NARUC-NASEO Task Force on Comprehensive Electricity Planning

Distribution System Planning Fundamentals & Promising Practices
August 21, 2019

• Curt Volkmann, GridLab
• John Shenot, Regulatory Assistance Project
• Commissioner Dan Lipschultz, Minnesota PUC
• Tricia Debleeckere, Minnesota PUC
Overview of Integrated Distribution Planning

Curt Volkmann
President, New Energy Advisors, LLC
curt@newenergy-advisors.com
www.newenergy-advisors.com
DER Growth and its Implications

- Significant growth in distributed generation, EE, DR, CHP, EVs, energy storage, microgrids
- Increased complexity of distribution system planning and operations
- Increased flexibility
- New opportunities for customers and third parties to provide *Local Distribution Grid Services*, reducing the need for conventional ratepayer-funded capital investments
  - Distribution capacity or peak load reduction
  - Voltage regulation
  - Reliability/resilience
  - Hosting capacity
Small and Targeted Investment

Source: SolarCity Grid Engineering, 2016
Geo-Targeted Demand Response

Individual customers providing and receiving compensation for Local Distribution Grid Services to reduce costs for all customers ...
From today’s Distribution Planning ...
NEW IDP CAPABILITIES

The successful transition to full Integrated Distribution Planning requires the development of five new capabilities, specifically:

1. Advanced Forecasting and System Modeling
2. Hosting Capacity Analysis
3. Disclosure of Grid Needs and Locational Value
4. New Solution Acquisition
5. Meaningful Stakeholder Engagement

ADVANCED FORECASTING AND SYSTEM MODELING

An initial step in today's distribution planning process involves the forecasting of load growth and future circuit and substation peak demands over a 5-20 year time horizon. These forecasts are based on circuit and substation loads recorded at the time of previous peaks, adjusted for weather impacts, expected growth rates, and known changes in load such as the addition or loss of major customers.

The resulting forecasts are largely deterministic, meaning they often do not reflect randomness or uncertainty. Utilities apply these static "snapshots" in time and linear extrapolations of historical data to identify where system limits may be exceeded and where upgrades may be required to accommodate load growth.

As such, load forecasts are a critical input into a utility's capital expenditure plan and directly impact a utility's revenue requirement. Figure 3 illustrates the deterministic results from a typical utility load forecasting process.

As DER adoption grows, distribution systems will increasingly experience variability of loading, voltage and other attributes of system performance. New approaches to enhance forecasting in a high-DER future include probabilistic planning and DER adoption scenario analyses.

Probabilistic planning, as opposed to the current deterministic approach, accounts for uncertainties introduced by factors such as increasing DER penetration and weather variability. Scenario analyses consider a range of possible futures where varying levels of DER are adopted on the system.

While utilities have well-established methodologies for developing load forecasts, the methodologies for DER forecasting are evolving and the necessary techniques and software tools are still under development. For utilities in the early stages of building this capability, modeling is often based on historical patterns of DER adoption or goals set for utilities.

Many leading utilities are using customer-adoption models to forecast expected quantities of DER, and analysis of individual customers' propensity to adopt based on demographics or load to forecast locations of DER deployment.

Customer-adoption models explicitly use historical DER deployment, location-specific DER technical potential, various DER economic considerations, and end-user behaviors as predictive factors.

Table 1 summarizes key steps of an effective DER adoption forecast. Ultimately, utilities must determine what impacts the adoption of various DER types will have on individual circuit load profiles throughout the year. It is important to know the extent to which DER production is coincident with peak load on each circuit, as well as expected DER output at times of minimum circuit loads.

75% utilization is the desired maximum
70% utilization or less is preferred for operational flexibility

FIGURE 3. Typical Distribution Load Forecasting Results
### New IDP Capabilities

<table>
<thead>
<tr>
<th>Capability</th>
<th>Description</th>
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<tbody>
<tr>
<td>1) <strong>Advanced Forecasting and System Modeling</strong></td>
<td>Probabilistic planning and DER adoption scenario analyses; more granular load and power flow modeling; enhanced modeling of new smart inverter capabilities; and the ability to monitor, manage and optimize DER connected to the system.</td>
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<tr>
<td>2) <strong>Hosting Capacity Analysis</strong></td>
<td>Determining how much additional DER each distribution circuit can accommodate without requiring upgrades.</td>
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<tr>
<td>3) <strong>Disclosure of Grid Needs and Locational Value</strong></td>
<td>Identification and publication of locations where DER can provide grid services as non-wires solutions (NWS).</td>
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<tr>
<td>4) <strong>New Solution Acquisition</strong></td>
<td>Acquiring or sourcing DER to provide grid services using pricing, programs or procurement.</td>
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<tr>
<td>5) <strong>Meaningful Stakeholder Engagement</strong></td>
<td>Establishing processes for open dialogue, transparent information sharing, collaboration, and consensus building among stakeholders.</td>
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Hosting Capacity Results
Getting Started with IDP

- Establish clear objectives and guiding principles
- Require utility reports to understand current capabilities
  - Planning methods and tools; spending categories and amounts; proposed HCA use cases; NWS suitability criteria and pilots
- Establish IDP Technical Working Group(s)
  - DER adoption and growth scenarios; smart inverter functions and settings; NWS suitability criteria and process for pilots; HCA use cases, methodology, timeline for implementation; development of data sharing portals
Additional resources...

https://gridlab.org/publications/

https://rmi.org/insight/non-wires-solutions-playbook/
Thank you!

