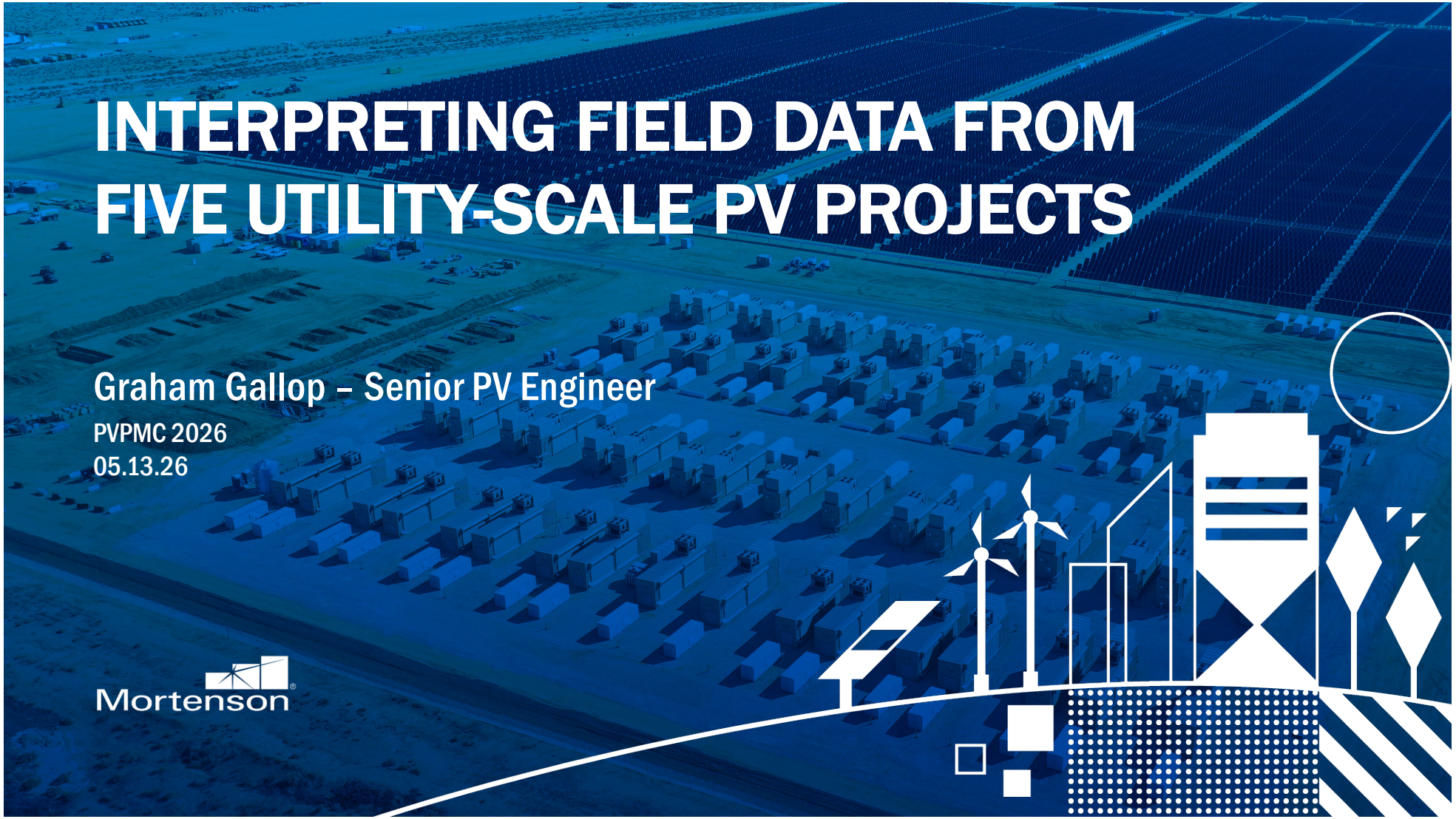

INTERPRETING FIELD DATA FROM FIVE UTILITY-SCALE PV PROJECTS

Graham Gallop – Senior PV Engineer

PVPMC 2026
05.13.26

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ABOUT US

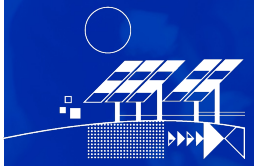
MORTENSON EXPERIENCE

72 YEARS
CONSTRUCTION EXPERIENCE

$10.9B
ANNUAL REVENUE

10,000+
EMPLOYEES NATIONALLY

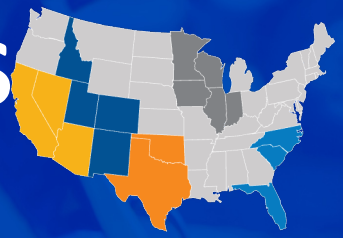
SOLAR EXPERIENCE



16 YEARS
SOLAR CONSTRUCTION EXPERIENCE

110+ PROJECTS
INSTALLED AND IN PROGRESS

18 STATES
WITH MORTENSON SOLAR PROJECTS



14+ GW
INSTALLED AND IN PROGRESS

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1. The results

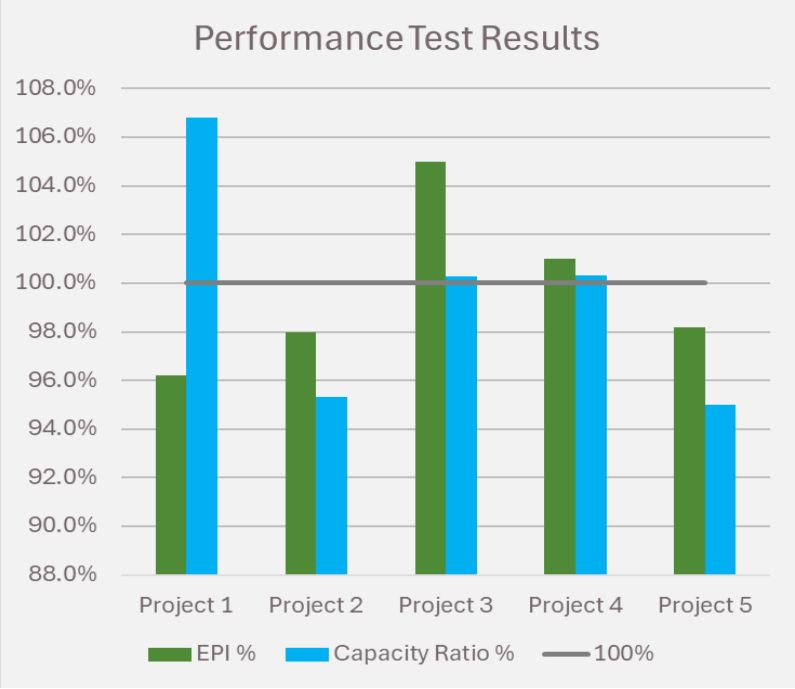
PERFORMANCE TESTING

- Energy Performance Index (EPI) Test
  - Evaluates energy over time
- Capacity Test
