POWER ANALYTICS

Taking the Unpredictability Out of Power

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Background

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Taking the unpredictability out of power

1. The greatest threats to your business
2. Monetizing downtime/ Planned vs. unplanned/ External vs. internal
3. Electrical deaths and injuries
4. Taking control over power reliability and costs
5. Analytics for electrical power infrastructure
6. Organizations embracing power analytics
7. Discussion

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The threats to your operations

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What poses the greatest threat to your business continuity?

Fire?

Flood?

Earthquake?

Storm damage?

Bombing?

Hurricane?

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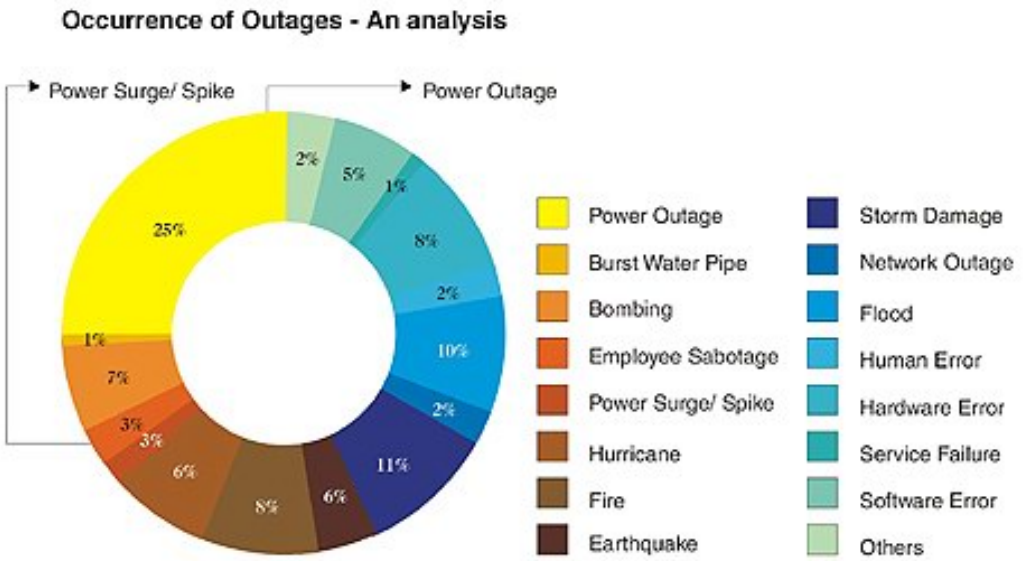
The threats to your operations

Electrical power problems cause more damage than fires, floods, earthquakes, bombings and hurricanes… combined



Electrical power problems costs America more than $164B per year

Source: Contingency Planning & Research; Electrical Power Research Institute (EPRI)

The threats to your operations

How much is $164 billion?

Top Five in the FORTUNE 500

(x3)

(x10)

Sources: FORTUNE, Dell Computer, NASA,

The threats to your operations

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How much is $164 billion?

You could buy every NFL, Major League Baseball, NHL and NBA team..
(three times over!)

Sources: FORBES

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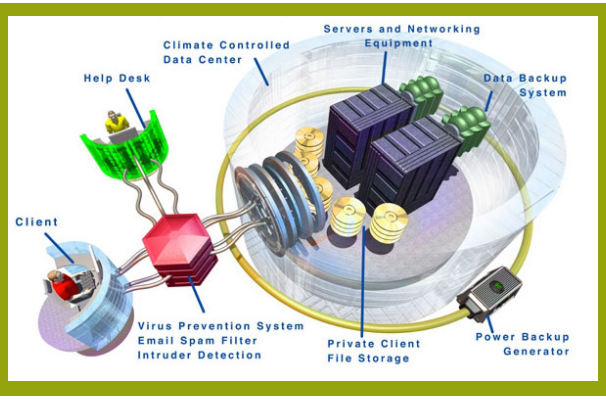
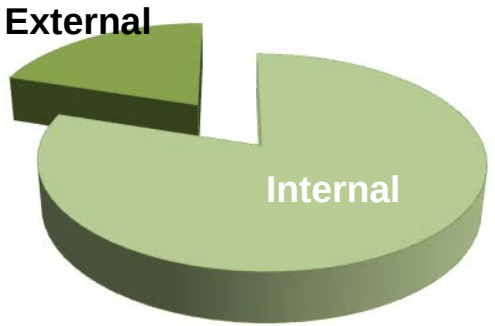
The threats to your operations



