SCE's Additional LGP Analysis

Resolution E-5230 Workshop #4

April 7, 2023

Scope of SCE's LGP Analysis

1. Select a circuit, and any 3-phase node on that circuit
    a. Select 12 or 16 kV circuits with geographic diversity, e.g., San Joaquin Valley, Metro, Coastal, Valley, Inland.
2. Define the circuit load profile for two time periods of 12 months each:
    a. Compile the 576 circuit load profile for time period 1 (2021 Jan-Dec) and the 576 circuit load profile for time period 2 (2022 Jan-Dec)
3. Parameters for information only and do not play a role in the analysis:
    a. Obtain the nameplate amount of generation that has interconnected to the subject circuit during time period 2.
    b. Obtain the upstream and downstream conductor sizes and ampacities
4. Compute the ICA Uniform Gen Static Grid for the selected node for period 1 and period 2; store the results
5. For time period 1 and time period 2, create the following ICA-SG profiles (9 profiles for 2 time periods = 18 profiles):
    a. Create a **288** minimum ICA-SG profile by taking the lowest ICA-SG value for each hour, multiply the profile by 90%
    b. Create a **144** ICA-SG profile by taking the minimum of the 90% ICA-SG values (profile a.) over every 2-hour window
    c. Create a **96** ICA-SG profile by taking the minimum of the 90% ICA-SG values over every 3-hour window
    d. Create a **84** ICA-SG profile by using 90% ICA-SG for 4pm-9pm, use the monthly minimum 90% ICA-SG for other 18 hours each month
    e. Create a **72** ICA-SG profile by taking the minimum of the 90% ICA-SG values over every 4-hour window
    f. Create a **48** ICA-SG profile by taking the minimum of the 90% ICA-SG values over every 6-hour window
    g. Create a **36** ICA-SG profile by taking the minimum of the 90% ICA-SG values over every 8-hour window
    h. Create a **24** ICA-SG profile by taking the minimum of the 90% ICA-SG values over every 12-hour window (12am- 12pm, 12pm-11pm)
    i. Create a **12** ICA-SG profile by taking the monthly minimums of the 90% ICA-SG values
6. Compare the results for each time period, and each level of granularity (288, 144, 96, 84, 72, 48, 36, 24, 12).
    a. Risk: Count the number of hours where ICA-SG profile for time period 2 is less than the ICA-SG profile for time period 1.
    b. Consequence: Calculate the percent difference and the magnitude difference (kW) on an hour-by-hour basis. Identify the limiting criteria for each hour where the hourly value from time period 2 was less than the hourly value from time period 1.
    c. Benefit: Calculate the energy (kWh) and power (kW) delivered over the course of the year for each of the 9 profile types.
7. Repeat the process for a different node on a different circuit until one node on at least 5 different circuits are analyzed.

Definitions

- **Risk:** Count of hours where the year 2 LGP value exceeded the coincident year 1 LGP value
- **Consequence:** Severity or magnitude of year 2 hourly LGP value exceeding year 1 hourly LGP value. Shown as a table in the bottom left of the following slides.
- **Benefit:** Quantified as 1) the maximum instantaneous power delivered (kW) over the course of the LGP profile, and 2) the cumulative energy delivered over the course of the 288 profile (kWh) NOT extrapolated to a full year.

Relevant ICA Criteria:

- **Steady State Voltage:** Amount of generation that can be installed without violating Rule 2 (+/- 5% of nominal)
- **Voltage Variation/Fluctuation:** Amount of generation that can be installed without causing 3% variation in Voltage
- **Thermal:** Amount of generation that can be installed without causing thermal overloads anywhere in the system

Recommendation & Findings

SCE maintains the Joint IOU recommendation for 12 unique LGP values (monthly minimums), repeated 24x each month to produce a 288 profile

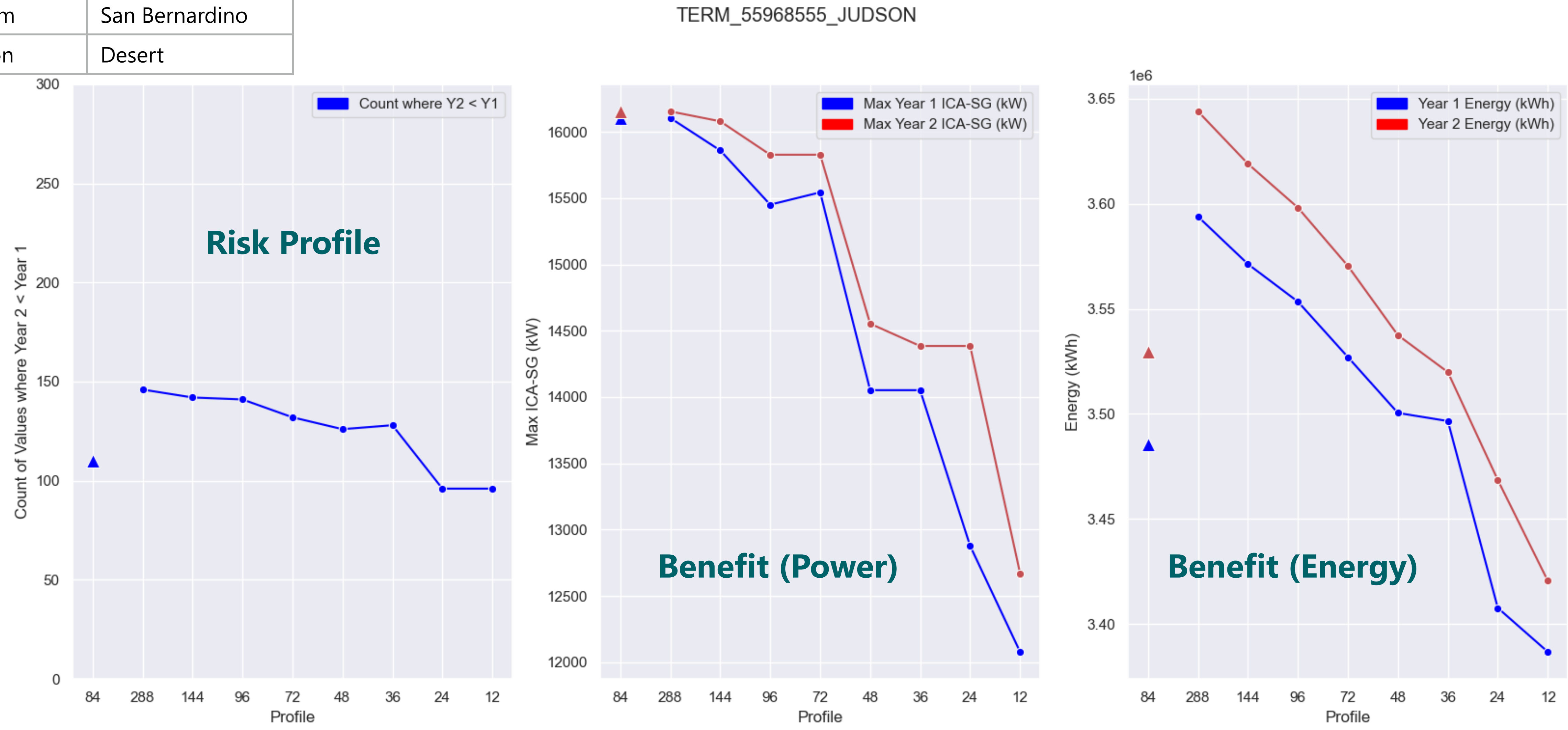
- **Risk:** 4 out of the 5 nodes analyzed saw a higher risk of causing an unexpected criteria violation for all profiles with more than 12 LGP values. One node (TERM_16664551_PESO) had a slightly lower risk associated with the 84-point profile, likely due to one zero value in the ICA results
- **Consequence:** In all cases, the severity increased as the number of LGP values increased
  - Over 25x increase (6,213 kW) when considering cases with one or more zeros (TERM_226139488_BAUXITE)
  - Over 2x increase (399.3 kW) when excluding nodes with one or more zeros (TERM_55968555_JUDSON)
- **Benefit:** As expected, peak instantaneous **power** (kW) and cumulative **energy** (kWh) increased as the number of LGP values increased

- The limiting criteria varied by node and number of LGP values, however, Voltage Variation and Thermal were the most common limiting criteria

Circuit	**Judson 12 kV**
Node ID	TERM_55968555
Substation	Redlands
System	San Bernardino
Region	Desert

Total DER Count/Nameplate (kW)	264 (1,532 kW)
Period 2 DER Count/Nameplate (kW)	45 (283 kW)