  - Evaluates power at each moment

Table 1 – Performance test results

Project #	Project Size	EPI %	Capacity Ratio %
Project 1	~100 MW	96.2%	106.8%*
Project 2	~100 MW	98.0%	95.3%*
Project 3	~100 MW	105.0%	100.3%
Project 4	~100 MW	101.0%	100.3%
Project 5	~100 MW	98.2%	95.0%
Average		99.70%	99.50%

*Test not concluded.



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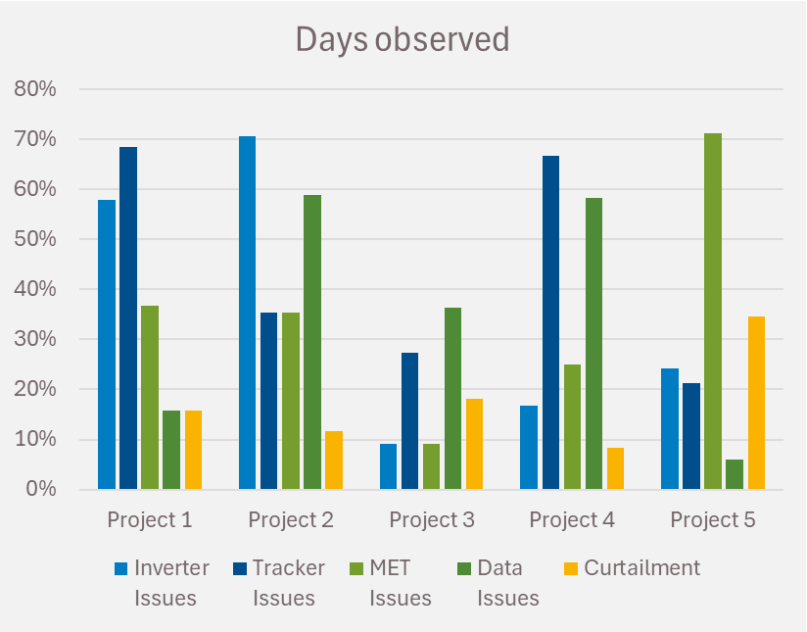
OBSERVATIONS

- Every test reveals new challenges and constraints.
- Equipment issues are common right after site commissioning.

Table 2 – Observed issues (% of days, including non-test data)

Project #	Inverter Issues	Tracker Issues	MET Issues	SCADA Issues	Curtailment
Project 1	58%	68%	37%	16%	16%
Project 2	71%	35%	35%	59%	12%
Project 3	9%	27%	9%	36%	18%
Project 4	17%	67%	25%	58%	8%
Project 5	24%	21%	71%	6%	35%



