons associated with the process. Documented evidence must be provided to indicate that the outcomes are in accordance with required design specifications. See point 2 in the appendix for a risk management process to holistically identify, evaluate and mitigate risks associated with the project.

no need to explain this term

Intellectual property (IP) refers to creations of the mind, such invention *no need to explain this term* works; designs; and symbols, names and images used in commerce', (Organisation, n.d.).

Incorrectly cited, this is not the Harvard Method

Any of the sort generated by the company are the company's rights and for their use only. Such of which may have been developed within the project.

4. Functional Design Specification and Test Plan

Table 1 - Project Outcomes A lead in sentence would be helpful

Project Outcomes	
<i>Good level of detail in each outcome</i>	
1. <i>This column is too wide since there is only a number in it</i>	The system must have an adequate isolator in accordance with the IET wiring regulations, where the power can be isolated in the event of an emergency and reinstated when safe.
2.	The PLC and level transmitter must be protected by a C rated industrial based circuit breaker.
3.	The system must stop by the use of an emergency stop device.
4.	There must be indication for the following, power supply, PLC run indication, healthy indication displayed from Control Logix Ethernet/IP and healthy indication from all I/O modules on the PLC rack.
5.	There must be detection of the low and high water levels by the transmitter. The low level will be at 5m and the high level at 1m. These parameters must be set up within the transmitter. A 4-20mA bandwidth is to be established in the transmitter with a 1-5m range. A zero live must be set up in the parameters to detect a cable break.
6.	If the transmitter detects a high water level it must then generate an alarm to the SCADA system. This can then act as an electrical interlock preventing plant from operating until the water has been cleared. This will be designed in the programming phase of the project.
7.	There needs to be the programming of the SCADA HMI. The HMI aesthetics will provide a clear visual of the actual level and whether in alarm or not.
8.	Maintenance must be required. The transmitter will require maintenance to maintain an accurate water level. The transmitter must be calibrated on a regular basis to achieve this. Engineering access is required to carry out calibrations.

Table 2 - FDS
This is a good way of itemising each part of the FDS

Functions	Requirements
F.1	Desired set point to be entered (1-5m)
F.2	Set up bandwidth 1m – 4A and 5m – 20A
F.3	Must display level in meters
F.4	Must detect no water 5m (low level)
F.5	Must detect water at 1m (high level)
F.6	Must display a 'live zero', 0A if cable breaks
F.7	Calibrate level transmitter with known source
F.8	Generate alarm at high level (1m)
F.9	Stop production at high level to drain water
Aesthetics	
A.1	SCADA HDMI must clearly display level
A.2	SCADA graphic of PV water level
A.3	SCADA alarm generated for high level
A.4	Accept alarm function
A.5	Alarm reset when water level below high
A.6	Engineering access to change set point
A.7	Engineering access to alter level hights
A.8	Engineering access to calibrate transmitter
Safety	
S.1	Isolator to isolate equipment
S.2	C rated industrial circuit breakers on primary and secondary side of the transformers.
S.3	Emergency stop to stop equipment in emergency procedures.
S.4	Electrical interlock at high level to stop production until water is drained away.
Diagnostics	
D.1	Low level set at 5m
D.2	High level set at 1m
D.3	High level alarm at 1m
D.4	Live zero at 0A detect cable break
Technical documentation	
T.1	Range up to 15m
T.2	Deviation of $\leq 2\text{mm}$
T.3	Output signal of 4-20mA
T.4	Process pressure -1 – 3bar
T.5	Process temperature of -40 - 80°C
T.6	Operating voltage of 12-35VDC
Environmental	
E.1	PLC currently in place with spare I/O
E.2	Adequate I/O for software requirements
E.3	VEGA Level Transmitter to order

Suitability	
SB.1	Any adequate PLC modular or rack mounted suitable for the project.
SB.2	VEGA provide and stock all suitable accessories necessary.
SB.3	Current rack mounted PLC in place is expandable for additional I/O if necessary or expansion necessary.
SB.4	VEGA provide a range of level transmitters of which have a level range greater than 5m, which would be suitable for the project.
Maintenance	
M.1	Regular calibration of level transmitter
M.2	No moving parts, which means less maintenance, but regular electrical maintenance required in PLC panel.
M.3	Dusting and cleaning ventilation filters
M.4	Backing up the PLC's programming and software.

Table 3 - Test Planning

Test Number	FDS Item Reference	Description of Test	Expected Outcome	Actual Outcome	Pass or Fail Decision	Evidence Reference
		<i>some of these as configuration tasks not tests</i>				
1	F.1	Set the desired high level SP.	SP to be established.			
2	F.2	Set up bandwidth 1-5m, 1m – 4A and 5m – 20A.	Bandwidth established.			
3	F.3 <i>how is this a test?</i>	Ensure visual reading on transmitter and reading in meters.	Level measurement in meters.			
4	F.4 <i>what is the test?</i>	Must detect no water low level reading at 5m.	5m low level limit made.			
5	F.5	Detect water high level at 1m.	1m low level limit made.			
6	F.6	Using circuit protect break cable to ensure live zero reading at 0A.	Detect cable break by displaying 0A.			
7	F.8 <i>how</i>	Generate alarm at high level, 1m.	Ensure alarm present at 1m.			
8	A.1	SCADA level display is the same as the level transmitter.	Both SCADA and transmitter displaying the same values.			
9	A.3	Ensure SCADA displays alarm description at high level.	Alarm present on SCADA.			
10	A.4	Ensure alarm can be accepted when high level cleared.	Alarm acknowledged and accepted.			
11	A.5 <i>How is this a test?</i>	Alarm reset operational.	Alarm cleared and reset when alarm conditions cleared.			
12	A.6	Access to engineering level to change SP.	Engineering access acquired.			

