Resolution E-5230 Workshop #1

February 1, 2023

Topic E: Implementation of Limited Generation Profiles Using Current Smart Inverter Functions

Background on Topic E

"To expedite the use of available hosting capacity it is prudent, therefore, for the Large IOUs to discuss any challenges to implement Issue 9 and Proposal A-B 3 using current smart inverter settings.

The Large IOUs shall elaborate on challenges and concerns as stated in the Working Group Reports and discuss and propose solutions.

The Large IOUs shall determine which functional elements are already present in commercially available inverters, and which are not, to establish LGP functionality prior to the approval of standards.

Should implementation of Issue 9 and Proposal A-B 3 be feasible before approval of standards, the Large IOUs shall outline a clear process and the requirements, including technical, to be considered in the implementation of the LGP option.

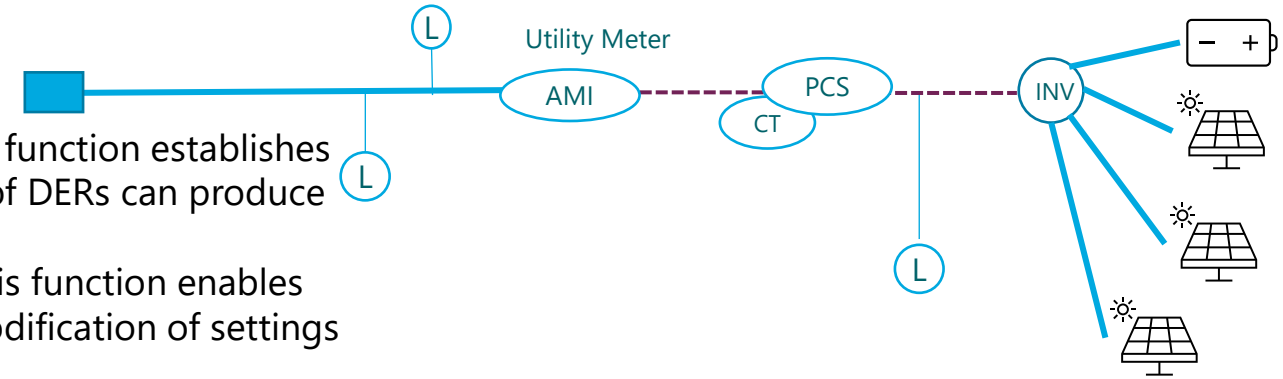
The Large IOUs shall also establish a mechanism for validating proposed profiles. If the implementation of this mechanism is not feasible, the Large IOUs shall clearly articulate the reasons.

We remind the Large IOUs that the subsequent ALs shall specify which items have reached consensus within the workshop participants and which items have not reached consensus. If an item has not reached consensus, the Large IOUs shall provide details as to the bases for lack of consensus and the alternative proposals, if any."

- Resolution 5230

Smart Inverters Function Definition:

- Function 3 - Limit Maximum Active Power Mode: This function establishes an upper limit on active power that a DER or system of DERs can produce or use.
- Function 8 – Scheduling Power Values and Models: this function enables scheduling of active and reactive power, as well as modification of settings for other functions.



Assumes DC coupled, graphic for illustration purpose only

PCS/Certification/NRTL

The Large IOUs shall determine which functional elements are already present in commercially available inverters, and which are not, to establish LGP functionality prior to the approval of standards. More specificity on how functions 3 and 8 will interact at this time.