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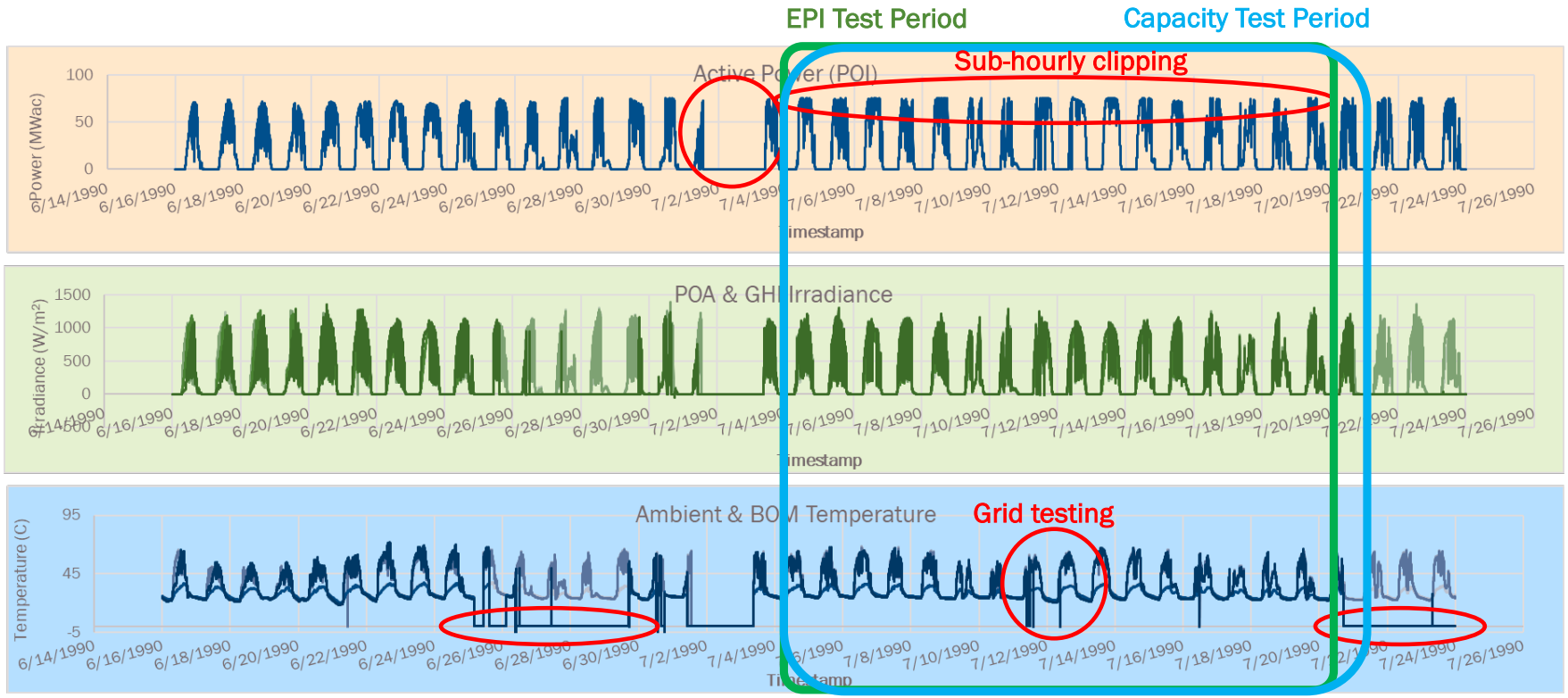
2. The project data

PROJECT 1 – RAW DATA



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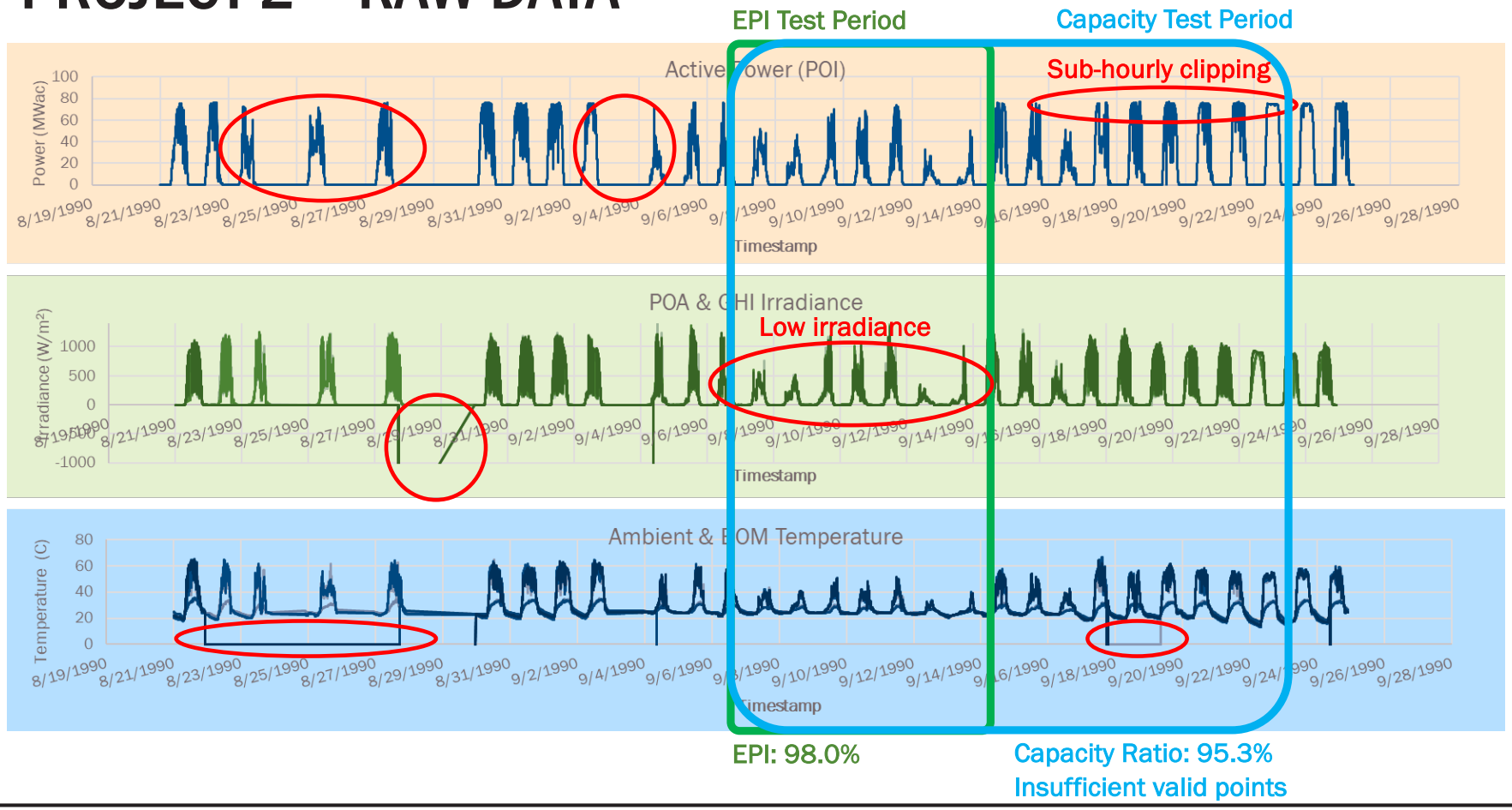
PROJECT 2 – RAW DATA



