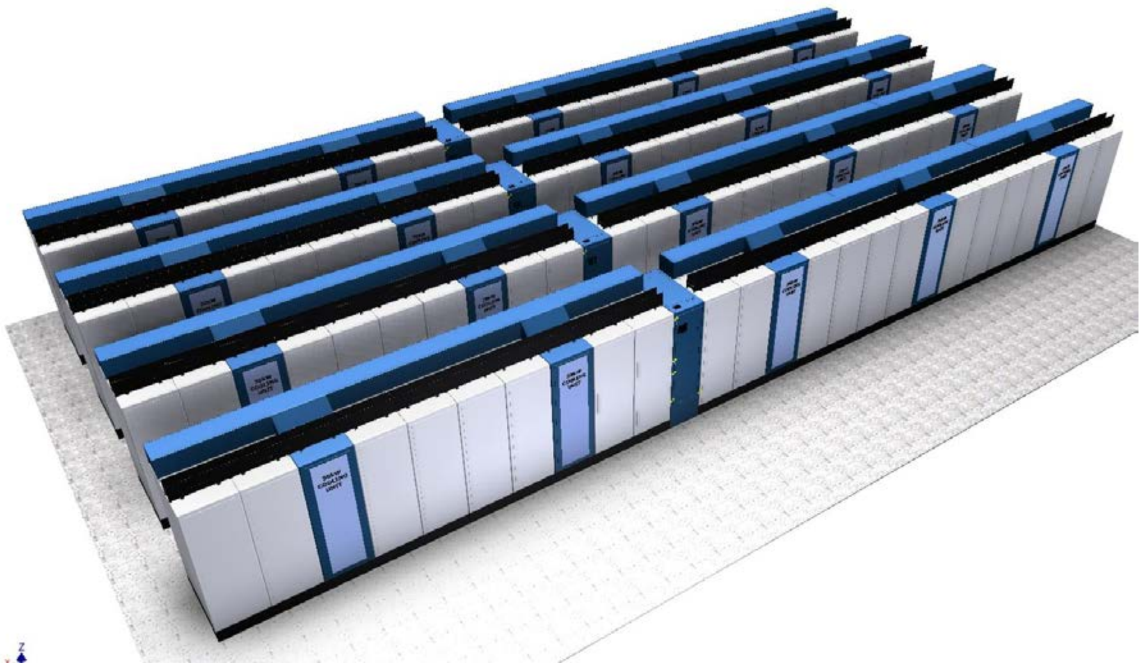
Variable Density, Closed-Loop, Water-Cooled Data Center Solution



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Overview

Great Lakes Case & Cabinet Co., Inc. has worked with Naissus Thermal Management Solutions, of Toronto, Ontario to develop one of the most efficient and effective closed-loop water-cooled enclosures in the industry, with the ability to easily handle a 30kW load under normal conditions. Together, Great Lakes and Naissus have translated that same technology into a variable density cooling system, which is deployed in "pods" of up to six enclosures, supported by a single 30kW cooling station. That 30kW can then be distributed, as needed, to individual enclosures in a single grouping, in densities ranging from 5 kW to 15kW.

The Great Lakes/Naissus design allows each grouping or "pod" of enclosures to essentially act as its own "data center" without any reliance on CRAC units or the "over-cooling" of the data center space.

Utilizing dedicated chilled water delivered via a high-efficiency pumping system as its cooling medium, the cooling station serves as a heat exchanger, taking in heated exhaust from the enclosures in the pod via a proprietary plenum system, passing that hot air over a unique coil mounted within the station. The conditioned water, at a consistent temperature and flow, converts that heated exhaust into conditioned air. That conditioned/cooled air is then delivered to each of the enclosures in the pod via a proprietary plinth platform to deliver that conditioned air within a plenum chamber inside each enclosure and directly in front of the mounted equipment. High efficiency fans are located throughout the system to help drive both conditioned air and heated exhaust. High speed vanaxial fans are located in the cooling station to collect and focus exhaust and to direct it across the heat exchanger in the most efficient manner possible, while maintaining static pressure

Unlike "in-row/close-cooled" systems, this solution maximizes the efficiency of the conditioned air by delivering it to rack mounted equipment without the risk of bypass air flow or hot air recirculation. The system is truly "closed loop" in nature and requires no additional air conditioning within the data center space.

The system is easily installed on a "slab" floor with water and power delivery from above and from outside the data center space.

Tremendous Flexibility, in Support of Future Demand

While initial pod deployment may require 5KW or less per enclosure, future co-location customers may have varying needs and anticipated growth requirements which necessitate medium or high density cooling. The cooling station can be deployed as needed to support two, three, four or up to six enclosures as desired. If there is a need for even higher density, the Great Lakes CLWC (closed loop water cooled) enclosure may be included in a pod to create a 30kW option.

