GRID MODERNIZATION INITIATIVE
PEER REVIEW
GMLC 1.4.25 - Distribution System Decision Support Tool Development and Application

MICHAEL R. INGRAM, NREL
September 4-7, 2018
Sheraton Pentagon City – Arlington, VA
Distribution System Decision Support Tool Development and Application
High-Level Project Summary

**Project Description**
Identify strategies and provide technical assistance to state regulators and utilities that focus on advanced electric distribution planning methods and tools, with a focus on incorporating emerging grid modernization technologies and the significant deployment of DER

**Value Proposition**
- Electric distribution systems are aging and in need of expensive upgrades
- Large amounts of DERs are being integrated to distribution systems in U.S.
- PUCs and decision makers have asked for assistance in understanding the distribution systems, planning and prioritizing upgrades

**Project Objectives**
- Provide technical assistance to state regulators in partnership with NARUC
- Identify gaps in existing and emerging planning practices & approaches
- Compile information on existing planning tools, identify gaps and necessary functions
- Provide technical assistance to electric utility industry and associated stakeholders
7.0 Institutional Support

7.1 Provide Technical Assistance to States and Tribal Governments

7.2 Support Regional Planning and Reliability Organizations

7.3 Develop Methods and Resources for Assessing Grid Modernization

7.4 Conduct Research on Future Electric Utility Regulations

Task 7.1.1 Provide TA to all states

- Enhance utility distribution planning methods & tools
- Provide TA to state PUCs and utilities
- Support industry dialogue with concept papers
Distribution System Decision Support Tool Development and Application

Project Participants and Roles

Michael Ingram – NREL (Electric Utility)
Lisa Schwartz – LBNL (Regulatory)
Juliet Homer – PNNL (Tools & Regulatory)

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Data from DOE, EIA, NRECA, APPA, EEI

Institutional Support

9/5/2018
Support Regulatory Agencies – Deliver in-person training courses for state PUCs on emerging distribution planning practices, methods and tools, with support and guidance from NARUC and a state PUC advisory group. Develop detailed summary of state activities in distribution system planning with DERs and grid modernization (from a regulatory perspective). 2017 & 2018

Engage with APPA and NRECA; Identify the highest priority TA on distribution system tools and needs that this team can provide. Share information with other GMLC teams. 2017 & 2018

Provide detailed assessment of existing distribution planning tools, capabilities, gaps and recommendations for filling those gaps. 2017 & 2018

Interview top distribution system analysis tool vendors (CYME, Synergi and Milsoft) to assess capabilities of current tools, planned developments and gaps. 2018
Developed, facilitated and presented at Regional PUC workshops (NE, MW, West) targeted at state utility regulators on distribution system planning and emerging issues.

Detailed summary of state activities in distribution system planning with DERs and grid modernization - from a regulatory perspective.

Summary report on commercial distribution system analysis (DSA) tools, including maturity and gaps, for addressing high levels of DERs.

Technical assistance to many states assessing and deploying grid modernization and support for planning organizations. (including CA, CO, HI, MA, MN, NY, OR)
3 Regional Trainings, 33 States

- **New England** – CT, ME, MA, NH, RI, VT
- **Midwest** (MISO footprint) – AR, IL, IN, IA, KY, MI, MN, MO, MT, ND, OH, SD, TX, WI
- **West** – AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, WY
- 101 sessions on utility distribution systems and distribution planning, in-depth technical sessions, and moderated discussion
- Public utility commission advisory group identified distribution planning needs to help guide training program
- Co-hosted by National Association of Regulatory Utility Commissioners, National Association of State Energy Officials and regional partners
New England (9/2017)
► 63% rated training excellent, 30% good (7% average)

Midwest (1/2018)
► 71% rated training excellent, 26% good

West (5/2018)
► 89% rated training excellent, 11% good

100% of respondents would recommend the training to colleagues (all regions)

