

# **Assessment of Existing Data Centers for Critical Facilities Round Table Group**

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# BACKGROUND INFORMATION

## ASSIGNMENT

- Data Center Criteria

Type	Raised Floor	Power Density	Tier Level
Primary	80 K sq.ft.	125 w/sq.ft.	4
Secondary	40 K sq.ft.	75 w/sq.ft.	2 to 3

- Anywhere, but California

## TIME FRAME

- Began Search                      September 2001
- Finished Search                  January 2002

## INVENTORY OVERVIEW

- Age
- Quality
- Condition
- Owners
- Locations

# EVALUATION CRITERIA – LEVEL 1

## **BUILDING AND SITE**

- Current Size
- Growth Potential
- Hazards
- Structure
- Accessibility

## **MEP INFRASTRUCTURE**

- Systems
  - Utility Power
  - Emergency Power
  - UPS Power
  - HVAC
  - Fire Suppression
- Key Issues
  - Capacities
  - Configuration
  - Redundancy
  - Fault Tolerance

# BUILDING ATTRIBUTES RATING CRITERIA

	HAZARDS			STRUCTURE				ACCESSIBILITY
	Seismic or Storm Zone	Proximity to Airport	Proximity to Environmental Hazards	Structural "Robustness"	Floor Loads	Exterior Envelope	Clear Height to Structure	Accessibility by IT
<b>A</b>	None	More than 5 miles	More than 5 miles	Hardened structure, designed to exceed standard building code roof and wind loads by multiple of 1.5 or more	200+ PSF	Precast concrete walls, no windows, double roof membrane with leak detection	18 - 22 ft	Less than 2 hours travel time
<b>B</b>	Siesmic zone 1	Between 1/2 and 5 miles	Between 1/2 and 5 miles	Hardened structure, designed to exceed standard building code roof and wind loads	150+ PSF	Precast concrete walls, some strip windows, high performance single roof membrane	15 - 18 ft	Half day travel time
<b>C</b>	Siesmic zone 2 or higher or high risk tornado / hurricane zone	Under flight path or adjacent to airport	Adjacent to chemical, manufacturing, or treatment plant	Complies with standard building code roof and wind loads	100+ PSF	Converted office or warehouse building. Numerous strip windows, standard commercial roof membrane	12 - 15 ft	One day travel time

# ELECTRICAL RATING CRITERIA

	Sources	Feeds	Transformers	Main Switchboards	Output Distribution	Generators	Output Distribution	Modules	Output Distribution
A+	2	2	2 N	2 N	Ring bus with electrically operated tie breakers interconnecting all MSB's	N + 2	N + 1 emergency power distribution boards with redundant feeds to each MSB	2 N	Dual UPS line-ups feed dual PDU's with ASTS on 208v output feeds
A	2	2	N + 2	N + 2	Ring bus with electrically operated tie breakers interconnecting all MSB's	N + 1	One emergency power distribution board with redundant feeds to each MSB	N + 2	Multiple dual transformer PDU's with ASTS on 208v output feeds
A-	1	2	N + 1	N + 1	Tie breakers for inter-tie of MSB's	N + 1	One emergency power distribution board with redundant feeds to each MSB	N + 1	Multiple single transformer PDU's with ASTS on 208v input feeds
B+	1	1	N + 1	N + 1	Dedicated isolated MSB	N + 1	One emergency power distribution board for service to ATS with maintenance bypass switch	N + 1	One path of power - no ASTS
B	1	1	1	1	Dedicated isolated MSB	1	Generator output breaker feeds standard ATS	N + 1	One path of power - no ASTS
B-	1	1	1	1	Shared main switchboard	1	Generator output breaker feeds standard ATS	1	One path of power - no ASTS
C	1	1	1	1	Main switchboard serves other building loads in addition to data center load	0	none	1	One path of power - no ASTS

# HVAC RATING CRITERIA

	System Design	Chilled Water Source	Condenser System	Chiller Units	Electrical distribution	CRAC Units	Redundant Make-up Water
<b>A+</b>	Central plant chilled water	Centrifugal chillers	cooling towers	<b>2 N</b>	2N	<b>N + 50%</b>	On-site storage tanks
<b>A</b>	Central plant chilled water	Centrifugal chillers	cooling towers	<b>N + 1</b>	2N or N+1	<b>N + 25%</b>	On-site storage tanks or wells
<b>A-</b>	Distributed chillers	Screw or recip compressors	DX condensers or Glycol dry-coolers	<b>N + 1 or N + 25%</b>	N+1	<b>N + 25%</b>	not required
<b>B+</b>	Central plant chilled water	DX chillers	cooling towers	<b>N + 1</b>	N+1	<b>N + 2</b>	none
<b>B</b>	Distributed chillers	Centrifugal chillers	Glycol dry-coolers	<b>N + 1</b>	N+1	<b>N + 2</b>	not required
<b>B-</b>	Distributed chillers	Recip compressors in CRAC	DX remote condensers	<b>N + 1</b>	N+1	<b>N + 1</b>	not required
<b>C</b>	Rooftop Package AH Units	Screw or recip compressors	Integrated DX condensers	<b>N + 1</b>	Single feed, no back-up emergency generator	<b>N</b>	not required