The Pod

An Example:

A Pod of Six Enclosures Supported by a 30Kw "Cooling Station"

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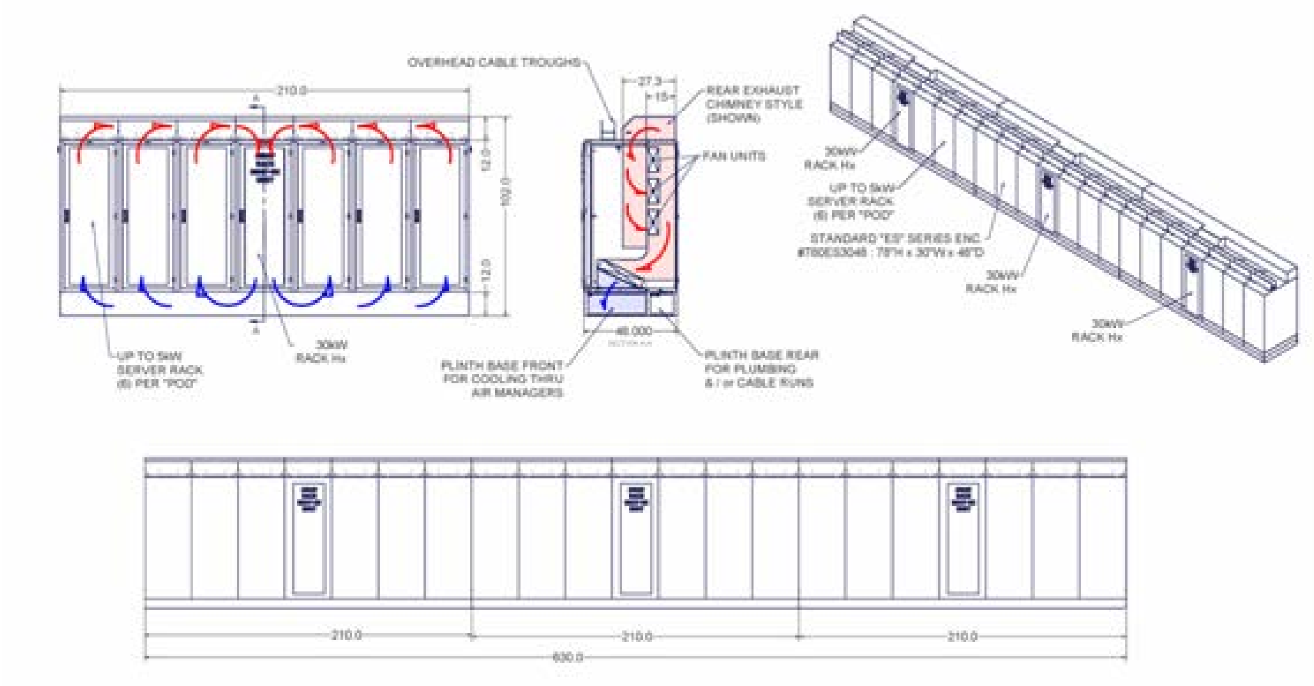
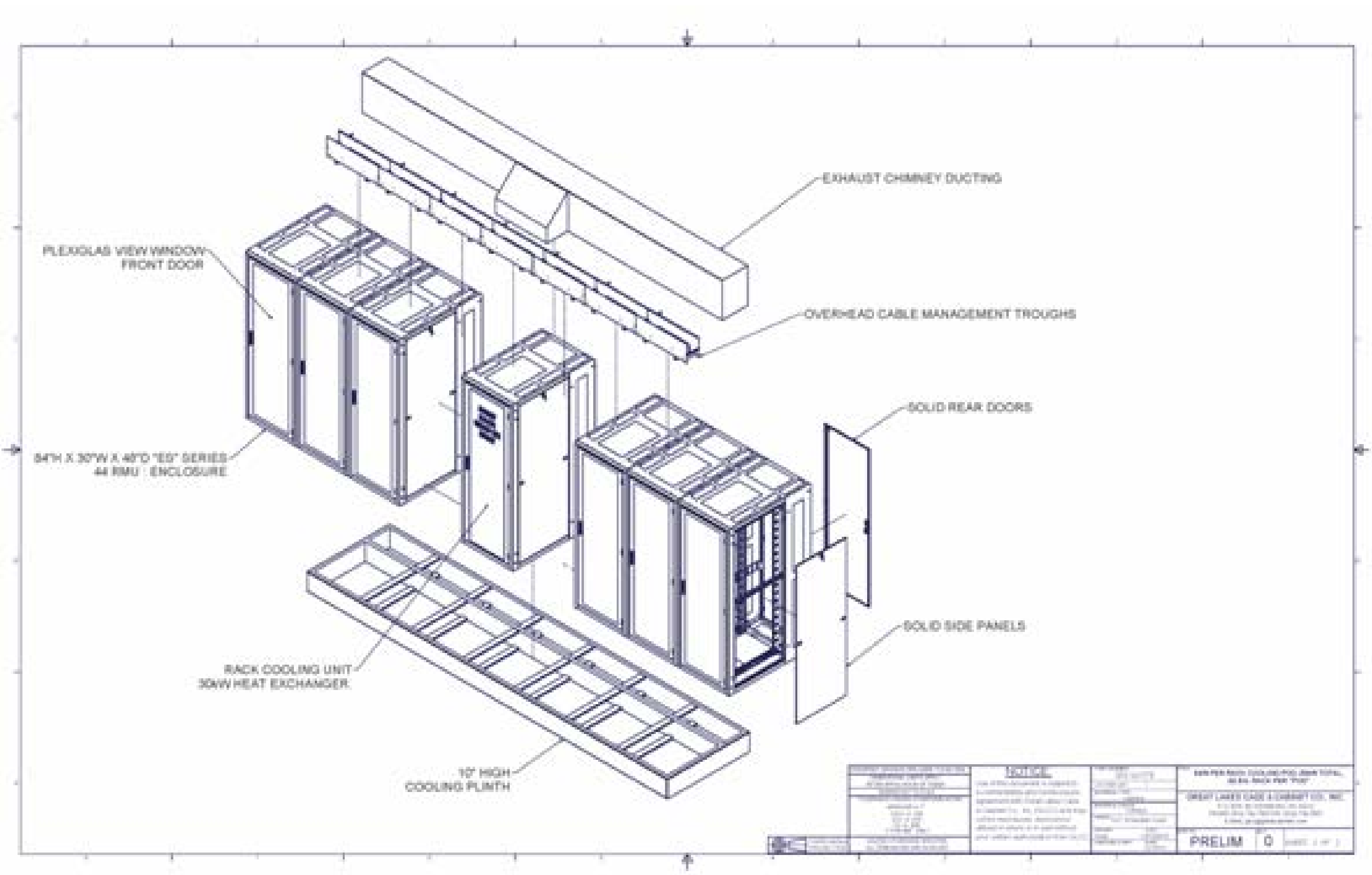