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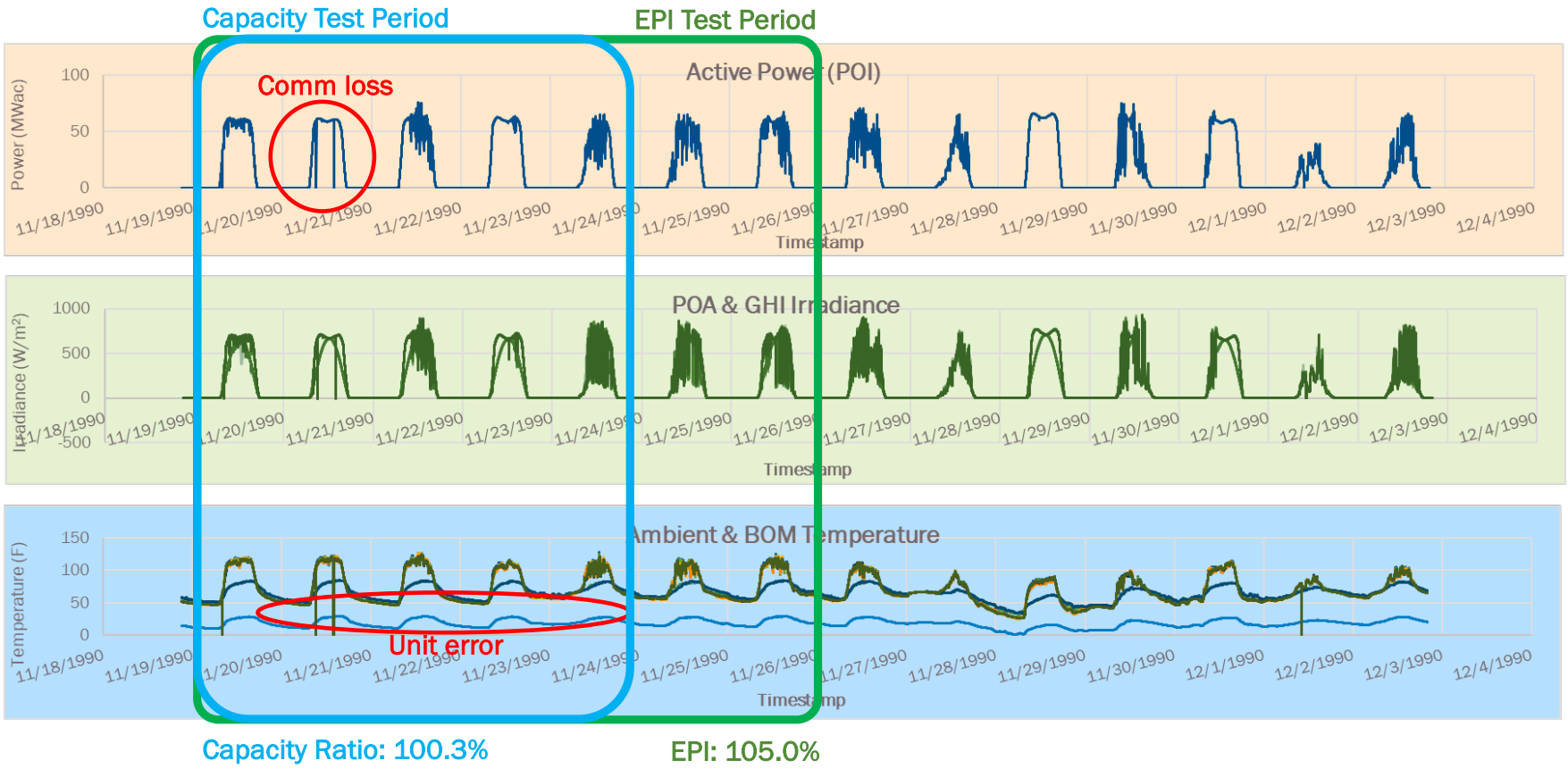
PROJECT 3 – RAW DATA