- What is required to enable LGP, prior to the approval of standards, for a generating facility with on-site load?
  - Required, but currently not available: A certified Power Control System (PCS), or certified equivalent, that monitors net export generation at Point of Common Coupling (PCC) and sends signal to inverter to limit inverter power output to achieve LGP export limit at PCC.
  - Alternative, currently available, on a limited basis (according to the CEC website): Inverters with either 1) an *integrated* CSIP-certified gateway, or 2) the ability to function with an *external* CSIP-certified gateway.
    - It is the IOUs' understanding that CSIP certified gateway would store the schedule (Function 8) and would send hourly commands to the inverters which would then use their Limit Output Power Mode to limit output (Function 3) to the LGP limits
  - Challenges & Recommended Solutions
    - It is unknown to the IOUs whether a CSIP-certified gateway (integrated or external) can monitor at the PCC and send signals to control inverter output
    - IOUs have not tested this functionality and thus are not able to confirm that this method can be operationalized
    - While CSIP appears to be an alternative standard, IOUs view CSIP as not intended to be applied for an LGP use case. Function 8 (scheduling) using a CSIP-certified gateway was initially envisioned to serve as the communication channel between the generating facility (inverter or gateway) and a third party (aggregator or utility), not to monitor the PCC and control inverters. The alternative application of this technology requires further testing and validation.
- What is required to enable LGP, prior to the approval of standards, for a generating facility with no on-site load?
  - Currently available, on a limited basis (according to the CEC website): Inverters with either 1) an *integrated* CSIP-certified gateway, or 2) the ability to function with an *external* CSIP-certified gateway.
    - It is the IOUs' understanding that this would allow the inverters to accept a schedule (Function 8)
  - Challenges & Recommended Solutions
    - Consistent with D.20-09-035, OPs 50, 51, and 52, it is the IOUs' recommendation that performance of functions 3 and 8 to support LGP must be certified to be in conformance with the Underwriters Laboratory (UL) Power Control Systems Certification Requirements Decision (CRD) test protocol (expected in 2023 Q1-Q3).
- The IOU labs do not provide certification services for DER equipment.

Resolution E-5230: Topic E

Discuss PG&E's DERMS Project (See WG 2, pg 123) and findings and how it affects LGP. Discuss how the information will be leveraged. And if not, why not? What further research is needed.

- **PG&E's DERMS Project (EPIC 3.03) was unable to test a full LGP profile**
  - PG&E encountered significant challenges in the pilot with regards to implementing basic telemetry functions via IEEE 2030.5. Challenges were based on the maturity of the technology and difficulty achieving interoperability, even among CSIP-certified devices.
  - Challenges implementing basic telemetry limited PG&E's ability to have adequate resources and time to implement and test control capabilities to the desired extent.
  - PG&E was able to test some limited control functionality, but not to the extent of implementing a full LGP profile.
- **PG&E proved it could implement a single constraint via communications, but not a full profile**
  - PG&E successfully tested scheduled controls on one inverter with a CSIP-certified gateway with OpModFixedW (Mapped to Modbus Max Watt function) and opModConnect functions, applying a single scheduled start time and duration.
  - The CSIP-certified server did not have a way to schedule more than one scheduled event at a time. Without modification, it is not possible to implement an LGP type profile (monthly or 24-hour interval) in the existing CSIP-certified server at PG&E.
- **Suggested Further Research:**
  - More testing needed to confirm/develop method to schedule multiple limits needed to implement a LGP (if not using a PCS certification).
  - Testing should be done for both a local isolated system without external communications and for a system communicating to a third party
  - Testing should be done for the specific inverter-gateway combination (or just an inverter if CSIP-certified without a gateway) used by the customer requesting the LGP interconnection option.
  - If implementing a LGP based on an external signal (e.g., PCC), this would need to be tested separately (if not using PCS).

Validation of Customer Provided LGP Profile

The Large IOUs shall also establish a mechanism for validating proposed profiles. If the implementation of this mechanism is not feasible, the Large IOUs shall clearly articulate the reasons.

1. Customer submits agreed-upon LGP Template with all required information (see details on slide 9)
2. IOUs will verify that information with the most updated ICA results
3. If the ICA results currently published are up to date
    a. If up to date, use those
    b. If not up to date, refresh ICA results (per OP 2)
4. Verify that the customer provided LGP complies with the requirements of the decision to have a 10% buffer
5. If compliant, proceed with interconnection per Rule 21 requirements
6. If not compliant, IOU to inform customer of the need to update LGP
    a. If customer responds with values that comply with the 10% buffer, that updated profile will be included as an attachment to the interconnection agreement
    b. If customer does not respond, IOUs will proceed to evaluate the project using nameplate (not as an LGP)

NOTE: IOUs will not process LGP projects that do not comply with the 10% buffer under supplemental review or detailed study. LGP projects must have 10% buffer.

Topic F: Implementing More Than 12 LGP Values Per Year

Background on Topic F

“In adopting a modified version of the Large IOUs’ counter proposal, the Decision modified the proposal such that the 'frequency of changes is expanded to monthly limits to align with the Integration Capacity Analysis.' The Decision, however, did not specify that the monthly profile was limited to only one value.

