Integrated Capacity Analysis Working Group

September 19, 2017

In-person meeting

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Agenda

Time	Topic
9:00 – 9:15	A. Intros, overview, schedule
9:15 – 9:30	B. Review of Proposed Decision
9:30 – 10:00	C. Expansion of ICA to single phase feeders; creation of network models (joint IOUs)
10:00 – 10:45	D. Operational flexibility (EPRI, joint IOUs)
10:45 – 11:00	E. Break
11:00 -11:30	F. Load modifying resources (joint IOUs)
11:30 – 12:00	G. Online maps reflecting queued projects (joint IOUs)
12:00 – 12:30	H. DERs that serve peak load (joint IOUs)
12:30 – 12:40	Wrap up and next steps

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ICA and LNBA Working Group Background: June 7 ACR

Interim status reports are due as follows:

- **Group I: August 31, 2017**
- **Group II, III, IV: October 31, 2017**

The groupings, scoping documents, and interim status reports help form a tentative schedule for the Working Group going forward.

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~~**August:** Group I topics~~
~~*August 31: Group I Status Report due*~~
September: Group II topics
October: Group III and IV topics
October 31: Group II/III/IV Status Report due
November: Revisit priority topics from Group I and/or revisit other topics as necessary
December: Discuss draft final report
January: Final report due

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Future meetings

September (Group II):

- Expansion of ICA to single phase feeders, creation of network models
- Method for reflecting effect of potential load modifying resources on ICA
- Develop non-heuristic approach to modeling operational flexibility
- Consider how online maps could reflect queued projects on a given circuit
- DERs that serve peak load

October (Group III and IV):

- Ways to make ICA information more user-friendly and easily accessible (data sharing)
- Interactive ICA maps
- Market sensitive information
- Incorporate findings and recommendations from DRP track on DER and load forecasting as appropriate

November (Revisit priority topics from Group I/other topics as necessary)

December: Discuss draft final report

January 8: Final report due

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Proposed October Dates

Monday, October 16: ICA meeting (9am - 1pm)

Tuesday, October 17: LNBA meeting (9am – 1pm) + LNBA subgroup on avoided transmission (2pm-4pm)

Proposal write ups due: Monday, October 23

Comments due: Monday, October 30 MID-DAY

Interim status report due: October 31

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Status of Group I topics

Group	Topics	Proposal	Feedback	Next steps
1	Further define ICA planning use case and methodologies	Joint IOUs	IREC, Stem, ORA, Vote Solar, Clean Coalition, SEIA	
1	Develop standard PV generation profile	Joint IOUs	Clean Coalition	Nov. meeting
1	Model smart inverter functionality	Joint IOUs	CALEIA, Clean Coalition, IREC	
1	Perform comparative assessment	Joint IOUs	none	ID 3rd party volunteer

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Overview of Proposed Decision

Commission Proposed Decision regarding Track 1 Demo Projects was made available on August 25, 2017.

http://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=194540363

Integration Capacity Analysis (ICA) – Working Group

IOU Slides

September 19, 2017

Final Demo A WG Recommendation

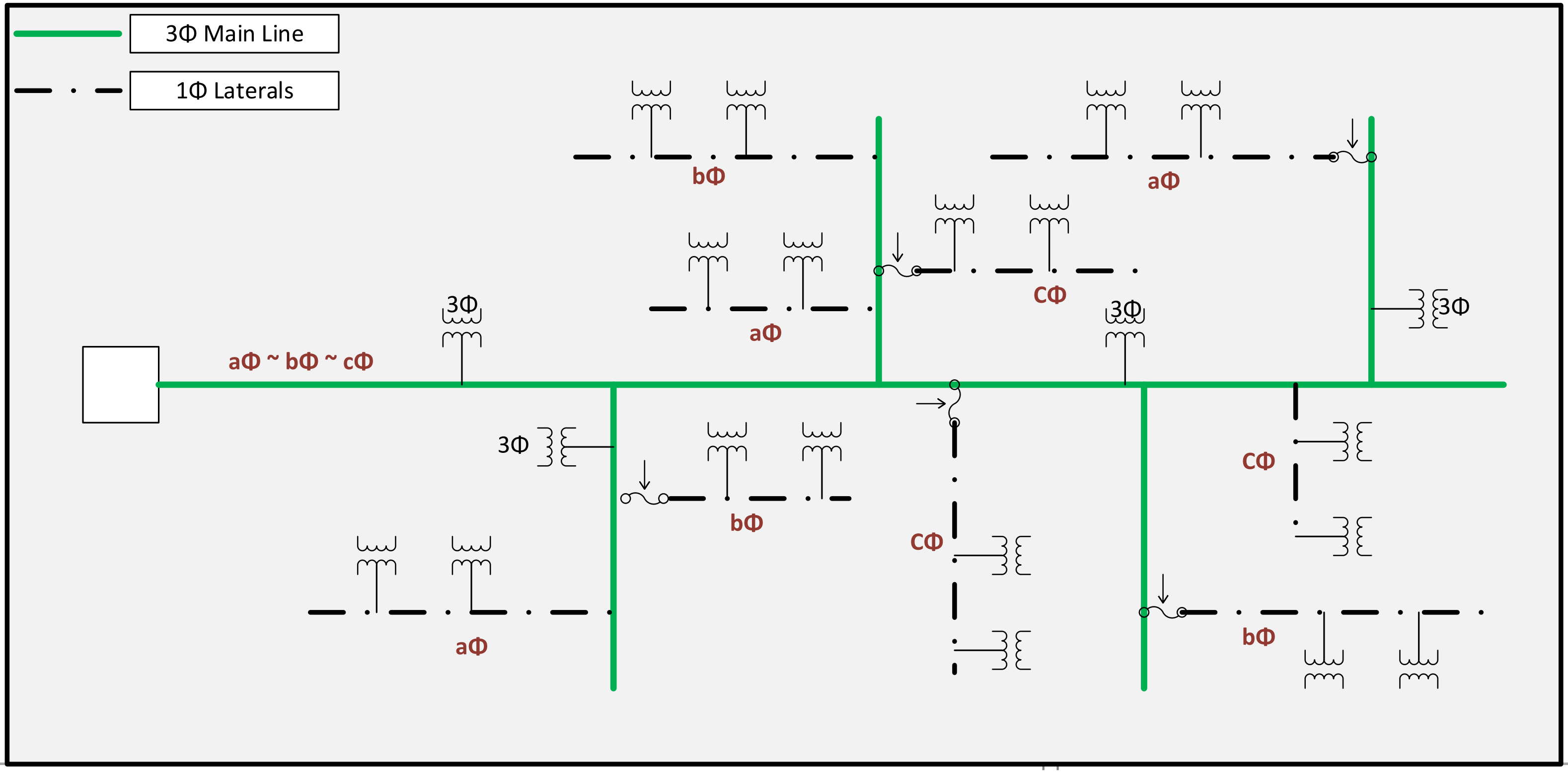
- Addition of Single-Phase should be added as a high priority item in the Long Term Refinements
- Include Single-Phase in the mapping with no ICA values for Single Phase
- IOUs outlined that determining accurate Single Phase ICA values may require significant investment:
  - The information for single phase laterals is not as accurate as that of three-phase systems and significant cost to determine the accuracy of single phase lateral may be required for development of network models which include single phase
    - Single phase fusing
    - Wire/conductor type

