115/34.5KV SOLAR PLANT & SUBSTATION

BLACK & VEATCH

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Department of Electrical and Computer Engineering

sdmay25-41

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AGENDA

Safety Moment

Project Overview

User Needs

Requirements

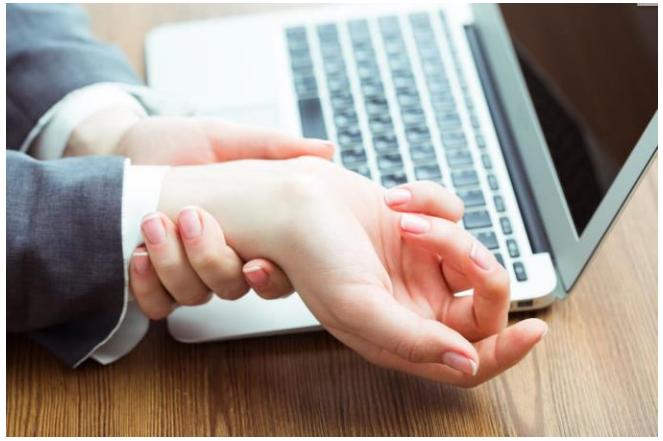
Engineering Standards

Conclusions

SAFETY MOMENT

Office Ergonomics

- Poor ergonomics can lead to varies injuries such as
  - Carpal Tunnel Syndrome
  - Trigger Finger
  - Neck Pain



- These injuries come from repetitive movements or poor posture
- Often overlooked as the office is not considered an unsafe environment
- Prevent these injuries by
  - Maintaining good posture
  - Taking breaks to avoid repetition
  - Utilizing ergonomic equipment (mice, chair, wrist wrest)

PROJECT OVERVIEW

Because of increasing utility renewable energy requirements, Iowa State University has been involved in the development of a 115/34.5kV Distribution Substation and a 60 MW Solar Plant. Our team will manage the whole design process, from the solar layout, electrical layout through all associated construction deliverables. The reliability and safety of the substation will be ensured with critical calculations such as load-flow analysis, short-circuit studies, system protection, and grounding. Our team will then develop an original tool that will be utilized for the optimization of elements of conceptual design. In this process, creative problem-solving is encouraged. Black & Veatch will give the conceptual design information and standards that shall guide our team throughout the project.

USER NEEDS

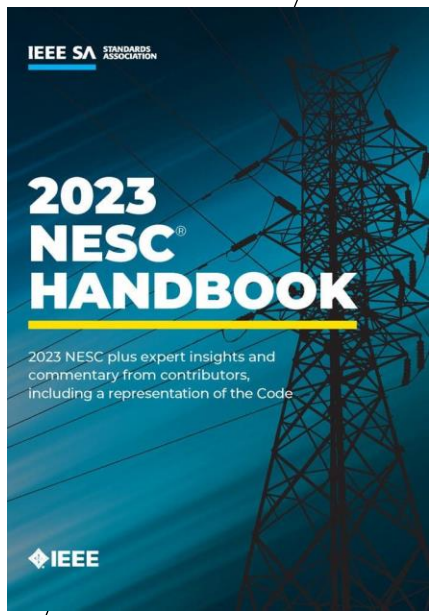
- **Utility Company:**
  - Need a way to generate clean energy because of government standards regarding carbon emissions.
  - Need increased grid reliability
  - Need scalable infrastructure for future expansions
- **Community:**
  - Citizens need power generation to keep the lights on in their homes
  - Need for economic development through job creation
  - Increase of property value in the area
- **Regulatory Authority:**
  - Need compliance with environmental regulations
  - Need adherence to safety standards
  - Reporting and performance documents for local/state guidelines

REQUIREMENTS

- **Technical Requirement:**
  - The substation must handle 115/34.5kV with a capacity to distribute up to 60MW without degradation of power quality
  - ✓ Why? - Ensures robust, uninterrupted service that can scale with demand
- **Safety Requirement:**
  - All components must meet IEEE 1547 and NEC standards for electrical safety and operational reliability
  - ✓ Why? - This is critical to prevent accidents and ensure long-term operational safety
- **Environmental Requirement:**
  - Solar farm must positively contribute to carbon emission reduction efforts and provide source of clean energy
  - ✓ Why? - Ensures conservation of the environment and reduced use of limited traditional fuel resources

