Leveraging Open-Source Tools to Advance Industry Capabilities:
OpenDSS

Jeff Smith, Senior Program Manager
Distribution Operations, Planning, and Studies
EPRI
jsmith@epri.com

Advanced Energy Conference
March 28, 2018
New York City, NY
Landscape – The Future Integrated Grid

Power System that is Highly Flexible, Resilient and Connected and Optimizes Energy Resources
Integrating New Technologies and Advanced Resources

- Grid-edge control
- Automation
- PV
- Storage
- Advanced metering
- Demand response
- Customer choice
- Adv Communications
Advanced Distribution Operations

- Advanced Applications
  - Volt/var optimization
  - Fault location, isolation, and restoration (FLISR)
  - Unbalanced power flow with distributed controls
  - Optimal network management
  - Contingency analysis
  - Operator training
  - Predictive failure

- Enabling
  - Effective integration of distributed resources, automation and control, and improved situational awareness
  - Enhanced system operation and automation technologies, processes, and work rules that incorporate new technologies and resource alternatives to improve safety, efficiency, and reliability
  - Integration and coordination of DSP and ISO processes and priorities
Advanced Distribution Planning

- **Advanced Capabilities**
  - Probabilistic planning
  - Load and DER forecasting
  - DER/customer choice modeling
  - Hosting capacity assessment
  - DER Interconnection screening
  - Non-wires solution assessments
  - DA/DMS simulation
  - Automated scenario/mitigation analysis

- **Enabling**
  - Effective integration of distributed resources, new automation and control, and facilitation of new domain interactions
  - Informed system design and investment decisions that consider new technologies and resource alternatives
  - Safe, reliable, and efficient system designs given rapidly changing system conditions and uncertainty
  - Efficient and timely planning assessments and decisions
Integrated Transmission and Distribution Operations and Planning

Integrated Approach to Planning and Operations

- Planning
  - Transmission
  - Distribution

- Operations
  - Transmission
  - Distribution

Control Center RT-Ops
Modeling & Sim. Methods
Load/DER Forecasts & Models
DSO/TSO Interaction
Risk-Based Planning
Protection and Coordination
DER Integration

EMS, Markets
DER Aggregators
Networked Transmission
Radial Distribution
Active Customers, Assets, and Dispatchable Generation
Advanced Distribution System Analysis Platform
Open-Source Distribution System Simulator (OpenDSS)

New Technologies
- Grid-edge control
- Automation
- PV
- Storage
- Advanced metering
- Demand response
- Customer choice
- Adv Communications

Operations

Planning

Integrated Transmission and Distribution Analysis
OpenDSS – Brief Overview

- Open source of EPRI’s Distribution System Simulator
  - Originally developed in 1997 for DG interconnection and planning
  - Open-sourced in 2008

- Designed from the beginning to capture
  - Time-specific impacts and
  - Location-specific impacts

- Unique application capabilities
  - Operations and planning
  - Integration into other simulation toolsets/environments
  - Co-simulation (power and communications)

Core Solution Capability
- Full, unbalanced 3P power flow
- Quasi-Static time-series analysis (QSTS)
- Linear and non-linear analysis
- Arbitrary n-phase circuit analysis
- Harmonics analysis
- Stray voltage/current analysis
- Fault analysis

DER Models
- Smart inverters (Phase I, II, and III functions)
- Storage models with controllers
- PV system models
- Wind system models
- Demand response
- Microgrid modeling
- DER Short-circuit models

Advanced Control Systems
- Coordinated and integrated volt/var control
- DERMS control
- Full regulation control for LTC’s, line regs, cap banks

High-Performance Computing Capabilities
- Parallel processing
- Multithreading circuit processing
- Multi-core management

Misc
- Both radial feeders and meshed networks
- Transmission systems
- Real-Time Simulation