Group II – Item A – Expansion of ICA to single phase feeders

Demo A Discussion

Single phase laterals have significant limitation

- Designed to connect small amount of (Load or DER)
- Designed with levels of load as to not create significant imbalance
  - Imbalance creates circuit overloads, operational issues, voltage issues
- Generally are protected (fused) for the load on the single phase lateral



Long Term Proposed Work

As proposed in Demo A conversations:

IOUs should evaluate ***<u>one feeder</u>*** for single phase ICA in order to:

- Predict the level the complexity, scope, and cost would be required to add single phase ICA values
- Determine how the tools would need to be updated to include single phase ICA evaluation
  - Such as circuit imbalance evaluation
  - Evaluate in the protection function in the tools are appropriate for single phase fuse evaluation
- Evaluate if alternative means of determining single phase ICA is appropriate
  - Connected Single Phase Load for ICA_{Gen}
  - Use fuse size to determine Single Phase ICA
  - Other

Evaluation Time

- Considering other work
  - Other Analysis for the ICA WG
    - PV profiles
    - Line losses evaluation (LNBA)
    - Smart Inverter Evaluation
    - Comparative Assessment
  - Implementation of ICA
    - System-wide implementation of interconnection use case
    - Initial implementation Planning Use Case
- Commence evaluation Q1 2018
- Deliver results Q2 2018

Non-Heuristic Approach to Operational Flexibility

- **The IOUs will display ICA with and without "Reverse Flow" Operational Flexibility**
  - *IOUs will display ICA with and without Operational Flexibility using the "reverse flow" method*
  - *No stakeholders have provided any possible analysis approaches than what utilities have performed*
  - *Challenges to face in performing a "non-heuristic" method of operational flexibility:*
    - *There is no established method other than performing power flows on various possible switching scenarios*
    - *There is no efficient method to create abnormal switching conditions in vendor tools other than manually opening and closing switches*
    - *Calculation times and computing costs will significantly increase due to the multitude of possible switching conditions*

- **Recommendation:**
  - Keep using approach of displaying/using both ICA values appropriately until new method can be adopted
  - The IOUs continue to invite researchers and the vendor community to develop approaches to efficiently analyze abnormal conditions

ICA and Operation Flexibility

EPRI Perspective

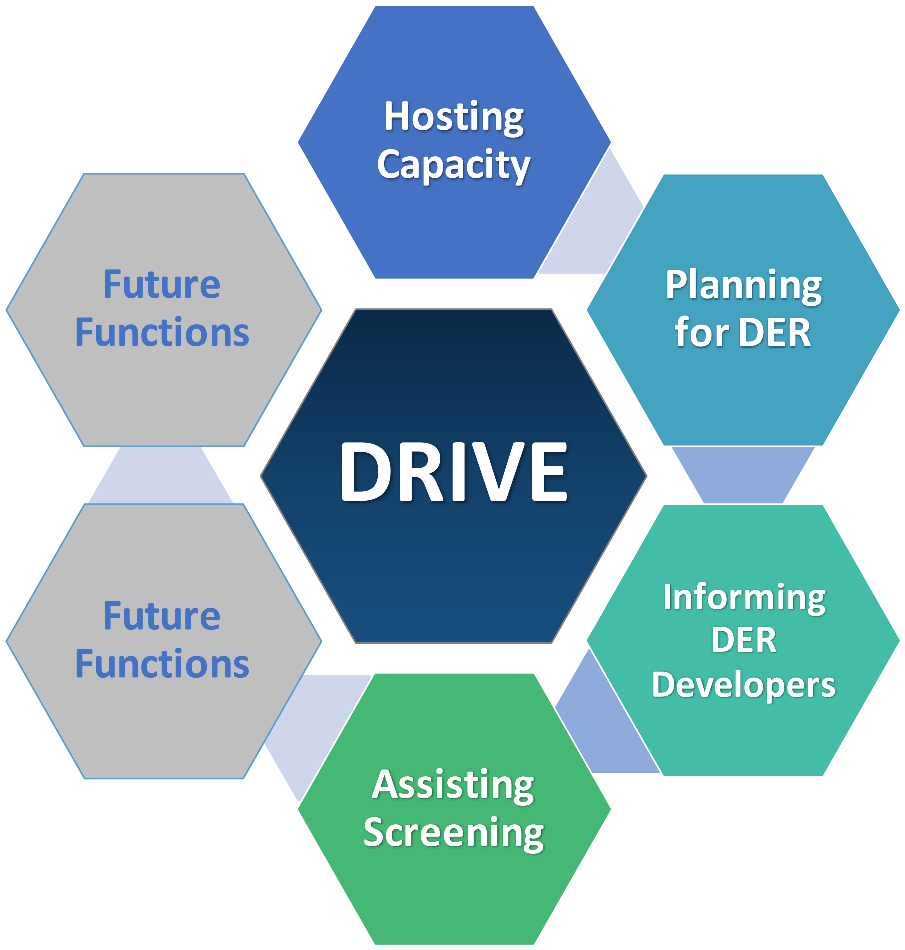
Matthew Rylander, Technical Leader
Power System Studies
mrylander@epri.com