13	A.7	Access to engineering level to alter high and low levels.	Engineering access to alter level limits.			
14	A.8	Access to engineering level to calibrate transmitter.	Engineering access to calibrate transmitter.			
15	S.1	Isolate transmitter to ensure equipment safely isolated.	Isolation successful and equipment dead.			
16	S.2	Ensure successful operation of circuit breaker. <i>How will you test it?</i>	Circuit breaker fully operational and equipment dead.			
17.	S.3	Emergency stop fully operational. <i>What's the test?</i>	Emergency stop activation successful.			
18.	S.4	Ensure electrical interlock fully operational.	Electrical interlock safely disables plant.			

The budget will be no more than £2000, the Allan Bradley PLC is already available with spare I/O for the project. Programming software is available on the company's PC. This will help bring the cost down. *This belongs in a different section*

These constraints have already been covered
The project is greatly affected by the environmental code of practice due to the great levels of water ingress which is being digested by the work place. This could pose a hazard and threat to the project. Legal / Commercial constraints can pose a potential hazard as water ingress into electrical cable tunnelling can be a major disaster.

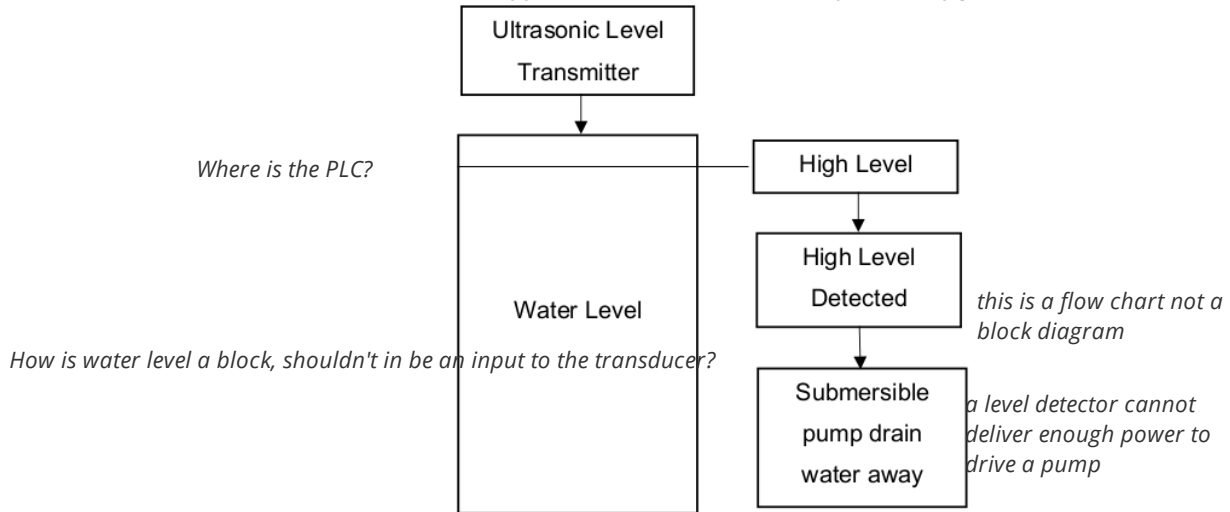
For the FDS table, see table 2 and for the Test Planning Table, see table 3.
This should have been stated earlier

5. Literature Review and Choice of Final Solution

Solution 1 – Ultrasonic Level Transmitter

Figure 1 - Solution 1

You could have a lead-in sentence that briefly describes the solution with reference to figure 1.

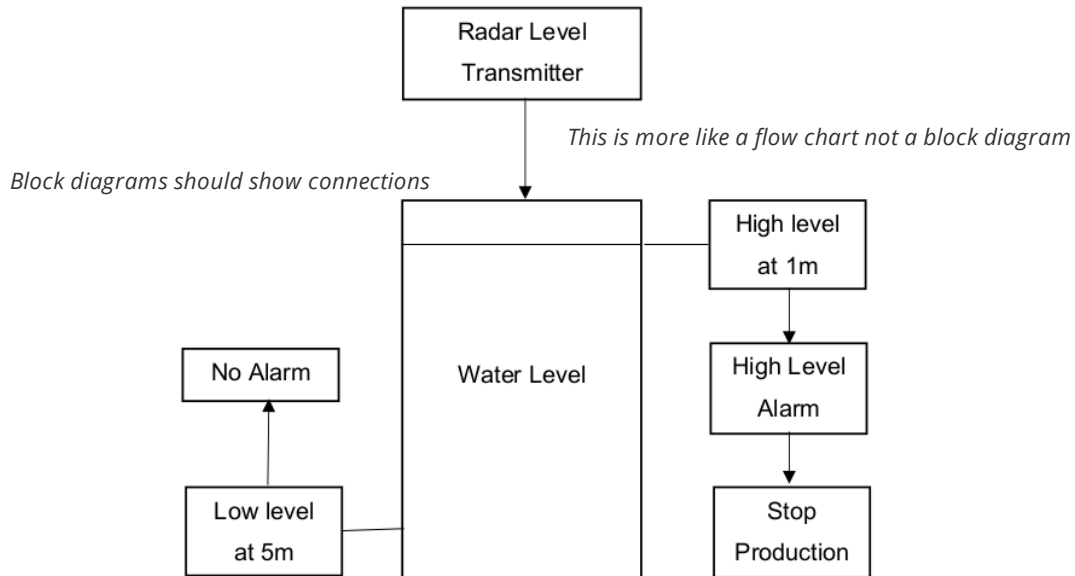


This solution uses

Solution one is to use an ultrasonic level transmitter, which will then determine the level of the water. Once the water has reached a high level an alarm will be generated and a submersible pump will be used to drain the water away. The level transmitter suitable for this application is the VEGASON 61 for continuous level measurement. 'In non-contact ultrasonic level measurement, the sensor emits ultrasonic pulses in the direction of the medium, which then reflects them back. The elapsed time from emission to reception of the signals is proportional to the level in the tank. Ultrasonic sensors are ideal for simple standard applications, both for liquids and bulk solids', (VEGA, 2022). One suitable pump for this application is the TIP Extrema 400/11 CX. 'This is a partly stainless steel pump that is highly suitable for processing dirty water as it can process solids of up to 40mm with a maximum capacity of 24,000 l/h', (Pump, 2023). It has the ability to switch automatically at different water levels. It has a submersion depth of 7m, which is suitable. Flow rates of 5,380 l/h at 10 meters.