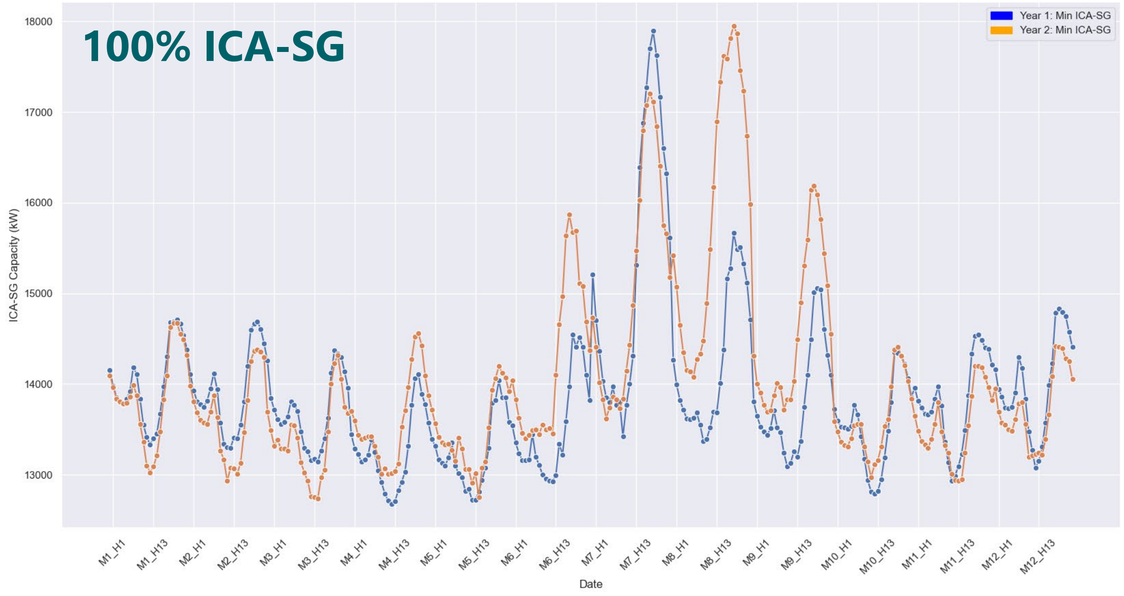
Upstream Conductor (Ampacity)	750 CLP (559 A)
Downstream Conductor (Ampacity)	653 ACSR (920 A)



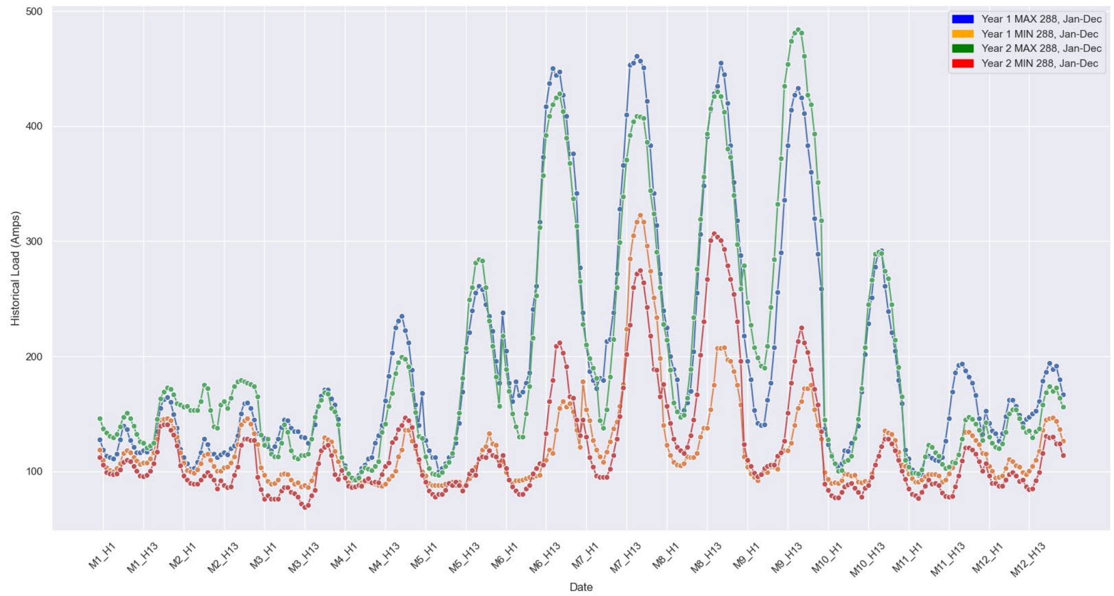
LGP Values	**84**	**288**	**144**	**96**	**72**	**48**	**36**	**24**	**12**
Maximum Deviation Year 2 to Year 1 (kW)	765.7	765.7	765.7	685.5	506.7	506.7	394.0	366.4	366.4