The Decision addressed the frequency of change and did not restrict the number of values within a month to be only one. **The adopted 288-hour format includes 24 values per each of the 12 months of the year. Essentially this amounts to customers submitting the same value 24 times a month, on a monthly basis for a year when one value would suffice.**

The Large IOUs are therefore directed to discuss the 288-hour format and how it may allow for more than one value per month. Given that the Working Group Two Report was filed October 31, 2018, four years from the current date, we expect there is now more information and experience available to the Large IOUs to allow this.

The Large IOUs shall discuss their learnings and best practices in the workshops and propose how implementation of more than one value per month may be accomplished to better take advantage of the available capacity on a circuit to accomplish the goals of Issue 9."

- Resolution 5230

IOUs' Position

- The IOUs maintain that IOUs will implement LGP in a way as approved by the Decision:
  "The adopted 288-hour format includes 24 values per each of the 12 months of the year. Essentially this amounts to customers submitting the same value 24 times a month, on a monthly basis for a year when one value would suffice"
- The IOUs will discuss reasoning of why this is appropriate at this time
- The IOUs will present on necessary elements needed to allow more than one unique value per Month in LGP
- The IOUs will present on data analysis as requested part of SIWG meeting to demonstrate the increased risk with implementing more granularity

Risk of allowing more granularity in the LGP schedule

Higher risk of DER causing issues with real time grid conditions

- The LGP interconnection option does not change Utilities' responsibility for, and commitment to, safety and reliability.
- Generation ICA utilizes a circuit load profile that is derived from 12 months of historical circuit loading and topology at the time ICA calculations are performed. These historical inputs are not accurate predictors of real-time grid conditions at a granular level *100% of the time. (past performance is not a guarantee of future results)*
- If real-time circuit loading during a given month and hour is **less** than the values used to calculate the ICA SG at the time of an LGP's interconnection, there is an increased likelihood of experiencing voltage or thermal criteria violations. The greater the difference between the circuit load used to calculate the ICA SG values and the real-time circuit load (where real-time is lower than loading used at ICA SG calculation), the greater the likelihood of unexpected criteria violations occurring.
    - Causes of reduced circuit load include but are not limited to the adoption of more energy efficient appliances (gradual and lower impact), and businesses changing or completely ceasing operations (potentially sudden and severe impact) or just real-time customer operations (such as reduced operation due to maintenance)
- The lowest ICA_SG value for each month will be dominated by the lowest circuit loading value of each month (generally).
    - The probabilities that real time circuit loading will be below the historic "*lowest circuit loading value of each month*" is **significantly less than** the real time circuit loading being below the historic "**lowest circuit loading value of 24 hours each month**"
- The IOUs' analysis supports the likelihood of increased risks to safety and reliability when the LGP is allowed to include up to 288 unique values per year

Risk of allowing more granularity in the LGP schedule

Higher Risk of PCS failing and leading to safety and reliability issues

- A PCS that receives multiple-value profiles, and utilizes Functions 3 and 8 in combination, has not been deployed in the field; the IOUs do not have operational experience with such PCS. The reliability of such equipment is unknown.
- In the scenario that a PCS fails to correctly implement its designated profile, the IOUs' Distribution System Operations' groups will have to identify and address any resulting issues. Emergency measures may have their own reliability risks, may not be sustainable for long periods of time, can be costly and should be avoided where possible. Going from 12 values to 288 values amplifies the possibility that emergency measures are required.

Elements needed to allow more than one unique value per Month in LGP

Phase 1 (NOW)

- Start with one unique value per Month for LGP Implementation using 288 profile formant (24 values the same for each month)
- Gains 3 Years of Operating experience with LGP including
  - Operational challenges
  - Safety/reliability challenges due to a highly flexible and changing distribution grid
  - Interconnection processing
  - Utilization levels

Phase 2 2026

- Evaluate learnings from Phase 1
  - Determine learning and best practices
  - Determine if any safety/reliability challenges occurred and if so determine if mitigations can be implemented
  - Evaluate if Customer technology adherence to performance requirements
  - Determine if changes or enhancements to standards are required
- Increase frequency based on learnings from phase 1

