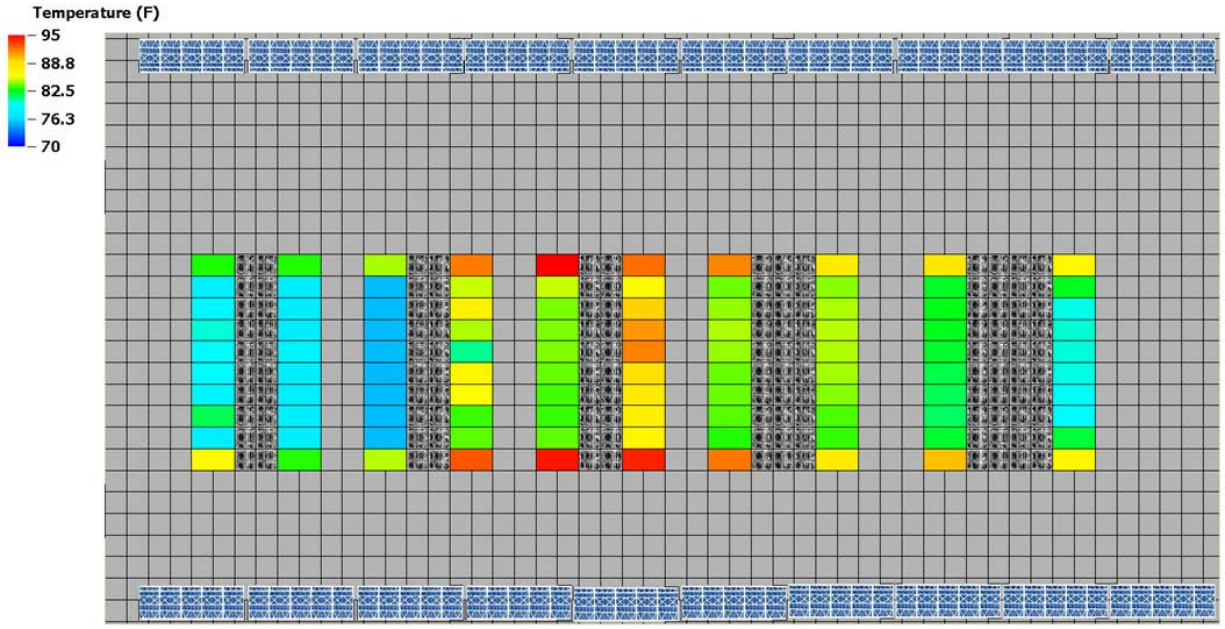
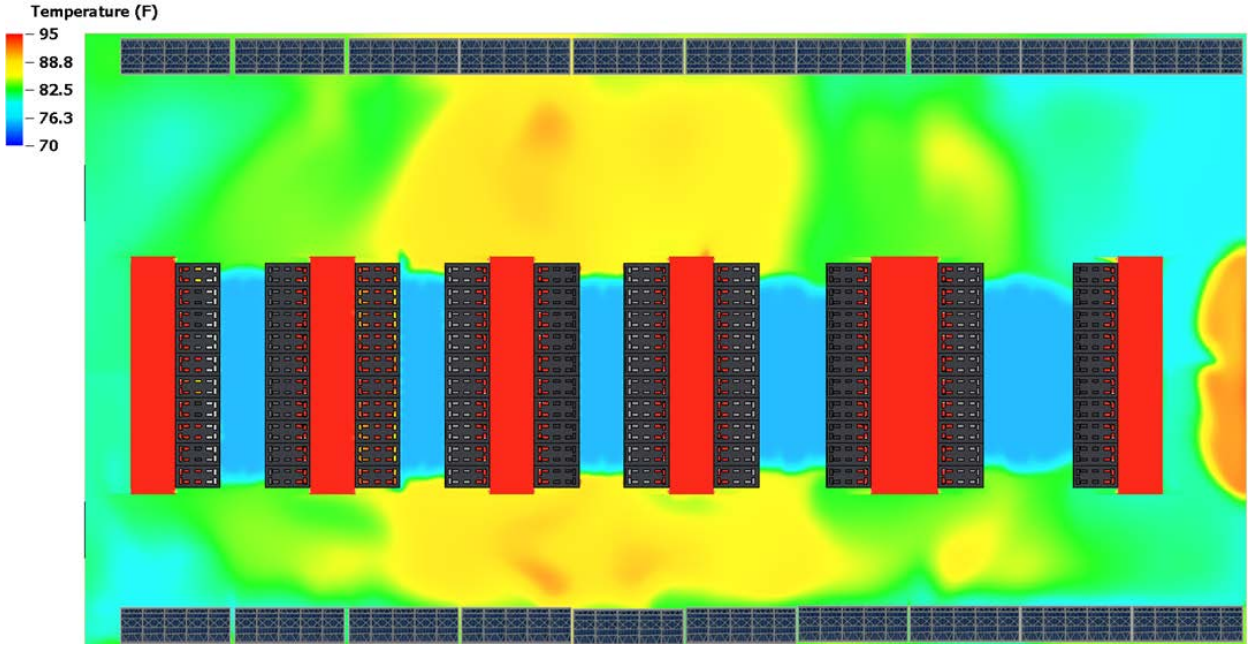
Analysis Case 4

Hot Aisle End of Row Doors



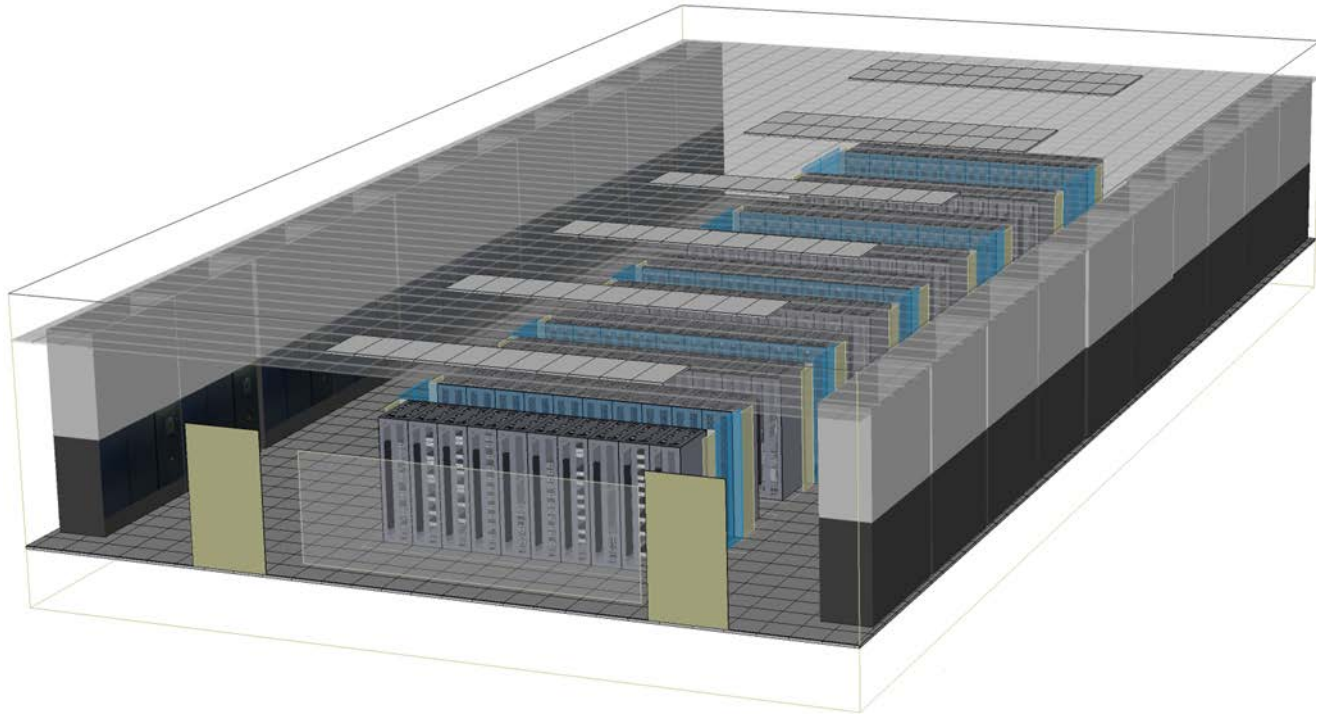


Analysis Case 5

Cold Aisle End of Row Doors

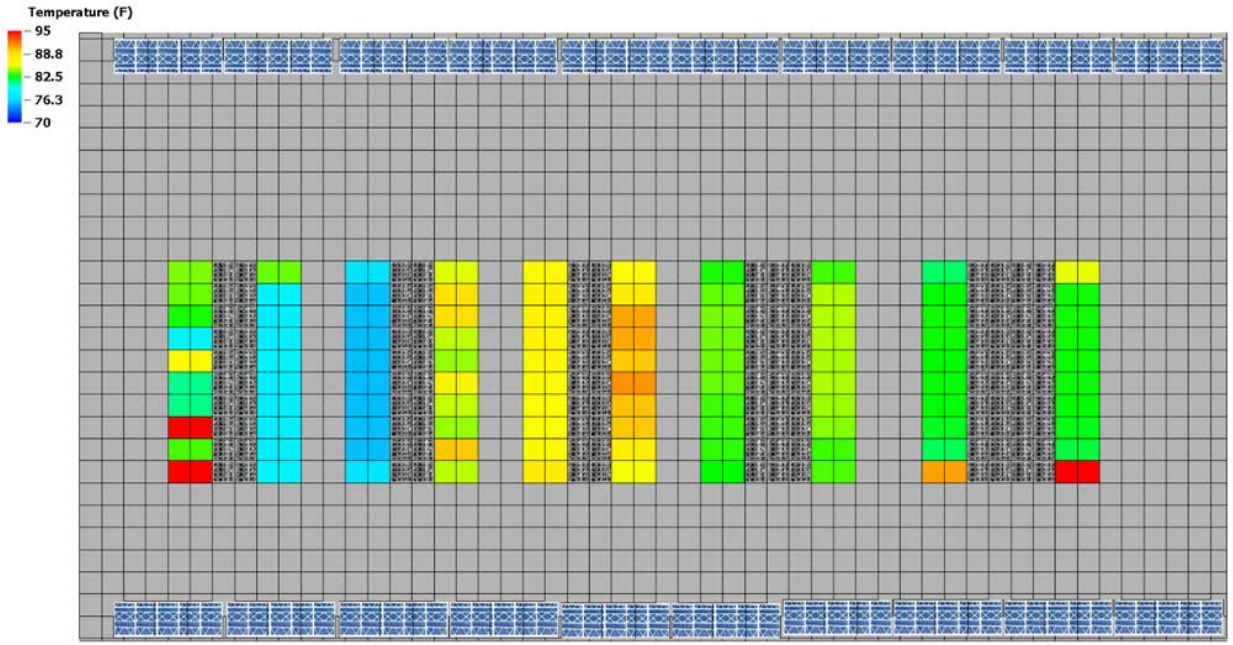
Cold Aisle End of Row Doors Condition Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	360000	238%	75.0	102.0	20%