Consequence

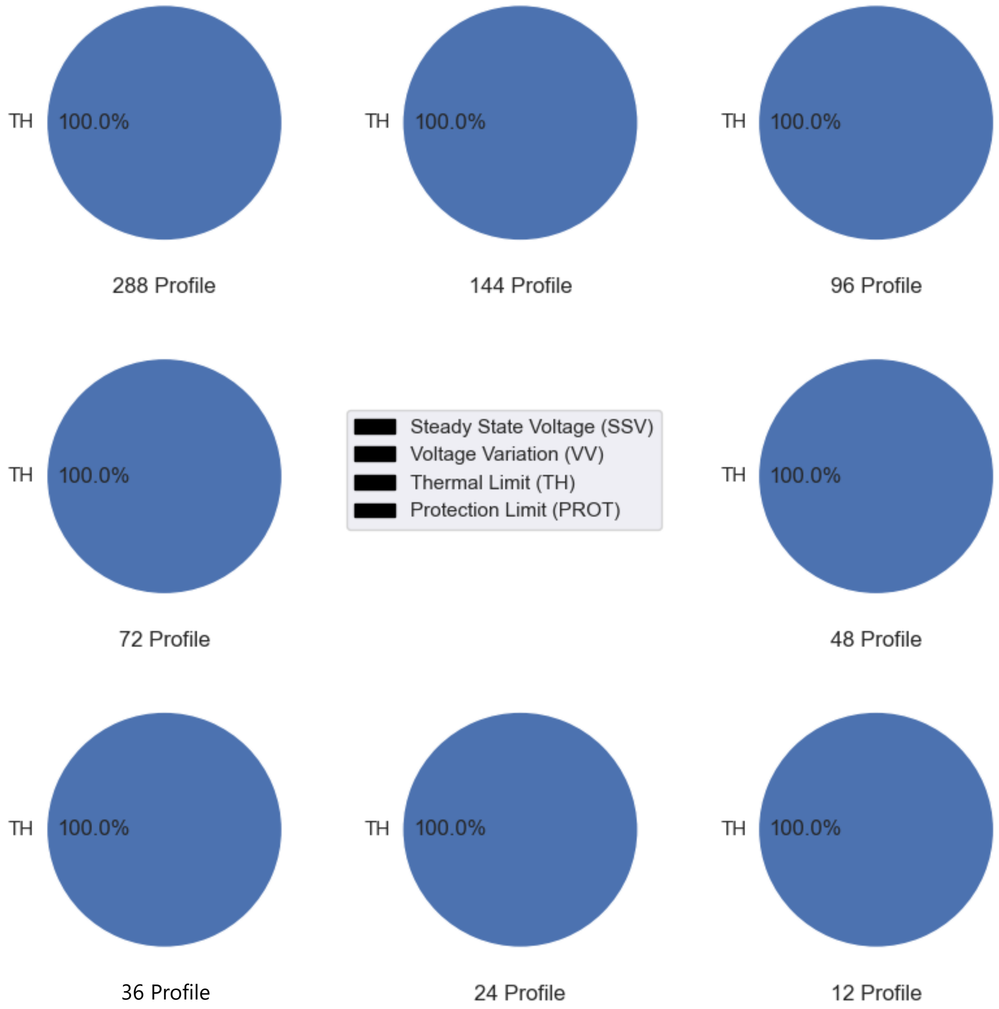
JUDSON_12KV Minimum ICA-SG Trends



JUDSON_12KV Net Historical Load



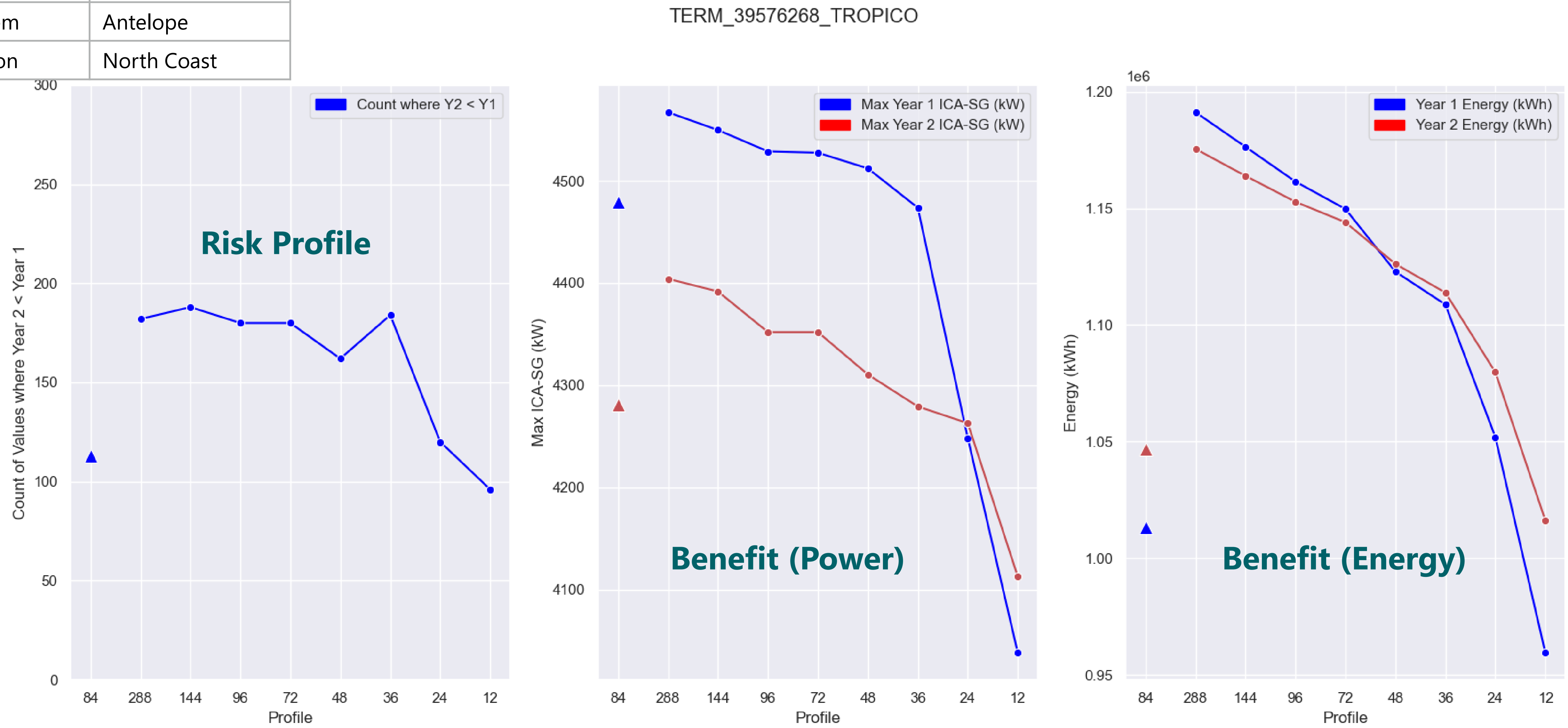
TERM_55968555_JUDSON Limiting Studies



Circuit	**Tropico 12 kV**
Node ID	TERM_39576268
Substation	Lancaster
System	Antelope
Region	North Coast

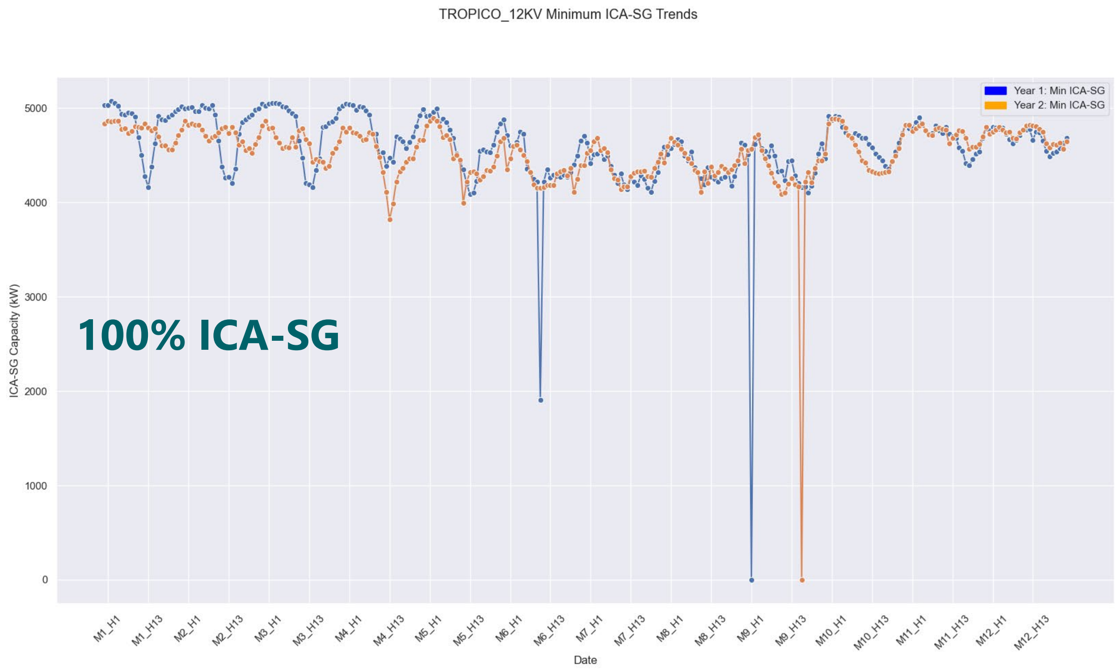
Total DER Count/Nameplate (kW)	280 (2,991 kW)
Period 2 DER Count/Nameplate (kW)	35 (207 kW)

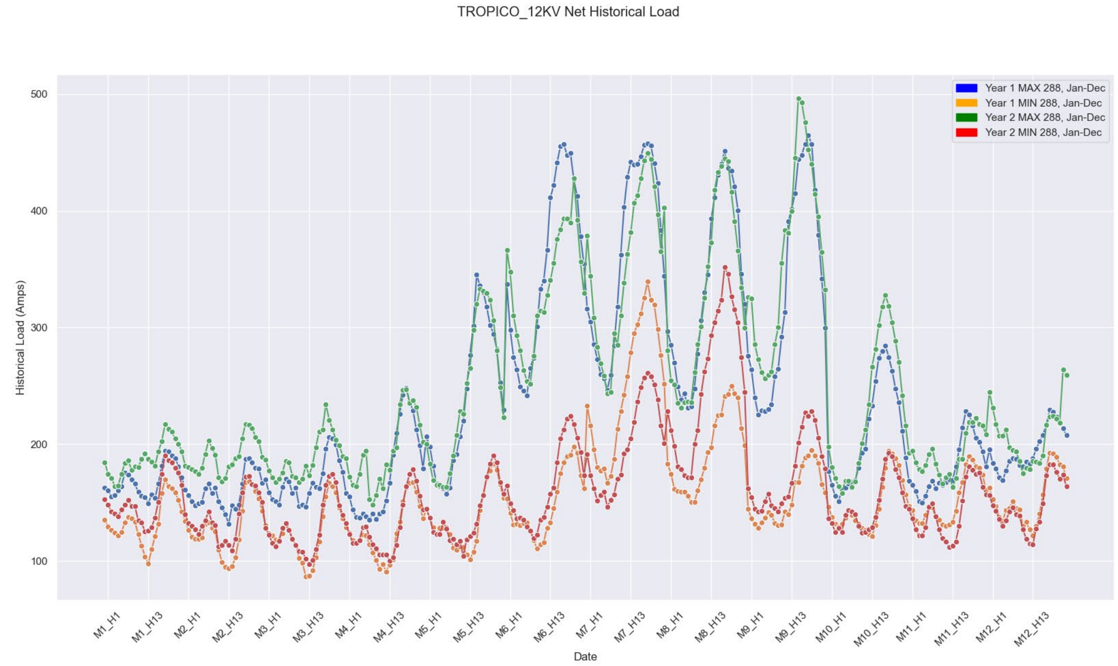
Upstream Conductor (Ampacity)	350 CLP (355 A)
Downstream Conductor (Ampacity)	#2 JCN (139 A)