Solution 2: Radar Level Transmitter

Figure 2 - Solution 2

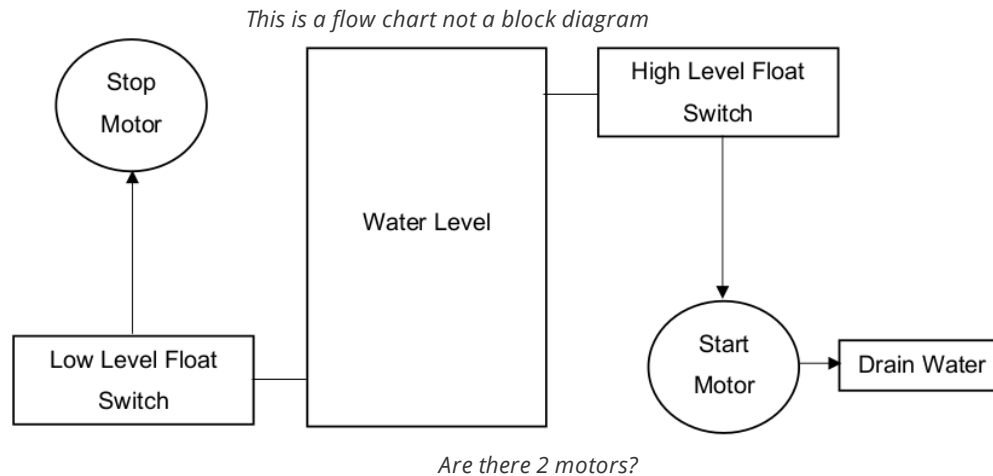


Solution two uses a level transmitter to monitor the water level. When the water reaches the high level it will generate an alarm and stop production. The level transmitter for this VEGAPULS 31. This is a radar type level transmitter. It is a two wire 4 to 20mA radar sensor for continuous level measurement. 'VEGAPULS 31 provides non-contact level measurement of liquids in standard applications in all industrial plants. The sensor has EX approval and is certified to the current ATEX and IEC standards. VEGAPULS 31 is a maintenance free operation due to non-contact 80GHz radar technology and is able to give exact measurement with on-site display and the ability to integrate with existing control systems. The sensor is independent of medium properties and process conditions', (International, 2023). In this application, the water is drained away manually using the equipment currently in place.

If the FDS requires automatic draining, all solutions must do the same thing but in a different way.

Solution 3: Float Level Switches

Figure 3 - Solution 3



Solution three uses float switches to stop and start the motor in order to constantly drain the water away. One suitable component for this application is the VEGAPOINT 11, which is an ultra-compact capacitive limit switch for the detection of water based liquids. 'In capacitive point level detection, the sensor and vessel form the two electrodes of a capacitor. Any capacitance change caused by a level change is converted into a switching signal. The short cable and rod versions mean that the level switches can be perfectly adapted to any application for overfill or dry run protection as well as oil/water or foam detection', (VEGA, 2023). This application requires a pump motor. One suitable component is the EUROM Flow 400. It uses float switches to turn the pump on and off. It will work with both clean and dirty water. The motor capacity is 400W, which makes it suitable to drain the water away. It has a flow rate of 125 l/min, which means the water will be drawn away quicker to lower the level and clear the alarm. It has a max depth of 5m, which is suitable for this application.

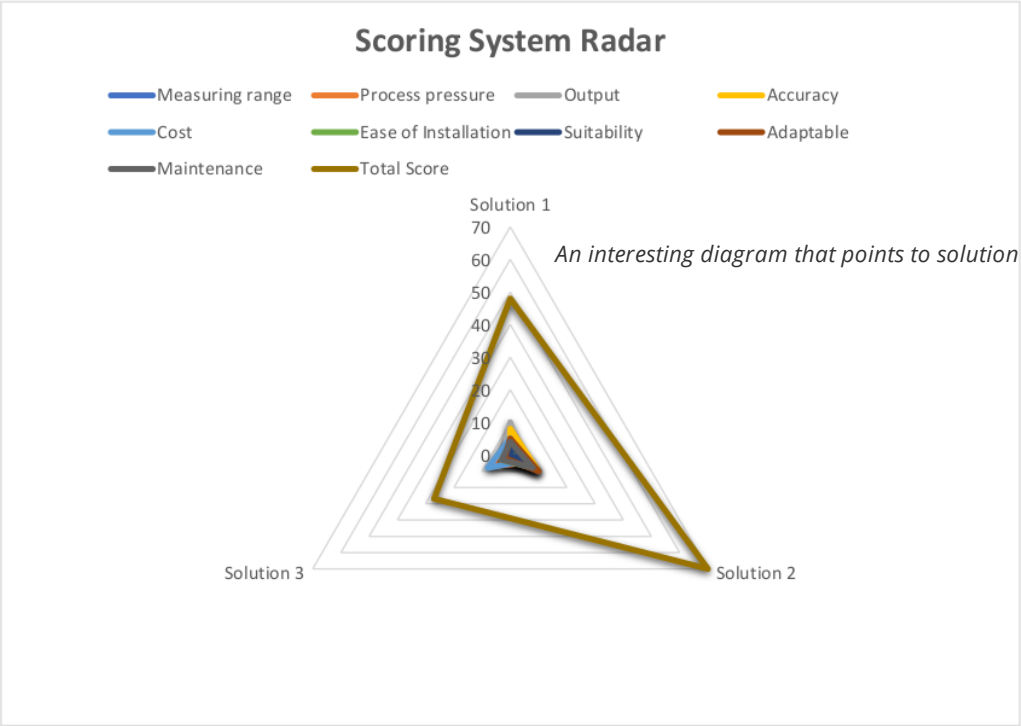
Table 4 - Costing Table

Solution 1 Cost				
Equipment				Cost
VEGASON 61 Ultrasonic Level Transmitter				£556.00
EUROM Flow 400 Submersible Pump				£51.93
Total Cost				£607.93
Solution 2 Cost				
Equipment				Cost
VEGAPULS 31 Radar Level Transmitter				£790
Total Cost				£790
Solution 3 Cost				
Equipment				Cost
VEGAPOINT 11 Limit Switch				£139.00
TIP Extrema 400/11 CX Motor Pump				£234.90
Total Cost				£373.90

