



# sdmay19-17: Burns and McDonnell Substation Design

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Client: Burns and McDonnell

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## Problem Statement

Burns & McDonnell has tasked sdmay19-17 with designing a new, 138/69 kilovolt (kV) substation that will not be built, but that could theoretically “be used as an inter-connection for a new wind generation plant near Ames, IA.”

## Overview

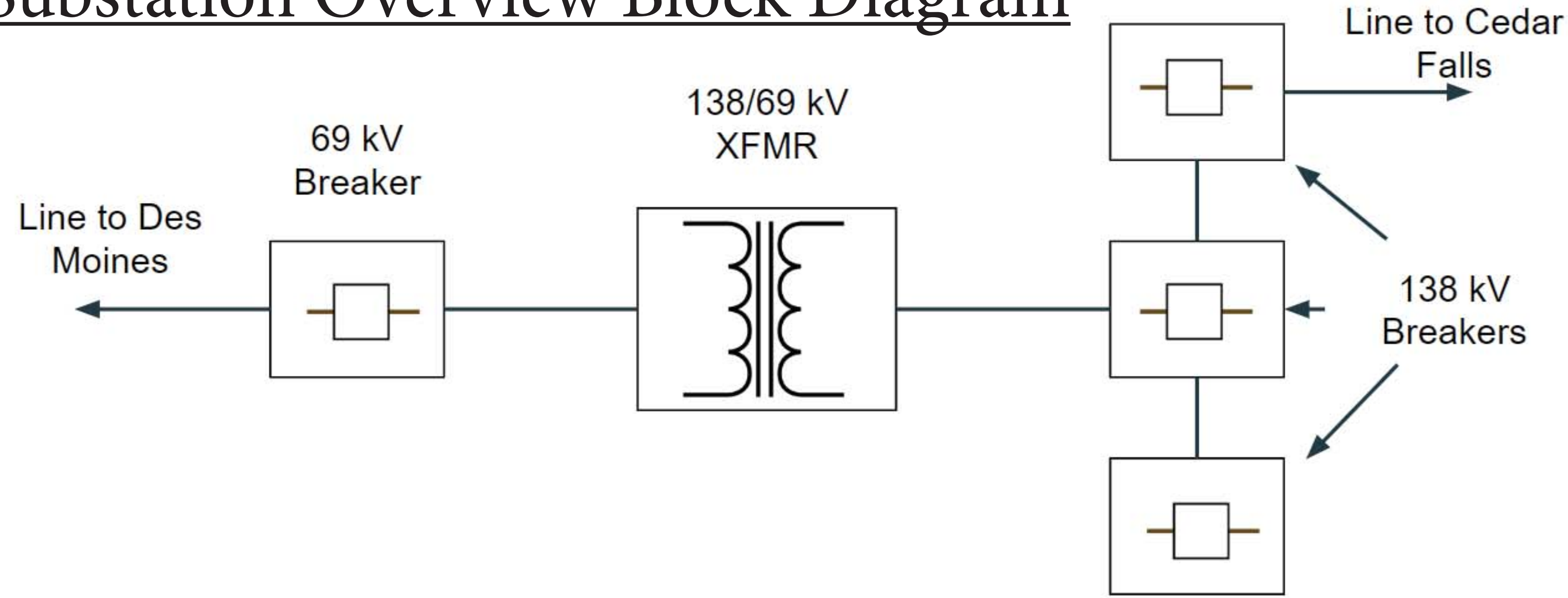
- Three 138 kV Circuit Breakers
- One 69 kV Circuit Breaker
- One 138/69 kV Transformer
- Ring Bus Configuration
- Future “Breaker-and-a-half” Scheme
- Two transmission lines entering/exiting substation
- Grounding System withstand 21 kA Fault Current
- Site Size of 400' x 400'

