

Mission Critical Power Quality

Jonathan Price

Norman Disney & Young

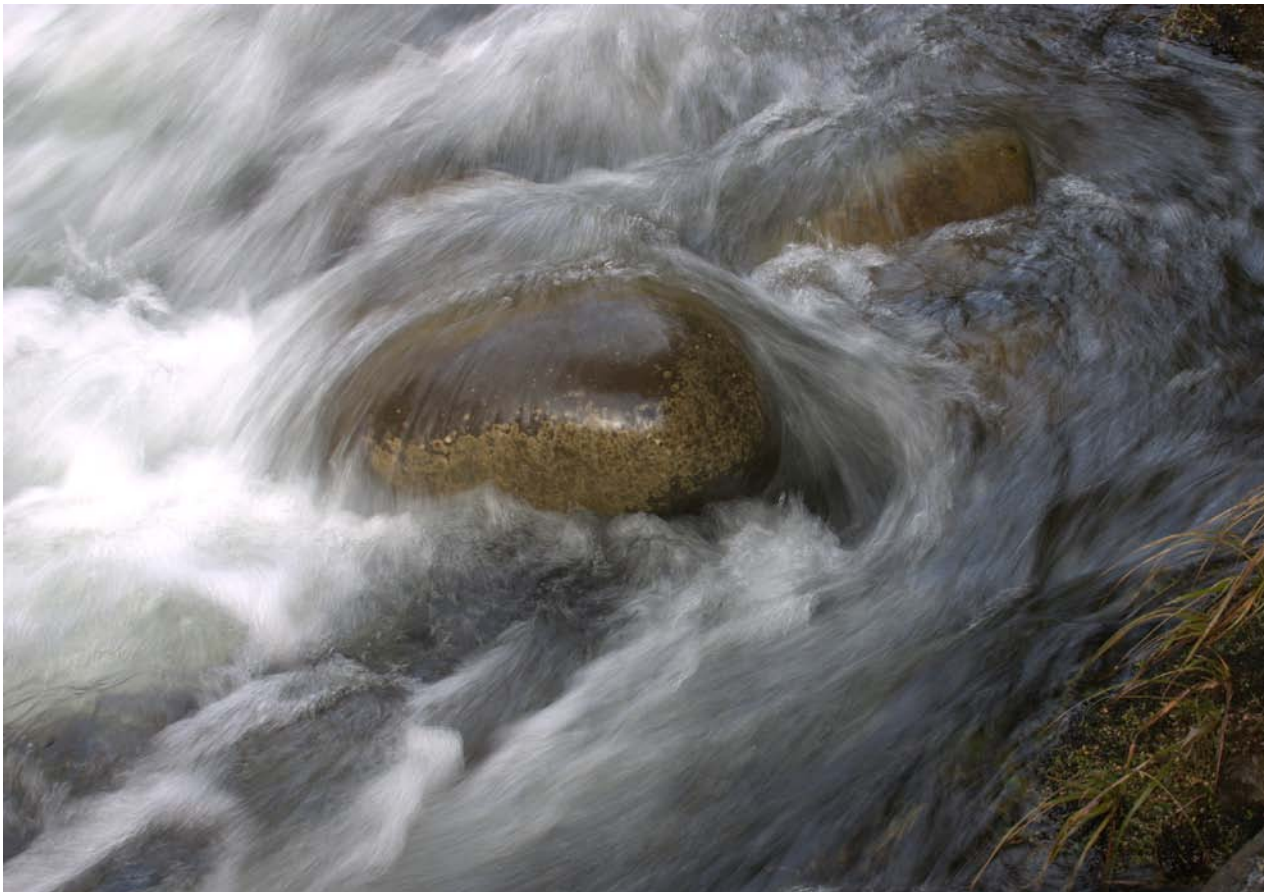
Quality vs Reliability

“Power quality problems don’t make headlines the way power reliability problems do And power quality problems can be more difficult to understand, analyze and solve than reliability problems. But that doesn’t mean power quality should be ignored. “

(Article: Avoiding Power Quality Headaches in Data Centers By K.L. Godrich November 2004)

The PQ “System”