ENGINEERING STANDARDS

- **IEEE 1547.3-2023** covers the interconnection of distributed resources like solar arrays with the grid, which also addresses maintaining voltage within acceptable limits during power transfers to and from the grid.
- **IEEE 2778-2020** This guide is primarily concerned with the grounding system design for photovoltaic solar power plants that are utility owned and/or utility scale (5 MW or greater).
- **IEEE 80-2000** Covers grounding and safety in AC substations
- **IEEE 998-1996** Covers lightning strike protection in substations
- **IEEE 525-1987** Covers the design and implementation of cables and wiring in substations
- **IEEE 605-1987** Covers rigid bus structures in substations
- **IEEE 1427-2020** Covers electrical clearances in air insulated substations
- **IEEE 485-1983** Covers sizing for lead acid batteries inside substations



❖ *Our design complies with these standards to ensure safety, reliability, and efficiency, incorporating best practices in electrical engineering*

CONCLUSIONS

Recap

Fulfilled Needs:

- Our project successfully recognizes and addresses the comprehensive needs of users, fulfilling technical, safety, and environmental requirements

Community Benefits:

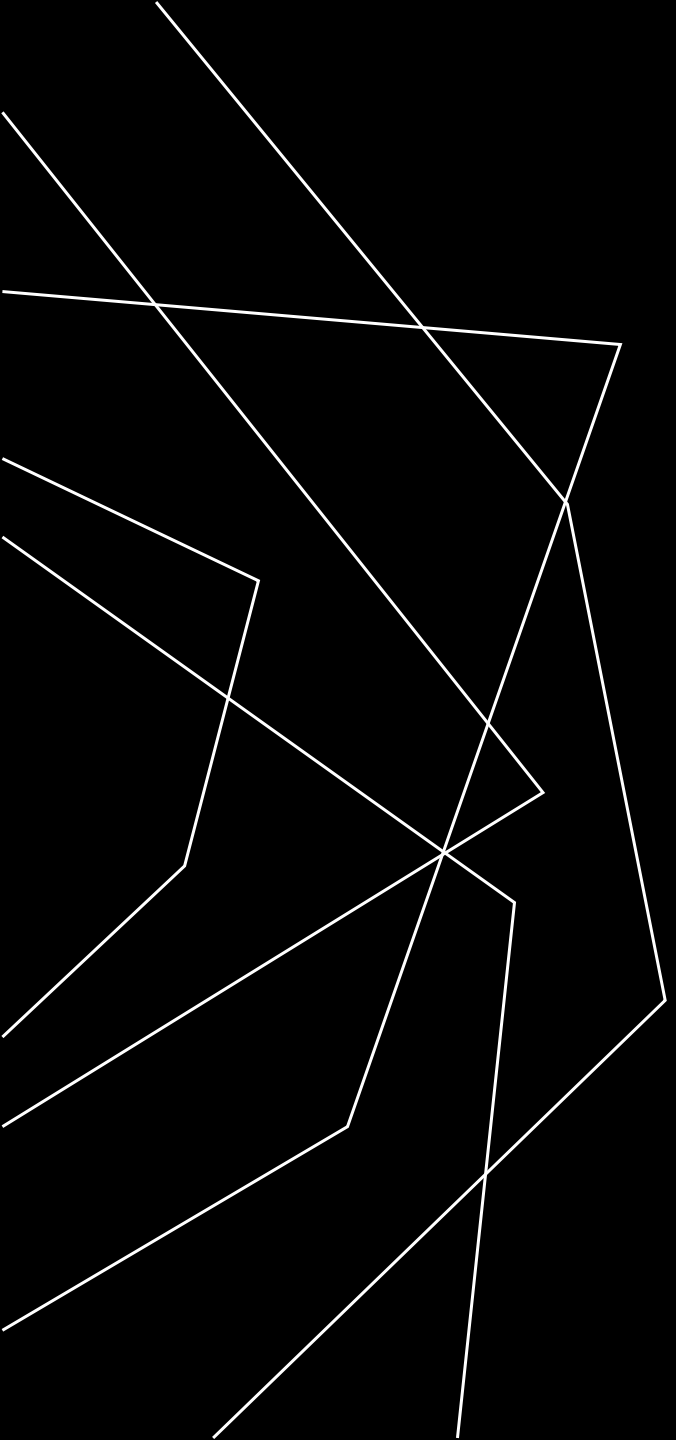
- The solar farm will provide a sustainable and entirely clean energy source, significantly benefiting the local community's power needs.

Design and Engineering Approach:

- We will conduct essential engineering evaluations, including load-flow analysis, short-circuit studies, system protection, and grounding assessments, to guarantee safety and efficiency

Closing Remarks

Our design effectively meets the diverse needs of the utility company, community, regulatory authority, and all others by the implementation of the solar farm, ensuring reliability, safety, and sustainability



THANK YOU

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