# NETWORKING RATING CRITERIA

	No. of Providers in Building	No. of Providers in Street	Providers in Area	Redundant Entrance Vaults	Necessity to backfeed sonet rings	Existing Sonet Rings
A						
B						
C						
D						
F						

# EVALUATION CRITERIA – LEVEL 2

## **INCOMING POWER SERVICE**

- Power Quality/Outage History
- Service Routing/Distance
- Energy Cost

## **ELECTRICAL AND MECHANICAL SYSTEMS**

- Power System Study
- Equipment Acceptance Test Reports
- Commissioning Reports
- Equipment Maintenance/Testing Records

## **OTHER SYSTEMS**

- Fuel Oil Storage/Distribution
- Back-up Water Storage
- Building Monitoring
- Security
- Lightning Protection and Grounding

<b>SUMMARY</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
	<b>Kansas City, MO</b>	<b>Austin, TX</b>	<b>Richardson, TX</b>	<b>Chandler, AZ</b>	<b>St. Louis, MO</b>
<b>Gross Building Size</b>	<b>100,000</b>	<b>130,000</b>	<b>106,652</b>	<b>314,000</b>	<b>106,652</b>
Existing Raised Floor	43,500	42,000	67,051	73,000	67,051
Future Raised Floor	-	40,000	-	70,000	-
<b>Total Raised Floor</b>	<b>43,500</b>	<b>82,000</b>	<b>67,051</b>	<b>143,000</b>	<b>67,051</b>
Existing Office	10,000	12,000	7,417	30,000	7,417
Future Office	-	-	-	-	-
Total Office	10,000	12,000	7,417	30,000	7,417
Equipment/Storage/Staging	46,500	36,000	32,184	141,000	32,184
Building addition feasible?	yes, additional area on site	yes, 80,000 sf approved by zoning	yes, additional area on site	yes, additional area on site	yes, additional area on site
Comments	Designed as bank data center, totally 2N reliability for power and HVAC w/ hardened structure. Highest fault tolerant design	Designed as web hosting facility but with corporate data center standards for power, HVAC and hardened structure	Designed as web hosting facility with data center standards for power, not HVAC but hardened structure	Designed as e-commerce data center, nearly 2N reliability, Very high fault tolerant design	Designed as web hosting facility with data center standards for power, not HVAC but hardened structure
<b>COST</b>					
<b>Anticipated Purchase Price, subject to negotiation</b>	<b>\$ 30,000,000</b>	<b>\$ 50,000,000</b>	<b>\$ 45,000,000</b>	<b>\$ 95,000,000</b>	<b>\$ 60,000,000</b>
Cost to Complete	\$ 6,337,500	\$ 2,530,000	\$ 4,152,528	\$ 1,095,000	\$ 4,152,528
Future Cost to Expand Raised Flr	\$ -	\$ 10,800,000	\$ -	\$ 27,230,000	\$ -
<b>Total Anticipated Cost</b>	<b>\$ 36,337,500</b>	<b>\$ 63,330,000</b>	<b>\$ 49,152,528</b>	<b>\$ 123,325,000</b>	<b>\$ 64,152,528</b>
<b>Cost per SF Total Raised Floor</b>	<b>\$ 835.34</b>	<b>\$ 772.32</b>	<b>\$ 733.07</b>	<b>\$ 862.41</b>	<b>\$ 956.78</b>
<b>OPERATIONAL COSTS</b>					
Estimated Annual Utility Cost	\$ 1,279,218	\$ 2,029,972	\$ 1,498,656		
Present Value 10 year Cost	\$ 9,890,915	\$ 15,695,743	\$ 11,587,608		
Present Value 10 year Cost per SF	\$ 227.38	\$ 191.41	\$ 172.82		
<b>PRICE PLUS PV 10 YR COST per SF</b>	<b>\$ 1,062.72</b>	<b>\$ 963.73</b>	<b>\$ 905.89</b>		
<b>CAPACITY</b>					
UPS Power Density on existing floor	57 va/sf	60 va/sf	60 va/sf	60 va/sf	60 va/sf
Add'l Power Density Planned	none, requires building addition	30 va/sf	20 va/sf	30 va/sf	20 va/sf
<b>RELIABILITY</b>					
<b>Functionality</b>	<b>Tier 4</b>	<b>Tier 4</b>	<b>Tier 3</b>	<b>Tier 4</b>	<b>Tier 3</b>
Utility Power Redundancy	2 feeds from two grids	2 feeds from 1 grid, future 2nd grid	2 feeds from 1 grid, future 2nd grid	2 feeds from two grids	2 feeds from 1 grid, future 2nd grid
Power Redundancy	2 N	2 N	N + 1	N + 2	N + 1
Mech Redundancy	2 N	N + 1	N + 25%	N + 2	N + 25%
Electrical Comments	concurrent maintenance	concurrent maintenance	concurrent maintenance	concurrent maintenance	concurrent maintenance
<b>RATINGS</b>					
Electrical	A+	A	A	A	A
HVAC Systems	A+	A	B	A	B
Structural	A	A	A	A	A
Operational Efficiency	A	A	B	A	B
<b>Overall Rating (1 - 10)</b>	<b>10</b>	<b>9</b>	<b>8</b>	<b>9</b>	<b>8</b>
<b>CONNECTIVITY</b>					
Networking & Connectivity	<b>B</b>			<b>A</b>	
Fiber Carriers to the Building	3	3	3	2	3

