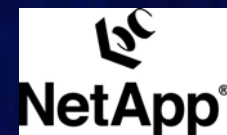




**Reliable, Energy Efficient, and
Cost-Effective
On-site Cogeneration and Back-up
Power System
for a
Mission Critical Data Center**

**Critical Facilities Roundtable
Dan Hoffman
Director of Facilities
May 19, 2004**



▶ **Highly Reliable**

- **Redundancy (N+1)**
- **Concurrently Maintainable**
- **Reliable, Available, Serviceable**

▶ **Scalable and Flexible**

- **Phase plan for growth**
- **Allow for changing power and cooling requirements**

▶ **Reduce Operating Expenses**

- **Energy Efficient Design**

“Traditional” Data Center	Netapp State-of-the-Art
Diesel Generators w/automatic transfer switch	Natural Gas Cogenerators w/paralleling switchgear
Electric Chillers	Adsorption Chillers (use waste heat)
Cooling Towers w/storage tank	Cooling Towers w/well
UPS w/batteries	UPS w/mechanical rotor
Underfloor supply air w/ mixed return air stream	Overhead Hot aisle/Cold aisle with returns over hot aisles
Air Handlers with constant flow and common supply plenum	Air Handlers with variable flow and automatic zone controls
100% recirculated air	Fresh air economizers
Fixed power distribution	Changeable power distribution

Primary System	Source	1st back up	Duration	2nd back up	Duration
Electrical Generation	Generators	N+1	Continuous by gas supply	PG&E Utility	Continuous by grid supply
UPS	Flywheel	N+1	17 seconds		
Rack Power	Electrical Bus	N+1	Continuous		
Gas Supply	PG&E	Stored Gas	36 hours	Fuel Truck	Continuous
Water Supply	Utility	Well	Continuous		
Chilled Water	Chillers	N+1	Continuous	Boiler Water	Continuous by gas supply
Condenser water	Cooling Tower	N+1	Continuous	Airside economizer	Continuous (Temperature varies)
Air Handling	Air Handlers	N+1	Continuous		
Pumping	Pumps	N+1	Continuous		



▶ **Normal Operation Mode (Utilities)**

- PG&E Electricity (5% of elec load)
- PG&E Gas (for generators, 95% of elec load)
- Sunnyvale Water (for cooling tower make-up)