## Scope

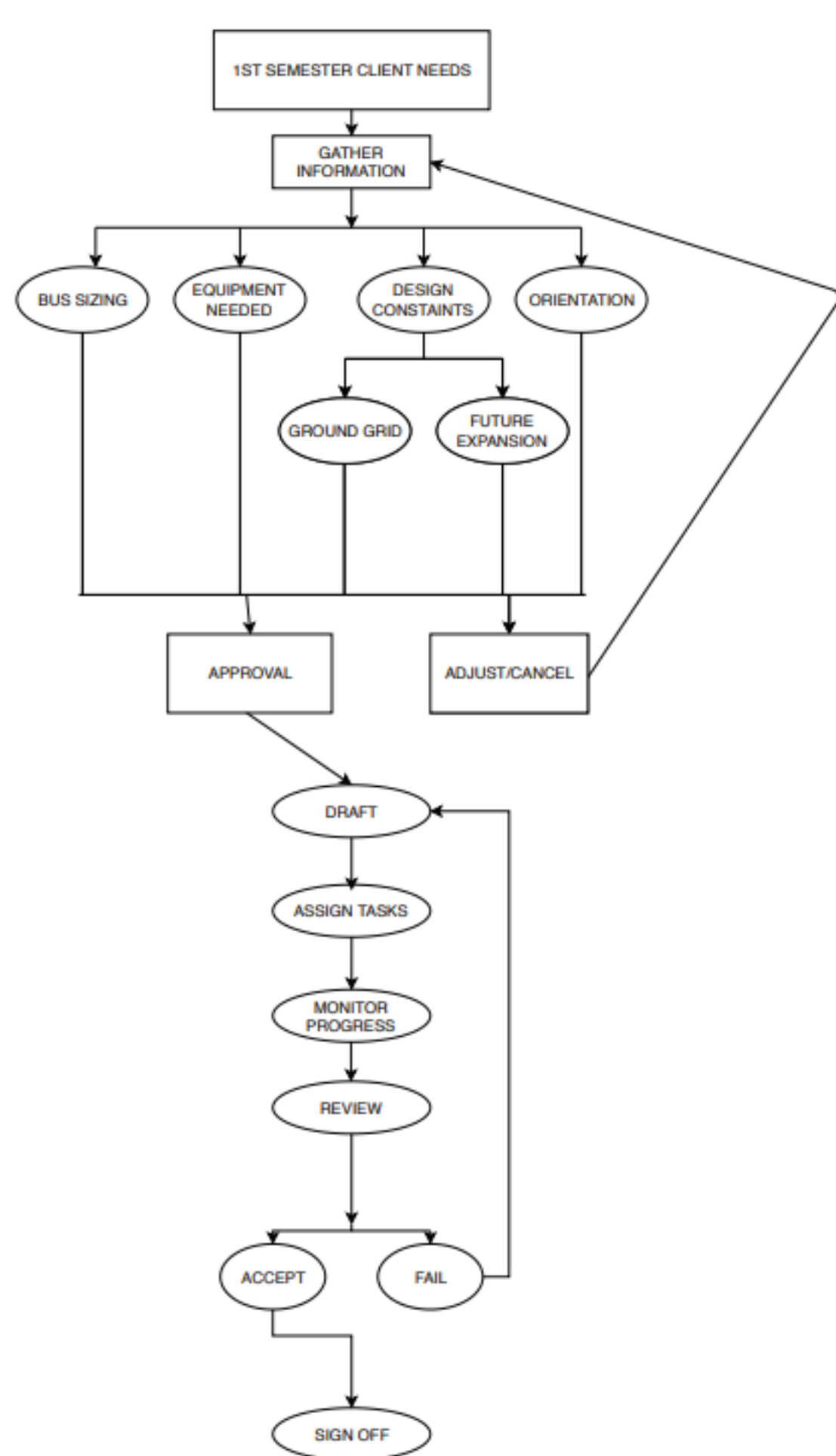
- Site Design
- Ground Grid Design
- Lightning Protection Design
- AC/DC Studies
- One-line Design
- Transformer and Breaker Schematics



