to deliver reduced temperature water from the LAMEE and recovery coil (or a reduced temperature coolant) to the data center to provide cooling to the data center without moving air from the data center through the cooling system.

[0016] Examples according to the present application can include an air-cooling system for a data center or other enclosed space, the air-cooling system having a LAMEE as an evaporative cooler. The LAMEE and the recovery coil can collectively produce cold water that can be used to cool a process air stream. A process air plenum can receive the hot process air from the enclosed space. The cold water from the LAMEE and the recovery coil can be delivered into the process air plenum to provide air cooling to the hot process air. In an example, the cold water can circulate through a liquid-to-air heat exchanger configured to cool the hot process air with the cold water.

[0017] Conditioning systems having the three components described above can operate in multiple modes for both air cooling and liquid cooling, as well as for the various pre-cooler designs. The inclusion of a pre-cooler in the conditioning systems can eliminate the need for supplemental mechanical cooling in some cooling applications.

[0017a] According to an aspect there is provided a conditioning system for providing cooling to a heat load, the conditioning system comprising:

a scavenger plenum having an air inlet and outlet, the scavenger plenum configured to direct scavenger air in an air flow path from the air inlet to the air outlet;

an evaporative cooler arranged inside the scavenger plenum in the air flow path and having a first cooling fluid circuit configured to circulate a first cooling fluid through the evaporative cooler, the evaporative cooler configured to selectively evaporate a portion of the first cooling fluid;

a first cooling component arranged inside the scavenger plenum between the air inlet and the evaporative cooler, the first cooling component configured to selectively condition the scavenger air flowing through the first cooling component;

a second cooling component arranged inside the scavenger plenum between the evaporative cooler and the air outlet and having a second cooling fluid circuit configured to circulate a second cooling fluid through the second cooling component, the second cooling component configured to reduce a temperature of the second cooling fluid using scavenger air; and

a process cooling fluid circuit connected to at least one of the first cooling fluid circuit and the second cooling fluid circuit, the process cooling fluid circuit configured to provide a process cooling fluid to cool the heat load.

[0017b] According to another aspect there is provided a method of providing cooling to a heat load, the method comprising:

selectively directing scavenger air through a pre-cooling unit arranged in a scavenger air plenum, the scavenger air entering the plenum at an air inlet and exiting the plenum at an air outlet, and the pre-cooling unit configured to condition the scavenger air entering the plenum;

selectively directing the scavenger air exiting the pre-cooling unit through an evaporative cooler arranged in the plenum, the evaporative cooler having a first cooling fluid circuit and configured to selectively evaporate a first cooling fluid in the first cooling fluid circuit;

directing the scavenger air exiting the evaporative cooler through a recovery coil arranged in the plenum, the recovery coil having a second cooling fluid circuit and configured to reduce a temperature of a second cooling fluid in the second cooling fluid circuit using the scavenger air; and

providing cooling to the heat load using a process cooling fluid in a process cooling fluid circuit, the process cooling fluid circuit connected to at least one of the first cooling fluid circuit and the second cooling fluid circuit.

[0017c] According to another aspect there is provided a conditioning system for providing cooling to a heat load, the conditioning system comprising:

a plurality of process cooling units, each process cooling unit configured to produce a reduced-temperature cooling fluid and comprising:

a scavenger plenum having an air inlet and outlet, the scavenger plenum configured to direct scavenger air in an air flow path from the air inlet to the air outlet;

an evaporative cooler arranged inside the scavenger plenum in the air flow path and having a first cooling fluid circuit configured to circulate a first cooling fluid through the evaporative cooler, the evaporative cooler configured to selectively evaporate a portion of the first cooling fluid;

a first cooling component arranged inside the scavenger plenum between the air inlet and the evaporative cooler, the first cooling component

configured to selectively condition the scavenger air flowing through the first cooling component; and

a second cooling component arranged inside the scavenger plenum between the evaporative cooler and the air outlet and having a second cooling fluid circuit configured to circulate a second cooling fluid through the second cooling component, the second cooling component configured to reduce a temperature of the second cooling fluid; and

a process cooling fluid supply circuit connected to at least one of the first and second cooling fluid circuits of each of the plurality of cooling units and configured to supply a process cooling fluid to the heat load to cause heat rejected by the heat load to be received by the process cooling fluid, the process cooling fluid comprising at least one of the first and second cooling fluids; and

a process cooling fluid return circuit configured to receive the process cooling fluid after the process cooling fluid receives heat rejected by the heat load and to return the process cooling fluid back to each of the plurality of process cooling units for recirculation through at least one of the second cooling component and the evaporative cooler of each of the plurality of process cooling units.