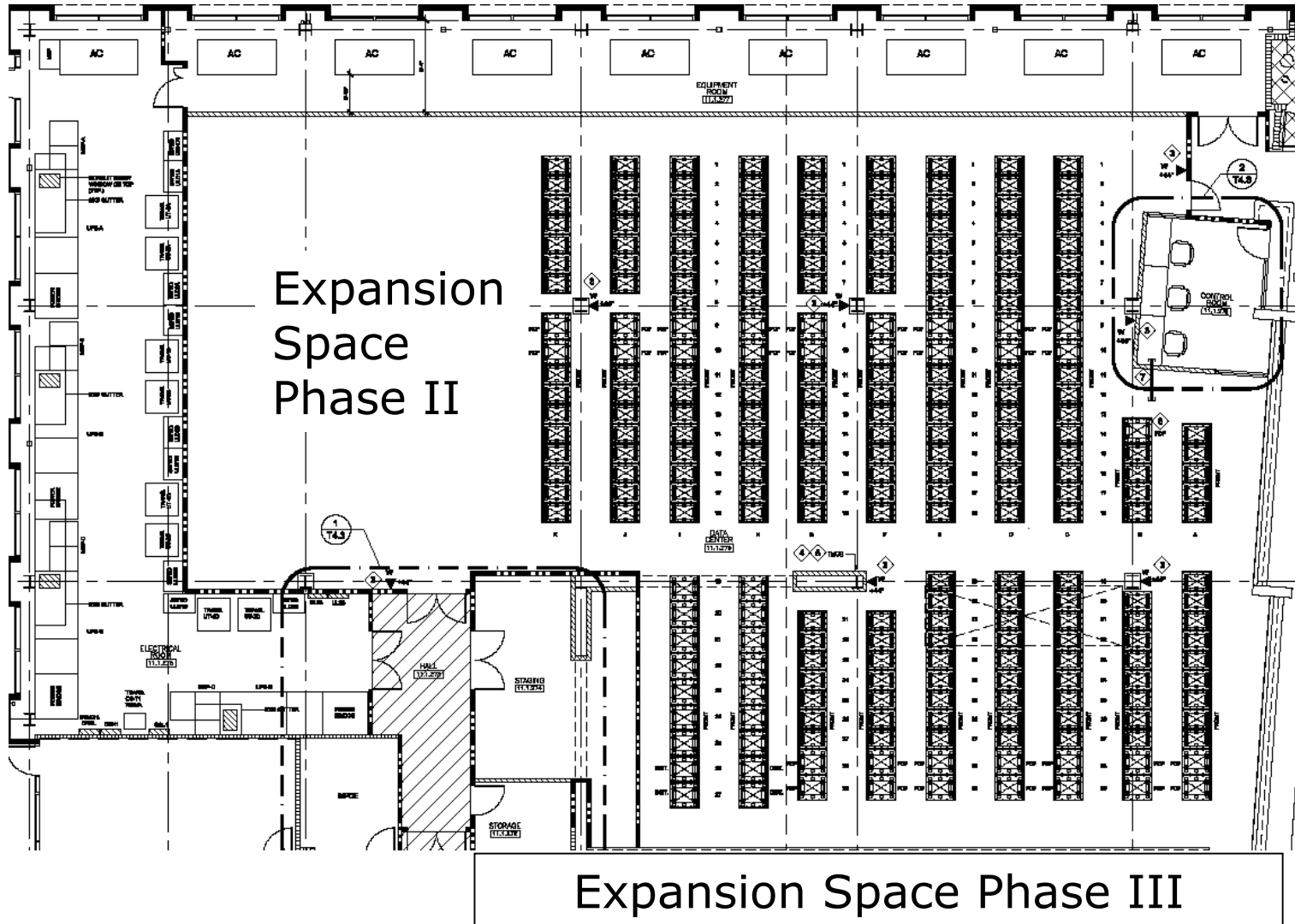
▶ **“Island Mode” – divorced from utilities**

- Stored Propane Gas on-site (36 hours) for 100% load, can refuel on the fly
- Well water on-site (for cooling tower make-up)
- Automatically transitions from normal to island mode and back without any disruption

Ph.	Racks	Gen.	UPS	Chiller	Clg Twr	Air Hndlr	Power (avg) (W/rack)	Air Cond. (Tons/rack)
I	300	3	2	3	2	8	3100	0.8
II	403	5	3	4	3	12	3600	1.1
III	483	7	4	5	4	17	4200	1.3

