



**Prifysgol Cymru**  
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## Project Proposal

Engineering and Project Management ACDA5025

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## **1. Introduction**

### **1.1. Project Description**

Following an Intervention from the Health and Safety Executive (HSE), there is a requirement to undertake a site visit and develop a proposal for safety improvements to access electrical equipment, such as a transformer enclosure. The proposal details an Electronic Trapped Key Verification unit. The unit must be designed as per IEC 60947 [1] and BS 7671 (IET Wiring Regulations) [2]. The basis of the solution must also correlate to the Electricity at Work Regulations 1989 [3].

## **2. Aims and Objectives**

- Project to be proposed, engineered and constructed within 9 weeks of project start date  $\pm 10\%$
- Install new systems with minimal disruption to ongoing operations.
- Produce drawing/engineering deliverables, Bill of Materials, man-hour estimates, and other relevant documentation for installation purposes within the first 4 weeks.
- Evaluate and consider all environmental, ethical and societal impacts.

## **3. Project Background**

- 3.1. This project is required due to a recent investigation by the HSE, which raised concerns over achieving appropriate isolation and safety of the site's 11 kV/400 V transformer enclosure, to ensure of safe isolation of the incoming third-party supply. Therefore, an appropriate isolation solution is to be proposed, engineered and constructed, adhering to the best practices and relevant standards.

## **4. Project Design**

### **4.1. General:**

The proposed Electronic Trapped-Key interlock system will introduce a new safety solution for equipment isolation and controlled access. The solution is designed to ensure that access is granted only after all steps are completed in the correct order using the electronically coded keys. Implementing the Electronic Verification provides a safe, modern practice that addresses HSE concerns.

The interlock system will be designed and built around two newly installed electronic key-exchange units. The first unit will accept three electronically

coded isolation keys, each needed to complete the isolation action. The system releases an authorised electronic transfer key once all three keys are correctly placed and verified. This transfer key can then be taken to the second key exchange unit, where it's validation will trigger the release of five other electronic access keys which can be used to access the equipment enclosure.

#### **4.2. Safe Isolation:**

The two newly installed exchange units are designed to enforce a safe isolation sequence prior to equipment access. As mentioned, the first exchange unit receives three electronically coded keys, each corresponding to a specific isolation condition:

- MV circuit breaker key released when in off position.
- The MV earth switch key is released when the earth selector is engaged, and the earth switch is closed.
- LV main incomer key released when circuit breaker racked out and in the isolated position.

Only when all three keys are inserted and verified will the energise its internal solenoid mechanism and release the transfer key. This ensures of safe isolation before any further access or progression is possible. The exchange units will operate at 24 V d.c.

#### **4.3. Control and Monitoring**

The system installed will integrate with a specific Control and monitoring interface, which will be located within the sites LV control panel. The interface also operates at 24 V d.c. and provides live indication of the key's status, isolation status and access authorisation. It will utilise digital inputs to receive signals from both exchange units. The CMI will also provide volt-free contacts for optional integration with the site's existing SCADA or PLC systems, enabling remote monitoring of isolation and access states.

#### **4.4. Electronic Key Technology**

The electronic keys used within the system will contain uniquely coded identifiers stored on embedded RFID. Each key will be powered passively through the reader interface, eliminating the need for onboard batteries and reducing long-term maintenance. According to industry guidance from manufacturers such as Fortress Interlocks and Castell, electronic verification significantly reduces the risk of incorrect key insertion and enhances procedural compliance by ensuring each key is uniquely tied to a specific isolation step [4].

## 5. Resource

The estimated cost for the project is £27,500 ± 5%. Cost is determined by each discipline's requirements and contribution, as well as the equipment/materials required. The cost estimates are shown in both Table I and Table II. A Cost Benefit Analysis can also be found in Appendix D.

**Table I: Man-hour Estimates**

| Activities                                               | Discipline   | Position                                       | Hours | Rate (£ per hour) | Cost (£) |
|----------------------------------------------------------|--------------|------------------------------------------------|-------|-------------------|----------|
| System Architecture and Design                           | Engineering  | Electrical Designer                            | 40    | 20                | 800      |
|                                                          |              | Electrical Engineer                            | 24    | 60                | 1440     |
|                                                          |              | Principal Engineer                             | 8     | 85                | 680      |
| Electronic Hardware Design                               | Engineering  | Electrical Engineer                            | 40    | 60                | 2400     |
|                                                          |              | Principal Engineer                             | 12    | 85                | 1020     |
| Firmware & Control Logic Development                     | Engineering  | Electrical, Control & Instrumentation Engineer | 48    | 60                | 2880     |
|                                                          |              | Principal Engineer                             | 8     | 85                | 680      |
| Mechanical / Enclosure Design                            | Engineering  | Electrical Designer                            | 24    | 20                | 480      |
|                                                          |              | Senior Electrical Technician                   | 16    | 65                | 1040     |
| Prototype Build – Wiring, Assembly, Panel Work           | Construction | Electrical Technician                          | 40    | 50                | 2000     |
|                                                          |              | Senior Electrical Technician                   | 24    | 65                | 1560     |
| Cable Installation & Termination (internal wiring looms) | Construction | Electrical Technician                          | 32    | 50                | 1600     |

|                                                               |             |                              |    |      |        |
|---------------------------------------------------------------|-------------|------------------------------|----|------|--------|
|                                                               |             | Senior Electrical Technician | 32 | 65   | 2080   |
| Testing & Commissioning (functional, safety, interlock logic) | Engineering | Electrical Technician        | 20 | 50   | 1000   |
|                                                               |             | Senior Electrical Technician | 20 | 65   | 1300   |
| Project Management & Documentation                            | Support     | Project Manager              | 24 | 85   | 2040   |
|                                                               |             | Engineering Manager          | 16 | 100  | 1600   |
| Total                                                         |             |                              |    | 1070 | 24,520 |