Some of the things participants liked best:
• The depth of the presentations and expertise of the trainers
• Quality of presenter[s] and team approach to coverage of topics
• Quality of content and applicability
• Learning directly from the active researchers on topics that are cutting-edge, as well as the basic background
• Explained concepts in terms that all could understand
• Came away with some solid actions & questions to take home
**State Engagement in Electric Distribution Planning**, PNNL, LBNL, and NREL. 
December 2017

| Statutory requirement for long-term distribution plans or grid modernization plans\(a\) | California | Hawaii | Massachusetts | Minnesota | New York | D.C. | Florida | Illinois | Indiana | Maryland | Michigan | Ohio | Oregon | Pennsylvania | Rhode Island | Washington |
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(a) For one or more utilities.
Results from Distribution System Tools Report:
Focus on Analysis Types & Applications

- Power Flow Analysis
- Power Quality Analysis
- Fault Analysis
- Dynamic Analysis

Maturity Levels ranking:
0 – None of the DSA tools offer this function
1 – Only a small number of DSA tools offer it
2 – More than 50% of DSA tools offer it
3 – Most or all tools offer the function

This report has provided significant input into the DSPx project

### Distribution System Analysis Types and Applications

<table>
<thead>
<tr>
<th>Analysis Type</th>
<th>Maturity Level</th>
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<td>Power Flow Analysis</td>
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<td>Peak Capacity Planning Study</td>
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<td>Voltage Drop Study</td>
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<td>Ampacity Study</td>
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<td>Contingency and Restoration Study</td>
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<td>Real-Time Performance</td>
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<td>Power Quality Analysis</td>
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<td>Voltage Sag and Swell Study</td>
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<tr>
<td>Harmonics Study</td>
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<td>Fault Analysis</td>
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<td>Arc Flash Hazard Analysis</td>
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<td>Protection Coordination Study</td>
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<td>Fault Location Identification</td>
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<tr>
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Information from report presented at IEEE conferences in 2017 & 2018
Support of Massachusetts Technical Standards Review Group (ongoing)

Technical assistance for the Minnesota PUC in their Interconnection Rule Making
  Presently working to incorporate new national standards IEEE 1547-2018, UL 1741SA.

Midwest Governor’s Association Support

California PUC training on DER, distribution planning
1.4.29: Future Electricity Utility Regulation – Contribute design and implementation options. Electric utility regulation is a key aspect of this project as this team works to educate regulators on existing and emerging planning methods and tools. Providing TA to MN PUC for interconnection policy.

1.3.5 DER Siting and Optimization Tool for CA – NY and CA regulators are coordinating on tool development and demonstration

1.2.1: Grid Architecture – Apply evolving grid architecture with distribution planning tools and methods.

1.2.3 Testing Network & Open Library – Coordinating tools report with Open Library.

1.3.22: Technical Support to the NYS REV Initiative – Partner with NY utilities and BNL team to understand advanced approached in distribution system upgrades, planning, non-wires alternatives. Evaluation of alternative distribution planning methods used by Con Edison in the Brooklyn-Queens Demand Management project.

1.1: Foundational Analysis for GMLC Establishment – Validate and demonstrate grid performance metrics

Next Generation Distribution System Platform (DSPx) – Developing a cooperative report focused on distribution interconnection standards and codes, distribution planning tools. Coordinate with DSPx and provide inputs as requested (e.g., the distribution planning tools report).
Deliver technical report that identifies distribution system planning tools for DERs and grid modernization – current capabilities, data needs and gaps [09/2018].