Final Phase DERMS

- Full 288 hourly limit implementation (if limited by Phase 2)
- Need IOU technology to be operational (DERMS)
- Need ALL communication addressed (including Cybersecurity)
- Need customer equipment to execute DERMS operational commands. IOUs understanding is that technology is evolving but further testing may be required (See PGE's experience in slide 5)
- Need the regulatory (Rules and Tariffs) to be updated to require DERs to respond in accordance to DERMS commands

Required Format for LGP

- Utility interconnection portals currently allow customers to upload a comma-separated values (.csv) file that contains 288 datapoints. The format provided here is illustrative; specific terminology is subject to change and may vary across IOUs.
- Customers to be aware of the differences in downloadable data across IOUs and account for the minimum ICA-SG value for each month and hour (minimum of the min and max load profiles)
- However, additional enhancements to planning tools and ICA process may be needed to enable efficient and automated integration of LGP into the interconnection process. In addition, distribution modeling enhancement would be necessary to reflect the LGP projects.
- Once an LGP project connects, a unique output profile must be stored, maintained, and referenced in system planning, interconnection, and ICA studies.

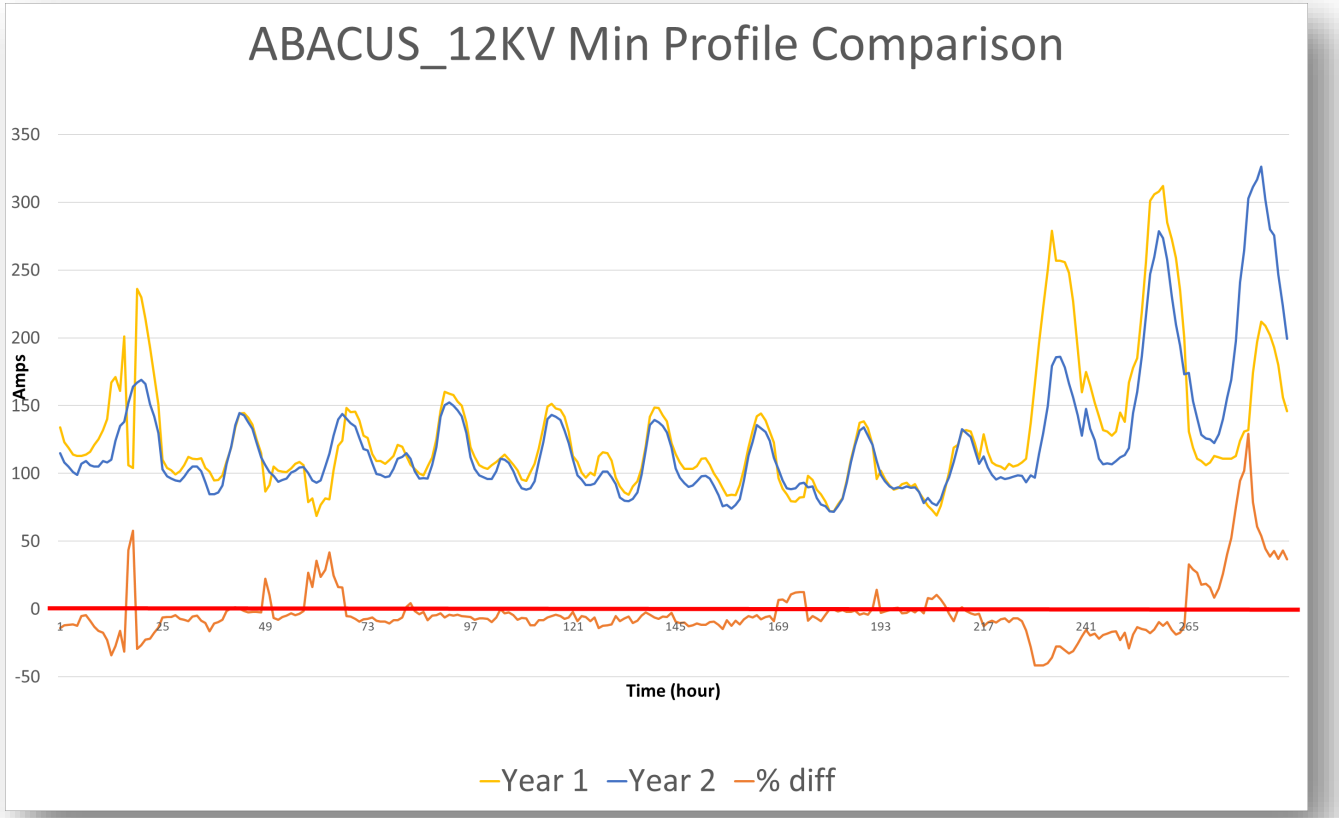
Circuit Name	Circuit ID	Node ID	Extraction Date	Month	Hour (0-23)	ICA-SG (Min. Uniform Gen ICA in MW)	ICA-SG with 10% Buffer (MW)	Customer Determined LGP (max. MW Export at PCC)

