Uptime Institute®

# *Mission Related - Critical Power Requirements*

**Todd Traver - Uptime Institute, Vice President IT Optimization and Strategy**

# The Story of Uptime

“For over 25 years, Uptime Institute has provided customers with the assurance that their digital infrastructure will perform at a level consistent with their business needs, across the wide range of expected operating conditions. Used by tens of thousands of sites around the globe, Uptime Institute and its Tier Standard has become the de facto standard of digital infrastructure performance”

# The Tier Standard Difference

- The industry's only data center standard that is based solely on meeting the objectives and achieving results, rather than implementing a rigid prescription or schematic
- The Tier Standard is a TWO volume set; the first deals with topology, and the second focuses on operations
- Encourages innovation and allows any approach and technology to be used which results in meeting the Tier Standard's objectives
- The Tier Standard is referenced by (MOU Agreements) over 100,000 individuals
- Successfully used by thousands of sites in more than 100 countries

# Tier Classification Genesis

- An Owner's Request

  Data Center Performance and Investment Criteria

- An Industry Solution

  Tier Classifications Define Site Infrastructure Performance

- An International Standard

  Data Center Site Infrastructure Tier Standard

- Adjudicated Standard

  Owners Advisory Committee (OAC)

# Building Characteristics

- As critical facility complexity increases, the components, categories, and behaviors associated with Building Characteristics
  - Require more rigor
  - Are more complex in terms of design and in terms of operations
  - Cost more

- Critical facility design must consider the critical equipment (both IT and support infrastructure) and the activities of the Operations team responsible for them
  - Mission
  - People

# Definitions

- Availability/Uptime
  - Period-of-time when the critical facility is operational and available for use
  -
- Reliability
  - Engineering modeling computation by component or system
- Infrastructure
  - The electrical, mechanical, and structural systems that make up a critical facility
- Topology
  - The physical configuration of the infrastructure
- N
  - Required number of units (components) necessary to meet the need
  - The capacity of the system when discussing the design load or demand
  - Excludes IT-level architecture redundancy
- Outage
  - Outage is loss of IT equipment
  - Loss of utility power, water, gas, or a hot day are expected events
- R
  - Number of redundant components

# Critical Facilities

- Purpose built
  - Critical facilities are not typical facilities because of their special infrastructure requirements
  - Possible to convert an existing facility (office building, warehouse, etc.) to a Tier I or II facility
  - Rigor required to achieve a Tier III or IV facility necessitates a purpose-built facility

- Single purpose
  - Having a single-purpose facility eliminates potential conflicts between functional areas
  - When combined with office space, the support to people often takes away for the support to the critical facility

# Critical Mechanical Systems

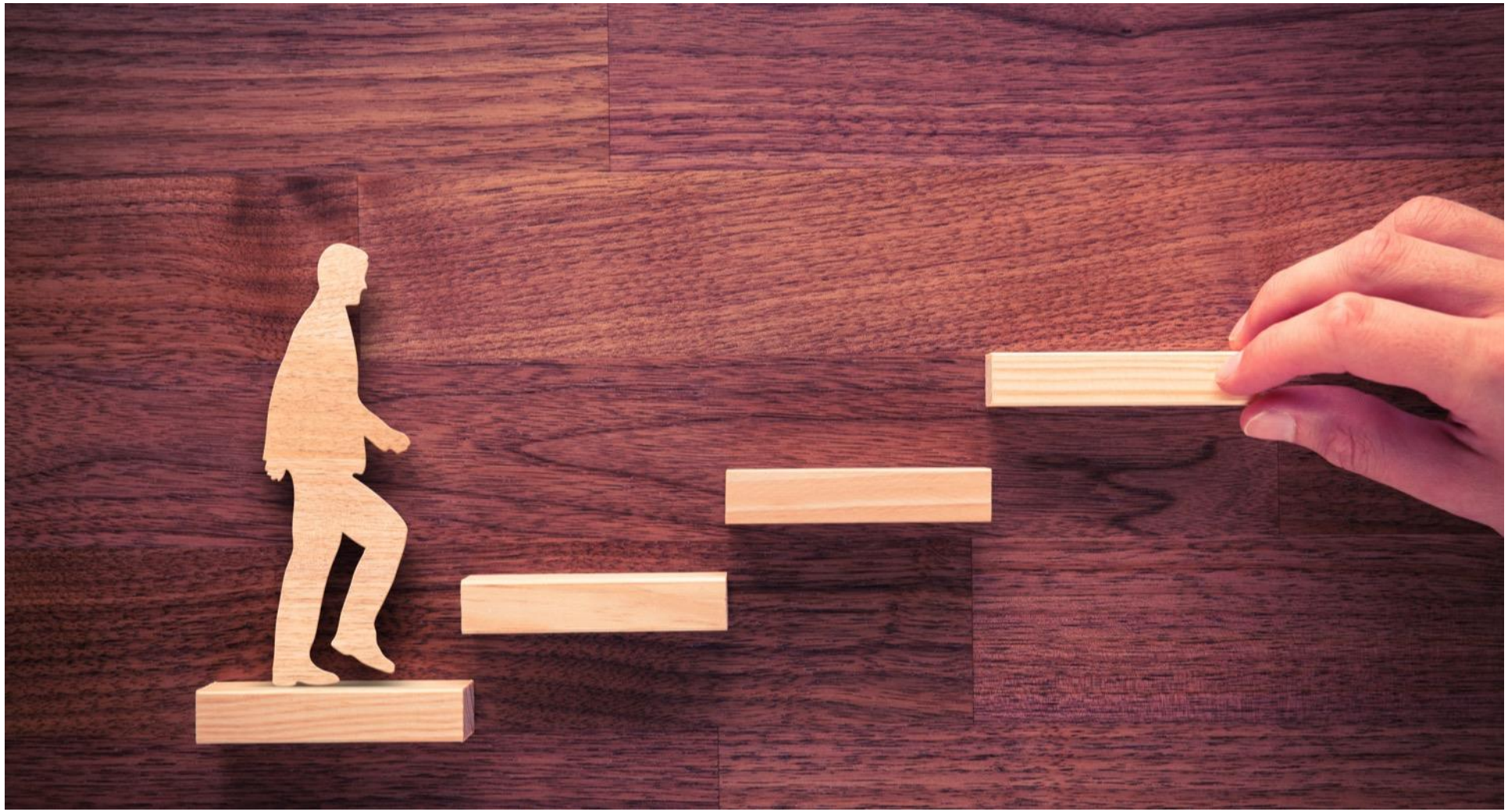
- The mechanical support systems deliver the power-in and heat-out necessary to provide mission reliability