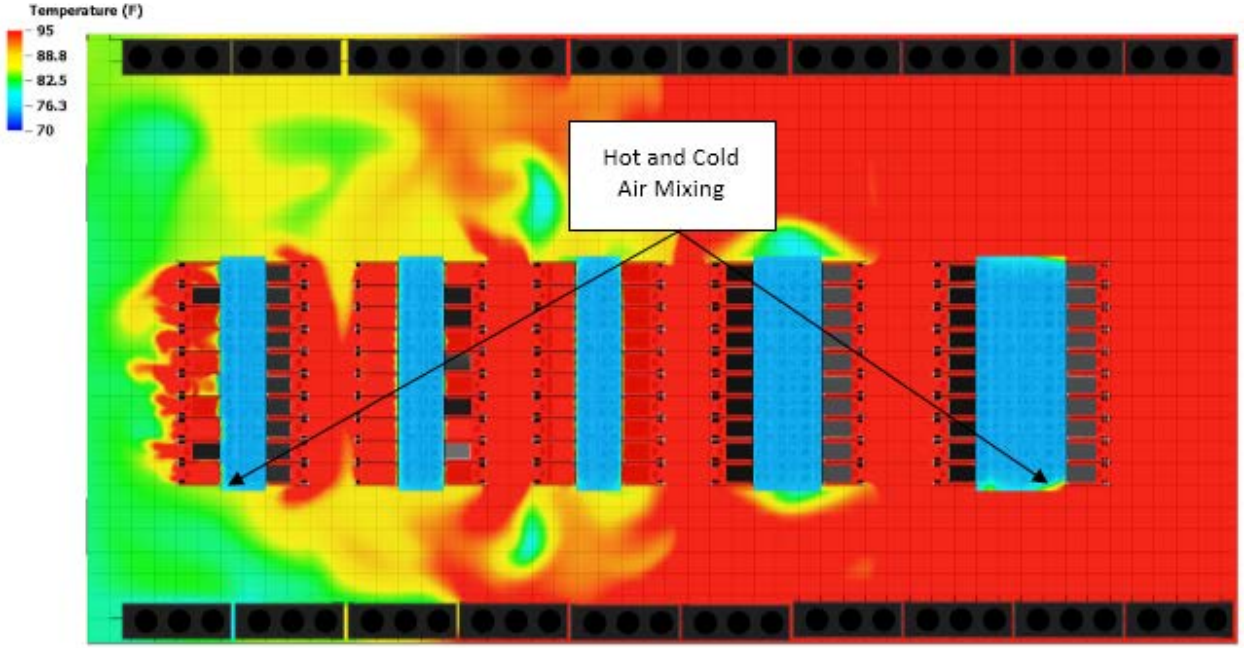
- Study includes (20) 18,000 CFM air handlers
- End of Row Doors on Cold Aisles
- Air blocks installed around mounting rails with a simulated leakage rate of 3%.
- Space under IT cabinet blocked.



Analysis Case 5

Cold Aisle End of Row Doors



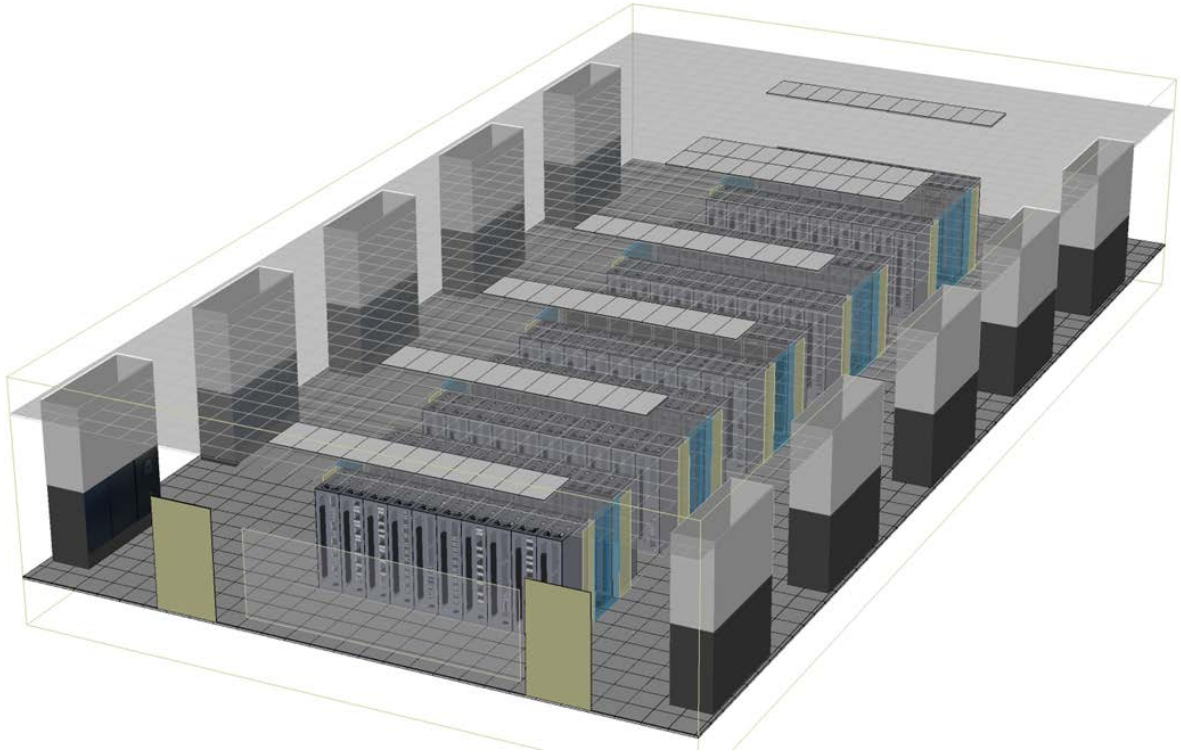


Analysis Case 6

Cold Aisle Containment (CAC)

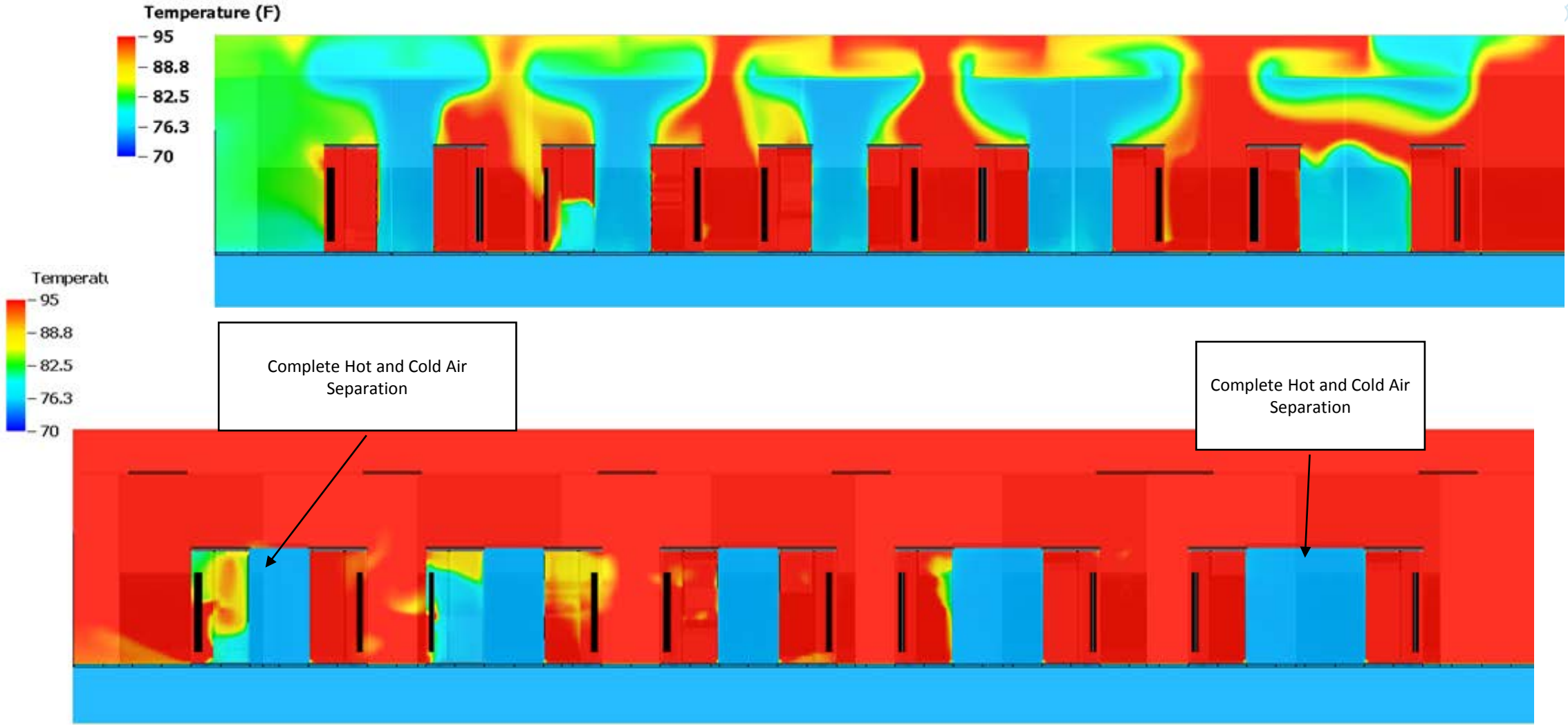
Cold Aisle Containment Conditions Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	180000	19%	75.0	80.9	93%

- (10) 18,000 CFM air handlers
- 93% of Cabinets within ASHRAE 2011 Class A1
- Contained Cold Aisles



