GRIDWORKS

Rule 21 Working Group 2

IN-PERSON WORKSHOP

APRIL 4, 2018

OPERA PLAZA

REMOTE ACCESS: HTTP://WWW.UBERCONFERENCE.COM/GRIDWORKS/

Agenda

10:00 – 10:15: Introductions

10:15 – 10:30: Energy Division

10:30 – 12:15: Introduction to ICA (*Joint IOUs)*

12:15 – 1:00: Lunch

1:00 – 2:30: Scoping Discussion

2:30 – 3:00: Wrap Up and Next Steps

Introduction and Overview

On July 13, 2017, the Commission issued the Order Instituting this Rulemaking (OIR) in order to consider a variety of refinements to the interconnection of distributed energy resources under Electric Tariff Rule 21 of Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company (the Utilities), and the equivalent tariff rules of the small and multi-jurisdictional electric utilities.

Among the principal topics to be considered in the new rulemaking (R.17-07-007) is the incorporation into Rule 21 of the utilities' Integration Capacity Analysis (ICA) tools, currently under development in the Distribution Resources Plan (DRP) proceeding (R.14-08-013). The ICA tools use power flow analysis to determine the ability of a circuit to host distributed energy resources. Incorporating the ICA tools into Rule 21 may better inform interconnection siting decisions and further streamline the Fast Track process for certain projects.

CPUC Energy Division: Remarks

Rule 21 Group 2 Working Group Meeting

April 4, 2018

Topics

- ICA Road Map
- What is Integration Capacity Analysis (ICA)
- Components of ICA
  - 2018 requirements based on Track 1 PUC ruling
    - Thermal
    - Steady State Voltage (SSV)
    - PQ/Voltage Fluctuations
    - Protection
    - Operational Flexibility
- ICA Publishing
  - ICA/Load values

ICA Road map

- ***2013 - AB327 is passed –*** among other requirements, the bill "would require an electrical corporation, by July 1, 2015, to submit to the commission a distribution resources plan proposal, as specified, to identify optimal locations for the deployment of distributed resources"

- ***August 14, 2014 –*** PUC issues a rulemaking decision which stablishes the policies, procedures and rules on how IOUs should develop the Distribution Resource Plan (DRP)

- ***February 2015 –*** Assigned Commissioner Ruling (ACR) was issued which provided DRP guidance on the DRP which IOUs must file by July of 2015

- ***July 2015 –*** IOUs file DRPs which included a version of ICA maps based on directional methodologies (Streamline, representative circuits, etc.)

- ***August 2016 -*** PUC ruling DRP outlining the requirement for several demonstration projects. One of these demonstrations was Demonstration A (DEMO A) which would demonstrate two ICA methodologies as well as publishing of data for two Distribution Planning Areas (DPAs)

- ***December 2016 –*** IOUs complete demonstration project A, publish maps with ICA information, and provide circuit loading and criteria limitations as required by DEMO A for two DPAs

- ***October 2017 –*** PUC ruling on Track 1 Demonstration Project A provides ruling on which ICA methodology is to be used for system 2018 system wide deployment of ICA and requires that this be completed by July 2018 (focus on Interconnection Use Case)

What is Integration Capacity Analysis

- Also known or referred to as “Hosting Capacity Analysis” in several forums and research work activities
  - Not all hosting capacity is created the same

- The methodology used will specify how much DER hosting capacity may be available on the distribution network down to the line section or node level (DRP Guidance)

  Example for SCE

  - ***Approximately average of 600 nodes per feeder, 576 hours and several categories***
  - ***Approximately 10 billion data points***

- This analysis quantifies the capability of the distribution system to integrate DER within thermal ratings, protection system limits and power quality and safety standards (DRP Guidance)

- Perform an analysis using dynamic modeling methods using power flow modeling software tools and with heuristic approaches only when necessary (DRP Guidance)

Detailed ICA System Wide Implementation

Summary of final decision (Track 1) Issued Oct 2017

- ICA results are to be update on a monthly basis based for changes in circuits:
  - Circuits which have changed (configuration, new line sections)
  - Circuits which have changed loading (new load, load reduction, change in load profile)
  - Circuits which have new “significant” DER interconnected

- 576 hourly load profiles are to be used (Peak and minimum day for each month 24*2*12= 576 hours)

- Publish six ICA values on the maps (uniform generation, uniform load, Fixed solar PV)
  - Three with Operational Flexibility Limitation
  - Three without Operation Flexibility Limitation

- Data for ICA categories must available for download by the user

- Calculated ICA values must account for pre-existing conditions (Ex. Low voltage should not restrict generation ICA, High voltage should not restrict Load ICA)

- Used technology-agnostic approach which does not make assumptions on DER portfolios. Users can utilize an ICA translator to convert the uniform generation value to any type of DER technology.

