

Case Study: Electrical Design and Control System for Water Treatment Plant

Project Objective

The primary objective of this project was to design and implement a comprehensive electrical control system for a water treatment plant. The project aimed to enhance system reliability and operational efficiency through meticulous control circuit design, component selection, PLC Logic development, HMI development, and robust documentation.

Scope of Work

System Design and Development

Development of Control Circuit and Panel Layout Drawings

Creation of detailed schematic diagrams and three-dimensional models of control circuits and panel layouts.

Component Selection

Selection of appropriate components and design circuits using a predefined database based on specific job specifications.

PLC Logic Development

Development of new PLC logic or utilization of existing subroutines from the server to ensure effective control of the water treatment processes.

HMI Development

Design and implementation of Human-Machine Interface (HMI) screens and alarm systems for data logging and user interaction, tailored to customer requirements.

Documentation and Support

Providing comprehensive documentation, including schematics, panel layouts, and operational guides, to support both the implementation and ongoing maintenance of the control system.

Design and Engineering Process

Initial Assessment and Requirement Gathering

- **Load Protection and Component Selection:** Calculating load requirements and selecting appropriate switchgear and PLC components.

- **PLC BOM and Network Configuration:** Drafting network configuration drawings for PLCs and creating multiline and panel layout drawings according to standards.
- **BOM Reports:** Generating individual BOM reports for each control panel, including provisions for updates and replacements.
- **Interface and Data Exchange:** Estimating and documenting interfacing signals and handshaking requirements between SCADA systems and control stations.

Detailed Design

- **Single Line Diagrams (SLD) Creation:** Developing SLDs for each machine and master control panel.
- **PLC Logic and HMI Development:** Programming PLC logic and developing HMI screens in an offline environment. Creating cable layout and terminal layout drawings.
- **Multiline and Panel Layout Drawings:** Developing drawings according to NEC standards for clear panel configurations.

Implementation

- **Testing and Support:** Conducting internal testing on PLC blocks and providing remote support for program downloading and installation.
- **On-Site Commissioning:** Providing on-site support during startup, integrating and testing machines, and preparing operational and maintenance guides.
- **Post-Startup Support:** offering remote assistance for adjustments after startup, creating reusable libraries of PLC logic, and drawing macros for future projects.

Results and Outcomes

Deliverables

Enhanced Efficiency

The project delivered a well-organized control system, resulting in improved operational efficiency and reliability of the water treatment process.

Improved Accuracy

Precise 2D and 3D drawings, along with detailed PLC and HMI configurations, reduced errors and optimized system performance.

Comprehensive Documentation

Thorough documentation and post-startup support ensured that plant operators were well-informed and capable of managing the system effectively, minimizing downtime.

Business Benefits

Cost-Effectiveness

Leveraged predefined component databases and reusable libraries to reduce costs associated with component selection and system programming.

Seamless Integration

The structured approach to data exchange and interface signals enabled smooth integration with existing plant control systems and third-party servers.

Conclusion

Overall, this project successfully provided a robust and efficient electrical design and control system, delivering significant business benefits, including enhanced operational efficiency, cost savings, and comprehensive support for future maintenance and scalability.