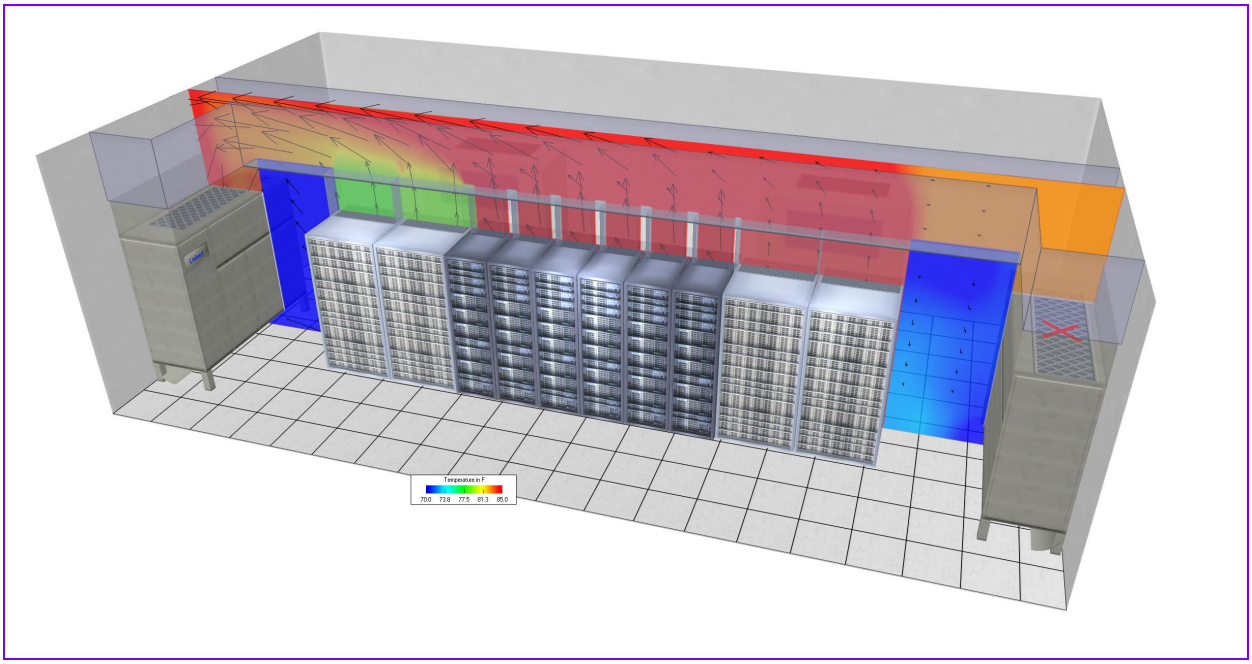
Computational Fluid Dynamics (CFD) Simulation - Extra Small Computer Room - Rectangle Version



This report contains the results and images from a CFD simulation. It shows the performance of the current cooling system in this representation of a generic extra small computer room for use within VA.

Data Center & Infrastructure Engineering
Solution Delivery, DevSecOps, OIT

Geometry and Objects

Data Center Dimensions

Item	Value
Floor Length	20.0 ft
Floor Width	39.5 ft
Tile Size	24.0 inch
UF Plenum Height	0.0 inch
Real Ceiling Height	12.0 ft

Object Count

Object	Count
Downflow CRACs	2
Server Racks	10
Hot Boxes	2
Vertical Partitions	6
Horizontal Partitions	1

Downflow CRACs by Style

Downflow CRAC Style	Total Units	Failed Units	Total Airflow (CFM)	Nominal Cooling (Ton)	Nominal Cooling (kW)
Liebert DS053AS/AD/DS/DD	2	1	8,000	15.1	53.2

Racks by Style

Rack Style	Total Racks	Turned Off	Total Heat Load (kW)	Total Airflow (CFM)
CPI TeraFrame 60 cm x 110 cm x 45 U (Ducted)	6	0	30.0	4,731
CPI TeraFrame NF8N with Chimney	4	0	11.2	1,766

Heat Load/Cooling Airflow

Total Heat Load and Airflow

Item	Value
Net Floor Area	742 sq ft
Heat Load Density	61.2 W/sq ft
Total Heat Load	45.5 kW
Total Airflow Demand	7,497 CFM
Total Airflow Supplied	8,000 CFM

Cooling Airflow Supplied

Source	Value
Downflow CRACs	8,000 CFM
Special CRACs	0.0 CFM
Upflow CRACs	0.0 CFM
In-Row Coolers	0.0 CFM
Overhead Coolers	0.0 CFM
Spot Coolers	0.0 CFM
UF Vents (Net)	0.0 CFM
AF Inlet Vents	0.0 CFM

Summary of AF Results

Total Heat Load and Cooling

Item	Value
Total Airflow Demand	7,497 CFM
Total Airflow Supply	8,000 CFM
Total Heat Load	45.5 kW
Cooling by Cooling Units	45.5 kW

Heat Loads and Cooling Achieved

Item	kW	Ton
Server Rack Heat Load	41.2	11.7
Hot Box Heat Load	4.26	1.21
Cooling by Downflow CRACs	45.5	12.9
Cooling by Upflow CRACs	0.0	0.0
Cooling by RDHx	0.0	0.0
Cooling by In-Row Coolers	0.0	0.0
Cooling by Overhead Coolers	0.0	0.0
Cooling by Spot Coolers	0.0	0.0
Cooling by Inlet Vents	0.0	0.0

