

Corey Taylor - Project Proposal

by Corey Taylor

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Prifysgol Cymru
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University of Wales
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Clarification Plant Pump Automation Upgrade

Project Proposal

By

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Project Supervisor - Stephen Mosey

Project submitted as part of the requirements for the award of

BEng (Hons) Electrical and Electronics Engineering

October 2023



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1. Introduction

This project is being undertaken to improve the efficiency of our existing sump system, named the 'Arnallt', by transitioning from a conventional float switch setup to an automated, PLC driven system. The Arnallt pumping station is an integral component of Tata Steel's Port Talbot site, and forms part of the site's 'Main Pumphouse Clarification Plant'. This facility serves the purpose of the removal of sludge, scale and oil while cooling down hot mill wastewater to maintain service water temperature at 20°C, with a tolerance of +/- 3°C.

The Arnallt sump system comprises of eight pumps, responsible for transferring water from an off-site river via an underground culvert, situated at the clarification plant. This system consists of six small and two large capacity pumps. The smaller pumps channel water to the seaward site of the beach weir, whereas the two larger pumps supply the stormwater basin, which are other elements of the clarification plant. These pumps manage the Arnallt sump's water level, ensuring it stays within the predefined threshold and activating a high-level alarm if levels rise above this. Currently, all pumps at the Arnallt sump operate solely on basic float switches. This means the pumps activate and deactivate based on the water's current level, and therefore switch on and off excessively. This setup is outdated and inadequate for a continuous 24-hour water inflow process, and consequently it results in excessive strain on the pumps, causing them to deteriorate prematurely.

Additionally, there is a valve at the works reservoir that can be opened to allow more Arnallt river water to flow into the sump, facilitating water level management when necessary. To address these issues, it has been agreed that upgrades are required to these pumps, offering comprehensive control of the entire system. This will enable remote monitoring and control from a designated control room or office.

The proposed solution involves replacing the existing float switch contactors with Allen Bradley PLCs, which are the standard equipment used throughout the Energy department. These PLCs will be installed to provide real-time status updates on the pumps and water levels, allowing the accessibility of remote control through a PC

interface. This upgrade will improve the efficiency and longevity of the system while simplifying its management.



- The Arnallt Contactor room and Sump area containing the 8 pumps

1.1. Aims & Objectives

Within this proposal, the aims & objectives of the project have been highlighted using the SMART criteria, which stand for Specific, Measurable, Achievable, Relevant, and Time-bound.

This approach ensures that the project goals are well-defined, quantifiable, attainable, aligned with the company's goals, and have clear deadlines for achievement.

Following this format, the SMART objectives are as follows: -

Specific: The objective is to improve the efficiency of the Arnallt sump system to aid water management within Tata Steel's Main Pumphouse Clarification Plant.

Measurable: Reduce energy consumption within the Arnallt system by 15% during the first year of implementation.

Achievable: Upgrade the sump system with modern PLC technology and remote monitoring capabilities within a 6month timescale.

Relevant: Ensure that the upgraded sump system aligns with Tata Steel's sustainability goals. Keeping the system standardised in line with other PLCs used within Energy.

Time-Bound: Complete the installation of the PLC driven sump system and initiate remote monitoring by the end of Month 7²⁴.

2. Background to the Project

The proposed upgrade to the Arnallt sump system not only addresses the existing operational inconvenience of the system but also aids with the forward-looking tone for the plant's future performance. As a system that's been in operation since the 1980s, it has served its purpose well but now faces the inevitabilities of ageing equipment and wear and tear. The slight variations in each pumps setup, resulting from years of several repairs and updates, emphasize the need for a unified and modern solution that ensures consistent performance and simple, standardised maintenance for the future.

In addition to its operational benefits, the upgrade aligns perfectly with the company's environmental and financial sustainability goals. The adoption of newer, energy efficient equipment is both a practical and conscientious decision. By transitioning from basic float switches to a PLC based control system, efficiency will be improved both financially (in the long term) and environmentally, and the project will tie in well with the company's requirement to reduce the plant's carbon footprint. The inclusion of remote monitoring and real-time fault detection through the PLC system showcases commitment to proactive maintenance. Reducing unnecessary downtime and minimizing repair costs by addressing issues before they escalate is paramount, and upgrading this system will help greatly in that regard.

The upgrade of the Arnallt sump system is a pivotal step in the ongoing improvements of the Main Pumphouse Clarification Plant and complements the company's current drive towards lower energy usage, lowering repair costs and more efficient running of plant. The project, when complete, will be added to the current Operating Manual for the Clarification Plant.

[1]

3. Project Design

The Arnallt sump system upgrade project will use a systematic and well-structured approach, following established development methods commonly used within the company.



3.1 Data Collection, Evaluation, and analysis

A fundamental aspect of the project is the collection of relevant live data. This data, which includes various aspects of the sump system, such as water levels and energy consumption, will be gathered using modern PLC technology. These tools will provide real-time data, ensuring that the analysis is based on current system status. Data collection will be ongoing, allowing the system's performance to be monitored continuously.