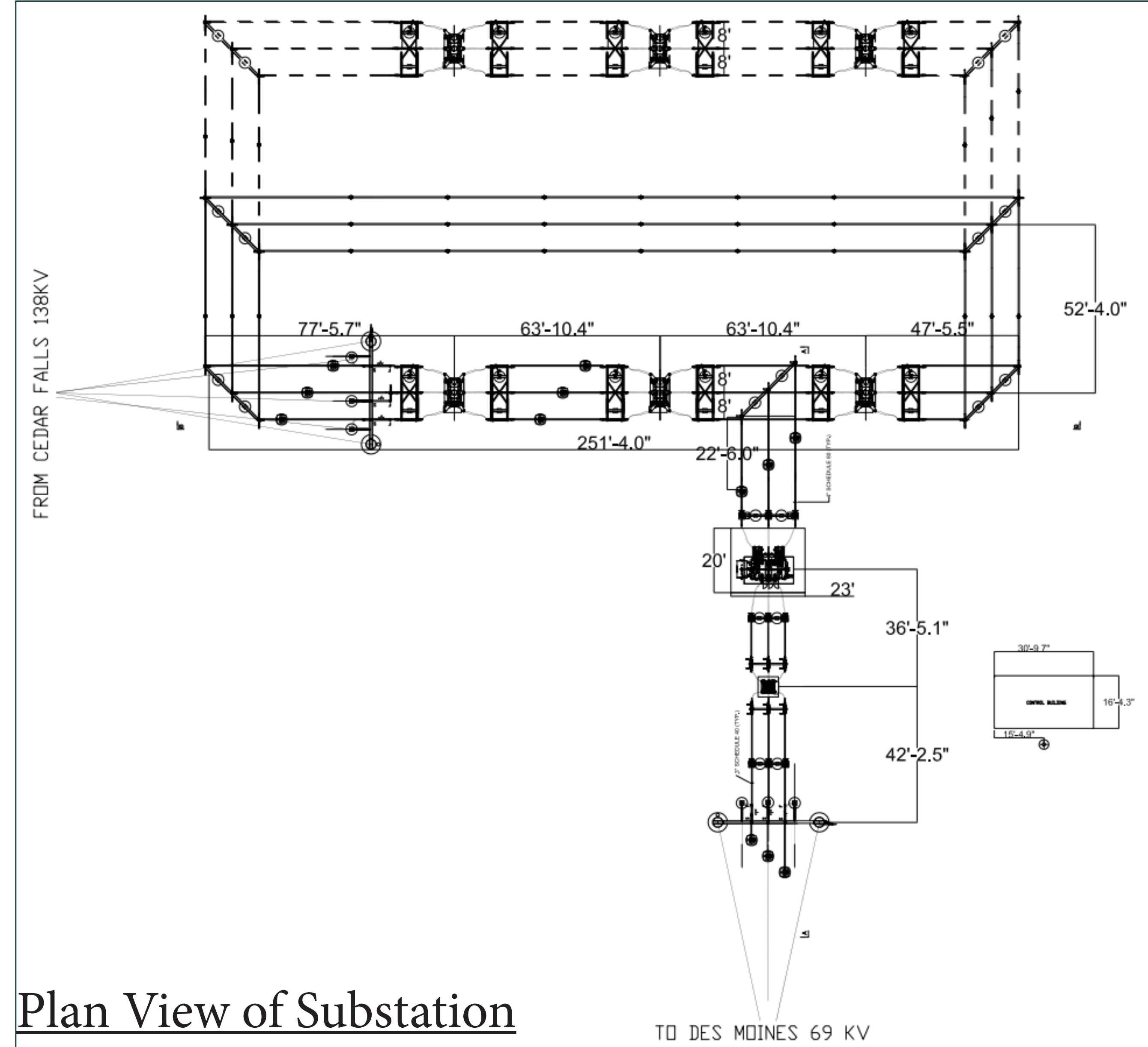