- The more reliant your company is on computers, networks, and telecommunications, the more “mission-critical” they are to your operations… and the faster you lose money
- **Bad news:** 40% of all downtime is caused by electrical power problems
- **Good news:** 80% of problems are internal in origin… thus, they can be preempted



Sources: Electric Light & Power; Electrical Power Research Institute (EPRI)

Monetizing power problems

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Planned vs. Unplanned Downtime

- **Planned:** Scheduled system maintenance, technology upgrades, etc.

  The cost for planned mission-critical application downtime ranges from $167,200 to $800,000 per day, depending on the size of the company and the industry in which it competes.

- **Unplanned:** Downtime caused by accident, human error, Acts of God

  The cost for unplanned mission-critical application downtime averages $576,000 per day… and can be as high as $154.8 million per day in transaction-intensive data centers

Sources: IBM, Oracle

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Monetizing power problems

Calculating $/hr.

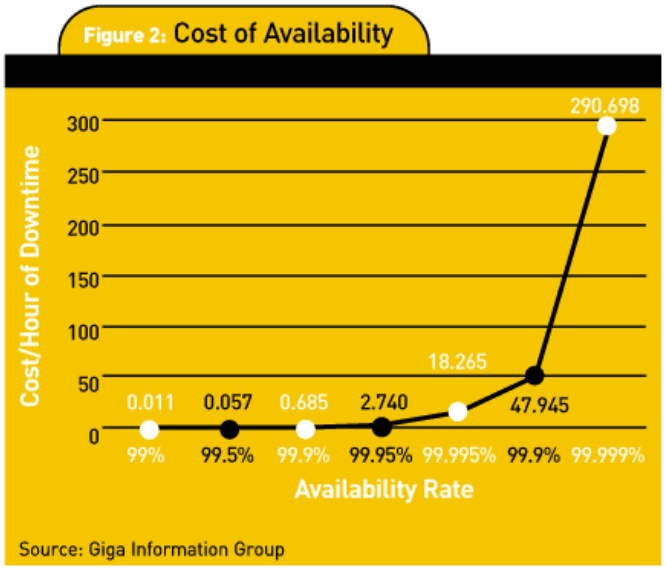
- Cost estimate to achieve 99% = $100K/year
  (99% availability = 87.6 hours of downtime/yr)
- Cost estimate to achieve 99.999% = $320K/year

Figure 1: Cost of Downtime by Industry

Application Segment Affected	Average Cost of Downtime (measured per hour)
Shipping	$28,000
Teleticket Sales	$69,000
Airline Reservations	$89,000
Home Shopping	$113,000
Pay-Per-View	$150,000
Credit Card Sales	$2.65 Million
Financial Markets	$6.45 Million
Average:	$42,000*

Impact on Revenue

$42,000 average hourly revenue*
X 87.6 hours downtime
$3.7M annual revenue lost



Sources: Forrester Research, Giga Group, Oracle, MLI, Gartner Group

Monetizing power problems

Case Study: Extreme Example of High Stakes

One customer is a major credit card company, that processes more than $9 million in transactions per minute (TPM)…

