GRIDWORKS

Rule 21 Working Group 2

IN-PERSON WORKSHOP

APRIL 25, 2018

CPUC GOLDEN GATE ROOM

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

Agenda

10:00 – 10:10: Intro and agenda

10:10 – 10:40: Revisit guiding principles and concept proposal (expedited process, fast track process, normal interconnection process)

10:40 – 11:25: PV ICA value application -concept discussion

11:25 – 12:30: ICAWOF limit and mitigation options (e.g., operational constraints, curtailment, etc.) – concept discussion

12:30 – 1:30: Lunch

1:30 – 2:00: Stakeholder presentation on R21 and ICA automation (GPI and Clean Coalition)

2:00 – 2:30: Streamlining remaining R21 screens – preliminary discussion

2:30 – 3:00: Next steps, assignments, schedule

Recap of Issue 8 discussion to date:

April 4:
- "ICA 101"
- Scoping Memo
- Schedule and Process

April 11:
- Refining the Scoping Memo
- Concept discussion: applying ICA to Rule 21 screens
- Concept discussion: revised Rule 21 process

April 18:
- Concept discussion: Streamlining Screens F, G, L
- Initial discussions: PV ICA value

Guiding Principles

1. **Safety and Reliability:** Any modifications to the Rule 21 technical framework and study requirements must account for the safety and reliability requirements of interconnecting DERs
    a) All applicable screens must be addressed. No screens will be "ignored" or "assumed" to not have negative affects without sufficient technical merit

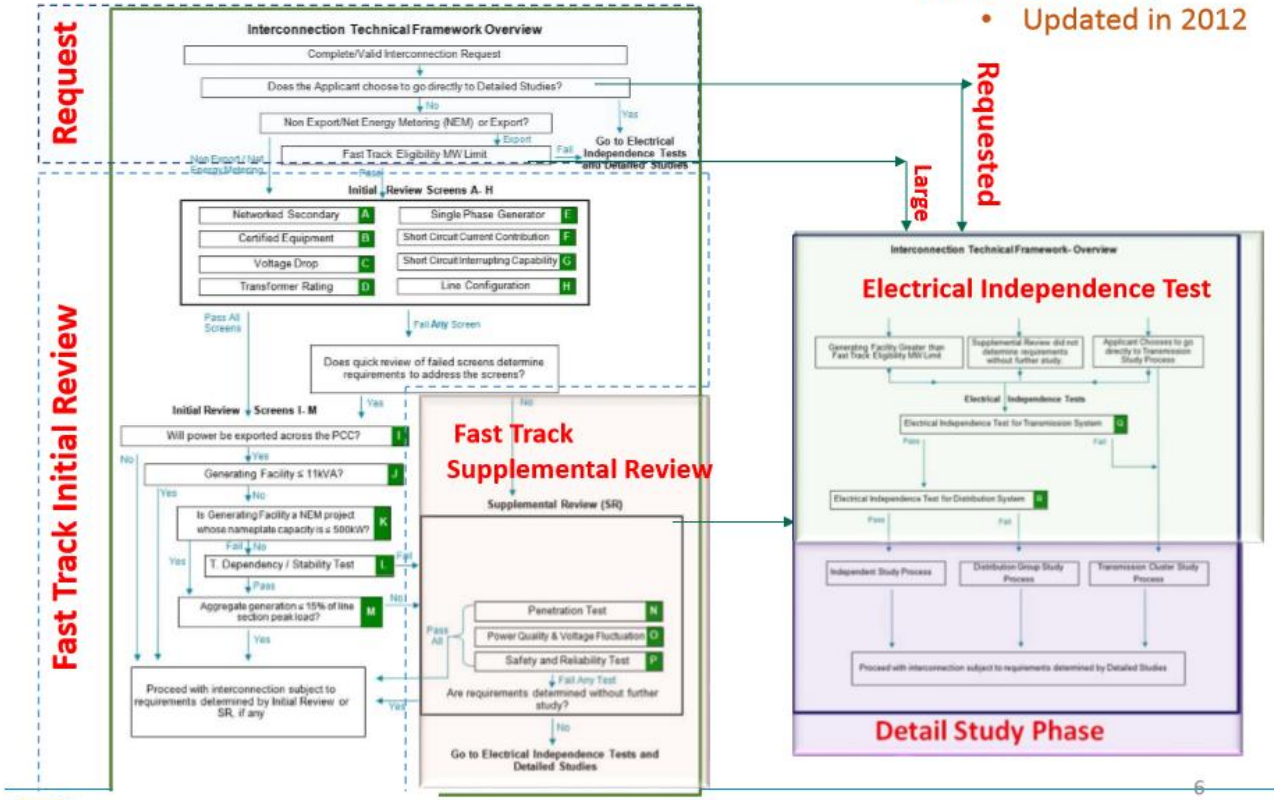
2. **Maximize** the information and results from the ICA calculations
    a) Modify those screens which are evaluated in the ICA methodology and calculations
    b) Modify Rule 21 to align with the ICA calculation methodology and limitations

3. **Minimize** the affect of those screens which are not addressed by the ICA calculations to the extent that it is possible
    a) Continue to evaluate those screens which are not accounted or evaluated in the ICA

Existing Rule 21 Framework

For reference only

- Updated in 2012



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Revisiting Concept – Revised R21 Process

Proposed IR categories:

1. EXPEDITED PROCESS: Certified DER sizes up to ICAWOF with specified requirements

2. FAST TRACK PROCESS: DER sized up to ICAWNOF with specified requirements and evaluated under Supplemental Review
   - Conditions of operations/related to Issue 9: if “mitigation” ?