ICAWG
September 19, 2017

Why Use Hosting Capacity?

- Enable DER Planning
- Inform Developers
- Assist Interconnection Screening

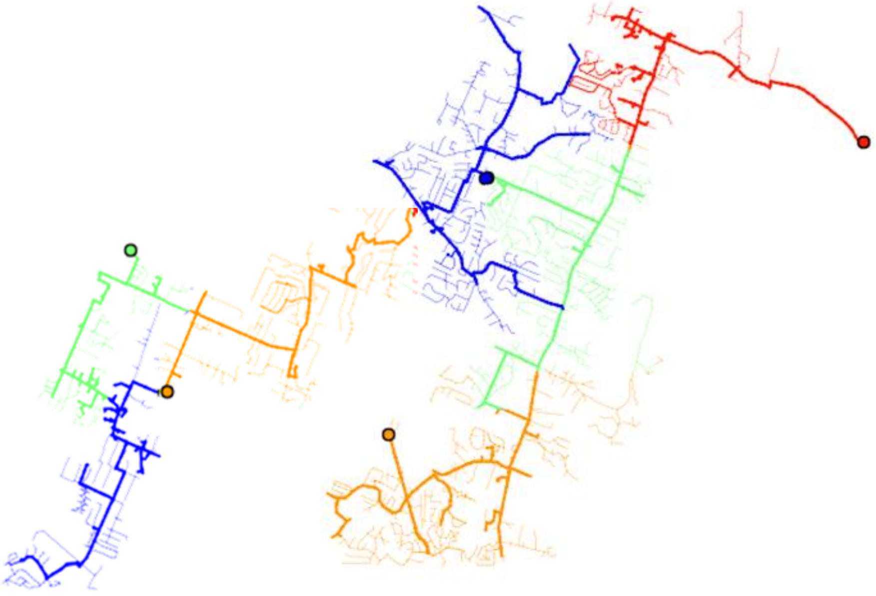
- Assist Operational Dispatch

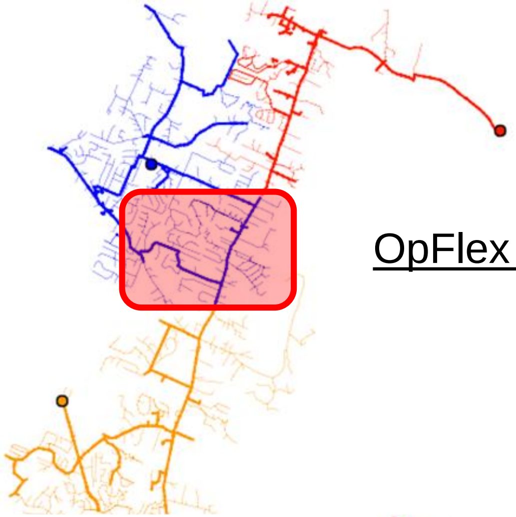


Operational Flexibility Scenarios

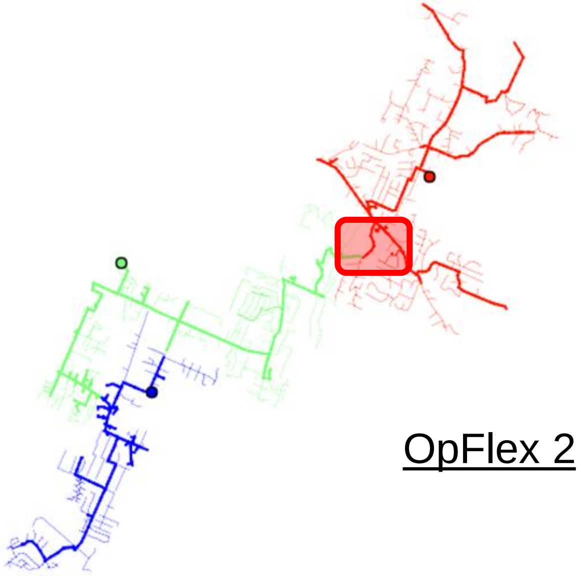
Feeder Reconfiguration under High-Penetration PV Conditions. EPRI, Palo Alto, CA: 2015. 3002005792.

Normal





OpFlex 1

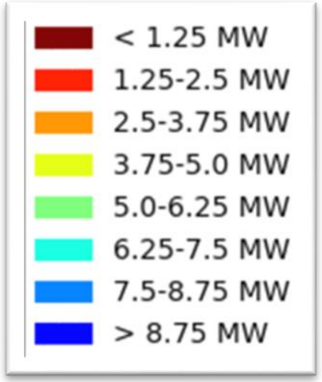


OpFlex 2

Hosting Capacity During Operational Flexibility

Not all reconfigurations result in significantly lower hosting capacities.