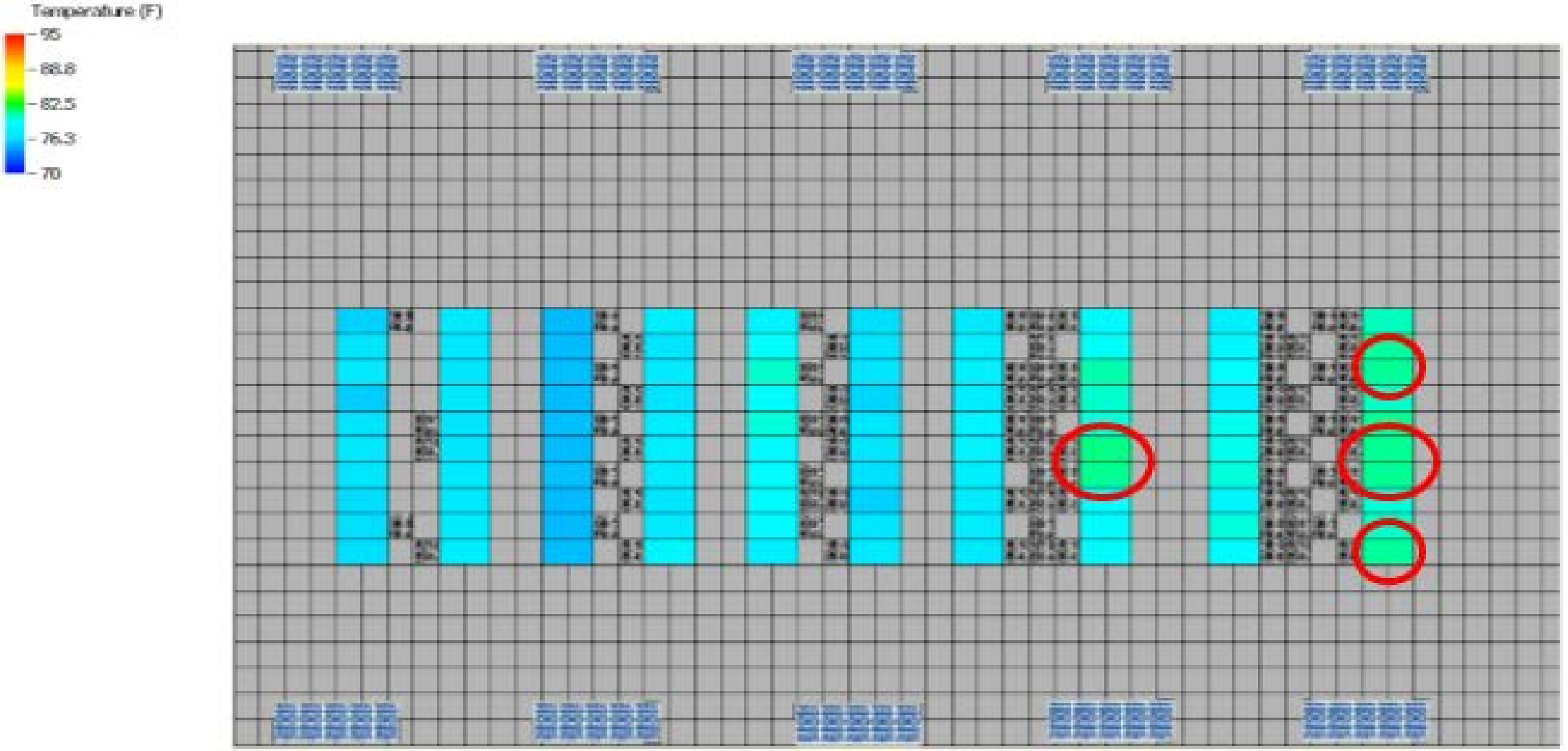
Analysis Case 6

Cold Aisle Containment (CAC)



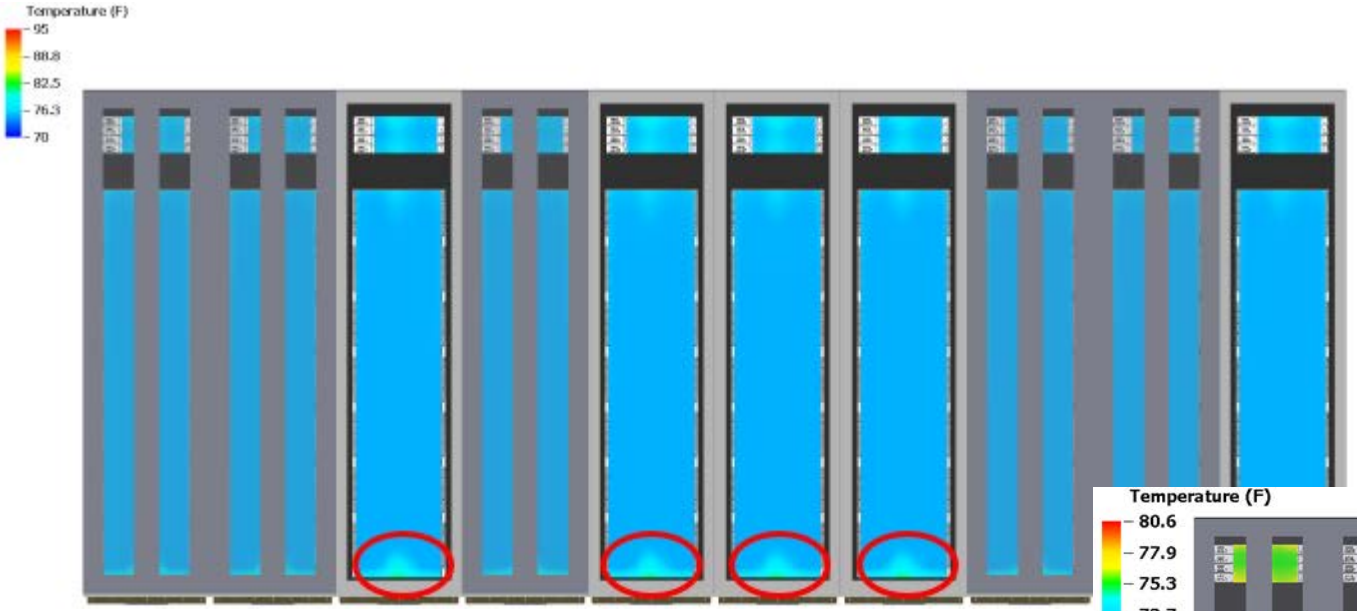
Analysis Case 6

Cold Aisle Containment (CAC)

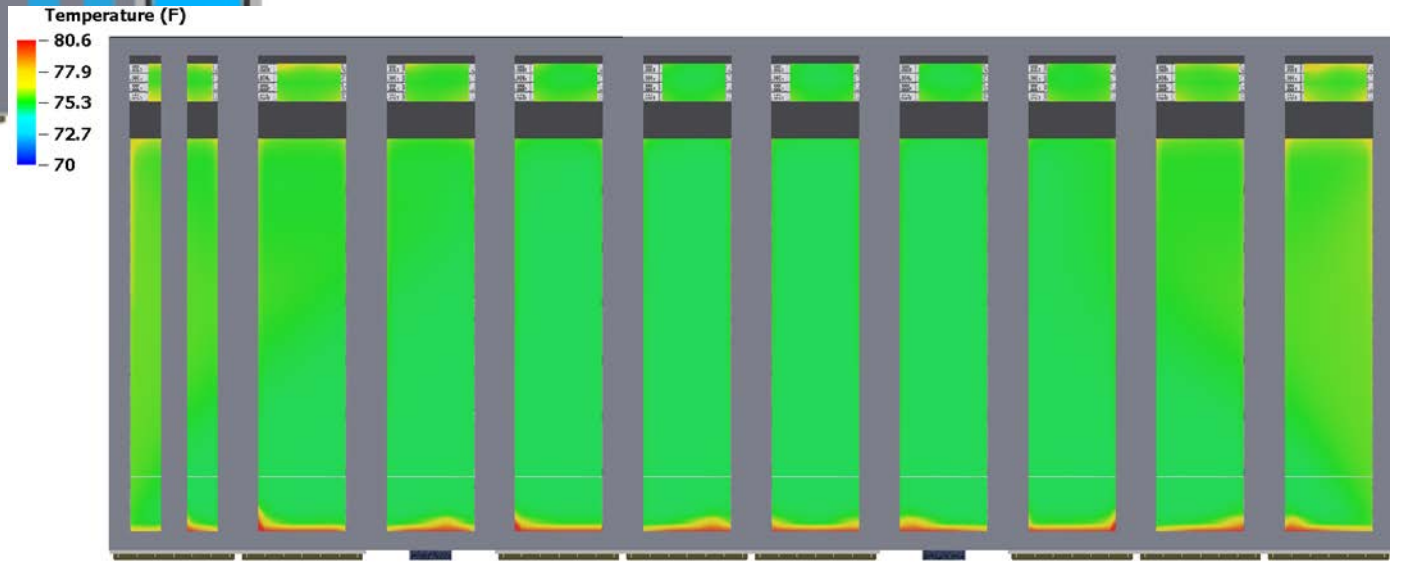


Analysis Case 6

Cold Aisle Containment (CAC)



Elevation View of Row 10 Cabinets.



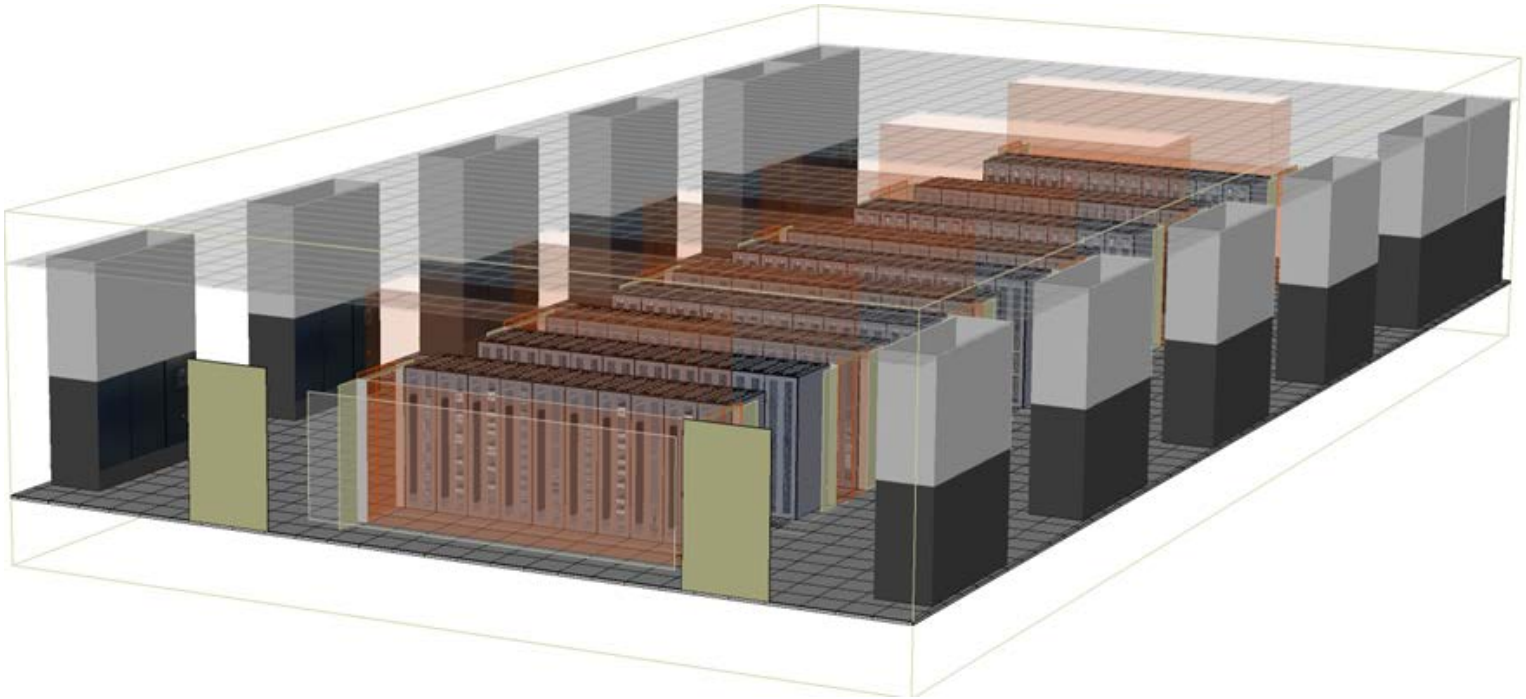
Cabinet Elevation with Full Perforated Door.