Source of supply



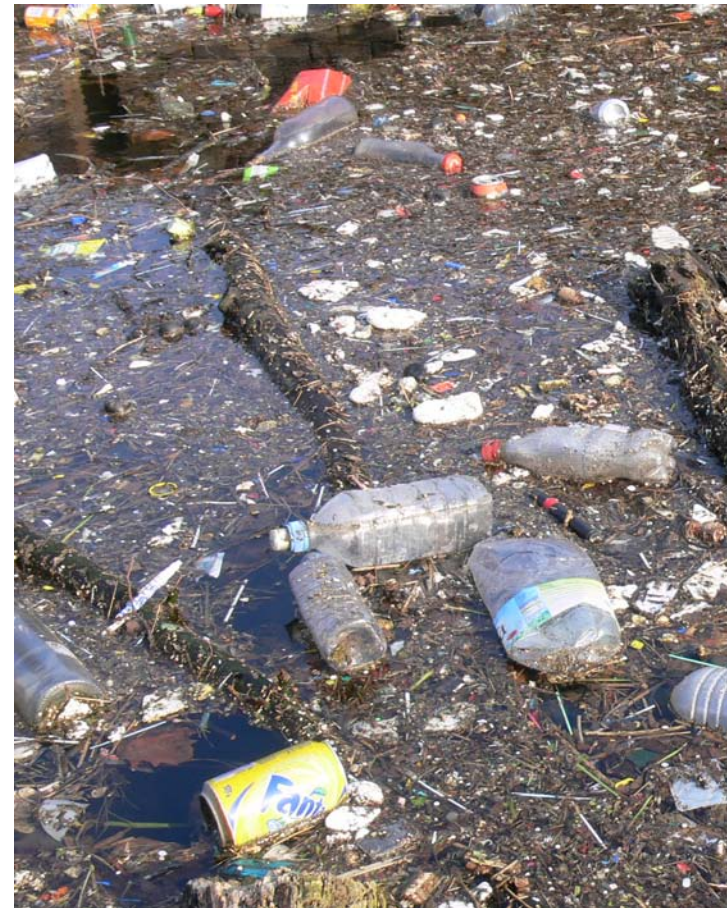
The PQ “System”

Consumers



The PQ “System”

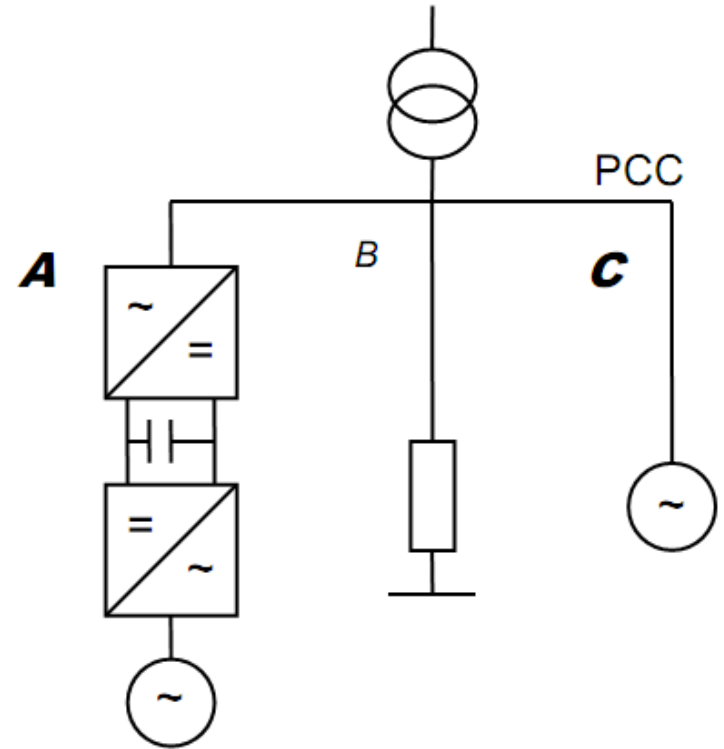
Emitters or polluters



The PQ “System”

Electrical PQ system
consists of:

- Supply
- A – Non-linear loads
- B – Linear loads
- C – Fluctuating loads e.g. Motors



Agenda

- “Traditional” power quality issues
 - Where are they now?
- Developments in power quality management
- Power quality planning & strategies
- Configuration of electrical systems
- Future considerations
- Case studies

