Central Iowa Power Cooperative

Power Plant – Relay Replacement

ISU Senior Design Group: Dec15-22

By Dan Dye

CONTENTS:

LIST OF FIGURES:

PROBLEM STATEMENT

There are three main parts to this project. First, Due to age and condition of existing power plant electro-mechanical relay equipment will be retired and new microprocessor based relaying equipment will be installed. The senior design project will be responsible for the complete design of the relay replacement which includes all required schematics and wiring diagrams.

Second, the senior design project will complete arc flash calculations and analysis for the existing metal clad switch gear. Metal clad switch gear has be know in the industry to have a high potential for arc flash issues and determining the potential of these issues allows the operator to be aware of the potential and use the proper amount of precaution and personal protective equipment.

Third, the senior design project will provide engineering solutions to operate the switch gear safely. By researching alternative and analysis of the potential of arc flash, engineering solutions shall be provided to advise in choosing the proper safety precautions during operations.

GOALS

The goal of this project is to produce a 100% complete:

- For-construction drawing set to complete the replace of four power plant electromechanical relays with microprocessor based SEL relays.
- Arc flash calculations and analysis for the existing metal clad switch gear.
- Two engineering solutions to operate the switch gear safely.

All goals are to be completed on time, under budget, and with emphasis on CIPCO cultural priorities of safety, reliability, and compliance.

PROJECT SCOPE

RELAY REPLACEMENT

This primary goal of this project is to replace four power plant electromechanical relays with microprocessor based SEL relays. A full set of for-construction drawings will be completed showing the remove and addition of equipment and wiring, including communication equipment. The drawings will be completed using existing drawings while following CIPCO drafting standards and design templates. Relay functions for this situation will be identified and described.

ARC FLASH CALULATIONS AND ANALYSIS

The second part of this project is to complete arc flash calculations and analysis. These will be used to show the potential of an arc flash on metal clad switch gears which are controlled by the relay equipment that will be replaced.

SAFE OPERATION OF METAL CLAD SWITCH GEAR

Metal clad switch gear have an industry history of arc flash safety problems during operation. The third part of this project will be to identify two engineering solutions to operate the metal clad switch gear and relay equipment safely. Cost estimates and benefits of both solutions will be reviewed.

EXCLUDED FROM PROJECT

DESIGN SIMULATION AND TESTING

While all due diligence will be given during the design of this project, simulation and testing will not be completed as the part of this project. Verification of design documentation will be completed during design review meetings with CIPCO.

RELAY SETTINGS

Relay settings will not be included as part of the relay replacement. Identification of suggested relay functions will be included.

RELAY TESTING

Microprocessor based relays require very precise testing due to the amount of features and internal programming. Relay tests or system check out procedure will not be provided as part of this senior design project.

PROJECT REQUIREMENTS

The following list of requirements were established with CIPCO and accordance with CIPCO document “Project Scope” included under section design documents. The template for the CIPCO Project Scope was provided by CIPCO.

SPRING SEMESTER 2015 DELIVERABLES

RELAY REPLACMENT DESIGN

- Relay One Line Diagram
- Elementary Diagram / Current Schematic
- Control Schematic
- Panel Wiring

- Communication Processor Wiring
- Drafting and Review

ARC FLASH CALCUATION

- Calculation per IEEE

SAFE OPERATION OF METAL CLAD SWITCH GEAR

- Research and identify two possible engineering solutions
- Pros and Cons of both solutions

FALL SEMESTER 2015 DELIVERABLES

RELAY REPLACEMENT DESIGN

- For construction package
- Relay functions
- S.C.A.D.A. and relay communication

ARC FLASH ANALYSIS

- Calculation Analysis
- Compliance Regulations

SAFETY OPERATION SOLUTIONS

- Compliance regulation
- Cost Estimates
- Operation Guides

ASSUMPTIONS OF THIS PROPOSAL (not complete)

Relay Replacement

Arc Flash

Safety Operation

VALIDATION & ACCEPTANCE TEST

During the design process all drawings, calculations, and solutions will be reviewed by CIPCO engineering for accuracy and correct implantation. Design documentation will be revised per CIPCO feedback and revised until the documentation is correct per CIPCO standards and expectations and ready for implementation.

DESIGN CONSTRAINTS (not complete)

OPERATING ENVIRONMENT

The operating environment is will be considered for each part of the project due to the harsher power plant environment.

COMPLIANCE

(List of standards to adhered to)

STANDARDS

(List of standards to adhered to)

TECHNICAL APPROACH (not complete)

PROCESS DETAILS (not complete)

SOFT WARE REQUIRMENT

AutoCAD software will be used to alter existing .dwg files for this design following CIPCO templates and standards.

PROJECT SCHEDULE

Power Plant - Relay Replacement

Iowa State EE Senior Design - December 2015

Group: Dec15-22

Dan Dye

Key Activities	Weeks - Spring 2015														
Spring	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Develop Project Scope															
Develop Project Plan															
Develop Man-hour Budget															
Gantt Chart															
Design Relay One Line Diagram															
Design Elementary Diagram / Current Schematic															
Design Control Schematic															
Design Panel Wiring															
Design Communication processor Wiring															
Design Review															
Arc Flash Calculation															
Arc Flash Design Review															
Safe Operation Engineering Solutions															
Safe Operation Engineering Solutions Design Review															
Compleation of Project Report															
Presentation Practice / Presentation															

Key Activities	Weeks - Spring 2015														
Fall	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Relay Replacement Deisgn Construction Package															
Relay Replacement Deisgn Function															
Arc Flash Calcuation Analysis															
Arc Flash Calcuation Compliance Regulations															
Arc Flash Analysis Review															
Safety Operation Solutions Compliance Regulations															
Safety Operation Solutions Cost Estimates															
Safety Operation Solutions Operation Guild															
Safety Operation Review															
Compleation of Final Project Report															
Design of Project Poster															
Presentation Practice															
Presentation															

TABLE 1: PROJECT SCHEDULE GANTT CHART

RISK (not complete)

RISK ITEMS

RISK TO THE PROJECT TIMELINE

PLANNING FOR RISK

COST CONDSIDERATION (not complete)

CONCLUSION (not complete)