**Table II: Bill of Materials**

| Description                                                                  | Quantity | Cost(£) |
|------------------------------------------------------------------------------|----------|---------|
| Electronic Trapped Key Exchange Box (industrial enclosure with key switches) | 2        | 400     |
| Electronic Trapped Key Control Unit (microcontroller or small PLC + IO)      | 1        | 250     |
| Keys / Electronic Key Interfaces                                             | 4        | 200     |
| Industrial Enclosure / Panel (steel or robust plastic, DIN-rail)             | 1        | 180     |
| Safety Locks                                                                 | 5        | 1000    |
| Electrical Cabling                                                           | 50m      | 100     |
| Cable Glands                                                                 | -        | 50      |
| Total                                                                        |          | 2180    |

## 6. Project Planning

### 6.1. Engineering Phase:

Figure 1 demonstrates the Gantt Chart produced for the engineering aspect of the project, outlining each activity and the estimated time for the activities to be completed. This Phase is estimated to take 3.5 weeks.

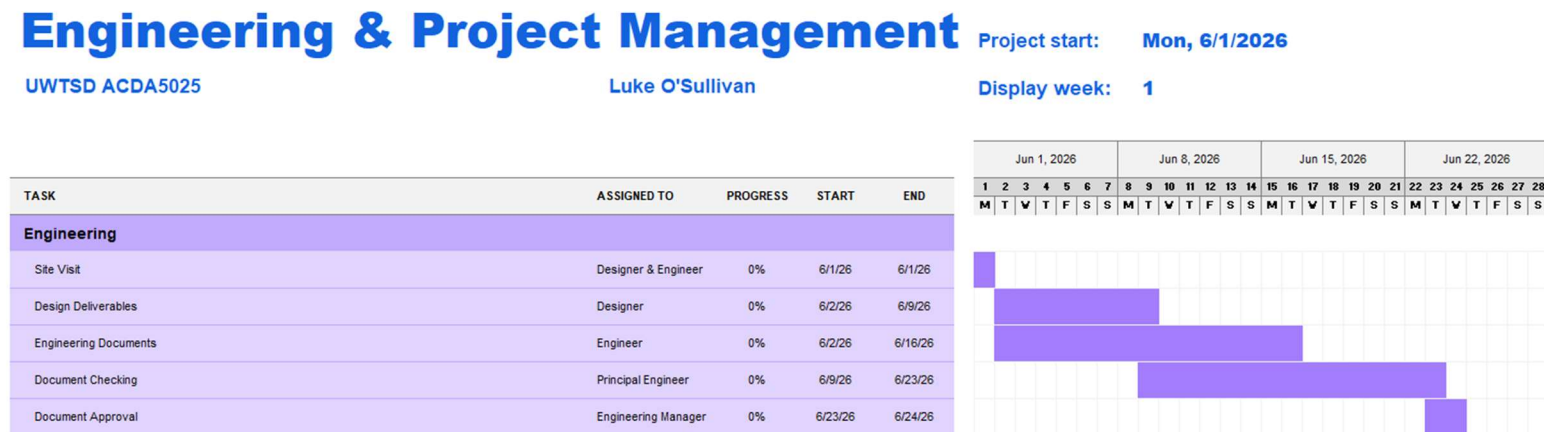


*Figure 1 : Engineering Phase Gantt Chart*

To begin the engineering phase, a site visit will be conducted before any deliverables can be started. This site visit takes one day to complete and involves scoping out the area, equipment locations, and potential on-site supplies.

Both the Engineer and the Designer will work simultaneously to complete the required deliverables. The documentation produced should align with the same ideas and technical information included across the board. The production of the deliverables will take approximately 2 weeks.

Next, the deliverables produced will undergo a thorough checking and approval process. This will be completed by the Principal Engineer and the Engineering Manager. The document checking can be started once the design deliverables have been completed, and checking processes may begin whilst engineering documents are still being produced. This is due to design deliverables being estimated to take less time, and to speeding up the checking process to avoid documents sitting around or employees having actions to complete. All documents will then undergo an approval process by the engineering manager before documents can be issued, and construction can begin.

## 6.2. Construction Phase:

Figure 2 demonstrates the Gantt Chart produced for the Construction phase of the project, outlining each activity and the estimated time for the activities to be completed. This phase will take approximately 4 weeks to complete.



*Figure 2: Construction Phase Gantt Chart*

The construction phase begins with the electrical technicians installing cable containment. This will involve installing trunking, glands, supports etc. Due to the minimal containment required this will only require two people 5 days to complete at most.

The next phases of the involve installing the new protection equipment, this phase begins once the cable containment has been installed. This is the main part of the construction phase where the main systems are installed and wired, the suitable locks will be installed during the device wiring and termination phase. The main construction phases will take approximately 2 weeks to complete.