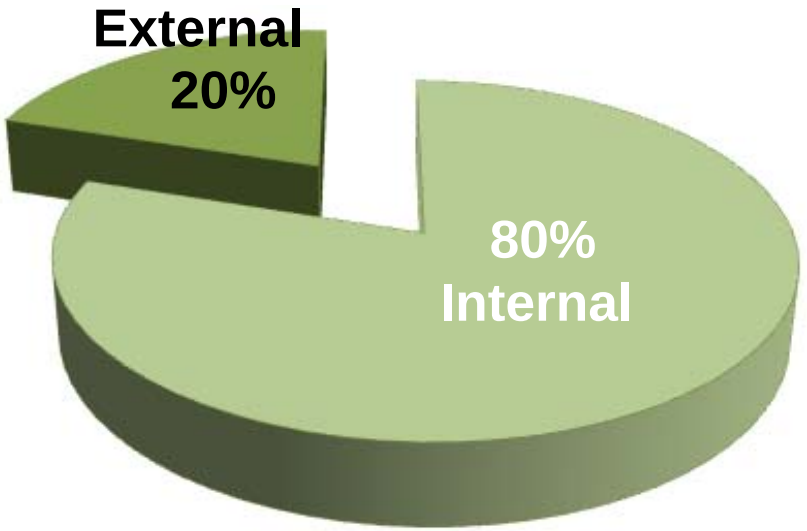
At that TPM rate, you could pay to build an NFL stadium in about the time it takes to watch the first quarter of a football game

Source: Customer annual report

Source of threats to continuity

External vs. Internal Power Problems

- Accidents
- Maintenance/ repairs
- Local power outages
- Regional Blackouts/ Brownouts



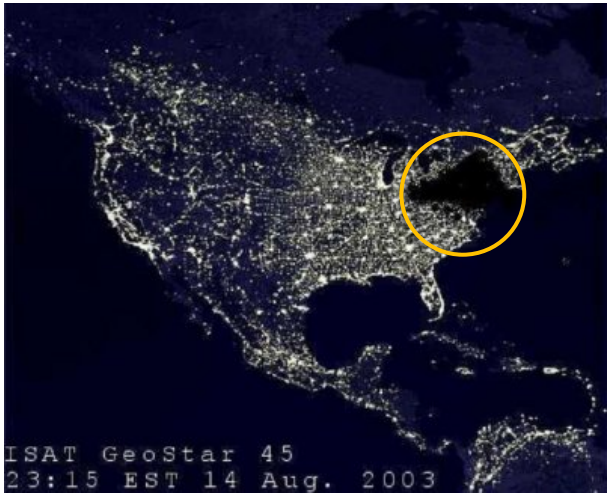
- Human error
- Spikes/ lags
- Power flow problems
- Short circuits
- Overloading
- Power quality
- Arc flash

External power problems

Case Study: 2003 Northeast Blackout

Of 500 data center executives interviewed by AFCOM, about half reported significant financial losses:

- 10 lost more than $10M in financial damages
- 2 reported losses of between $5-$10 million
- 15 reported losses between $1-$5 million
- 25 reported losses between $500,000-$1 million
- 50 report losses of $100,000-$500,000
- 125 reported loses of between $10,000-$100,000



