

Power Up the Possibilities With 3D Design for Substations

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In an industry where change is the only constant, staying ahead of technological advancements can seem overwhelming. However, keeping in step with evolving technology offers big benefits, such as increased efficiency and strengthened resilience, particularly in the utility industry. While traditional 2D design methods were once sufficient for substation design, as we embrace technological progress and the growing complexity of infrastructure projects, digital transformation for all components of utility system design has become essential.

3D design extends beyond layouts and schematics and delivers more accurate and comprehensive models. This digital transformation signifies a strategic step for the energy industry toward seamless power facility planning, optimized resource management, and enhanced communication throughout the project lifecycle. This is often referred to as building information modeling (BIM).

Let's examine the transformative power of the 3D design process for the future of utility systems. Discover the robust benefits of 3D design, tackle the challenges of integrating new technologies, and uncover how this technology can lay the groundwork for more innovative, efficient, and sustainable power engineering solutions.

TRADITIONAL 2D DESIGN

Historically, engineers have used 2D digital platforms like CAD software to design substations. The downside to a 2D approach



is the inability to visualize spatial relationships, increasing the potential for human error and creating a cumbersome review and revision process. This scenario forces utility companies to allocate resources to integrate these components into the overall system design, decreasing efficiency, increasing costs, and prolonging project schedules.

One challenge is the uniqueness of each substation design, leading to inconsistencies across different design and construction projects and sites. Additionally, the lack of standardization forces designers to rely on their best judgment for physical layouts and cross-sectional views. Many utilities design substations without accounting for future site and/or system modifications. This absence of standardization further increases costs as companies must find ways to integrate new substation requirements. While this methodology has

served the industry well, substation design is falling behind as more power system components, such as foundations, steel structures, control rooms, and communications systems, are designed using 3D technology.

THE BENEFITS OF 3D DESIGN FOR SUBSTATIONS

While transitioning to 3D design comes with challenges, including potentially significant initial costs for software and training, replacing legacy systems incompatible with new 3D technologies, and defusing internal resistance as teams adapt to new workflows, processes, and tools, the long-term benefits of 3D modeling and design significantly outweigh the drawbacks. These benefits include:

- » **Enhanced Visualization:** Models provide a comprehensive representation, allowing stakeholders to easily understand spatial relationships within the system, which may include virtual reality walkthroughs.
- » **Digital Twin Implementation:** Digital twin technology enables predictive maintenance, optimized performance, and increased system reliability.
- » **Real-Time Collaboration:** Many 3D design tools are cloud-based platforms with shared interfaces. These enable multiple users to work on the model simultaneously, facilitating collaboration and quicker decision-making.
- » **Improved Accuracy:** Detailed 3D models accurately represent every substation component, reducing errors and omissions, minimizing rework, and identifying clash detection.
- » **Effective Stakeholder Engagement:** 3D models are more intuitive and accessible than 2D drawings, increasing stakeholder engagement.
- » **Simulation and Scenario Planning:** Design tools often include simulation capabilities, allowing teams to visualize potential issues and proactively test scenarios before construction.
- » **Streamlined Processes:** Establishing streamlined processes prevents information siloing and enhances project coordination, aligning project and organizational goals.
- » **Documentation and Reporting:** Software platforms can generate detailed and standardized reports and documentation, providing clear and concise information for project reviews, approvals, and regulatory compliance.

- » **Training and Onboarding:** Interactive 3D models can help new team members quickly grasp the project scope, accelerating the onboarding process.

THE FUTURE OF SUBSTATION DESIGN

As the energy industry moves toward a more integrated, technology-driven approach, utilities must consider a comprehensive digital transformation strategy. Implementing standard software programs, is essential for achieving a holistic power system design. Looking forward, we anticipate the following utility digital transformation:


- » **Adopting 3D Modeling and Design:** 3D modeling will become the standard, enhancing accuracy, improving visualization, and increasing stakeholder collaboration.
- » **Focusing on Sustainable Design:** There is an increasing emphasis on sustainability, minimizing the carbon footprint of substations and supporting the integration of distributed energy resources.
- » **Increasing Cybersecurity Measures:** Utility companies will implement advanced security protocols and technologies to protect critical infrastructure from cyber threats and ensure the power grid's resilience.
- » **Creating Modular and Scalable Designs:** Substation designs will become more modular and scalable, which will be easier with default substation-specific library components. This type of design also supports modular construction, resulting in lower costs, faster construction, and reduced waste.
- » **Focusing on Resiliency and Reliability:** Future substation design will prioritize resilience and reliability, incorporating features for energy savings, extreme weather events, natural disasters, or other disruptions and increasing customer satisfaction.

Overall, the future of power substation design will be characterized by increased efficiency, innovation, and sustainability and driven by advanced technology adoption and a focus on designing and building robust, adaptable infrastructure.

EMBRACING TRANSFORMATION

Digital transformation in the power industry is underway, promising a future in which digital precision can help drive a utility's success. 3D design is not just a technological upgrade;

it's a paradigm shift in substation engineering, offering unparalleled accuracy, enhanced visualization, and streamlined processes that spur efficiency and innovation.

As the energy industry continues to evolve, embracing this technology is essential for utilities seeking to stay ahead of the curve, optimize resources, and deliver superior performance. 



About the Author

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About the Article

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