Power Usage Effectiveness (PUE)

Seeking Order from Chaos

Schneider Electric

What is PUE?

PUE is an energy intensity metric that is intended to illustrate the efficiency of delivering power to the white space IT loads.

PUE = Facility Power / IT Equipment Power

It looks simple, it looks friendly, but don’t be fooled! There is a monster lurking underneath there.

The Wild West of PUE Reporting

- PUE is the most prevalent metric for measuring efficiency
- Calculating PUE is an art with little consistency or transparency
- PUE values are be affected by:
  - Environmental conditions
  - Redundancy architecture
  - Metering location
  - Timing & frequency of measurement

Some law and order is needed

Developing a PUE Reporting Standard

- A standard is sorely needed:

"These days, I view each and every public statement of PUE with a heaping shovel-full of skepticism regardless of company or perceived leadership position." - Mike Manos, Digital Realty Trust

- Organizations are attempting to create a reporting standard to address the lack of trust with current reporting methods.

Green Grid Guidelines

1. Define what “Facility Power” and “IT Equipment Power” are
2. Determine where and how measurements should be taken
3. Create nomenclature to easily communicate the calculation used for PUE

Green Grid Guidelines

Facility Power
Power •Electric distribution infrastructure •Lighting
Heating, Ventilation, & Air Conditioning (HVAC)
Physical Security
Building Management System

IT Equipment Power
Computer Devices
Network Devices
IT Support Systems
Storage
Telecommunications
Miscellaneous Devices

Green Grid Guidelines

	Level 1 (Basic)	Level 2 (Intermediate)	Level 3 (Advanced)
IT Equipment Power Measurement From…	UPS	PDU	Server,….
Total Facility Power Measurement From…	Data Center input power	Data Center input less shared HVAC	Data Center input less shared HVAC plus building lighting, security…
Minimum Measurement Interval	Monthly/Weekly	Daily	Continuous (xx min)

