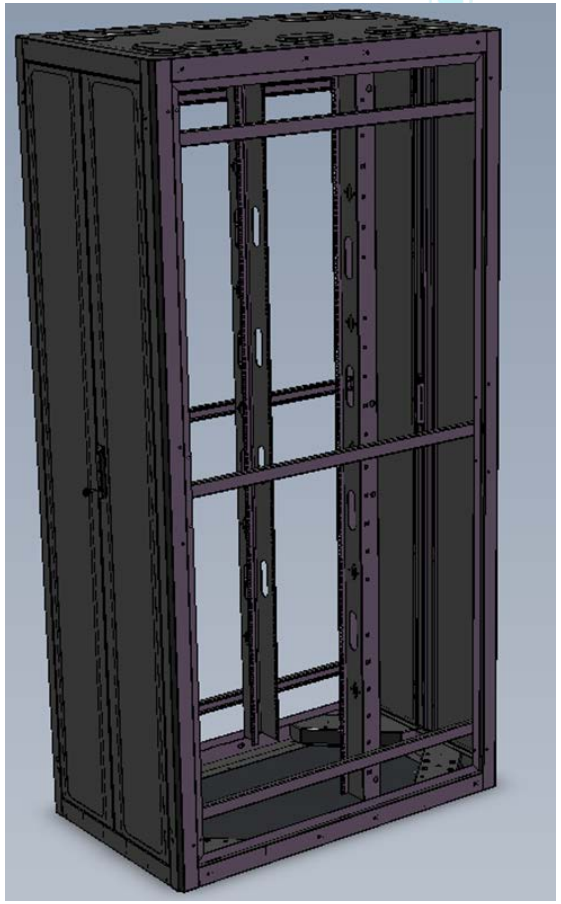
Study Overview- Cases Analyzed

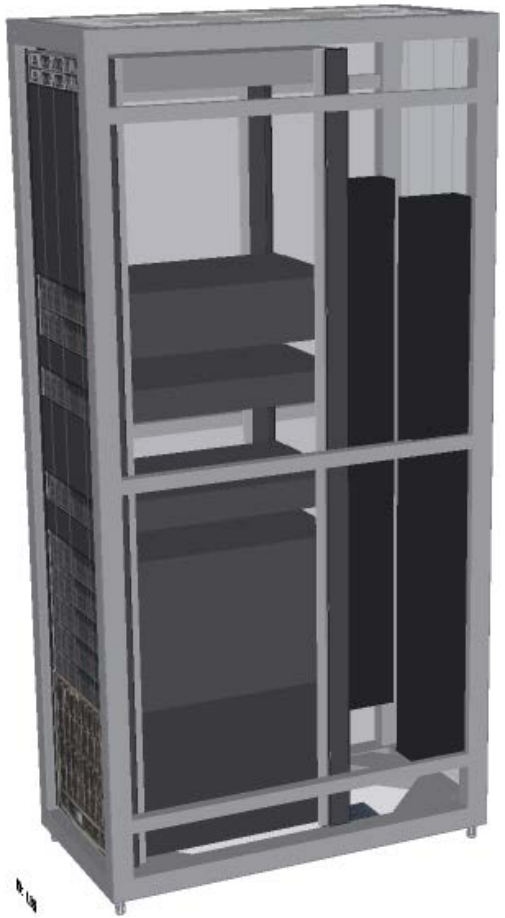
1. Baseline with supply air temperature at 55 °F
2. Baseline with supply air temperature at 75 ° F
3. Baseline with rail sealing kits and supply air temperature at 75 °F
4. Hot Aisle End of Row Doors
5. Cold Aisle End of Row Doors
6. Cold Aisle Containment (CAC)
7. Hot Aisle Containment (HAC)
8. Hot and Cold Aisle Containment
9. Cabinet Chimney Containment
10. Cabinet Chimney Containment with Cold Aisle Containment

Study Overview-Cabinet Construction

The AMCO Titan DT cabinet

- 51RU
- 24 in. wide X 48 in. deep
- Open bottom
- Solid Side Panels
- (10) brushed cable openings on the cabinet top with 75% sealing efficiency
- 8” X 6” brush grommet is placed in the rear center of the cabinet bottom with a sealing efficiency of 80%.
- Un-used rack U-space is blanked with a 5% leakage factor.
- In the models where the mounting rail air blocks are installed, a 3% leakage factor is applied.