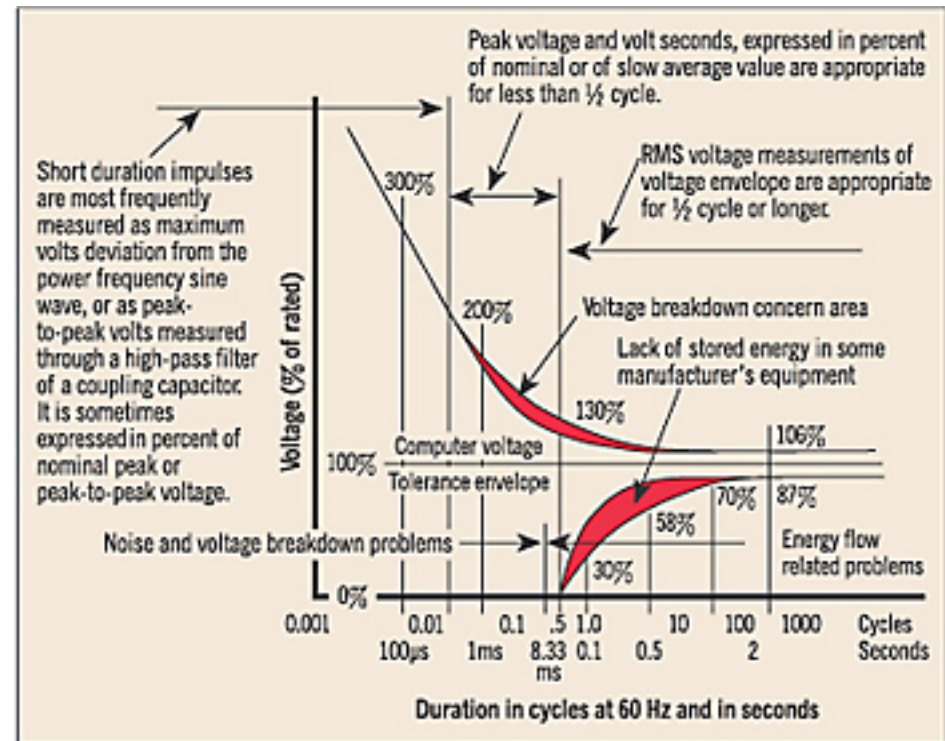
Power Quality Issues

The good news.....



Standards

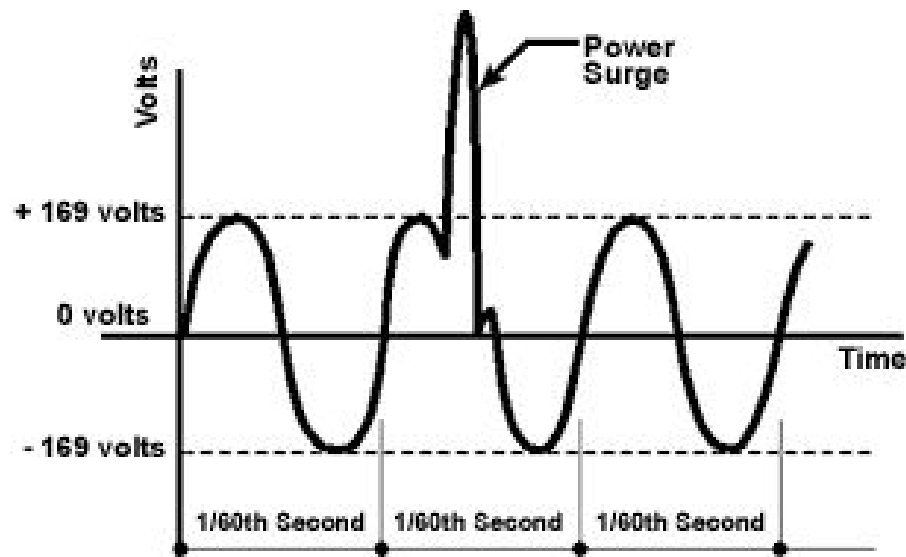
- CBEMA/ ITIC
- **NZCEP 36:1993 (IEEE 519)**
- EN 50160
- IEEE 1159
- IEEE 1100
- AS/NZS (IEC) 61000 series



Big improvements in the past 10 years!!

IT Equipment

- How sensitive is equipment to power quality?
- How is Power Quality of equipment improved?