Rack Temperature Results

Rack Statistics

Range of Max Inlet Temp	Number of Racks
Above 80 F	1
Between 75 F and 80 F	0
Between 70 F and 75 F	2
Below 70 F	9

Hot Boxes are included

Rack Temperatures in Detail

No.	Rack or HotBox Name	Xref	Yref	Heat Load	Nominal Airflow	Actual Airflow	TinMax	ToutMax	Tbot_F	Tmid_F	Ttop_F
1	Row 2 - HDA A_1	7.0	6.1	2.80	442	824	67.8	78.5	67.2	67.6	67.7
2	Row 2 - HDA A	10.4	6.1	2.80	442	782	68.6	79.9	67.4	67.7	67.8
3	Row 2 - Rack 8 SD	13.8	6.0	5.00	789	896	69.2	86.8	67.5	68.0	68.7
4	Row 2 - Rack 9 SD	15.8	6.0	5.00	789	854	69.0	87.5	67.8	67.9	68.5
5	Row 2 - Rack 10 SD	17.8	6.0	5.00	789	818	68.7	88.0	67.9	67.7	68.2
6	Row 2 - Rack 3 SD	19.8	6.0	5.00	789	791	68.2	88.1	67.9	67.7	67.9
7	Row 2 - Rack 1 SD	21.8	6.0	5.00	789	770	68.0	88.5	67.9	67.7	67.7
8	Row 2 - Rack 2 SD	23.8	6.0	5.00	789	750	68.0	89.1	68.0	67.8	67.7
9	Row 2 - HDA B_1	25.8	6.1	2.80	442	452	69.8	89.4	68.1	67.9	67.8
10	Row 2 - HDA B	29.1	6.1	2.80	442	446	71.4	91.2	68.8	68.1	67.9
11	Hot Box 1	25.3	16.4	2.13	500	500	88.6	90.9			
12	Hot Box 1_1	7.3	16.4	2.13	500	500	70.5	83.1			

Xref and Yref in ft; Heat Load in kW; Airflow in CFM; Temperatures in F.

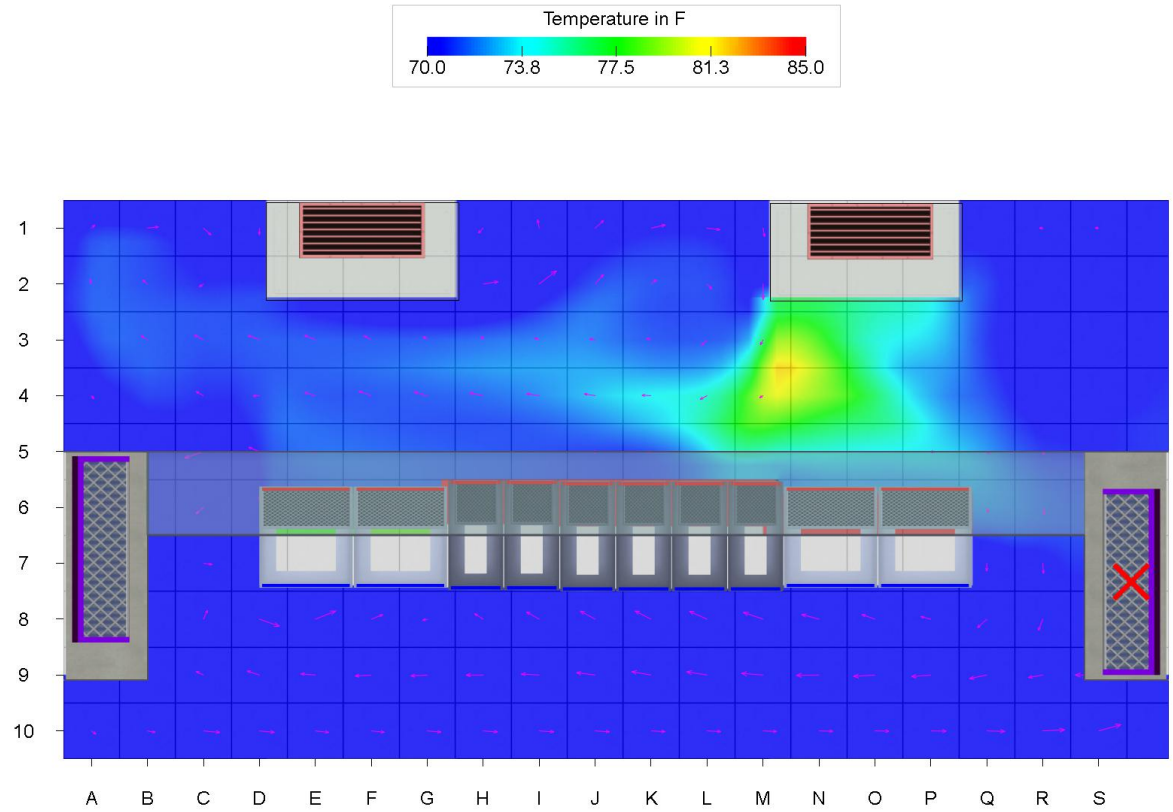
Results for Cooling Units

Downflow CRACs: Cooling & Temperatures

Name	Xref	Yref	Airflow	T_Return	T_Supply	Cooling (Ton)	Cooling (kW)
CRAC 1	3.0	2.8	8,000	85.4	66.3	12.9	45.5
CRAC 1_1	36.5	11.0	turned off	-----	-----	-----	-----

Xref and Yref in ft; Airflow in CFM; Temperatures in F; Cooling Produced in Ton and kW.