[0017d] According to another aspect there is provided a conditioning system for providing cooling to a heat load, the conditioning system comprising:

a process cooling unit comprising:

a scavenger air plenum having an air inlet and outlet, the plenum configured to direct scavenger air in an air flow path from the air inlet to the air outlet;

an evaporative cooler arranged inside the plenum in the air flow path and having a first cooling fluid circuit configured to selectively circulate a first cooling fluid through the evaporative cooler, the evaporative cooler configured to selectively evaporate a portion of the first cooling fluid;

a pre-cooler arranged inside the plenum upstream of the evaporative cooler, the pre-cooler having a second cooling fluid circuit configured to selectively circulate a second cooling fluid through the pre-cooler to selectively condition the scavenger air, prior to selectively passing the scavenger air through the evaporative cooler; and

a recovery coil arranged inside the plenum downstream of the evaporative cooler, the recovery coil having a third cooling fluid circuit

configured to circulate a third cooling fluid through the recovery coil, the recovery coil configured to reduce a temperature of the third cooling fluid;

a process cooling fluid circuit connected to at least one of the first cooling fluid circuit and the third cooling fluid circuit, the process cooling fluid circuit configured to supply at least one of the first cooling fluid and the third cooling fluid to the heat load to cause heat rejected by the heat load to be received by the at least one of the first and third cooling fluids; and

an auxiliary cooling unit configured to cool the second cooling fluid exiting the pre-cooler, wherein the auxiliary cooling unit is part of the second cooling fluid circuit and separate from the first and third cooling fluid circuits.

[0017e] According to another aspect there is provided a method of providing cooling to a heat load, the method comprising:

selectively directing scavenger air through a pre-cooler arranged inside a scavenger air plenum, the scavenger air entering the plenum at an air inlet and exiting the plenum at an air outlet, the pre-cooler having a first cooling fluid circuit configured to selectively circulate a first cooling fluid through the pre-cooler to selectively condition the scavenger air;

selectively directing the first cooling fluid exiting the pre-cooler through an auxiliary cooling unit to decrease a temperature of the first cooling fluid;

selectively directing the scavenger air through an evaporative cooler arranged inside the scavenger air plenum downstream of the pre-cooler, the evaporative cooler having an evaporative cooler fluid circuit configured to circulate an evaporative cooler fluid through the evaporative cooler, and the evaporative cooler configured to selectively evaporate a portion of the evaporative cooler fluid;

directing the scavenger air through a recovery coil arranged inside the scavenger air plenum downstream of the evaporative cooler, the recovery coil having a second cooling fluid circuit configured to circulate a second cooling fluid, and the recovery coil configured to reduce a temperature of the second cooling fluid using scavenger air; and

supplying a process cooling fluid in a process cooling fluid circuit to the heat load, the process cooling fluid receiving heat rejected by the heat load, wherein the process cooling fluid circuit is connected to the second cooling fluid circuit and the process cooling fluid comprises the second cooling fluid, and

wherein the first cooling fluid circuit is separate from the second cooling fluid circuit.

[0018] This overview is intended to provide an overview of subject matter in the present application. It is not intended to provide an exclusive or exhaustive explanation of the invention. The detailed description is included to provide further information about the present application.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] In the drawings, which are not necessarily drawn to scale, like numerals may describe similar components in different views. Like numerals having different letter suffixes may represent different instances of similar components. The drawings illustrate generally, by way of example, but not by way of limitation, various embodiments discussed in the present document.

[0020] FIG. 1A is a schematic of an example conditioning system for providing liquid cooling.

[0021] FIG. 1B is a schematic of an example conditioning system for providing liquid cooling.

[0022] FIG. 2 is a schematic of an example conditioning system for providing air cooling.