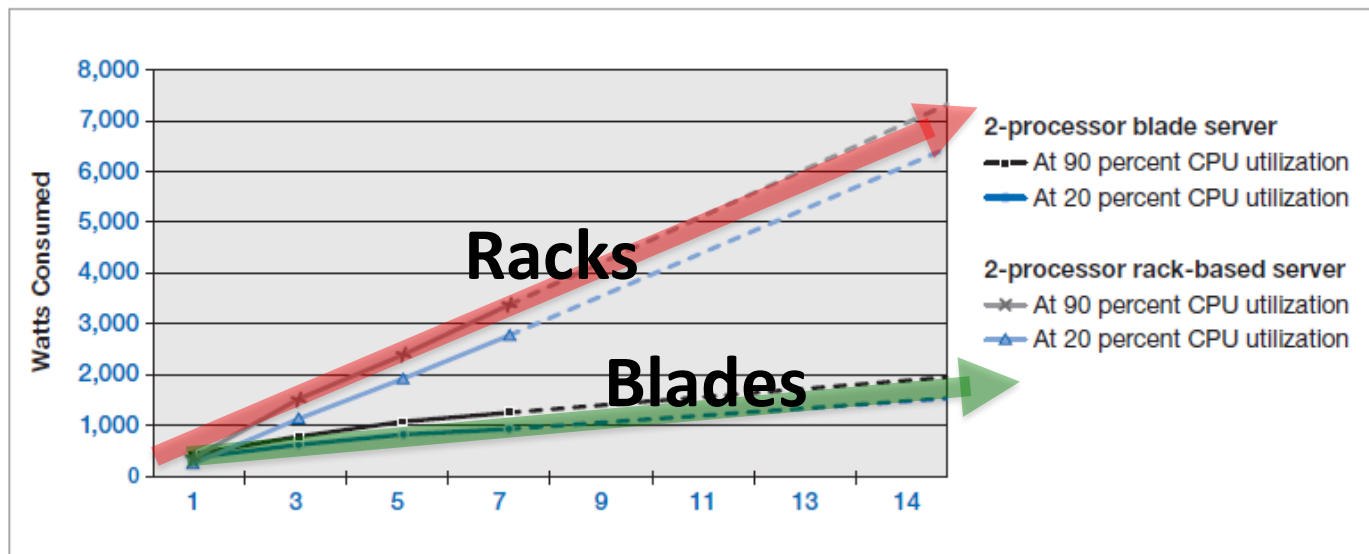
Power Supplies

- Power Supply Unit (PSU's) power quality has improved - a lot! (mainly IEC 61000)
- Better at:
 - Power Factor
 - Harmonics
 - Load matching for efficiency



Racks vs Blades

- Improved power utilisation and performance
- Significantly improved power utilization of blade servers compared to rack mounted

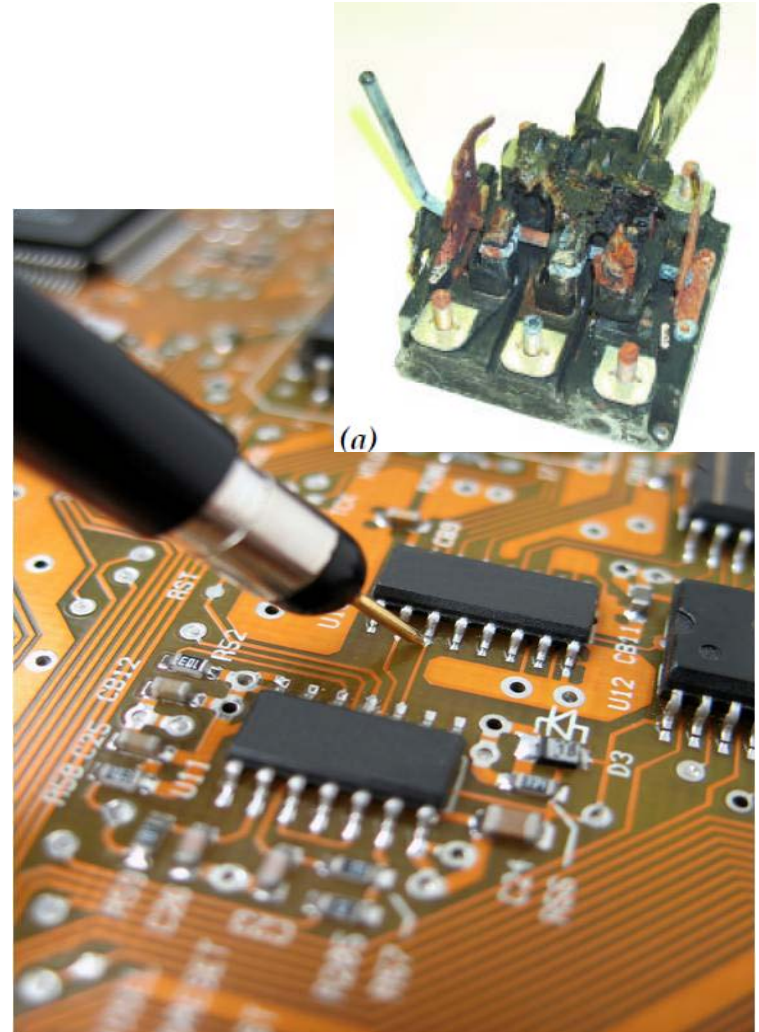


Courtesy: Intel White Paper – Blade Server Benefits

Power Quality Issues

So why are we here now?

Because these guys still
need TLC....



