Electric Utility Substation Design Panel Discussion

Terri Humel - Nashville Electric Service
Casey Neels – Lower Colorado River Authority
Joe Weaver - Nashville Electric Service
Erik Wolf – Duke Energy

UT1980-P: Meet with electric utility industry peers to discuss the intricacies of substation design. Find out how other utilities are using design resources. Compare workflows. Share successes, failures and challenges. Benefit from others' experience. Share ideas for improving processes. The more knowledge we have, the better we can design substations

Learning Objectives
At the end of this class, you will be able to:

1. Compare workflows with industry peers
2. Compare use of design resources
3. Learn from others experiences
4. Gain ideas for improving processes

About the Speakers

Terri Humel is the Principal Associate Engineer in the Substation Design section at Nashville Electric Service. She developed and wrote the procedure and training manual for designing the physical layout of electrical substations using AutoCAD 3D modeling. She facilitated the implementation of Autodesk Inventor Professional, Vault Professional and the SD Tool Kit. She received an Associate's Degree in Mechanical Engineering from Nashville State Technical Institute. thumel@nespower.com

Casey Neels is an Engineering Analyst for the Substation Engineering Department at Lower Colorado River Authority, located in Austin, Texas. He has been at LCRA for nine years and has over thirteen years of experience in AutoCAD and Autodesk Inventor Professional. His primary responsibility is to be a key contributor in developing and maintaining drawing standards and processes, in addition to supporting engineers, designers, and the drafting team. Prior to his work at LCRA, Casey worked for an architecture firm as a design technician. He was responsible for creating and maintaining AutoCAD standards and construction drawings under the direction of an architect. Casey graduated from Hamilton Technical College with Associates degree in Computer Aided Drafting and Design. Casey.Neels@LCRA.org

Joe Weaver is the Principal Associate Engineer in the Control Design section at Nashville Electric Service. He has spent the past 27 years designing electrical substation protection, control and communications systems. Over the years, the tools used for drafting and design have evolved from vellum and pencils, through many versions of AutoCAD®, leading to the adoption of AutoCAD Electrical in 2010. During this time, he has also served as CAD manager for this section as well as many others in the Engineering Department. Currently, Joe is developing/adapting ACADE and the Substation Design Tool Kit for NES. jweaver@nespower.com
Erik Wolf is an Engineering Technologist in the Physical Design group of Substation Engineering at Duke Energy, located in Charlotte, NC. He is currently involved in implementing Autodesk® Inventor® Professional and Substation Design Solution for the Physical Design group. His responsibilities are content development, revising and defining workflow processes, and training. Erik also facilitated the implementation of AutoCAD® Civil 3D® and the training of users for the site development group at Duke Energy. Prior to working at Duke Energy Erik worked for a local Autodesk reseller supporting, training, and implementing the Autodesk infrastructure products. Erik also has 10 years of site development experience. He received an Associate’s Degree in Applied Science from Columbia-Greene Community College.  erik.wolf@duke-energy.com

Nashville Electric Service

About NES
- Twelfth largest publicly owned utility - formed in 1939
- Purchase power –TVA @ 23 feed points
- Cover 700 sq. miles and serve over 359,000 customers
- 12 largest in the nation
- 2010 – One of 6 utilities awarded APPA’s Reliable Public Power Providers (RP3) Diamond Status the industry’s highest designation for reliability and safety.

About Control Design
- 3 Designers, 4 Engineers & 4 Contract Support Designers
- 68 Primary Substations – FO Comm. Network (Ethernet, SCADA & Protection)
- Build 1 new Station every 2-3 years and work 25-50 Station upgrades per year
- AutoCAD® Version 1.2 - 1985
- AutoCAD® Map3D - 2007
- Autodesk® Electrical® since 2010

NES Control Design’s Workflow
- Job Initiation
- Design Process
  - Project Evaluation - Scope
  - Drawing Selection – Scope Impact, Standards
  - Design Phase – Including Internal Review
  - Outside Review – Test & Relaying Groups
  - Issue for Construction
  - As Built Changes

NES Control Design’s Resources
- Historical Data – Existing Designs
- Manufacturer's Information – Catalogs, Spec Sheets, etc.
- Standards – Internal, Industry and International
- Software – AutoCAD, AutoCAD Electrical, Vault Pro
- Hardware - Dell PC, Intel Quad Core i7 2600 processors, 16GB of RAM, 500GB HD, 1GB NVidia Graphics card
- Network - Windows 7 Enterprise & Linux on CISCO Blade Servers, 10GB Ethernet
NES Control Design’s Successes & Challenges

- **What didn’t work**
  - Adhering too closely to legacy processes & symbology
  - Trying to reinvent every wheel rather than adapt
  - Lack of Standards – Relying on aging knowledge base
  - Incomplete knowledge of software configurations

- **What is working**
  - Clearly defining current work processes (And new ones)
  - Establishing new Internal Standards to capture knowledge
  - Adapting to Industry & International Standards (IEEE)
  - Using provided symbols as much as possible, Utility Consortium
  - Making better use of Autodesk resources