- **Abnormal #1** does not greatly affect the feeder-aggregate hosting capacity because the added elements are near the feeder head. This does not greatly change the overall feeder voltage profile or the Overvoltage Hosting Capacity.
- **Abnormal #2** decreases the feeder-aggregate hosting capacity due to added elements remote from the feeder head. This can significantly change the overall feeder voltage profile and Overvoltage Hosting Capacity at remote locations.

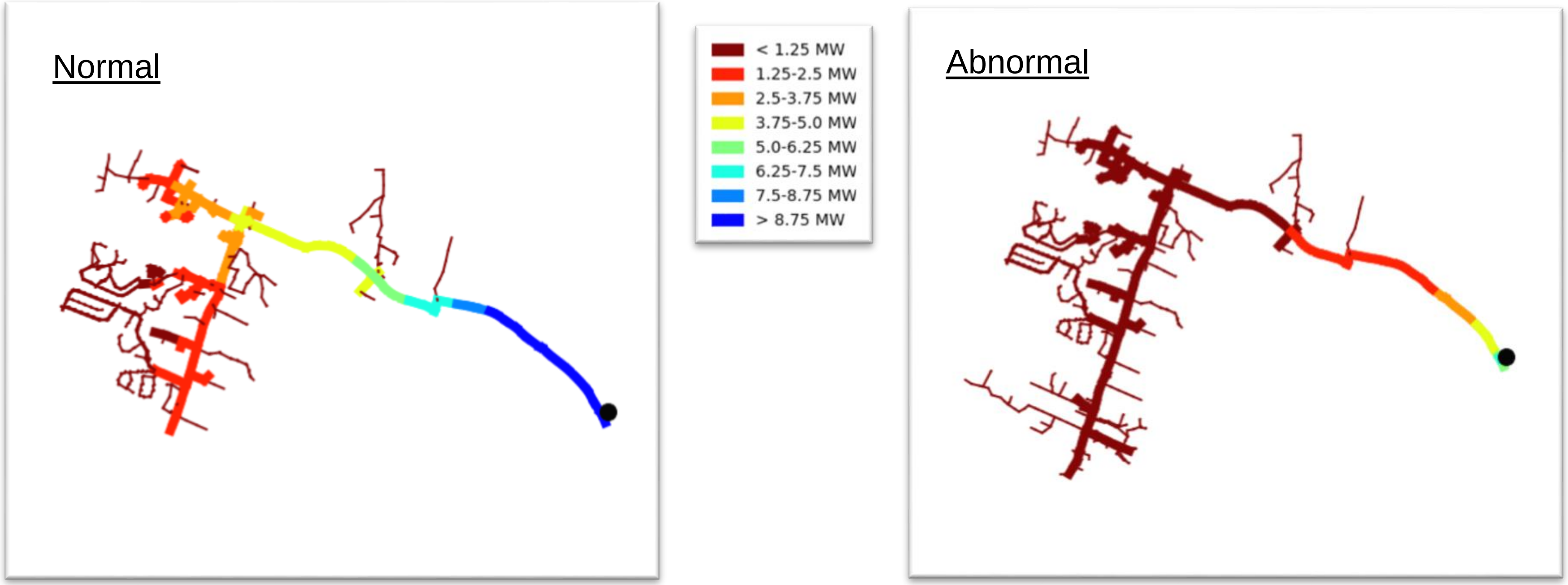


Normal | Abnormal #1 | Abnormal #2

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Hosting Capacity During Operational Flexibility

- The feeder hosting capacity value is dependent on the configuration of the feeder
- It might be impractical to pre-calculate hosting capacity for all operational scenarios
- It might be more practical to recalculated hosting capacity on a daily basis in the Distribution Operations and use those results to potentially curtail DER



Summary

- Hosting capacity is dependent on feeder characteristics and feeder characteristics change when reconfigured.
- The feeder-aggregate hosting capacity can be greater than 50% less in the reconfigured state, however, not all feeder-aggregate hosting capacities decrease. Planning margins for a reduction in hosting capacity would be difficult to mandate.
- The best procedure to determine absolute minimum hosting capacity for feeders and/or nodes is to analyze each individual state.

Note:
The Normal planning criteria have been used in this analysis for all configured states. Some contingency conditions may allow relaxed planning criteria and thus hosting capacity in the abnormal condition would change.

Considering Operational Flexibility in Hosting Capacity

- It is hard to analyze each individual state of the system
- To analyze each state of the system the methods to calculate hosting capacity needs to be
  - Automated
  - Efficient
- It might be impractical to pre-calculated hosting capacity for all operational flexibility scenarios
- It might be more practical to recalculated hosting capacity on a daily basis in the Distribution Operations and use those results to potentially curtail DER

Together…Shaping the Future of Electricity

Integration Capacity Analysis (ICA) – Working Group

IOU Slides – Load Modifying resource

September 19, 2017

ICA for Load Modifying resources

- From the ICA WG scoping document:

  Objective: The interim long-term refinement report details initial proposed scoping questions on this non-consensus topic. The WG should aim to refine and clarify the topic, determining what are appropriate analyses or studies to undertake to develop a potential methodology.

  Scoping Questions: Is it realistic, and does it improve the ICA, if the following are further studied for potential inclusion or modification in the ICA?

  1) probabilistic modeling approaches (e.g., inclusion of resource reliability/uncertainty variables);

  2) resource impacts modeled on specific key indicators of ICA;

  3) potential impacts of new and existing load modifying resources on ICA, based on their impact of historical and forecast load profiles on the distribution grid?