- Include attributes circuit & substation ID, line section ID, Voltage, existing, queued and total generation, circuit and substation load profiles when confidentiality is not compromised, customer class breakdown

What is Considered/Included in ICA Calculations

1. ICA for all three phase nodes and line sections radial distribution feeders (circuits)
2. Account for feeder's electrical components Thermal Loading limitations (cable, conductor, VRs, etc.)
3. Account for deviations is Steady State Voltage (SSV) throughout the feeder.
   Injecting real power at one node must not overvoltage other ports of the circuit(s)
4. Impacts of DER to Protection systems. *Injecting DER at one node must not desensitize the relay to a point that it cannot effectively protect the system*
5. Impacts of DER to Voltage Fluctuations and Power Quality(PQ). *The value of ICA must be limited to not create significant voltage changes in system voltage*
6. Impacts of DER to Operational Flexibility. *The level of DER connected limited to not inhibit the ability to reconfigure the distribution system as necessary for operations*

   Two values are determined

   1. ICA values not accounting for Operational Flexibility
      ICA With **N**o **O**perational **F**lexibility(**ICAWNOF**)
   2. ICA values accounting for Operational Flexibility
      ICA With **O**perational **F**lexibility(**ICAWOF**)

What is Not Considered or Included in ICA Calculations

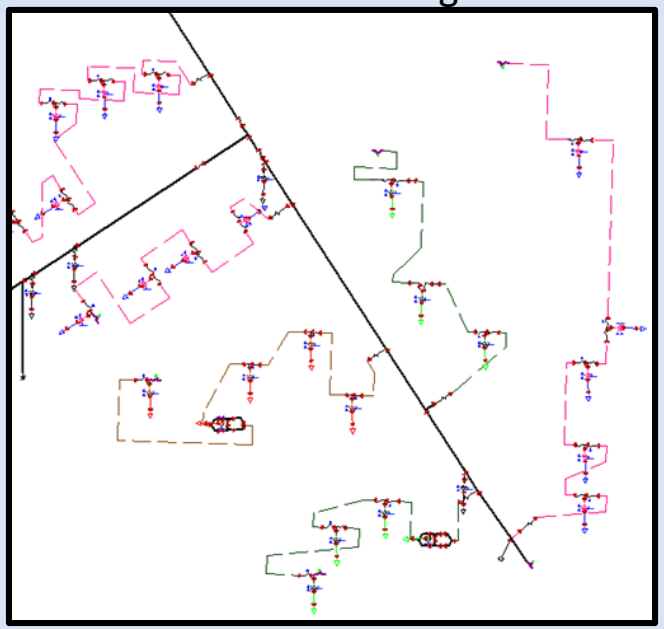
1. Substation Level ICA limitations(Txfmr Banks, busses, CBs)
2. Subtransmission/Transmission Limitations
   - Stability/Capacity
3. Secondary Networks
4. Secondary systems, service drops, service transformers
5. ICA values for rotating machine (Synchronous or Induction Generation)
   a. ICA uses 1.2p.u SCD contribution which is for inverter based technology
6. Single Phase radials
7. Smart Inverter functionality – Volt/Var with reactive power priority
   a. Pending PUC decision
   b. Pending tool development advancements
8. All PV system configuration– PV ICA only addresses PV installation equivalent to what was used in PV-Watts® when determining regional PV profiles
   a. Does not address tracking systems, inverters limit output, etc.
9. Technology specific ICA – (Customer may use the uniform ICA values with translator to develop technology specific ICA values)
   1. PV+ storage, PV with trackers, peak shaving storage, etc.

Thermal ICA value

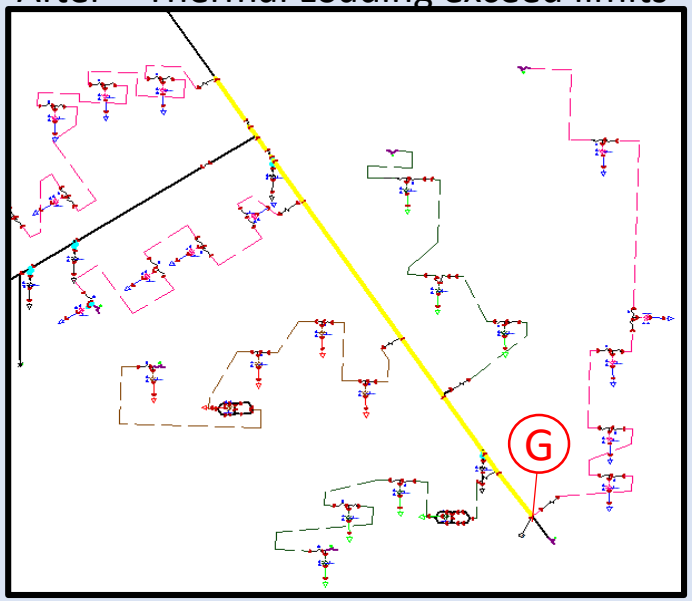
What it is: The maximum amount of load or generation ICA which can be connected to a node without exceeding the thermal value of any conductor or apparatus in the feeder.