- Mechanical support systems include
  - Mission critical hardware spaces
  - Personnel spaces

# Critical Electrical Systems

- Critical Distribution
  - UPS output to mission critical hardware
  - Includes other critical environments
- UPS Systems
- Power Backbone
  - Site power source to UPS input and mechanical systems
- Engine Generators
- Utility Power Source

# Tier Classifications



# Tier Classifications

- Tier I – Basic Capacity (N)
- Tier II – Redundant Components (N+)

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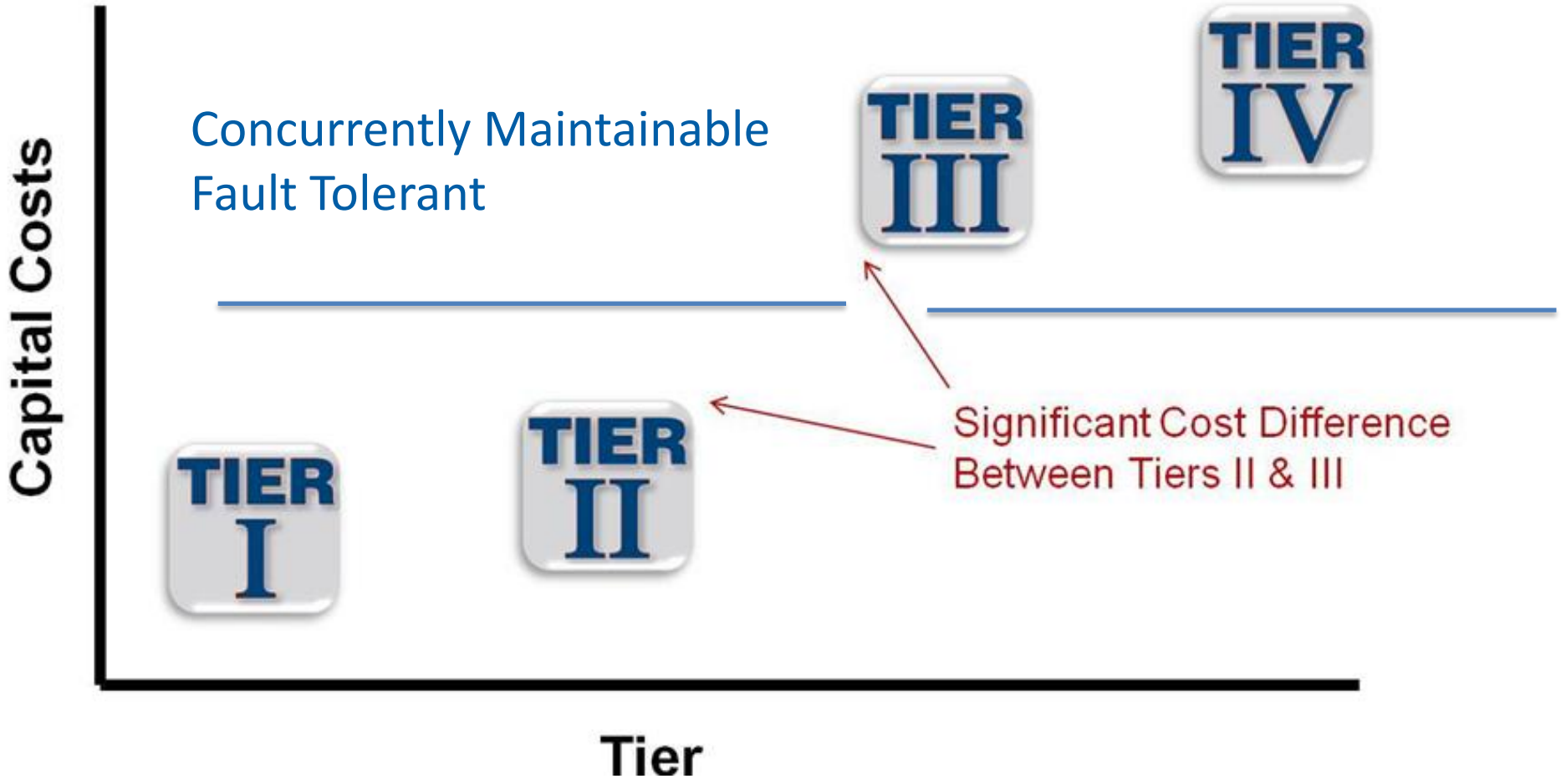
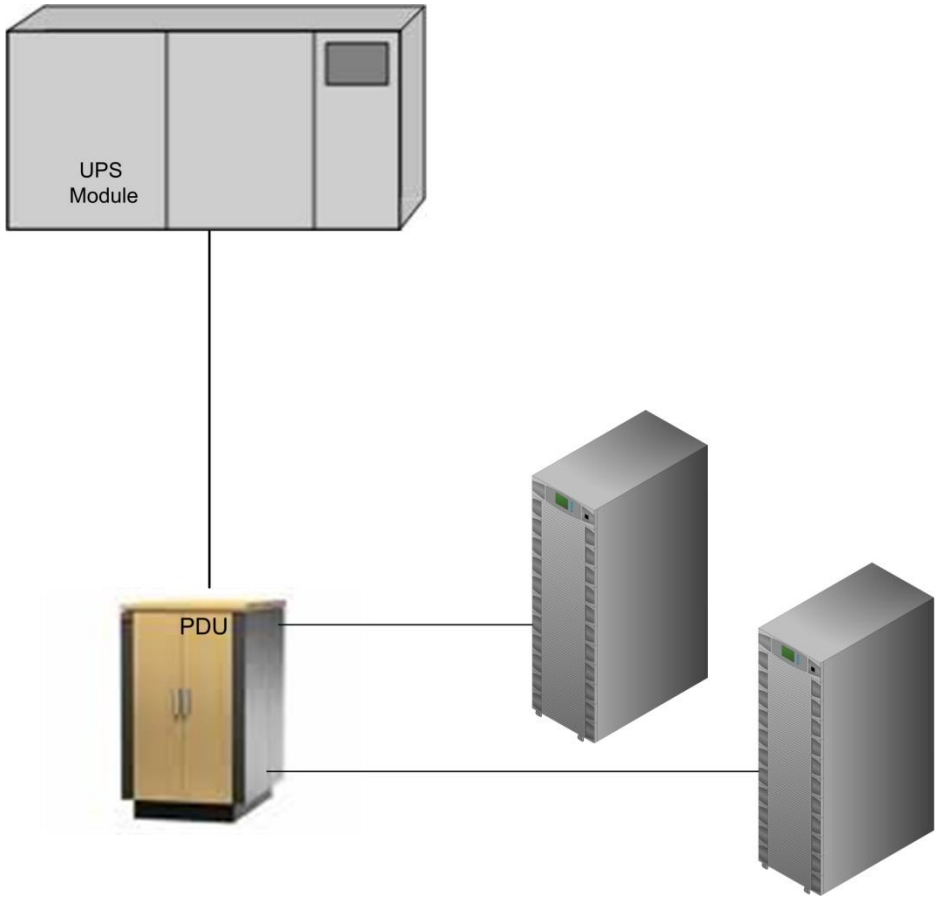
- Tier III – Concurrently Maintainable (N+1)
  - Applies to ***each and every*** component and path
- Tier IV – Fault Tolerant (N+1+)
  - Considers a ***single*** event, and ***consequential*** impact