Curt Volkmann
President, New Energy Advisors, LLC
curt@newenergy-advisors.com
www.newenergy-advisors.com
Oversight of Distribution Planning: Guidance for Public Utility Commissions

NARUC-NASEO Task Force Webinar: Distribution System Planning Fundamentals & Promising Practices

John Shenot
Senior Associate
The Regulatory Assistance Project (RAP)®

Fort Collins, Colorado
United States

+1 802 595 1669
jshenot@raponline.org
raponline.org
Why might PUCs consider taking an active role in distribution planning?
Distribution System Costs are Rising Steadily…

...and Much Faster Than Inflation


* https://www.bls.gov/data/inflation_calculator.htm
Distribution Share of Retail Bills is Large and Projected to Grow

Data Source: EIA Annual Energy Outlook 2019

2017: 25.8%
2030: 32.7%
2040: 34.0%
Introducing the MADRI Guide to Integrated Distribution Planning (IDP)
Mid-Atlantic Distributed Resources Initiative (MADRI)

- Informal stakeholder collaborative
- Restructured states in PJM market (DC, DE, IL, MD, NJ, OH, PA)
- Began in 2004
- Meets ~quarterly to explore and discuss DER issues
Process Map for Commission Oversight of an IDP Requirement

*In addition to establishing process and/or filing requirements, an order creating an IDP requirement could address jurisdictional (Section II.G.) and operational expenses (Section II.E.)
Commission Reviews Its Statutory Authority

Commission Has Authority to Require IDP?

Yes

Administrative Rules Needed or Desired?

Yes

Commission Initiates Rulemaking for Process and/or Filing Requirements

No

Commission Conducts Informal Investigation or Workshop

Commission Issues Order Creating IDP Requirement*

No

Utility Initiates IDP Process (see Section III for details)

Commission Issues Filed Draft IDP and Stakeholder Comments

Commission Provides Direction to Utility on Needed or Recommended Changes to Draft IDP

IDP Acceptable to Commission?

Yes

Commission Issues Order Approving or Acknowledging IDP (see Section II.D)

Utility Implements Action Plan and Requests Cost Recovery

No

Stakeholders Review and Comment on Draft IDP

Commission Reviews Filed Draft IDP and Stakeholder Comments

Utility Files Draft (or Proposed) IDP

End

Yes

Authority Obtained?

Utility Requests Additional Statutory Authority if Needed and Warranted

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Key Decisions at the Outset

- Scope: Utility versus Jurisdiction-Wide Planning
- Scope: DERs to Consider
- Planning Horizon, Timing of Filings and Update Frequency
- Stakeholder Participation
- Binding or Nonbinding Effect of a Completed IDP
Possible Synergies with Other Regulatory Proceedings

• Grid modernization initiatives
• DER interconnection standards and procedures
• Resource planning
• Transmission planning
• Changes to the electric utility business model and alternative ratemaking options
• Creation of a distribution system operator?
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Resource – Coming Soon!!!

Integrated Distribution Planning for Electric Utilities:
Guidance for Public Utility Commissions

Draft available at https://www.madrionline.org/resources/
Final to be published soon
About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org
Minnesota’s Actions and Developments in Distribution System Planning
How It Started

• Commission-led Investigation

• Commission/Staff – Opened Individual Investigation Dockets for each of the four-rate regulated utilities

• Distribution Planning Filing Requirements Established by Order

• Initial Plans filed in 2018 and 2019
Workshops
A. How do Minnesota utilities currently plan their distribution systems?
   Establish a baseline understanding of our utility planning processes

B. What does each utilities current year plan look like and assume?
   Understand the current state of plans

C. Are there ways to improve or augment the utilities’ planning processes?
   Provide stakeholders an opportunity to identify potential improvements in planning processes
Minnesota-based Integrated Distribution Plan ‘wants’:  
• foundational understanding of utility’s long-term distribution plans;  
• context for individual utility investment requests;  
• proactive consideration of potential futures and non-traditional methods of planning;  
• system reliability, efficient uses of resources, and maximized customer benefits; and,  
• public policy goals achievement.
Process for Setting Distribution Plan Requirements

- Staff Straw Proposals
- Commission Review and Approval for Release
- Comment Period
- Commission Decision

April 2018 to August 2018
Integrated Distribution Plan Requirements

1. Administrative Requirements (Timing)
2. Stakeholder Process
3. Filing Requirements
   A. Baseline Data
   B. Hosting Capacity and Interconnection
   C. DER Forecasting
   D. Long-Term D’sys Modernization and Infrastructure Investment Plan
   E. Non-Wires Alternatives Analysis
Integrated Distribution Plan Requirements
Baseline Data

Baseline Data

System, Financial, DER

Figure 43: Escalated Operations – State of Minnesota Electric Jurisdiction
Capital and O&M Expenditures (2013 to 2017)

MN Storm Restoration Totals (Capital and O&M)

- 2013: $20.1 (Capital), $7.3 (O&M)
- 2014: $20.1 (Capital), $3.8 (O&M)
- 2015: $20.1 (Capital), $3.9 (O&M)
- 2016: $19.6 (Capital), $6.6 (O&M)
- 2017: $18.2 (Capital), $15.1 (O&M)
Integrated Distribution Plan Requirements
Hosting Capacity & Interconnection

Hosting Capacity and Interconnection
DER Scenario Analysis

Figure 58: Distributed Solar PV Forecast
Integrated Distribution Plan Requirements
Grid Modernization

Long-Term Distribution System Modernization and Infrastructure Plan
Integrated Distribution Plan Requirements
Non-Wires Alternatives

Non-Wires Alternatives Analysis

HYL061 with WSG076 Contingency Load

Overloaded by 4.0 MW and 24.08 MWh
How will integrated distribution system planning evolve?

To be continued...
Commissioner Dan Lipschultz
Dan.Lipschultz@state.mn.us

Tricia DeBleeckere
Tricia.DeBleeckere@state.mn.us