- From the WG report:

  Load Modifying Resources – We propose that all DERs (i.e. energy efficiency, demand response, distributed generation and storage, EV, and other demand-side resources) be classified as load-modifying (LM) resources

ICA for Load Modifying resources – Scoping Questions

- 1) probabilistic modeling approaches (e.g., inclusion of resource reliability/uncertainty variables);
  - The use of probabilistic approaches for ICA will degrade its use for interconnection, as interconnection studies are deterministic in nature
  - DER providers need certainty regarding the impacts of their system

  IOU Proposal: No Change to the ICA
- 2) resource impacts modeled on specific key indicators of ICA;
  - **Similar to (1), utilizes probabilistic approaches**
- 3) potential impacts of new and existing load modifying resources on ICA, based on their impact of historical and forecast load profiles on the distribution grid?
  - Existing DERs are part of the load profile of the circuit
  - IOUs do not have visibility into the individual operating profiles of existing DERs

  IOU Proposal: No change to the ICA

ICA: Function and Purpose

Function

- ICA is a tool to identify the limits of the existing and future distribution system to incorporate DERs without significant upgrades

Purpose

- ICA can be used by DER providers to identify optimal locations for interconnection
- ICA can be used to identify circuits/substations where grid mod upgrades may increase hosting capacity

Presentation of Queued Projects

IOUs agree that Queued generators would be added to the ICA monthly update:

- Based on Application Deemed Complete
- Based on when a Point of Interconnection has been determined
- Update will also take into account withdrawn generator projects

Integration Capacity Analysis (ICA) – Working Group

IOU Slides – DERs that serve Peak load conditions

September 19, 2017

ICA for serving peak load conditions

- From the ICA WG scoping document:

  Objective: The ICA WG will evaluate whether a proposal to add four additional load shapes to ICA would allow DERs to better serve high-load conditions while maintaining grid stability at low-load conditions.

  Scoping questions: Additional discussion is necessary to determine data requires for producing additional profiles, and level of effort needed to analyze additional profiles, with consideration of expected results, computational time, engineering resources, and other constraints.

- From the WG report:

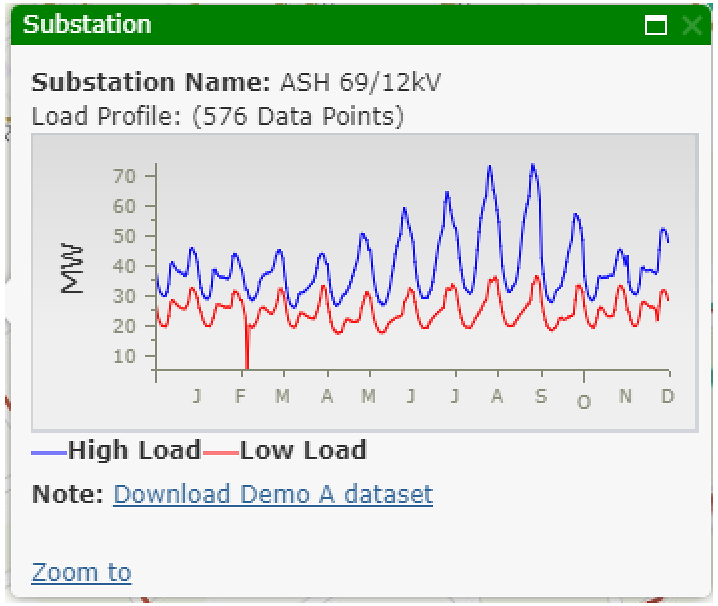
  Therefore, we ask that additional ICA profiles for occupancy and temperature driven load patterns be developed as part of the long term refinement. In practice, this could mean that ICA would provide four minimum ICA profiles as listed in the table below (where “Cold” could mean any day with a forecast high temperature below some agreed upon monthly threshold; “Hot” otherwise):

	“Hot” Day	“Cold” Day
Weekday		
Weekend		

  With such information, DERs could safely begin to serve the higher loads…and then self-restrict generation during times of low net load.

ICA for serving peak load conditions – IOU Perspective

- DEMO A included 576 hours of analysis
- Both high and low load curves were included
  - High load values can represent "weekday/hot" curves
  - Low load values can represent "weekend/cold" curves
  - Other weather/date combinations will lie between these two
- The current ICA curves allow users to identify high load opportunities while adhering to low load limits
- ICA will continue to be determined by most limiting factor
- Real time dispatch restrictions may be higher or lower than identified ICA limit due to operating conditions
  - ICA is an interconnection/planning tool, not an operating tool



Creating additional ICA curves provide little to no value above the existing ICA curves

Locational Net Benefit Analysis Working Group

September 19, 2017

In-person meeting

drpwg.org

Agenda

Time	Topic
1:30 – 1:40	A. Intros, overview, schedule
1:40 – 2:00	B. Recap of Proposed Decision
2:00 – 2:45	C. Incorporate forecasting uncertainty metric (joint IOUs)
2:45- 3:00	D. Only use base DER growth forecast scenario (joint IOUs)
3:00 – 3:50	E. Situational awareness - Joint IOUs - SEIA
3:50 – 4:00	F. Wrap up and next steps

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Future meetings

September (Group II):

- Incorporate a forecasting uncertainty metric in LNBA for planning deferrable projects
- Only use base DER growth scenario
- Explore possible value of situational awareness

October (Group III):

- Methods for evaluating location-specific benefits over a long term horizon that matches with the offer duration of the project (includes unplanned grid needs, locational value beyond 10 years)
- Explore asset life extension/reduction value
- Include benefits of increased reliability (non-capacity related) provided by DERs
- LNBA should value benefits of DERs reducing the frequency/scope of maintenance projects
- Include benefits of DER penetration allowing for downsized replacement equipment due to be installed in the case of equipment failure or routine replacement of aging assets