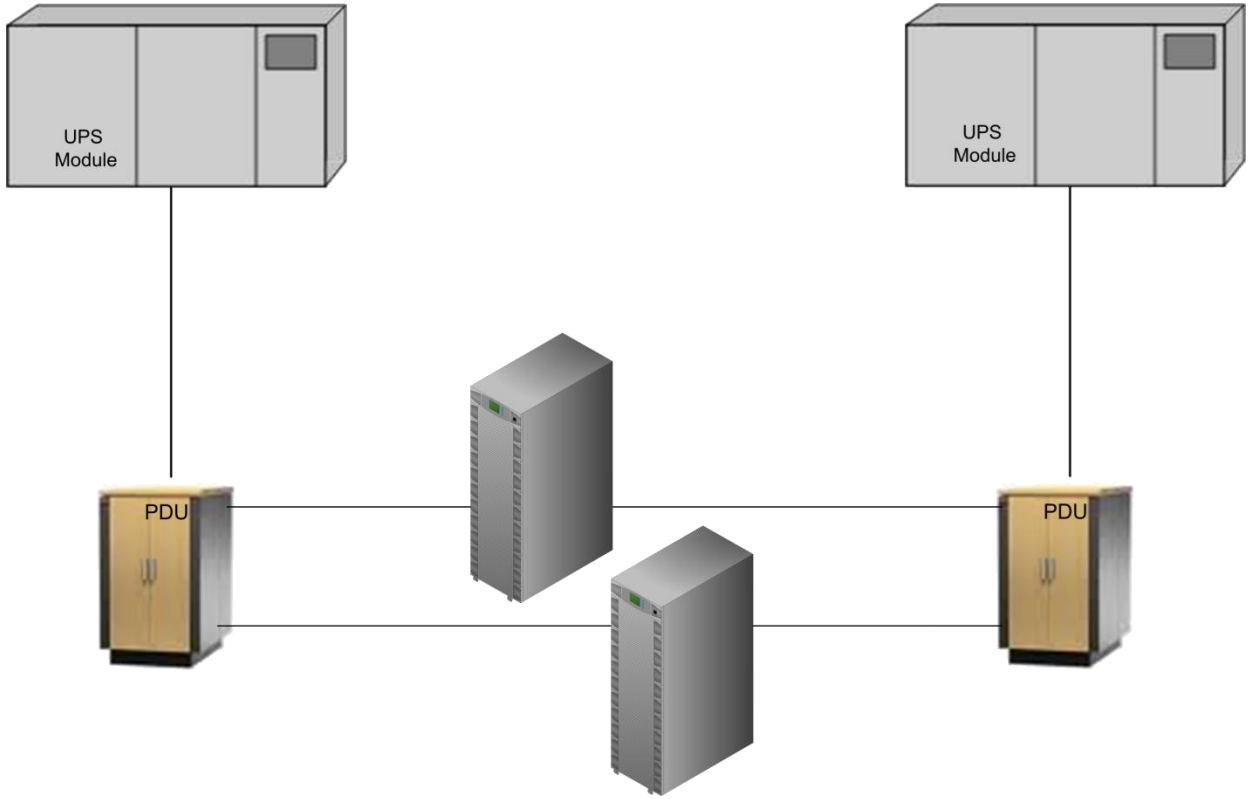
# Relative Cost of Tier Designs

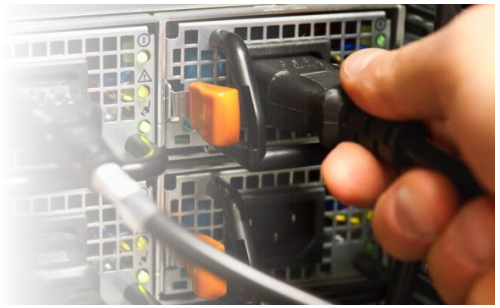


# Basic Capacity and Single Power Path



# Redundant Components and Dual Power Path

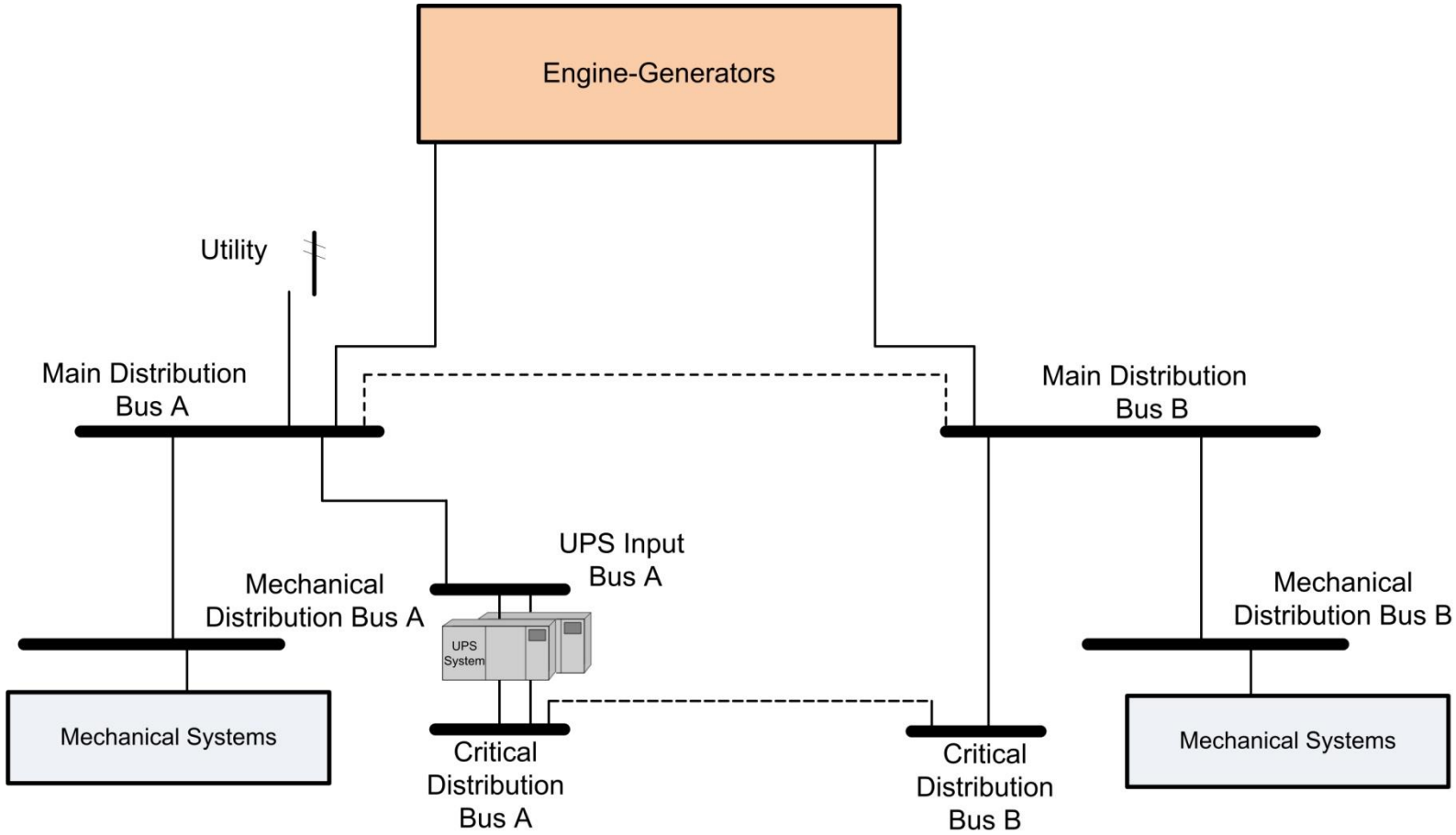


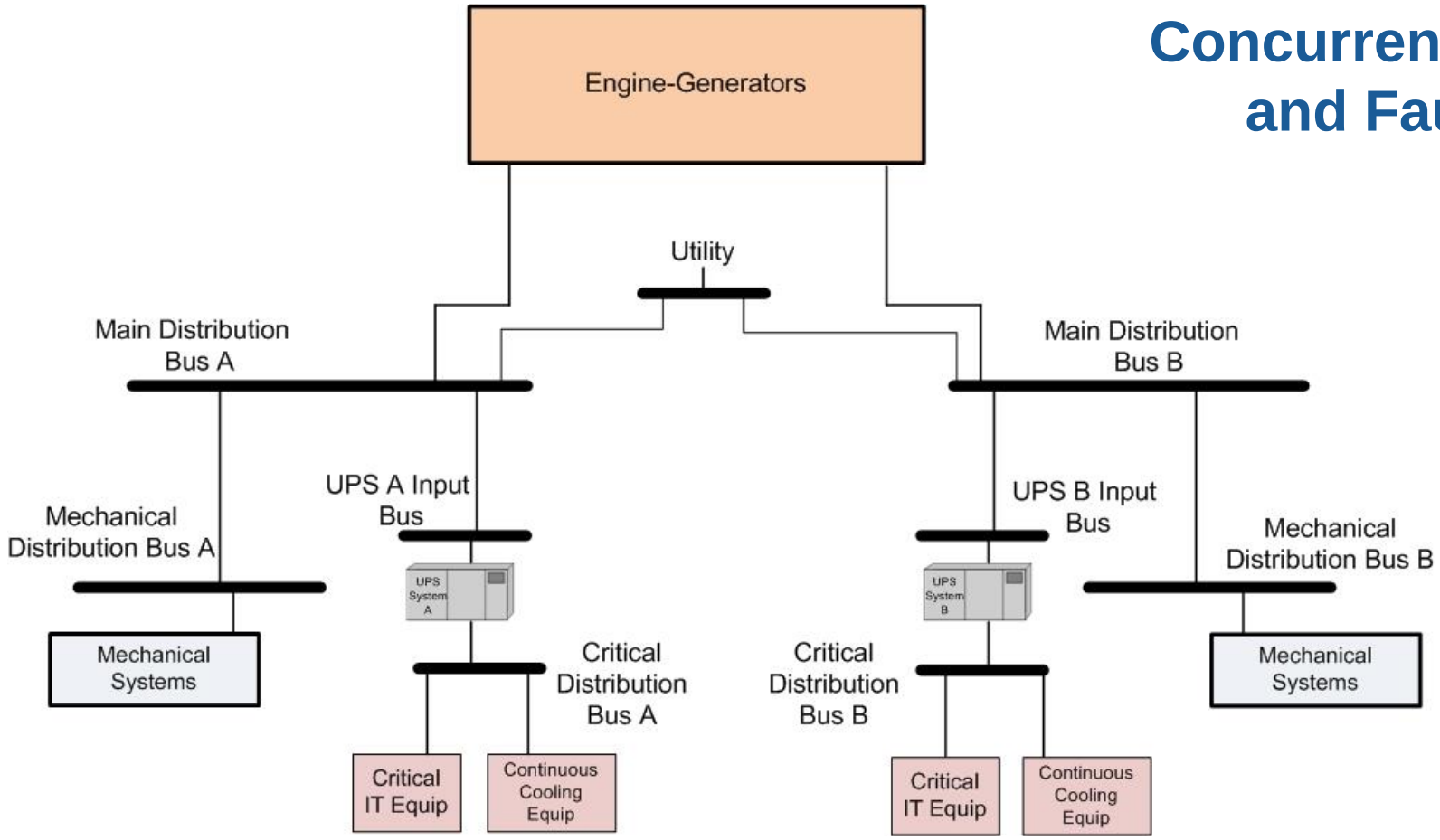
**Concurrently Maintainable**

# Tier III – Power Backbone

**Concurrently Maintainable**