<b>SUMMARY</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
	<b>Alpharetta, GA</b>	<b>Atlanta, GA</b>	<b>Coppell, TX</b>	<b>Bedford, MA</b>	<b>Miami, FL</b>
<b>Gross Building Size</b>	<b>95,000</b>	<b>88,105</b>	<b>80,000</b>	<b>93,200</b>	<b>108,500</b>
Existing Raised Floor	21,000	37,900	32,000	15,355	35,400
Future Raised Floor	-	-	-	17,800	-
<b>Total Raised Floor</b>	<b>21,000</b>	<b>37,900</b>	<b>32,000</b>	<b>33,155</b>	<b>35,400</b>
Existing Office	15,000	5,000	3,000	3,000	5,000
Future Office	-	-	-	-	-
<b>Total Office</b>	<b>15,000</b>	<b>5,000</b>	<b>3,000</b>	<b>3,000</b>	<b>5,000</b>
Equipment/Storage/Staging	59,000	45,205	45,000	57,045	68,100
Building addition feasible?	yes, 30,000 sf approved by zoning	yes, unused 2 level parking deck	no	no	no
Comments	Designed for satellite transmission equipment on 2nd level of data center with open steel grating	Designed as web hosting facility with data center standards for power, not HVAC but hardened structure	Designed as web hosting facility with standard power and HVAC, built in light industrial structure	Designed as web hosting facility with standard power and HVAC, built in light industrial structure	Designed as web hosting facility with standard power and HVAC, built in light industrial structure
<b>COST</b>					
<b>Anticipated Purchase Price, subject to negotiation</b>	<b>\$ 22,000,000</b>	<b>\$ 17,620,000</b>	<b>\$ 16,000,000</b>	<b>\$ 13,980,000</b>	<b>\$ 21,700,000</b>
Cost to Complete	\$ 8,090,000	\$ 4,990,000	\$ 6,000,000	\$ -	\$ -
Future Cost to Expand Raised Flr	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Total Anticipated Cost</b>	<b>\$ 30,090,000</b>	<b>\$ 22,610,000</b>	<b>\$ 22,000,000</b>	<b>\$ 13,980,000</b>	<b>\$ 21,700,000</b>
<b>Cost per SF Total Raised Floor</b>	<b>\$ 1,432.86</b>	<b>\$ 596.57</b>	<b>\$ 687.50</b>	<b>\$ 421.66</b>	<b>\$ 612.99</b>
<b>OPERATIONAL COSTS</b>					
Estimated Annual Utility Cost	\$ 687,091		\$ 715,236		
Present Value 10 year Cost	\$ 5,312,583		\$ 5,530,207		
Present Value 10 year Cost per SF	\$ 252.98		\$ 172.82		
<b>PRICE PLUS PV 10 YR COST per S</b>	<b>\$ 1,685.84</b>		<b>\$ 860.32</b>		
<b>CAPACITY</b>					
UPS Power Density on existing floor	80 va/sf	71 va/sf	81 va/sf	60 va/sf	60 va/sf
Add'l Power Density Planned	none req'd.	71 va/sf	81 va/sf	60 va/sf	60 va/sf
<b>RELIABILITY</b>					
<b>Functionality</b>	<b>Tier 3</b>	<b>Tier 3</b>	<b>Tier 3</b>	<b>Tier 3</b>	<b>Tier 3</b>
Utility Power Redundancy	2 feeds from two grids	2 feeds from 1 grid	2 feeds from 1 grid	2 feeds from 1 grid	2 feeds from 1 grid
Power Redundancy	N + 1	N + 1	N + 1	N + 1	N + 1
Mech Redundancy	N + 1	N + 1	N + 1	N + 1	N + 1
Electrical Comments	concurrent maintenance	concurrent maintenance	concurrent maintenance	concurrent maintenance	concurrent maintenance
<b>RATINGS</b>					
Electrical	B	B	B	B	B
HVAC Systems	B	B	B	B	B
Structural	B	B	C	B	B
Operational Efficiency	A	C	C	C	C
<b>Overall Rating (1 - 10)</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>6</b>	<b>6</b>
<b>CONNECTIVITY</b>					
Networking & Connectivity					
Fiber Carriers to the Building	1	3	2		