Data Analysis performed in Response to Request made at 1/19/23 Meeting

SOUTHERN CALIFORNIA EDISON®
SDGE™
PG&E®

Data Analysis 1: SCE Minimum Net Load Profile Comparison

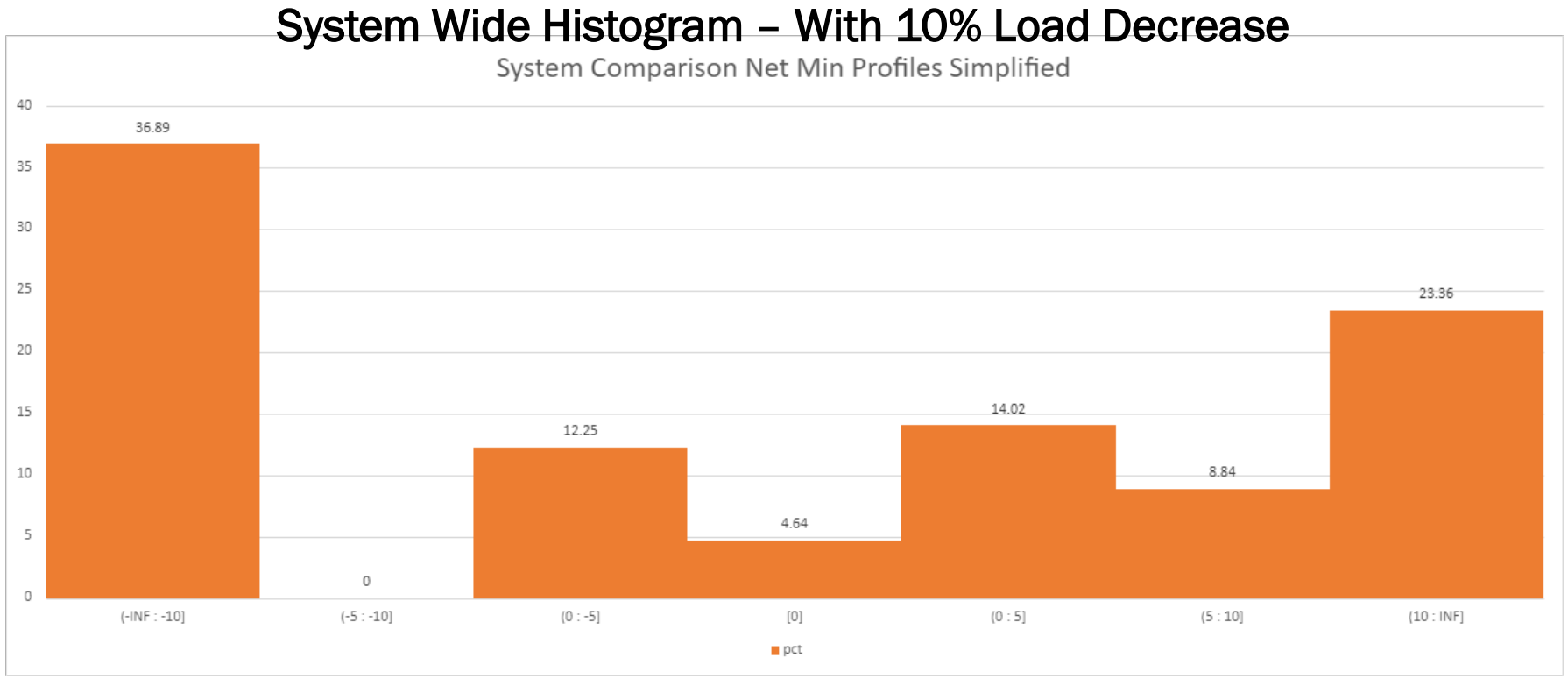
SCE's ABACUS 12 kV Net Load Profile Year 1 vs. Year 2