The chosen solution for this project is solution two, the VEGAPULS 31 radar level transmitter. However, it is the most expensive solution, but judging from the technical literature, this is the best and most suitable solution for the problem. Solution three does provide a solution to the water level problem in the cable tunnels, judging from the technical specification it only has a measuring range of 1m, which does not make it suitable for this application as at least 5m is required. *All solutions must meet the requirements of the FDS, see F4* Solution 2 is also a suitable solution to this application and does meet the 5m depth required and it is cheaper than solution 3, however, it will only just reach the 5m mark and if a greater depth needed to be reached then the level transmitter will have to be changed, which will cost the company even more money. If changes or modifications need to be made in the future then solution 2 is adaptable with a large range of 15m. Therefore, solution 2 is more efficient and suitable for the project. It does not require a submersible pump or pump motor, which means less equipment and less maintenance. Given that a depth of at least 5m is required, this does make this specification crucial as if it cannot be met then it is not suitable for the application. *accuracy should have been specified in the FDS* Solution 3 provides no accuracy, the motor will only start when the float switch reaches the high level limit. It does not give a level measurement reading. This makes it difficult to determine the level of water. With the VEGAPULS in solution 2 it provides great accuracy, so that the level of the water can be determined accurately. For the scoring matrix see table 5 and for the comparison table see table 6, both in the appendix. For the radar displaying the chosen solution based on the scoring matrix see figure 4 in the body.

Upon inspection of the local main control room there is an Alan Bradley PLC present with spare I/O. This means that there is no need to buy a PLC rack and I/O modules. That has saved the company money. The only cost will be for the level transmitter, a multicore cable and installation. The level transmitter will be a VEGA transmitter with a minimum five meter range. The cost for this particular transmitter is set. The company will pay the price set by VEGA. What the project will cost, the company will save millions over the years as components will not need replacing and production will not suffer from down time. This comes back to the justification of the project and why this project is being implemented.

Figure 4 - Scoring System Radar



6. Project Planning, Work breakdown and Management Techniques

Point five in the appendix shows the design and implementation stages of the project. This is a work breakdown structure method in the form of a Gantt chart to monitor the progress of the

project and ensure that it is on track and due to be completed on the specified date highlighted in the project proposal. Gantt charts ~~are useful as it~~ will determine whether the project is behind, on or ahead of schedule. This is a good management technique to ensure the project meets the deadline. The red blocks highlight what needs to be designed or implemented and when. The green blocks will highlight what design or implementation have been carried out and when. It could be viewed as the red blocks are the desired implementations and the green blocks are the actually implementation. This will be completed further into the project. See point four for the WBS chart. See table 7 for the Gantt chart. See table 8 for costing spreadsheet, all in the appendix.

Management techniques that need to be implemented in engineering projects are 'to create clear, realistic and measurable goals, ensuring effective communication throughout the duration of the project, encourage feedback in order to improve the project and implement new ideas, autonomy by delegating difficult roles to more senior and qualified personnel and employee a good team', (McLeod, 2021).

'Quality Management System (QMS) is defined as a structured system that documents processes, procedures, and responsibilities for continuously delivering high quality products and services that meet regulatory and customer requirements', (QMS, 2023). The aim of quality management is to provide a framework that increases communication, collaboration, and consistency across the company while reducing waste and promoting continuous improvement. The justification behind this project was to reduce expenditure and downtime by replacing components damaged by water ingress. QMS can help in the following, an effective way of reducing cost associated with rework and customer complaints. Improve the efficiency of the project by eliminating waste and streamline quality processes. Ensure that the project complies with quality standards. Aid with processes including purchasing. Processes are the activities that are performed to achieve quality objectives. To provide quality instruments in the project for calibration and testing equipment which must be maintained to a high degree of quality to ensure accuracy.

Continuous improvement including CAPA. One of the reasons why the VEGAPULS 31 was selected for the project was because of its ability to adapt in more larger or greater projects. It has the potential to go beyond the requirements of the project if improvements are to be made in the future. Continuous improvement is the process of continually improving quality by making small, incremental changes. Corrective and preventive action (CAPA) is the process for addressing quality issues and preventing quality problems from occurring.

There are many principles set out in engineering management such as, 'to seek alternative systems perspectives in order to enhance understanding and to justify. Understand the enterprise context. System developments are undertaken by the company because they provide benefits. Integrate systems engineering and project management. Project management and systems engineering management are highly overlapping endeavours. Invest in the early stages of projects. For any activity in a project there will be a correct time to undertake it', (Emes, 2012). Incorrectly cited, this is not the Harvard Method

'Commercial context is the action taken for the purpose of obtaining anything of value', (Services, 2023). The project utilises commercial context in that it is taking action for the purpose of obtaining a more efficient, sustainable and effective means of eliminating a problem, which will in turn be of great value to the company as it will save time and money.

Whenever changes need to be made to the project, the company has an MOC (management of change) policy in place. When changes are made to the program, software or electrical components of the project an MOC will be carried out. The reason why the change is being made and whether there are any other possible solutions must be answered. It entails a thorough investigation by the engineering team to ensure that it is safe to carry out this change. The overall outcome must be determined and any potential dangers must be identified. It will include a risk assessment where all the hazards and risks involved behind the change will be evaluated to determine whether the change is safe to make. Once everything has been addressed and it has been calculated safe and necessary to make the change, then it will be implemented.