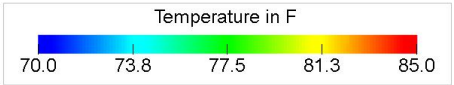
Four Feet Above Floor

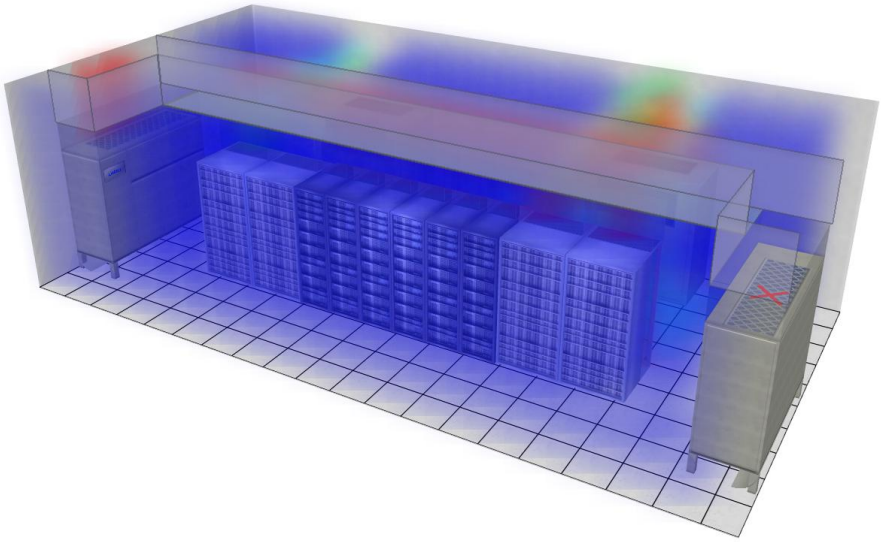


Labels shown along axes

Temperature Distribution at z = 4 ft (1.2 m) (Plan)