3. NORMAL PROCESS: DER sized higher than ICAWNOF or which may fail SR (non-certified DER equipment)
   - Conditions of operations/related to Issue 9

Rule 21 Group 2 Working Group Meeting

April 25, 2018

Presentation Topics for Discussion Purposes Only and do not Represent an Approved Proposal

Use of ICA Load Profile Creates New Interconnection Issues That Must be Addressed

Current Study Practices Utilize Minimum Load Values

- Use of Minimum Load Values decreases the risk that future load changes impact interconnection facility by ensuring a level of margin to account for load changes
    - Current method provides for cost assurance and lowers risk of future operational constraints
        - Utilities have no control over customer load changes (ex: closures, energy efficiency, relocations)

Use of ICA Load Profile in place of Minimum Load Value

- Use of ICA Load Profile within Rule 21 Study Review Process does not provide any level of margin to account for future load changes that are beyond utility control
- This increases the risk that future operational constraints and need for system upgrades will occur after interconnection of generation, due to such future load changes
- This creates a potential cost allocation issue
    - System upgrades that would have been assigned to an interconnection project under a “Minimum Load Value” interconnection review will no longer be attributed to an interconnection project
- How should costs associated with such system upgrades be addressed?

Discussion on Utilization of ICA Load profiles

#1: ICA values are heavily influence by historical Loading

- Historical Loads are not guaranteed
  - Customer reduce/increase load
  - Customer impose energy efficiency /install self generation
  - Customers relocate or change business plans

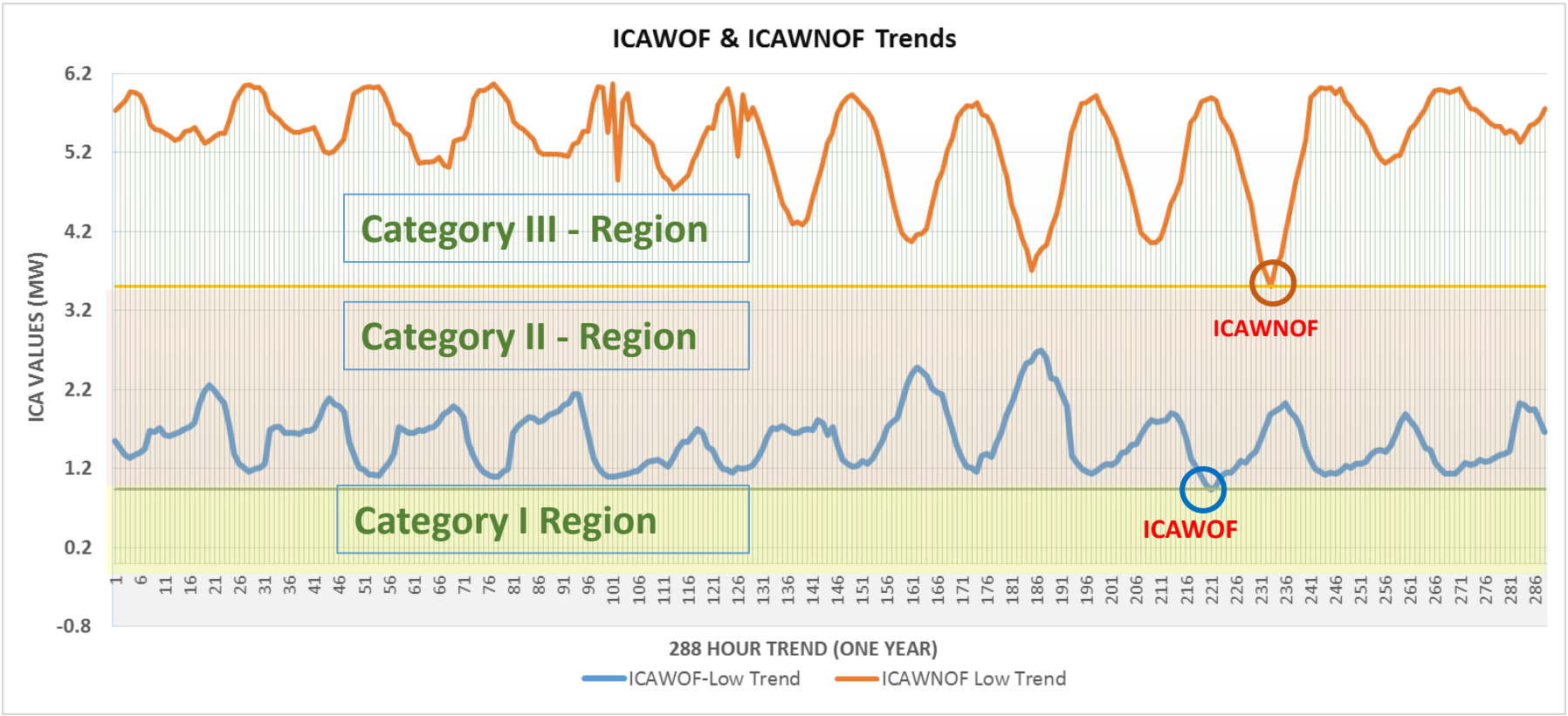
#2: Current interconnection practices are generally accommodating of customer load fluctuations