- Utilizing a randomly selected circuit, Year 1 minimum net load profile (yellow) was extracted and overlayed with Year 2 minimum net load profile (blue) for the same circuit.
  - Note: These profiles are inputs to ICA
- The orange curve shows the % difference between the load profiles for Year 1 and Year 2.
  - Where the orange curve is below the red line (zero line) the load in year 2 was less than the load in year 1 for that month and hour (load decreased that hour)
  - Where the orange curve is above the red line (zero line) the load in year 2 was greater than the load in year 1 for that month and hour (load increased that hour)
- **Data-Based Conclusion:** Load variability from year to year is exemplified in the graph (left); this can potentially lead to higher risks if an LGP project's profile is more granular (i.e., maximizing hosting capacity) which in turn can lead to more chances of overshooting available margins.

Year 1: September 2020 to August 2021
Year 2: September 2021 to August 2022

Data Analysis 2: SCE Systemwide % of Circuit Nodes Experiencing 10% Decrease In Load

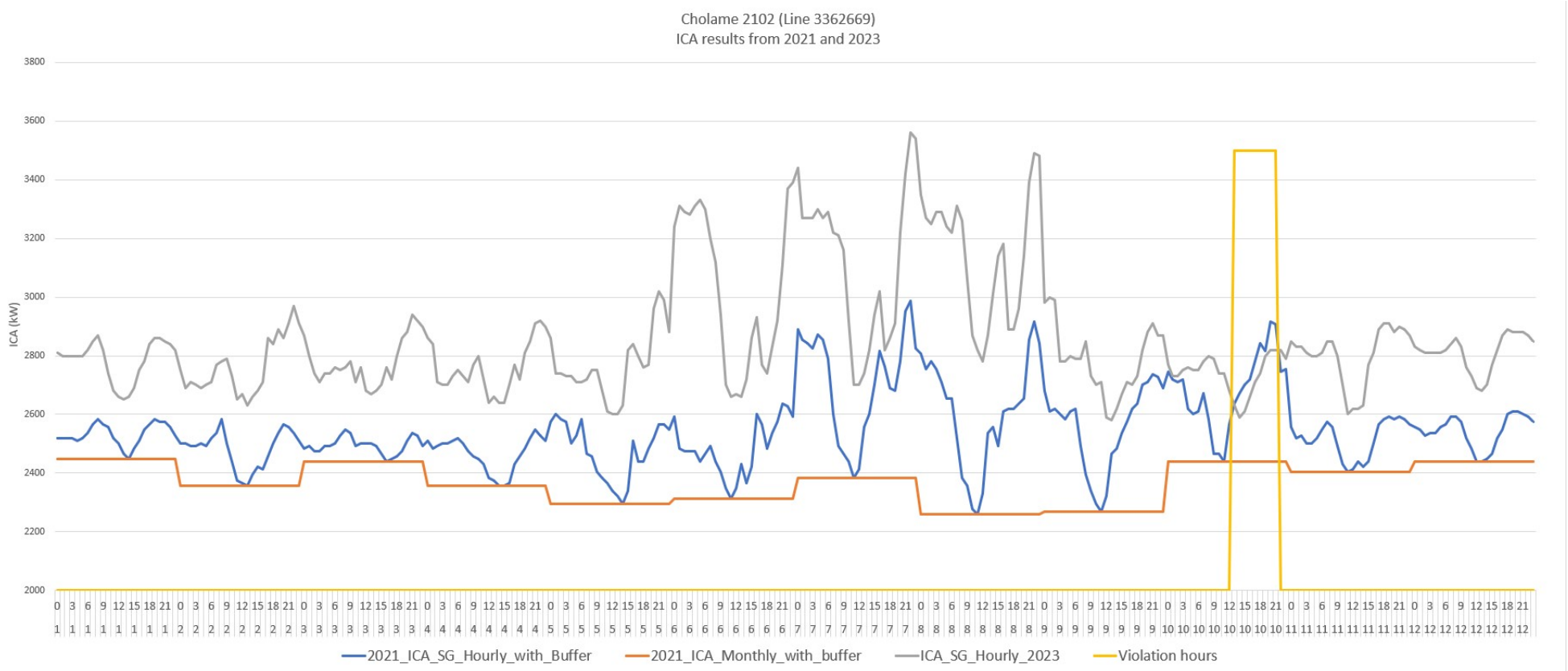


Graph Interpretation:

The histogram represents SCE's system level net load profile data analysis. The data represents the difference between Year 1 minimum net load profiles and Year 2 minimum net load profiles across SCE's territory where Year 2's load decreased by 10% as compared to Year 1 (for each hour and not reflective of peak loading). The histogram groups the data into 7 bins using cumulative percentage (pct). This shows that ~37% of the circuit nodes analyzed experienced a decrease of load by 10% or more for each hour.

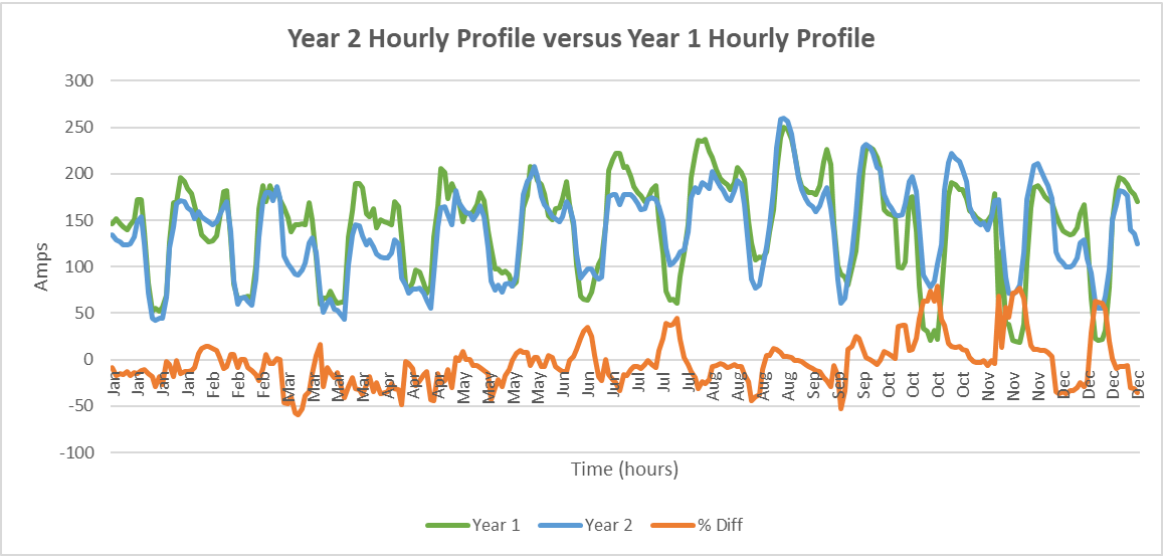
- ~37% of SCE's distribution circuits experienced a decrease in load of 10% or more (for each hour-not reflective of peak loading)
- These results indicate a correlation of the risk with adopting a more granular 288-hour (unique value) and the possibility of running into safety and reliability issues in real time.