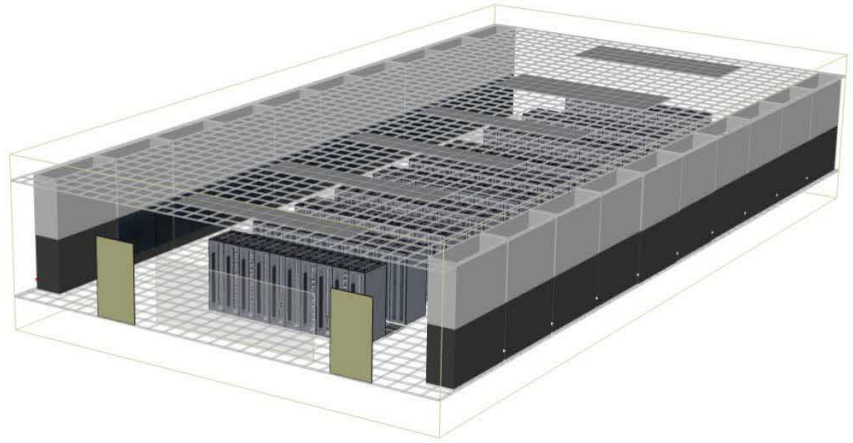


Study Overview-
ASHRAE Environmental Conditions

Classes (a)	Equipment Environmental Specifications							
	Product Operations (b)(c)					Product Power Off (c) (d)		
	Dry-Bulb Temperature (˚F) (e) (g)	Humidity Range, non-Condensing (h) (i)	Maximum Dew Point (˚F)	Maximum Elevation (f)	Maximum Rate of Change(˚F/hr) (f)	Dry-Bulb Temperature (˚F)	Relative Humidity (%)	Maximum Dew Point (˚F)
Recommended (Applies to all A classes; individual data centers can choose to expand this range based upon the analysis described in this document)								
A1 to A4	64.4 to 80.6	41.9°F DP to 60% RH and 59°F DP						
Allowable								
A1	59 to 89.6	20 to 80% RH	62.6	10,000	9/36	41 to 113	8 to 80	80.6
A2	50 to 95	20 to 80% RH	69.8	10,000	9/36	41 to 113	8 to 80	80.6
A3	41 to 104	10.4˚F DP & 8% RH to 85% RH	75.2	10,000	9/36	41 to 113	8 to 85	80.6
A4	41 to 113	10.4˚F DP & 8% RH to 90% RH	75.2	10,000	9/36	41 to 113	8 to 90	80.6
B	41 to 95	8% RH to 80% RH	82.4	10,000	NA	41 to 113	8 to 80	84.2
C	41 to 104	8% RH to 80% RH	82.4	10,000	NA	41 to 113	8 to 80	84.2

