Claims

[Claim 1]

A computation device that determines a heat storage mode when heat storage is performed in a geothermal heat utilization system, the geothermal heat utilization system including:

a heat source well facility including a hot water well, a cold water well, a well-side pipe connecting the hot water well and the cold water well, and a pump provided at the well-side pipe; and

an auxiliary heat storage facility including a cooling tower, a chiller, and a refrigerant circuit connected to at least one of the cooling tower or the chiller and configured to exchange heat with the well-side pipe,

the computation device comprising:

an acquisition unit configured to acquire a simulation condition;

a first calculation unit configured to calculate, based on the simulation condition, a first simulation result being a result of a simulation in a first heat storage mode in which heat storage by the cooling tower is included;

a second calculation unit configured to calculate, based on the simulation condition, a second simulation result being a result of a simulation in a second heat storage mode in which heat storage by the chiller is included; and

a determination unit configured to determine one of the first heat storage mode and the second heat storage mode based on the first simulation result and the second simulation result, wherein

the determination unit determines any one of the first heat storage mode and the second heat storage mode in association with an individual virtual outside air condition of a plurality of virtual outside air conditions.

[Claim 2]

The computation device according to claim 1, wherein

the first simulation result and the second simulation result each include at least one of a temperature of injected water to the cold water well from the well-side pipe having exchanged heat with the refrigerant circuit, a heat storage amount in the heat source well facility, or power required for heat storage.

[Claim 3]

The computation device according to claim 1 or 2, wherein

the determination unit determines the heat storage mode based on a comparison result between power required for heat storage in the first heat storage mode and power required for heat storage in the second heat storage mode.

[Claim 4]

The computation device according to any one of claims 1 to 3, wherein

the second calculation unit calculates the second simulation result such that a heat storage amount in the second heat storage mode becomes the same as a heat storage amount in the first heat storage mode.

[Claim 5]

The computation device according to any one of claims 1 to 4, wherein

the plurality of virtual outside air conditions each include at least one of a virtual outside air temperature or a virtual outside air humidity.

[Claim 6]

The computation device according to claim 5, further comprising:

a temperature calculation unit configured to calculate, in the first heat storage mode, a limit outside air temperature at which a temperature of injected water to the cold water well from the well-side pipe having exchanged heat with the refrigerant circuit becomes an upper limit injected water temperature, wherein

the determination unit selects the second heat storage mode as the heat storage mode at the virtual outside air temperature equal to or higher than the limit outside air temperature.

[Claim 7]

A computation method of determining a heat storage mode when heat storage is performed in a geothermal heat utilization system, the geothermal heat utilization system including:

a heat source well facility including a hot water well, a cold water well, a well-side pipe connecting the hot water well and the cold water well, and a pump provided at the well-side pipe; and

an auxiliary heat storage facility including a cooling tower, a chiller, and a refrigerant circuit connected to at least one of the cooling tower or the chiller and configured to exchange heat with the well-side pipe,

the computation method comprising:

acquiring a simulation condition;

calculating a first simulation result based on the simulation condition, a first simulation result being a result of a simulation in a first heat storage mode in which heat storage by the cooling tower is included;

calculating a second simulation result, based on the simulation condition, the second simulation result being a result of a simulation in a second heat storage mode in which heat storage by the chiller is included; and

determining one of the first heat storage mode and the second heat storage mode based on the first simulation result and the second simulation result, wherein

in determining one of the first heat storage mode and the second heat storage mode, determining any one of the first heat storage mode and the second heat storage mode in association with an individual virtual outside air condition of a plurality of virtual outside air conditions.

[Claim 8]

A program for causing a computer to perform a method of determining a heat storage mode when heat storage is performed in a geothermal heat utilization system, the geothermal heat utilization system including:

a heat source well facility including a hot water well, a cold water well, a well-side pipe connecting the hot water well and the cold water well, and a pump provided at the well-side pipe; and

an auxiliary heat storage facility including a cooling tower, a chiller, and a refrigerant circuit connected to at least one of the cooling tower or the chiller and configured to exchange heat with the well-side pipe,

the method comprising:

acquiring a simulation condition;

calculating a first simulation result, based on the simulation condition, a first simulation result being a result of a simulation in a first heat storage mode in which heat storage by the cooling tower is included;

calculating a second simulation result, based on the simulation condition, the second simulation result being a result of a simulation in a second heat storage mode in which heat storage by the chiller is included; and

determining one of the first heat storage mode and the second heat storage mode based on the first simulation result and the second simulation result, wherein

in determining one of the first heat storage mode and the second heat storage mode, determining any one of the first heat storage mode and the

second heat storage mode in association with an individual virtual outside air condition of a plurality of virtual outside air conditions.

[Claim 9]

A control device comprising:

a mode information storage unit configured to store heat storage mode information related to the heat storage mode determined by the computation device described in any one of claims 1 to 7; and

an operation control unit configured to operate a geothermal heat utilization system based on the heat storage mode information stored in the mode information storage unit.