Green Grid Guidelines

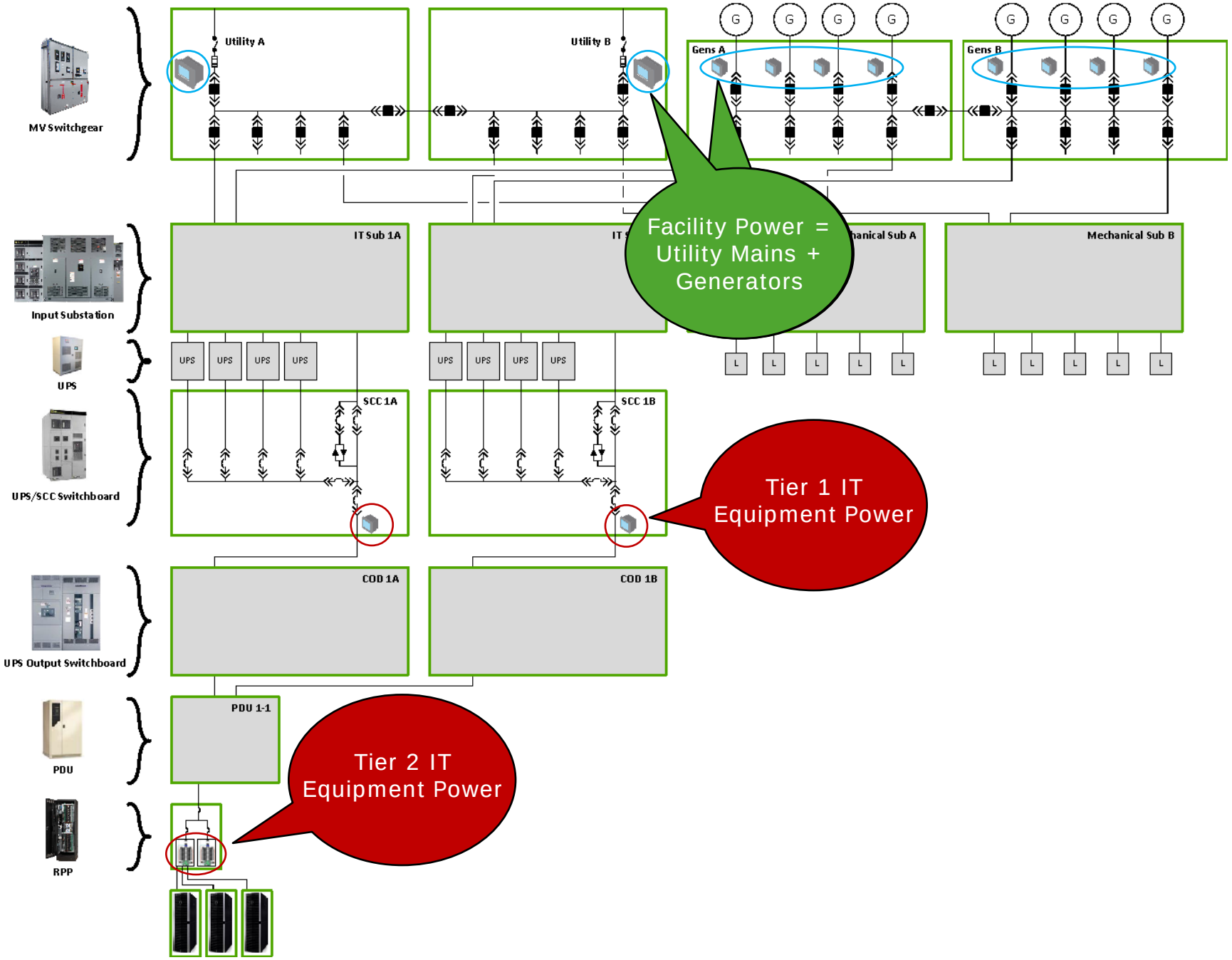
	Single DCiE measurement (0.45) taken using a Level 1 meter placement
	Yearly average DCiE (0.51), using data points gathered monthly with a Level 1 meter placement
1.6 $PUE_{L1,MW}$	Monthly average PUE (1.6) using data points gathered weekly with a Level 1 meter placement
	Weekly average DCiE (0.43), using data points gathered daily with a Level 1 meter placement
1.8 $PUE_{L2,WC}$	data points gathered continuously with a Level
2.1 $PUE_{L3,YC}$	Yearly average PUE (2.1) using continuous measurements with a Level 3 meter placement.