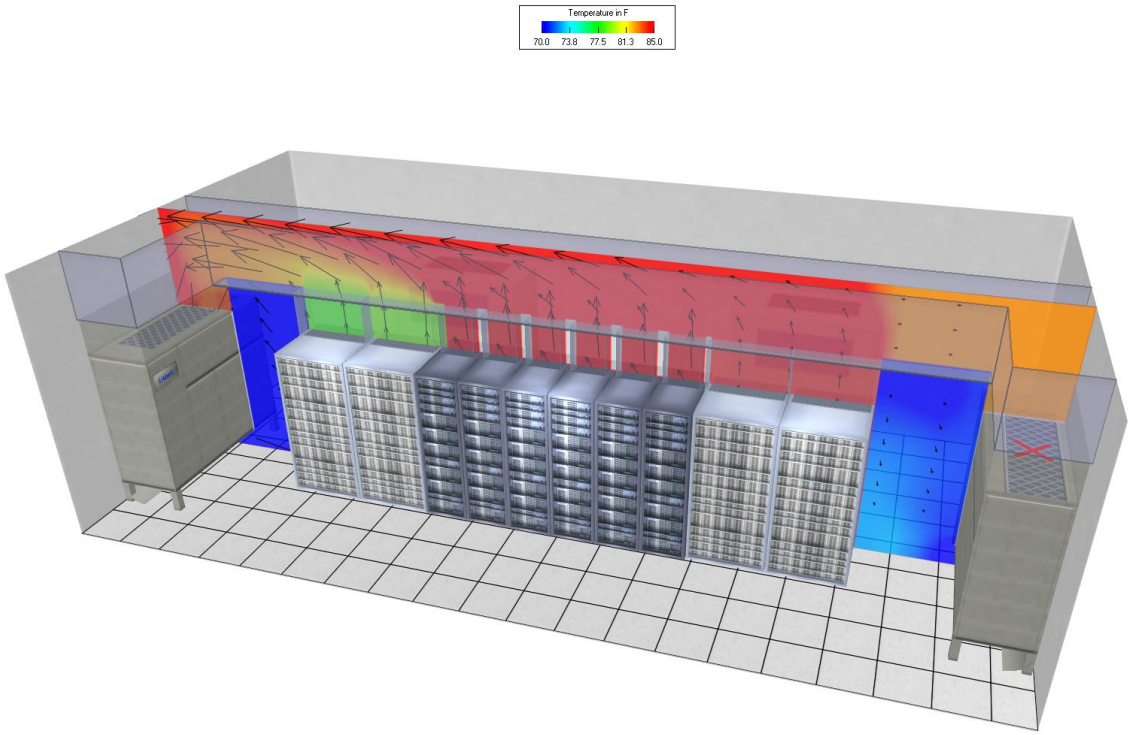
Temperature Fog





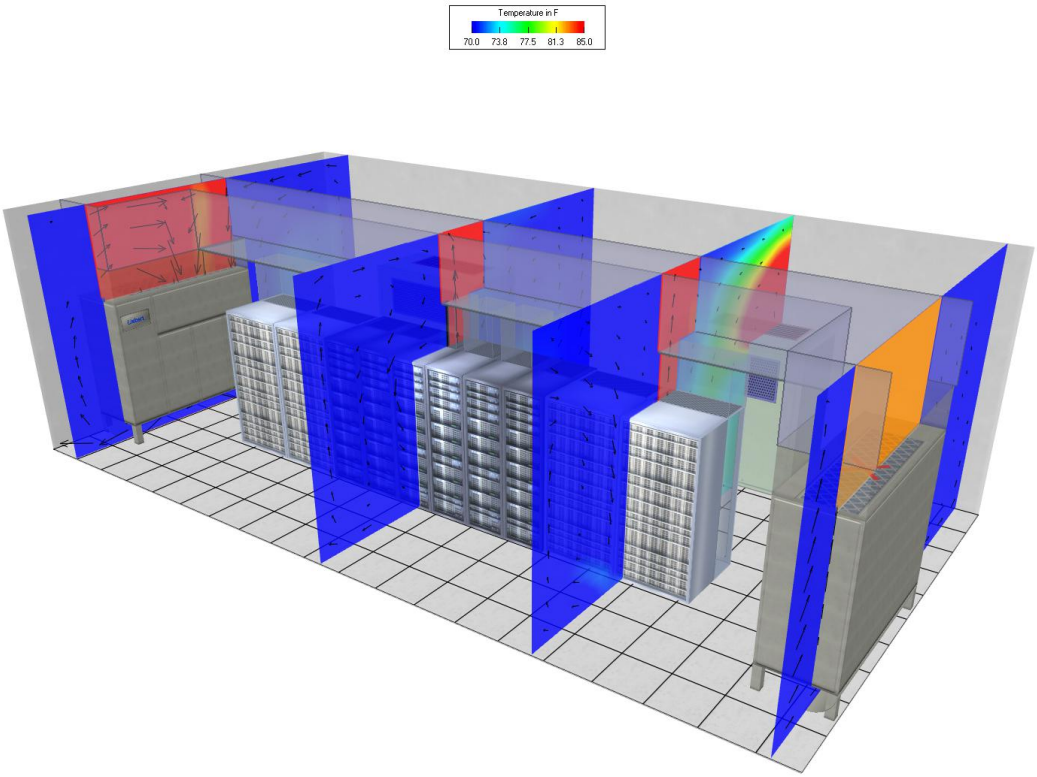
Temperature Fog (3D)