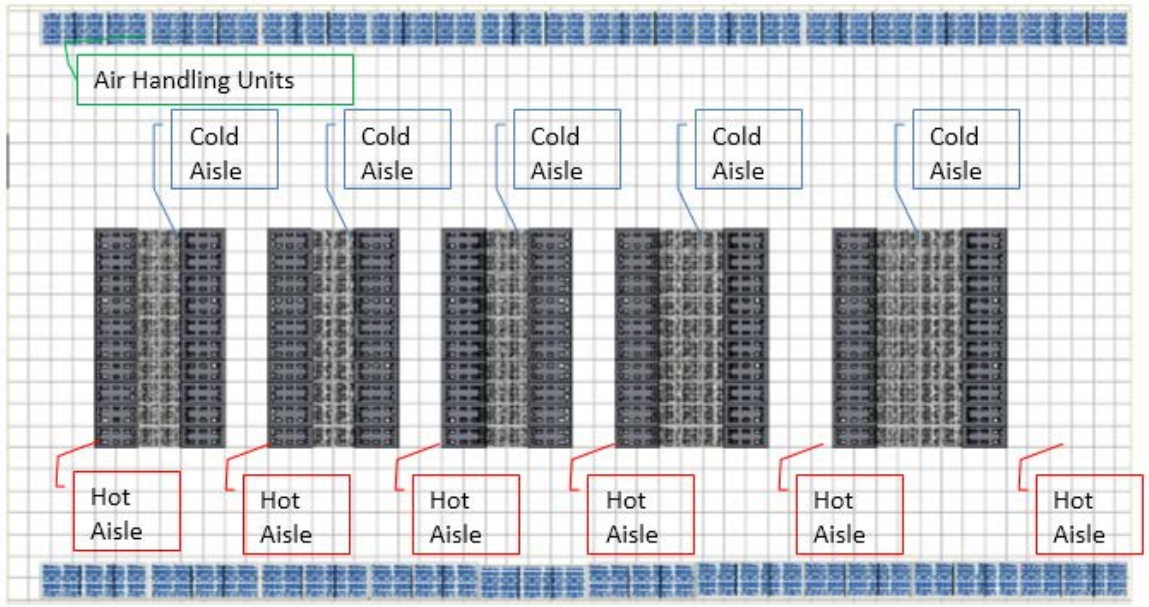
Study Overview- Room Overview

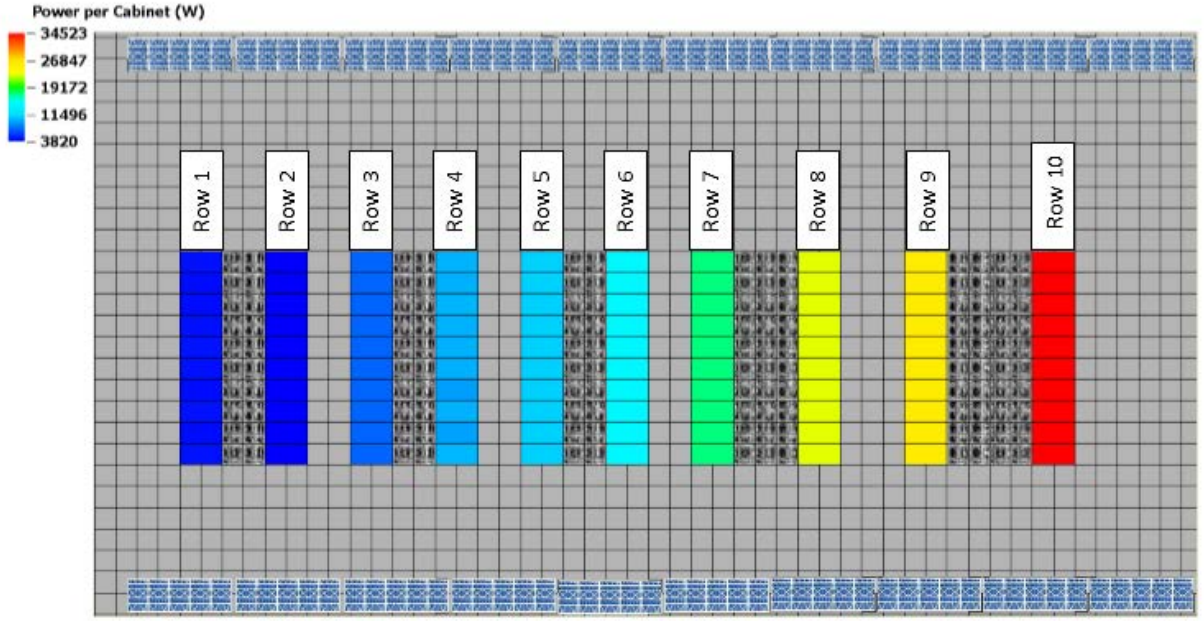
- Room Size 5,700 sq ft.
- 100 IT Equipment Cabinets
- 10 Cabinets 10 Rows
- Cabinet Density 3.8kW to 34.5kW
- 1,500 kW of IT load
- Room Height: 14.0 ft. from top of raised floor to bottom of the lay in ceiling.
- Raised floor plenum height: 4.0 ft.
- Lay-in Ceiling Plenum Height: 3.0 ft.
- Supply Air Temperature Control



Study Overview-Room Layout

Row #	Input Power Strip Plug	Volts	Amps	Phase	Power strip Capacity (kW)	Actual Row Power (kW)
1	L6-30P	208	30	1	5.0	43.3
2	L21-20P	208	20	3	5.8	38.2
3	L21-30P	208	30	3	8.6	72.1
4	IEC	208	60	1	10.0	91.0
5	L22-20P	400	20	3	11.1	108.2
6	CS6365C	208	50	3	14.4	143.4
7	IEC	208	60	3	17.7	172.8
8	IEC	208	80	3	23.0	225.7
9	IEC	208	100	3	28.8	258.0
10	HARDWAIRED	208	120	3	34.5	345.2
					Total Room IT Electrical Load	1497.9