# Tier IV – Power Backbone




**Concurrently Maintainable and Fault Tolerant**

# Engine-Generator Systems

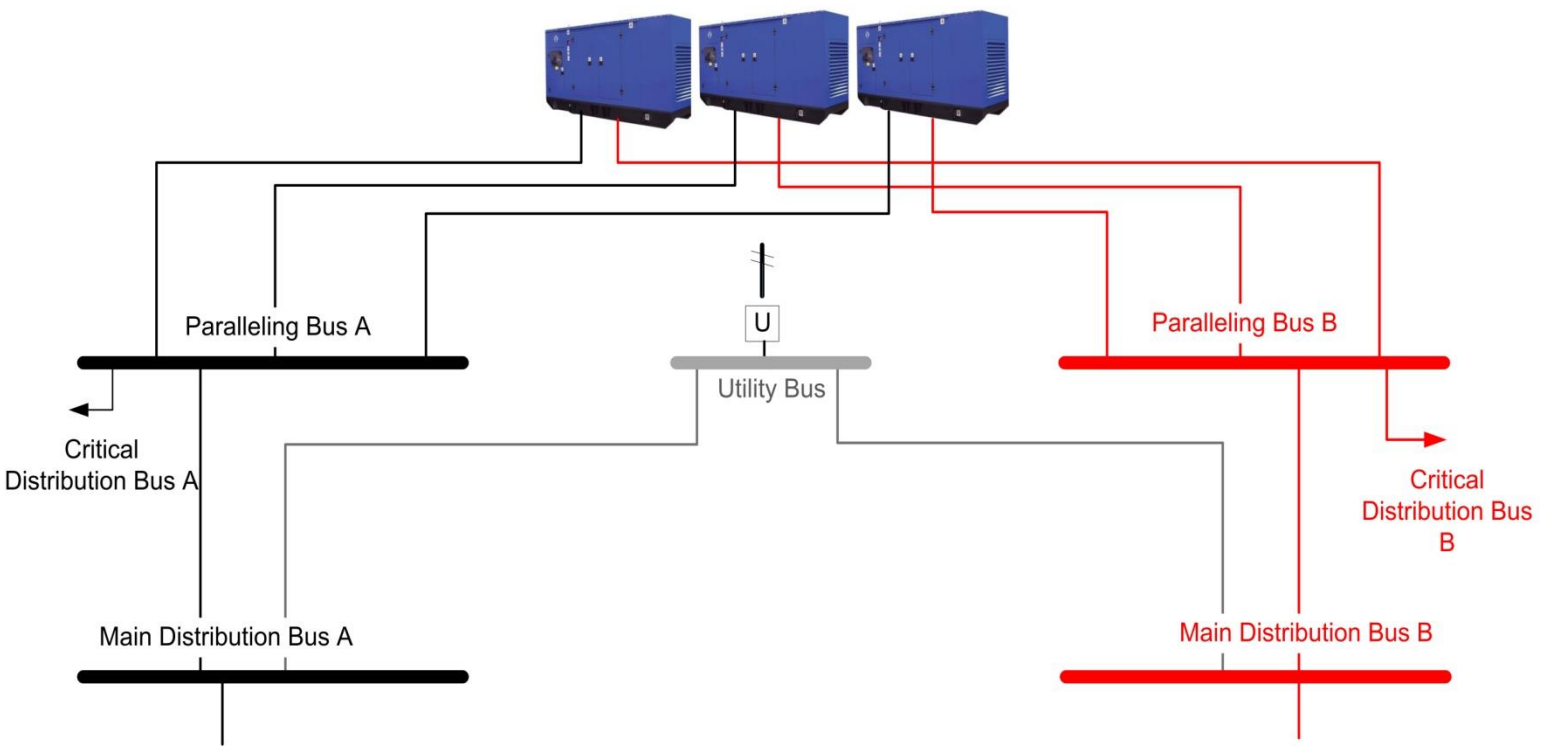
- Consider engine generators as on-site power source
  - Tier III requires Concurrent Maintainability while carrying the load
  - Tier IV requires Fault Tolerance while carrying the load
- Manufacturers' Engine Ratings
  - Tier III and Tier IV engine-generator capacity is based on manufacturers' ***unlimited runtime capacity*** at site conditions
  - Standby and non-derated prime-rated units are acceptable only for Tier I and Tier II
- Run-time Limits
  - Manufacturers' runtimes represent capability constraints
  - Government regulated (typically environmental) runtimes represent regulatory constraints