- Utilization of minimum load with peak DER output while restraining has its benefits
  - Future load reductions generally do not impose of issues
  - Distribution system flexibility is generally not affected

#3: Utilization of full ICA profile needs to be carefully considered

- Safety and reliability issues are more likely and these need to be addressed
- Cost for future mitigations due to future changes need to be discussed
- Technology utilization for system with high risk (Full usage of Phase I, Phase II and Phase III)

Discussion on utilization of DER profiles



Category I: High Speed Interconnection

Category II: Fast Track Interconnection

Category III: Extended Evaluation Required; Communication; Controls; Capabilities; system changes

Discussion on Utilization of DER profiles
Important Consideration

Not all DER interconnection need to be complicated

- Keep Interconnection process simple for simple interconnection requests
- Increase complexity and requirements for larger interconnection requests

Category I: Highest Speed Interconnections

- Customers **do not need to provide** DER profiles
- This level of DER has been evaluated for most technical components (SSV, PQ, Protection, Thermal, Sys-Flex)
- Customers seeking to interconnect small DERs (~1MW<) would benefit from using this category

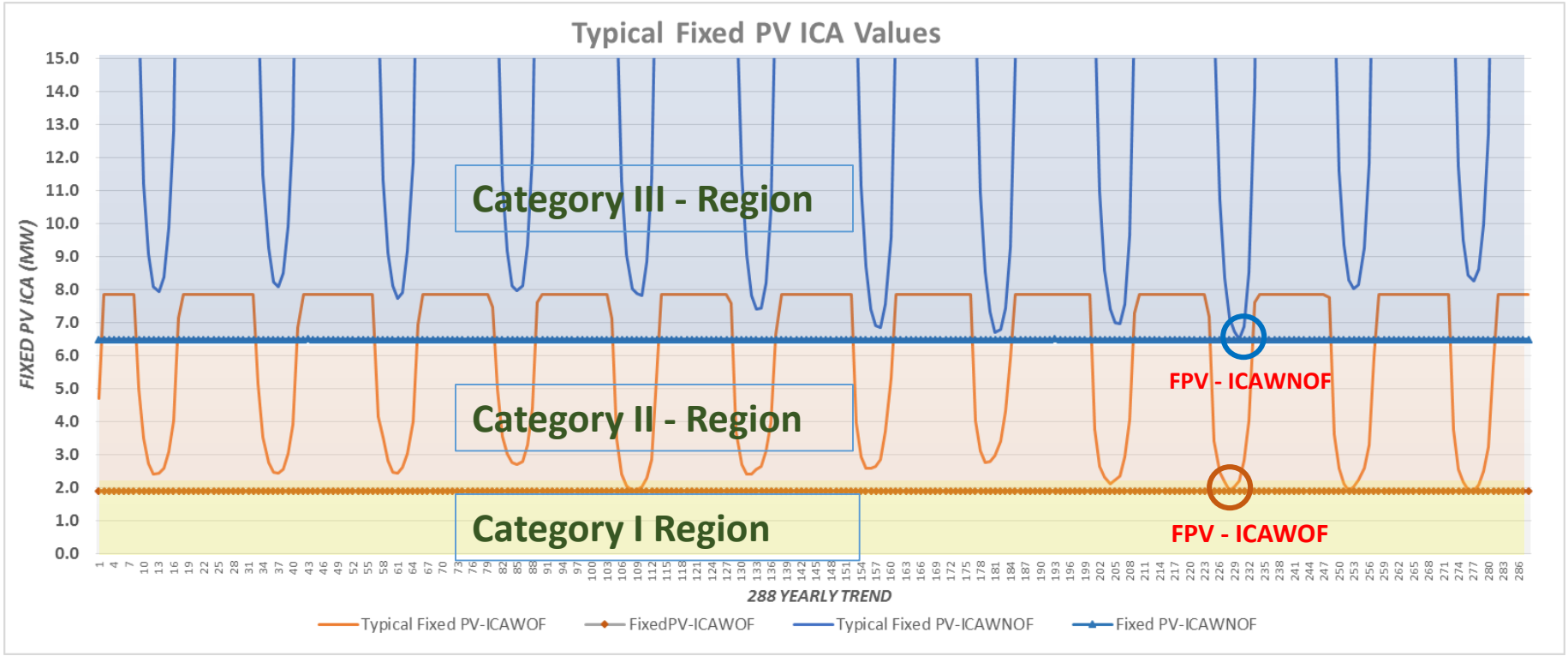
Category II: Fast Track Interconnections