How is it derive: Iterative power flows are used to determine the maximum value which can be connected at each node before a thermal overload occurs. (in this example – CYME is programed to show Yellow when thermal loading is exceed .

Before – Thermal Loading within limits



After – Thermal Loading exceed limits

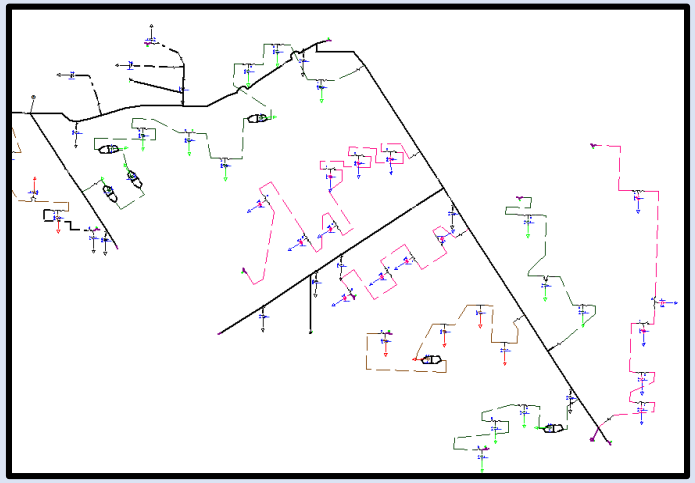


Steady State Voltage (SSV) ICA value

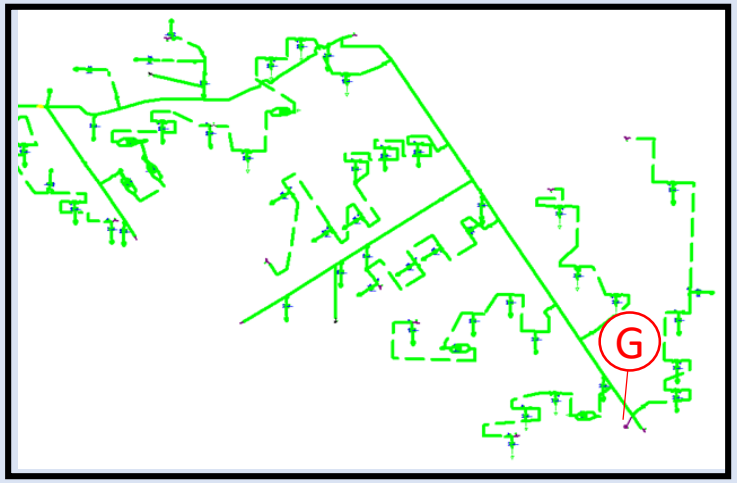
What it is: The maximum amount of load or generation ICA which can be connected to a node without moving the voltage at any part of feeder outside the range of +/-5% of nominal (For 120V, the range would be 114V to 126V)

How is it derive: Iterative power flows are used to determine the maximum value which can be connected at each node before the voltage deviates from the range (in this example – CYME is programed to show **green** when threshold is exceed .

Before – Voltage within thresholds



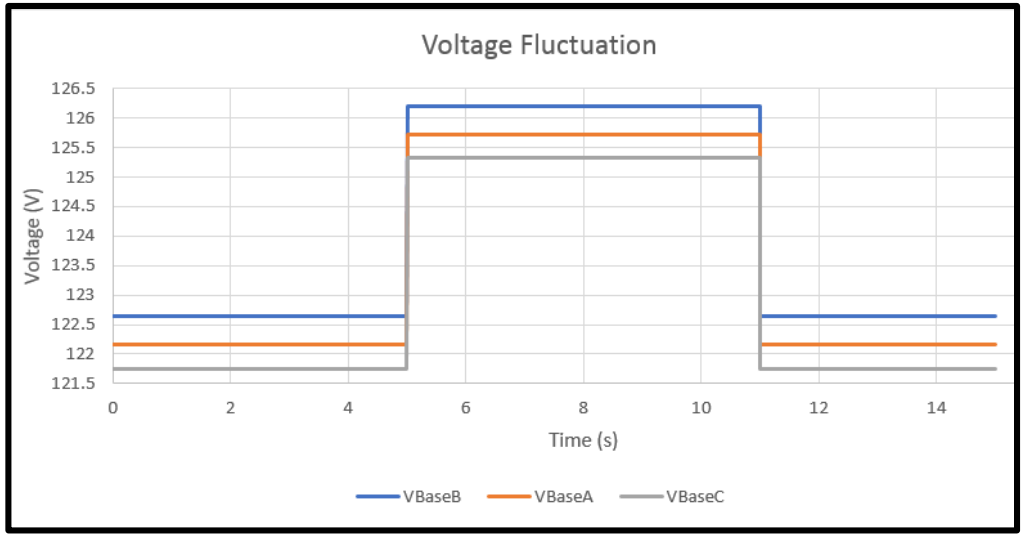
After – Voltage exceeds thresholds



PQ/Voltage Fluctuations

What it is: The maximum amount of load or generation ICA which can be connected to a node without changing the voltage by more than 3%.