The system integration phase involves combining all the installed components to ensure that the system works as one, fully operational and safe unit. Once the exchange boxes and CMI have been mounted and wired, technicians will begin linking the devices through their signal and power connections, confirming correct routing and termination throughout the panel. This involves configuring and programming each electronic key with the CMI, allowing the system to verify the key(s) ' actions. This phase will take approximately 5 working days as the system(s) must be connected, configured and verified to ensure full safety and operation before testing and commissioning can begin.

The final stage of the construction phase is testing and commissioning. This ensures of the quality and functionality of the new systems installed before it is deemed operational for working practice. Testing and commissioning will take approximately 2 days to complete.

### 6.3. Project Support:

Figure 3 demonstrates the Gantt Chart produced for the Project support outlining each activity and the estimated time for the activities to be completed. This phase spans across the entire project.

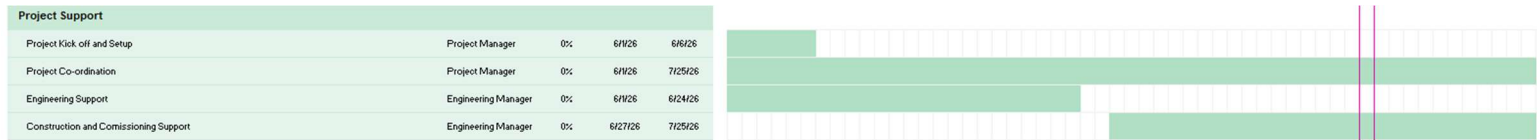


*Figure 3: Project Support Gantt Chart*

The project manager will be involved throughout the project's lifespan, from project setup through to the end of the construction phase. It is crucial that the project manager is consistently present, monitoring, coordinating and maintaining control over the project over the estimated 9 weeks.

The engineering manager will be involved throughout the project, supporting both the engineering and construction phases. The support will involve document checking, technical assistance and construction advice.

## 7. Critical Path Analysis

Critical Path analysis outlines the key aspects and tasks of the project that lead to project completion. By mapping the key stages, it allows for efficient scheduling and quality delivery. Figure 4 below demonstrates the critical path analysis for the projects engineering phase.

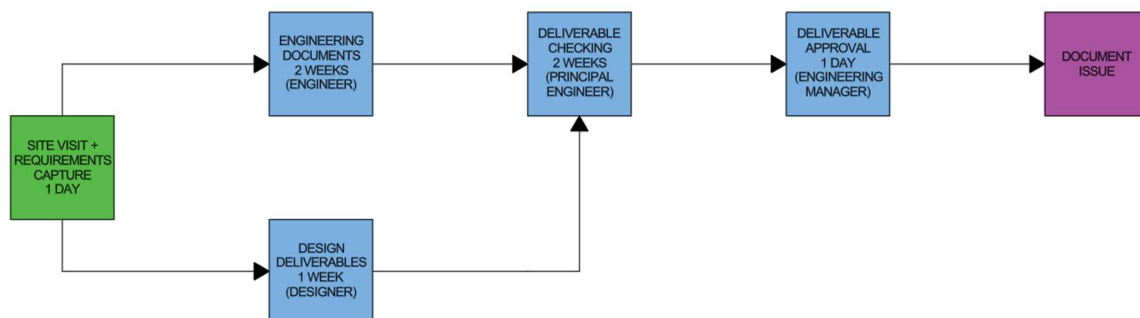


*Figure 4: Engineering Phase Critical Path Analysis*

Figure 5 below demonstrates the critical path analysis for the construction phase.

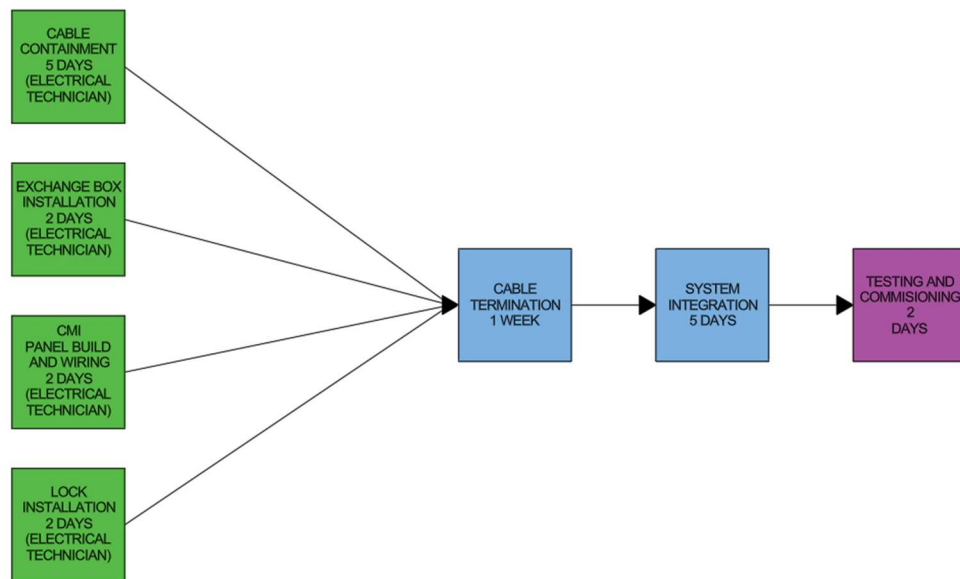


*Figure 5: Construction Phase Critical Path Analysis*

Figure 6 below demonstrates the critical path analysis for the Project Support throughout the project lifecycle.