- **Goals for improvement**
  - Continued interaction with other utilities to share information
  - Continue to establish AutoCAD Electrical standards internally
  - Work with Autodesk and other utilities to create a set of Electric Utility Standards for ACADE

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**Duke Energy**

**About Duke**

- Largest publicly owned utility - formed in 1905
- Electric and Gas Utility
- Serves 7.1 million Electric Customers and 500,000 Gas Customers
- Operate 7,711 Substations
- 32,000 miles of Transmission Lines and 250,020 miles of Distribution Lines
- Covers 104,000 square miles
- Sources of power are from Nuclear, Fossil, Hydro, Wind and Solar
- Voltage Ranges are from 525kV to 4160V

**Duke’s Workflow**

- Job Initiation
- Design Process
- Drawing Creation
- Approval and Release
- As built changes

**Duke’s Resources**

- Legacy Drawings
- GIS Data
- Manufacturer Specifications
- Standards – Corporate and Industry
Software
- Autodesk SDS 2012
- Autodesk Inventor Professional 2012
- AutoCAD Electrical 2012
- AutoCAD Civil 3D 2012
- Autodesk Vault Professional 2012
- Autodesk Naviswork 2012
- Maximo

Software Vendors
- Autodesk
- IBM

Hardware
- Lenovo D20 4158H8 Thinkstation
- Windows 7 Enterprise
- (2) 2.67GHz Quad Core processors
- 24GB of RAM
- (2) 500GB hard drives
- Nvidia Quadro 4000 2GB RAM
- Dual Lenovo 22” ThinkVision monitors

Duke’s Successes & Challenges

Challenges
- Change Management
- Legacy design practices
- Hardware Performance
- Evolving Corporate Standards
- Asset Catalog/Libraries
- Regional design requirements/preferences
- Document Management – Incorporating legacy systems with newer technologies moving forward
- Multiple projects at the same Substation

Successes
- Material ordering
- Improved Accuracy of construction drawings
- Part Validation during 3D modeling process
- Identify design deficiencies

Goals for improvement
- Integrating Civil 3D site model with Inventor station model
- Integrating Asset Management software with Autodesk Vault
- Standardizing design philosophies corporate wide
- Standardizing content creation
- Improve hardware/software/network performance
Lower Colorado River Authority

About LCRA

- Founded in 1934 by the state of Texas legislature
- Deliver wholesale electricity to 40 retail utilities
- Serve more than 1 million people in 55 counties
- 3,300 miles of transmission lines
- Own or operate 352 substations
- A total of 3,045 MW generated thru 6 hydro-electric dams and 5 power plants (1 coal-fired plant, 1 combined-cycle gas-fired plant, 2 natural gas plants and 1 gas-fired “peaking” facility)
- Regulates water discharge to manage floods and releases water for sale to municipal, agricultural, and industrial users along the 600 mile stretch of the Texas Lower Colorado River
- Own and maintain 16,000 acres of recreational lands, with more than 40 parks, natural science centers and nature preserves

LCRA’s Workflow

- Job Initiation
- Design Process
- Drawing Creation
- Approval and Release

LCRA’s Resources

- Software
  - Autodesk Inventor Professional 2012
  - Autodesk Vault 2012
  - AutoCAD 2012
  - AutoCAD Civil 3D 2012

- Hardware
  - Dell Precision T5500 16GB RAM
  - Windows 7 64Bit
  - Intel Xeon 2.93Ghz Processor

- Vendors
  - Contacting your vendors for major equipment (transformers, switches, breakers, etc.) is essential for cost and time savings

LCRA’s Successes & Challenges

- Challenges
  - File management and understanding how the structure of files stored in Vault works
  - Changing the way the substation design flows between various groups (where civil, structural, and electrical design fits in the process)
  - Where to start when designing an addition to an existing substation
  - What extent of detail to go into when designing additions to a customer station, when the customer owns most or all of the equipment
Successes

- New construction projects
- Small parts & assembly files
- Checking correct clearances between equipment
- Giving management, construction crews and public a view of the substation before actual construction starts

Goals for improvement

- Development of combining grading plans and top of concrete (foundations)
- Development of fabrication drawings for scale assemblies such as steel fabrication drawings
- Improving Autodesk Inventor large assembly files performance with “Level of Detail”
- Improving on the communication traffic between the IT network and Autodesk Inventor large assemblies
- Control panel fabrication drawings
- Developing civil drawings and grounding grid within in Autodesk Inventor
- Customizing Autodesk Inventor materials (cables and piping styles)

Conclusion

Electric utilities are, in general, facing the same set of challenges for the future. We have an aging workforce, aging infrastructure, growing power demand, increased ecological and federal regulations, and the need to improve customer satisfaction through reliability and aesthetics. The way we design substations is vital to meeting these challenges.

Each of the utilities represented by this panel has expressed the fact that substation design is a coordination of Civil, Structural and Electrical engineering along with work/asset management. Internal issues we all seem to be dealing with are the need to improve communication with IT, better hardware, better use of software, getting buy-in from the stakeholders and developing standards.

Defining the problems we are facing today is one half of the battle. Unless we make improvements that are needed right now we won’t be ready for the challenges of the future.

The more information we can share and knowledge we have, the better we can design substations.