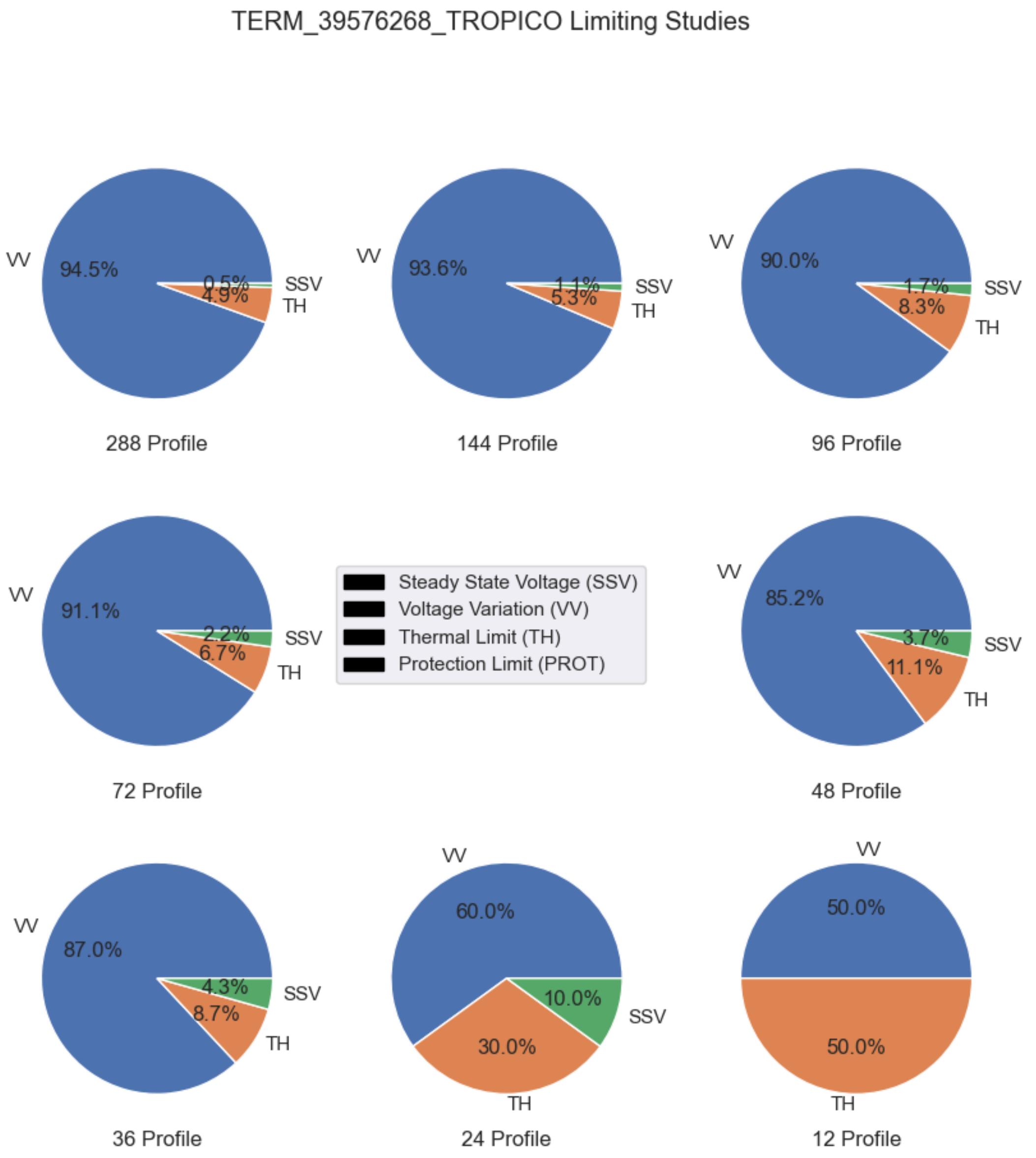


LGP Values	84	288	144	96	72	48	36	24	12
Maximum Deviation Year 2 to Year 1 (kW)	3745.2	3745.2	3745.2	3745.2	3694.9	3745.2	3694.9	3694.9	509.4

Consequence


TROPICO_12KV Minimum ICA-SG Trends
Year 1: Min ICA-SG
Year 2: Min ICA-SG
ICA-SG Capacity (kW)
100% ICA-SG
Date

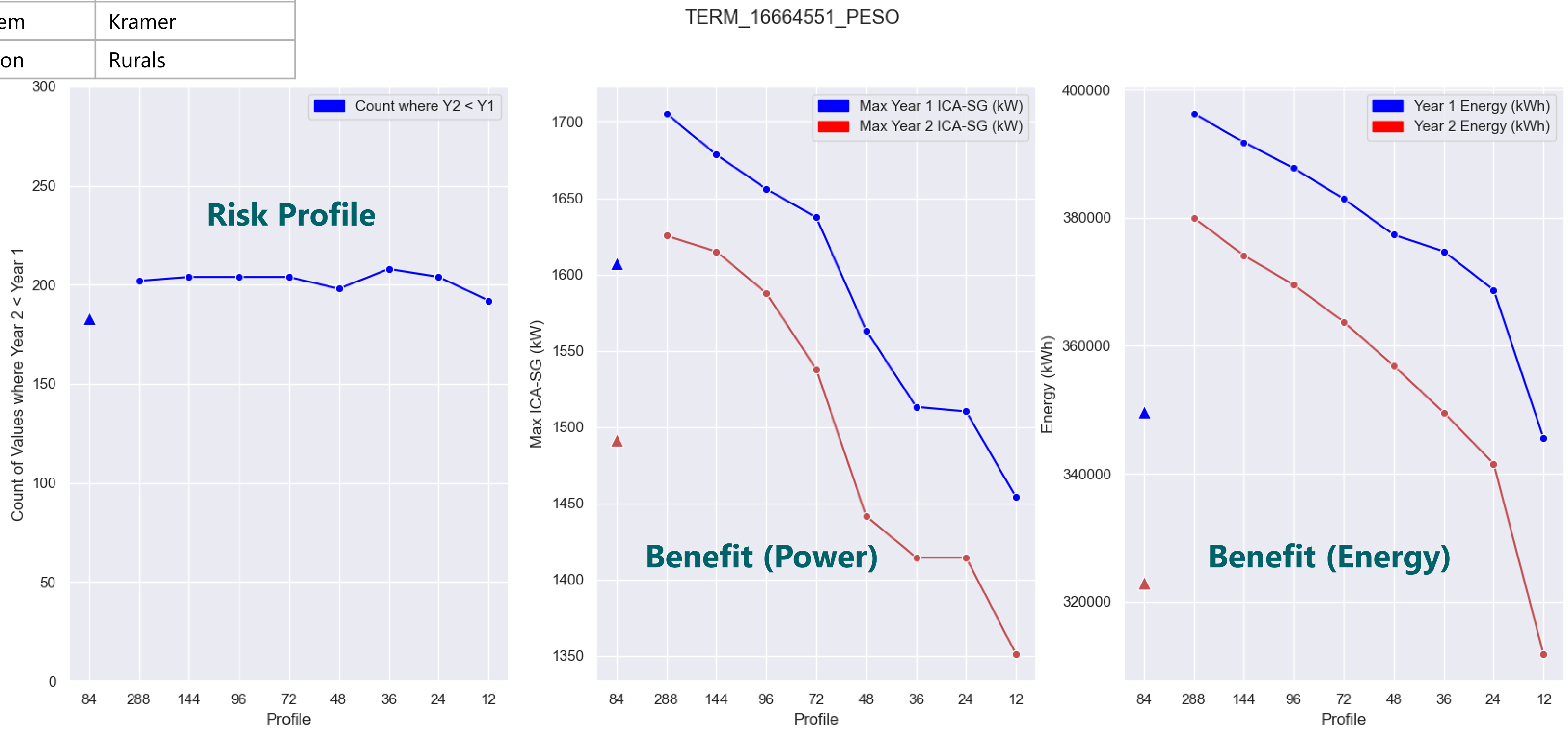

TROPICO_12KV Net Historical Load
Year 1 MAX 288, Jan-Dec
Year 1 MIN 288, Jan-Dec
Year 2 MAX 288, Jan-Dec
Year 2 MIN 288, Jan-Dec
Historical Load (Amps)
Date


TERM_39576268_TROPICO Limiting Studies
288 Profile
144 Profile
96 Profile
72 Profile
48 Profile
36 Profile
24 Profile
12 Profile
Steady State Voltage (SSV)
Voltage Variation (VV)
Thermal Limit (TH)
Protection Limit (PROT)

Circuit	Peso 12 kV
Node ID	TERM_16664551
Substation	Tortilla
System	Kramer
Region	Rurals

Total DER Count/Nameplate (kW)	213 (2,731 kW)
Period 2 DER Count/Nameplate (kW)	34 (368 kW)

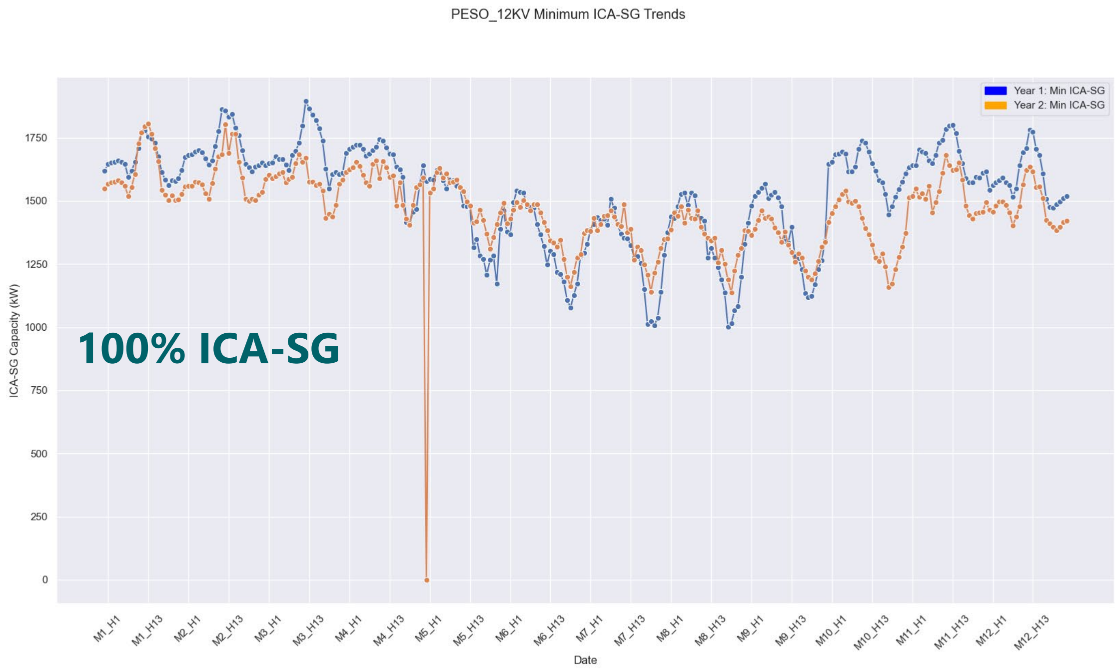
Upstream Conductor (Ampacity)	336 ACSR (605 A)
Downstream Conductor (Ampacity)	336 ACSR (605 A)