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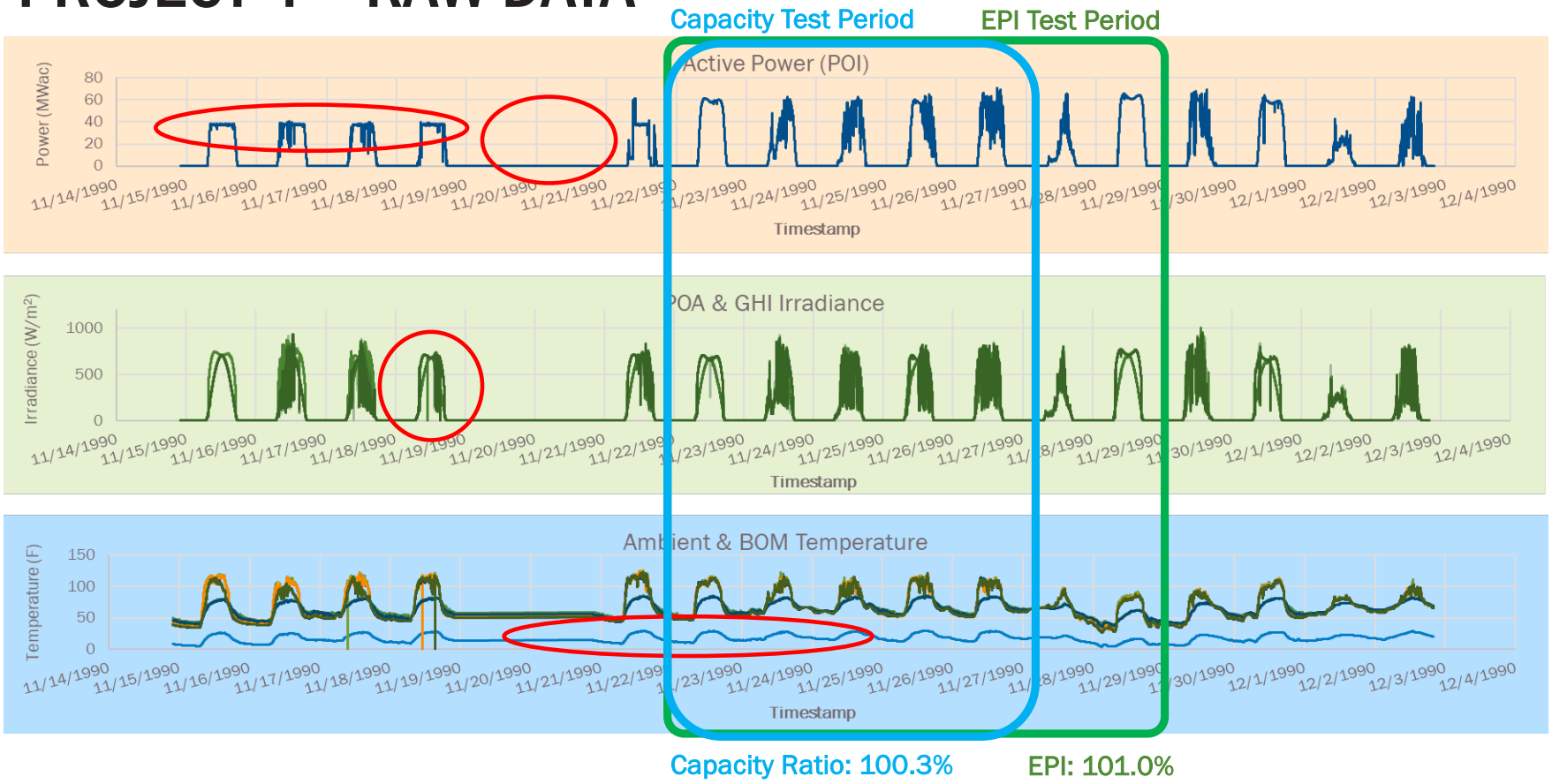
PROJECT 4 – RAW DATA