Analysis Case 7

Hot Aisle Containment (HAC)

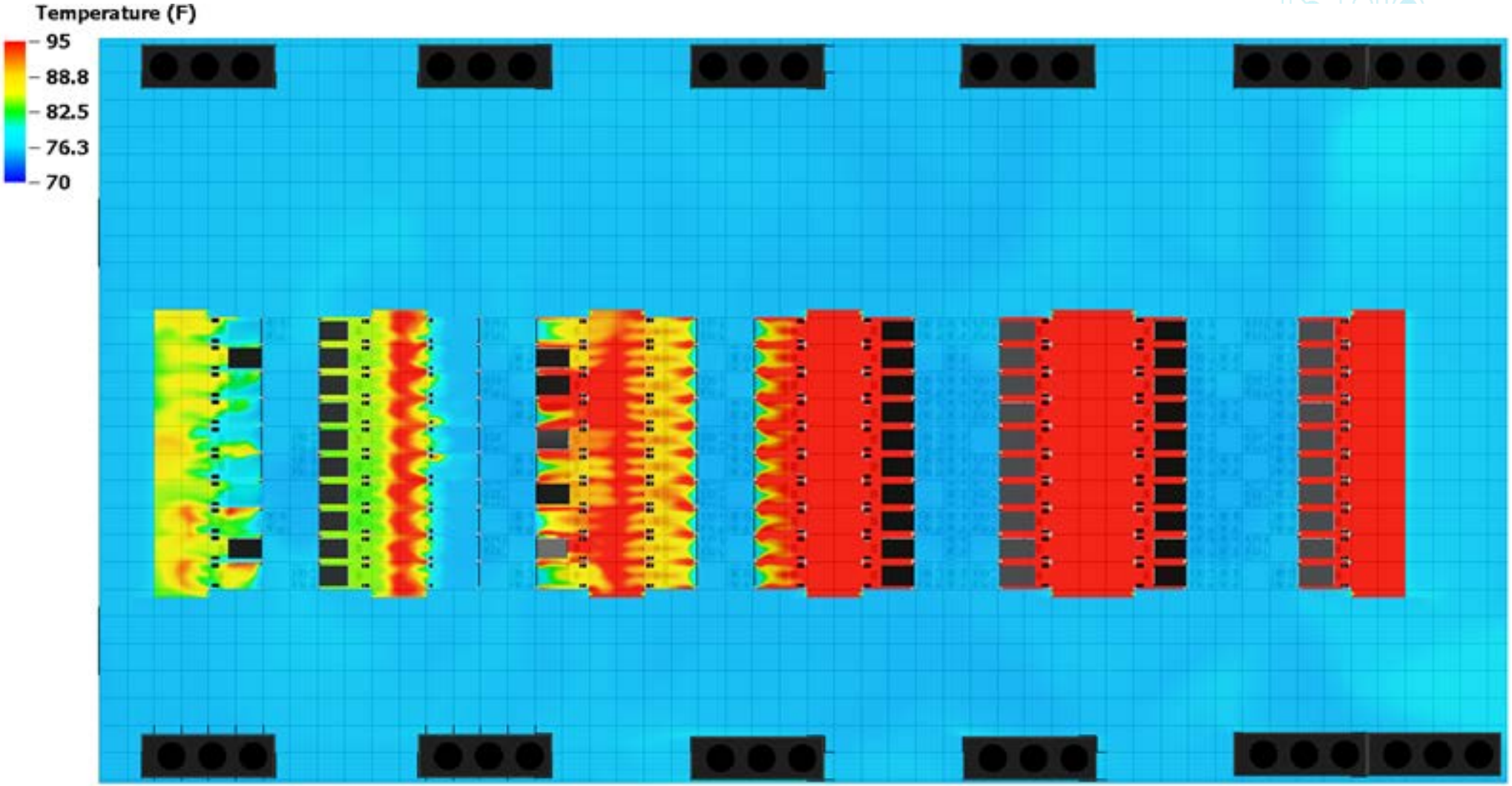
Hot Aisle Containment Conditions Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	216000	43%	75.0	81.7	84%

- (12) 18,000 CFM air handlers
- 93% of Cabinets within ASHRAE 2011 Class A1
- Contained Cold Aisles



Analysis Case 7

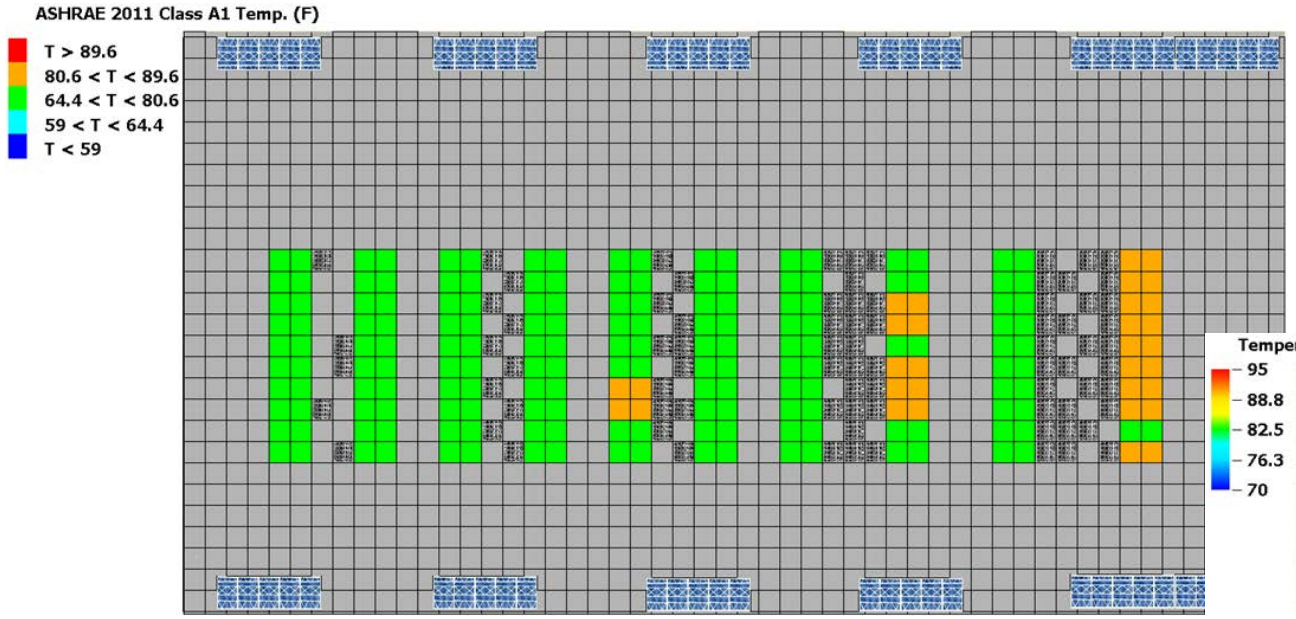
Hot Aisle Containment (HAC)

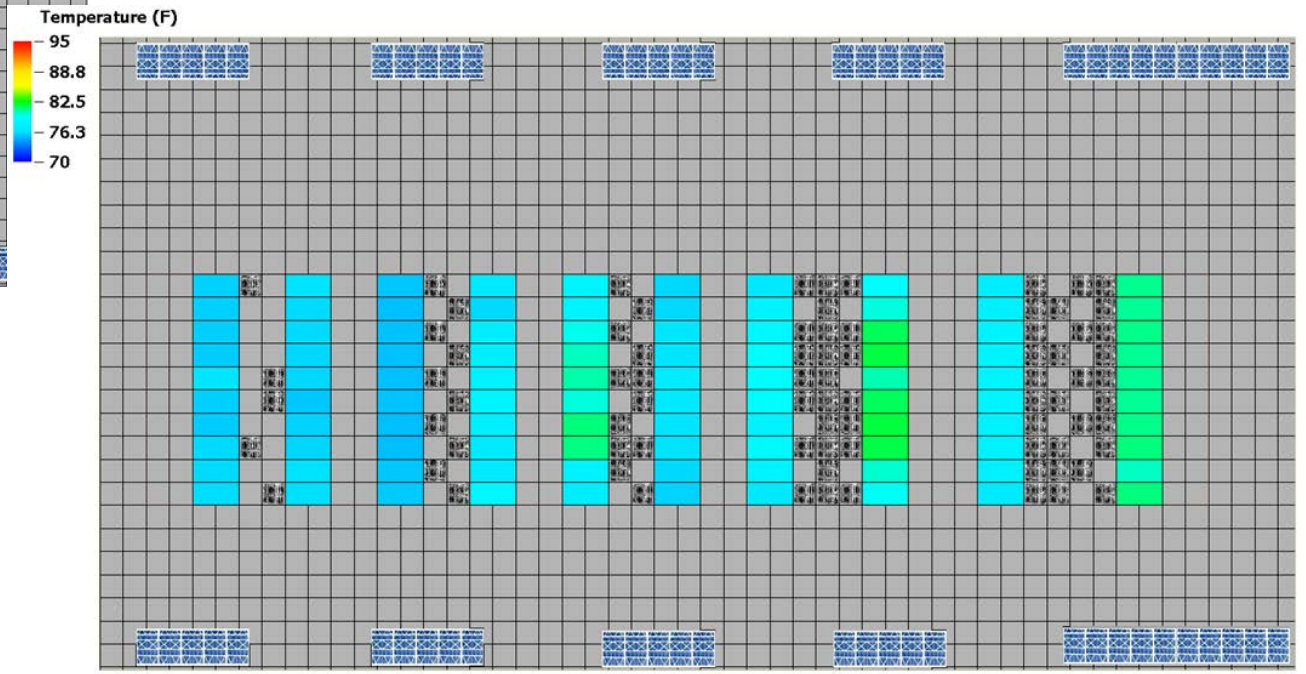


Temperature Plot at 6’ Above Raised Floor.