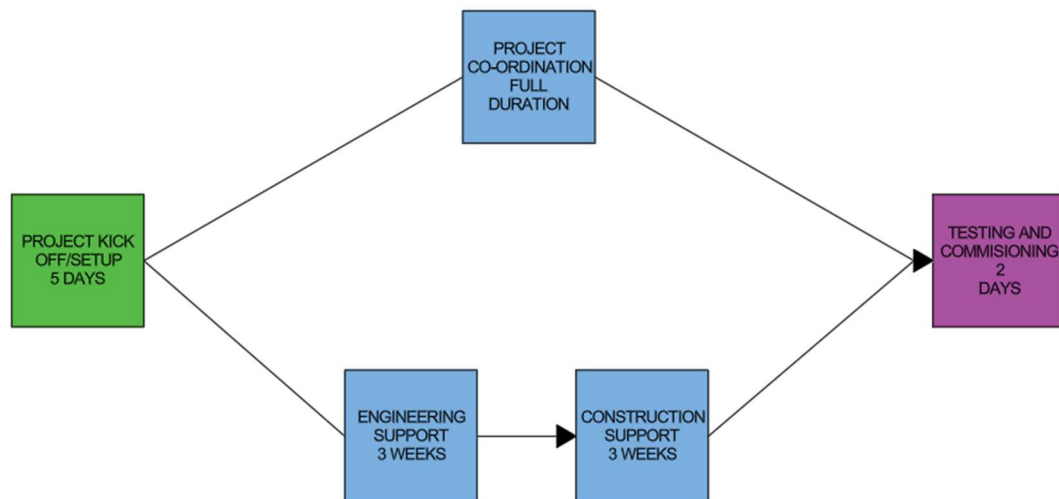


*Figure 6: Project Support Critical Path Analysis.*

## 8. Project Outcomes

### 8.1. **Expected Result:**

The completion of the project will be an operational electronic trapped key system that ensures a high level of safety, co-operation with the HSE, and adherence to all relevant standards. The outcome could be compared to industrial applications already in use, such as the Castell Trapped key interlock systems, which are shown below. Where castell utilises mechanical systems, this project focuses on a modern, electronic version.



Figure 7: Castell Key Exchange box (Ikon Website) [5]



Figure 8: Castell Key systems (Pneutrol Website) [6]

## 8.2. Project Deliverables:

Table III below provides a list of design deliverables and documents that will be issued during the Engineering phase of the project to allow for straightforward construction.

**Table III: List of Deliverables**

| Document Number   | Document Title                          |
|-------------------|-----------------------------------------|
| UWTSD-EEL-BLD-001 | Electrical Block Diagram                |
| UWTSD-EEL-SLD-001 | Electrical Single Line Diagram          |
| UWTSD-EEL-BOM-001 | Bill of Materials                       |
| UWTSD-EEL-CSC-001 | Electrical Cable Schedule               |
| UWTSD-EEL-SOW-001 | Scope of Work                           |
| UWTSD-EEL-GAD-001 | Transformer General Arrangement         |
| UWTSD-EEL-GAD-002 | Interlocking System General Arrangement |

Examples of the design deliverables produced for this project are shown in Figures 9 and 10 below.