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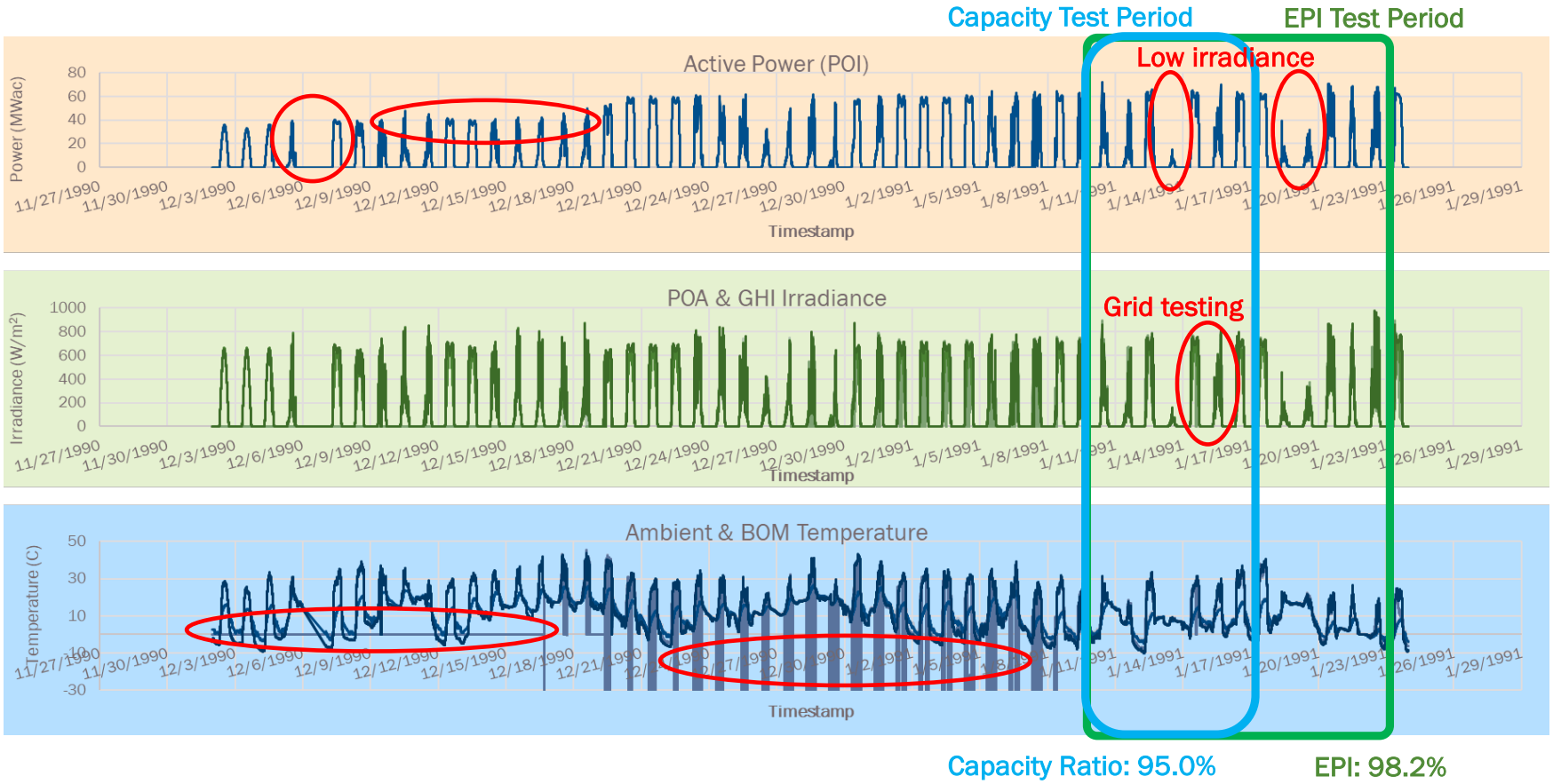
PROJECT 5 – RAW DATA



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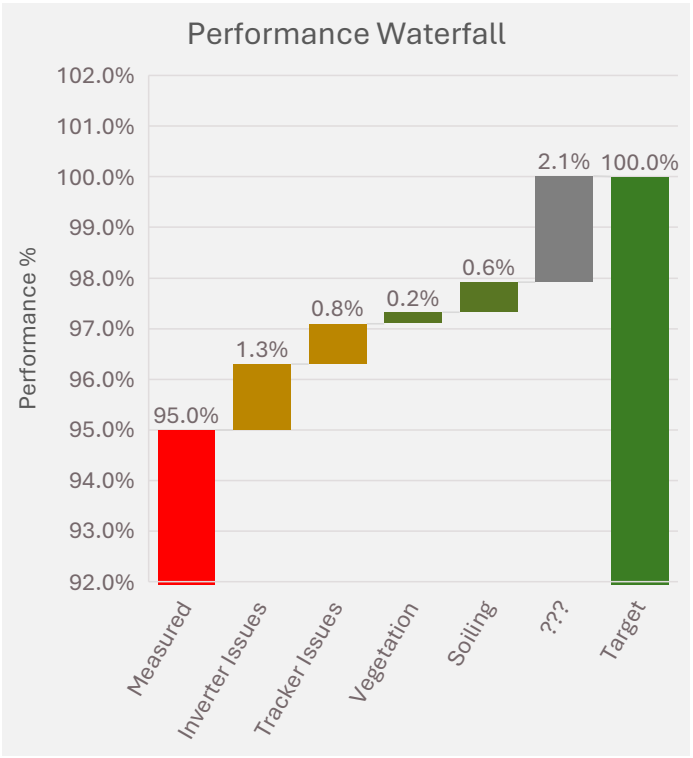
3. How we handle the data

WE CAN EXPLAIN

- Perceived underperformance is often a combination of different issues and conditions.
- Knowing what to look for and where to look is important.