- Customers **do not need to provide** DER profiles
- This level of DER has been evaluated for most technical components (SSV, PQ, Protection, Thermal)
- Distribution system flexibility must be evaluated via SR
  - SR evaluation will reveal Technology Implementation Requirements (Phase II, Phase III)

Category III: Extended Evaluation

- Customers **must to provide** DER profiles
- Distribution system flexibility for the ICAWNOF must be evaluated via SR
- Customer must be **capable and acceptable to change** output profiles down to ICAWNOF to accommodate changes in load profiles
- Technology utilization with full usage of Phase I, Phase II and Phase III to communicate customers changes in ICA profiles [in real time – when technology is available]
- How are changes to ICA profiles shared among several DER customers (queued? Evenly?)
- Changes to Interconnection agreements should be considered to address future changes

Utilization Of Fixed PV ICA Values



Category I: High Speed Interconnection

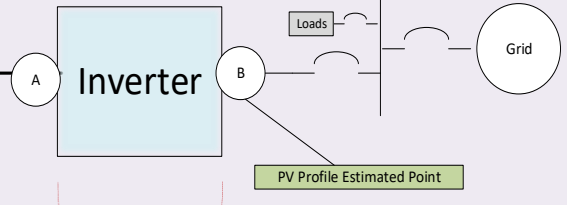
- All categories have been evaluated
- Non-ICA related screens need to be evaluated

Category II: Fast Track Interconnection

- Operational Flexibility needs to be evaluated
- Non-ICA related screens need to be evaluated

Category III: Analyzed Through Profiles (Slide #3 and 4)

Typical Fixed PV Installation



Fixed PV panels Capacity

- **STC Nameplate (Factory)**
- Fixed Rooftop
- Tilt Angle – **18 (deg)**
- Azimuth - **180 (deg)**

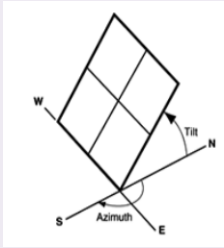
Inverter Efficiency – 96.5%

- **DC to AC Conversion of power**
- A – Input DC power to Inverter
- B – Output AC power from Inverter
- Efficiency = B/A

Losses – Total 14 %

PTC (CEC) Nameplate (Life Condition)

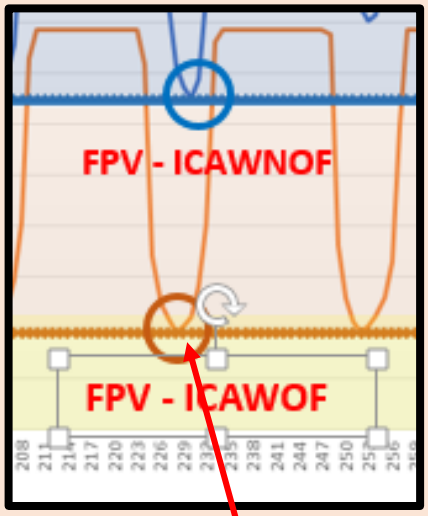
- Soil - 2%
- Shading - 3%
- Mismatch - 2%
- Wiring – 2%
- Connections – 0.5%
- Degradation – 1.5%
- Nameplate Rating - 1%
- Availability – 3%
- Wiring – 2%



Source: PV Watts®

CEC- AC Nameplate

Fixed PV Panels* PTC (CEC) rating* Inverter Efficiency



FPV-ICA Values Account For:

- **14% losses**
- **96% Inverter Efficiency**
- **Tilt/Azimuth - 18/180 degrees**

Typical Fixed PV System

- All residential fixed installations≤30KW
- Fixed PV installations >30KW – PV DC Nameplate rating with:
  - Fixed – South facing
  - Losses>10%
  - Efficiency <98.5%

For Slide #5: FPV – ICAWOF = 2.0MW

- Assumes that losses will be 14%
- Assumes usage of inverter with 96.5% efficiency
- Assumes Tilt & Azimuth = 18 /180 degrees

Automation potential for Rule 21 interconnection

TAM HUNT, GREEN POWER INSTITUTE

SAHM WHITE, CLEAN COALITION

A little history

"Interconnection 3.0" proposed by Jaclyn Marks at CPUC Energy Division in 2010 and 2011

- Focused on automation of the interconnection process

Taken up by Clean Coalition as an initiative in 2012

- Was discussed but not implemented in R.11-09-011

Community Environmental Council advocated a "Click n Claim" automation process in the DRP (R.14-08-013) in 2014-2016

Green Power Institute took up the cause in R.17-07-007 in 2017

What do we mean by automation?