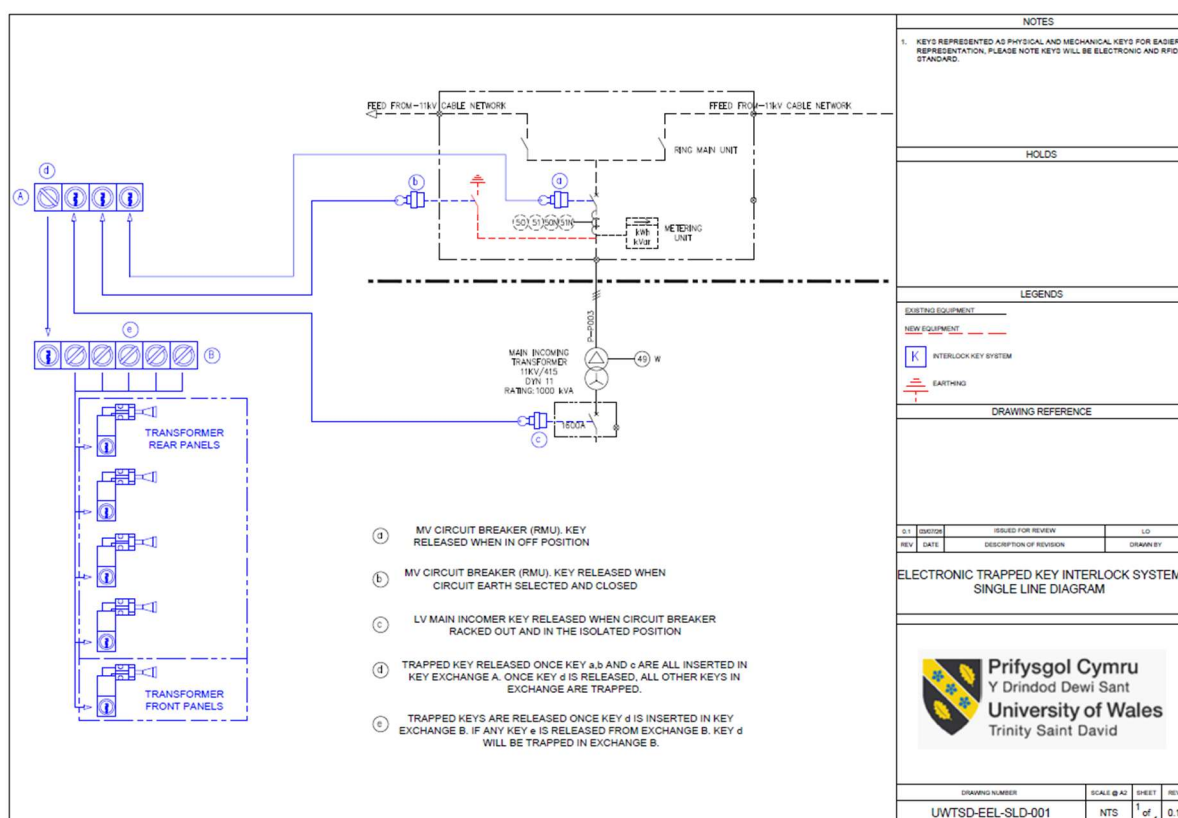


**Figure 9: PDF Print of UWTSD-EEL-SLD-001**

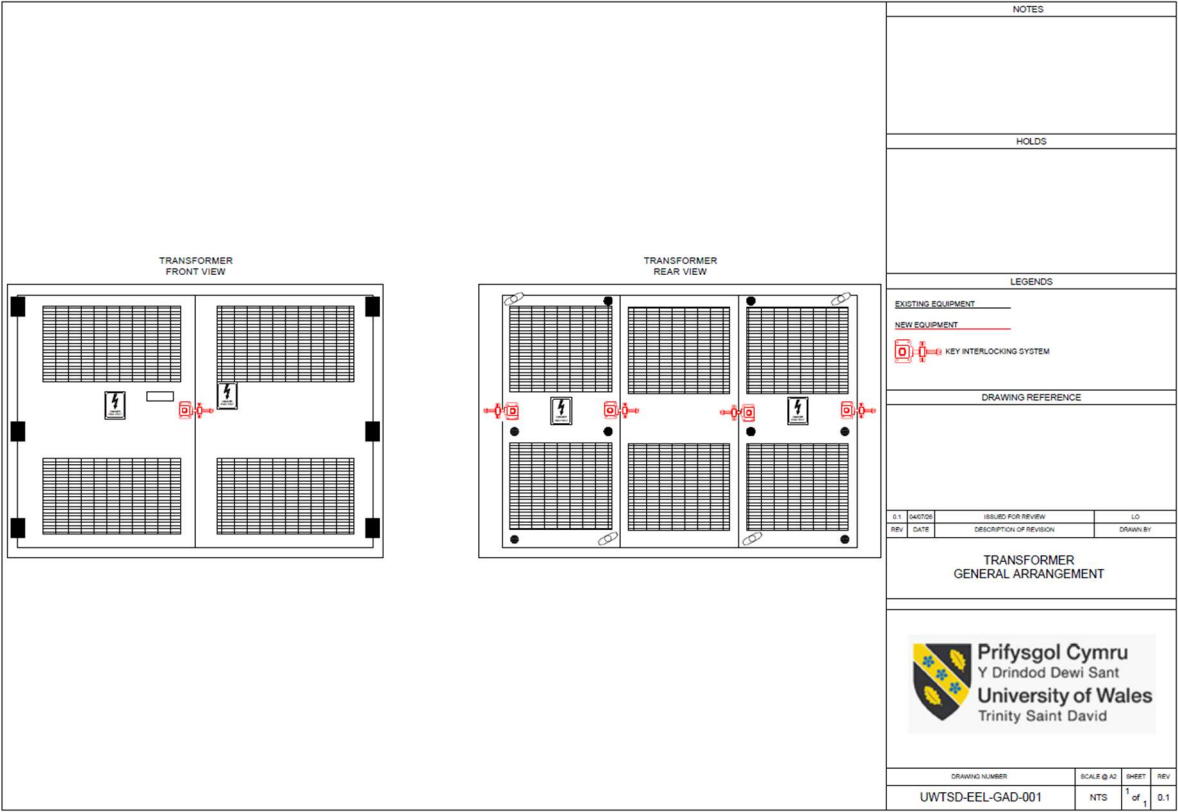


Figure 10: PDF Print of UWTSD-EEL-GAD-001

### 8.3. Project Milestones:

The project milestones outline the major checkpoints that complete the project from early preparations to installation and final commissioning. Providing a clear workflow for the project progression. Figure 11 below clearly illustrates the project milestones.