Source: AFCOM

Internal power problems

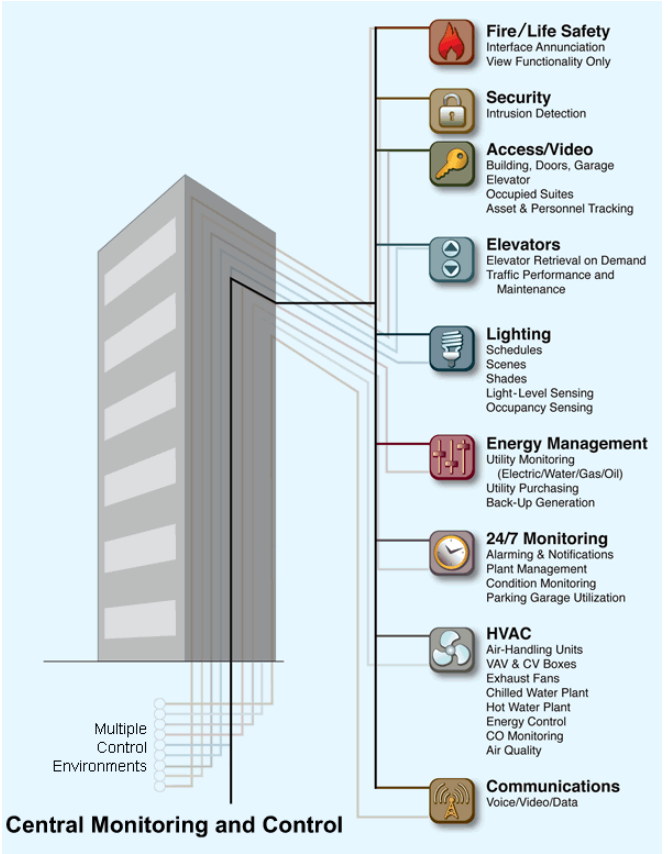
Understanding internal problems

In modern “intelligent buildings,” electrical power is like the central nervous system in the human body. When it fails:

•Vital operations – HVAC, lighting, safety systems, security, elevators, etc. – become inoperable. Restarts are costly, time consuming, and potentially dangerous

•Overloading the power system beyond its design capacity can cause “phantom” outages (e.g. “The Vacuum Cleaner in the Data Center”)

•Sensitive computer, office, and medical equipment can be ruined by outages, EMI, spikes, and surges



Internal power problems

Electrical Accidents / Arc Flash

Besides causing costly downtime, electrical power is a leading source of workplace damages, accidents, and death:

- Electrical accident in the workplace kills a worker every 28 hours, even in recently-inspected facilities
- An “arc flash” explosion was to blame for 75% of those accidents
- Arc explodes outwards reaching temperatures up to 11,000 degrees F (versus the sun, which is 7,000 degrees F at its surface)
- See Google or YouTube results for “arc flash accident”

Source: OSHA, Bureau of Labor Statistics, IEEE

Internal power problems

A waste of time… and energy

•Energy is the single largest operating expense for commercial buildings, and is frequently 40% greater than anticipated in the planning stage

•30% of commercial building energy use is unnecessary or inefficient; the larger the property, the higher proportional levels of waste... and the harder to cure inefficiencies

•39% of America's energy consumption is related to commercial and public buildings; environmentally, commercial office buildings account for 18% of America's carbon output

•Bottom Line: Improving efficiency not only lowers energy costs, but is equivalent to increasing property value by 5%.

Source: US Environmental Protection Agency / Energy Information Administration

Is there any good news?

Working towards a solution

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Introducing Power Analytics

•Both a methodology and a combination of computer-aided design (CAD) and on-line software technologies

•Uses complex models to accurately predict when and where problems have the potential to occur, to avoid them ("collision avoidance" vs. "airbags")

•Integrates facilities, engineering, IT, and contingency planning

•Emphasis is on preemption… not just rapid response or fault tolerance

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What are power analytics?

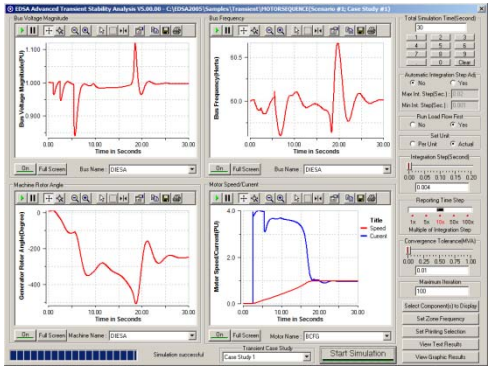
Power analytics: Perfect by Design

- Mission-critical power model is perfected in the CAD stage, to serve as the benchmark for live operations in real-time
- Live operations are continually compared back to the original CAD model; deviations (between “as-designed” and “in-reality”) are instantly isolated and diagnosed
- Improved operations and energy savings ensure rapid ROI