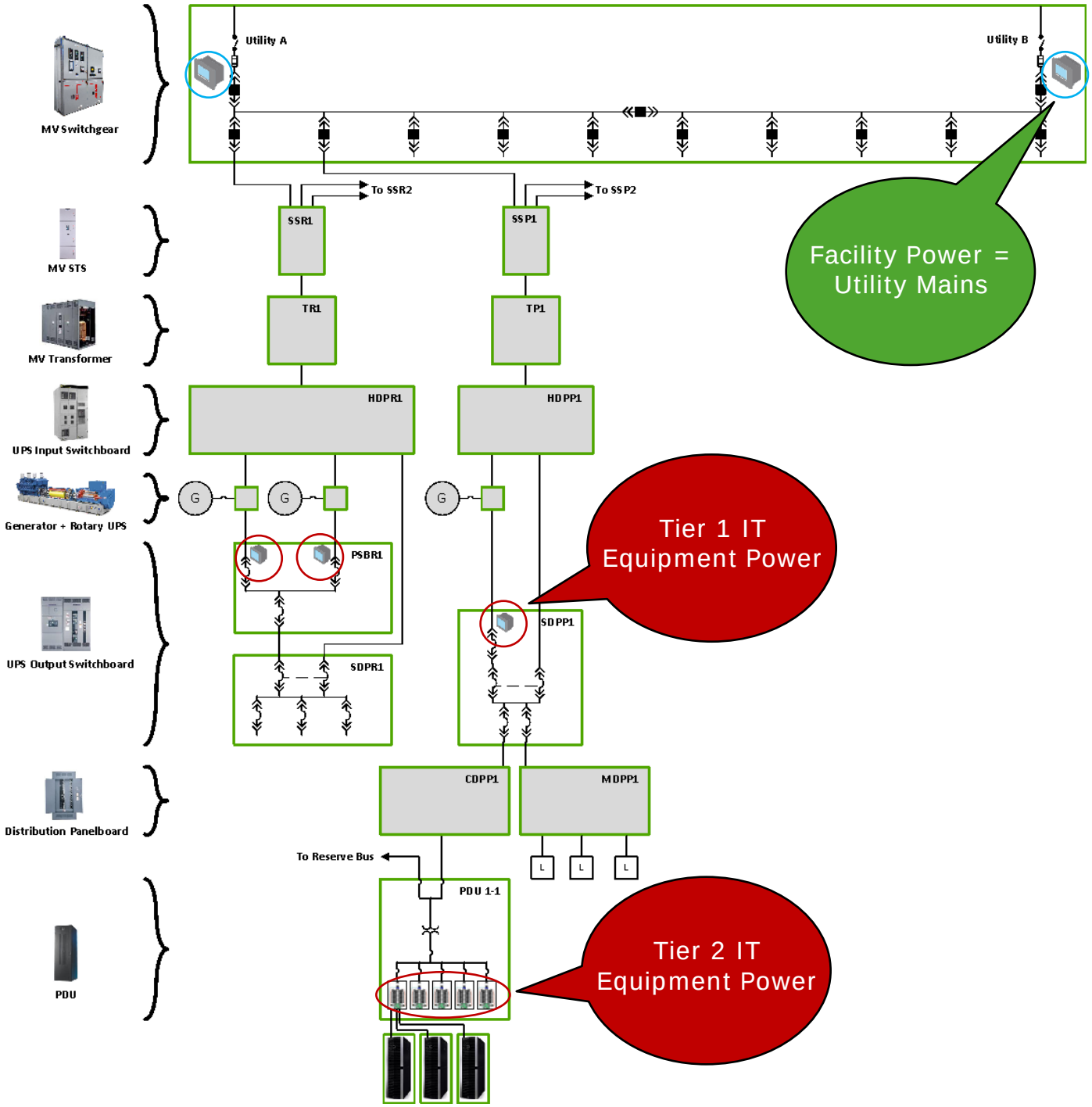
The reporting Level (i.e. L1, L2, L3)