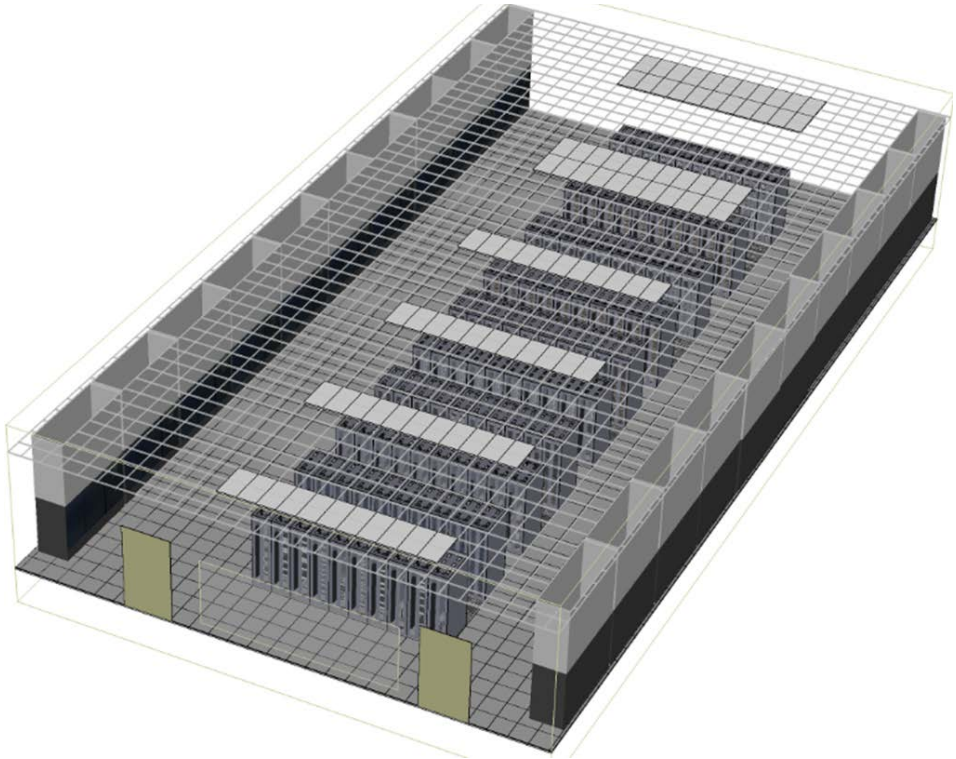


Analysis Case 1

Baseline with Supply Air Temperature at 55°F

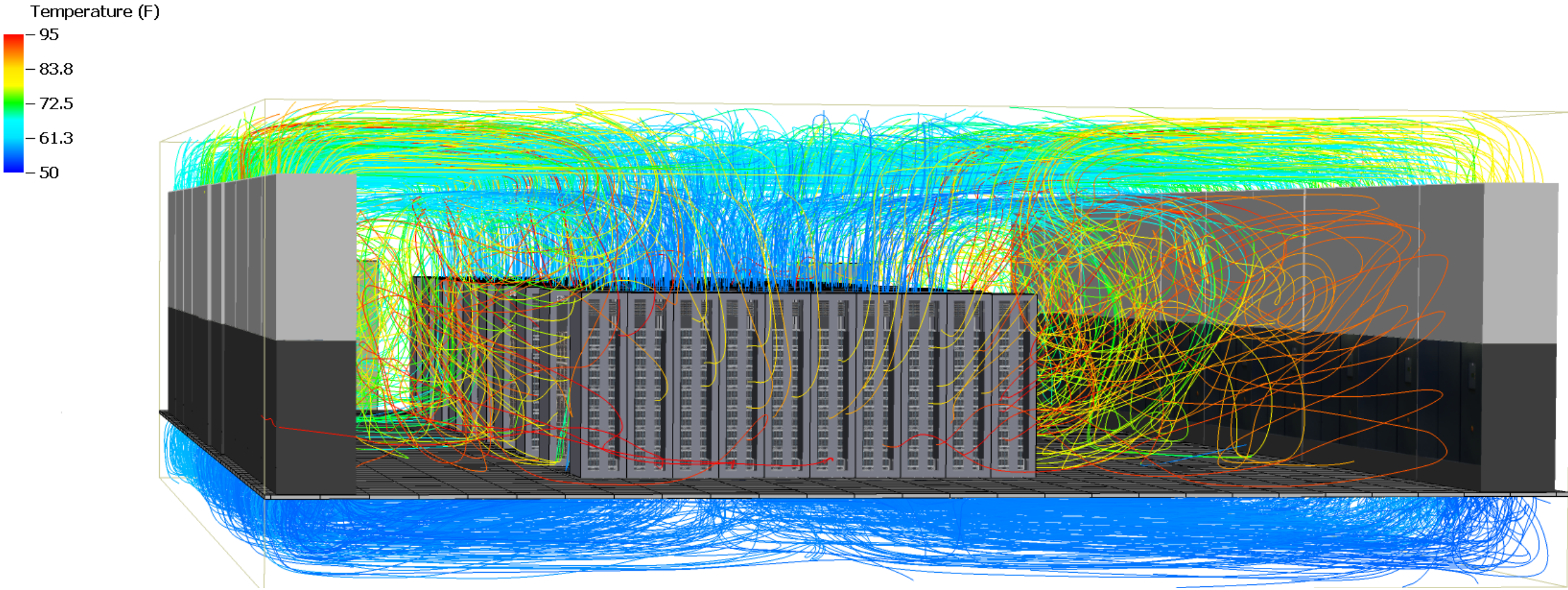
Baseline with Supply Air Temperature at 55°F Conditions Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	360000	238%	55.0	115.0	32%

- Study includes (20) 18,000 CFM air handlers
- Cabinets are raised above the floor 1.9” to simulate castors and leveling legs
- The IT equipment mounting rails do not have sealing kits around the perimeter.