Analysis Case 7

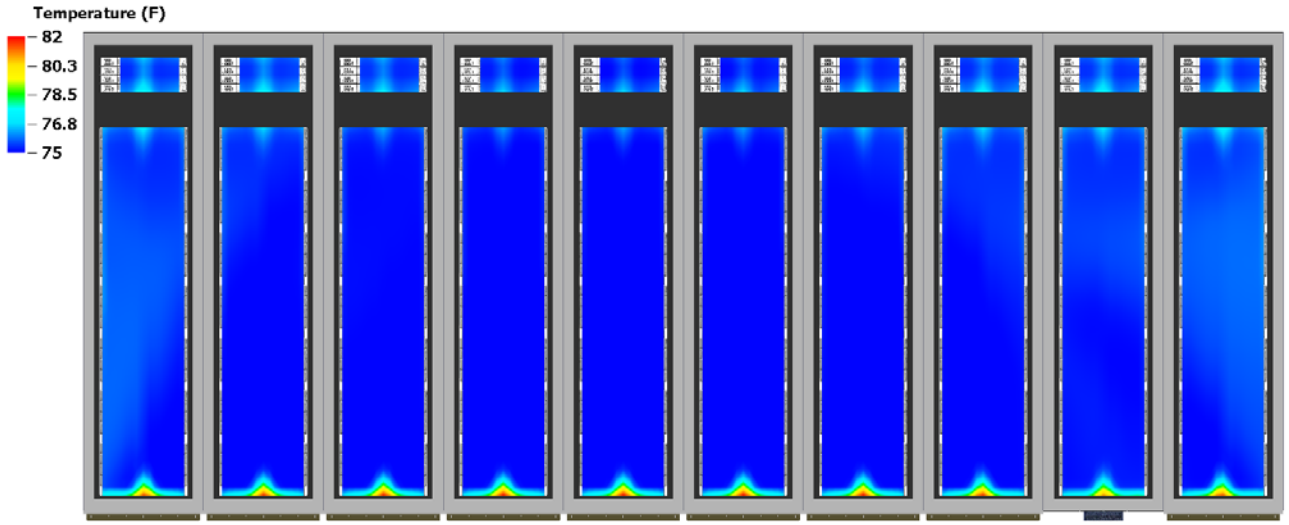
Hot Aisle Containment (HAC)

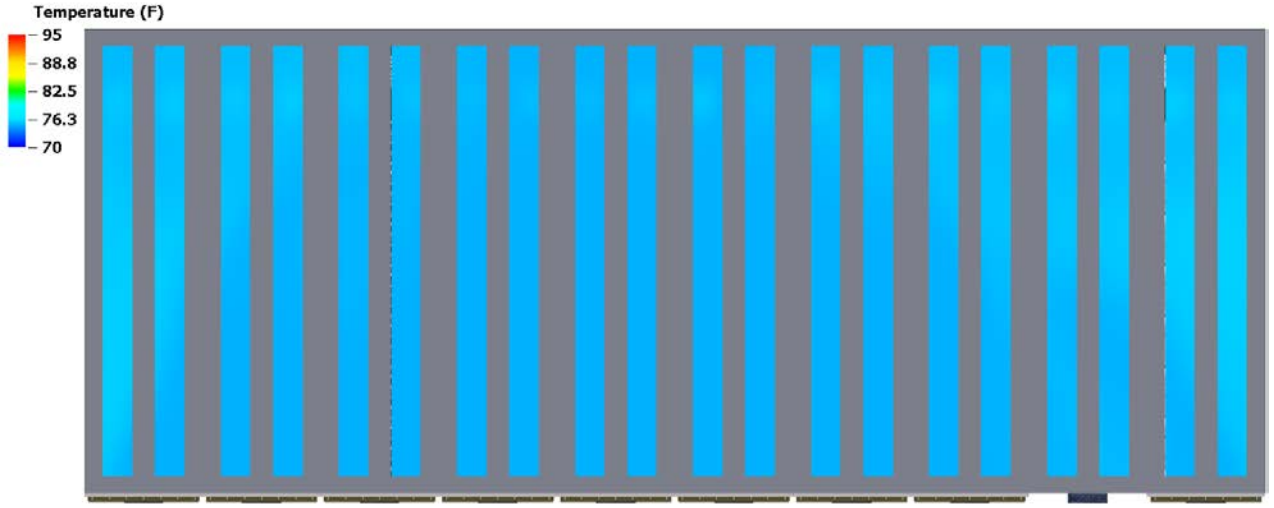




Analysis Case 7

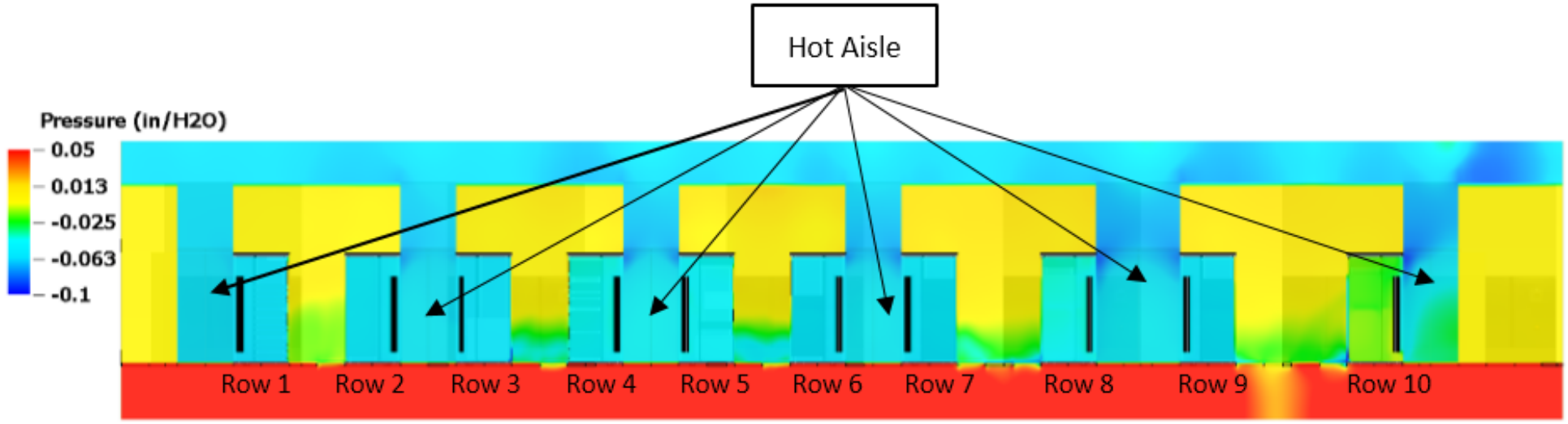
Hot Aisle Containment (HAC)

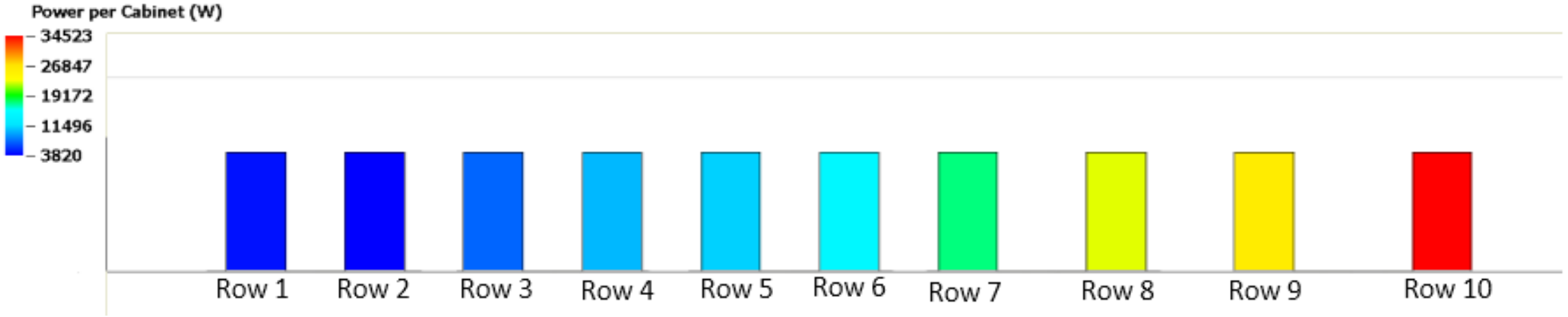




Analysis Case 7

Hot Aisle Containment (HAC)