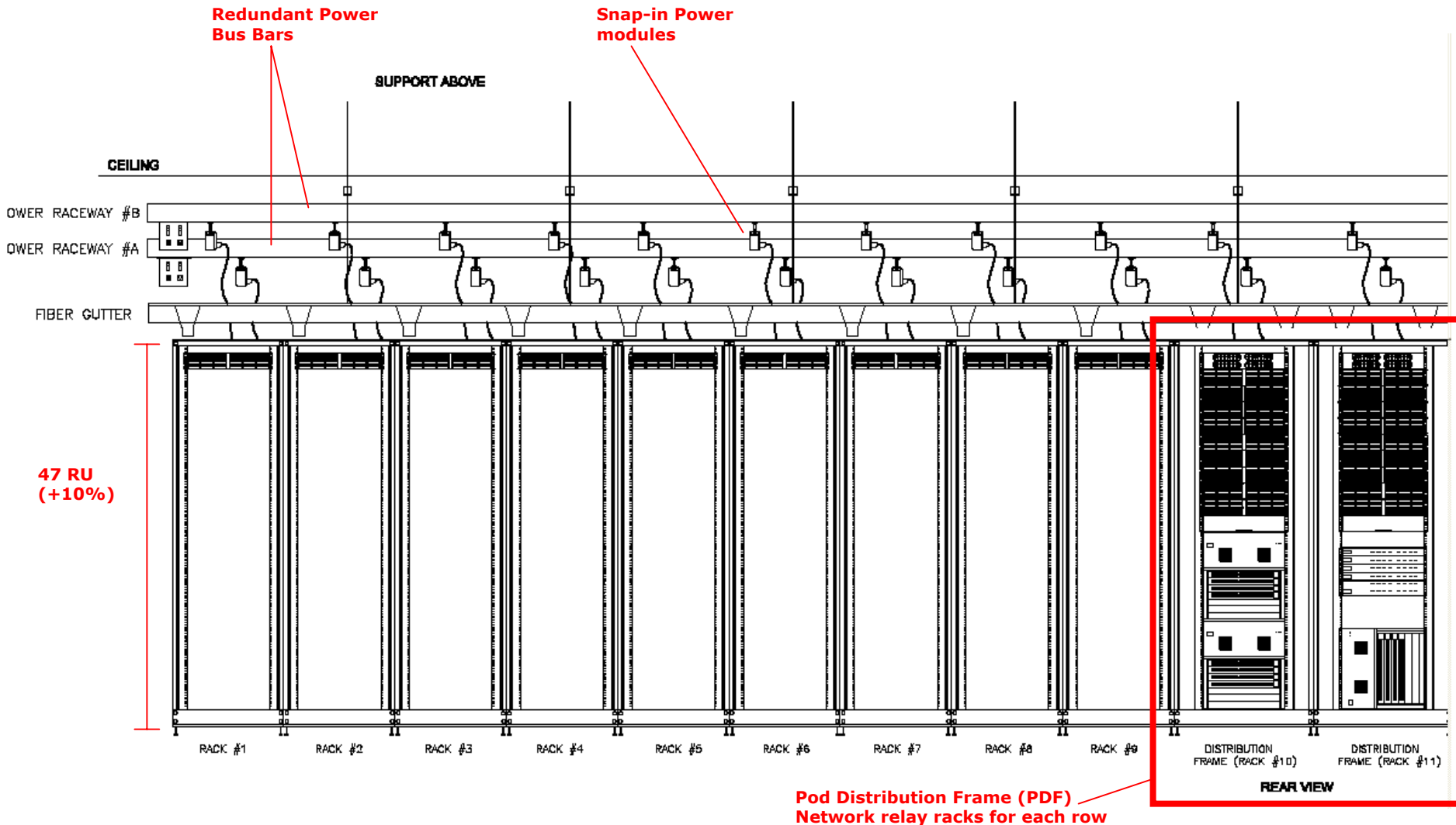
- ▶ Data Center growth rate at 5 racks/month
- ▶ Need to install additional mech/elec equipment for each phase

The Design - Floorplan



The Features – Rack Layout

Flexible Overhead Power and Data Delivery



▶ **ENERGY SAVINGS**

- ▶ **Cogeneration provides “free” chilled water**
 - representing 30% energy savings available 24x7
- ▶ **Economizers provide “free” air cooling**
 - representing 30% energy savings 20% of 24x7
- ▶ **Variable Air Volume Air Conditioning**
 - automatically adjusts amount of airflow needed in a row
- ▶ **Individual diffusers can be manually closed**
- ▶ **Hot Aisle/Cold Aisle design**
 - more efficient for cooling equipment

▶ **ENVIRONMENTAL BENEFITS**

- ▶ **Less natural resource usage (natural gas to make elec)**
- ▶ **Less air pollution due to reduced energy usage**
- ▶ **No battery disposal**
- ▶ **No ozone depleting refrigerant**
- ▶ **No salt solution to dispose of**