Analysis Case 1

Baseline with Supply Air Temperature at 55°F

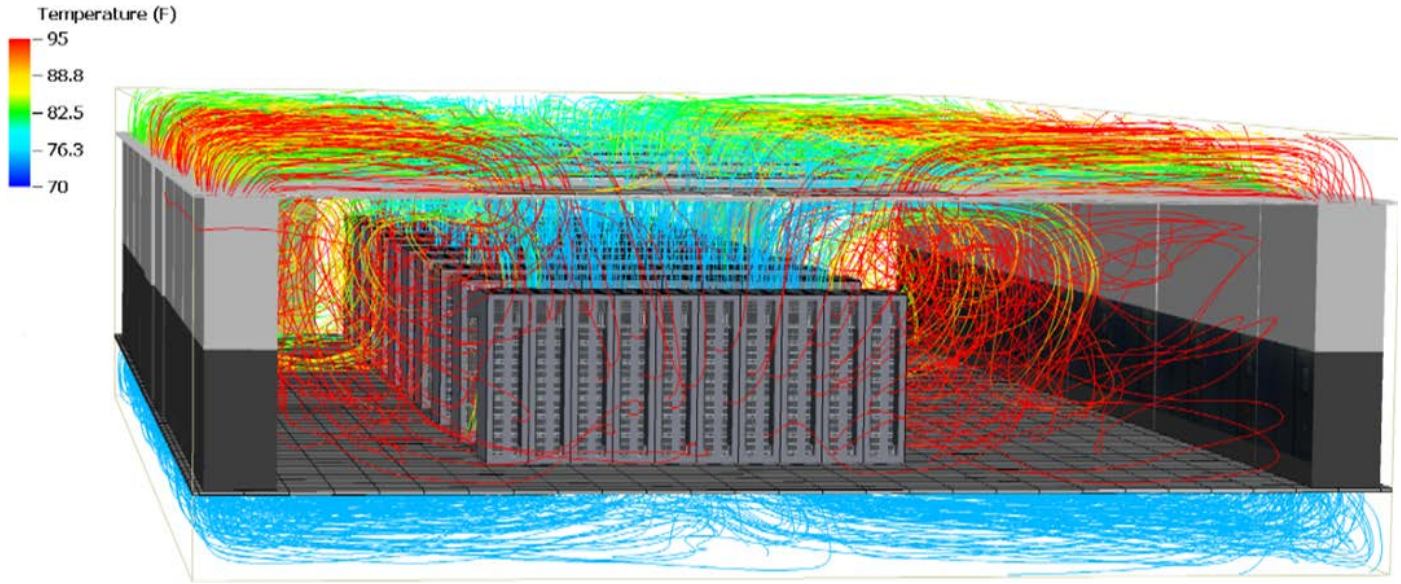


Analysis Case 2

Baseline with Supply Air Temperature at 75°F

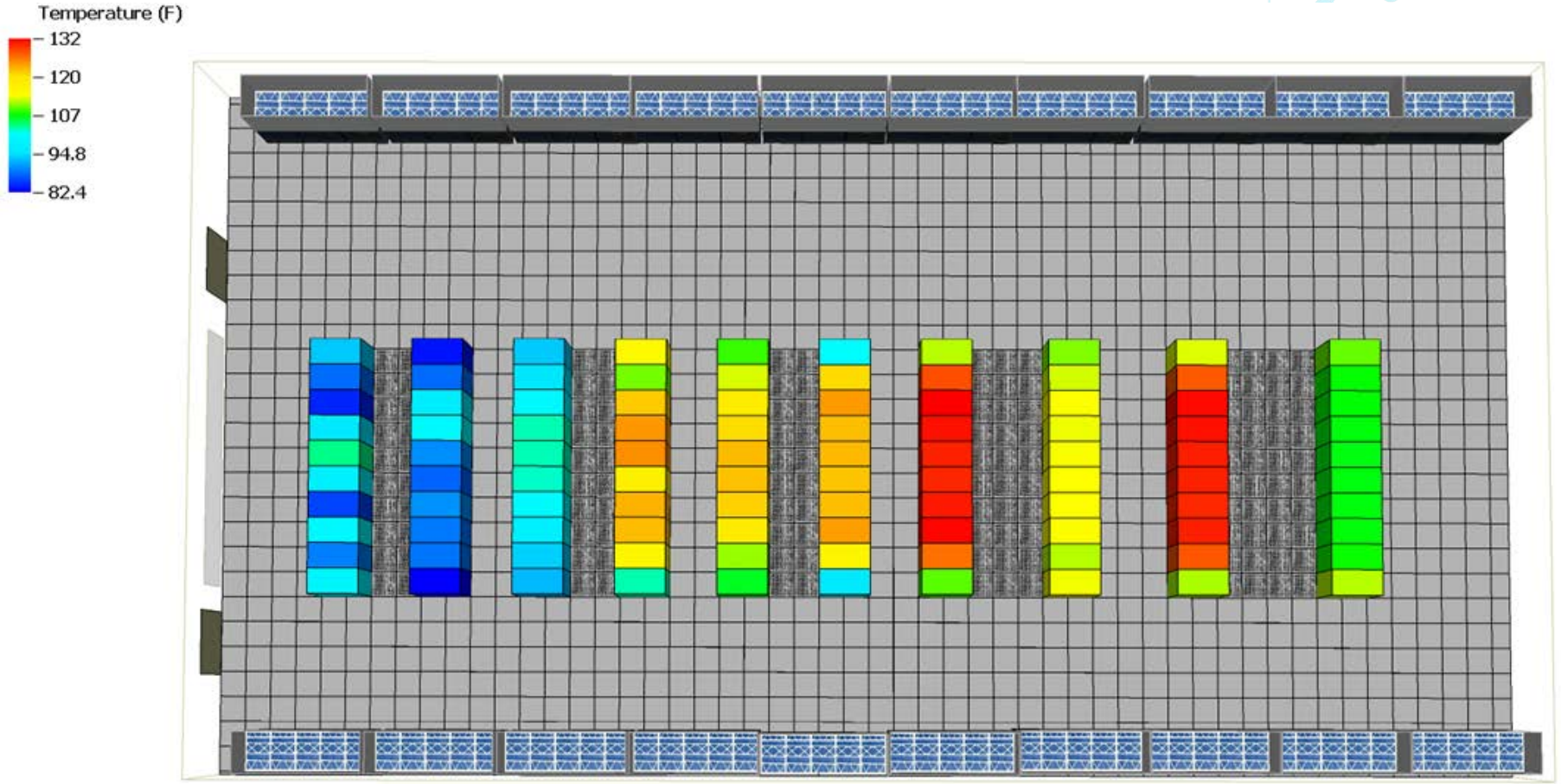
Baseline with Supply Air Temperature at 75°F Conditions Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	360000	238%	75.0	132.0	0%

- Study includes (20) 18,000 CFM air handlers
- Cabinets are raised above the floor 1.9” to simulate castors and leveling legs
- The IT equipment mounting rails do not have sealing kits around the perimeter.