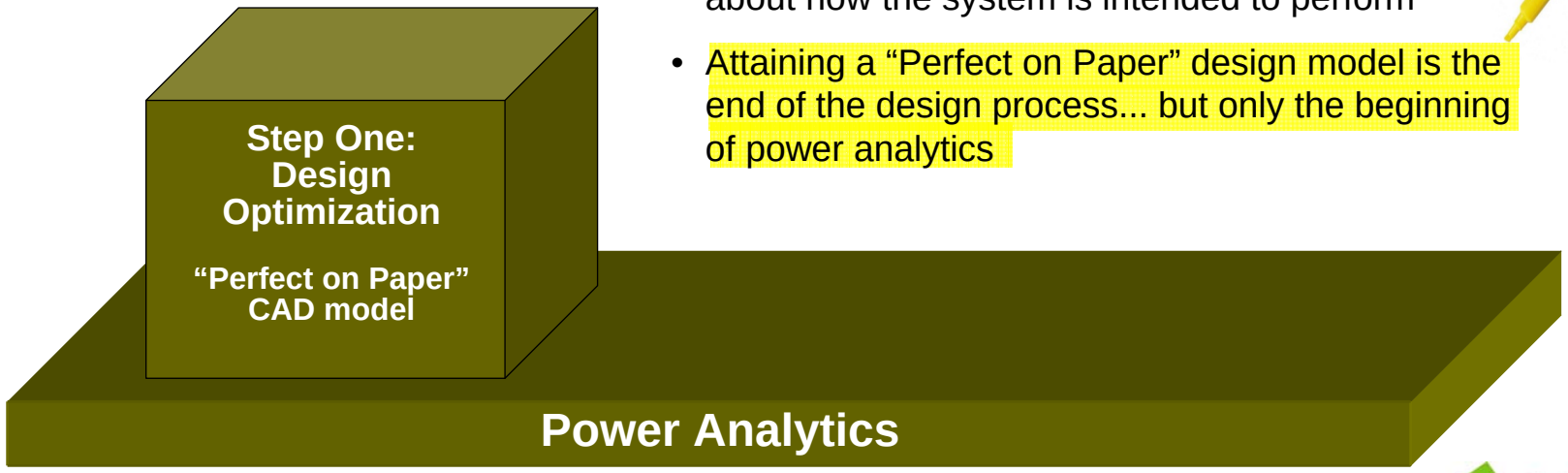
- The Bottom Line: power system faults, inefficiencies, and other “surprises” are engineered out in the design stage… and permanently preempted once in the facility is operational

Steps to power analytics

The design model is the foundation for all downstream analytics...

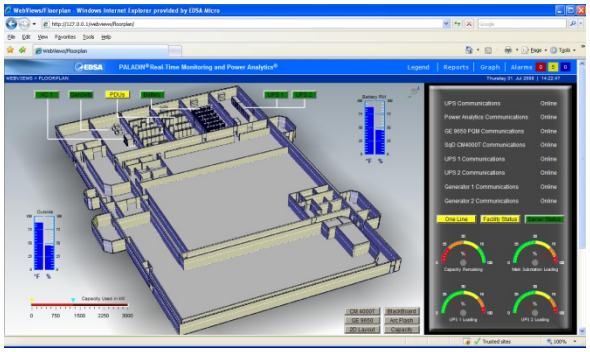


- Design model is actually a detailed database of performance specifications for all components in the model... from the largest piece of equipment to the smallest length of power cable
- "Ideal" interaction between components are codified in the model; deviations are noted and resolved
- Model captures and encodes the designer's intent about how the system is intended to perform
- Attaining a "Perfect on Paper" design model is the end of the design process... but only the beginning of power analytics