The collected data will be processed and analysed using the Studio 5000 software to create a user-friendly interface via an HMI and remote PC access, allowing for insights into system efficiency, energy savings and possible early detection of faults within the system. The Studio 5000 software is ideal for this task, given its compatibility with Allen Bradley PLCs, which will be the chosen PLC due to their wide use across the Energy department, and the entire site.

The analysis process will provide valuable feedback for the system's optimization. If, for instance, energy consumption is not meeting the targeted 15% reduction, the data can reveal where improvements are needed, enabling further adjustments to the control logic to adjust this as required.

3.2 Risks & Limitations

Knowing potential risks and limitations that may occur in the project is crucial. The main risk will be associated with unforeseen technical challenges during the implementation of the PLC. However, thorough planning will help mitigate these risks by allowing time for any errors and quick adaptations to any issues that may occur.

A limitation that will be considered is that while upgrading the Arnallt system, it remains within the constraints of the current infrastructure. Therefore, some

challenge may persist despite the upgrade, such as limitations in space for installation and equipment compatibility.  9 lar projects have been completed in the past, so these risks should be manageable.

4. Resources & Planning

In the planning phase of the Arnallt sump system upgrade project, detailed attention is directed toward resource allocation, project scheduling, and documentation.

These elements are crucial to ensuring a smooth and well-structured execution.

A primary focus of the planning is the identification of the project's deliverables.

These are the outcomes that the project will produce. The deliverables include the upgraded PLC driven system, project progress reports and training materials for the relevant personnel. By compiling a clear list of deliverables, everyone involved receives a good understanding of the expected results.

The project's timeline and resource allocation are visualised through a Gantt chart, laid out over the course of the expected life of the project. This visual representation of work to be carried out presents the project's expected chronology, deadlines and serves as a roadmap of where the project should be in terms of progression to date.

The Gantt chart allows for more efficient resource management and ensuring the project milestones are met within the required timeframes.

For transparency and documentation purposes, supplementary information will be shown in the form of appendices. These will include limited but highly relevant pieces of information and will contain documentation such as technical specifications, financial breakdowns, referenced materials, images of progression and any additional data directly supporting the project.

4.1 Hardware Resources

Below is a list of the hardware required to carry out the project. This will be submitted to TATA's  10 manager for Energy Department for approval before delivery can be arranged.

	A	B	C	D	E	F	G
1	Arnallit - List of Consumables						
2							
3	Item	Qty	Price Ea	Total Price	URL		
4							
5	19 core 1.5mm SWA Cable (100m)	1	£1,232.26	£1,232.26	RVFV19G15 CAE Groupe 19 Core		
6	Wall box - (1m x 0.8m x 0.4m) (ip66 minimum) with backplate	1	£419.09	£419.09	1SL0204A00 1SL0204A00 ABB 1S		
7	100m armoured CAT 5	1	£347.14	£347.14	9854CB3 SL033 Alpha Wire Cat5 E		
8	Tray Cable Medium Duty 300mm x 3m Hot Dipped Galvanised	2	£42.24	£84.48	RS PRO Self-coupling Light Duty Tr		
9	110v coil Finder relays	12	£24.47	£293.64	48.61.8.110.0060SPA Finder 48 S		
10	24v coil Finder Relays	6	£6.61	£39.66	40.52.7.024.0000 Finder PCB Mou		
11	4A double pole MCB	2	£32.04	£64.08	A9F54104 Schneider Electric Acti 9		
12	2 A double pole MCB	2	£30.00	£60.00	A9F54106 Schneider Electric Acti 9		
13	MCB linking bars for the above items	1	£31.69	£31.69	A9XPH124 Schneider Electric Acti 9		
14	Disconnect terminal blocks	100	£0.80	£80.00	RS PRO Disconnect Terminal Block		
15	24v PSU (90-264v ac input) 10A output	2	£60.84	£121.68	DRL-24V240W1EN Delta Electroni		
16	Din rail isolator switch	1	£174.05	£174.05	https://uk.rs-online.com/web/p/isolat		
17	earth terminals din rail	20	£1.13	£22.60	RS PRO 2-Way DIN Rail Earth Block		
18	end stops din rail	20	£7.45	£149.00	1061200000 Weidmuller W Series		
19	Panel Trunking 2m length x 50mm x 50mm	4	£14.48	£57.92	RS PRO Grey Slotted Panel Trunkin		
20	Din rail End caps	20	£0.24	£4.80	RS PRO End Plate for Use with CD		
21	20mm stuffing glands	5	£4.96	£24.80	RS PRO Black Nylon Cable Gland, I		
22	Panel wire black 0.5 mm 100m	1	£22.60	£22.60	RS PRO Black 0.5 mm² Hook Up Wi		
23	Panel wire red 0.5mm 100m	1	£23.39	£23.39	RS PRO Red 0.5 mm² Hook Up Wire		
24	Bootlace ferrule kit rs stock - 228-0321	2	£41.02	£82.04	RS PRO French Colour Coded Boot		
25	RS PRO 200mA F Glass Cartridge Fuse, 5 x 20mm	3	£0.31	£0.93	RS PRO 200mA F Glass Cartridge F		
26	Digital ammeter with 4-20 ma output	6	£108.68	£652.08	APM-M1-APO Trumeter LCD Digita		
27							
28			Total Cost	£3,987.93			

