

User Needs and Requirements

Derek Elkins, Patrick Musoy, Mackenzie Ray,
Nathan Tegeler, Matthew Wells

Client: Burns and McDonnell
Advisor: Hugo Villegas
Team: SDDec-24-02





What is a substation?

A substation acts as a middleman in the electricity supply chain.

It takes voltage from one level to another.

- Step up - low to high
- Step down - high to low

A Bus is system of uninsulated conductors that carry electricity from one point to another



Project Overview-Ames Substation

- Our main goal is to tap in a 69kV, 2 MW solar farm into an existing substation
- This station already has 3 input lines, the solar farm would make four
- Each lines requires a different pilot/relaying (communication of system) scheme based on its specific needs and standards
- Must design a bus configuration system that will implement the new line with a high level of reliability and a relatively low level of complexity to make both designing and maintenance easier
- End goal is to have a dynamic simulation with an event analysis report

User Needs

- The average American
 - Most jobs nowadays require electricity in some way
 - Heating and air conditioning
- The atypical American
 - Appreciates the new solar farm because it promotes clean energy initiatives
 - Enjoys non industrialized
- Stakeholders/Investors
 - Need all equipment documented
 - Including pricing, lead times, data sheets
 - Want a high level of reliability and redundancy to reduce faults
 - Large faults mean large loss of money





Requirements

- Relaying and bus configuration schematics
- One line drawing
 - Shows all equipment and connections between them
- Elevation drawing
 - Show physical spacing of our bus lines
- Lightning Study
 - Prevent massive shutdown in the event of lightning
- PSCAD simulation
 - Simulate different fault conditions
 - Ensure relays work properly
- AC/DC study (possible)





Engineering Standards



IEEE

- IEEE Requirements
 - C37.91-2021
 - Guide for Protecting Power Transformer
 - C37.119-2016
 - Guide for Breaker Failure Protection
 - C37.234-2021
 - Guide for Protecting Power System Buses
 - C37.113-2015
 - Guide for Protecting Transmission Lines



Conclusions

- People from all different backgrounds require power for countless different reasons
- Stockholders and investors in both the design and construction companies want to keep their product secure
- Without reliable power we could not function

Classification of Electric Power Distribution Network