<b>SUMMARY</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>
	<b>Carrollton, TX</b>	<b>Carrollton, TX</b>	<b>Chicago, IL</b>	<b>Seattle, WA</b>	<b>Chantilly, VA</b>
<b>Gross Building Size</b>	<b>101,000</b>	<b>90,000</b>	<b>100,000</b>	<b>80,000</b>	<b>54,500</b>
Existing Raised Floor	15,000	44,000	47,000	40,000	20,000
Future Raised Floor	50,000	-	-	-	14,000
<b>Total Raised Floor</b>	<b>65,000</b>	<b>44,000</b>	<b>47,000</b>	<b>40,000</b>	<b>34,000</b>
Existing Office	15,000	5,725	5,300	5,000	10,000
Future Office	-	-	-	-	8,500
Total Office	15,000	5,725	5,300	5,000	18,500
Equipment/Storage/Staging	21,000	40,275	47,700	35,000	10,500
Building addition feasible?	no	yes, 40,000 SF	no	no	no
Comments	Designed as web hosting facility with standard power and HVAC, built in a spec office building structure	Designed as web hosting facility with standard power and HVAC, built in light industrial structure	Designed as web hosting facility with standard power and HVAC, built in a spec office building structure	Designed as web hosting facility with standard power and HVAC, built in a spec office building structure	Designed as web hosting facility with standard power and HVAC, built in light industrial structure
<b>COST</b>					
<b>Anticipated Purchase Price, subject to negotiation</b>	<b>\$ 24,000,000</b>	<b>\$ 49,500,000</b>	<b>\$ 55,000,000</b>	<b>\$ 44,000,000</b>	<b>\$ 9,000,000</b>
Cost to Complete	\$ 4,010,000	\$ 8,900,000	\$ 8,225,000	\$ 7,000,000	\$ 1,400,000
Future Cost to Expand Raised Flr	\$ 24,250,000	\$ -	\$ -	\$ -	\$ 6,118,000
<b>Total Anticipated Cost</b>	<b>\$ 52,260,000</b>	<b>\$ 58,400,000</b>	<b>\$ 63,225,000</b>	<b>\$ 51,000,000</b>	<b>\$ 16,518,000</b>
<b>Cost per SF Total Raised Floor</b>	<b>\$ 804.00</b>	<b>\$ 1,327.27</b>	<b>\$ 1,345.21</b>	<b>\$ 1,275.00</b>	<b>\$ 485.82</b>
<b>OPERATIONAL COSTS</b>					
Estimated Annual Utility Cost	\$ 1,452,824	\$ 983,450			
Present Value 10 year Cost	\$ 11,233,234	\$ 7,604,035			
Present Value 10 year Cost per SF	\$ 172.82	\$ 172.82			
<b>PRICE PLUS PV 10 YR COST per SF</b>	<b>\$ 976.82</b>	<b>\$ 1,500.09</b>			
<b>CAPACITY</b>					
UPS Power Density on existing floor	50 va/sf	63 va/sf	38 va/sf	70 va/sf	88 va/sf
Add'l Power Density Planned	none, requires additional equipment	none, requires additional equipment	tbd	tbd	none req'd.
<b>RELIABILITY</b>					
<b>Functionality</b>	<b>Tier 4</b>	<b>Tier 2</b>	<b>Tier 2</b>	<b>Tier 2</b>	<b>Tier 2</b>
Utility Power Redundancy	2 feeds from two grids	2 feeds from 1 grid	1 feed from 1 grid	2 feeds from 1 grid	2 feeds from 1 grid
Power Redundancy	2 N	modified N+N	modified N+N	modified N+N	N + 2
Mech Redundancy	N + 1	N+1	N+1	N+1	N + 2
Electrical Comments	concurrent maintenance	Single points of Failure	Single points of Failure	Single points of Failure	concurrent maintenance
<b>RATINGS</b>					
Electrical	B	C	C	C	B
HVAC Systems	B	C	C	C	B
Structural	C	C	C	C	C
Operational Efficiency	B	C	C	C	C
<b>Overall Rating (1 - 10)</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>5</b>
<b>CONNECTIVITY</b>					
Networking & Connectivity					
Fiber Carriers to the Building	4	3	4	2	3