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Session 3

Energy Security:

Framework for Analysis

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Energy Requirements Clarified

Energy Requirements are Defined by:

- Criticality of continuity (Mission Critical)
  - Can you afford a power loss?
- Disruption of operations
  - How time sensitive is your requirements?
  - How long can you sustain an outage before it affects your production?
  - What is the cost of that delay?
  - Can you relocate that function?

Data Center Variances in requirements

Reliability Based on Risk of Loss

- **High Risk**
  - Financial/Insurance/Certain DOD
- **Medium Risk**
  - Government
- **Low Risk**
  - Educational/Science

Reliability and Availability

- **Reliability** – The probability that a product will perform its intended function under specified conditions.

- **Availability –** The availability of an item under combined aspects of its reliability, maintainability, and maintenance support to perform its required function at a stated instant or over a stated period of time.

Mission Critical - Tier Classifications

- The **Uptime Institute**, a Santa Fe, New Mexico-based think tank and professional services organization, has defined a Tier rating for data centers that gauges levels of reliability and redundancy for critical building infrastructure.

- The levels are:

  Tier – 1
  Tier – 2
  Tier – 3
  Tier – 4

Tier Levels*

Tier Level	Requirements	Annual Downtime
1	• Single non-redundant distribution path serving the IT equipments • Non-redundant capacity components • Basic site infrastructure guaranteeing 99.671% availability	28.8 hours
2	• Fulfils all Tier 1 requirements • Redundant site infrastructure capacity components guaranteeing 99.741% availability	22.7 hours
3	• Fulfils all Tier 1 & Tier 2 requirements • Multiple independent distribution paths serving the IT equipments • All IT equipments must be dual-powered and fully compatible with the topology of a site's architecture • Concurrently maintainable site infrastructure guaranteeing 99.982% availability	1.6 hours
4	• Fulfils all Tier 1, Tier 2 and Tier 3 requirements • All cooling equipment is independently dual-powered, including chillers and Heating, Ventilating and Air Conditioning (HVAC) systems • Fault tolerant site infrastructure with electrical power storage and distribution facilities guaranteeing 99.995% availability	26 minutes

** Courtesy of Uptime Institute Tier Classification Standards Overview*

Design for Reliability

Possible Objectives

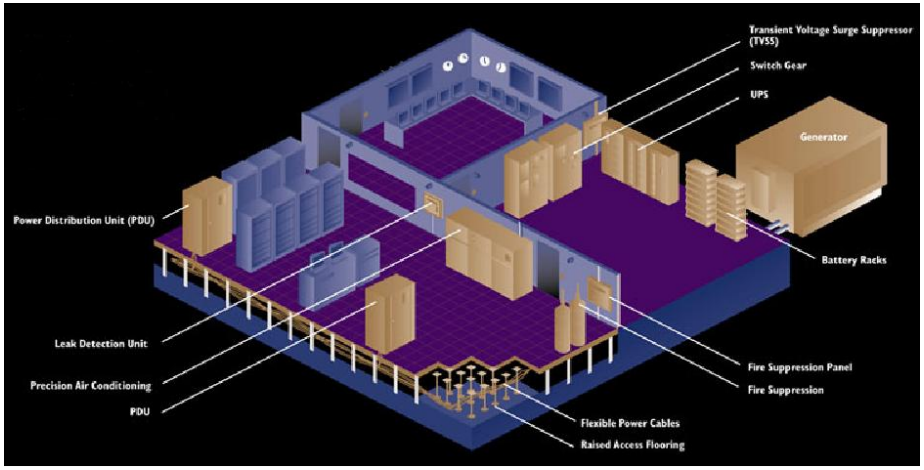
- Down Time Sensitivity™
- Capital Expenses (CAP EX)
- Operational Cost(OPCOST)
- Reliability
- Availability
- Maintainability
- Safety
- Fault Tolerance
- Change Tolerance
- Cycle Cost

Requires:

– integration of reliability engineering and design / development

– Continuous design review from reliability point of view

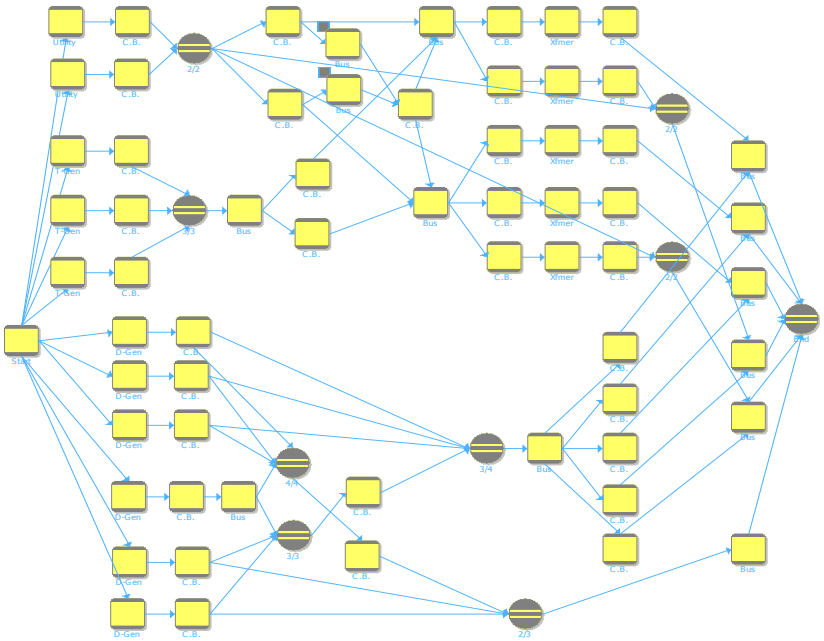
– Incorporation of known principles of system reliability



Scientific Approach to Reliability

- Reliability Block Diagram (RBD)
- BlockSim 7
- Reliability Center Maintenance (RCM)

Item	MTBF per hour	MTTR per hour	Sources	Part Number	
Utility	11,116.75	0.53	Gold Book - 3-33 Multi-circle utility supp		
Cable (15kV)	434,296.50	5.13	Peyton's paper below ground, Insulated		
Cable Connector	23,624,073.00	0.75	Peyton's paper, Item 29		
Circuit Breaker (15kV - NC)	372,410.40	14.80	Peyton's paper, 5kV, Vacuum, >600am		
Circuit Breaker (15kV - NO)	220,321.70	9.39	Peyton's paper, 5kV, Vacuum, >600am		
Circuit Breaker (15kV)	296,366.05	12.10	(NC+NO)/2		
Fuse (15kV)	13,295,858.00	5.50	MTBF -- Peyton's paper, >5kV, <= 15kV		
SWGR Bus (15kV)	488,208.80	2.27	Peyton's paper, SWGR Bare Bus, >5kV		
Backup Diesel Generator (running)	15,033.80	25.74	Peyton's, Packaged, Diesel Engine Ger		
Backup Diesel Generator	70,932.00	18.28	Peyton's, Packaged, Diesel Engine Ger		
Backup Diesel Generator	12,404.67	24.44	Peyton's, Packaged, Diesel Engine Ger		
Gas Turbine Generator	5,070.60	27.39	Peyton's, Packaged, gas turbine gen, 2		
Gas Turbine Generator	46,853.70	6.18	Peyton's, Packaged, gas turbine gen, 2		
Gas Turbine Generator	4,575.44	25.32	Peyton's, Packaged, gas turbine gen, 2		
Transformer	693,748.20	3.65	Peyton's paper, Forced air, Liquid, < 50		
Circuit Breaker (480V - NC)	4,732,057.00	0.50	Peyton's paper, 600V, Drawout (Metalcl		
Circuit Breaker (480V - NO)	1,584,631.00	2.00	Peyton's paper, 600V, Drawout (Metalcl		
Circuit Breaker (480V)	3,158,344.00	1.25	(NC+NO)/2		



New Approach

- Establish Prime Plant on site vs Backup Plant
- Sell to Grid
- Switch over when Grid goes down
- Provides dual redundancy required
- Dependent on utility availability cost rules and overall economics

Lessons learned

- Failure due to unmanaged Growth
- Cx brought in too late to fix SPOF
- Broken Water line
- Restrictions on maintenance
- Poor maintenance
- Inadequate Cx

How time sensitive are your requirements

- Does outage cost you more than just time?
  - Are their financial repercussions?
  - Are their safety issues?
  - Are there security issues?
- How does duration affect each of those areas?

Disruption of operations

- How does duration affect costs
  - What is the cost of that delay?
    - Are their labor costs?
    - What are impacts to delivery schedules?
    - What are impacts to customer relations?
  - Can you relocate that function?
  - What is the ROI based on that Loss
    - Probability X $ Value Loss = $ value Risk
    - $ Cost/ $ Risk = ROI

Lessons learned

- Cost sensitivity generally overstated
- Minimal “real” mission critical applications
- Less than 20% require power within short time frame
- Generally go 7-14 days without power for remaining operations

Some Questions to Ponder

- If savings can be obtained then based on ROI vs the risk?
- If you could disrupt operations for 14 days due to a hurricane then you are not critical response?
- Best solutions are onsite where the cost is within the current energy economics model
  - Island with multifuel prime load that offsets CAPex costs for backup requirements
  - Microgrid solution where economics supports