WHAT’S UNIQUE ABOUT COMMISSIONING DATA CENTERS

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2001 Limited Update to Cost of Downtime Research Study

- 46% of participating companies said each hour of downtime would cost their companies up to $50k
- 28% said each hour would cost between $51K and $250K
- 18% said each hour would cost between $251K and $1M
- 8% said each hour would cost $1M+
“As to the indirect cost factors most critical to their company’s survival, an overwhelming 57% said that the combination of “Customer Service or Expectations” and “Competitive Advantage” were most critical”

Source: Contingency Planning Research & Eagle Rock Alliance, Ltd.
Facility Goals

• Achieve the highest levels of reliability and availability

• Operate at the lowest costs

• Recognize when equipment is near its end of life and form strategies to manage replacement and/or retrofit
The Life of a Facility

- **Phase 1**: Infant Mortality Period
- **Phase 2**: Random Failure Period
- **Phase 3**: Wearout Period

Graph showing failure rate over time with three distinct phases:

- **Phase 1**: Decrease in failure rate
- **Phase 2**: Constant failure rate
- **Phase 3**: Increase in failure rate

**Time** axis

**Failure Rate** axis
The Life of a Facility

Phase 1
Infant Mortality Period
Minimize by Commissioning

Time
Failures
Failure Rate

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Phase 1: Commissioning

- Commissioning is the process of ensuring that the systems are installed, functionally tested and capable of being operated and maintained in conformity with the design intent.

- Commissioning begins with planning and includes design, construction, start-up, acceptance and training, and can be applied throughout the life of the building.
Phase 1: Commissioning

- Commissioning is your best opportunity to:
  - Control the transfer of knowledge
  - Effectively eliminate infant mortality failures before you accept the facility
  - Assure proper installation
  - Assure calibration and performance
  - Assure component/sub-system/system interoperability
Phase 1: Commissioning

- Knowledge transfer
  - Documentation of design intent
  - Documentation of basis of design
  - Establish equipment/system test specs
  - Establish equipment/system baselines
  - Assure appropriate O&M documentation
Phase 1: Commissioning

• Effectively eliminate installation & infant mortality failures before you accept the facility by:
  
  – Rigorous factory acceptance tests
  – Site inspections and verification of correct installation, point-to-point wiring, mounting, etc.
  – Performance testing to maximums of equipment specifications
Phase 1: Commissioning

- Assure Component/Sub-System/System Interoperability

- Verify engines, paralleling gear, UPS, transfer devices, chillers, pumps, CRAC’s, BMS and Life Safety Systems work together in all normal, emergency and maintenance modes
Data Center Uniqueness
ITI (CBEMA) Curve

Duration in Cycles (c) and Seconds (s)
ITI (CBEMA) Curve

- Test equipment to verify operation within specifications
Reliability and Availability

- **Reliability** (R) is the probability that a product or service will operate properly for a specified period of time under design operating conditions without failure.

- **Availability** (A): Availability is the long-term average fraction of time that a component or system is in service and satisfactorily performing its intended function.
Parallel Redundant – Single Cord
2N Configuration - ASTS - Single Cord
2N Configuration – Dual Cord
Distributed Redundant - ASTS - Dual Cord
Case 3
1. M2B-TR failure
2. No. 5–7 gen. auto start
3. P/1–P/3 auto sync–closed
4. P8/G,P7AB/G–1 manual close
5. Close SYN–G and Group–U to be started & sync–closed
6. Run proper number of gen-sets for total loads of Group–U and Group–P

Source: CRIFAS
Data Center Cooling

Source: Innovative Research, Inc.
Data Center Cooling

Source: Innovative Research, Inc.
Data Center Cooling Measuring Points

Cold aisles only

Source: ASHRAE
Heat Load Testing Data Center Cooling
Heat Load Testing Data Center Cooling
Case Studies
UPS Overlapping Transfer Failure

File: UPS-1A Load Steps #2.log

- Ia Ave = 113.97
- Ib Ave = 117.36
- Ic Ave = 123.17

Graph showing current (amps) over time.
Installation Problem

- Fan Inlet
- VFD installed at fan inlet causing restriction and turbulence
Installation Problem

- Loose connections, incorrect washer, signs of corrosion or electrolytic action
Infant Mortality

- Blown SCR section of rotary UPS
UPS Transformer Problem

- Cabinet screw into UPS input transformer
Failure of Entire Chiller System During Scheduling Sequence

This is the result of the heat load being added.

This peak is the result of loss of HVAC system.

Loss of utility, Generator start.

Return to utility.

End of test, load removed.
Interoperability Problem Generator Paralleling Bus Disturbance
Interoperability Problem Generator Paralleling Bus Disturbance (cont.)
Data Center Trends
• Facilities costs are starting to exceed IT Hardware costs
• Companies are “virtualizing” servers
• Companies are locating data centers in areas with low electrical rate
• Companies are seeking “modularity/scalability” in design
Figure 1: 2000-2010 Product Heat Density Trends Chart

Year of First Product Announcement / Year of First Product Shipment

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Heat Densities are increasing

Cooling is becoming more critical

Data Centers are becoming “Green”

More diverse mechanical systems are being applied

(air and water side economizers, heat wheels, uninterruptible cooling, water cooled cabinets, etc.)
Questions?