How it is derived: The ICA power flow tool will simulate the DER turning on and turning off and will compare the voltages before and after to determine change in voltage and % change.



$$\% \triangle = \| \ (Va - Vb)/Vb * 100$$

Where
Vb = Voltage measurement with DER **off**
Va = Voltage measurement with DER **on**

Example (from Graph)
Vb=121.575
Va =125.25

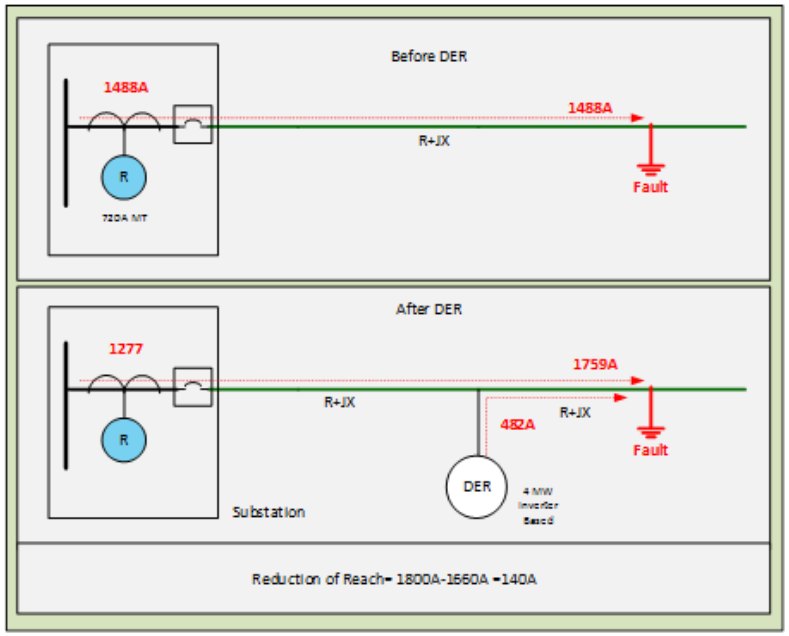
$$\% \triangle = \frac{125.25 - 121.575}{121.575} * 100$$

$$\% \triangle = 3.0\% \text{ (Maximum ICA limit)}$$

Protection ICA Value

What it is: The maximum amount of load or generation ICA which can be connected to a node without reducing the protection device's ability to detect faults. This is also referred to as reduction of reach.

How it is derived: The ICA power flow tool performs a fault flow analysis to evaluate the reduction in fault current flow at the protection sensing devices due to DER being connected downstream from the protection sensing device. ICA is limited to when DER reduces fault at sensing relay to less then 2.3*Minimum Trip Setting



Before – Meets Criteria

Fault Current seen by Prot. Dev. (A)	Fault Current (A)	Protected
1488.54	1488.57	Yes

MT=600
Multiple =1488/600
=2.48 (meets ICA criteria)

After – Fails Criteria

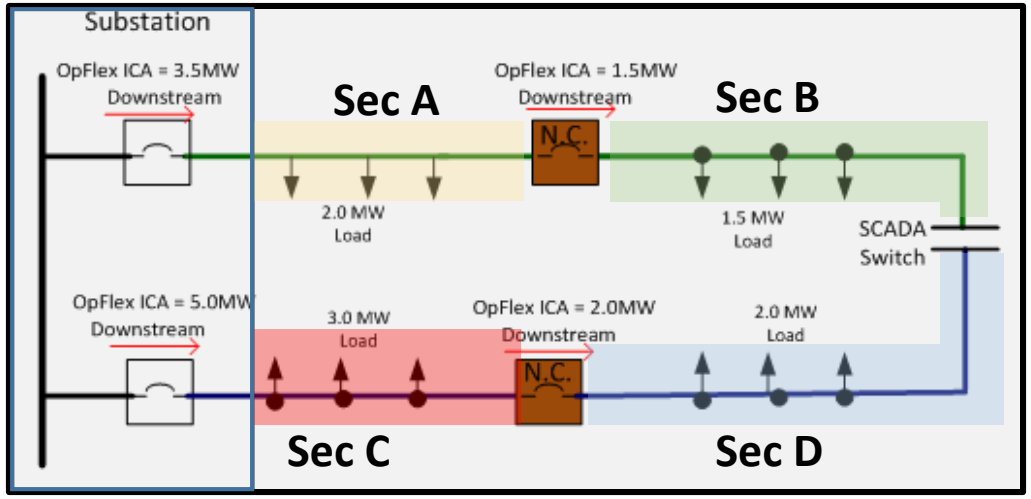
Fault Current seen by Prot. Dev. (A)	Fault Current (A)	Protected
1277.1	1759.89	No