Incorrectly cited, this is not the Harvard Method
'Intellectual property rights provides the rights to benefit from the project', (Agency, 2021). This provides the right for the company to benefit from the outcome of the project.

7. Conclusions and Recommendations

The function design specification and test planning are two crucial elements to determine whether the project was a success or not. Here decisions were made as to what tests must be carried out. *How will it be simulated, what software are you going to use?* The project will be simulated from the beginning to try and identify any difficulties that need to be addressed early that may cause a problem later on in the project. With careful simulation and regular testing of the project when each stage is implemented will increase the probability of the project being completed on time and being a success.

Engineering management plays an important role in the project. By looking at more than one solution to the problem and making comparisons it helps to ensure that the most sufficient and effective solution is being implemented. One that the company will greatly benefit from, not only now, but also in the future.

In order for any project to be successful there must be project planning, work breakdown structure and effective management techniques. Here the project was completely divided from start to finish highlighting each essential task. This enables the project to be monitored to determine the current stage and what needs to be done to achieve the completion of the project by the deadline.

This makes no sense as all three solutions should meet the requirements of the FDS and only the best should be selected. It can be developed further, by adopting features of all three solutions into one. Where there would be a level transmitters monitoring the level along with motors and submersible pumps all working together to flush the water away as quickly as possible eliminating all possibilities of water damage. This should be your solution if the FDS requires it!

8. Citation List

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9. Appendix

1. Project Proposal

SGEL6000 INDEPENDENT PROJECT

PROJECT PROPOSAL DOCUMENT

Student Name: Sean Parry

Project Title: Cable Tunnelling Water Level

Date: 22/09/23

Budget: £2000.00

Description of Project

The project will be an industrial based project. The planning, implementing, testing and commissioning will all take place within the workplace and under the company's authorisation.

The project is needed to monitor and control the water level that is currently causing a potential hazard within the cable tunnels. This water needs to be controlled and monitored to prevent water ingress and corrosion to the cables which feed the contactor rooms and sub stations within plant. The risks involve possible cable replacing and if cables become damaged then plant will be inoperable until the cables are replaced and this will require much time. The project will address this problem and reduce these potential hazards.

Those involved with the project will include the student, the academic tutor and the industrial supervisor. All three are necessary to build the project, to guide and direct the project and finally to authorise and fund the project. All three will play a crucial role to complete the project.

The budget for the project is and will not exceed £2000.00.

The completion date for the project will be the 11th of April 2024. By this date the project as a whole must be built, tested and commissioned in accordance with the project plan.

Agreement for project proposal

Student Signature: _____ Sean Parry _____ Date: 22/09/2023

Industrial Supervisor Signature: _____ Ashley Hopkins _____ Date: 22/09/2023

Academic Tutor Signature: _____ Robert Davies _____ Date: 22/09/2023

2. Risk Assessment for implementation phase

Risk Assessment									
Job Description / Permit No / Job Ref: Cable Tunnelling Water Level									
Hazards	Moving Machinery	Yes	No	Controls In Place	1	2	3		
	Pressure Systems	Yes	No		1	2	3		
	Hydraulic Systems	Yes	No		1	2	3		
	Electrical Hazards	Yes	No		1	2	3		
	Hot Temperatures	Yes	No		1	2	3		
	Noise	Yes	No		1	2	3		
	Adjacent activity	Yes	No		1	2	3		
	Slip, Trips & Falls	Yes	No		1	2	3		
	COVID-19	Yes	No		1	2	3		
	Other Hazards	Yes	No		1	2	3		
Other Hazard(s) Detail / Problem Statement: None									
Other Hazard(s) Controls Used / Implemented None									
Date: 22/12/2023									
Time:									
Tick the correct box below:									
Type of Work:		Visual Inspection		Maintenance		Installation			
Type of People:		Working Party		PICWP		SL			
Number of People:		<2		3-5		>5			

Risk Assessment Instructions & Controls

Hazard	Control 1	Control 2	Control 3
Moving Machinery	Isolate	Removal of Personnel	Temporary Guarding
Pressure Systems	Isolate	Remove Stored Energy	Secure (e.g. pin)
Hydraulic Systems	Isolate	Remove Fluid Power	Secure
Electrical Hazards	Isolate (e.g. LV Cert/Permit)	Guard (e.g. temporary)	PPE
Hot Temperatures	Guard	Adopt Method of Work to avoid Splash	PPE
Noise	Isolation	Noise Barriers (e.g. shroud/enclosure)	PPE (e.g. Ear Muffs)
Adjacent activity	Separate (barrier) Activities	Speak to Person in Charge	PPE (e.g. Goggles)
Slip, Trips & Falls	Clean up	Safely route cables & hoses	Improve light
COVID-19	Strict Social Distancing ≥2m	If <2m, Wear Face Mask (P1 or better)	Wash Hands Thoroughly before doing anything else
Other Hazards	Working Party withdrawn	Review of arrangements initiated	Permits in Place
Further Interpretation			
Type of People:	PICWP – Person in Charge of Working Party	SL – Safety Leader	

3. Scoring matrix for solutions

The scoring system is a simple 0-10. 0 being very poor and 10 being excellent.