X Axis View



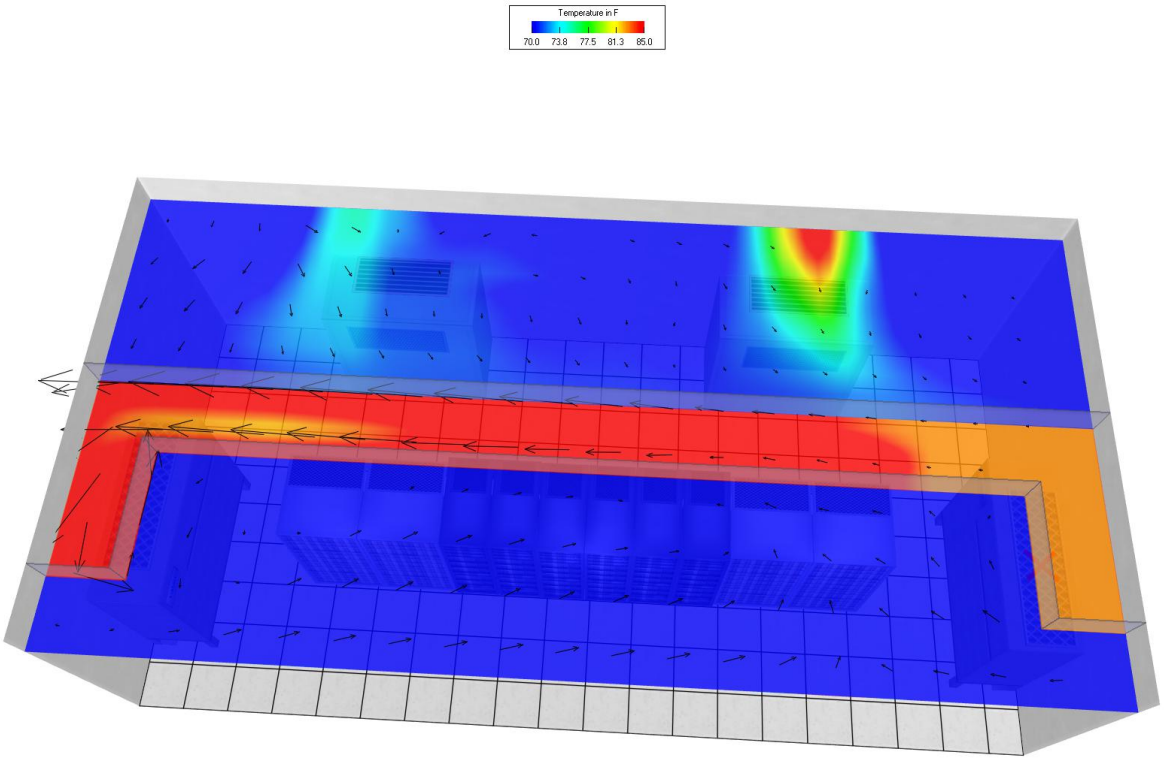
One CRAC Failed

Y Axis View

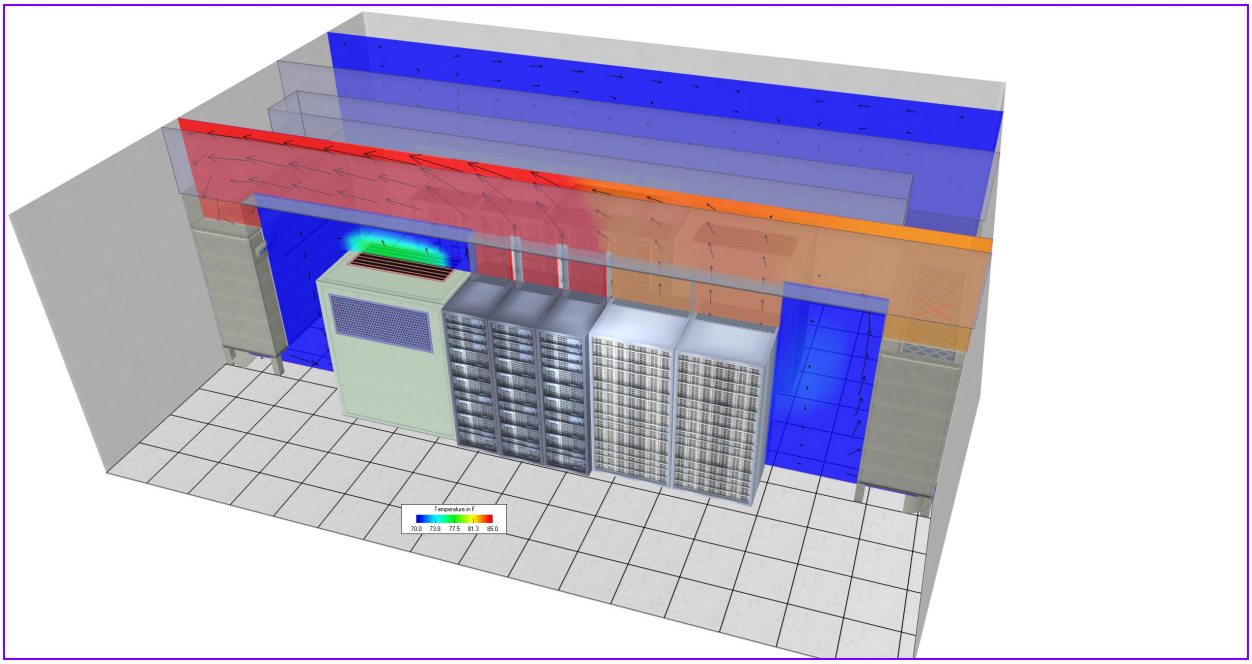


One CRAC Failed

10.5 Feet Above the Floor



Computational Fluid Dynamics (CFD) Simulation - Extra Small Computer Room - Square Version



This report contains the results and images from a CFD simulation. It shows the performance of the current cooling system in this extra small computer room for use within VA.

Data Center and Infrastructure Engineering
Solution Delivery, DevSecOps, OIT

Geometry and Objects

Data Center Dimensions

Item	Value
Floor Length	24.0 ft
Floor Width	32.5 ft
Tile Size	24.0 inch
UF Plenum Height	0.0 inch
Real Ceiling Height	12.0 ft

Object Count

Object	Count
Downflow CRACs	2
Server Racks	10
Hot Boxes	2
Vertical Partitions	6
Horizontal Partitions	2

Downflow CRACs by Style

Downflow CRAC Style	Total Units	Failed Units	Total Airflow (CFM)	Nominal Cooling (Ton)	Nominal Cooling (kW)
Liebert DS053AS/AD/DS/DD	2	1	8,000	15.1	53.2

Racks by Style

Rack Style	Total Racks	Turned Off	Total Heat Load (kW)	Total Airflow (CFM)
CPI TeraFrame 60 cm x 110 cm x 45 U (Ducted)	6	0	30.0	4,731
CPI TeraFrame NF8N with Chimney	4	0	11.2	1,766

Heat Load/Cooling Airflow

Total Heat Load and Airflow

Item	Value
Net Floor Area	732 sq ft
Heat Load Density	62.1 W/sq ft
Total Heat Load	45.5 kW
Total Airflow Demand	7,497 CFM
Total Airflow Supplied	8,000 CFM

Cooling Airflow Supplied

Source	Value
Downflow CRACs	8,000 CFM
Special CRACs	0.0 CFM
Upflow CRACs	0.0 CFM
In-Row Coolers	0.0 CFM
Overhead Coolers	0.0 CFM
Spot Coolers	0.0 CFM
UF Vents (Net)	0.0 CFM
AF Inlet Vents	0.0 CFM

Summary of AF Results

Total Heat Load and Cooling

Item	Value
Total Airflow Demand	7,497 CFM
Total Airflow Supply	8,000 CFM
Total Heat Load	45.5 kW
Cooling by Cooling Units	45.5 kW

Heat Loads and Cooling Achieved

Item	kW	Ton
Server Rack Heat Load	41.2	11.7
Hot Box Heat Load	4.26	1.21
Cooling by Downflow CRACs	45.5	12.9
Cooling by Upflow CRACs	0.0	0.0
Cooling by RDHx	0.0	0.0
Cooling by In-Row Coolers	0.0	0.0
Cooling by Overhead Coolers	0.0	0.0
Cooling by Spot Coolers	0.0	0.0
Cooling by Inlet Vents	0.0	0.0