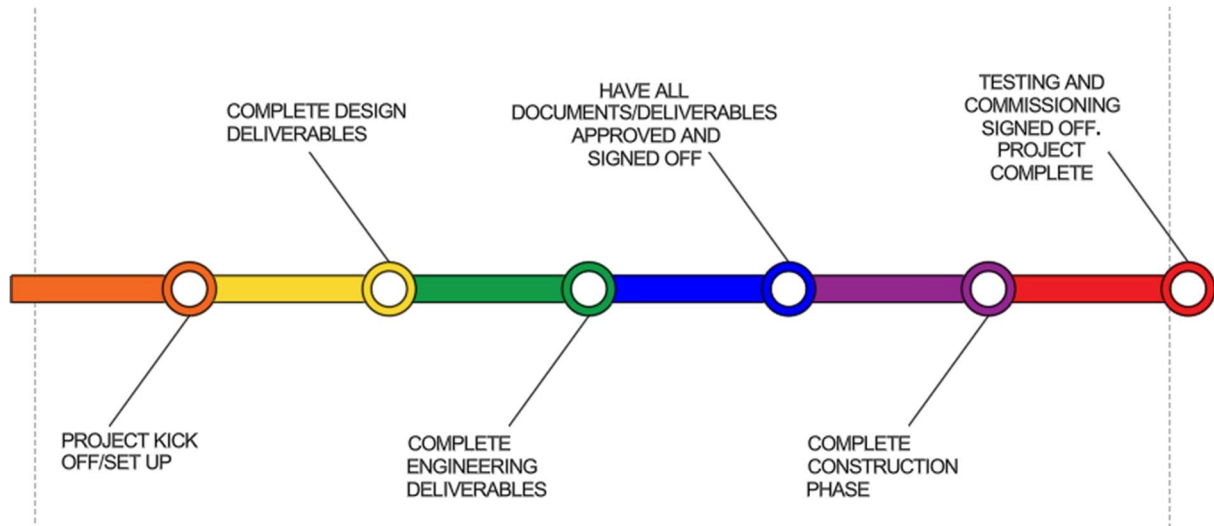


Figure 11: Illustration for Project Milestones

## 9. Risk Identification and Control

### 9.1. General:

The implementation of an electronic trapped key interlock system poses several risks that must be considered and controlled throughout its lifecycle. With the installation and configuration phases being completed sequentially, any delays that occur, such as deliveries, site access or extended testing periods. These delays may cause tasks to overlap, affecting the overall timeline and schedule. Integration risks are also present, as integration and commissioning may introduce configuration errors, wiring issues, or incorrect control logic that will require correction. Human factor risks remain significant; industry research on human reliability highlights that mistakes during installation, panel wiring, or lock mounting can lead to equipment damage or noncompliance with safety procedures [7]. Finally, common issues such as staff unavailability may result in reduced capacity and schedule slippage. Figure 12 below demonstrates a Project Risk Matrix.

| Risk Matrix |                | Severity              |                      |          |                                        |                                     |
|-------------|----------------|-----------------------|----------------------|----------|----------------------------------------|-------------------------------------|
|             |                | Insignificant         | Minor                | Moderate | Major                                  | Severe                              |
| Likelihood  | Almost Certain |                       |                      |          |                                        |                                     |
|             | Likely         |                       | Project Delays       |          |                                        |                                     |
|             | Possible       |                       | Staff Unavailability |          | Configuration/Integration Errors       |                                     |
|             | Unlikely       | AutoCAD/Design Errors |                      |          | Installation Errors - Equipment Damage | Human Mistakes/Engineering Mistakes |
|             | Rare           |                       |                      |          |                                        |                                     |

Figure 12: Project Risk Matrix

For the project, an HSE Risk Assessment template may also be used before and during the project [8]. Figure 13 shows the risk assessment below.



Health and Safety Executive

### Risk assessment template

Company name:

Assessment carried out by:

Date of next review:

Date assessment was carried out:

| What are the hazards? | Who might be harmed and how? | What are you already doing to control the risks? | What further action do you need to take to control the risks? | Who needs to carry out the action? | When is the action needed by? | Done                 |
|-----------------------|------------------------------|--------------------------------------------------|---------------------------------------------------------------|------------------------------------|-------------------------------|----------------------|
| <input type="text"/>  | <input type="text"/>         | <input type="text"/>                             | <input type="text"/>                                          | <input type="text"/>               | <input type="text"/>          | <input type="text"/> |
| <input type="text"/>  | <input type="text"/>         | <input type="text"/>                             | <input type="text"/>                                          | <input type="text"/>               | <input type="text"/>          | <input type="text"/> |
| <input type="text"/>  | <input type="text"/>         | <input type="text"/>                             | <input type="text"/>                                          | <input type="text"/>               | <input type="text"/>          | <input type="text"/> |
| <input type="text"/>  | <input type="text"/>         | <input type="text"/>                             | <input type="text"/>                                          | <input type="text"/>               | <input type="text"/>          | <input type="text"/> |
| <input type="text"/>  | <input type="text"/>         | <input type="text"/>                             | <input type="text"/>                                          | <input type="text"/>               | <input type="text"/>          | <input type="text"/> |
| <input type="text"/>  | <input type="text"/>         | <input type="text"/>                             | <input type="text"/>                                          | <input type="text"/>               | <input type="text"/>          | <input type="text"/> |

More information on managing risk: [www.hse.gov.uk/simple-health-safety/risk/](http://www.hse.gov.uk/simple-health-safety/risk/)

Published by the Health and Safety Executive 10/19

Figure 13: HSE Risk Assessment Template [8]

**9.2. Quality Assurance and Control:**

To ensure the documentation and deliverables are produced to a high standard of quality. With the possibility of mistakes minimised, a thorough checking and approval process is in place. For this, a technical document checklist has been implemented for the project and will be used and signed by the creator, checker, and approver. The checklist being used can be found in Appendix C.