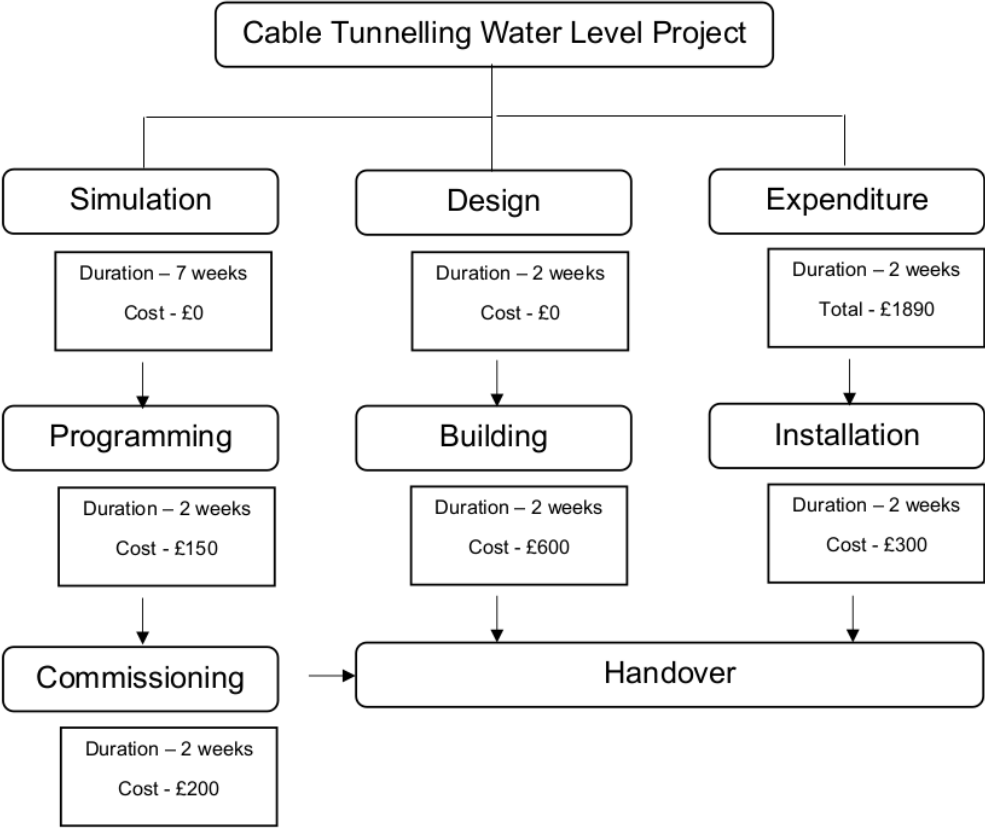
Table 5 - Scoring Matrix for Solutions

Scoring System			
Specification	Solution 1	Solution 2	Solution 3
Measuring range	5	10	1
Process pressure	5	5	7
Output	10	5	3
Accuracy	8	10	0
Cost	5	4	8
Ease of Installation	3	8	3
Suitability	3	10	0
Adaptable	5	10	2
Maintenance	4	8	3
Total Score	48	70	27

Table 6 - Comparison Table

Comparison Table			
Comparison	Solution 1	Solution 2	Solution 3
Type	Ultrasonic	Radar	Float switches
Measuring range	5m	15m	1m
Process temperature	-40 - 80°C	-40 - 80°C	-20 - 100°C
Process pressure	-0.2 – 2 bar	-1 – 3 bar	-1 – 25 bar
Process rating	IP66/IP67/IP68	IP66/IP67, Type 4x	IP66/IP67/IP69
Output	Profibus PA Foundation Fieldbus 4-20mA/HART 2-wire 4-20mA/HART 4-wire	4-20mA/HART	Transistor PNP I/O Link
Accuracy	±4mm	±2mm	N/A
Frequency	N/A	80GHz	N/A
Ambient Temperature	-40 - 80°C	-40 - 70°C	-40 - 70°C
Beam Angle	N/A	8°	N/A
Drain	N/A	Manual	N/A
Submersible pump	EUROM Flow 400	N/A	N/A
Motor	N/A	N/A	TIP Extrema 400/11 CX

4. WBS Chart



5. Gantt Chart

Table 7 - Gantt Chart

Project Gantt Chart 2024																
	January				February				March				April			
	05	12	19	26	02	09	16	23	01	08	15	22	05	12	19	26
Design/Drawing																
Simulation																
Expenditure																
Building																
Programming																
Function Test																
Installation																
Test/Commission																
Handover																

This is very linear, no contingencies

6. Costing Spreadsheet

Table 8 - Costing Spreadsheet

Costing Spreadsheet									
Item	Quantity	Description						Time HR	Cost
VEGAPULS 31	1	Radar sensor for continuous level measurement						0	£790
50m Multi-core Electrical Cable	1	50m multi-core cable from sensor to the MCC						1	£300
Installation	1	Mounting and securing the radar sensor in place						1	£50
Electrical Installation	1	Installing and running new multicore cables to the MCC						2	£250
Software	1	Software currently in place						0	£0
Programming	1	Programming time						2	£150
Design of SCADA HMI	1	Designing mimic on SCADA for level measurement						3	£150
Testing/Commissioning	1	Test and commission application						8	£200
Total Cost									£1,890.00

SGEL6000

Independent Project

Log Book

Sean Parry

Cable Tunnelling Water Level

2023-2024

Summary of Entries

Log Entry	Date	Brief Description of Activity	Duration (hrs)	Accumulated (hrs)
1	06/10/23	Discussions held to determine appropriate project	2	2
2	13/10/23	Decision made and project identified	1	3
3	20/10/23	Discussion held regarding implementation of the project	1	4
4	27/10/23	-	0	4
5	03/11/23	-	0	4
6	10/11/23	Update on project to determine possible start date	1	5
7	17/11/23	Inspected area to determine installation of the project	1	6
8	24/11/23	-	0	6
9	01/12/23	-	0	6
10	08/12/23	-	0	6
11	15/12/23	-	0	6
12	22/12/23	Research carried out into level measurement	3	9
13		<i>This is too little since this log book covers a whole term</i>		
14				
15				
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Log Entry Sheet

Log Number	1
Date	06/10/2023
Duration (hrs)	2
Accumulated time (hrs)	2

Record of Activities and Achievements

During the course of this week discussions have been held as to what would be a suitable project that would meet the demands and needs to the company. The company/industry is very dependent on the many Allan Bradley PLC's that are located across site. Each PLC plays a vital role in the control process of the plant. As with each company/industry there is always room for improvement. Further discussions will be held to determine how plant can be improved and how this can be implemented.