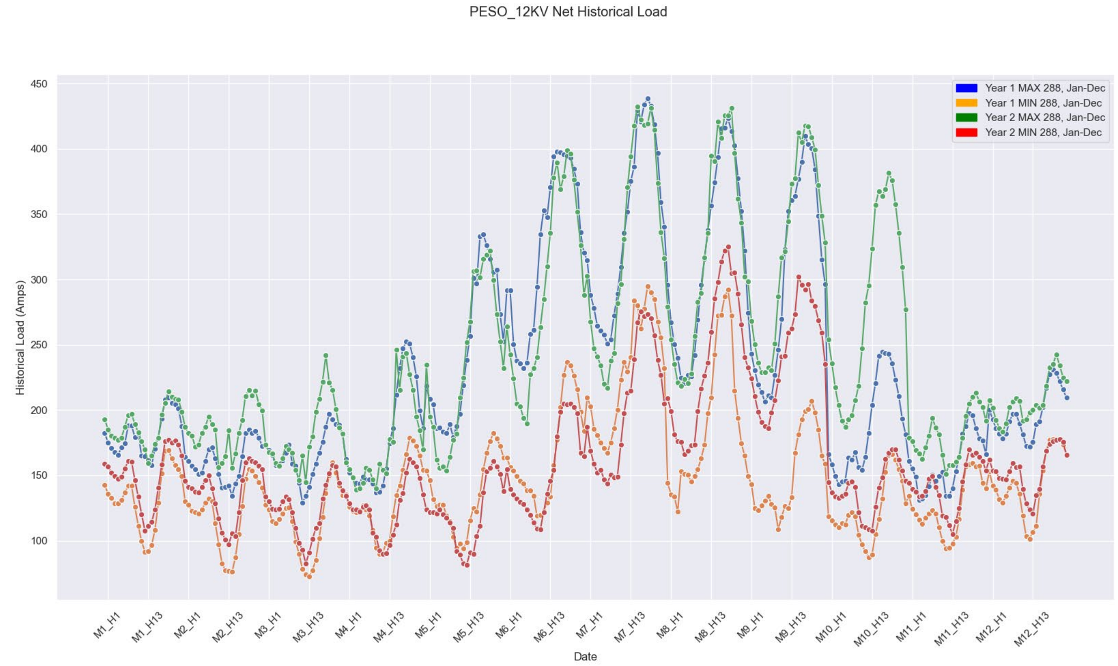


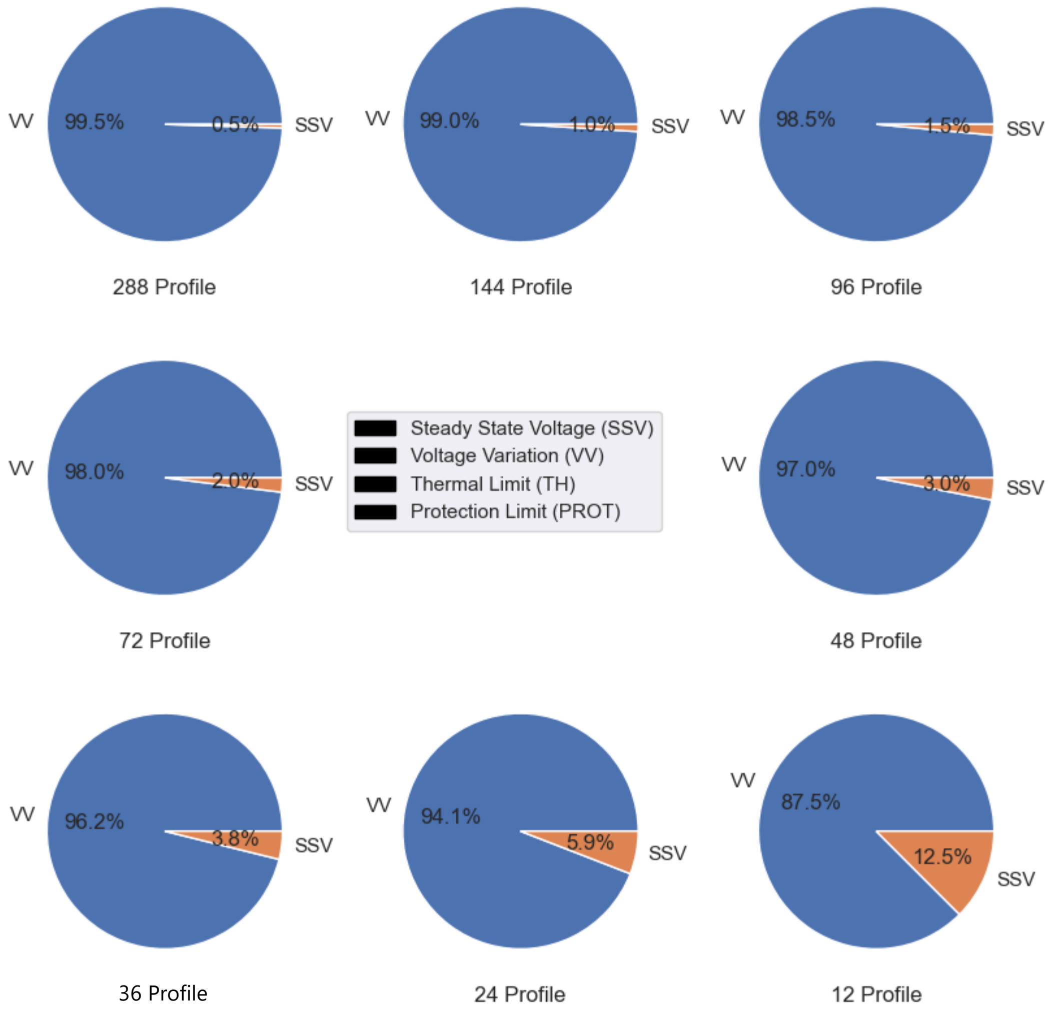
LGP Values	84	288	144	96	72	48	36	24	12
Maximum Deviation Year 2 to Year 1 (kW)	1055.4	1419.8	1419.8	1419.8	1419.8	1419.8	1393.4	1331.8	1055.4

Consequence

TERM_16664551_PESO Limiting Studies



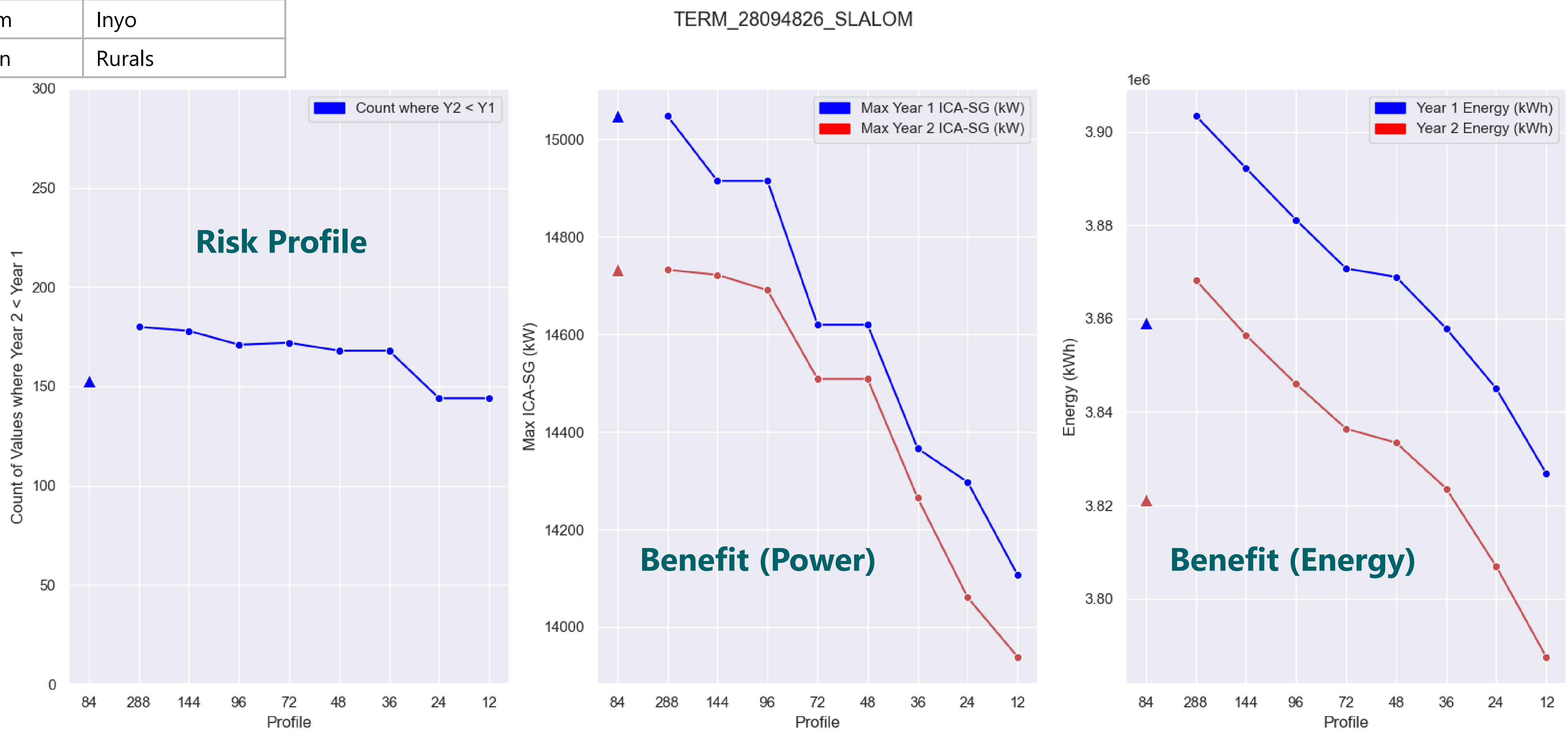




Circuit	Slalom 12 kV
Node ID	TERM_28094826
Substation	Skiland
System	Inyo
Region	Rurals