Vegetation shade

Module crack ground fault



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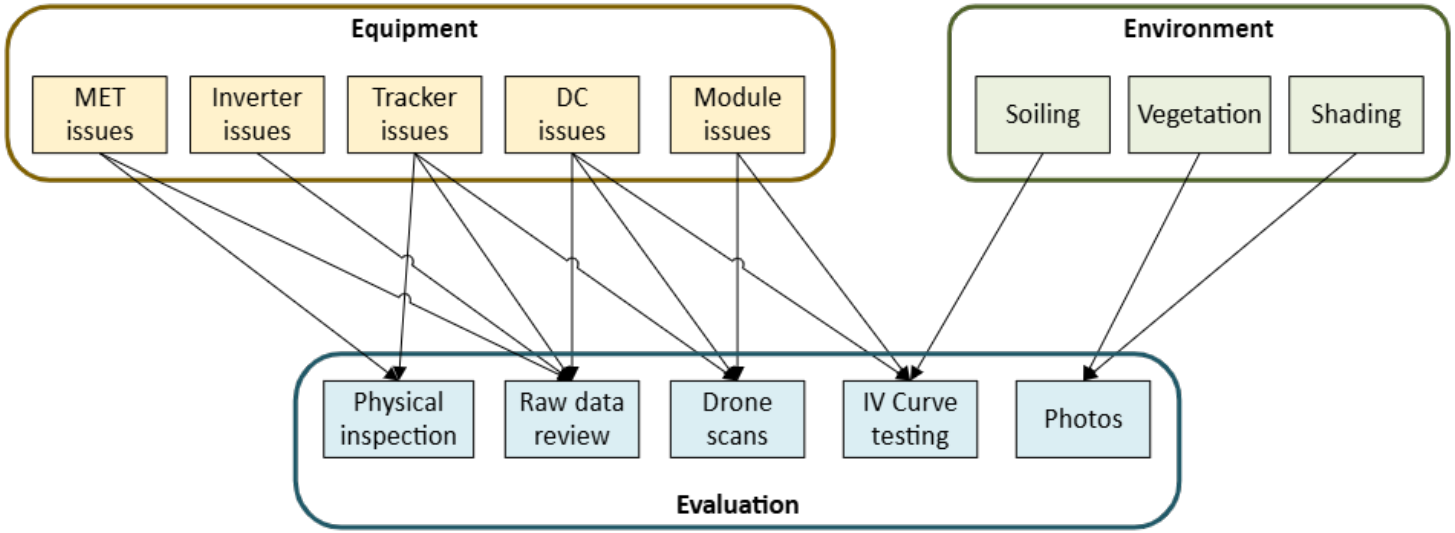
DETECTING ISSUES

- It can be challenging to determine root causes.
- Keep an eye out for issues never seen before.



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USING STANDARDS TO HELP

- Standards are used to create performance testing exhibits.
- Standards don't remove risk or ambiguity.
- Standards require engineering judgement.

Table 3 - Shared Capacity Test Exclusions

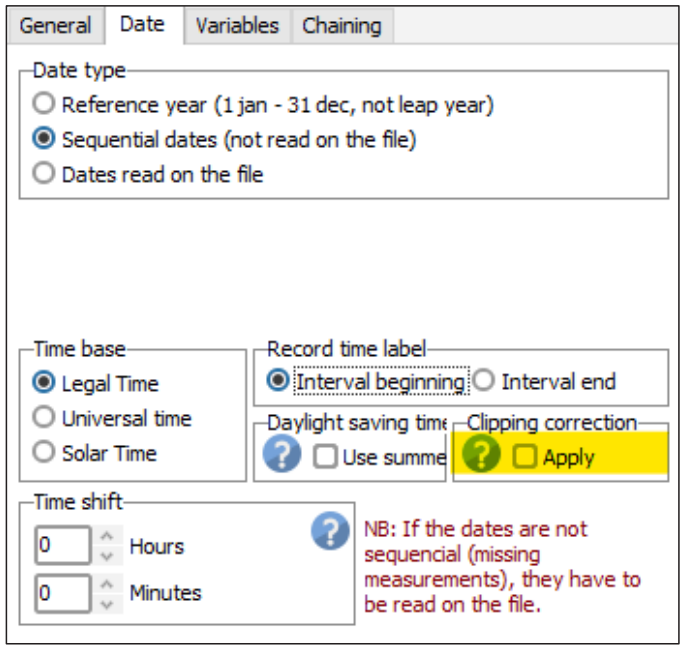
Exclusion	ASTM-E2848	IEC-61724-2
Inverter utilization	9.1.8	14.3.2
Shade	9.1.9	14.3.3
Angle of incidence	9.1.10	14.3.4
Data out of range	9.1.6	14.4.1
Missing data	9.1.4	14.4.3
Unstable irradiance	9.1.7	14.6