Plans for next week

The plan for next week is to speak with engineering/management of the company and determine an improvement idea that could be implemented on plant. With the desired improvement chosen, the necessary planning can begin as to how this improvement can be implemented to meet the needs of plant.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	2
Date	13/10/2023
Duration (hrs)	1
Accumulated time (hrs)	3

Record of Activities and Achievements

Discussion held in the place of work as to what improvements could be made to plant and to incorporate a project that will implement this improvement. The decision was made to design a project on cable tunnelling water level. This is an issue that is currently in place at the moment and this project will address this particular problem. With a project in place and in mind, the background, problem identity and constraints can be considered.

Plans for next week

The plan for next week is to further develop the background, problem identity and constraints that are associated with this project. Consideration needs to be given as to where the project will be based and how the development will be carried out. Problem definition needs to be identified and consideration given to the current system/process involvement and limitations. Accuracy of results and existing process. Efficiency of existing systems. Finally, to explain any environmental restrictions of dangers.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	3
Date	20/10/2023
Duration (hrs)	1
Accumulated time (hrs)	4

Record of Activities and Achievements

Discussion held with PC&A Engineer as to how the project will be implemented and what equipment will be used. The measuring equipment has not been identified as of yet, but possible transmitters have been discussed to determine the correct electrical components for the task.

Plans for next week

Awaiting a start date as to when the project can begin implementation.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	4
Date	27/10/2023
Duration (hrs)	0
Accumulated time (hrs)	4

Record of Activities and Achievements

Due to works demands nothing achieved this week.

Plans for next week

Awaiting a start date for the project.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	5
Date	03/11/2023
Duration (hrs)	0
Accumulated time (hrs)	4

Record of Activities and Achievements

Due to holidays nothing achieved this week.

Plans for next week

Awaiting a start date for the project.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	6
Date	10/11/2023
Duration (hrs)	1
Accumulated time (hrs)	5

Record of Activities and Achievements

Upon return to work email sent to engineering department as to determine a possible start date for the project and an update as to the current position of the project.

Plans for next week

Awaiting a start date for the project.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	7
Date	17/11/2023
Duration (hrs)	1
Accumulated time (hrs)	6

Record of Activities and Achievements

Attended site with the engineering team to inspect area of the project. Upon arrival a thorough investigation was carried out of the cable tunnels to determine the best possible way to install the level transmitter. An analysis was carried out to try and identify any potential problems of which none could be found. Upon inspection of the area, the main control room was entered to inspect the PLC's. The level transmitter will be an analogue output from the PLC, so an inspection of the current PLC's revealed that there is a PLC in place and room on the rack to insert more I/O. Discussions were held regarding what equipment will be used and the decision was made to use a VEGA level transmitter with a length of up to 5m. The cable tunnelling depth was approximately 2m, so a 5m range level transmitter will be sufficient for the project.

Plans for next week

Source relevant components for the project.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	8
Date	24/11/2023
Duration (hrs)	0
Accumulated time (hrs)	6

Record of Activities and Achievements

Due to production and work demands, no work was carried out on the project this week.

Plans for next week

To carry out research into the different types of level measurement.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	8
Date	01/12/2023
Duration (hrs)	0
Accumulated time (hrs)	6

Record of Activities and Achievements

Due to production and work demands, no work was carried out on the project this week.

Plans for next week

To carry out research into the different types of level measurement.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	8
Date	08/12/2023
Duration (hrs)	0
Accumulated time (hrs)	6

Record of Activities and Achievements

Due to production and work demands, no work was carried out on the project this week.

Plans for next week

To carry out research into the different types of level measurement.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	8
Date	15/12/2023
Duration (hrs)	0
Accumulated time (hrs)	6

Record of Activities and Achievements

Due to production and work demands, no work was carried out on the project this week.

Plans for next week

To carry out research into the different types of level measurement.

Signed: Ashley Hopkins

Signed: Sean Parry

Log Entry Sheet

Log Number	8
Date	22/12/2023
Duration (hrs)	3
Accumulated time (hrs)	9

Record of Activities and Achievements

Research was carried out into the different types of level measurement. The company desired the VEGA level measurement transmitters due to their IP ratings and that they are compatible with the harsh environments. Consideration was given firstly, to the VEGAPOINT 11, which is a limit switch type of level measurement. This would detect the level of water and switch when it reaches too high and generate an alarm. Secondly, consideration was given to the VEGAPULS 31, which is a radar sensor for continuous measurement of level. This is a very high profile level sensor and is capable of reaching depths of 15m. Thirdly, consideration was given to the VEGASON 61, which is an ultrasonic sensor for continuous level measurement. This only reaches a depth of 5m, but does meet the requirements of the project.

Plans for next week

To purchase the required components for the project.

Signed: Ashley Hopkins

Signed: Sean Parry

50/100

PAGE 1

PAGE 2

QM

Good Structure

Report is structured exactly as stated in the assignment brief.

PAGE 3

PAGE 4

Text Comment. A good summary but there should be less emphasis on what's in the report, and more on the project itself.

Text Comment. You explain the reason for each section instead of telling your reader what's in them.

Text Comment. your reader will know the purpose of this section but needs to know here what it is.

Text Comment. here, you should have stated the problem

PAGE 5

PAGE 6

Text Comment. Why are there no photos or diagrams?

Text Comment. is there a tunnel?

Text Comment. repetition

Text Comment. What is the plant made up of?