MT=600
Multiple =1277/600
=2.12 (Fails ICA criteria)

ICA With Operational Flexibility ICA value (ICAWOF)

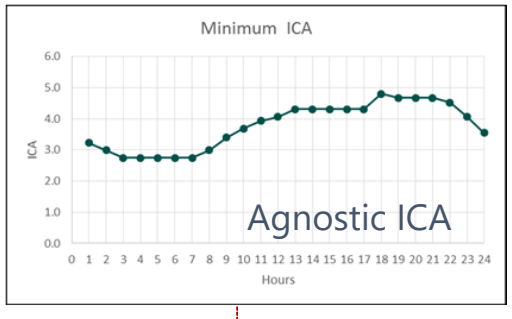
What it is: The maximum amount of load or generation ICA which can be connected to a node without exceeding loading beyond an automated SCADA switching devices

How it is derived: The ICA power flow tool determined the amount of load connected beyond the automated SCADA switching device. The ICAWOF value is limited to the amount of load beyond the SCADA switching device.



Section	ICAWOF
A	3.5MW
B	1.5MW
C	5.0MW
D	2.0MW

Typical Fixed PV ICA Value



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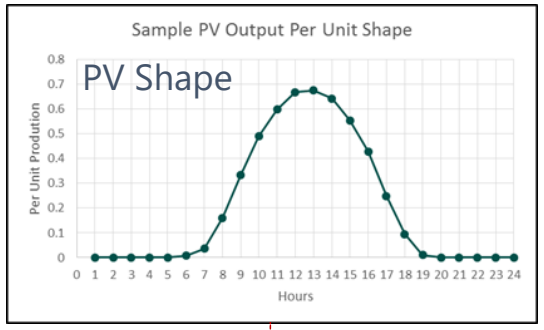

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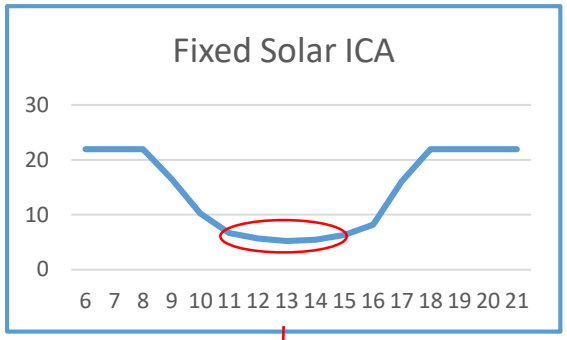
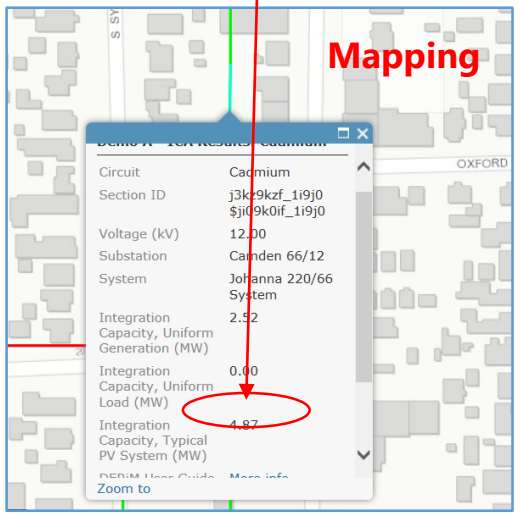


ICA Value – From
- Thermal
- Voltage
- PQ/Voltage Fluctuations
- Protection
- System Flexibility

- Typical PV shape from PV-Watts Tool
- 95th percentile curve

PW Watts Parameters
- DC size = Normalized to 1.0
- Module Type = Standard
- System Losses = 14%
- Tilt = 18 Degrees
- DC-AC ratio = 1.0
- Inverter Efficiency = 96%

THESE PARAMENTERS MUST BE CONSIDERED



ICA Values Publishing (Example)

The following ICA Generation values are calculated for a particular 3 phase node

Thermal (MW)	SSV(MW)	PQ (MW)	Protection (MW	Op-Flex (MW)
3.5	**3.76**	**5.9**	**6.5**	**2.75**