**9.3. Testing and Commissioning:**

To ensure quality, reliability, and safety of the system being installed, all functionality and safety tests must be completed before the interlocks are energised or installed ready for use. These tests involve verifying wiring, lock behaviour, and checking control logic. These tests are vital to rectify any issues that could cause equipment damage, unauthorised access, or non-compliance with standards and requirements. Following initial tests, the system will be tested a second time under operating loads and normal conditions to ensure it works together and performs consistently whilst maintaining proper safety integrity.

**9.4. Project Leeway/Allowances:**

The allowance for slack within a project and controlled allowances within activities provide a structured buffer against uncertain risks and delays. With a sequential scheduling, these allowances serve as protection against deviations that could severely impact the project.

**9.5. Contractors:**

Contractors are not scheduled to work on the project. Any additional resource requirements must be fulfilled strictly through internal employees and personnel. Under no circumstances should external contractors be engaged unless a severe and impactful issue arises. The use of an external contractor will require explicit authorisation from the Director(s) and the Engineering Manager.

## **9.6. Compliance with Standards:**

The installation of the Electronic Trapped Key Interlock system should comply with the following standards:

- BS 7671:2018 – Requirements for Electrical Installations. [2]
- Electricity at Work Regulations 1989 [3]
- BS EN 60204-1 - Safety of machinery and control panels [9]
- BS EN ISO 13849-1 – Functional safety of control systems [10]
- BS EN 61010-1 – Safety Requirements for electrical equipment used for testing and measurement [11]
- ISO 9001 – Quality Management Systems [12]

## **10. Environmental and Societal Impact**

### **10.1. Environmental:**

The installation of the Electronic trapped key interlock system is environmentally positive, as it aims to reduce equipment misuse and unexpected shutdowns and operate in an energy-efficient state. Improved equipment safety ensures that operations occur only under correctly interlocked conditions, contributing to lower resource consumption and reduced maintenance needs.

### **10.2. Societal:**

This project has a positive societal impact by improving workplace safety, streamlining operations and enhancing staff wellbeing. Reliance on internal resources reinforces the organisation and improves the organisational experience. Temporary disruptions whilst installation takes place are massively outweighed by the long-term benefit of having a modern, safer and reliable system for the industrial environment.

## **11. Ethical Considerations**

### **11.1. General:**

The project introduces several ethical considerations related to safety, responsibility and engineering practices. The safety systems ensure that unauthorised access is minimised and align with engineering ethics, where protection is optimised for individuals. The project also covers ethical transparency by minimising low-quality, unsafe or undocumented interventions. The use of internal personnel rather than external resources promotes ethical stewardship of organisational knowledge and reduces any concerns with competency. Overall, the project strengthens ethical responsibility by prioritising safety, competence, and accountability throughout its lifecycle.

## **12. Conclusion**

In Conclusion, the project proposal is expected to strengthen safety systems and accessibility controls and enhance on-site reliability. By installing high-quality interlocking mechanisms, complying with relevant engineering standards, and utilising internal expertise, the project delivers consistent, high-quality performance. The focus on safety, integrity, and a well-organised project will determine the project's success and the value of the new system.

## **References**

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[12] Quality Management Systems – Requirements, **ISO 9001:2015**, International Organization for Standardization, Geneva, 2015. (Accessed 05/07/2026)

## Appendix A – Equality, Diversity and Inclusion Certificate



Prifysgol Cymru  
Y Drindod Dewi Sant  
University of Wales  
Trinity Saint David

This is to certify that  
**Luke O'Sullivan**  
successfully completed the  
**Equality & Diversity Briefing**  
course with a score of  
**100%**  
on  
**10th June 2026**