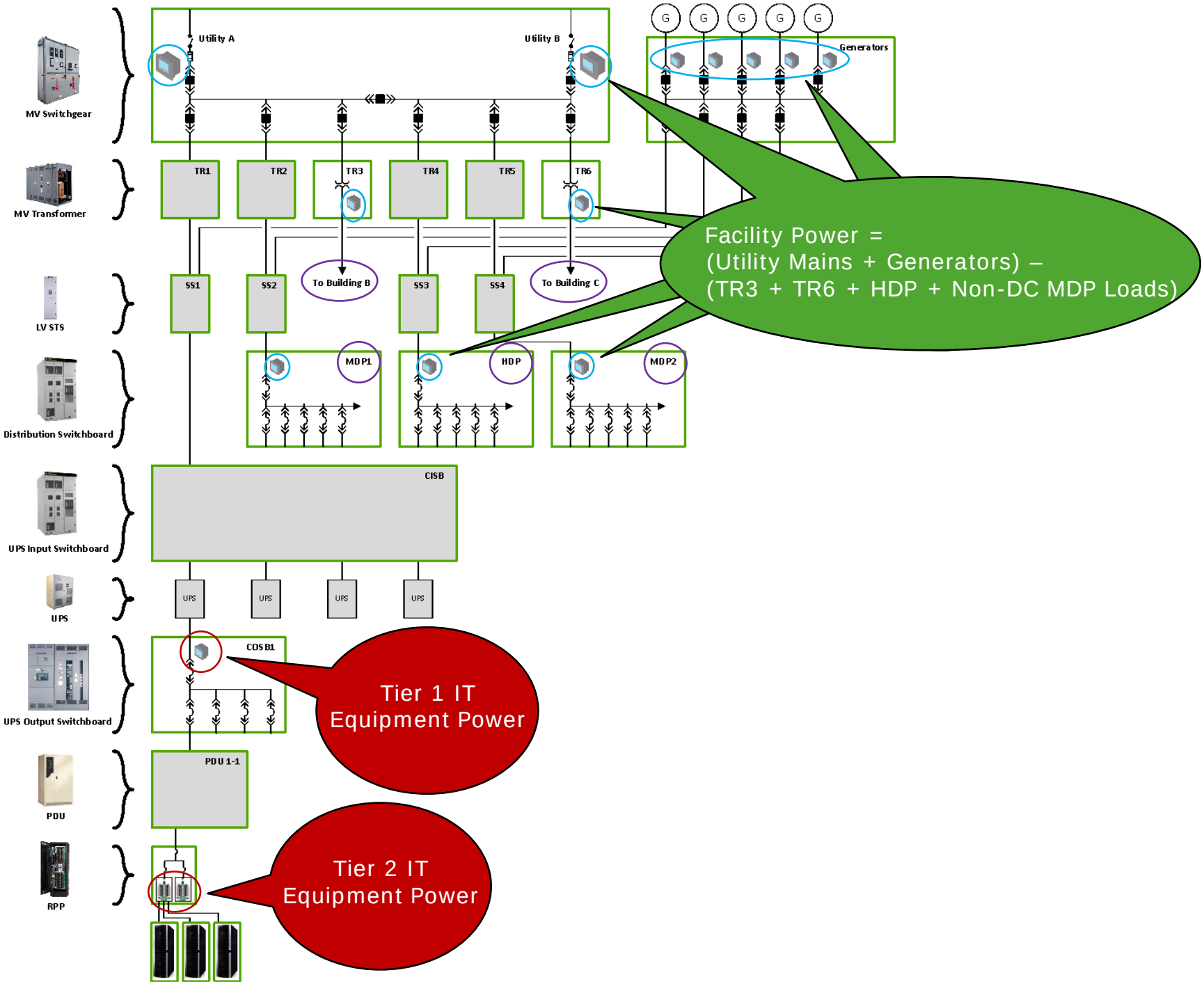
The timeframe the calculation is average over (i.e. Y, M, W, D)

The frequency of the measurement (i.e. M, W, D, C)