(1) Uniform Generation **ICA W**ith **O**peration **F**lexibility (ICAWOF)

$$ICAWOF = lower(Thermal, SSV, PQ, Protection, Op - FLex) = \mathbf{2.75\ MW}$$

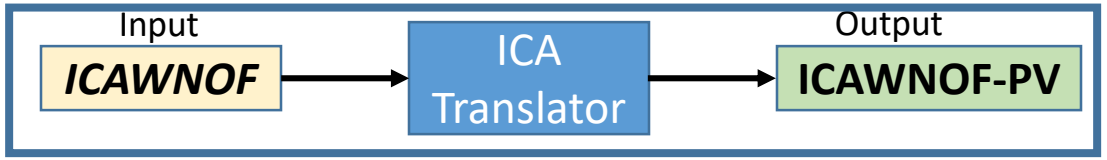
(2) Uniform Generation **ICA W**ith **N**o **O**peration **F**lexibility (ICAWNOF)

$$ICAWNOF = lower(Thermal, SSV, PQ, Protection) = \mathbf{3.5MW}$$

(3) Fixed Solar PV **ICA W**ith **O**peration **F**lexibility (ICAWNOF - PV)

ICA translator developed from PV Watt ® tool at the regional level

(4) Fixed Solar PV **ICA W**ith **N**o **O**peration **F**lexibility (ICAWNOF - PV)

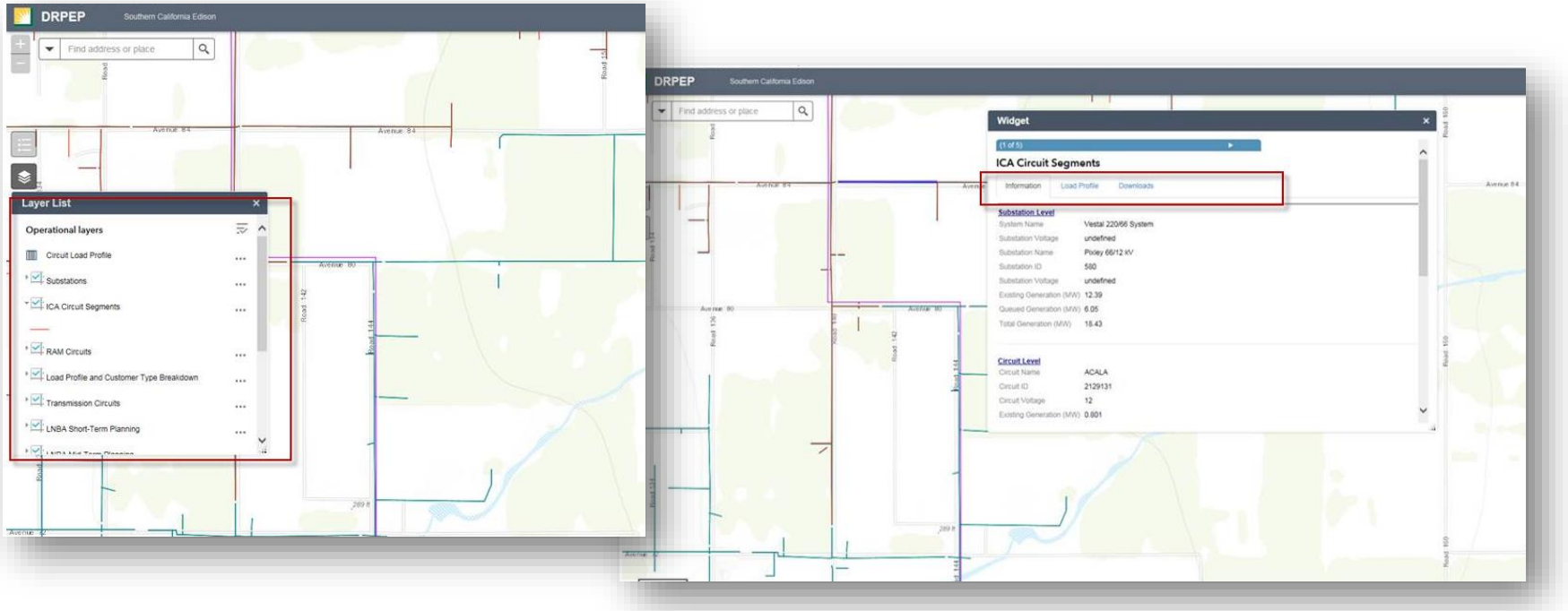


ICA translator developed from PV Watt ® tool at the regional level

(5 & 6) Load ICA. Same both With and Without Operational flexibility

Publishing – ICA Results (SCE Platform)