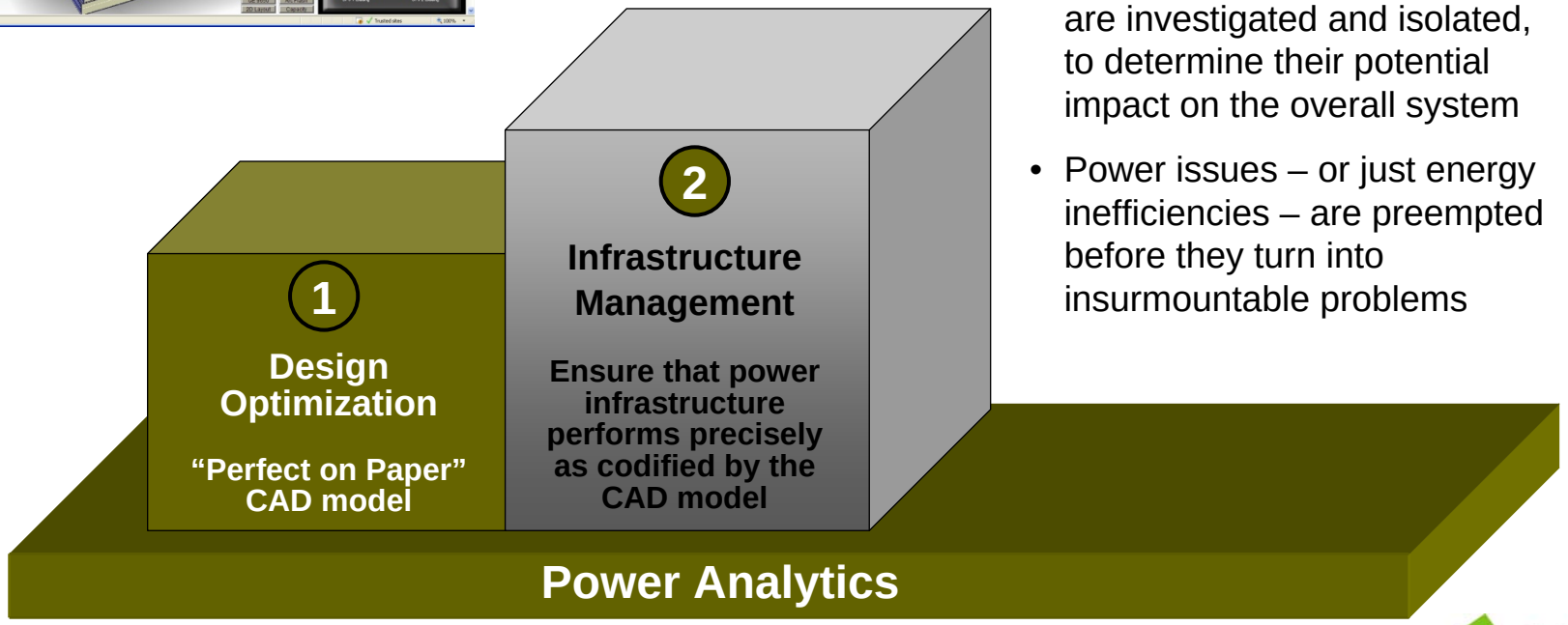


Steps to power analytics

... Resulting in a facility that performs precisely as designed...



- The design model can be redeployed in “live” mode, to serve as a benchmark for live operations
- Deviations between the “as-is” and “as-design” specifications are investigated and isolated, to determine their potential impact on the overall system
- Power issues – or just energy inefficiencies – are preempted before they turn into insurmountable problems



Steps to power analytics

... even at the campus power grid level

The power analytics lifecycle

Design Optimization

Model power network to create a detailed analytical model (not just graphical symbols) that is "Perfect on Paper"

Power Network Management

Ensure power network performs precisely as designed; simulate "what-if" plans and processes in an off-line virtual environment

Power Grid Optimization

Turn energy into a managed asset; ensure reliability and efficiency of power grid that support your local power network

Assess, Optimize, Plan

As elements in the power network or power grid evolve, power analytics give manageability to facility planning