Full automation of the Rule 21 interconnection process would be a procedure that requires *de minimis* human intervention for the large majority of applications from receipt of application through final review and draft Interconnection Agreement (for Fast Track)

Partial automation constitutes automation of practical aspects of the Rule 21 process in the near-term (1-2 years) and mid-term (3-4 years)

GPI's view is that partial automation in the near- and mid-term, and full automation in the long-term (5-6 years), is required to satisfy the DRP Final Guidance and the DRP ICA WG1 Final Report's requirement for "dramatic streamlining" of interconnection

DRP and automation: WG1 Final Report

"As a long-term vision, and not part of the ACR's [six month] scope, some members of the WG envision that the ICA should be updated on a real-time or daily basis to the extent possible to allow the reflecting values to be used in **an automated interconnection process**. Future enhancement should work towards this goal, while considering issues such as the following in coordination with the Rule 21 proceeding:

- **Development of automated interconnection studies which considers specific application information that cannot be known ahead of time to be reflected in ICA**. Generation queuing, commercial operation dates, and planned work/transfers can all have a unique impact on certain locations in the system and currently must be considered application-by-application with manual engineering review.
- …"

DRP and automation: WG1 Final Report

Automation is mentioned over 20 times in the DRP ICA Working Group Final Report; some examples:

- "PG&E notes that if full automation is desired, then focus must shift to automating more of the interconnection process versus the proactive ICA, which can only improve portions of the interconnection review."
- "SCE reiterates that it would incorporate significant changes to new circuit models on a monthly basis. SCE is currently developing automated processes to maintain the accuracy of network models and data as changes on the distribution system occur, as part of full system-wide deployment of ICA."
- "SDG&E currently automatically updates its models daily, but those are not currently validated for ICA purposes. SDG&E would need to validate those models that have monthly changes for the ICA update."

Similar automation efforts

EnergyNet 2011 and 2013 (final report) >> precursor to ICA?; funded by CEC

SP Energy Networks in the UK "Utility Map Viewer" (the model for IOAP)

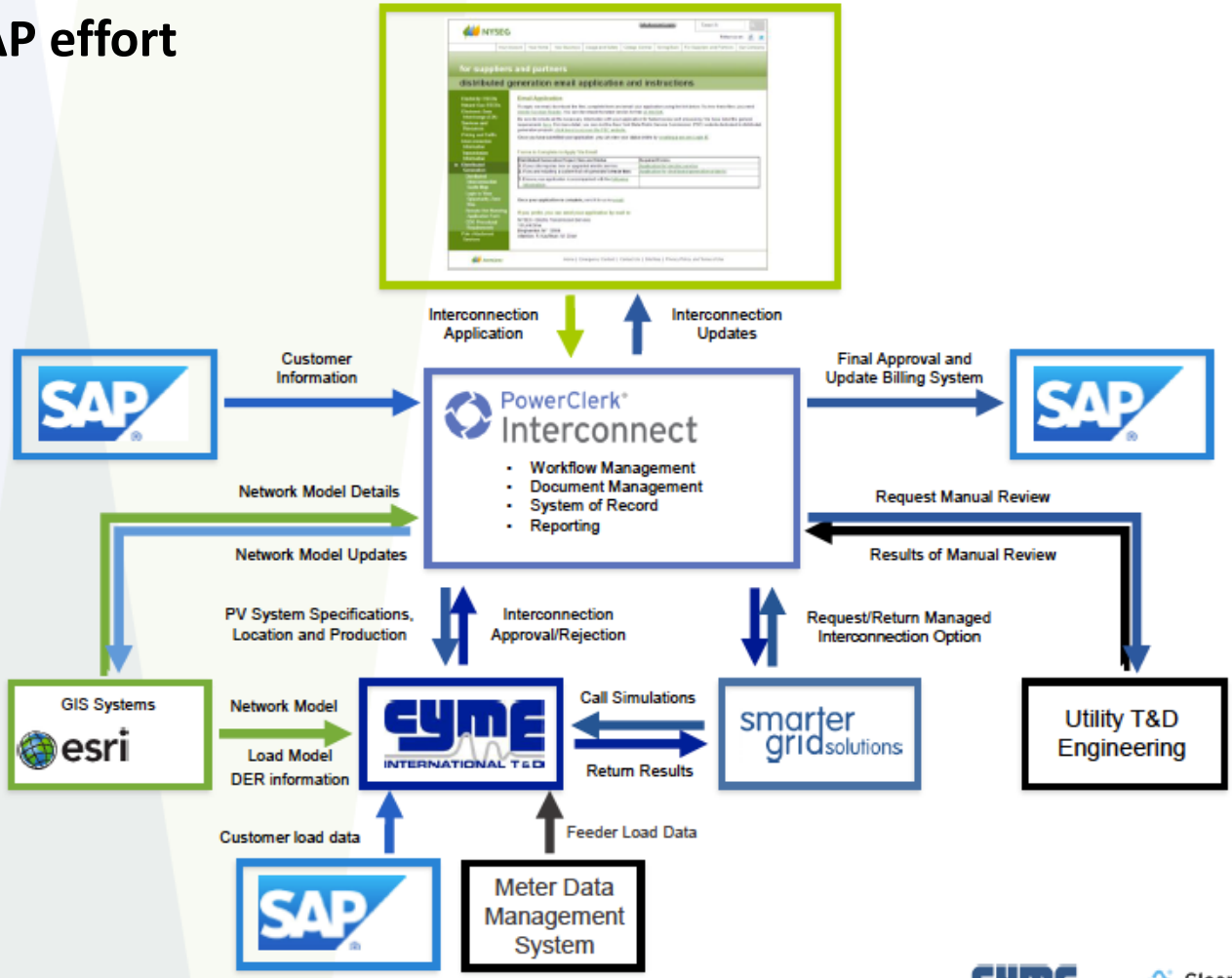
Avangrid's (NY) Interconnection Online Application Portal (IOAP), proof of concept is finalized, with larger rollout 2018/2019 pending regulatory approvals and funding:

- Clean Power Research to automate the administrative side of the interconnection process
- Cyme to automate the technical screening/power flow analysis
- Smarter Grid Solutions (SGS) to automate its Flexible Interconnection analysis
- Objectives:
  - Fully-automated interconnection processes
  - Hosting capacity maps – Static and Flexible hosting capacity
  - Data transparency for developers

SCE/DOE EASE project (with Smarter Grid Solutions and Energy Commission funding)

- focused on, *inter alia*, reducing interconnection time for >100 kW DER to five days or less
- Also underway in 2018

NY's IOAP effort



IOAP screens to be automated

Screen A: Anti-Islanding

Screen B: Fault Duty Contribution

Screen C: Primary Distribution Interconnection

Screen D: Transmission Interconnection Adjudication

Screen H: Distribution Equipment

Screen K: Voltage Rise

Screen L: Voltage

Source: SGS

What is already automated under Rule 21?

NEM application acceptance and review for projects under 30 kW is mostly automated for some utilities, starting in 2013

- See next slide

ICA is being automated and due for completion in July 2018

Other initiatives?

SCE and PG&E automation efforts

SCE, e.g., has automated the following:

- Power Clerk Interconnect (PCI) for Online Application for NEM and Rule 21-non-export projects
- While the intake process is through PCI, several internal handoffs are still required to process certain type of projects (New services NEM-aggregation, Meter adopters, NGO, etc.)
- Customers are able to see the project status and can provide documents via the tool until PTO is issued
- Limited integration with back-office systems which requires data from multiples sources gathered for technical review
- Not all projects go through PCI requiring additional handoffs
- Planned future efforts:
  - PCI envisioned to support all projects
  - Envisioned to integrate with existing and future back-office systems
  - Envisioned to streamline the DER Interconnection process through business process Optimization and Automation
  - Funding review is underway and although initial funding for limited scope was authorized, additional funding may be required at a future date and functionality may be contingent on funding allowances
  - Final scoping and related timelines remain under review

PG&E has also automated standard NEM under 30 kW

- PG&E is also undertaking several initiatives to further enhance its automation. This would include expanding its online invoicing, to projects submitted through the ACE-IT portal greater than 30 KW and less than 1 MW.
- Has also automated the Preapplication Report process
- Has already automated a number of Initial Review screens: A, B, F, G, J, K, M

How to automate Rule 21 interconnection?

Automating the application portal

IOUs already have online portals for submitting applications

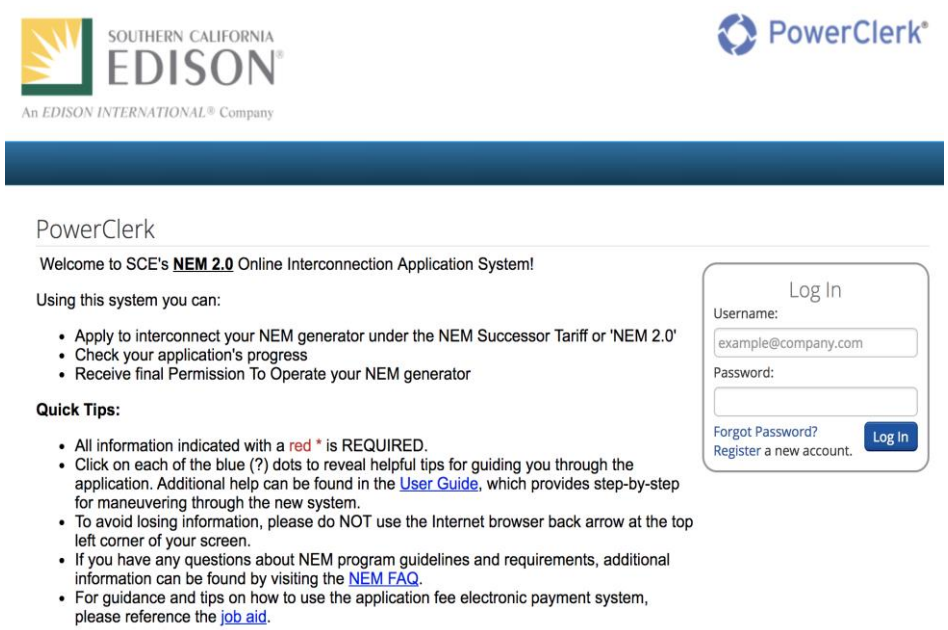
- E.g. PG&E “standard NEM interconnection” is mostly automated
- SCE here