Deployment	Functionality
July 2018	Publish system-wide ICA to public

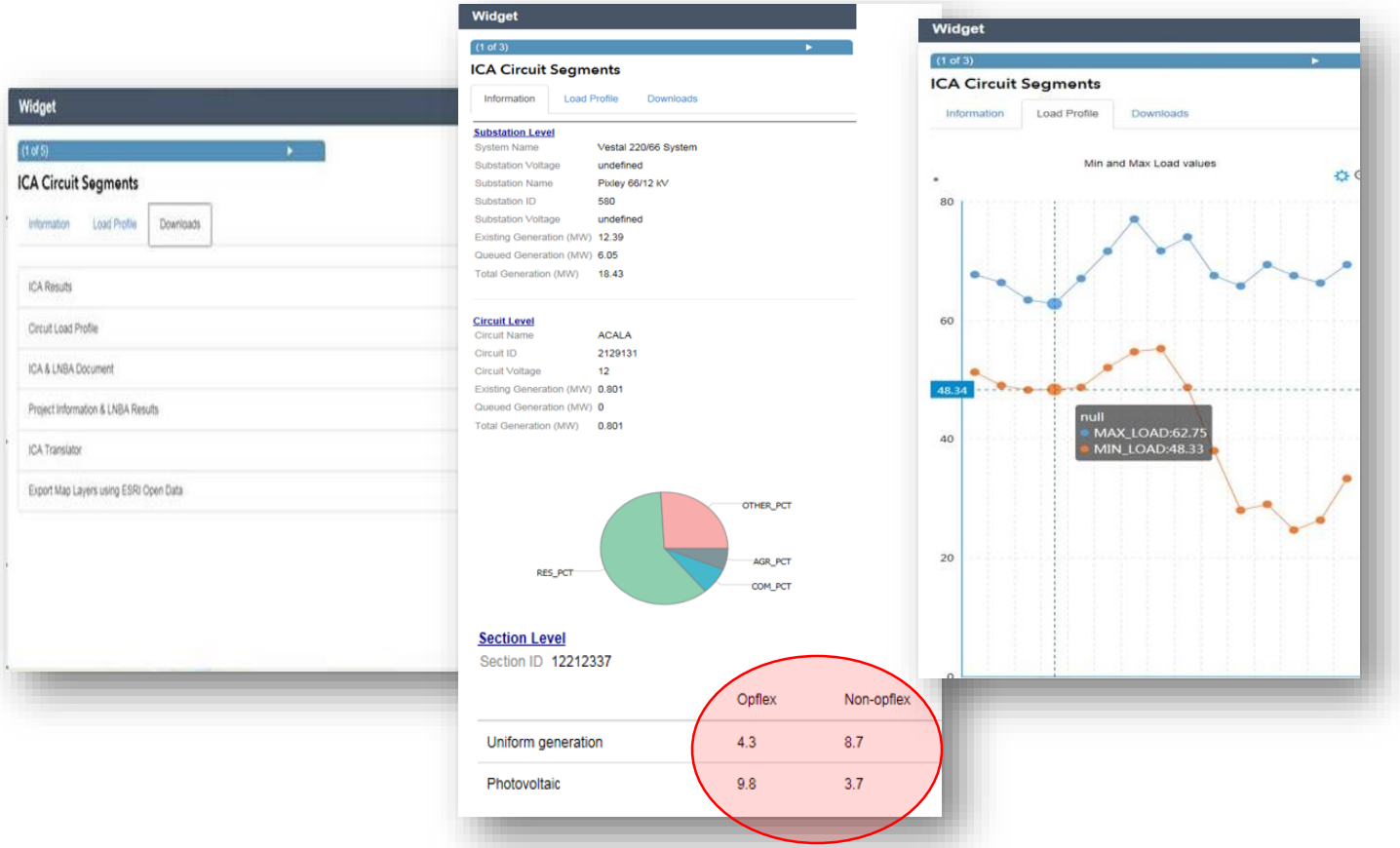


Tool – DRP External Portal (DRPEP)

- User can select the desired Layer – **<u>Will be defaulted to ICA layer</u>**
- User can select to view the circuit and loading profiles
- Use can download information
- **All Demo A layers and information will be removed once system wide has been deployed**

Publishing – ICA Results (SCE Platform)

Widget Functionality to Publish Required Datasets



- **ICA Results**
- **Substation/circuit level information**

Scoping Issues: Draft Schedule

There are five issue topics scoped for this Working Group. The schedule should be based on prioritization, but also take into consideration the development of issue proposals - the WG should only discuss a topic on a particular workshop date if there are proposals to discuss. The WG should look to wrap up issue development by August 21 at the latest to leave room for finalization of Issue Proposals.

Issues 8, 9, 10, and 11 will be discussed in order. Issue 6 will be discussed as a separate subgroup.

Gridworks has identified a definitive START date for each issue and a proposed wrap-up date, that can be adjusted, after considering tradeoffs.