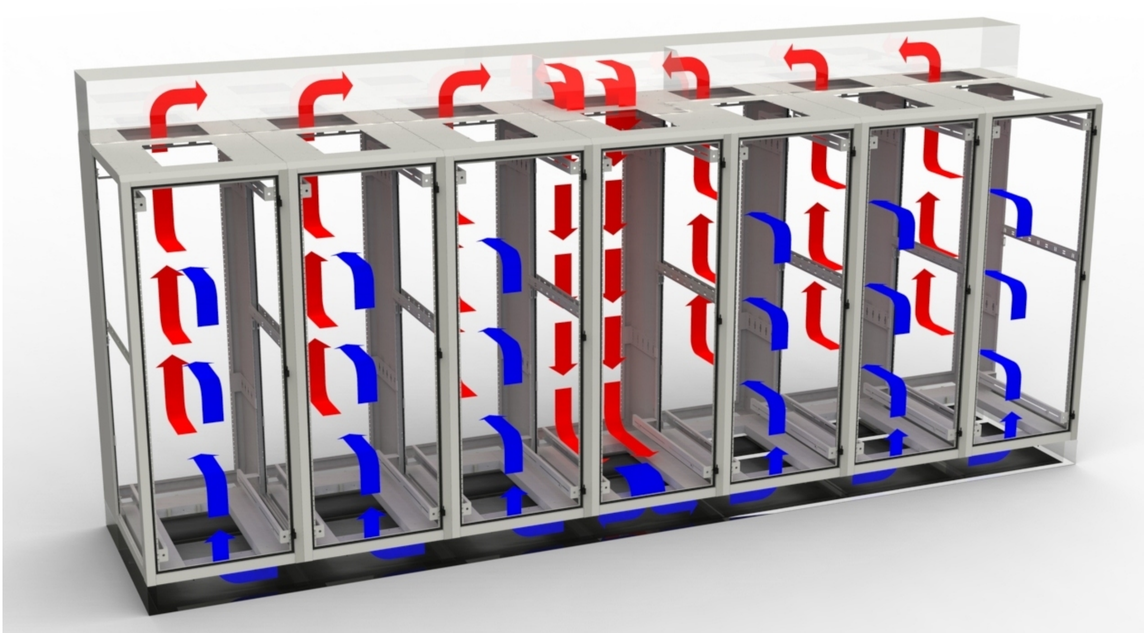
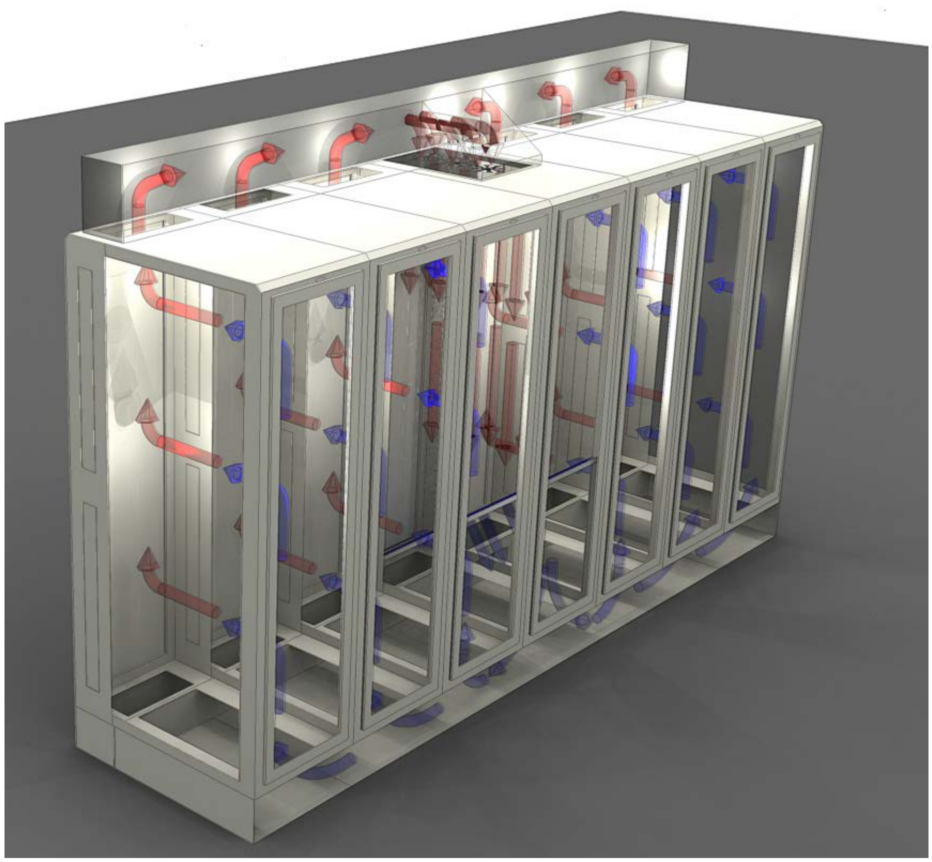