Power Quality Issues

- Surges
- Brown Out/ Black Out
- Sustained Low Voltages
- Power Factor
- Harmonics & Distortion
- Frequency Variations
- Fault Clearance of Equipment
- Earthing

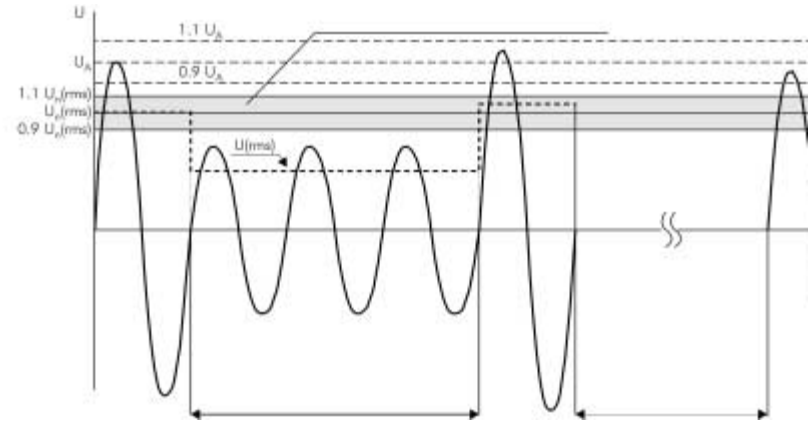


Figure 1 - Illustration of a voltage dip and a short supply interruption,
Courtesy: Copper Development Association

Power Quality Issues

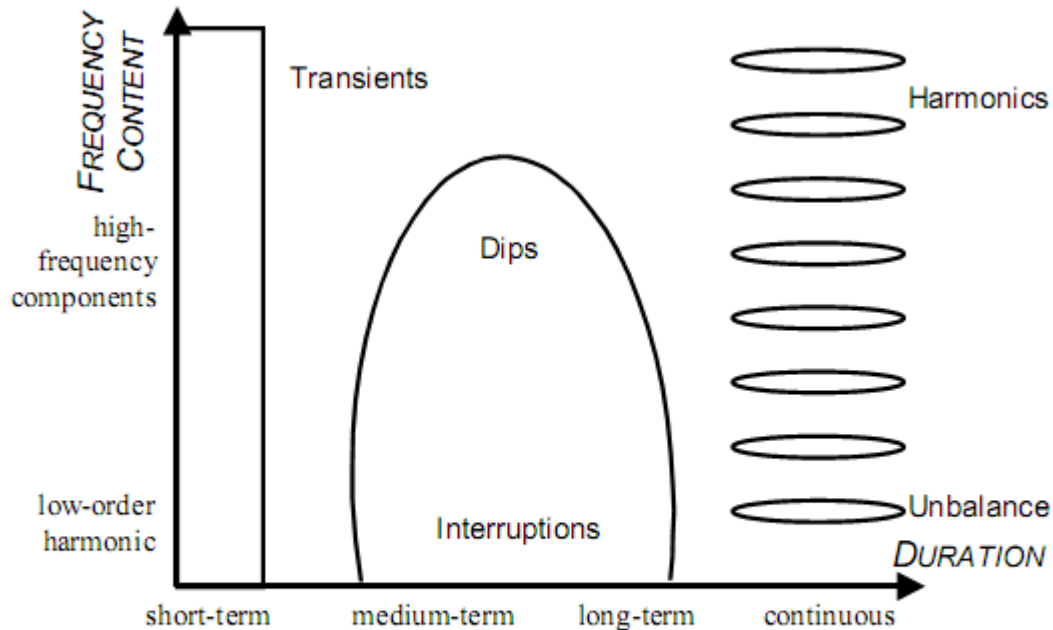


Fig. 1. Schematic division of the distorting emissions in the electromagnetic environment of an electricity distribution system.

