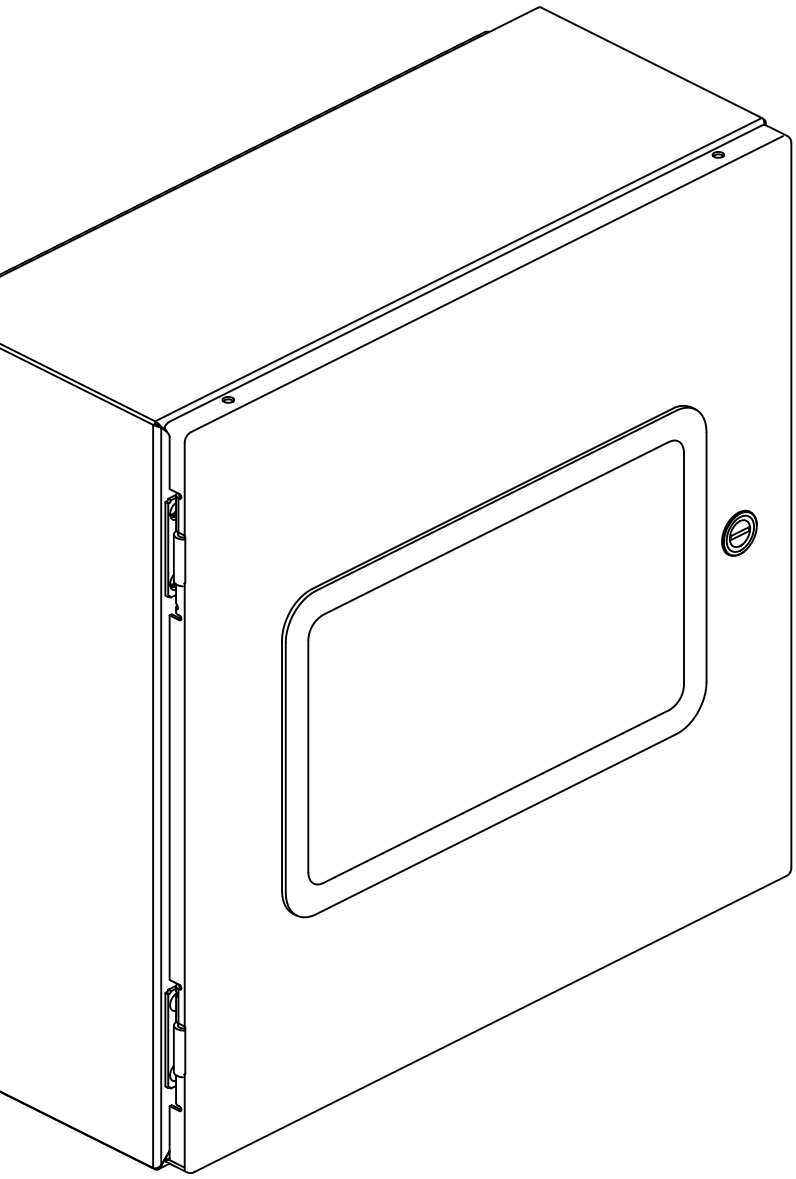
ARMSTRONG



OPTI-VISOR™ ultra-efficient Chiller plant automation

Control contractor requirements

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1.0 CHILLED WATER PLANT

1.1 GENERAL SYSTEM REQUIREMENTS

- The chilled water plant shall be a water-cooled all-variable speed plant with variable flow and variable speed chillers, variable flow cooling towers (variable speed fans and pumps) and variable speed distribution pumps.
- The application shall be comfort cooling.
- The system design shall be either variable flow primary system or variable flow primary/variable flow secondary system.
- Chilled water primary pumps, (secondary pumps) and condenser pumps could be in parallel, dedicated or duty/standby operation.
- All pieces of equipment in each set (cooling towers, condenser pumps, chillers and chilled water pumps) shall be identical.
- The chiller plant shall involve up to five chillers, up to five cooling towers, up to five variable chilled water primary pumps, (as many as required variable chilled water secondary pumps) and up to five variable condenser pumps.