Conditioned Air Flow Delivery and Collection of Heated Exhaust





An Example

Performance of Cooling Unit (Six Cabinets + Cooling Unit)

	Imperial Units		SI Units	
Heat Load	102500	BTU/h	30	kW
Water Temperature	55	°F	12.7	°C
Water Flow	18	gpm	1.13	l/s
Cold Air Supply	75	°F	24	°C
Hot Air Return	115	°F	46	°C
ΔT - Air	40	°F	22	°C
ΔT - Water	11.4	°F	6.3	°C
Air Flow	2500	CFM	1.18	m^3/s
Fan Power	4100	BTU/h	1200	W

PUE

	1.2	1.6	2.0
Total IT Load:	210kW	210kW	210kW
Total Facility Load:	252kW	336kW	420kW
Electricity Cost (KW/h):	$0.10	$0.10	$0.10
Annual Power Usage:	2,207,520kW	2,943,360kW	3,679,200kW
Annual Power Cost:	$220,752	$294,336	$367,920
Annual Power Savings:		735,840kW	1,471,680kW
Annual Cost Savings:		$73,584 (25%)	$147,168 (40%)

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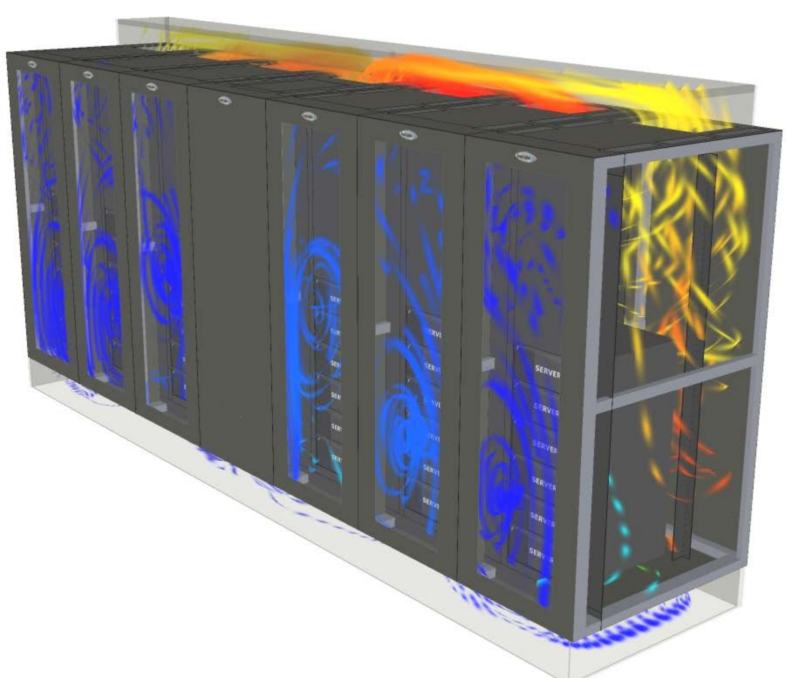
CFD Analysis

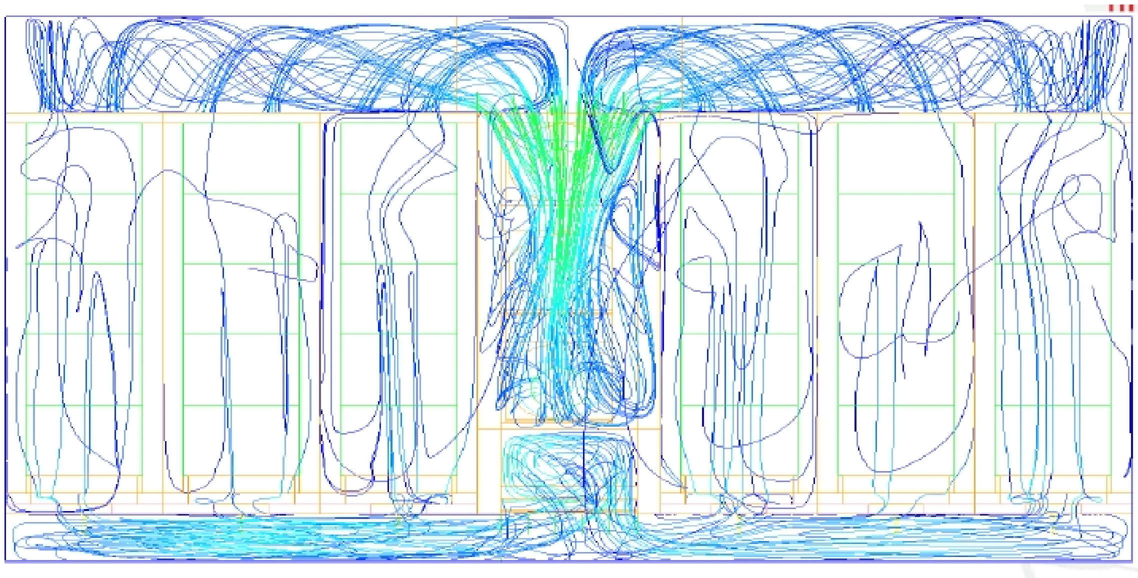
Computational Fluid Dynamics (CFD) modeling uses computer calculations to simulate the interactions of liquids and gases with various surfaces in a defined space. To better understand the role the enclosure plays in the operation of the data center, Great Lakes and Naissus Thermal Management Solutions have developed the capability to perform CFD analysis with data center specific software. We are now able to help customers to better understand what is currently happening in their data center environment, to test or plan capacity increases or, to test a data center, room or pod design before ever starting a build.

Using the performance data from the variable density pod, as calculated on page 5, a simulation effort was undertaken with the primary goal of ensuing adequate airflow through the system, which would result in proper internal air temperature and cooling of the installed equipment:

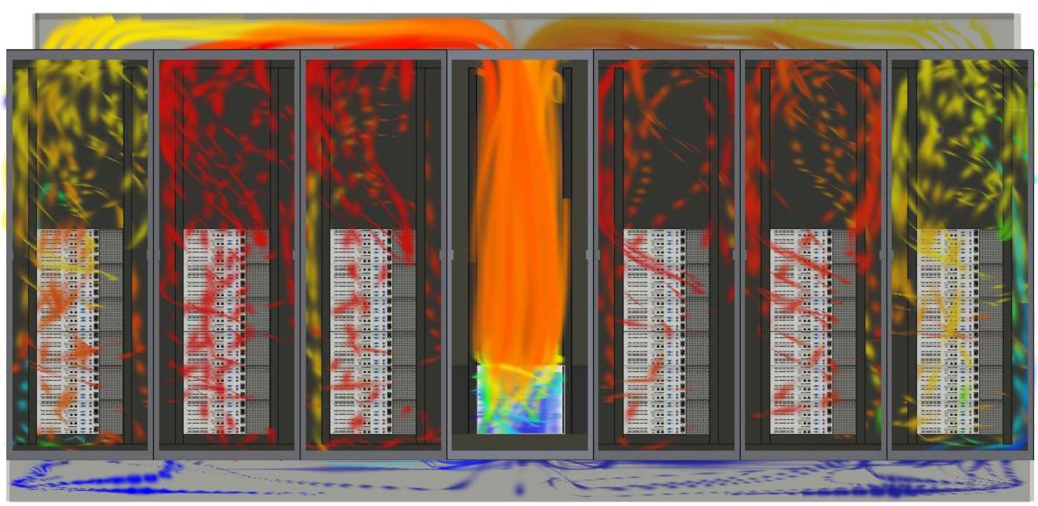
This thermal CFD rendering is an "iso view" of the variable density pod and shows how conditioned air flows from the "cooling station" (rack cooling unit as a 30kW heat exchanger) into the12" H bottom plinth, through the enclosures and into the exhaust chimney ducting in the top plenum of the pod



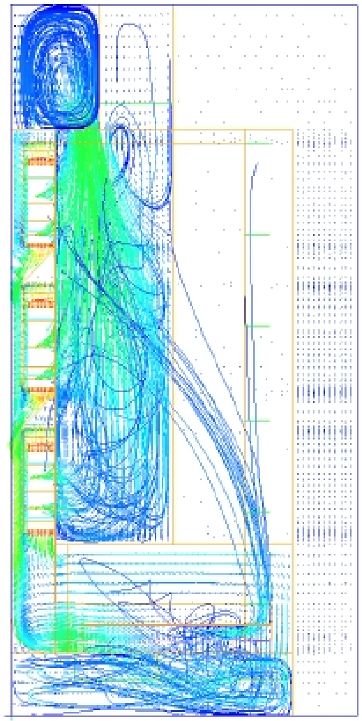
This “front view” rendering shows air flow through the bottom plinth and top plenum