November (Revisit priority topics from Group I/other topics as necessary)

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MORE THAN SMART

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LNBA WG Progress To Date

Group	Item	Discuss	Proposal	Review
1	Locational Services from Smart Inverter	◐	◐	◐
	DER portfolio working in concert	●	●	◐
	Pre-loaded DER profiles	●	●	◐
	VAR profiles *(Collapse under Smart Inverter)*	●	◐	◐
	Locational Energy	●	◐	◐
	Locational Capacity	●	●	◐
	Locational Losses	◐	◐	◐
	Transmission Sub-team	◐	◐	◐
2	Uncertainty metric for planned projects *(today)*	○	○	○
	Use base DER growth scenario *(today)*	○	○	○
3	Locational long-term benefits/unplanned needs beyond 10-years	○	○	○
	Situational Awareness *(Collapse under Smart Inverter)* *(today)*	◐	○	○
	Asset life extension	○	○	○
	Maintenance	○	○	○
	Downsizing replacement equipment	○	○	○

Goal is to construct WG final report from proposal(s)/decision to table and summaries of discussion/feedback for each.

● = Completed ◐ = In Progress ○ = Upcoming

Locational Net Benefits Analysis (LNBA) Working Group

IOU Slides
September 19, 2017

Item 7: Uncertainty Metric for Deferrable Projects

- Group 2, Item 7, ACR Language:
  - "Incorporate (forecasting) uncertainty metric in LNBA tool for planned deferrable projects."
  - "Requires coordination with development of deferral screening criteria under development in DRP Track 3 Sub-Track 3"

Item 7: Uncertainty Metric for Deferrable Projects

- “Project Certainty” in this context is defined by the year in which the projected distribution need is forecasted to occur

- Not related to the certainty to which DERs can be successful in meeting the distribution need

DRP Track 3 Sub-Track 3: DIDF

- Joint IOUs proposed two initial deferral screens

Illustrative Screens	Description
Technical Screen	Determine whether DERs can meet the identified need • Based on services identified in the IDER OIR
Timing Screen	Determine whether the DER solution can be deployed before the need date • Project type and complexity drive differing lead times

- Projects that pass both the technical screen and timing screen are determined to be potentially deferrable by DER and thus incorporated into the LNBA

DRP Track 3 Sub-Track 3: DIDF

- DIDF - Planned Project Certainty
  - IOUs propose certainty metric be applied for DER deferrable project prioritization in order to select projects to be included in an RFO for DER products/services
  - ORA/TURN propose a forecast certainty metric to further screen out DER deferrable projects

- Both proposals are compatible and can achieve the goal of selecting the most certain projects for potential DER deferral

Applying Project Certainty

- Certainty relates to the projected year in which the distribution capacity limits are forecasted to be exceeded
- Certainty is a qualitative metric relative to timing of distribution need and the load/generation driving the need
- Projects can be rated/prioritized by applying the qualitative certainty metric

Metric	**High Certainty**	**Low Certainty**
Project Timing Certainty	• Distribution need closer to present day • Capacity limits persistently and significantly exceeded in the same forecasted year throughout multiple planning cycles • Received formal requests to interconnect load and energize transformers	• Distribution need further away from present day • Capacity limits are exceeding in varying forecasted years throughout multiple planning cycles • Tentative load interconnection from master developments, but no formal requests

Proposal – LNBA & Planned Project Certainty

1. All potentially deferrable projects will be included in the LNBA
2. Qualitative certainty metric will be one metric utilized to select potential deferrable projects that would be included in a RFO for DER products/services
   - IOUs to develop a method to rate DER deferrable projects' certainty
   - Projects closest to present day while still allowing time for procurement, interconnection, and installation of DER
3. IOUs will display qualitative certainty metric rating on project pop ups in the LNBA mapping layer i.e. low, medium, high

Item 11:
"Only Use Base DER Growth Scenario, not high growth scenario"

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Context compared to Track 1 PD

- **Long-term Refinement Item 11: use of High Growth Scenario**
  - Contemplates analyses of multiple DER scenarios of “expected” or “potential” outcomes.
  - Purpose is additional analysis and understanding regarding identifying *needs that are expected to occur*, and investments/solutions for those needs (whether conventional investments or DER solutions)
  - Related to issues in Track 2 Sub-track 1. See August 9 ACR, Issue #8: “How the high and low DER growth scenarios may be used in the Grid Needs Assessment”
- **Track 1 PD: new counterfactual analysis to support 3rd use case**
  - Contemplates counterfactual scenario, a baseline “no programs” scenario to compare to planning forecast.
  - Purpose is not to determine future needs and investments, but rather to understand “what would have happened” without existing DER programs, solely for purpose of cost-effectiveness analysis of those programs.
- **Thus, two distinct questions:**
  - Should LNBA incorporate multiple growth scenarios to analyze what needs/investments are expected? (LT refinement item 11 and Track 3 Sub-track 1 ACR issue #8)
    - **Focus of this presentation**
  - Should LNBA incorporate a counterfactual “no programs” scenario? (Track 1 PD)
    - **Not currently in scope for Working Group**

Background to Item 11 on Growth Scenarios

- From ACR:
  - *May entail substantive discussion, but likely will not entail incremental methodology development; requires coordination with DER growth scenarios under development in DRP Track 3 Sub-track 1.*
- From MTS Scoping Document:
  - *Methodological choices for the high growth scenario and lessons learned from Demo B should be shared with the Track 3, sub-track 1 of the DRP (load and DER forecasts) and vice versa.*
  - *With additional information and knowledge gained through the conclusion of Demo B and the DER Growth Scenarios Working Group, are there possible methodological changes or alternatives to using the very high DER growth scenario that are within scope of the LNBA WG?*
  - *What ongoing coordination needs to be developed between the LNBA WG and Track 1 Sub-track 1 of the DRP?*