[2]

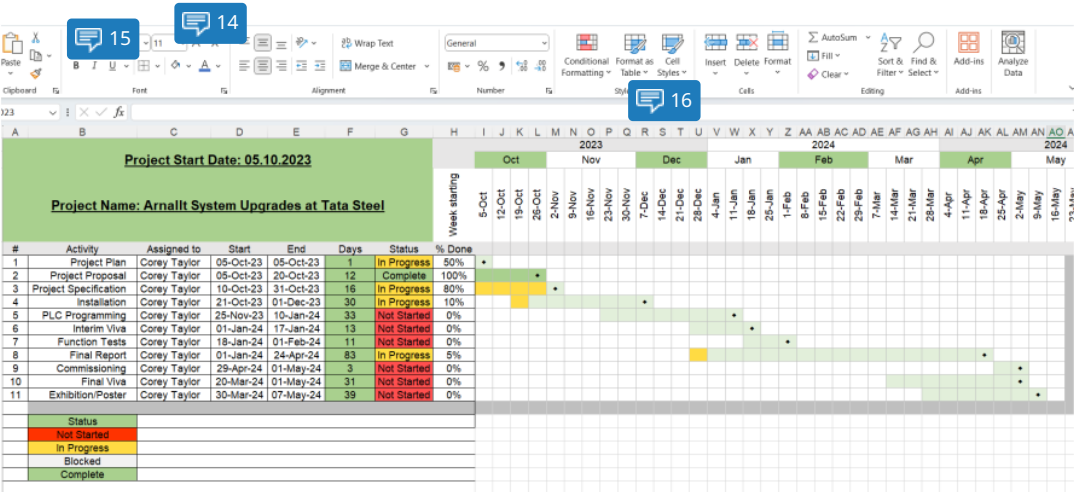
4.2 Software Resources

- Studio5000 Software will be used to programme the Allen Bradley PLC.

4.2 Planning Chart

The screenshot below illustrates the project's Gantt Chart, which has been designed to help ensure that the project stays on schedule and that no elements fall behind.

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Bibliography

[1] Unknown, "Main Pumphouse Clarification Plant Operating Manual".

[2] R. Online, "RS Online," [Online]. Available: <https://uk.rs-online.com/web/>.

Appendices

The images below show the current state of the Arnallt sump system and its contactor room. The images show the proposed area for installation of the PLC and cabinet within the contactor room.



- Proposed area to mount PLC panel. The two currently mounted small panels will be moved to the left-hand side of the image.



- Current isolators housing contactors for each pump, controlled by float switches submersed in water at site.





- More images to show the Arnallt system as a whole.



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GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

62/100

PAGE 1

PAGE 2



Comment 1

1) Research-informed Literature (20%)

For further improvement, consider refining the synthesis of ideas from the literature to strengthen the cohesiveness of your project

Marks Obtained: 9

2) Knowledge and Understanding of Subject (20%)

Your explanation of why the project is worth undertaking reflects a commendable depth of understanding. Overall, a good work.

Marks Obtained: 16



Comment 2

3) Analysis (30%)

Adding more specificity and detail to this discussion could further strengthen your analysis.

Marks Obtained: 17

4) Practical Application and Deployment (15%)

consider providing additional context in the appendices where necessary, offering a more comprehensive understanding of the supplementary materials.

Marks Obtained: 11

5) Skills for Professional Practice (15%)

Continue refining your writing style for even more impactful communication.

Marks Obtained: 9

PAGE 3



Comment 3

It would have been better if a table of content is included for figures.

PAGE 4



Comment 4

It is better to number the figures



Comment 5

It would have been better if similar projects have been referred and benchmarked



Comment 6

Good Work

PAGE 5



Comment 7

Project report has to be submitted before end of April 2024. But the project ends in May 2024.



Comment 8

It is better to have a block diagram, describing how the system works, how they are connected.



Comment 9

It would have been better if any possible ethical issues raised by the project to be highlighted



Comment 10

It would have been better if the document has uniform alignment and line spacing



Comment 11

Good Work



Comment 12

It would have been better if tables were numbered.



Comment 13

It would have been better, if a brief description about the software provided.



Comment 14

It would have been better if tables were numbered.



Comment 15

Plan to complete the project before the report submission date.



Comment 16

It is better to draw the table in the document if not, draw it in spreadsheet and crop the table and remove the tool bars.



Comment 17

It would have been better if referencing were included in the proposal.



Comment 18

Start from a fresh page



Comment 19

It is better to number the figures



Comment 20

It is better to number the figures



Comment 21

It is better to number the figures



Comment 22

It is better to number the figures