Total DER Count/Nameplate (kW)	0 (0 kW)
Period 2 DER Count/Nameplate (kW)	0 (0 kW)

Upstream Conductor (Ampacity)	1000 CLP (651 A)
Downstream Conductor (Ampacity)	750 JCN (559 A)

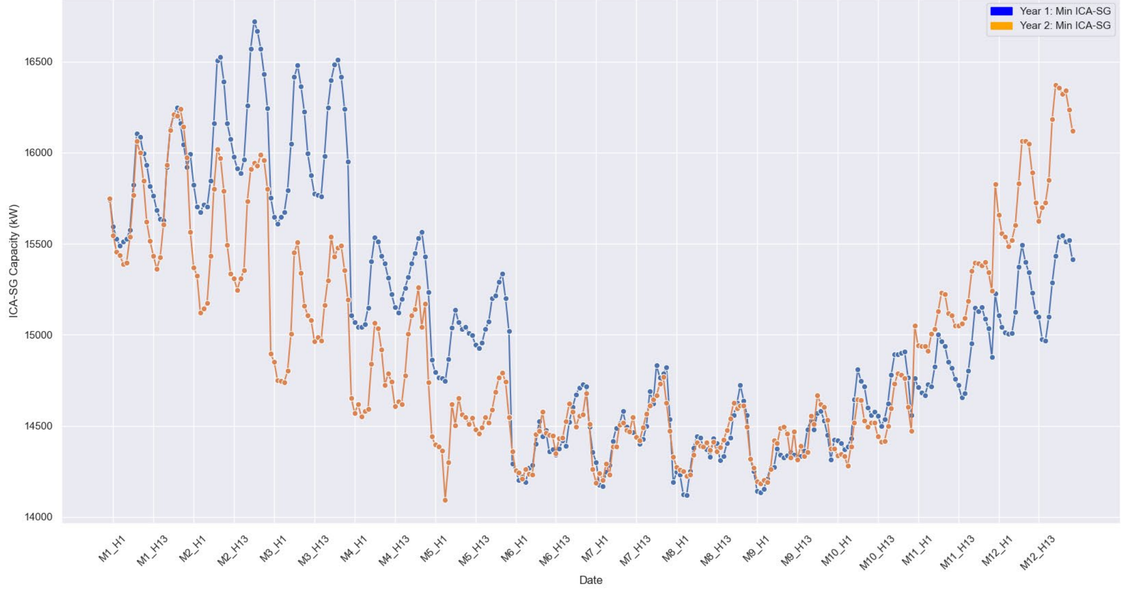


LGP Values	84	288	144	96	72	48	36	24	12
Maximum Deviation Year 2 to Year 1 (kW)	950.4	957.6	937.3	937.3	838.3	891.9	781.9	781.9	781.9