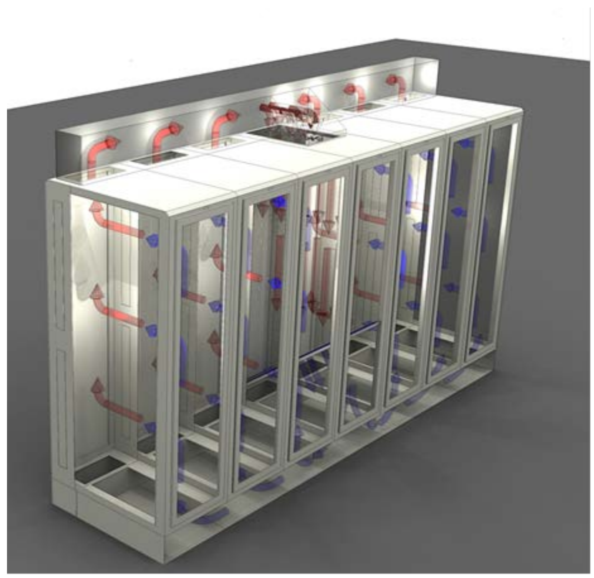


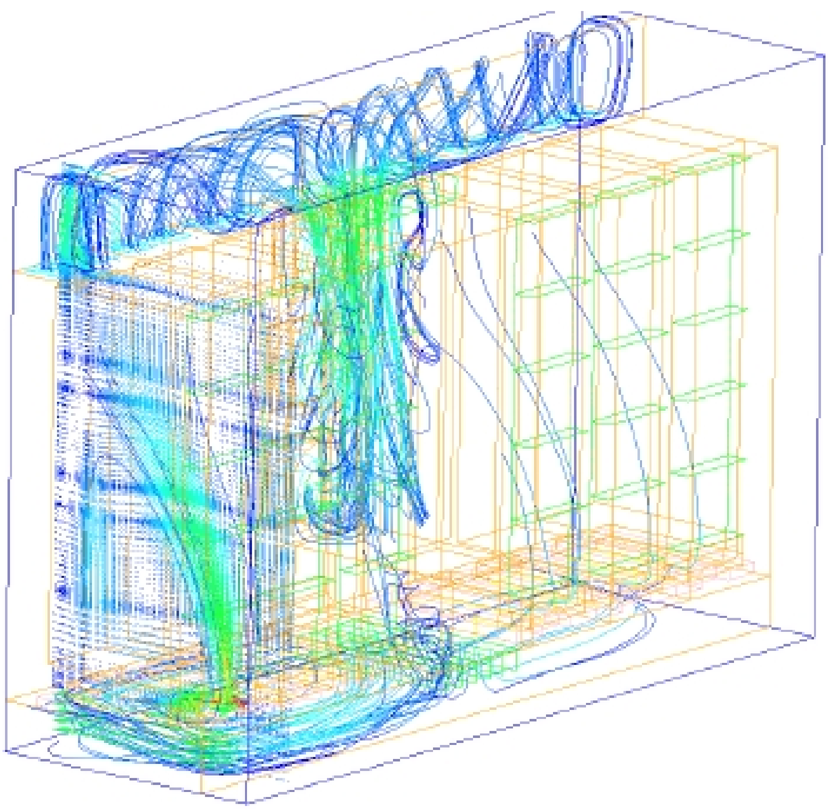
This “rear view” rendering shows the heated exhaust from the servers in each enclosure, moving up through the exhaust chimneys, being collected into the top plenum and moving into the cooling station to pass across the heat exchanger.



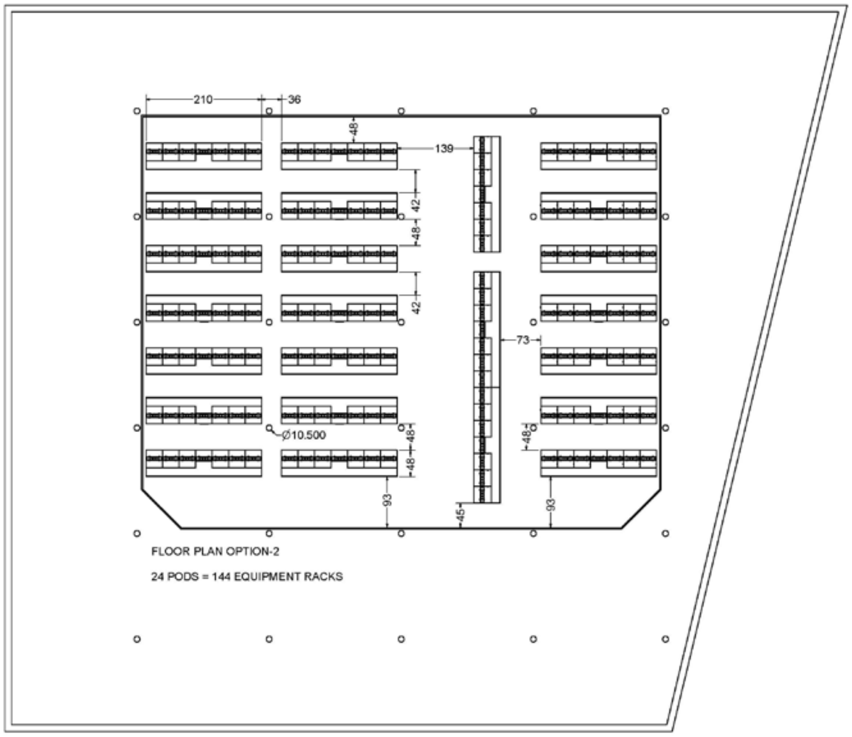
These "front, side and "iso view" renderings show air flow through the cooling station, bottom plinth and top plenum