# Engine-Generator Systems

# Tier III – Engine-Generator Concept (N+1)

**N = 2**

**Concurrently Maintainable**



# Tier III – Concurrently Maintainable

- Summary
  - Redundant capacity components and independent distribution paths
  - Elements of a distribution path may be inactive
    - Exception: the critical distribution pathways downstream of the UPS are not permitted to be inactive
  - Predicated on Fault Tolerant (dual-cord) IT equipment
  - No runtime limits on engine-generator capacity at design load

- Operations and Maintenance Considerations
  - ***Each and every*** capacity component and distribution path element can be taken out of service for maintenance, repair, or replacement on a planned basis without impacting the critical environment or IT processes

# Tier III – Practical Insights

- ***Each and every*** extends to
  - Valves and fittings
  - Switchgears and panels
- Maintenance focus requires
  - Dead lugs for safety during electrical activities
    - Completely de-energized electrical devices
  - Dry pipes to avoid liquid spills
    - Mechanically isolated to allow draining of the section or equipm
- Single points-of-failure *are not* eliminated

# Tier III – Operational Risks

- All or portions of the critical environment are susceptible to disruption due to failures or unplanned activities
- Scheduled maintenance activities occur on redundant components, distribution paths, and systems—which will reduce redundancy and may elevate the risk of disruption
- Operations (human) errors may lead to site disruption
- Single-corded IT equipment or incorrect installation may defeat the intent of the Tier III electrical infrastructure for that IT equipment

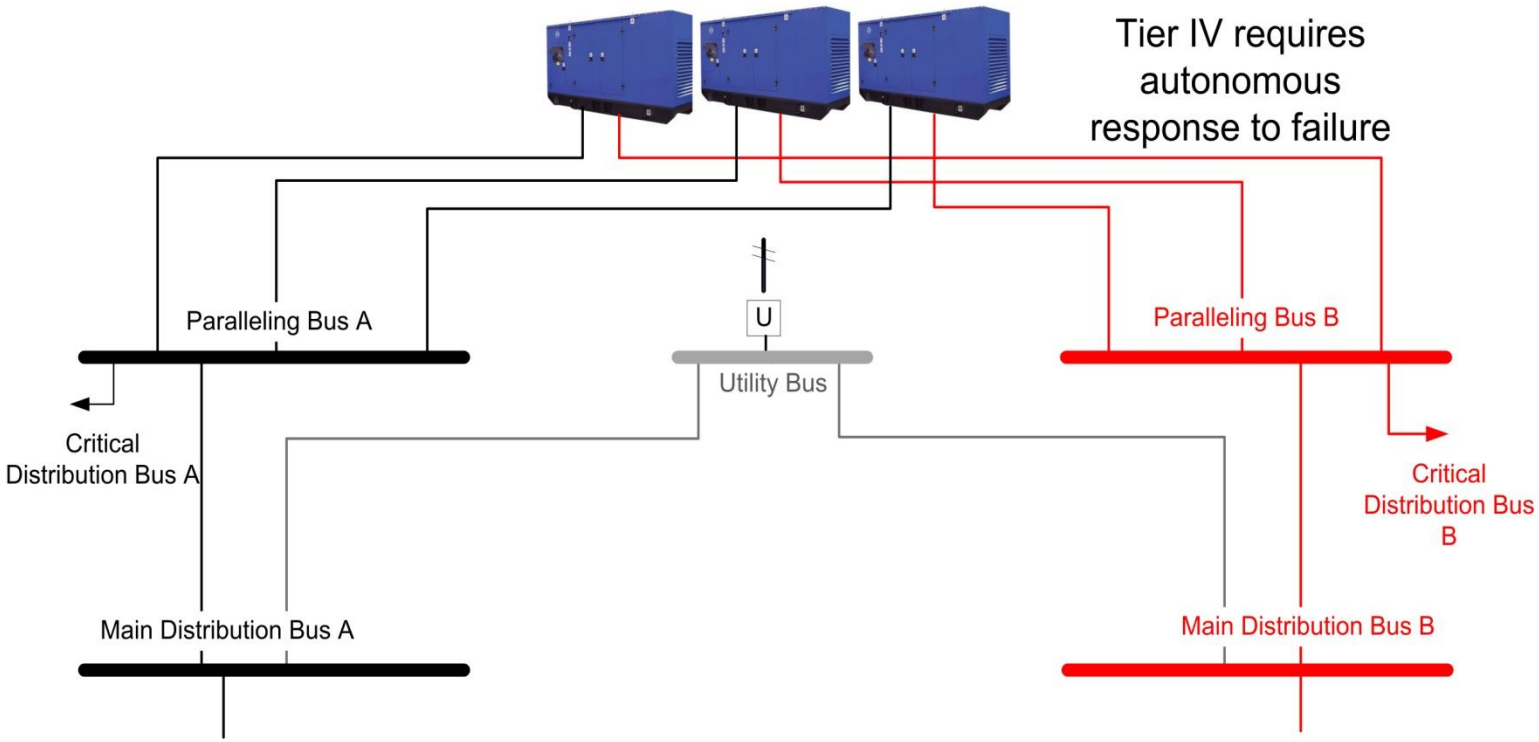
# Tier IV – Engine-Generator Concept (N+1)