Rack Temperature Results

Rack Statistics

Range of Max Inlet Temp	Number of Racks
Above 80 F	0
Between 75 F and 80 F	0
Between 70 F and 75 F	0
Below 70 F	12

Hot Boxes are included

Rack Temperatures in Detail

No.	Rack or HotBox Name	Xref	Yref	Heat Load	Nominal Airflow	Actual Airflow	TinMax	ToutMax	Tbot_F	Tmid_F	Ttop_F
1	Row 2 - HDA B	10.7	17.7	2.80	442	657	68.0	81.5	67.9	68.0	68.0
2	Row 2 - HDA B_1	14.0	17.7	2.80	442	619	67.9	82.2	67.9	67.9	67.9
3	Row 2 - Rack 2 SD	16.0	18.0	5.00	789	841	68.2	86.9	68.1	68.0	67.9
4	Row 2 - Rack 1 SD	18.0	18.0	5.00	789	831	68.3	87.3	68.3	68.1	67.9
5	Row 2 - Rack 3 SD	20.0	18.0	5.00	789	820	68.4	87.6	68.4	68.3	68.0
6	Row 2 - Rack 10 SD	13.0	6.1	5.00	789	866	68.2	86.4	68.2	67.8	67.2
7	Row 2 - Rack 8 SD	15.0	6.0	5.00	789	845	68.3	87.0	68.3	68.0	67.4
8	Row 2 - Rack 9 SD	17.0	6.0	5.00	789	825	68.3	87.4	68.3	68.2	67.6
9	Row 2 - HDA A_1	19.0	6.4	2.80	442	568	68.1	83.7	68.1	67.9	67.6
10	Row 2 - HDA A	22.4	6.4	2.80	442	558	68.1	83.9	68.0	67.9	67.8
11	Hot Box 1	7.2	6.4	2.13	500	500	67.4	80.6			
12	Hot Box 1_1	25.8	17.7	2.13	500	500	68.2	81.6			

Xref and Yref in ft; Heat Load in kW; Airflow in CFM; Temperatures in F.

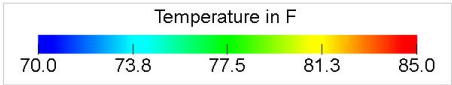
Results for Cooling Units

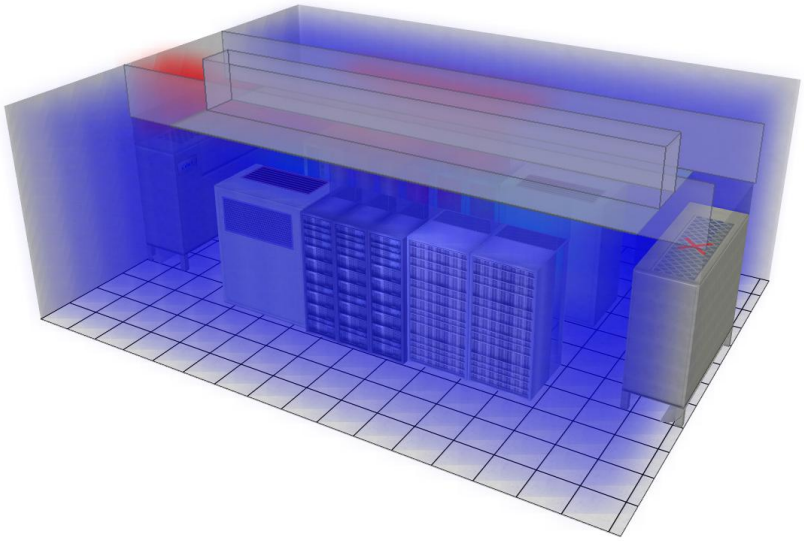
Downflow CRACs: Cooling & Temperatures

Name	Xref	Yref	Airflow	T_Return	T_Supply	Cooling (Ton)	Cooling (kW)
CRAC 1	3.0	8.0	8,000	85.3	66.4	12.9	45.5
CRAC 1_1	29.5	16.2	turned off	-----	-----	-----	-----

Xref and Yref in ft; Airflow in CFM; Temperatures in F; Cooling Produced in Ton and kW.