Developing a report focused on distribution interconnection standards and codes, and impact on distribution planning tools. To be published in collaboration with DSPx [12/2018]

Ongoing support for MN PUC and Mass TSRG with respect to interconnection rules, distribution planning methods, and national standards adoption

Extend and expand training (pending funding)
   ✓ Offer to PUCs and state energy offices in Mid-Atlantic and South [01/2019 and TBD]

Integrate grid modernization decision framework and implementation roadmap developed by DOE’s Next Generation Distribution System Platform (DSPx) initiative to inform transition pathways from legacy systems to modernized infrastructure [TBD]
Thank You For Listening !!!
Distribution System Decision Support Tool Development and Application

Western States Workshop Agenda (Backup Slide)

May 1, 2018 – Pre-training activities

1:00 – 4:00 pm
WIEB Strategy Advisory Committee meeting:
Dissemination of Western U.S. Interconnection Findings to States

4:00 – 5:00 pm
Considerations for a Modern Distribution Grid – Joe Paladin,
U.S. Department of Energy

May 2, 2018 – Training begins

8:00 – 8:15 am
Welcome and opening remarks – Maury Galbraith (WIEB),
Kerry Worthington (NARUC), Fred Hoover (NASEO), Lisa Schwartz (Berkeley Lab)

8:15 – 9:45 am
Distribution systems 101 – Kevin Schneider (PNNL) and Emma Stewart
(LLNL)

9:45 – 10:00 am
Break

10:00 – 10:45 am
Distribution system controls and automation – Barry Mather (NREL) and
Kevin Schneider (PNNL)

10:45 am – 12:15 pm
Utility distribution planning 101 – Mike Coddington (NREL) and Kevin
Schneider (PNNL)

12:15 – 1:15 pm
Lunch

1:15 – 2:45 pm
Distributed energy resources – Mike Coddington (NREL), Emma Stewart
(LLNL), Jeremy Twitchell (PNNL)

3:00 – 3:45 pm
Reliability metrics and reliability value-based planning – Joe Eto (LBL)

3:45 – 4:30 pm
Impacts of distributed energy resources on transmission systems:
The distribution/transmission interface – Barry Mather (NREL)

May 3, 2018

8:00 – 8:45 am
Forecasting load on the distribution and transmission system with
distributed energy resources – Andrew Mills (LBLN)

8:45 – 9:30 am
PUC distribution planning practices – Lisa Schwartz (LBLN)

9:30 – 9:45 am
Break

9:45 – 10:45 am
Emerging distribution planning analyses: Multiple scenario forecasts,
hosting capacity analysis, locational net benefits analysis – Debra Lew
(GE Energy Consulting)

10:45 – 11:30 am
Walk-through of long-term utility distribution plans:
Part 1 - Traditional plans - Lavelle Freeman (GE Energy Consulting)

11:30 am – 12:30 pm
Lunch

12:30 – 1:30 pm
Moderated discussion: How are states beginning to engage in
distribution system planning?
Moderator: Lisa Schwartz (LBLN)
- Value of state engagement – Chair Jeff Ackerman (CO PUC)
- Barriers to state engagement – Maury Galbraith (WIEB)
- Less time-intensive approaches vs. full-scale DSP – Jeremy Twitchell
  (PNNL)
- Oversight roles – Dallas Harris (NV PUC)
- Integrating DSP with other forms of planning – Dave Parsons (HI PUC)
- Stakeholder engagement – Kathi Scanlan (WA UTC)

Walk-through of long-term utility distribution plans:
Part 2 - Grid modernization plans and plans for high levels of distributed
energy resources - Debra Lew (GE Energy Consulting)

1:30 – 2:30 pm
Moderated discussion: What questions can states ask utilities to better
inform state engagement in distribution system planning?
Moderator: Lisa Schwartz (LBLN)
NREL-led IEEE Report on Alternatives to Traditional Distribution System Planning with Con Edison:

- Long-term Forecast showed Brooklyn Queens networks would see overloads on peak days
- Traditional approach was to build out distribution circuits, add substation transformers & switchgear, and new transmission upgrades (all underground)
- Cost estimate to serve all of this new load >$1 Billion
- NY DPU via NY REV seeks alternatives from Con Edison rather than traditional investments

Many solutions were employed, including Energy Efficiency measures, Fuel Cells, Solar PV systems, Volt-VAR Optimization, Demand Response, Gas-Fired Distributed Generation, Battery Energy Storage Systems (BESS), and more.....