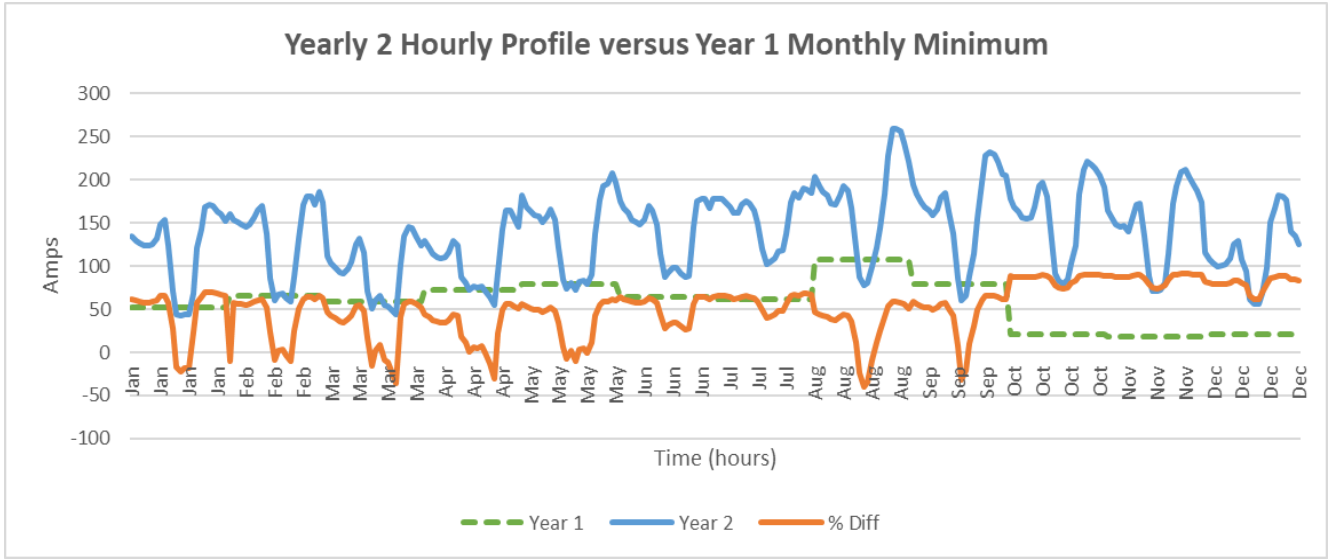
Data Analysis 3: PG&E ICA Profile Comparison



- Utilizing a randomly selected circuit, Year 1 (2021) 288 ICA-SG (blue) & Monthly profile (orange) with a 10% buffer was compared with Year 2 (2022) 288 ICA-SG profile (grey) for the same circuit.
- **Data-Based Conclusion:** As can be seen using a 288 profile (rather than a monthly profile) creates a possibility where year 2 hosting capacity falls below year 1 hosting capacity. This drop in hosting capacity in year 2 could result in grid impacts that were NOT considered during the previous interconnection. It is prudent for the IOU's to go through a cycle of interconnecting LGP projects using only 12 different values prior to moving to a 288 profile.

Data Analysis 4: SDG&E Minimum Net Load Profile Comparison[1]





- Utilizing a randomly selected circuit,. For the left graph, Year 1 net load profile (slide Green) was extracted and overlayed with Year 2 net load profile (Blue) for the same circuit. For the right graph, Year 1 monthly minimum net load profile (Dashed green) was calculated and overlayed with Year 2 net load profiles (blue) for the given circuit and shown in the left graph (note: hourly profiles are inputs to ICA)
- The orange curves show the % difference between the load profiles for Year 1 and Year 2.
- **Data-Based Conclusion:** as shown in the comparison, more granularity (i.e., maximizing hosting capacity) leads to more chances of loads being below minimum loading (minimum loads are used to calculate ICA values).

Year 1= Jan 2021 to Dec 2021
Year 2= Jan 2022 to Dec 2022

[1] For the shown analysis, SCADA data was pulled to aggregate as hourly load profiles. SDG&E did not have time to clean/scrub the data to perform its typical QA/QC with data inputs into its ICA process.

Responding to Questions in 1/19/23 SIWG Meeting

- IOUs agree with CalAdvocates' 1/19/2023 SIWG presentation that accommodating more than a single LGP value each month would, in concept, allow increased LGP exports.
  - This would logically be beneficial to the LGP customer.
  - However, the presentation did not include an assessment of the operational risks, and whether, and the extent to which, ratepayers would benefit.
- IOUs understand potential advantages of allowing DERs to operate at a more granular level (e.g., more than a single value each month). However, it is prudent to start with one value each month.
- Even though the Decision was issued in 2019, the Resolution on LGP was issued in late 2022. With respect to methodology improvements, learnings and best practices of allowing more than one value each month, utility practice is to make operational changes in accordance with Commission Orders/approval of Utility Advice Letters. Based on those Orders/approvals, cost recovery to enhance tools and processes would need to be determined. Given that Orders to operationalize LGP have not been given, IOUs have not had learnings and best practices developed.

Questions