Impacts



RED FACES ALL ROUND

Yesterday LSE trading doesn't open until 12.15pm after technical glitch

Feb 22 Borsa Italiana exchange closed until mid-afternoon

Feb 14 New super-fast Millennium trading system goes live

Feb 9 LSE announces planned merger with Canada's TMX

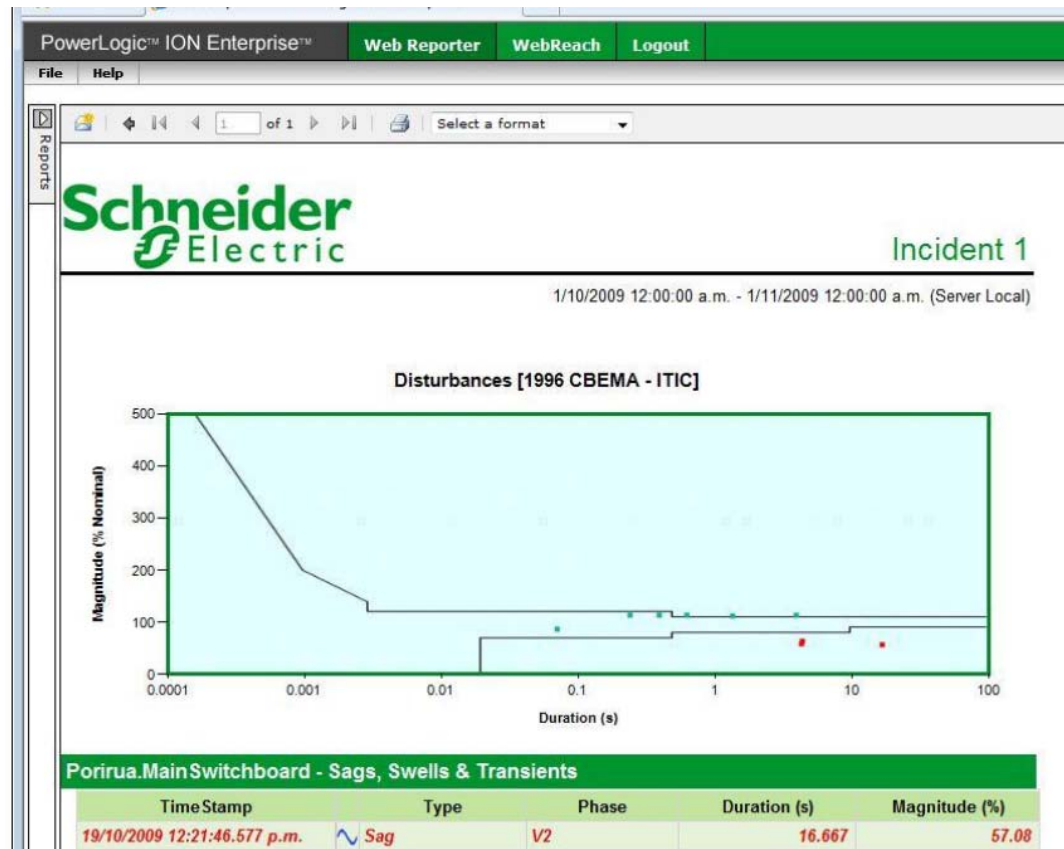
Nov 2 Postpones Millennium launch after trading disruption on Turquoise