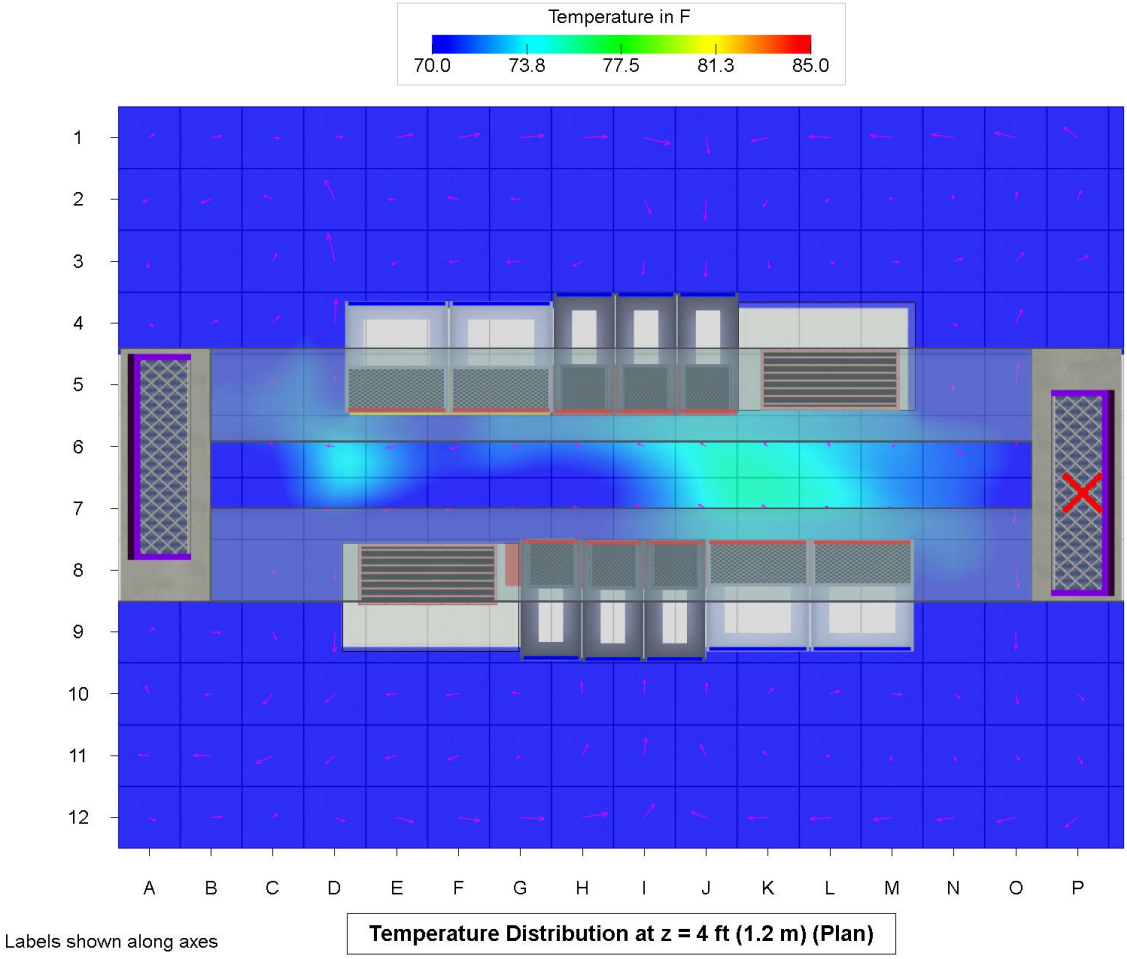
Temperature Fog



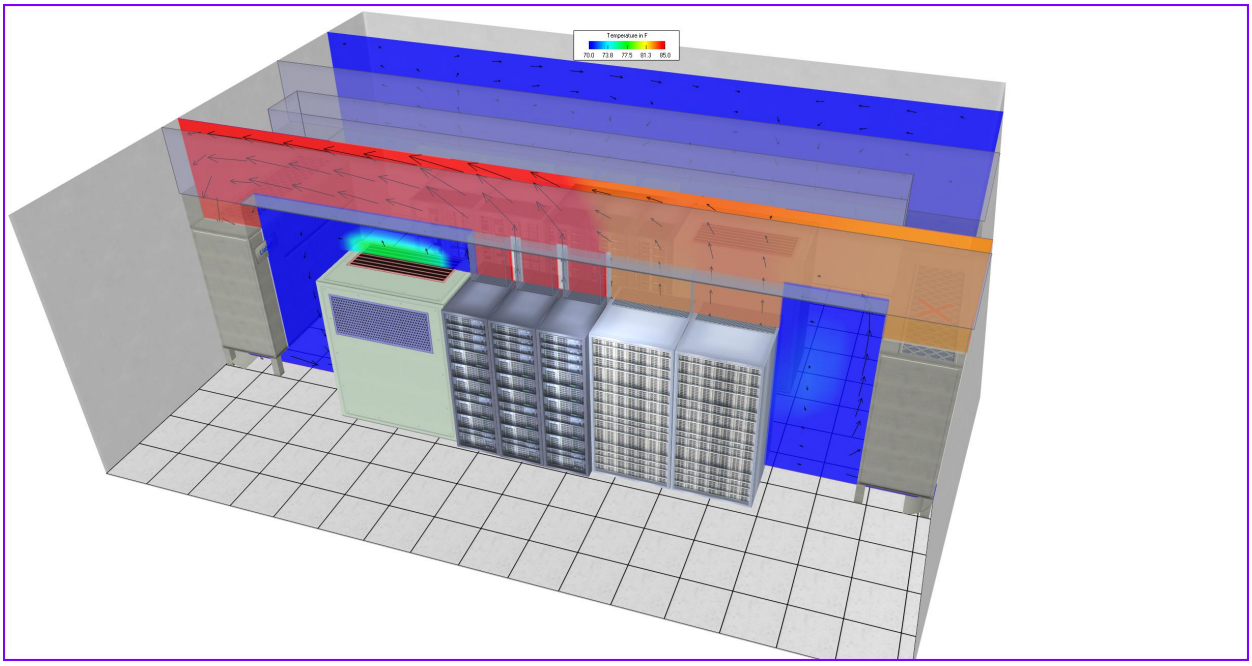


Temperature Fog (3D)

