115/34.5KV SOLAR PLANT & SUBSTATION

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BLACK & VEATCH

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INTRODUCTIONS & AGENDA

- Safety Moment
- Project overview
- Project management style and justifications
- Task decomposition
- Key milestones, metrics, and evaluation criteria
- Key risks and risk mitigation strategies
- Conclusions

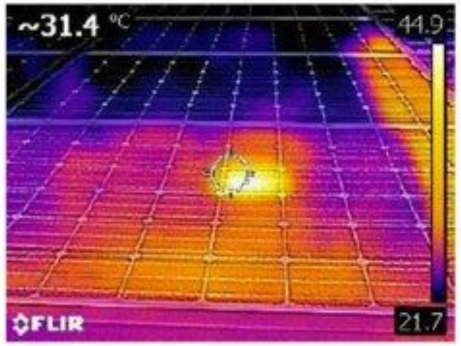
SAFETY MOMENT

Thermal Scanning in Solar Energy Systems

Definition: Thermal scanning is a procedure where a device is used to scan objects temperatures to detect unusual heat patterns of electrical components using infrared technology

Why Perform Thermal Scanning?

- Prevents Fires - Monitor inverters and connections to detect and address overheating before it becomes critical
- Avoids Electrical Hazards – Detect hot spots and potential short circuits that can lead to electrical shock
- Worker Protection – Identifies any risk or danger before any hands-on work with the system



Case Example: Identification of a unusually high temperature in a single cell of a solar panel. This hot spot indicated a potential malfunction or defect that could lead to fire risk

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.

PROJECT MANAGEMENT STYLE AND JUSTIFICATIONS

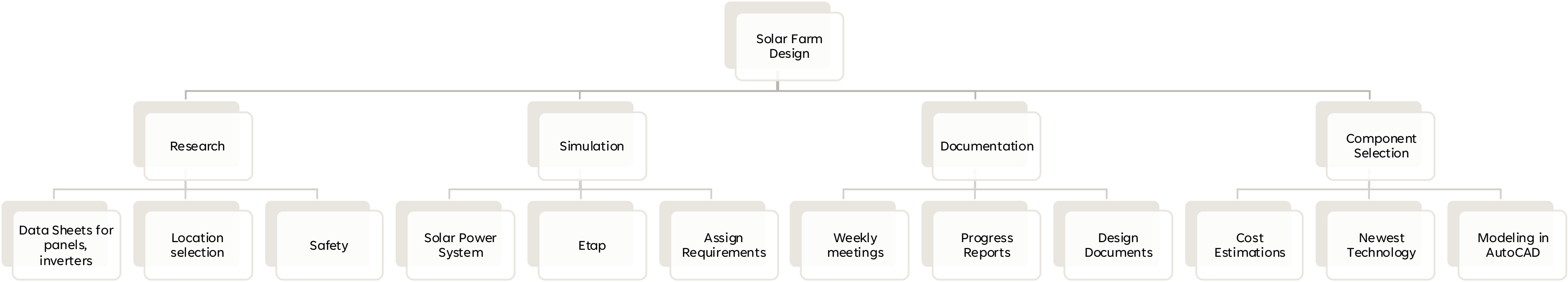
Waterfall Model

- Structured – sequential approach through project phases
- Clear milestones and well-defined deliverables at each stage.
- Work through each phase with minimal need for frequent iteration or changes once initial designs are finalized.
- Schedule order of tasks.
- More predictability.
- Comprehensive documentation
- Early detection of potential issues in planning or design.

Justification: The Waterfall model is effective for our project as we have fixed requirements. This model supports thorough initial planning and design verification before construction begins, aligning well with the project's goals.

TASK DECOMPOSITION

- Our 60MW solar farm and substation project is structured into phases over two semesters. Initially, our team conducted extensive research to select the optimal location and components based on factors like solar irradiation, costs, and efficiency. Using tools from our client and AutoCAD, we are in the process of designing the solar array and electrical diagrams to meet a 60MW output demand. In the upcoming semester, we will perform analysis calculations using ETAP and finalize the design of the substation to deliver power to the grid from our solar farm.



KEY MILESTONES, METRICS, AND EVALUATION CRITERIA

Solar Array Design Milestones:

- Power Requirements: 60 MW AC output.
- Site Optimization: Location maximizes sunlight and accommodates solar plant and substation.
- Voltage Regulation: Maximum voltage drop of 5% across the solar field.
- Engineering Documents: Complete CAD stages including layout, racking, electrical details, wire schedule, and code calculations.
- Component Efficiency: Choose compatible and efficient equipment

Substation Design Milestones:

- Detailed Drawings: Includes one-line, three-line diagrams, grounding grid, and conduit layout.
- Engineering Calculations: Bus, DC battery, lightning protection, grounding, and AC load calculations.
- Simulation and Analysis: ETAP simulation for short circuit, load flow, and arc flash analysis.
- Cost and Selection: Component selection and cost estimation.

Evaluation Criteria:

- Standards Compliance: Adherence to IEEE and local utility regulations.
- Project Performance: Achieve specified design outputs, maintain budget, and adhere to timeline.

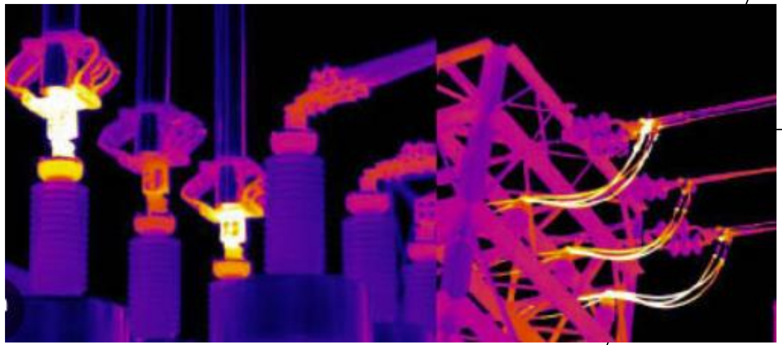
IEEE

KEY RISKS AND RISK MITIGATION STRATEGIES

Design Risks:

- **Improper Equipment Selection:**
  - Risk: Incorrect choice of equipment can lead to operational inefficiencies or failure.
  - Mitigation: Engage in weekly meetings with the client for detailed reviews and validation of component choices and sizing.

- **Incorrect Sizing:**
  - Risk: Improper sizing of equipment or cables could result in a non-functional solar array or substation.
  - Mitigation: Utilize industry best practices and standards for all design and sizing activities.



Physical Risks:

- **Arc Flash Hazards:**
  - Risk: Potential arc flashes during operation pose serious safety risks to field personnel.
  - Mitigation: Follow OSHA guidelines and IEEE standards for electrical safety to minimize the risk of arc flashes. Ensure all personnel are trained on safety protocols and have proper PPE.

CONCLUSIONS

Summary of Key Points:

- **Project Scope:** Designing of a 60 MW solar plant and a 115/34.5 kV substation to provide a clean source of energy for the community.
- **Design Milestones:** Achieved through site selection, component evaluation, and CAD designs.
- **Management Approach:** Adopted the Waterfall model for its structured, sequential approach for large project goals
- **Risk Management:** Implemented risk mitigation strategies to ensure safety and operational efficiency.

Future Work:

- Continued Research and Design Refinement: Further optimize the solar plant and substation designs based on ongoing analysis and client feedback.
- Simulation: Conduct detailed simulations to validate design choices and ensure they meet the project's specifications and efficiency goals.

THANK YOU

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