Growth Scenarios, Planning, and LNBA

- LNBA must remain consistent with distribution planning process
  - IOU planning process determines needs for investment (whether met via conventional or DER projects)
  - LNBA results are meaningless if divorced from IOU distribution planning
- Currently, IOU distribution investment plans uses a single forecast

Using multiple growth scenarios in planning is a Track 3 Issue

- Track 3 ACR on Growth Scenarios explicitly includes multiple scenarios.
  - See issue #8: "How the high and low DER growth scenarios may be used in the Grid Needs Assessment"
- Multiple forecasts introduce challenges and complexity
  - IOUs may not be sufficiently resources / have sufficient tools to execute complete distribution planning process multiple times in a single year.
  - Currently, no policy / protocol exists to reconcile multiple scenarios (e.g., decision process given competing results from different scenarios)
  - This is an important, complicated topic that should be discussed, but not in multiple venues simultaneously.
- Ultimately, planning process must drive toward a (single) plan for actual implementation
  - If multiple scenarios are considered, IOUs must still determine for each identified grid need whether immediate action is required (i.e. proceed with conventional and/or DER solution) or whether it is appropriate to delay until further information is received.
  - If planning considers multiple scenarios, unclear if LNBA should contemplate multiple scenarios, or simply track actual implementation plan.
    - This consideration should be discussed *following* Track 3 determination regarding if/how/when the planning process should incorporate multiple growth scenarios.

IOU Proposal

- Regarding multiple growth scenarios representing expected/potential future outcomes
  - LNBA should remain consistent with distribution planning process
  - When Track 3 has addressed the issue, consider appropriate refinements to LNBA
- Regarding new counterfactual “no programs” analysis
  - Addressed in Track 1 PD; not in scope for Working Group

Locational Net Benefits Analysis (LNBA) Working Group

IOU Slides
September 19, 2017

Item 13: Situational Awareness

- SEIA/Tesla slides 8/15 WG meeting:
  - Included “Data/Situational Awareness” as a “Smart Inverter Enabled Locational Benefit”
  - DERs can collect nodal level data
  - Data can be transmitted more frequently than utility data and aggregated/analyzed for utility use
  - Value could be calculated as the avoided cost of the utility-owned equipment (e.g. SCADA device) that would otherwise be installed to provide the service
  - http://drpwg.org/wp-content/uploads/2016/07/08.15.17-ICA-LNBA-deck.pdf

- 6/7/2017 ACR Language on Situational Awareness: Group 3, item 13

  “Explore possible value of situational awareness or intelligence”

  “Value of data-as-service for situational intelligence is likely hard to quantify on avoided or marginal cost basis, and is driven to some degree by Commission policy on the use of DER data for grid operations and/or planning”

- Makes sense to consider Situational Awareness under “Methods for valuating location-specific grid services provided by advanced smart inverter capabilities” (Group 1 topic)

Item 13: Situational Awareness

- IDER Competitive Solicitation Framework WG Final Report identified situational Awareness as non-consensus grid service, but included little detail:

Table 4: Additional Services

#	Additional Service	Description/example	Discussion
1	Grid visibility and situational intelligence	Measured conditions at the grid edge available second-by-second	Consensus additional service when data is not otherwise required
2	Reactive power support	Provided needed reactive power	Non-consensus. Disagreement over whether there is value beyond voltage regulation.
4	Conservation Voltage Reduction (CVR) benefits	Improved energy savings in a utility's CVR program due to smart inverters	Non-consensus. Definition of service may need to be developed further.

http://drpwg.org/wp-content/uploads/2016/07/2016-08-01-CSFWG-Final-Report-Joint-Competitive-Solicitation-Framework-Working-Group.pdf

Item 13: Situational Awareness

Joint IOU Perspective

- Agree with ACR that this service is "driven to some degree by Commission policy on the use of DER data," especially policy on the minimum data requirements for smart inverters
- To the extent that DERs can meet an actual need, the proposal to value this service based on avoided cost of utility-owned equipment that is otherwise needed to provide the service is reasonable
- However, key questions remain:
  - What data collection costs can be avoided by DERs?
    - This is not a typical service today. It is not clear which of today's costs can be avoided, if any. For example, data from DERs may not provide sufficient coverage to meet needs: If an IOU has a need for information on conditions on the distribution primary system, then customer-sited DERs on the secondary system are unlikely to be able to provide this.
  - Are there hidden costs of using DERs to provide grid data?
    - For example, data from new SCADA devices are easily integrated into existing UDC systems and tools; integrating data from non-SCADA, third-party devices may require additional hardware or software investment that should be accounted for when evaluating the least-cost solution.
  - What are the minimum interconnection requirements for smart-inverter-based DERs?
    - Some DERs (e.g. Large DG) are already required to have SCADA and generation meters to interconnect. At this time, the minimum requirements for smart-inverter-based DERs are still in development, including data-related requirements.

Item 13: Situational Awareness

Joint IOU Proposal

- Definition of "Data for Situational Awareness" service from DER:

  Provision to the utility distribution company (UDC) of grid information which is collected using DERs and which both 1) meets the requirements for a specified need (e.g. requirements for data type, detail, frequency, location, voltage level, security, completeness, etc.) and 2) is above and beyond minimum UDC requirements for the DER to interconnect.