Automation of wholesale DER and large NEM should be map-interactive, with ICA values plus a link to the application portal

- This is the beginning of the “Click n Claim” process that GPI has advocated

NY’s IOAP is a good model to emulate for “nuts and bolts”

- Working proof of concept has been completed



Automating “deemed complete” determination

An application must be processed by the utility within 10 Business Days (BDs), applicant notified of receipt, and if the Interconnection Request is deemed complete or not (E.5)

If online portal is populated correctly, with each item from the application and correctly named pdfs, this is automatable

If deemed complete, applicant is notified automatically by email that Initial Review will be completed within 15 BDs (E.5.a, F.2.a)

If not deemed complete, applicant is notified automatically of the deficiencies and that it will have 10 BDs (per the tariff) to cure (E.5.b)

Automating queue position assignment

Applies to all non-NEM applicants; queue position assigned based on date application received if no deficiencies were found, but otherwise assigned when “deemed complete” (E.5.c)

This can be automated by linking the required databases

Automating queue publication

Queue is published monthly by each utility (E.5.d)

Updates to the queue can be automated by linking databases, and then published in real-time or defined time periods

Automating ICA

"Three software suites are being developed to support the ICA system-wide implementation. The Grid Connectivity Model (GCM) develops and orchestrates interfaces to provide various data (e.g., substation capacity results, fault duty calculation, circuit configuration, load profiles, line regulator settings, etc.) to the System Modeling Tool (SMT) which utilizes the data from GCM to automate the ICA calculations. The scope of SMT also includes license fees for software like the Power System Analysis Tool. The Distribution Resources Plan External Portal (DRPEP) integrates with modeling and calculation tools that provide ICA results and publishes those results externally on the web map interface known as DERiM." (SCE ICA Interim Report Jan. 2018)

Final results due in July

Automating ICA updates

IOUs already planning to automate ICA updates, e.g. (DRP ICA Working Group Final Report, emphases added):

- "PG&E has a gateway tool for incorporating circuit updates into its circuit models on a weekly basis. PG&E also creates yearly planning models from a snapshot of the gateway model which contains specific modifications and planned worked on the circuits. Recommendations from the WG would require additional work to merge the planning models with the gateway models."
- "SCE reiterates that it would incorporate significant changes to new circuit models on a monthly basis. SCE is currently developing automated processes to maintain the accuracy of network models and data as changes on the distribution system occur, as part of full system-wide deployment of ICA."
- "SDG&E currently automatically updates its models daily, but those are not currently validated for ICA purposes. SDG&E would need to validate those models that have monthly changes for the ICA update."

Automating screens not included in ICA

(Initial Review & Supplemental Review)

Automation Timeframe Legend:

- **OK/NA**: automation already completed or not applicable for inverter based systems
- **ST**: Short Term
- **MT**: Medium Term
- **LT**: Long Term

Screen Letter	Descrption	Evaluation	Comment
A	Sec Network	Pass	Not in the Secondary Network
B	Certification	Pass	Certified
C	V Drop/Rise	Pass	New service request
D	TXf Rating	Pass	New service request
E	Single phase	Pass	3 Phase connection
F	SCCR>0.1	Quick Evaluation	ok up to 1 MW
G	SC Interp Rating>87.5%	Quick Evaluation	ok up to 1 MW
H	Line Config	Pass	e request
I	Export	N/A	Filter only
J	<11KVA	N/A	Filter only
K	NEM<500KVA	N/A	Filter only
L	T Dep/Stab	Quick Evaluation	Complexity depends on location to transmission System
M	<ICAWOF	Pass	Gen Facility < ICAWOF
N	Penetration	N/A	
O	PQ/V fluctuation	N/A	
P	Safety	N/A	
Q	T Depen- Test	N/A	
R	D- Depen Test	N/A	

ICAWOF 3-Phase

Automating screening

Screen A: Networked Secondary

- This is a screen that should be able to be addressed automatically through software as it only requires verification of whether the applicant's POI is on a Networked Secondary System. These networks should be clearly mapped and also indicated on the ICA maps. (ST)

Screen B: Certified Equipment

- This only requires verification against a database and could be automated through the application process, no engineering time should be required. (ST)

Screen C: Voltage Drop

- This only applies to motoring generators and thus will be automatically passed by most DERs today. (OK/NA)

Screen D: Transformer Rating

- Since the secondaries were not included in the ICA this screen will still require verification for projects connecting to a secondary. (MT)
- Projects with a primary connection are covered by ICA. (OK/NA)

Screen E: Does the Single-Phase Generator Cause Unacceptable Imbalance

- Since single-phase secondaries were not included in the ICA this screen will still require verification for projects connecting to a single phase secondary. (MT)
- Projects with a three-phase connection should not go through this screen however. (OK/NA)

Automating screening

Screen F: Is the Short Circuit Current Contribution Ratio w/in Acceptable Limits?