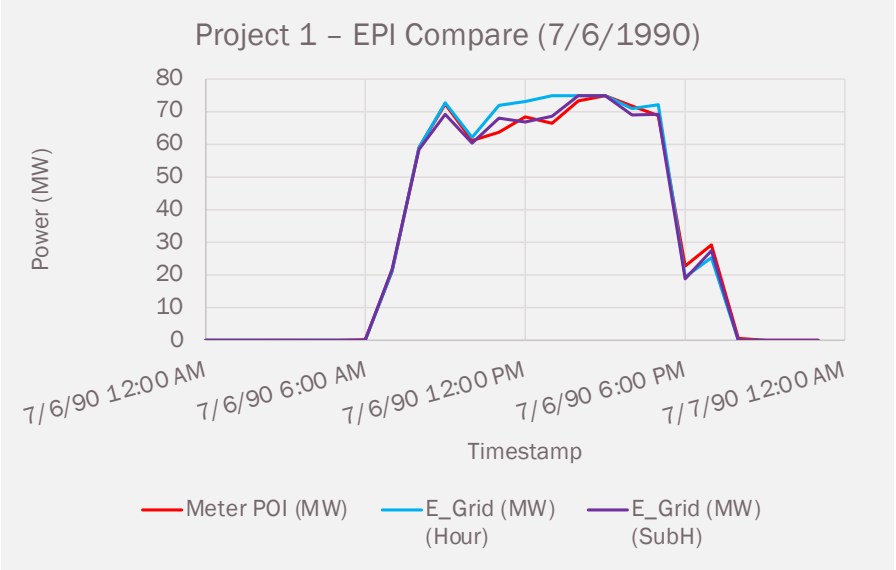
COMMON STANDARDS WE USE

- **ASTM E2848:**
  - Capacity Test
  - Published in 2013
- **IEC 61724-2:**
  - Capacity Test
  - Published in 2016, updated in 2025
  - Updates address modern tech such as bifaciality
- **IEC 61724-3:**
  - Energy Performance Index (EPI) Test
  - Published in 2016

KEEPING PACE WITH SOFTWARE

- Project 1 was re-evaluated in PVsyst with "Clipping correction" applied.





Project 1 – EPI Compare	Hourly	SubHourly
EPI % (7/6/1990)	97.5%	100.8%
EPI % (Test Period)	96.2%	98.5%

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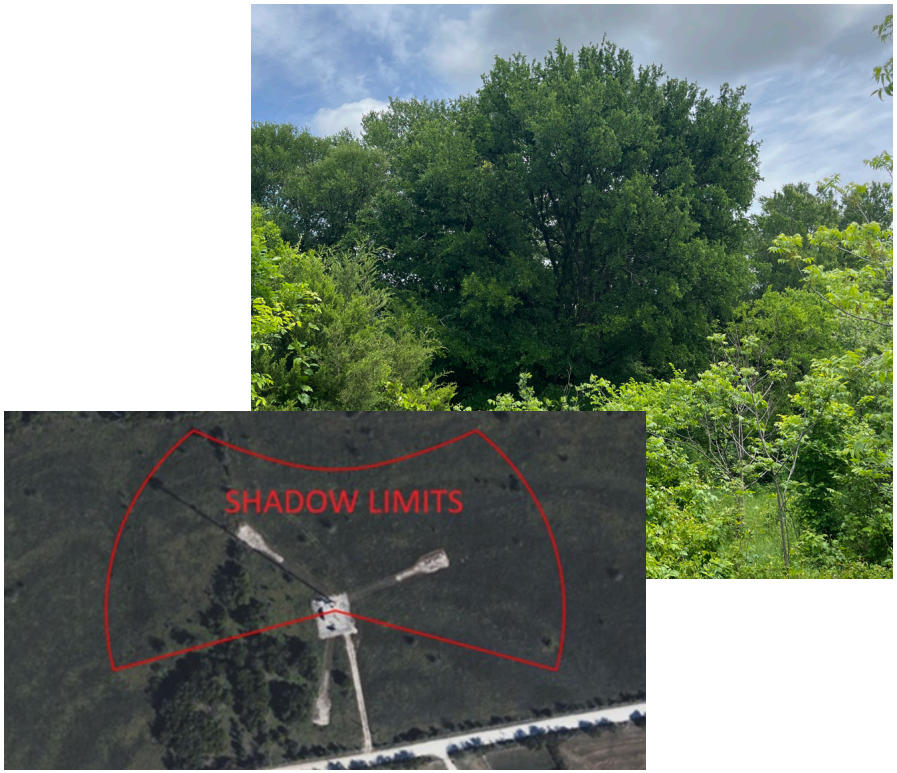
PREPARING IN PRECONSTRUCTION

- All models are wrong, but some are useful.
- Design choices and assumptions are made early in preconstruction:
  - DC:AC ratio, ILR
  - Sub-inverter balancing
  - Tree shade
- Stakeholders want to lock in designs earlier, with fewer updates for as-builts.
- The project schedule must allow time for curtailment and grid testing.



4. Takeaways

TAKEAWAYS

We must be self-aware and continuously improve.

Every project reveals unique challenges.

Problem solving framework for performance testing a utility-scale solar project:

- Detect known issues and monitor for new ones.
- Know how standards can help.
- Stay current on software updates.
- Ensure design assumptions and project schedule are aligned during preconstruction.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THANK YOU!
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