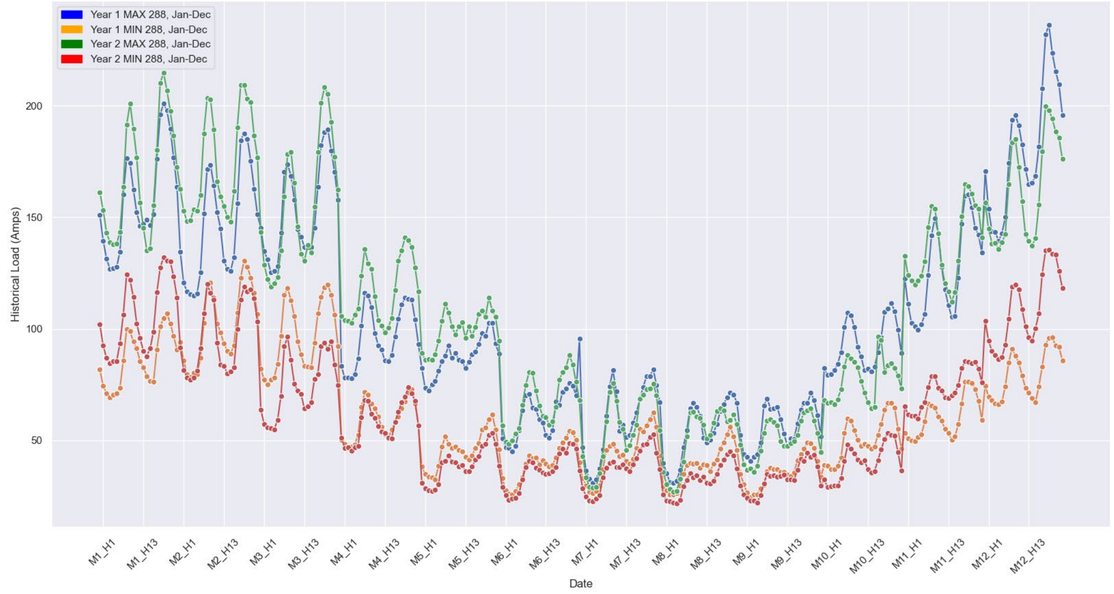
Consequence

100% ICA-SG

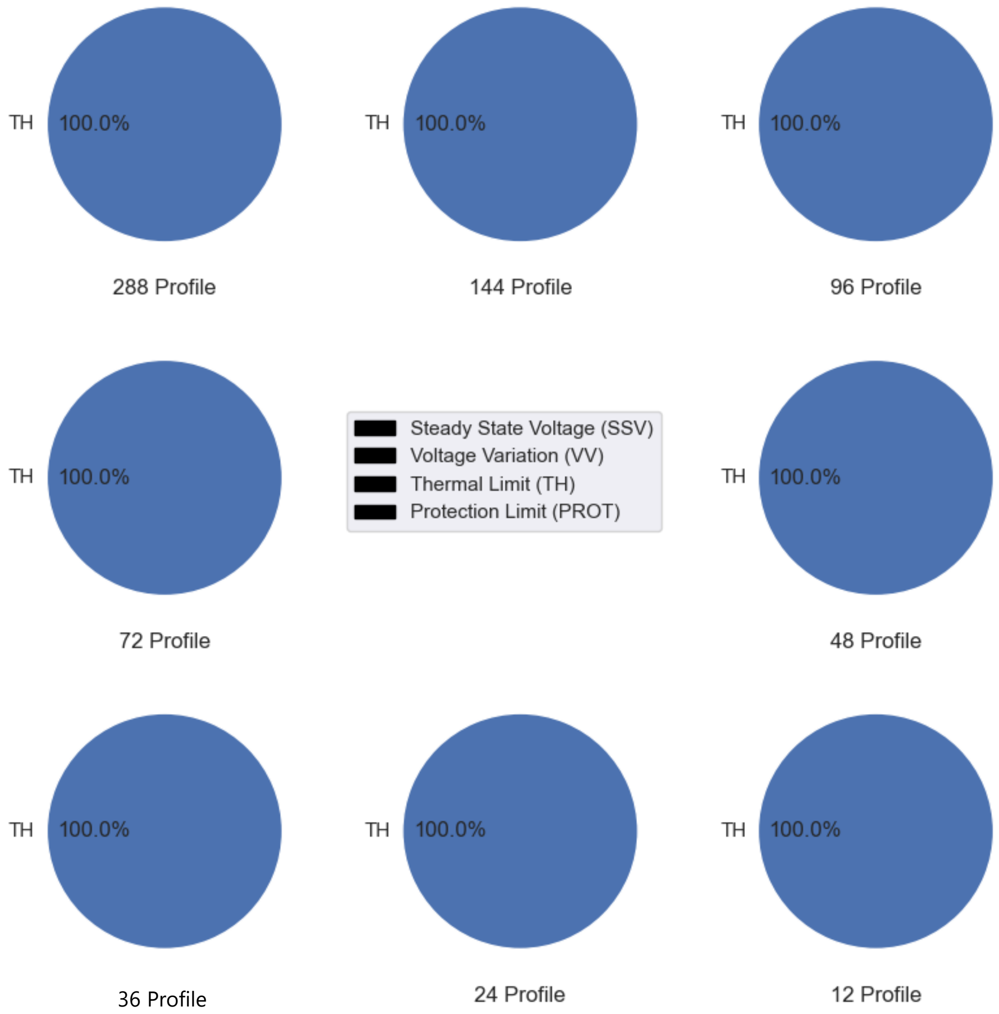
SLALOM_12KV Minimum ICA-SG Trends



SLALOM_12KV Net Historical Load



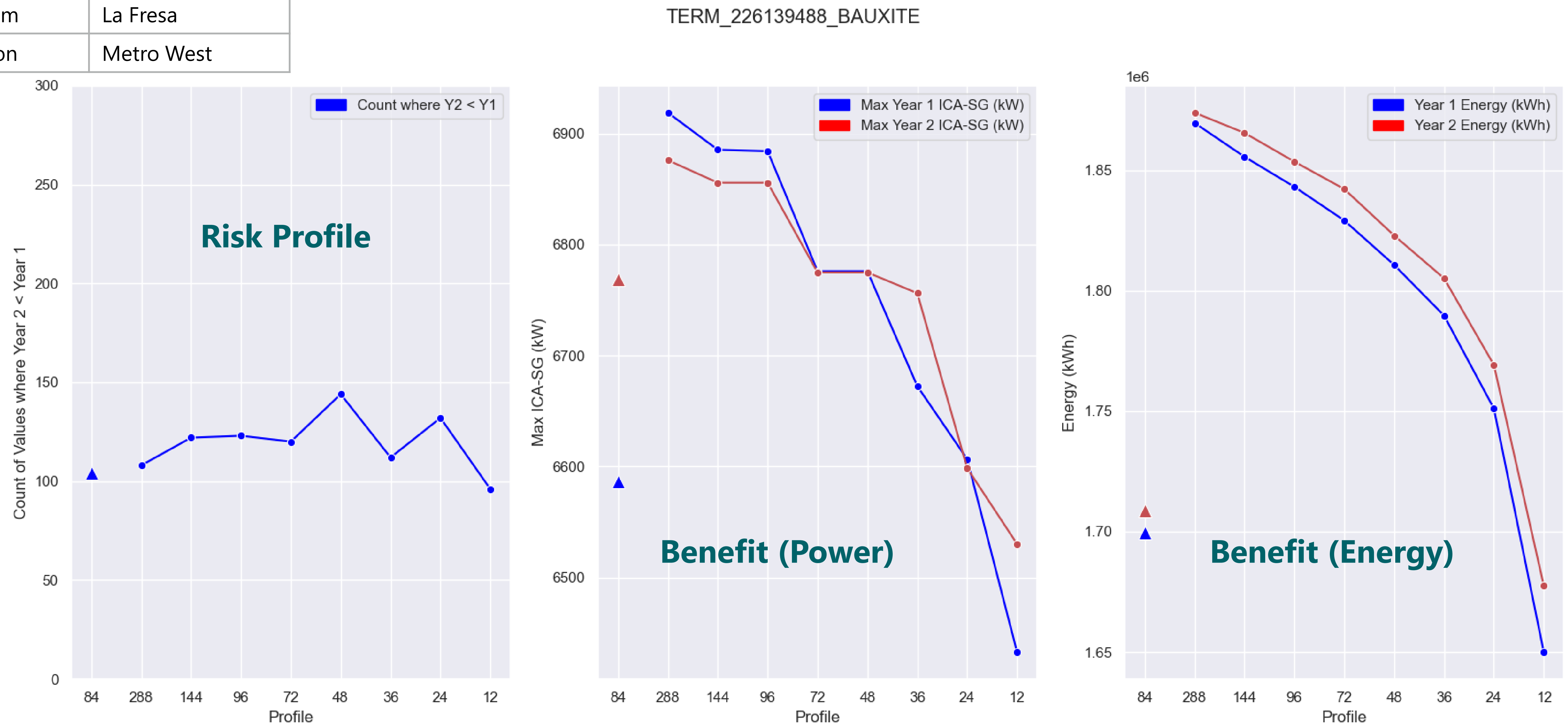
TERM_28094826_SLALOM Limiting Studies



Circuit	Bauxite 16 kV
Node ID	TERM_226139488
Substation	Crest
System	La Fresa
Region	Metro West

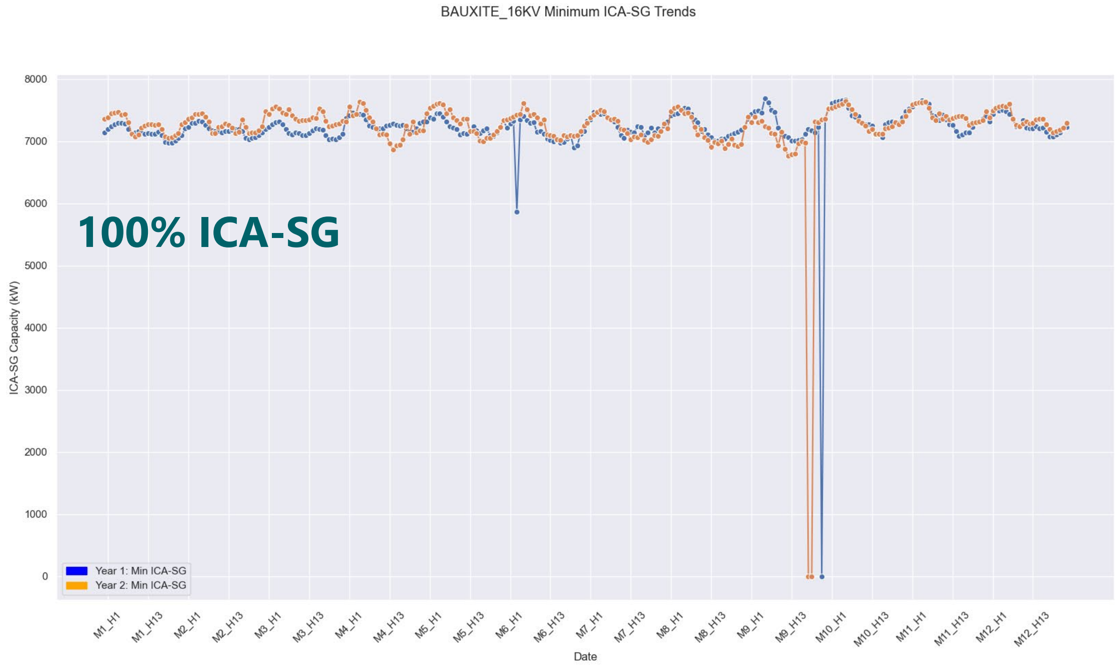
Total DER Count/Nameplate (kW)	113 (834 kW)
Period 2 DER Count/Nameplate (kW)	23 (261 kW)

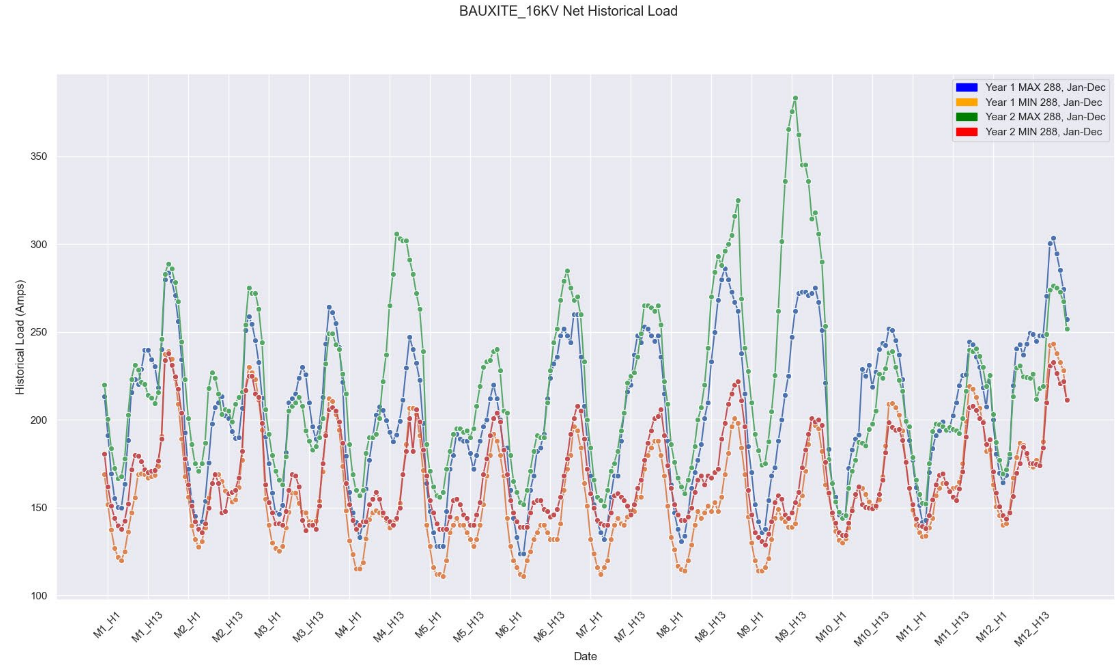
Upstream Conductor (Ampacity)	500 EPR (530 A)
Downstream Conductor (Ampacity)	500 EPR (530 A)