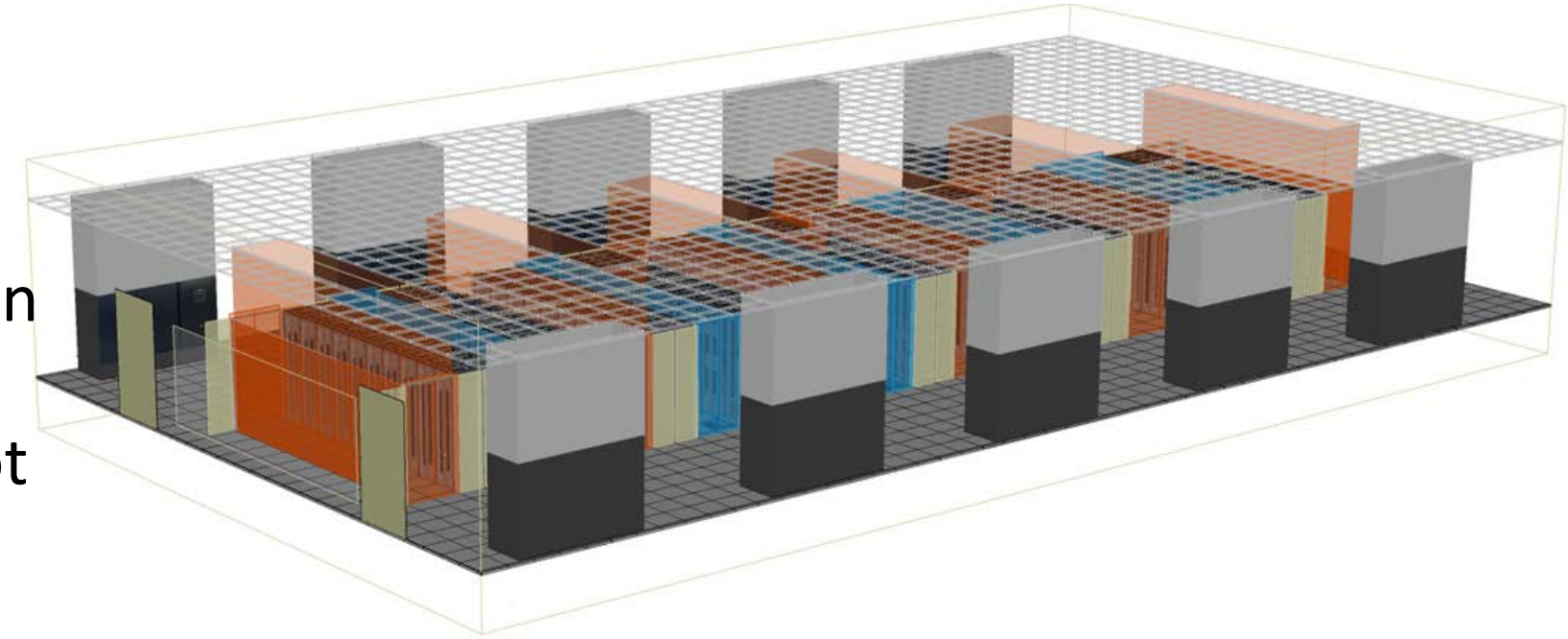


Analysis Case 8

Hot and Cold Aisle Containment (HAC and CAC)

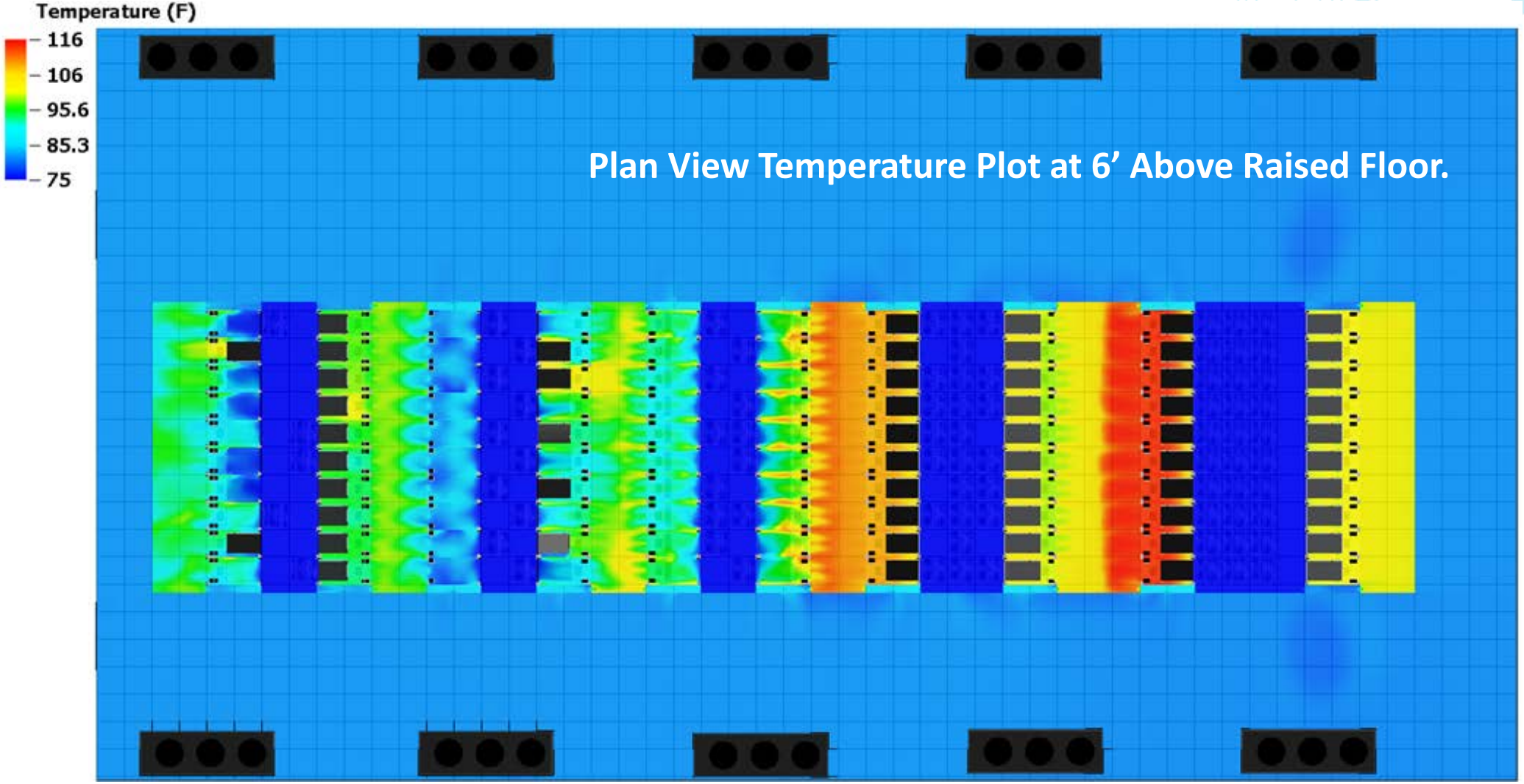
Cold and Hot Aisle Containment Conditions Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	180000	19%	75.0	80.1	100%

- (10) 18,000 CFM air handlers
- 100% of Cabinets within ASHRAE 2011 Class A1
- Contained Cold and Hot Aisles



Analysis Case 8

Hot and Cold Aisle Containment (HAC and CAC)