Analysis Case 2

Baseline with Supply Air Temperature at 75°F

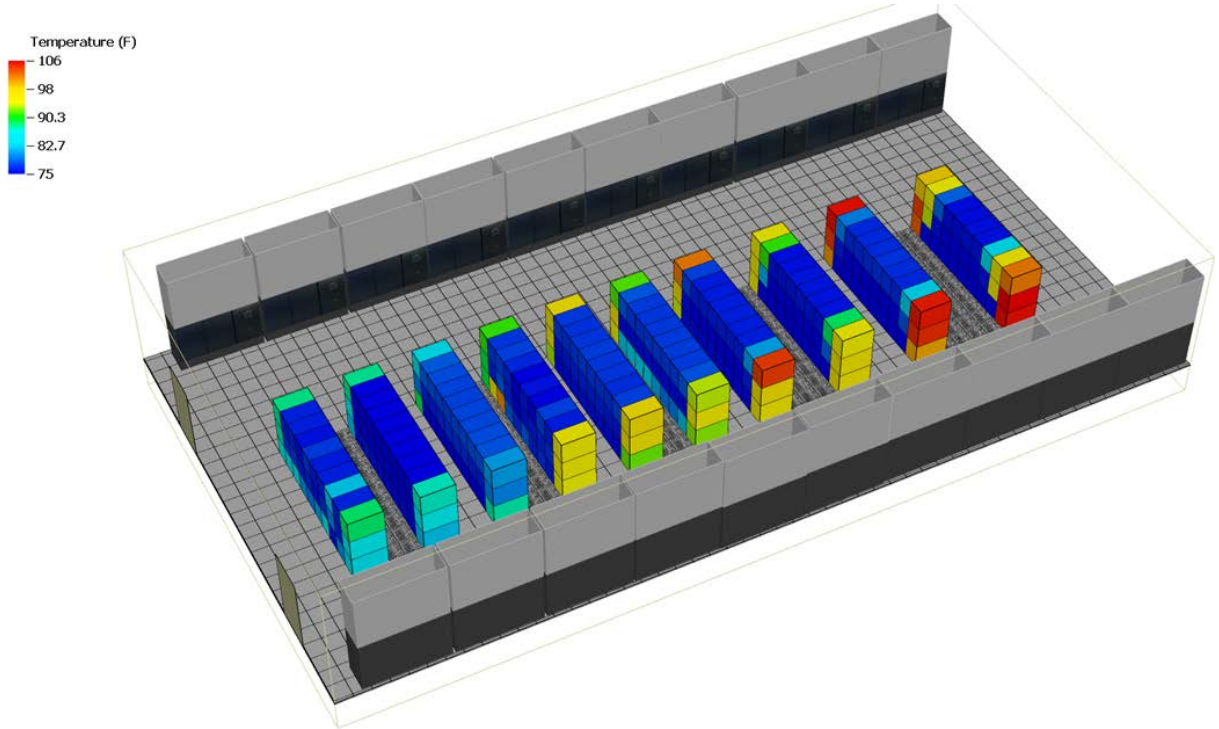


Analysis Case 3

Baseline with Rail Sealing Kits and Supply Air Temperature at 75°F

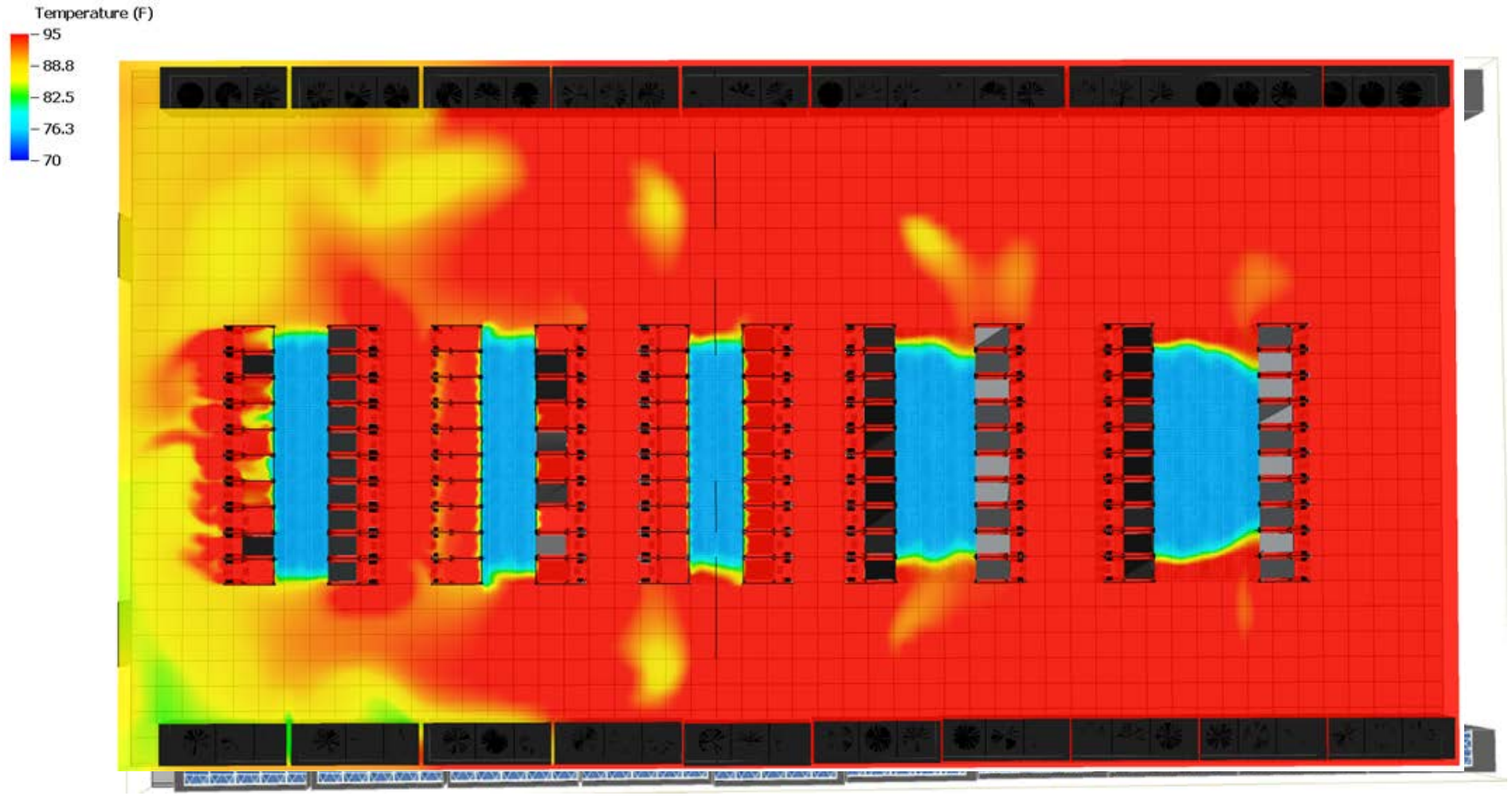
Baseline with Rail Sealing Kits and Supply Air Temperature at 75°F Conditions Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	360000	238%	75.0	106.0	25%

- Study includes (20) 18,000 CFM air handlers
- Air blocks installed around mounting rails with a simulated leakage rate of 3%.
- Space under IT cabinet blocked.



Analysis Case 3

Baseline with Rail Sealing Kits and Supply Air Temperature at 75°F



Plan View Temperature Plot at 6’ Above Raised Floor.

Analysis Case 4

Hot Aisle End of Row Doors

Hot Aisle End of Row Doors Condition Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	360000	238%	75.0	95.2	31%

- Study includes (20) 18,000 CFM air handlers
- End of Row Doors on Hot Aisles
- Air blocks installed around mounting rails with a simulated leakage rate of 3%.
- Space under IT cabinet blocked.