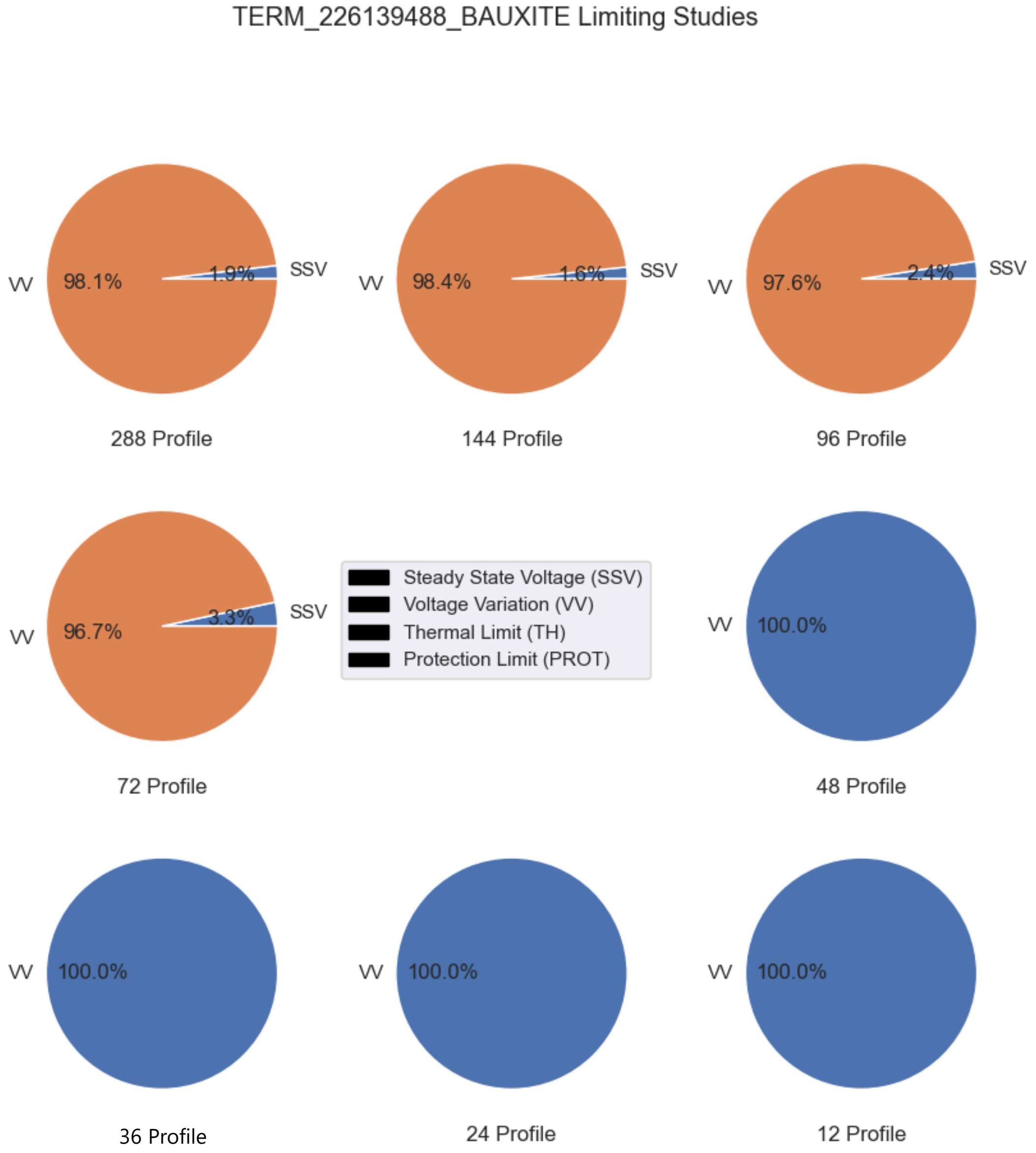


LGP Values	84	288	144	96	72	48	36	24	12
Maximum Deviation Year 2 to Year 1 (kW)	6469.5	6469.5	6455.6	6424.7	6321.8	344.1	305.9	256.6	256.6

Consequence

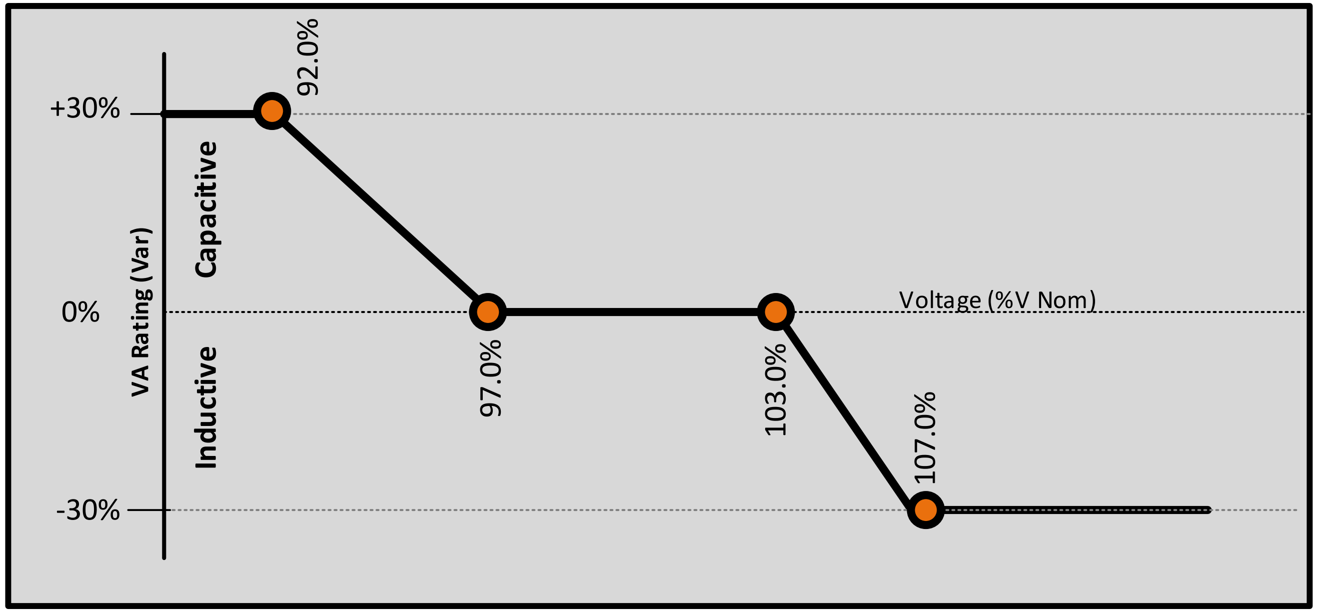

BAUXITE_16KV Minimum ICA-SG Trends
100% ICA-SG
ICA-SG Capacity (kW)
Year 1: Min ICA-SG
Year 2: Min ICA-SG
Date


BAUXITE_16KV Net Historical Load
Historical Load (Amps)
Year 1 MAX 288, Jan-Dec
Year 1 MIN 288, Jan-Dec
Year 2 MAX 288, Jan-Dec
Year 2 MIN 288, Jan-Dec
Date

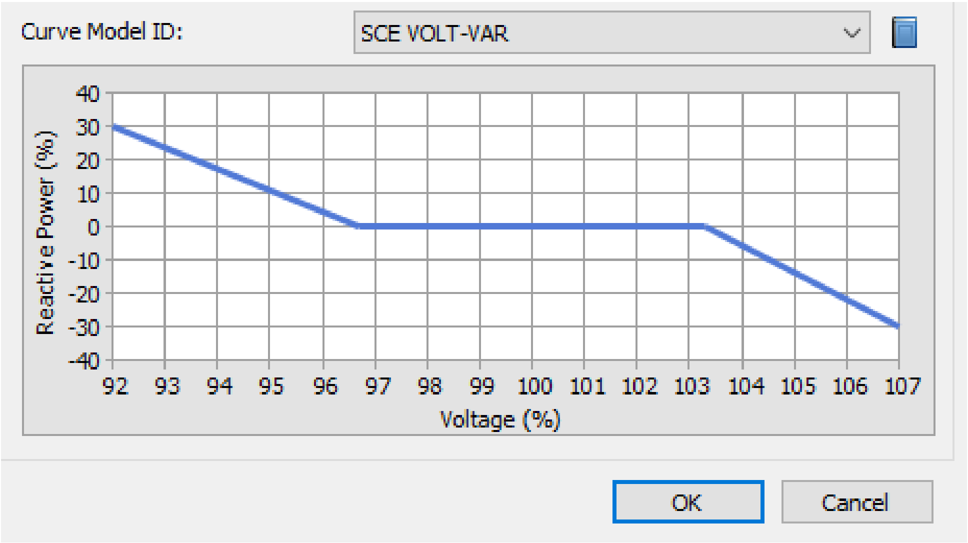

TERM_226139488_BAUXITE Limiting Studies
VV 98.1% 1.9% SSV
288 Profile
VV 98.4% 1.6% SSV
144 Profile
VV 97.6% 2.4% SSV
96 Profile
VV 96.7% 3.3% SSV
72 Profile
Steady State Voltage (SSV)
Voltage Variation (VV)
Thermal Limit (TH)
Protection Limit (PROT)
VV 100.0%
48 Profile
VV 100.0%
36 Profile
VV 100.0%
24 Profile
VV 100.0%
12 Profile

Appendix

Volt-VAR Curves



Volt-VAR Curve in SCE's Reply to CALSSA Protest of 4824-E-B



Volt-VAR Curve for Existing Inverter-based DER in CYME

Volt/VAr-Curve Voltage Setpoints V2 and V3

Voltage Setpoint	Voltage Value	Reactive Setpoint	Reactive Value	Operation
V1	92.0%	Q1	30%	Reactive Power injection
V2	97.0%	Q2	0	Unity Power Factor
V3	103.0%	Q3	0	Unity Power Factor
V4	107.0%	Q4	30%	Reactive Power Absorption

(Hh.2.j)

Voltage Setpoint	Voltage Value	Reactive Setpoint	Reactive Value	Operation
V1	92.0%	Q1	30%	Reactive Power Injection
V2	96.7%	Q2	0	Unity Power Factor
V3	103.3%	Q3	0	Unity Power Factor
V4	107.0%	Q4	30%	Reactive Power Absorption

(P.2.j)