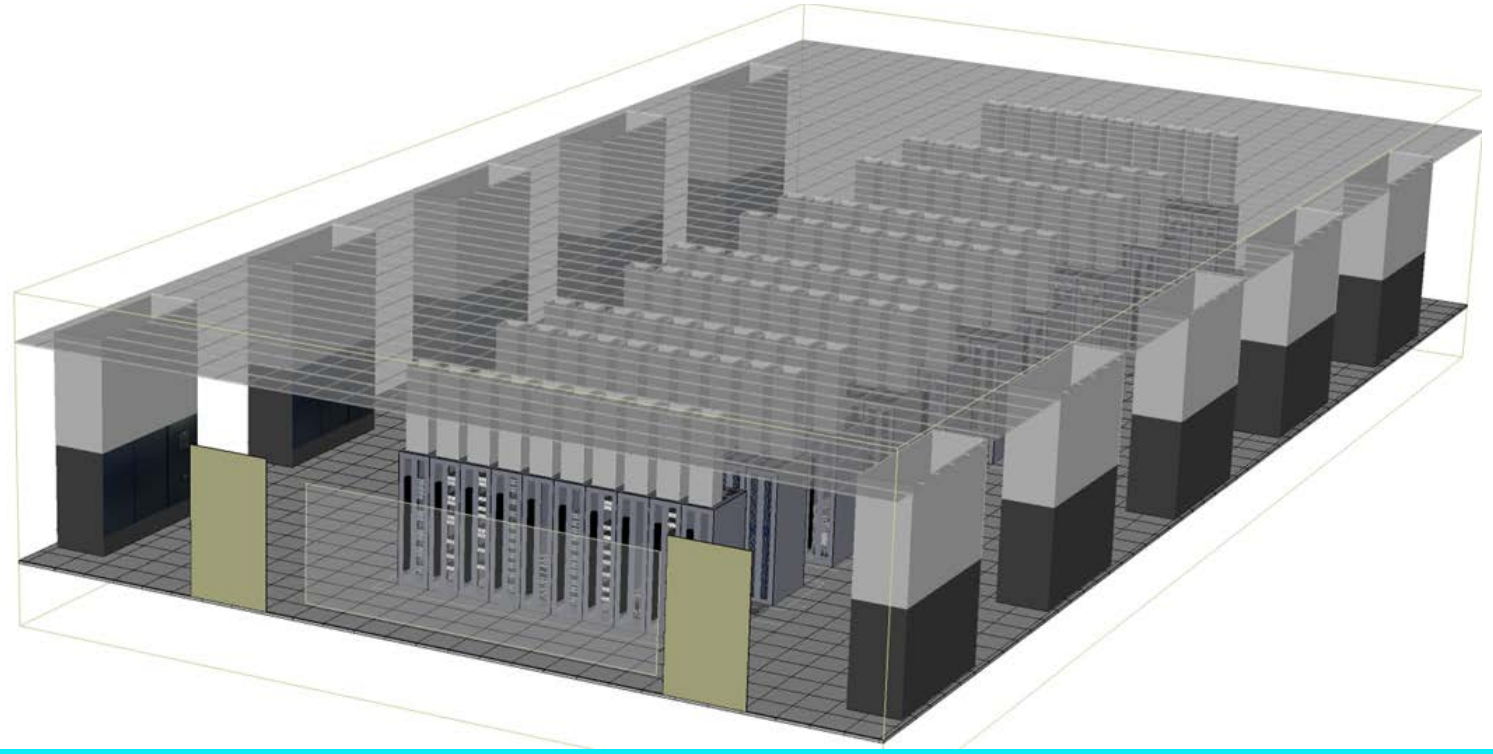


Analysis Case 9

Cabinet Chimney Containment

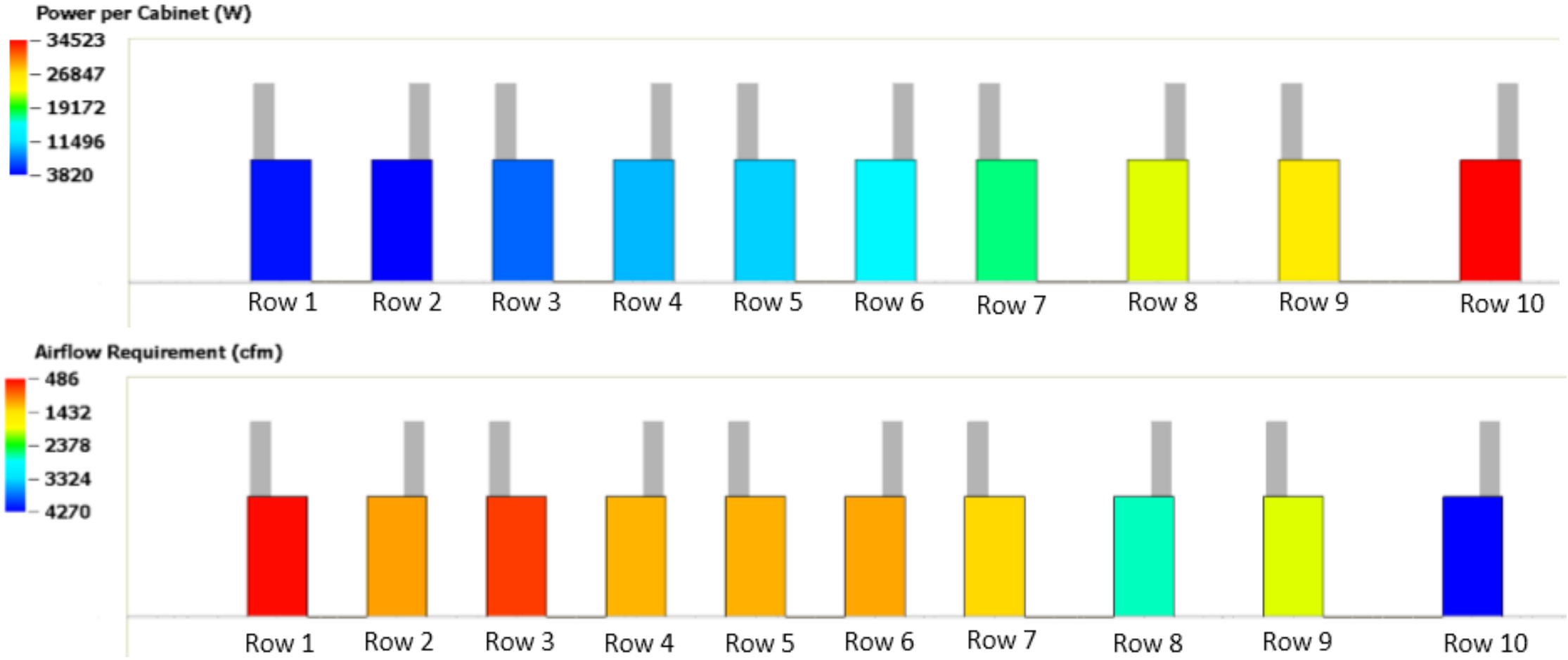
Cabinet Chimney Containment Conditions Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	180000	19%	75.0	104.0	48%

- The IMS AMCO chimney is 16.7” X 15.8” (W X L) and is centered in the rear of the cabinet



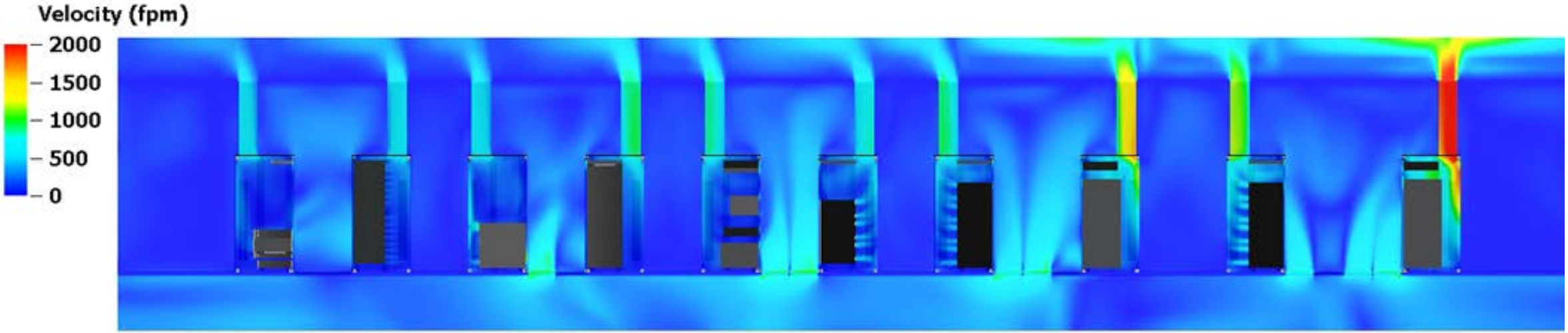
Analysis Case 9

Cabinet Chimney Containment

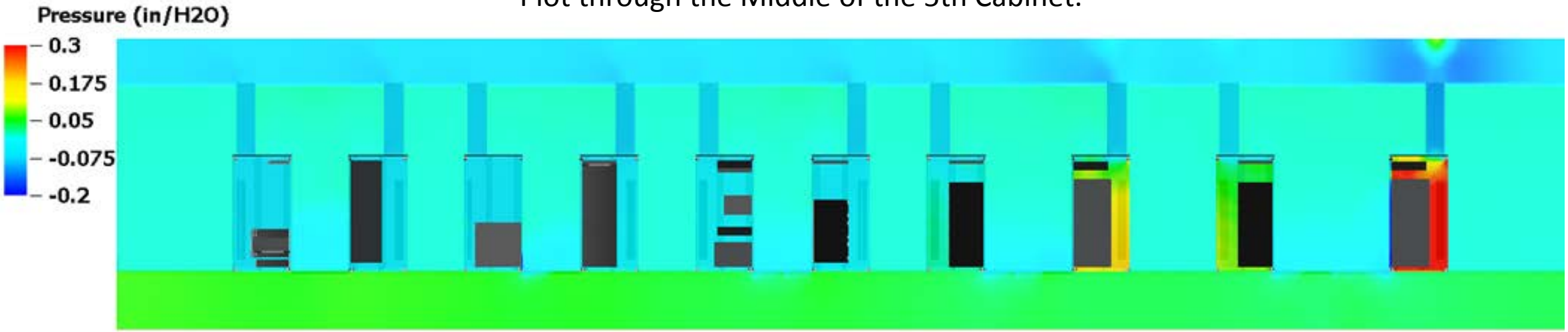


Analysis Case 9

Cabinet Chimney Containment



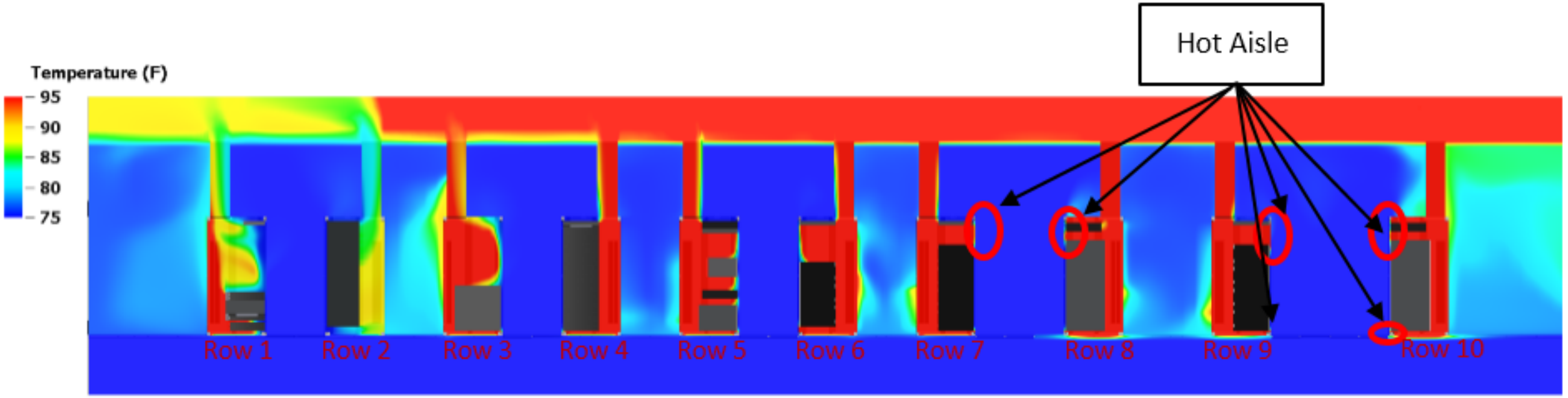
Plot through the Middle of the 5th Cabinet.



Analysis Case 9

Cabinet Chimney Containment

IMS AMCO Cabinet chimney solution begins to fail at 1380 CFM (17.28kW @ 80 CFM/kW) per cabinet.



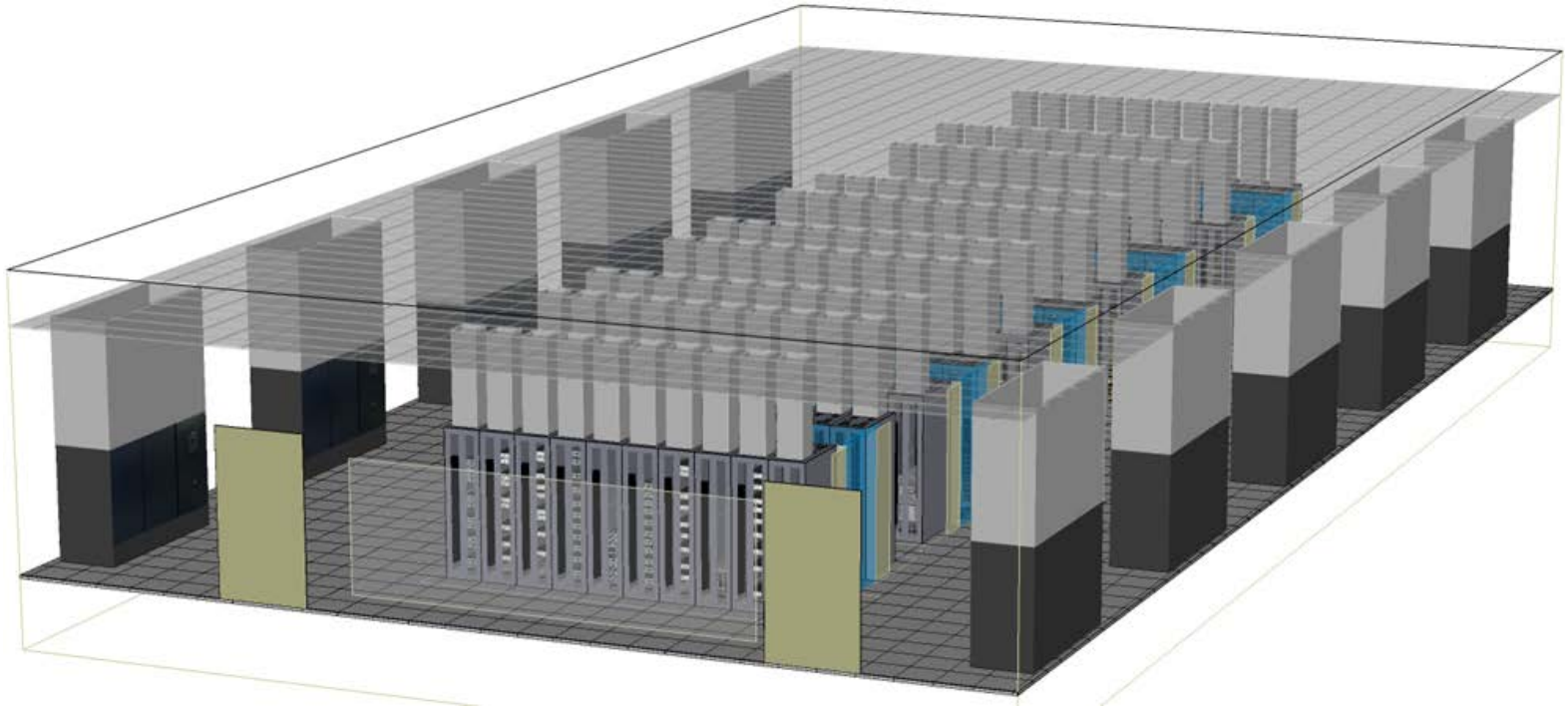
Temperature plot through the cabinet center of the 5th cabinet