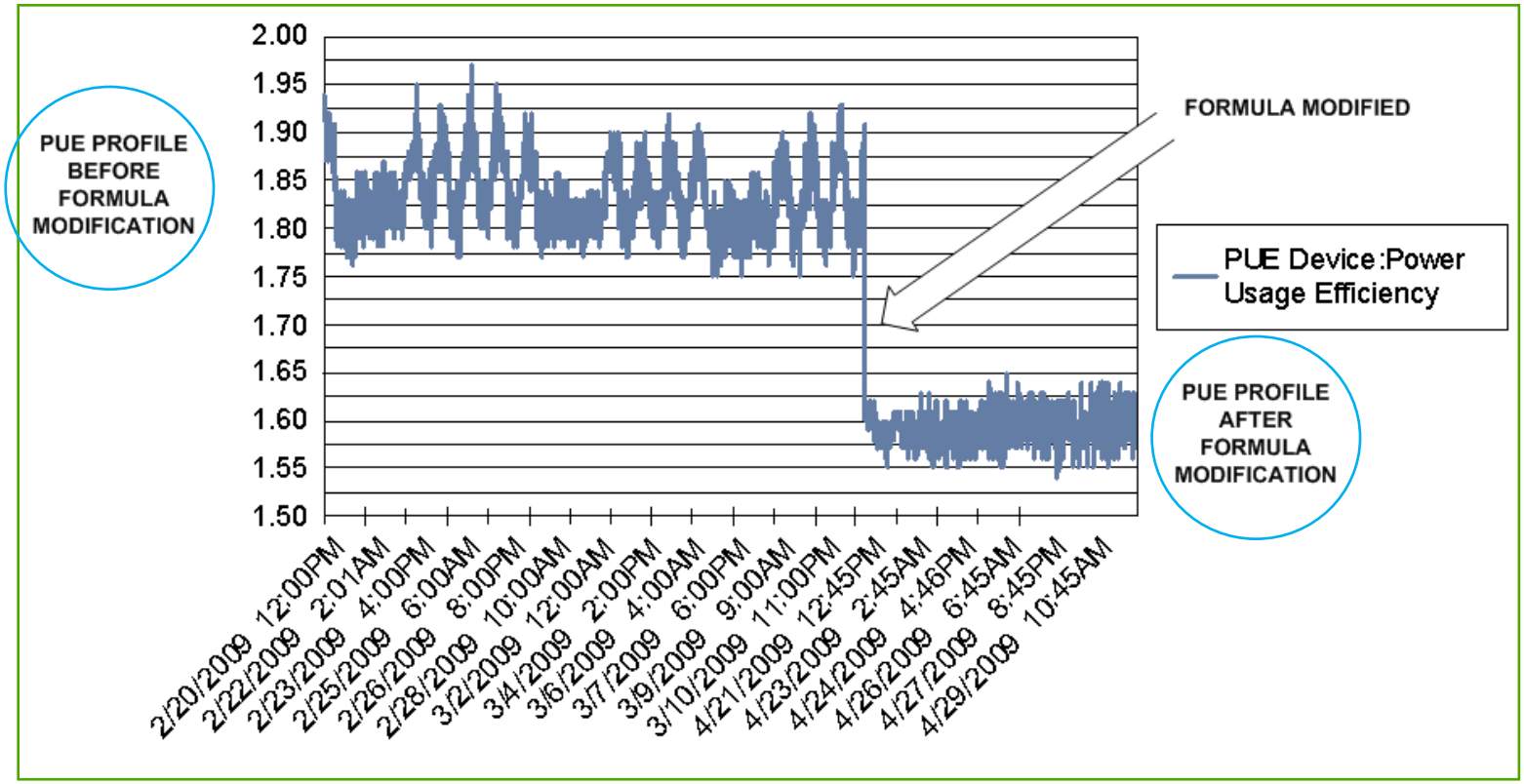
Practical Examples


MV Switchgear
Utility A
Utility B
Gens A
Gens B
G
Input Substation
IT Sub 1A
Mechanical Sub A
Mechanical Sub B
Facility Power = Utility Mains + Generators
UPS
UPS/SCC Switchboard
SCC 1A
SCC 1B
Tier 1 IT Equipment Power
UPS Output Switchboard
COD 1A
COD 1B
PDU
PDU 1-1
Tier 2 IT Equipment Power
RPP


MV Switchgear
Utility A
Utility B
To SSR2
To SSP2
MV STS
SSR1
SSP1
MV Transformer
TR1
TP1
UPS Input Switchboard
HDPR1
HDPP1
Generator + Rotary UPS
G
G
G
PSBR1
UPS Output Switchboard
SDPR1
SDPP1
CDPP1
MDPP1
Distribution Panelboard
To Reserve Bus
L
L
L
PDU 1-1
PDU
Facility Power = Utility Mains
Tier 1 IT Equipment Power
Tier 2 IT Equipment Power


MV Switchgear
MV Transformer
LV STS
Distribution Switchboard
UPS Input Switchboard
UPS
UPS Output Switchboard
PDU
RPP
Utility A
Utility B
Generators
G
TR1
TR2
TR3
TR4
TR5
TR6
SS1
SS2
SS3
SS4
To Building B
To Building C
MDP1
HDP
MDP2
CISB
UPS
COSB1
PDU 1-1
Facility Power =
(Utility Mains + Generators) –
(TR3 + TR6 + HDP + Non-DC MDP Loads)
Tier 1 IT
Equipment Power
Tier 2 IT
Equipment Power

The Many Truths of a PUE Value



Conclusions

1. The Green Grid reporting guidelines are a good guide, but not perfect
2. PUE seems simple, but “the devil is in the details”
3. The appropriate metering is essential for accurately calculating PUE