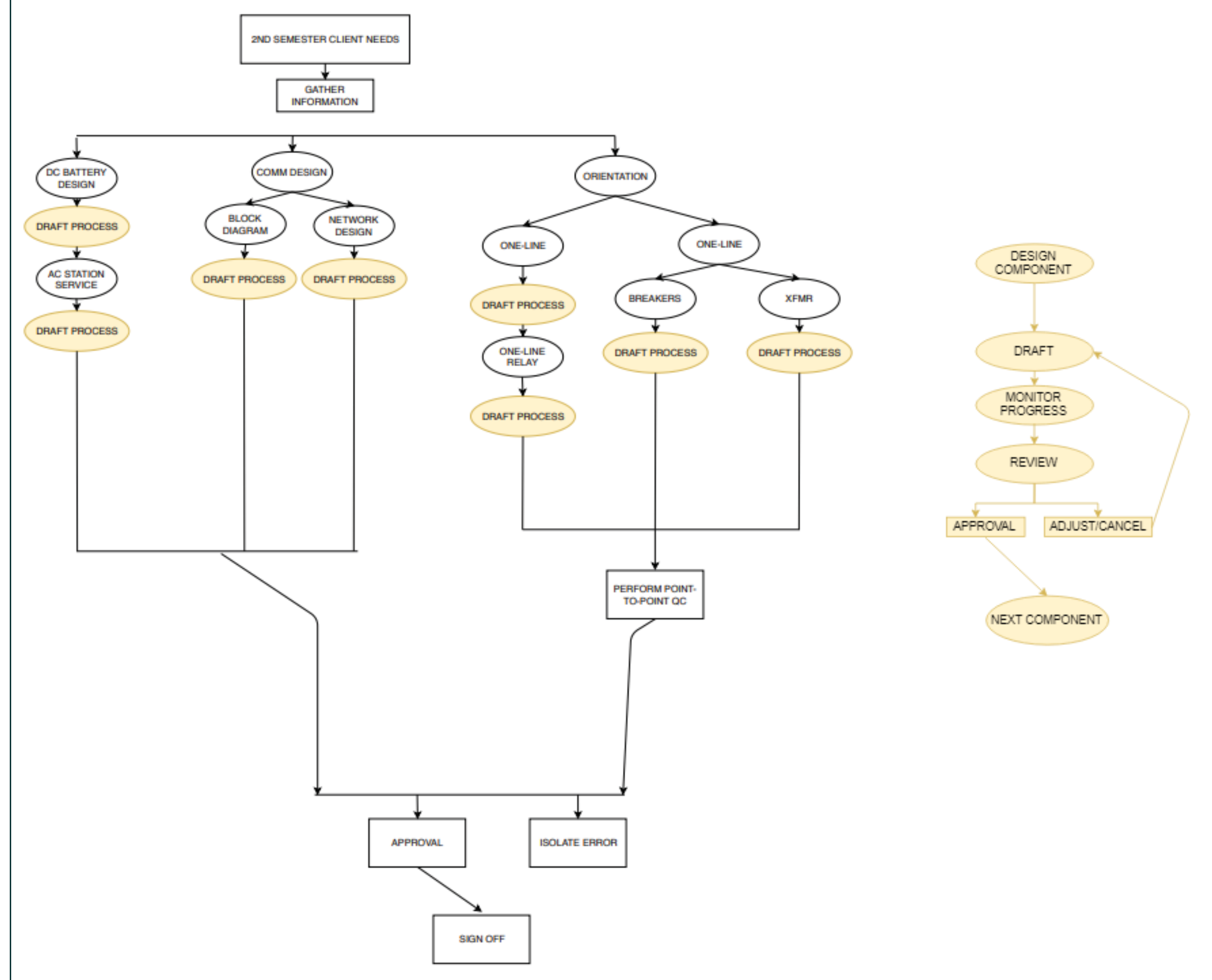
## Substation Overview Block Diagram