Scoping Issues: Draft Schedule

APRIL

Wednesday, April 4: Kickoff

Wednesday, April 11

Tuesday, April 17

Wednesday, April 24

MAY

Wednesday, May 2

Wednesday, May 9

Tuesday, May 15

Proposed- Issue 8

Tuesday, May 23

Wednesday, May 30

JUNE

Wednesday, June 6 – LA/SD

Wednesday, June 13**

Monday, June 18 (*tentative*)

Wednesday, June 27

Proposed- Issue 9

** proposed start – Issue 6 subgroup

BOLD: In Person

Scoping Issues: Draft Schedule

JULY

Tuesday, July 3

Wednesday, July 11

Tuesday, July 17 – LA/SD

Wednesday, July 25

Proposed- Issue 10

AUGUST

Wednesday, August 1

Wednesday, August 8 –LA/SD

Tuesday, August 14

Tuesday, August 21

Wednesday, August 29

Proposed- Issue 11

**Gridworks turns in final draft of Issue Proposals by Sept. 3, CPUC ED has final pen over Final Report, due Monday, Sept 17*

BOLD: In Person

Scoping Issues: Roles and Responsibilities

Gridworks has been hired as the Facilitator to 1) develop a Work Plan; 2) support and facilitate WG meetings; and 3) facilitate the development of Issue Proposals. Gridworks plans to work closely with all stakeholders to develop Issue Proposals (*see slide 25-26).*

CPUC Energy Division serves a co-facilitation role and will be responsible for editing the draft and final reports.

Joint IOUs plays a partial role in developing the agenda, present IOU proposals, and perspectives on non-IOU proposals. The IOUs will also respond to and provide clarification when non-IOU stakeholders represent IOU processes and IOU perspective on non-IOU proposals.

Scoping Issues: “Issue Proposal”

An **“Issue Proposal”** is defined as a summary of the issue at hand and proposals to address the questions stated in the ACR, including the viewpoints of all organizations. The issue proposal will track consensus, non-consensus, majority, and minority opinions on recommendations and be a fair and accurate representation of the issue and discussion at hand. Stakeholders may submit written comments to include a specific stakeholder opinion to be included in the issue proposal. Gridworks will take a neutral position and will not provide their own policy recommendations or advocate positions.

Scoping Issues: “Issue Proposal” Drafting

Gridworks will endeavor to circulate a draft issue proposal 2 weeks before an Issue is identified to wrap up in the draft schedule, for written comments. This draft will represent a summary and status of stakeholder recommendations to date, not necessarily representing final recommendations. Written comments are due in one week. Gridworks will make edits to reflect written comments and any final changes in discussion or position.

Scoping Issues: “Issue Proposal” Drafting

A second draft will be presented on August 21. August 21- September 3 will be used to revise language or individual positions, but not to raise new issues or recommendations. Gridworks will work closely with stakeholders to develop the Issue Proposals and additionally envisions multiple rounds of informal consultations, both during issue discussion and near the end of the WG process. During the second draft, the IOUs may also make clarify statements about utility practices and positions made by any WG member, including non-IOU stakeholders. During the revision process, parties will also have chance to add supporting or opposing arguments to recommendations, but new recommendations will not be accepted unless they are consensus recommendations.

Scoping Issues: “Scoping Memo”

The goal for the scoping memos is to form a quasi schedule for each issue, as well as to discuss what is in and out of scope

Gridworks, IOUs, and other interested stakeholders will use the March 14 and April 4 workshops’ presented information and resulting stakeholder discussion to begin developing scoping memos for each topic, Gridworks may hold the pen and coordinate additional conversations with WG members to develop collaborative scoping memos. Scoping memos should be finalized at the start of discussion for each issue, rather than finalize the scope of all five issues upfront.

Scoping Issues: “Scoping Memo”

Gridworks received comments from the following parties:

Tam Hunt, GPI

Sahm White, Clean Coaliton

Deborah Galimba, X Utility

Jin Noh, CESA

Andy Schwartz, Tesla

Sky Stanfield, IREC

Lillian Rafii, Small Business Utility Advocates

Scoping Issues: Review of Issues

Issue 8: How should the Commission incorporate the results of the Integration Capacity Analysis into Rule 21 to inform interconnection siting decisions, streamline the Fast Track process for projects that are proposed below the integration capacity at a particular point on the system, and facilitate interconnection process automation?

Issue 9: What conditions of operations should the Commission adopt in interconnection applications and agreements to allow DERs to perform within existing hosting capacity constraints and avoid triggering upgrades?

Issue 10: How can the Commission coordinate the ICA and each Utility's Rule 21 processes with the Rule 2, Rule 15, and Rule 16 processes in order to improve efficiency of the overall interconnection process? This is a coordination issue at this time. However, modifications to Rule 2, 15, or 16 will be addressed if necessary.

Scoping Issues: Review of Issues

Issue 11: Should the Commission adopt a notification-based approach in lieu of an interconnection application for non-exporting storage systems that have a negligible impact on the distribution system? If so, what should the approach entail?

Issue 6: Should the Commission require the Utilities to develop forms and agreements to allow distributed energy resource aggregators to fulfill Rule 21 requirements related to smart inverters? If yes, what should be included in the forms and agreements?

Next Steps

April 11 meeting: focus on Issue 8