Analysis Case 10

Cabinet Chimney Containment and Cold Aisle Containment

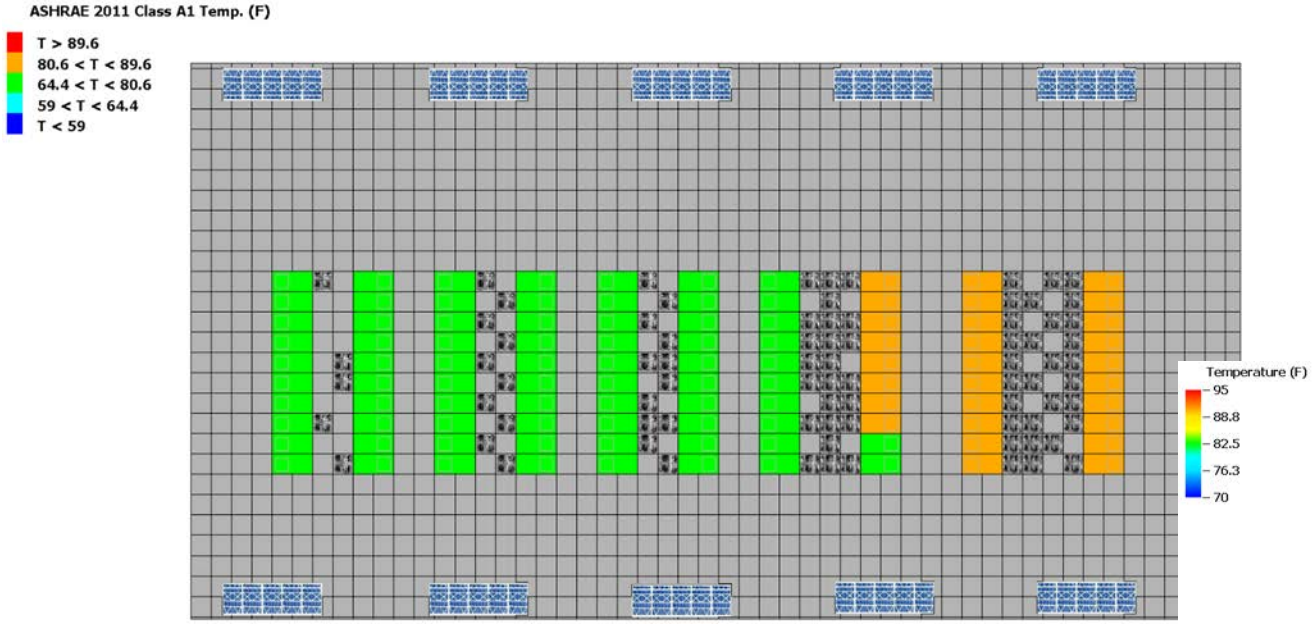
Cabinet Chimney Containment with Cold Aisle Containment Conditions Summary					
IT Equipment Airflow (CFM)	Air Handler Supplied Airflow (CFM)	Airflow Oversupply	Supply Air Temperature (°F)	Maximum Inlet Temperature (°F)	Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition
151273.2	180000	19%	75.0	87.1	72%

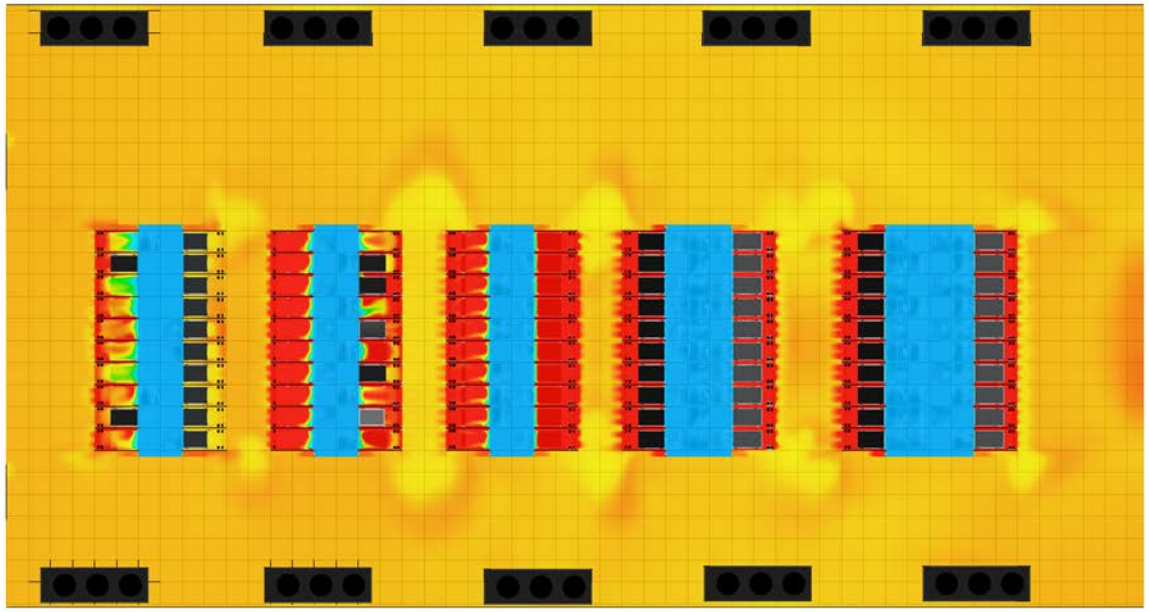
72% of the cabinets are within the ASHRAE 2011 class A1 recommended temperature range



Analysis Case 10

Cabinet Chimney Containment and Cold Aisle Containment





Conclusion

- A 75°F supply air temperature and an airflow oversupply of 238% exhibited a maximum IT equipment inlet temperature of 132°F
- End of row doors and cabinet airflow management improved the IT equipment inlet temperatures by 30°F over the baseline with 75°F supply air.
- Cold Aisle Containment (CAC)
  - 90% of the cabinets to be within the ASHRAE recommended class A1 temperature range
  - Airflow oversupply of 19%.
  - Maximum inlet temperature was 80.9°F
- Hot Aisle Containment (HAC)
  - 84% of the cabinets to be within the ASHRAE recommended class A1 temperature range
  - Airflow oversupply of 43%.
  - Maximum inlet temperature was 81.7°F
- Combining Cold and Hot Aisle Containment allowed all the cabinets to meet the ASHRAE recommended class A1 temperature range with a 19% oversupply.
- Cabinet Chimney Containment
  - 48% of the cabinets to be within the ASHRAE recommended class A1 temperature range
  - Airflow oversupply of 19%
  - For cabinets with IT equipment airflow below 1380 CFM (17.kW @ 80 CFM/kW), a passive chimney would be a viable containment solution.
- Cabinet Chimney Containment and Cold Aisle Containment
  - 72% of the cabinets are within the ASHRAE recommended class A1 temperature range
  - Airflow Oversupply 19%
  - Cabinets above 22kW produced local cabinet leakage.
  - Overall leakage impact was reduced through use of CAC

Summary Table

	Baseline 55F	Baseline 75F	Baseline 75F with Side Air Blocks	Cold Aisle End of Row Doors	Hot aisle En of Row Doo	Cold Aisle Containment	Hot Aisle ntainme	Cold and Hot Aisle Containment	abinet himeny tainment	Cabinet Chimney Containment with Cold Aisle Containment
IT Equipment Airflow	151273.2	151273.2	151273.2	151273.2	151273.2	151273.2	151273.2	151273.2	51273.2	151273.2
Air Handler supplied airflow (CFM)	360000	360000	360000	360000	360000	180000	216000	180000	80000	180000
Oversupply based on equipment specs	238%	238%	238%	238%	238%	19%	43%	19%	19%	19%
Supply Air Temperature (F)	55	75	75	75	75	75	75	75	75	75
Maximum Inlet Temperature	115.0	132.0	106.0	102.0	95.2	80.9	81.7	80.1	104.0	87.1
Percentage of Cabinets Meeting ASHRAE 2011 Class A1 Recommended Inlet Temperature Condition	32%	0%	25%	20%	31%	93%	84%	100%	48%	72%
Motor HP Calculation: HP=CFM *.0015										
Total Air Handler Motor Horsepower (HP)	540	540	540	540	540	270	324	270	270	270
Total Air Handler Motor Electrical Load (kW)	402.7	402.7	402.7	402.7	402.7	201.3	241.6	201.3	201.3	201.3
Annual Air Handler Motor Energy (kWh)	3529472.7	3529472.7	3529472.7	3529472.7	3529472.7	1764736.3	2117683.6	1764736.3	64736.3	1764736.3
Cost/ kWh	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
Total Annual Fan Energy Cost	$352,947	$352,947	$352,947	$352,947	$352,947	$176,474	$211,768	$176,474	176,474	$176,474

In the table above the fan horsepower is calculated using ASHRAE 90.1 Table 6.5.3.1.1A Fan Power Limitation table under the Variable Volume Option 1: Fan System Motor Nameplate hp. The motor horsepower is calculated using the following equation

$HP = CFM_s \times 0.0015$

Where

CFM_s = the maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.

HP = the maximum combined motor nameplate horsepower.