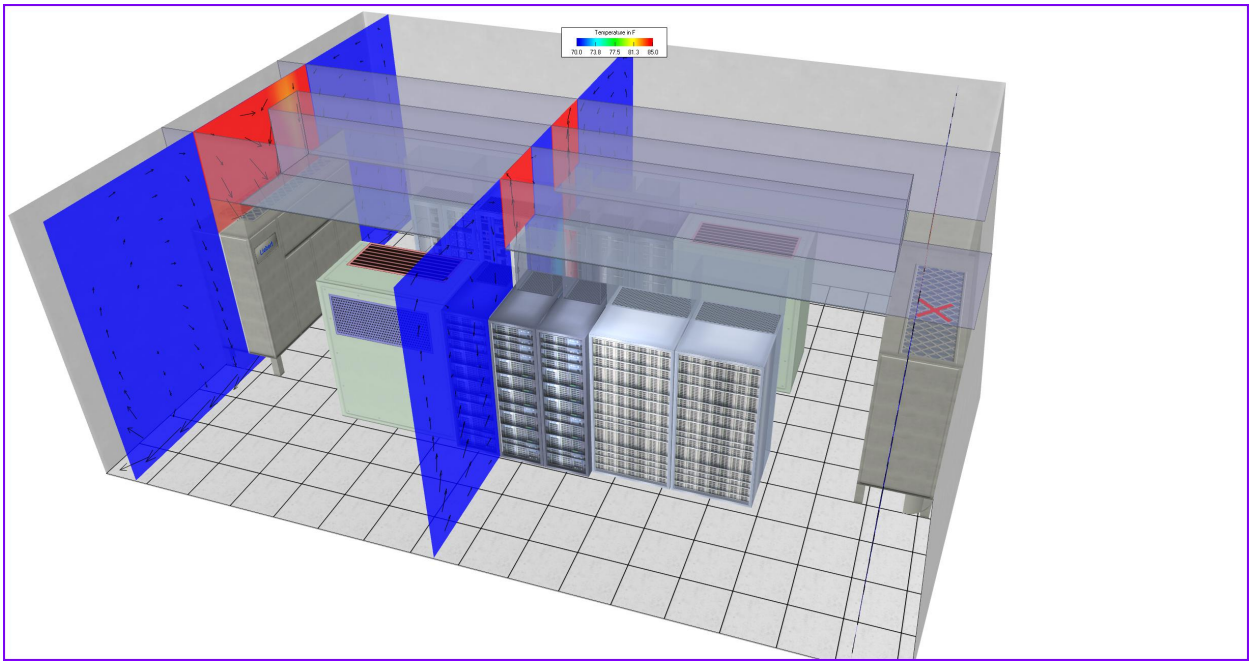
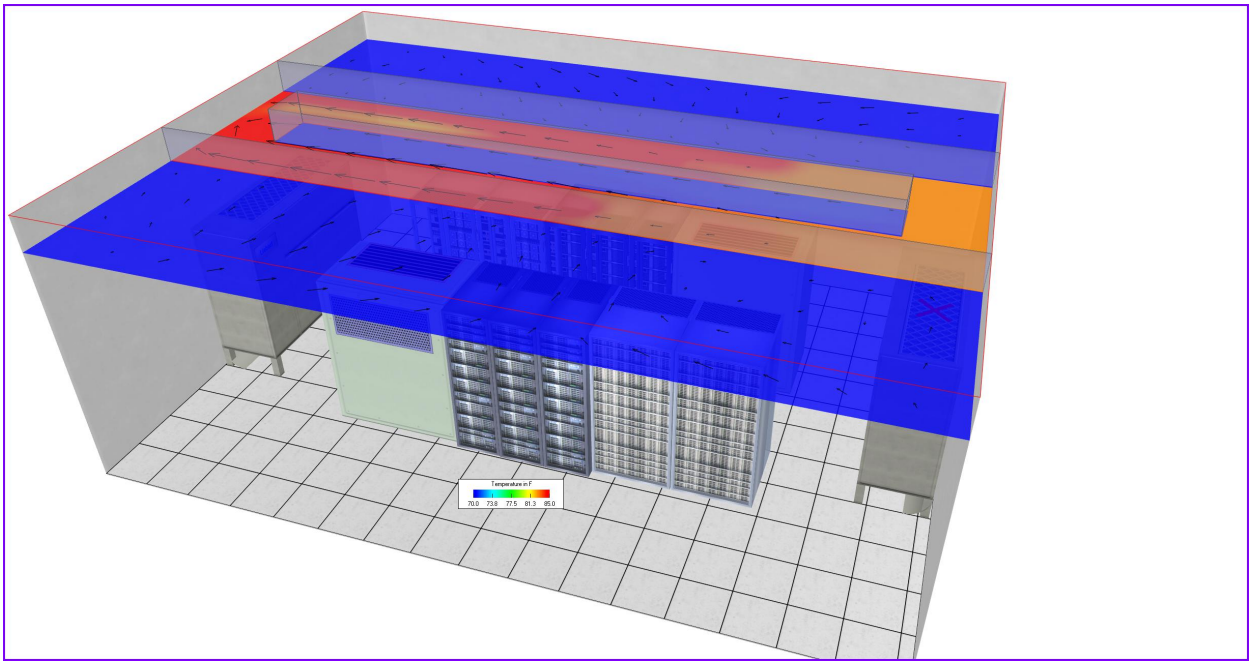
Four Feet Above Floor



X Axis



Y Axis



10.5 Feet Above Floor