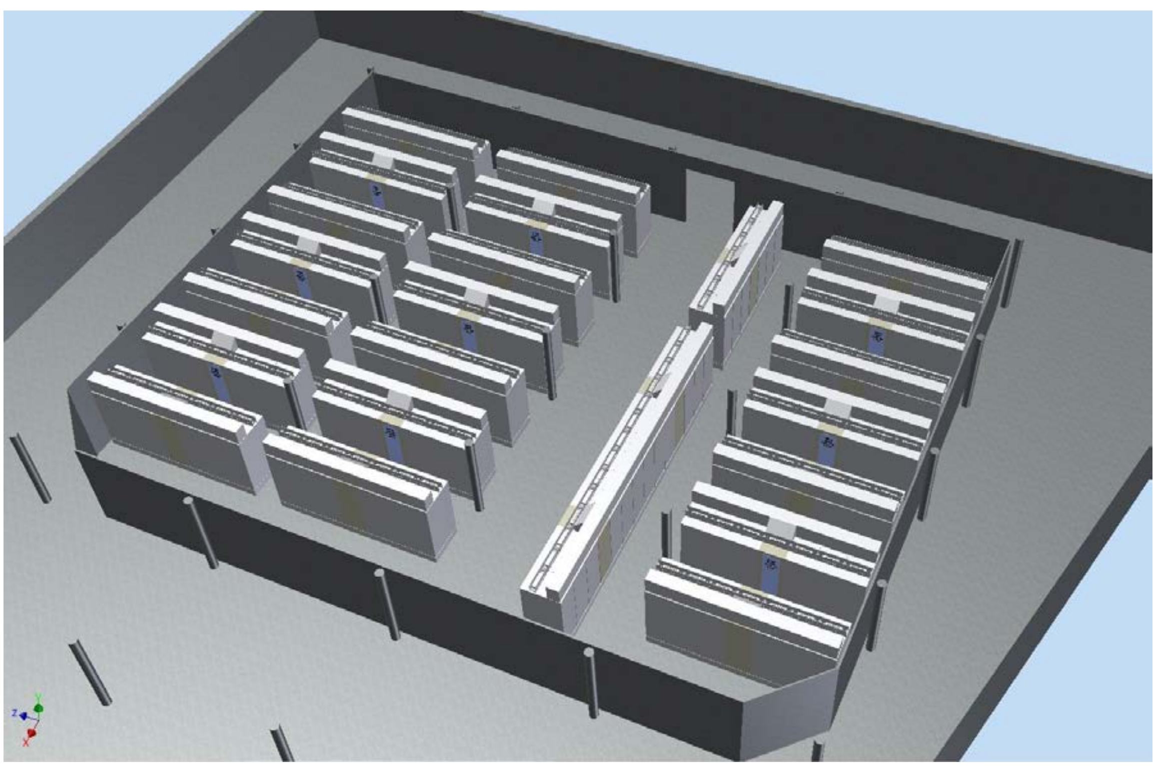






This drawing and rendering shows a data center layout for a project which utilizes 24 variable density pods to place 144 enclosures into service.





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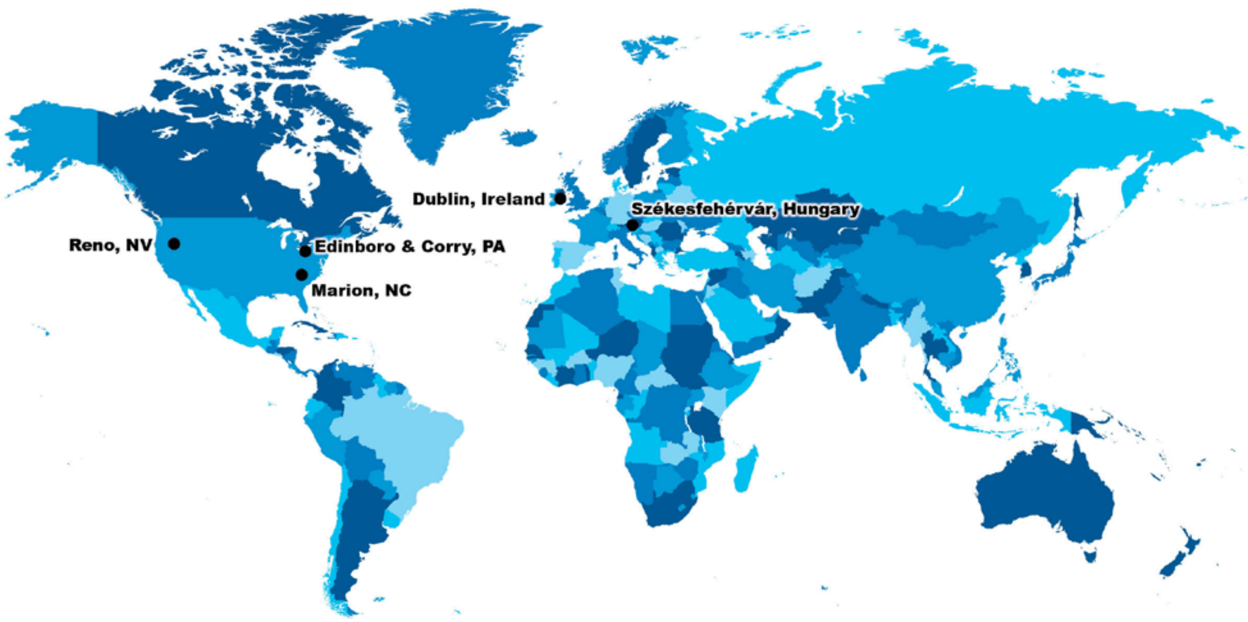

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