1.2 PLANT INFORMATION REQUIRED TO CONFIGURE THE OPTI-VISOR™

The following information shall be made available by the plant owner or its representatives, for predicted performance analysis and to configure the OPTI-VISOR™ for the plant:

- Plant geographical location and design day load.
- Load profile (expected hours of operation per year at different loads ranges).
- Plant piping and instrumentation diagram.
- Chiller nameplate and design data, including capacity, number of compressors, design kW draw, (design, maximum and minimum) condenser and chilled water flows, minimum load and tested performance at design load and at least four part load points, specifying flows and water temperatures for each point.
- Tower nameplate and design data, including capacity, design kW draw, design and minimum fan speeds, (design, maximum and minimum) water flows, and design approach.
- Pumps nameplate and design data, including design flow, head kW draw, and the flow/head curve at maximum speed.

2.0 CHILLED WATER PLANT CONTROL SYSTEM

The chilled water plant control system shall be an all-variable speed plant automation system that executes the following functions:

- Sequence and rotate the chillers.
- Adjust the chilled water supply temperature set point.
- Provide variable speed control instruction to the cooling tower pumps and fans.
- Control the variable primary (and/or secondary) chilled water distribution pumps in response to process variable from the load (DP signal sensors, flow meters, valve positions and/or kW meters).
- Provide instruction to the isolation valves and modulates the supply and condenser bypass valves, if present.
- Provide system alarms and warnings.
- Is capable of receiving optimization instructions from an external optimization controller utilizing Hartman LOOP™ demand based relation control through a local serial communications bus (required points listed below).

The chilled water plant control system may be part of the building automation system, or a stand alone plant automation controller (which may communicate plant operation status and alarm data to a building automation system and receive commands and parameters from it through a local serial communications BUS).

The chilled water plant control system shall receive the operating instructions from the OPTI-VISOR™, and is responsible to operate the plant equipment at those optimized equipment settings.

The chilled water plant control system is at all times (even if communication with the OPTI-VISOR™ panel fails) responsible for the safe sequencing, operation, and control of the plant equipment in compliance with all the plant equipment operating constraints, and shall, whenever possible, respond to equipment alarms by sequencing on additional standby equipment to maintain appropriate cooling to the building.

The plant control system shall be capable of reading and processing appropriate signals for at least the following data points, either through serial communication or hardwired, and directly or from associated panels:

- Analog input for primary flow, all plant elements consumed kW, and supply and return temperature sensors (chilled and condenser water).
- Analog input for zone differential pressure (DP), valve positions and/or zone BTU meters that determine the flow demand to be satisfied by the supply pumps.
- Digital input for status of condenser, primary [and secondary] pumps.
- Digital input for status of towers fans and chillers.
- Digital input for status of isolation valves.
- Digital input for alarm signals from chillers, pumps and fans.
- Digital output for condenser, primary (and secondary) pumps start/stop signals.
- Digital output for tower fans and chillers start/stop signals.
- Digital output for isolation valves open/close signals.
- Analog output for chiller's water supply temperature set point adjustment.
- Analog output for supply and condenser by-pass valves, if present.
- Serial data communications from the chilled water plant OPTI-VISOR™.

The plant control system shall receive the following control signals from the OPTI-VISOR™ panel through a local digital serial communications bus:

- Requested optimal number of chillers to operate.
- Requested optimal number of cooling towers/fans to operate.
- Requested optimal number of condenser water pumps to operate.
- Requested optimal condenser water pump speed.
- Requested optimal tower fan speed.
- Requested optimal chilled water supply temperature set-point.
- **Warning** – Plant control system not following optimization advice.
- Communication watchdog signal.

The plant control system shall send the following control signals to the OPTI-VISOR™ panel through the serial communications bus:

- Primary water flow
- Chilled water supply temperature
- Chilled water return temperature
- Condenser water entering temperature
- Condenser water leaving temperature
- Running status of each tower fan, condenser pump, chiller and primary pump.
- Speed of each fan, condenser and primary pump.
- Alarm status of each tower fan, condenser pump, chiller and primary pump (availability to run).
- kW draw of each tower fan, condenser pump, chiller and primary pump (or, at least, of each set).
- Communication watchdog signal.
- "OPTI-VISOR™ enable"

2.1 SENSORS AND SWITCHES

- The temperature sensors measuring the supply and return temperatures for each loop (condenser and chilled water); the two probes shall be matched pair. The accuracy of the temperature sensors shall be the lesser of 0.25% of span or 1F. Sensors shall be mounted such that the reading is not affected by stratification, the effects of radiation from heating elements are minimized, and rapid response to changing temperature is achieved.
- The accuracy of the differential pressure sensors shall be 0.25% of span.
- Pressure switches shall have adjustable ranges and adjustable differentials to suit the application. Pressure switches shall be sensitive enough to ensure correct monitoring. Switches shall be mounted such that they are not affected by turbulence or eddies.
- Flow sensors shall have an accuracy of 2% of reading or better. Magnetic or ultrasonic types are preferred. Sensors shall be mounted such that the reading is not affected by stratification.