## 1st Semester Flow Chart



## 2nd Semester Flow Chart



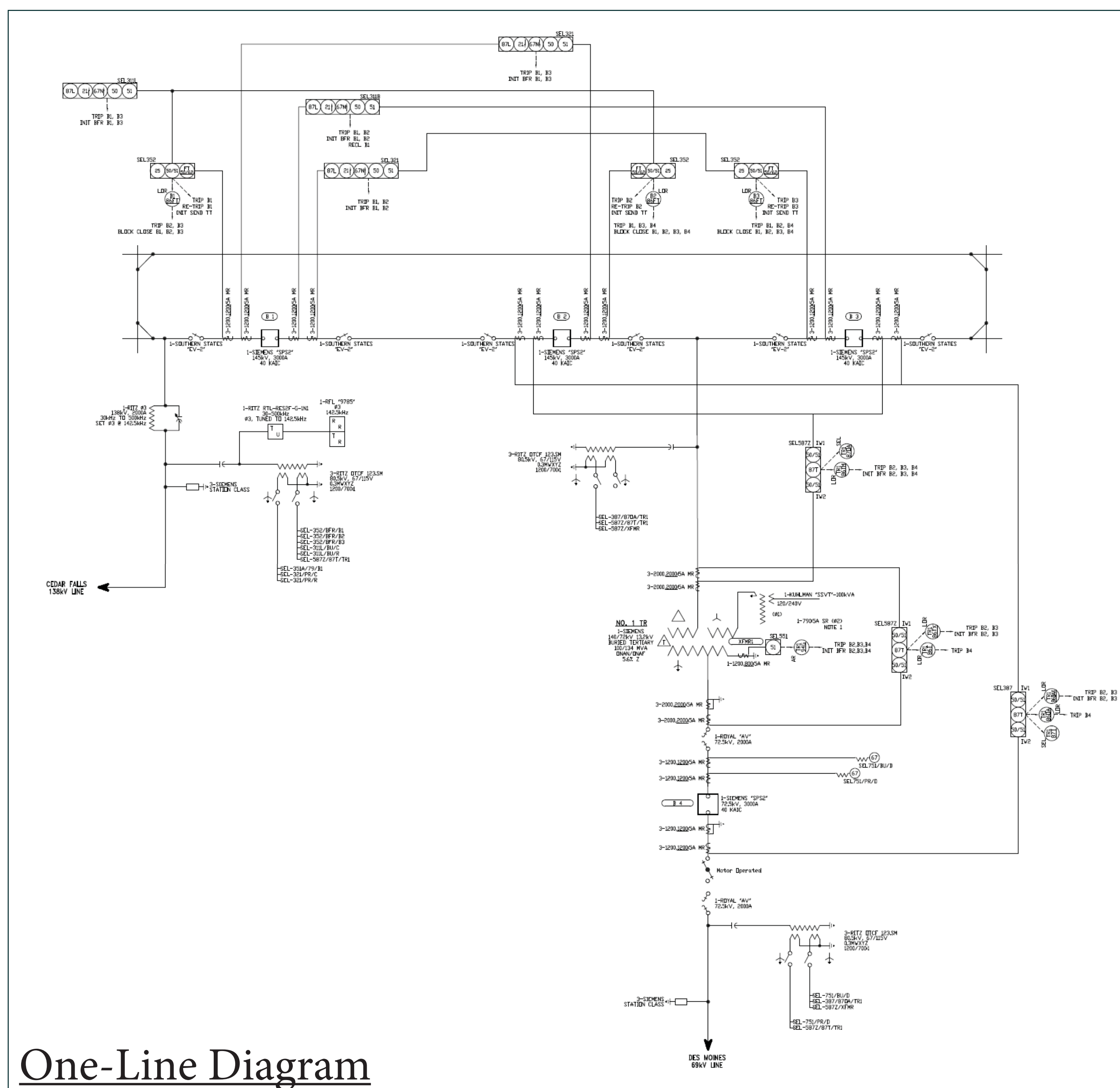
Plan View of Substation

## Standards

- IEEE 80: Guide for Safety in AC Substation Grounding
- IEEE 998: Guide for Direct Lightning Stroke Shielding of Substations
- IEEE 485: Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
- IEEE 484: Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
- IEEE 1188: Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
- IEEE 1184: Guide for Batteries for Uninterruptible Power Supply Systems

## Quality Review Process (Testing)

- Q1 Review: Independent evaluation of completing initial planning and preparation activities, setting study objectives, and/or conceptual design activities. Performed by a peer reviewer or review team
- Q2 Review: Independent evaluation of completing preliminary project activities. Includes written design basis for design projects and study/analysis data for report projects. Performed by a peer reviewer or review team.
- Q3 Review: Final checking of design documents. Performed by designer.
- Q4 Review: Peer review of reports and design documents. Performed by peer reviewer or review team.
- Q5 Review: Review of complete design, procurement, and/or construction packages. Performed by review team.
- Q6 Review: Review of complete design, procurement, and/or construction packages. Performed by Burns and McDonnell engineer.



One-Line Diagram

The Substation Design team would like to thank Grant Herrman, Aber Hamzah, and Brian Obermeier, employees of Burns & McDonnell, for their willingness to oversee this project and for serving the team as technical advisors. The Substation Design team would also like to thank Manimaran Govindarasu, the faculty advisor for this project, for serving the team as a technical and professional advisor.