Text Comment. repetition

Text Comment. use numbers

Text Comment. repetition

Text Comment. this belongs in the next section

Text Comment. the background is meant to set the scene for the problem definition, you should have explained the basic oxygen process and what the cable tunnels feed rather than explaining the problem which belongs in the next section

PAGE 7

Text Comment. this paragraph contains a lot of repetition

QM

Spelling

Spelling error

Text Comment. repetition

QM

Incorrectly cited, this is not the Harvard Method

Text Comment. This appears to be a quotation. It should be in double quote marks and begin with The company states that " "

PAGE 8

QM

Incorrectly cited, this is not the Harvard Method

QM

Spelling

Spelling error

Text Comment. use double " marks

Text Comment. There are too many quotations. It would be better to read them and put in your own words.

QM

Incorrectly cited, this is not the Harvard Method

QM

Incorrectly cited, this is not the Harvard Method

Text Comment. no need to explain this term

QM

Incorrectly cited, this is not the Harvard Method

Text Comment. A lead in sentence would be helpful

Text Comment. Good level of detail in each outcome

Text Comment. This column is too wide since there is only a number in it

Text Comment. This is a good way of itemising each part of the FDS

Text Comment. some of these as configuration tasks not tests

Text Comment. how is this a test?

Text Comment. what is the test?

Text Comment. how

Text Comment. How is this a test?

Text Comment. How will you test it?

Text Comment. What's the test?

Text Comment. This belongs in a different section

Text Comment. These constraints have already been covered

Text Comment. This should have been stated earlier

PAGE 15

Text Comment. You could have a lead-in sentence that briefly describes the solution with reference to figure 1.

Text Comment. Where is the PLC?

Text Comment. this is a flow chart not a block diagram

Text Comment. How is water level a block, shouldn't in be an input to the transducer?

Text Comment. a level detector cannot deliver enough power to drive a pump

Text Comment. This solution uses

Strikethrough.

QM **Incorrectly cited, this is not the Harvard Method**

QM **Incorrectly cited, this is not the Harvard Method**

PAGE 16

Text Comment. This is more like a flow chart not a block diagram

Text Comment. Block diagrams should show connections

QM **Incorrectly cited, this is not the Harvard Method**

Text Comment. If the FDS requires automatic draining, all solutions must do the same thing but in a different way.

PAGE 17

Text Comment. This is a flow chart not a block diagram

Text Comment. Are there 2 motors?

QM

Incorrectly cited, this is not the Harvard Method

PAGE 18

Text Comment. All solutions must meet the requirements of the FDS, see F4

Text Comment. accuracy should have been specified in the FDS

PAGE 19

Text Comment. An interesting diagram that points to solution 2

PAGE 20

Text Comment. A WBS is not a Gantt chart, they are two different diagrams but one is based on the other

Text Comment. No need to say how useful they are.

Strikethrough.

QM

Incorrectly cited, this is not the Harvard Method

QM

Incorrectly cited, this is not the Harvard Method

PAGE 21

QM

Incorrectly cited, this is not the Harvard Method

QM

Incorrectly cited, this is not the Harvard Method

PAGE 22

Text Comment. How will it be simulated, what software are you going to use?

Text Comment. This makes no sense as all three solutions should meet the requirements of the FDS and only the best should be selected.

Text Comment. This should be your solution if the FDS requires it!

PAGE 23

PAGE 24

PAGE 25

PAGE 26

PAGE 27

PAGE 28

PAGE 29

PAGE 30

PAGE 31

PAGE 32

PAGE 33

Text Comment. This is very linear, no contingencies

PAGE 34

PAGE 35

PAGE 36

Text Comment. This is too little since this log book covers a whole term

PAGE 37

PAGE 38

PAGE 39

PAGE 40

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GRADING FORM: NEW CSG-RUBRIC

SEAN PARRY**50****1. ENGAGEMENT WITH LITERATURE**

Sections 3 and 5: Engagement in research, judicial use and critical evaluation sources for project constraints and literature review of solutions. There is good evidence of research from a good range of sources. (6/10)

Sections 3, 5 and 8: Extent of reading, use of credible sources, use of Harvard method for listing and citing

Most citations seem to be quotations and not correctly cited. (3/10)

9**2. KNOWLEDGE AND UNDERSTANDING**

Section 3: Project background and problem definition

Little given of the background of the BOS plant.

Little information about the tunnels. The problem has been defined but is repeated a number of times. (2/5)

10

Section 3: Project constraints: Ethical.

Good level of detail given. (3/5)

Section 3: Project constraints: Sustainability

Good level of detail given. (3/5)

Section 3: Project constraints: Legal/Commercial

Some level of detail given. (2/5)

3. COGNITIVE AND INTELLECTUAL



Section 4: Functional Design Specification

Quite detailed with useful itemisation method (3/5)

9

Section 4: Test planning

This section has some good parts but many of the tests are poorly explained, you should be able to give the test table to another engineer and they should be able to carry them out for you. (2/5)

Section 5: Evaluation of solutions and justification of final solution

The 3 solutions should all meet the requirements of the FDS but some don't and although the choice of solution 2 is justified. The block diagrams are actually more like flow charts. (2/5)

Section 7: Conclusions and Recommendations

Some useful points noted, but you contradict your choice of solution by saying that all three solutions should be joined together but this goes beyond the requirements of the FDS. (2/5)

4. PRACTICAL APPLICATION



Section 6: Project Plan

Very simple and linear, no contingencies. (2/5)

9

Section 6: Working breakdown structure, costing exercise and management techniques
Good detail given. (3/5)

Appendix: Risk assessment for implementation phase
Very good detail given. (3/5)

Appendix: Planning phase log-book entries.
Very brief and lacking in time spent on the project. (1/5)

5. TRANSFERABLE SKILLS



Section 1: Executive summary

Read more like an introduction or report contents rather than a summary of the whole thing. (2/5)

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All Sections: Presentation quality of the report, diagrams, charts, tables, figure numbering, page, and section numbering etc
Good quality. (3/5)

All Sections: Quality of the writing style, use of punctuation and grammar
Generally well written but contains a lot of

repetition. (3/5)

Word count limit not exceeded

Not exceeded (5/5)