- Valuation of "Data for Situational Awareness"

  Consistent with other distribution services, the value of this service is equal to the avoided RRQ of deferring the otherwise-needed capital investment calculated using the Real Economic Carrying Charge (RECC) method, or equal to the avoided RRQ associated with an expense that would otherwise be incurred to meet the same need.

Locational Net Benefit Analysis: Situational Awareness

Distribution Resources Planning Working Group

September 19, 2017

LNBA forum for valuing grid services

- LNBA should not be limited to benefits that are currently realized by DERs.
  - Grid services not simply about capacity deferrals
  - We must define values now even though how some grid services will be realized commercially has yet to be resolved (this is an outstanding task in the IDER proceeding)
  - Creating values does not mean that values are necessarily *used* in applications of the LNBA. What is important now is to ensure there is a value so that services can be valued as we define the means by which these values are realized in practice

What is Situational Awareness?

- Definition from DOE DSPx:

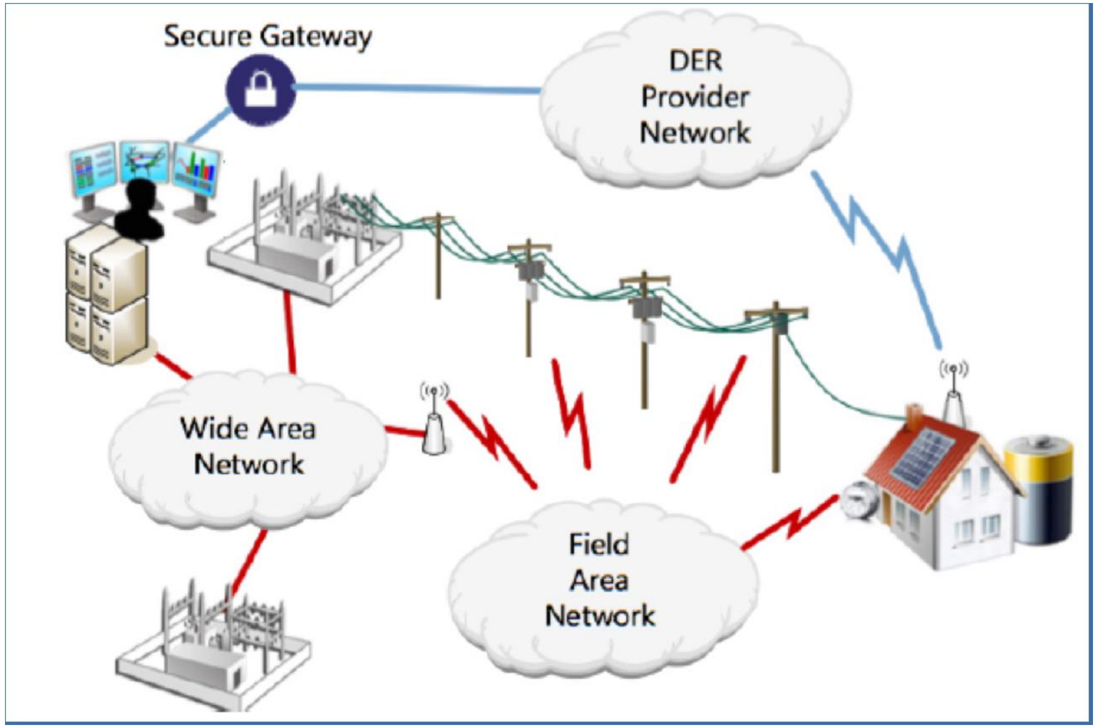
“The analog-to-digital transformation of the distribution grid requires a much **improved awareness of the current grid configuration, asset information and condition, power flows, and events** to operate the distribution grid reliably, safely, and efficiently. **This may include visibility of all steady-state grid conditions such as criteria violations, equipment failures, customer outages, and cybersecurity**. DER situational awareness is also required to operate a grid with high DER and optimize DER services to achieve maximum public benefit.”

Situational Awareness: Current Capabilities

- SCADA connected devices
  - Substation data
  - Some downstream SCADA data
- Advanced Metering Infrastructure
  - AMI meters capable of providing voltage data but generally only bringing back billing-related data
  - Radio networks only backhaul voltage and loading information from meters 1X per day; outage data can be communicated within 5 – 15 minutes.
- Result: limited and infrequent data on loading, power quality, and outages

Situational Awareness: Utility Proposals

- Utilities are seeking investments to improve their situational awareness:
  - Grid operations analysis and control systems:
    - ADMS
    - DERMS
    - GMS
  - Line sensors
    - Fault indicators
    - “smart” switches, capacitor banks, etc.
  - Improved telemetry
    - Wireless networks, greater bandwidth for more frequent communications with utility equipment and DERs



Situational Awareness: Utility Proposals

- What is the rationale of utility proposals?
  - What is the value of incremental reliability?
  - A fair assessment of any operational challenges created by distributed energy resources is needed
- Are these proposals cost effective?
- Are utilities leveraging capabilities of distributed energy resources in lieu of deploying more utility equipment?

DERs: a source of situational awareness

- Many distributed energy resources are deployed with monitoring equipment and communications-enabled smart inverters
- Third parties can feed data into utilities Distributed Energy Resources Management systems to:
  - Calculate gross load and more generally understand loading profiles
  - Identify faults for faster service restoration
  - Provide data at greater frequency than may be available through utility communications infrastructure
  - Provide nodal level data on power quality conditions

How to calculate a situational awareness avoided cost for LNBA

- Incremental cost of more frequent, customer-level data and provision of power quality information
  - additional bandwidth needed on wireless communications networks to backhaul data
  - Cost of additional metering to measure on site generation for calculating gross load
- Reduced truck rolls from better fault location (both length and frequency)
- Avoided cost of line sensors