## Appendix B– PREVENT Certificate



# AN INTRODUCTION TO THE PREVENT DUTY AS IT AFFECTS HIGHER EDUCATION

## CERTIFICATE OF COMPLETION

THIS ACKNOWLEDGES THAT

Name: Luke O'Sullivan

HAS SUCESSFULLY COMPLETED THE INTRODUCTION TO PREVENT E-LEARNING

Date: 10/06/2026

## Appendix C– Issued Documents Checklist

| CHECKLIST FOR ISSUED DOCUMENTS                                                                                                                                                         |                                                                                    |                          |                          |                          |                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| PROJECT NUMBER:                                                                                                                                                                        |                                                                                    |                          |                          |                          |                          |
| PROJECT TITLE:                                                                                                                                                                         |                                                                                    |                          |                          |                          |                          |
| TRANSMITTAL NUMBER:                                                                                                                                                                    |                                                                                    |                          |                          |                          |                          |
| DOCUMENT(S):                                                                                                                                                                           |                                                                                    |                          |                          |                          |                          |
|  <b>Prifysgol Cymru</b><br>Y Drindod Dewi Sant<br><b>University of Wales</b><br>Trinity Saint David |                                                                                    |                          |                          |                          |                          |
| No.                                                                                                                                                                                    | ITEM                                                                               | CREATOR                  | CHECKER                  | APPROVER                 | DOC CTRL                 |
| 1                                                                                                                                                                                      | CONTENTS OF TRANSMITTAL SHEET ARE SAME/ALIGNED WITH CONTENTS OF TRANSMITTAL FOLDER | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2                                                                                                                                                                                      | ALL APPROPRIATE ATTACHMENTS INCLUDED IN TRANSMITTAL FOLDER                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3                                                                                                                                                                                      | ACCOMPANIED WITH DOCUMENT SPECIFIC CHECKLIST                                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4                                                                                                                                                                                      | ACCOMPANIED WITH CHECKPRINT(S)                                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5                                                                                                                                                                                      | CONFIRM IF SINGLE DELIVERABLE OR PART OF PACK (3)                                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6                                                                                                                                                                                      | CORRECT TEMPLATE/BORDER                                                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7                                                                                                                                                                                      | CORRECT CLIENT LOGO / NAME                                                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8                                                                                                                                                                                      | <a href="#">CORRECT LOGO</a>                                                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9                                                                                                                                                                                      | CLIENT PROJECT NUMBER                                                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10                                                                                                                                                                                     | INDITE PROJECT NUMBER (IF APPLICABLE)                                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11                                                                                                                                                                                     | PROJECT TITLE                                                                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12                                                                                                                                                                                     | DOCUMENT TITLE                                                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13                                                                                                                                                                                     | DOCUMENT NUMBER(S) MATCH SD/MDI                                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14                                                                                                                                                                                     | DOCUMENT REVISION MATCHED MDI STATUS                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15                                                                                                                                                                                     | DOCUMENT REVISION MATCHED CLIENT REQUIREMENTS (4)                                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16                                                                                                                                                                                     | IS THE DATE OF ISSUE PRESENT ON DOCUMENT(S)                                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17                                                                                                                                                                                     | REVISION STATUS PRESENT IN REVISION BOX ON FRONT PAGE                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18                                                                                                                                                                                     | DETAILS OF REVISION INCLUDED ON RE-ISSUED DELIVERABLES                             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19                                                                                                                                                                                     | COMMENT SHEET ATTACHED WITH RESPONSES (1)                                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20                                                                                                                                                                                     | OTHER DISCIPLINE TO SIGN                                                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21                                                                                                                                                                                     | CREATOR SIGNED                                                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 22                                                                                                                                                                                     | CHECKER SIGNED (CHECKER MUST BE APPROPRIATE DISCIPLINE)                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 23                                                                                                                                                                                     | APPROVER SIGNED                                                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 24                                                                                                                                                                                     | APPROVER AUTHORISED TO SIGN                                                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 25                                                                                                                                                                                     | INITIALS ADDED TO NATIVE FILE AND PDFS SAVED                                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 26                                                                                                                                                                                     | IFC & IFI NATIVES SAVED IN TRANSMITTAL FOLDER                                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 27                                                                                                                                                                                     | TRANSMITTAL SENT                                                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 28                                                                                                                                                                                     | TRANSMITTAL SENT TO CLIENT DOCUMENT CONTROL ADDRESS                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 29                                                                                                                                                                                     | TRANSMITTAL COPIED TO RELEVANT OTHER RECIPIENTS                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 30                                                                                                                                                                                     | MASTER DOCUMENT INDEX UPDATED                                                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 31                                                                                                                                                                                     | CLIENT COMMENTS INCORPORATED (1)                                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 32                                                                                                                                                                                     | COMMENTS ON MASTER COPY INCORPORATED                                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 33                                                                                                                                                                                     | TECHNICAL CONTENT AND QUALITY CHECKED (2)                                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 34                                                                                                                                                                                     | NOTES AND HOLDS CLEAR AND APPROPRIATE FOR THAT REV                                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 35                                                                                                                                                                                     | SPELLING AND GRAMMAR CHECKED                                                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 36                                                                                                                                                                                     | MASTER DOCUMENT FILE UPDATED, INCLUDING REV AND WIP FOLDERS                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 37                                                                                                                                                                                     | IF DOCUMENT(S) ARE AN ADDITIONAL UNPLANNED REVISION PLEASE SELECT CHANGE TYPE (4)  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Comments:                                                                                                                                                                              |                                                                                    |                          |                          |                          |                          |
|                                                                                                                                                                                        |                                                                                    |                          |                          |                          |                          |
| PROJECT ENGR / PM AUTHORISE TO ISSUE (5)                                                                                                                                               |                                                                                    | CREATOR                  | CHECKER                  | APPROVER                 | DOC CTRL                 |
| Digital Signature:                                                                                                                                                                     |                                                                                    | <input type="text"/>     | <input type="text"/>     | <input type="text"/>     | <input type="text"/>     |

## **Appendix D– Cost Benefit Analysis**

| <b>Category</b>                    | <b>Description</b>                              | <b>Estimated Cost (£)</b> | <b>Estimated Benefit</b>                                          |
|------------------------------------|-------------------------------------------------|---------------------------|-------------------------------------------------------------------|
| System Hardware Procurement        | Locks, Exchange boxes, wiring, Components etc   | 3,000-7,000               | £15,000-30,000 saved – Lifecycle and safety improvements          |
| Installation/Testing Commissioning | Wiring, mounting, configuration, testing.       | 4,000-10,000              | £10,000-£25,000 saved – reduction in corrective work and downtime |
| Training                           | Staff training on new operations and procedures | 500-1,500                 | £5,000-12,000 Reduction in human error                            |
| Project Management                 | Co-ordination, documentation, QA/QC             | 1,000-3,000               | High-quality Project and Traceability                             |
| Operational downtime               | Temporary disruptions during installation       | 1,000-2,500               | Improved safety in the long term                                  |
| Long-term maintenance reduction    | Avoidable Maintenance                           | 300-800 Annually          | Thousands saved in avoided misuse and potential safety incidents. |