2.2 ELECTRICAL WIRING AND INSTALLATION

- All wiring for communication between sensors, controllers (including the OPTI-VISOR™ panel) and valve actuators shall be shielded so as not to be susceptible to electrostatic, magnetic, mode and cross talk noise. Electrical wiring shall conform to the requirements of the electrical services section of the specifications.

2.3 CONTROL CONTRACTOR RESPONSIBILITIES

The controls contractor is responsible for the following:

- Site audit and assessment of communications requirements between the plant control system, the plant equipment, and the OPTI-VISOR™.
- Furnish and site installation of any necessary variable frequency drives (VFDs) on existing pumps or fans to make the chiller plant an all-variable speed plant.
- Furnish and installation of any necessary instrumentation and control valves to provide the necessary control signal for the proper operation of the all-variable speed plant.
- Furnish and install the OPTI-VISOR™.
- Make the necessary control sequence changes to the existing plant control system to enable taking instructions from the plant OPTI-VISOR™.
- Modify the existing plant control system to include the necessary data-points for instructions from the OPTI-VISOR™.
- The supply and installation of all necessary ancillary hardware required to enable the all-variable speed plant operation with the OPTI-VISOR™.
- Commissioning of the plant control system and OPTI-VISOR™ with the support of the OPTI-VISOR™ manufacturers personnel.
- Installation of the intranet and Internet access.

2.3.1 INPUT/OUTPUT

The OPTI-VISOR™ panel shall receive the following control signals from the plant control system through a serial communications bus:

- Primary water flow
- Chilled water supply temperature
- Chilled water return temperature
- Condenser water entering temperature
- Condenser water leaving temperature
- Running status (on/off) of each tower fan, condenser pump, chiller and primary pump.
- Alarm status (availability to run) of each tower fan, condenser pump, chiller and primary pump.
- Speed of each fan, condenser and primary pump.
- kW draw of each tower fan, condenser pump, chiller and primary pump (or, at least, of each set).
- Communication watchdog signal.
- "OPTI-VISOR™ enable"

The OPTI-VISOR™ panel shall send the following control signals to the plant control system through the serial communications BUS:

- Requested optimal number of chillers to operate.
- Requested optimal number of cooling towers/fans to operate.
- Requested optimal number of condenser water pumps to operate.
- Requested optimal condenser water pump speed.
- Requested optimal tower fan speed.
- Requested optimal chilled water supply temperature set-point.
- **Warning** – Plant control system not following optimization advice.
- Communication watchdog signal.

2.3.2 COMMUNICATION PROTOCOL

The OPTI-VISOR™ shall be able to communicate with the chilled water plant in at least the following protocols: Modbus RTU, Modbus TCP, BACnet MSTP, BACnet IP, MetaSys N2, Lonworks and TREND.

2.3.3 INTRANET AND WEB ACCESS

The OPTI-VISOR™ shall provide an ethernet TCP/IP internet address with both read/write functionality. This access shall allow the relevant staff to locally or remotely:

- Using a standard internet browser, view a set of screens showing live and historical data, including plant energy efficiency, OPTI-VISOR™ recommendations, sensor readings, equipment running, speed and alarm status, plant controller compliance status and communication status.
- Receive alarm messages, automatically sent via email.
- Troubleshoot, configure and download program updates remotely.

2.3.4 SITE TESTING

Upon completion of all system startup and checkout procedures and while the mechanical systems is monitoring and controlling in a **normal operating** condition, the manufacturer and the facility personnel shall jointly demonstrate the performance of the complete system to maintain flows, temperatures, levels and pressures. The test must meet the particular building's design requirements to be considered passed and acceptable. Any failures shall require the test to be restarted.

2.3.5 CALIBRATION, COMMISSIONING AND PERFORMANCE REPORTING

The chilled water plant OPTI-VISOR™ panel shall be commissioned and fully operational after delivery to the site at an agreed date. Commissioning procedure shall conform to the **MECHANICAL SERVICES** section of these specifications.

The calibration and commissioning procedure shall consist of verifying communication, sequences of operation, operation within limits, and expected performance. All commissioning information shall be documented on commissioning data sheets which shall be submitted to the facility personnel for approval prior to testing. The facility personnel shall be notified of the commissioning schedule so they may witness the procedure.

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