- Protection is covered, but coordination is not. **But may be able to ID the few substations where this is an issue (ST)

Screen G: Is the Short Circuit Interrupting Capability Exceeded?

- ICA partially covers, substation needs to be reviewed. <1 MW may pass, or PG&E automated screening tool? (ST/MT)

Screen H: Line Configuration

- Should be able to be addressed automatically through software~~/ manual~~ verification if the information about wire configurations on the system is available. (ST/MT)

Screen I: Will Power Be Exported Across the PCC?

- This screen can be automated – Filtering screen only (ST)

Screen J: Is the Gross Rating of the Generating Facility 11 KVA or less?

- This screen can be automated and is likely no longer relevant with the ICA in place – Filtering screen only (ST)

Screen K: Is the Generating Facility a NEM Generating Facility with nameplate capacity less than or equal to 500 kW?

- This screen can be automated – Filtering screen only (ST)

Automating screening

Screen L: Transmission Dependency and Transmission Stability Test

- May be able to ID the substations where this is an issue (ST)

Screen M: Aggregate Generation ≤15% of Line Section Peak Load

- This screen is addressed by the ICA. (OK)

Screen N: Penetration Test (100% of Min. Load)

- This screen is addressed by the ICA (OK)

Screen O: Power Quality and Voltage Fluctuation

- This screen is addressed by the ICA (OK)

Screen P: Safety and Reliability Test

- Used in Supplemental Review as a "catch all" applied only when one of the earlier Initial Review screens is failed. (LT/NA, "safety valve")

Screen Q: Electrical Independence Test for Transmission System

- Based on ability to define areas of dependence on queued projects (ST/MT)

Screen R: Electrical Independence Test for Distribution System

- Based on ability to define areas of dependence on queued projects (ST/MT)

Automating offer of Generator Interconnection Agreement

A standard GIA is offered, currently, within 15 BDs of passing Initial Review (F.2.a), or 15 BDs from applicant's request after passing Supp. Review (F.2.e)

90 Calendar Days allowed for negotiation and signing (F.2.e)

How to get from A to Z on automation

Recognize that we're already at the middle of the alphabet in terms of existing automation efforts

We suggest that the Initial Review and Supplemental Review be progressively automated, eventually into a single analysis step, based on the previously discussed automation of ICA and additional screens not in ICA

The end goal is the following:

- Once automated Fast Track Review is passed, a GIA will be generated and sent automatically to the applicant, within one BD
- For the large majority of projects, time from application to receipt of GIA should be no more than five days

Thank you

Tam Hunt, GPI

Sahm White, Clean Coalition

Streamlining remaining R21 screens – preliminary discussion

Screen	Title	R21	ICA addresses	Streamline?	Automate?
A	Network secondary	IR	No		
B	Certified equipment	IR	No		
C	Voltage drop	IR	No		
D	Transformer rating (incl. voltage rise)	IR	No		
E	single phase generator	IR	No		
F	Short circuit current contribution (considers aggregation)	IR	No	In review	
G	Short circuit interrupting rating (considers aggregation)	IR	No	In review	
H	Line configuration	IR	No		
I	Will power be exported across PCC	IR	N/A (screening)		
J	Generating facility < 11kva	IR	N/A (screening)		
K	Is generating facility NEM project w/ nameplate capacity < 500kw	IR	N/A (screening)		
L	Transmission dependency/stability test	IR	No	In review	
M	Aggregate generation < 15% of line section peak load	IR	Yes	Y	
N	Penetration test	SR	Yes	Y	
O	Power quality and voltage fluctuation	SR	Yes	Y	
P	Safety and reliability	SR	Yes	Y	
Q	Electrical independence test for transmission system	DS	No		
R	electrical independence test for distribution system	DS	No		
Fast Track Export Limit	https://gridworks.org/initiatives/rule-21-working-group-2/		Yes	Y	

What are modifications that can be made in the short, medium, and long term?

Next Steps:

Schedule

Topics teed up for May 2 discussion:

- Streamlining of other Rule 21 screens and integration into the application portal
- Application review timelines for revised R21

Topics to re-visit:

- Screens F, G, L
- Intra-month map updates
- Others (see scoping memo), including:
  - Fast Track eligibility limits
  - Application Forms and Agreements
  - Application Fees
  - Detailed Study

Scoping Issues: Draft Schedule

APRIL

Wednesday, April 4: Kickoff

Wednesday, April 11

Tuesday, April 17

Tuesday, 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

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 – SAN DIEGO

Wednesday, July 25

Proposed- Issue 10

AUGUST

Wednesday, August 1

Wednesday, August 8 –

Tuesday, August 14

Tuesday, August 21

Proposed- Issue 11

Wednesday, August 29

**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