**N = 2**

**Concurrently Maintainable**

**Fault Tolerant**

Tier IV requires autonomous response to failure



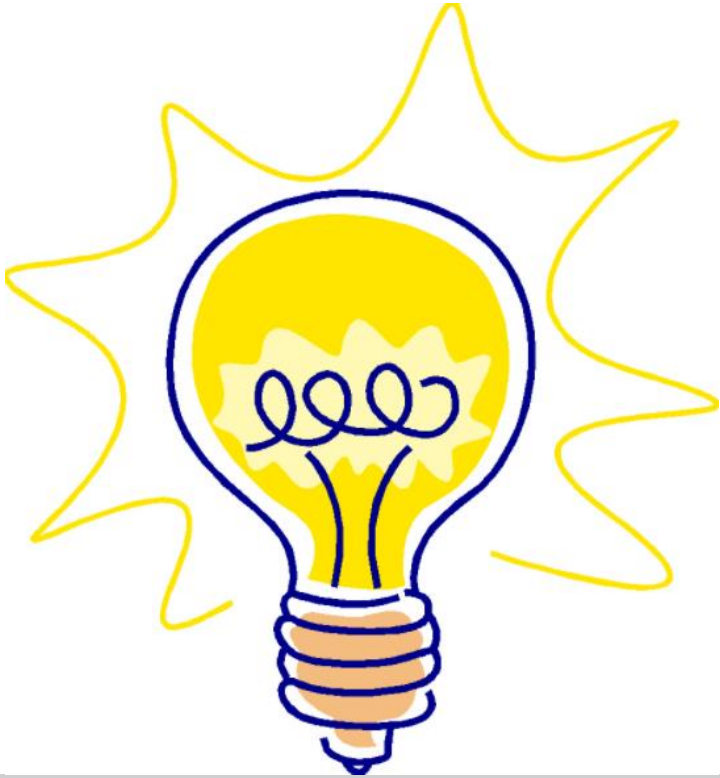
# Tier IV – Fault Tolerant

- Summary
  - Redundant, physically isolated (Compartmentalization)
    - Redundant capacity components
    - Redundant independent active distribution paths
  - Continuous Cooling for critical IT and UPS systems
  - Autonomous response (N after any failure)
  - No runtime limits on engine-generator capacity at design load

- Operations and Maintenance Considerations
  - ***Each and every*** capacity component and distribution path element can sustain a failure, error, planned, or unplanned event without impacting the critical environment or IT processes

# Tier IV – Practical Insight

- ***Single event*** with ***consequential*** impact
  - Loss of a switchboard impacts everything downstream powered by that switchboard
  - Replacing a valve requires a dry pipe on *both* sides
- Design considerations for Continuous Cooling are consistent with UPS for IT equipment power
- Most human errors are considered failure events
  - Exceptions
    - Emergency power off (EPO) activations
    - Certain fire suppression activations
    - Failure to properly connect IT loads
    - Accidental EPO activation
    - Intentional sabotage



# Tier IV – Operational Risks

- The critical environment is not susceptible to disruption due to failure of any single capacity component, distribution element, site infrastructure system, or single human error

- Scheduled maintenance activities occur on redundant components, elements, and systems—which may create a risk of disruption


- Operation of the EPO system, activation of the fire protection system, or malicious human interaction may lead to site disruption

- Single-cord IT equipment or incorrect installation may defeat the intent of the Tier IV electrical infrastructure for that IT equipment

# The value of Tier Design

- Provides the expected performance from your infrastructure
  - Common measurement to rate and compare data centers
  - Identifies potential areas of risk
- Provides designers with a tool to achieve the intended business objective
- Tiers concepts are simple; but difficult to implement !

# Tier Classification Summary

- Tier Classifications are progressive
  - Tier I is the foundation
  - Tier II includes Tier I, and adds redundant components, etc.

- ***Each and every*** Tier design consideration is exhaustive

- **Tier III** is about ***Concurrent maintenance***, but may have single points of failure

- **Tier IV** ***can sustain a failure***, error, planned, or unplanned event for each and every capacity component and distribution path element

# Mapping Business Objective to Tiers

- Tier design provides for Mission Critical reliability and resiliency
- Can the facility / mission afford *unplanned* downtime ?
  - If Yes, Tier III
  - If No, Tier IV
- Certification is required to ensure Mission Critical Reliability
  *( Uptime Institute finds the overwhelming majority of sites reviewed have critical exposures )*

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For more information Contact :

Todd Traver
ttraver@uptimeinstitute.com