[Claim 10]

The control device according to claim 9, further comprising:

an outside air condition acquisition unit configured to acquire an actual outside air condition, wherein

the operation control unit operates the geothermal heat utilization system based on the heat storage mode associated with the actual outside air condition acquired by the outside air condition acquisition unit.

[Claim 11]

A control method comprising:

storing heat storage mode information related to the heat storage mode determined by the computation device described in any one of claims 1 to 7; and

operating a geothermal heat utilization system based on the heat storage mode information stored.

[Claim 12]

A control program for causing a computer to perform a method comprising:

storing heat storage mode information related to the heat storage mode determined by the computation device described in any one of claims 1 to 7; and

operating a geothermal heat utilization system based on the heat storage mode information stored.

[Claim 13]

A control device comprising:

a computation device that determines a heat storage mode when heat storage is performed in a geothermal heat utilization system, the geothermal heat utilization system including:

a heat source well facility including a hot water well, a cold water well, a well-side pipe connecting the hot water well and the cold water well, and a pump provided at the well-side pipe; and

an auxiliary heat storage facility including a cooling tower, a chiller, and a refrigerant circuit connected to at least one of the cooling tower or the chiller and configured to exchange heat with the well-side pipe,

the computation device comprising:

an acquisition unit configured to acquire a simulation condition;

a first calculation unit configured to calculate, based on the simulation condition, a first simulation result being a result of a simulation in a first heat storage mode in which heat storage by the cooling tower is included;

a second calculation unit configured to calculate, based on the simulation condition, a second simulation result being a result of a simulation in a second heat storage mode in which heat storage by the chiller is included; and

a determination unit configured to determine one of the first heat storage mode and the second heat storage mode based on the first simulation result and the second simulation result, wherein

the determination unit determines any one of the first heat storage mode and the second heat storage mode in association with an individual virtual outside air condition of a plurality of virtual outside air conditions,

the control device including:

a mode information storage unit configured to store heat storage mode information related to the heat storage mode determined by the computation device,

an outside air condition acquisition unit configured to acquire an actual outside air condition, and

an operation control unit configured to operate the geothermal heat utilization system based on the heat storage mode information stored in the mode information storage unit, wherein

the operation control unit operates the geothermal heat utilization system based on the heat storage mode associated with the actual outside air condition acquired by the outside air condition acquisition unit.

[Claim 14]

A control method comprising:

a computation device that determines a heat storage mode when heat storage is performed in a geothermal heat utilization system, the geothermal heat utilization system including:

a heat source well facility including a hot water well, a cold water well, a well-side pipe connecting the hot water well and the cold water well, and a pump provided at the well-side pipe; and

an auxiliary heat storage facility including a cooling tower, a chiller, and a refrigerant circuit connected to at least one of the cooling tower or the chiller and configured to exchange heat with the well-side pipe,

the computation device comprising:

an acquisition unit configured to acquire a simulation condition;

a first calculation unit configured to calculate, based on the simulation condition, a first simulation result being a result of a simulation in a first heat storage mode in which heat storage by the cooling tower is included;

a second calculation unit configured to calculate, based on the simulation condition, a second simulation result being a result of a simulation in a second heat storage mode in which heat storage by the chiller is included; and

a determination unit configured to determine one of the first heat storage mode and the second heat storage mode based on the first simulation result and the second simulation result, wherein

the determination unit determines any one of the first heat storage mode and the second heat storage mode in association with an individual virtual outside air condition of a plurality of virtual outside air conditions,

the control method comprising:

storing heat storage mode information related to the heat storage mode determined by the computation device,

acquiring an actual outside air condition, and

operating the geothermal heat utilization system based on the heat storage mode information stored, wherein the heat storage mode is associated with the actual outside air condition acquired.

[Claim 15]

A control program for causing a computer to perform a control method comprising:

a computation device that determines a heat storage mode when heat storage is performed in a geothermal heat utilization system, the geothermal heat utilization system including:

a heat source well facility including a hot water well, a cold water well, a well-side pipe connecting the hot water well and the cold water well, and a pump provided at the well-side pipe; and

an auxiliary heat storage facility including a cooling tower, a chiller, and a refrigerant circuit connected to at least one of the cooling tower or the chiller and configured to exchange heat with the well-side pipe,

the computation device comprising:

an acquisition unit configured to acquire a simulation condition;

a first calculation unit configured to calculate, based on the simulation condition, a first simulation result being a result of a simulation in a first heat storage mode in which heat storage by the cooling tower is included;

a second calculation unit configured to calculate, based on the simulation condition, a second simulation result being a result of a simulation in a second heat storage mode in which heat storage by the chiller is included; and

a determination unit configured to determine one of the first heat storage mode and the second heat storage mode based on the first simulation result and the second simulation result, wherein

the determination unit determines any one of the first heat storage mode and the second heat storage mode in association with an individual virtual outside air condition of a plurality of virtual outside air conditions,

the control method comprising:

storing heat storage mode information related to the heat storage mode determined by the computation device,

acquiring an actual outside air condition, and

operating the geothermal heat utilization system based on the heat storage mode information stored, wherein the heat storage mode is associated with the actual outside air condition acquired.