Lowering energy costs

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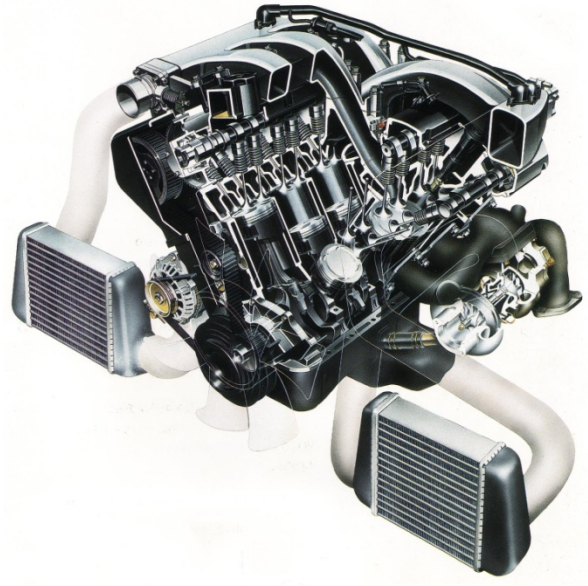
Ensuring Your Facility Remains "Fine-Tuned"



- Typical "white collar" facilities spend 55% of their energy on IT systems, and another 30% on HVAC (including cooling the IT equipment)

- IT and HVAC usage is intertwined… with very precise operating specifications for each

- Just as proper tuning is critical to maintaining a car engine's fuel efficiency, power analytics…

1. Diagnoses the performance of all power system components in real-time
2. Assesses the "ripple effect" of problems as soon as they are detectable
3. Alerts supervisory personnel to the problem, and recommended fixes

Source: PG&E

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Removing uncertainty

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Simulation of Actual Operating Conditions

- Enables a “test drive” of real-time maintenance, repair, and other procedures before attempting them on live systems
- Eliminates trial-and-error; you know exactly what the result of every action will be
- Test-fly and perfect maintenance and energy savings strategies without jeopardizing the safety of the facility itself
- Ideal for system experimentation and personnel training

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Removing uncertainty

Commissioning

- Does the finished facility precisely follow what was specified in the design?
- Have there been any design modifications or equipment changes that would cause the facility to turn out differently than planned?
- Was everything installed properly?
- How can we make absolutely sure there will be no surprises, once we “throw the switch?”

Removing uncertainty

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Power Analytics gives insight into the most important questions

- How close am I to maxing out my capacity?
- What happens to my reliability if I add equipment?
- What's the right sequence for my technology upgrade?
- What happens if I change my configuration?
- What's the reliability of my system today?
- What happens if we lose power?
- What is the overall "health" of my system right now?

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Return-on-investment

ROI can be long-term…. Or immediate

- Power analytics can pay for itself in two ways:
  1) Energy savings
  2) Averting unplanned downtime

- Energy savings: In a new mission-critical facility, ROI is typically less than year; when deploying power analytics in an existing facility, ROI is typically a little more than a year

- Preempting downtime: However, if power analytics can prevent unplanned downtime from occurring, ROI can be measured in minutes… or even seconds (depending on TPM)

New facility

Facility upgrade

Who is embracing analytics?

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Questions?

“The important thing is to never stop questioning...

Curiosity has its own reason for existing.”

- Albert Einstein

Presenter

Jim Neumann
Power Analytics
Vice President
of Marketing

jneumann@
PowerAnalytics.com

- Vice President of Marketing for Power Analytics Corporation
- 20+ years of IT and engineering software experience. Frequently speaks/published, on mission-critical power, energy management, business continuity, and “Green engineering”
- Former Vice President of Marketing for IBM Technology Group (Microelectronics, Storage, Networking, Printing, and Pervasive Computing)
- Former Director of U.S. Strategic Marketing/ Communications for AT&T Global Information solutions (now NCR)
- Executive MBA, Wharton/AT&T School of Business; MS, Business Communications, Boston University; BA, Communications and Marketing, University of Dayton