Oct 5 Computer glitch delays Turquoise trading for more than an hour

Technical glitch hits NAB net banking

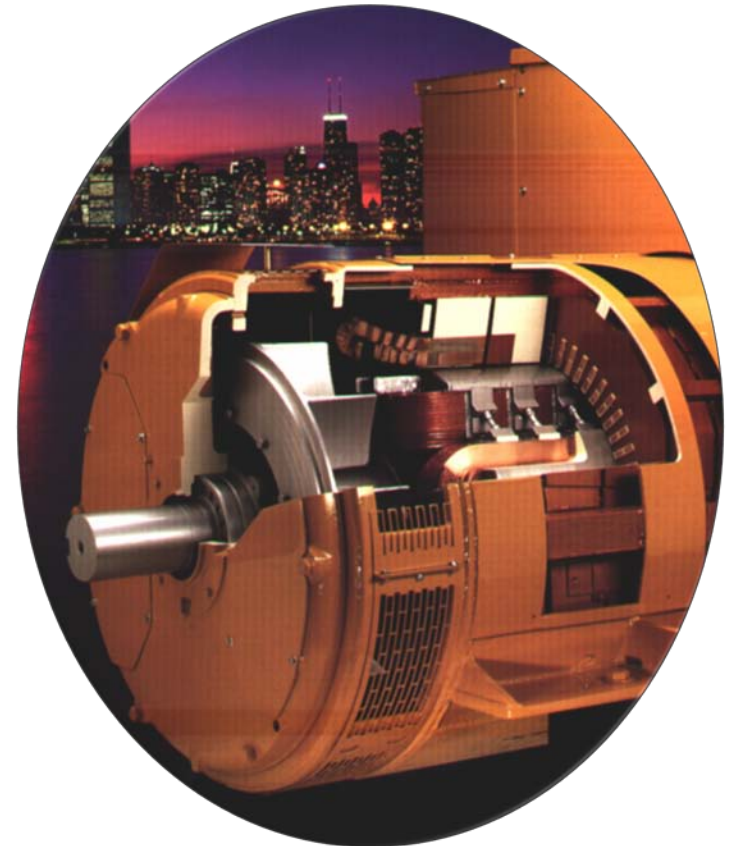
Mitigation

- How is power quality managed?
 - Centralised
 - Distributed



Mitigation

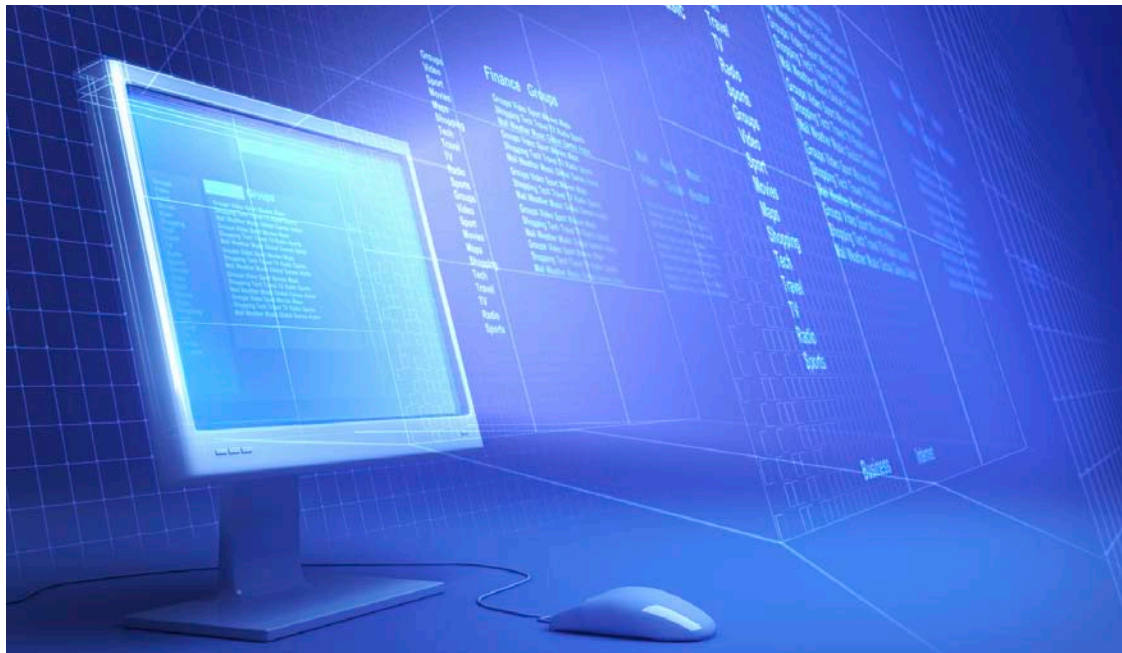
- Solutions:
 - Integrated power quality management
 - Surge Protection
 - Filtering (Active & Passive)
 - Environmental Monitoring



- Data Centre Power System Considerations
 - Supply configuration (A/B supply, backup power)
 - Power density within the technical space
 - Upgrading capabilities without service interruption
 - Power quality management
 - Cost benefit of fixing power quality
 - Commissioning & Testing

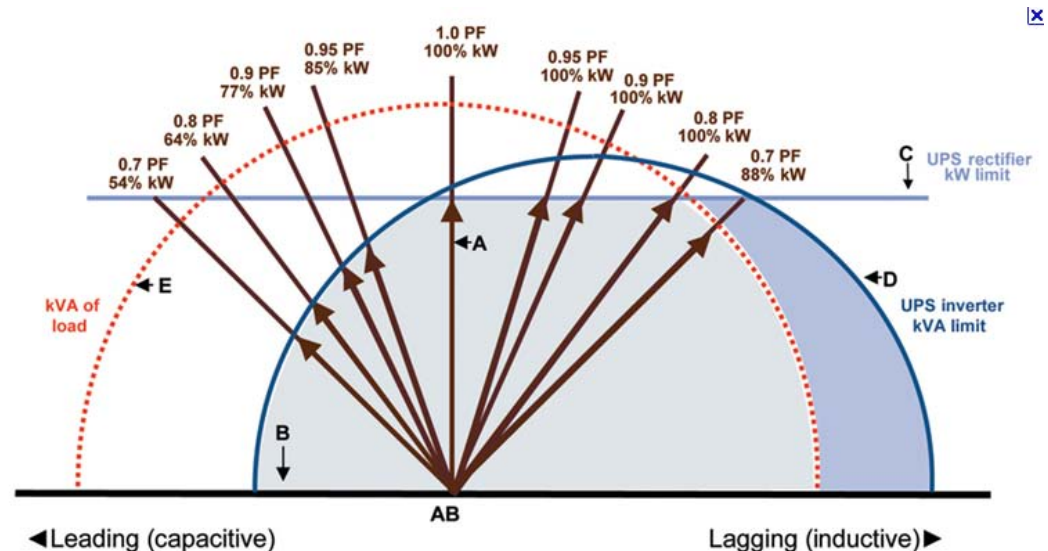
Planning

- Understand the loads
- Predictive models
- Cost/benefit of equipment selections



UPS Considerations

- Power factor management
- Fault clearance capabilities
- Testing of UPS/ validation of system capabilities



UPS Considerations

- Off line
- Line Interactive
- On Line

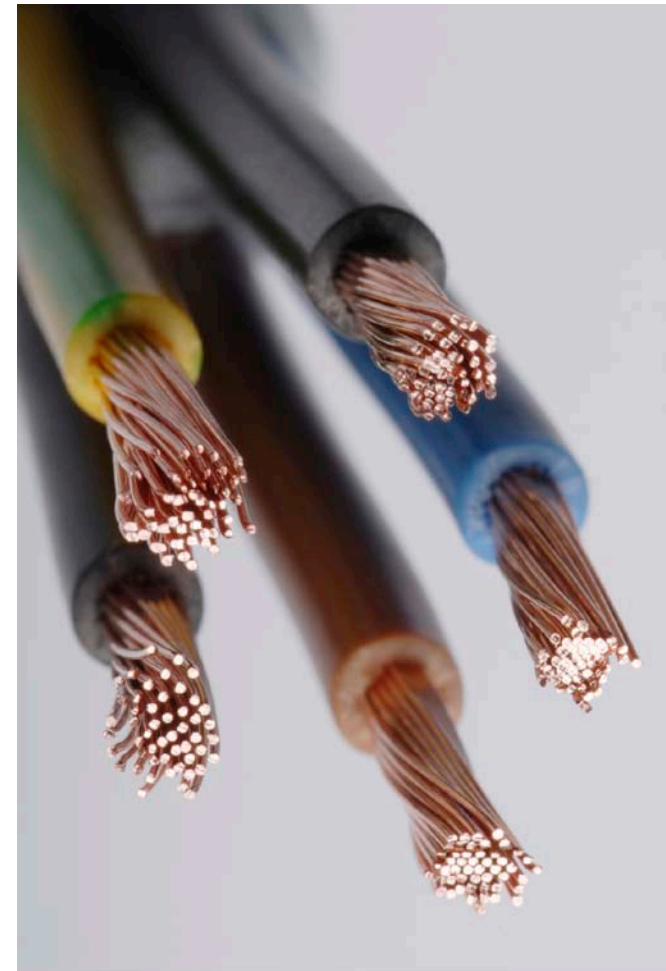
Feature	True Online	Line-Interactive	Standby
Zero Transfer Time	YES	NO	NO
Frequency Regulation	YES	NO	NO
Generates New Sine-wave Continuously	YES	NO	NO
Internal Filtered Dynamic Bypass	YES	NO	NO
Power Factor Correction	YES	NO	NO
Harmonic Distortion Correction	YES	NO	NO
Voltage Regulation	YES	SOME	NO
Eliminates Noise & Transients	YES	SOME	SOME
Power Outage Protection	YES	YES	YES

Courtesy: Liebert Power Quality Consultants

- Some new UPS designs are responding to the Line-Interactive issues

Switching

- Break Before Make Switching
 - Earth referencing
 - 3 pole vs 4 pole switching
 - Overlapping neutrals



Switching

- Static Switch configuration/settings
 - Tolerances must be set correctly & fully tested
 - Voltage and frequency implications



Equipment Selection

- Matching equipment to loads
- Impedance matching for paralleling systems
 - Generators
 - UPS



Commissioning

- Integrated System Testing
- Simulating load
- Day 1 vs Ultimate load configuration



Case Studies

- Generator paralleling
 - Multiple set operation, mismatching impedances
- UPS System operation
 - Heavy circulating between parallel UPS units
- Harmonic Assessment
 - Assessment of total site harmonics to assess PQ
- Static Switch Testing
 - Slew rate, transfer times, operating windows

Future Considerations

The good news continues....

- Further improvements in equipment power quality
- Less of an issue for UPS backed loads
- Simplified system configuration

....but:

- Still need to plan for power quality

Questions

www.ndy.com

For more information or a slide pack, contact:

Jonathan Price – j.price@ndy.com, +61 424 969 015

Rowan Peck – r.peck@ndy.com, +61 412 041 957

Case Studies

- Generator paralleling
 - 2 parallel generators working OK, 3rd one ordered and installed to match but didn't – alternator pitch differed due to some issues with as built info, and the result was about 1000 Amps flowing in the neutral of what should have been nearly nothing, circulating between the alternators.

Case Studies

- UPS Installation
 - Heavy circulating HF (3000hz) current between parallel UPS units on the output side , resulting in the failure in UPS Output MSB's ACB CTs. Power quality problem leads to power loss.
 - Issue was a slight phase difference in the chopping wave between units

Case Studies

- Harmonic Assessment
 - TIA 942 Tier 3 Corporate DC, 2010 build
 - ALL load is UPS backed (Mechanical, IT)
 - Design to IEE 519
 - Modeling done - extensive:
 - Design: 3% THDV at source; 2% at IT load supplies
 - Construction: 2% THDV, 12% THDI (worst case)
 - As Built: So far so good. Waiting on load migration.

References

- <http://www.facilitiesnet.com/datacenters/article/Avoiding-Power-Quality-Headaches-in-Data-Centers--2260>
- http://ecmweb.com/mag/electric_commissioning_mission_critical/
- <http://www.scribd.com/doc/16688803/Power-Quality-Issues-Problems-and-Related-Standards>