Chilled water plant controls

The control strategies Exergenics delivers, the plant variables they are calculated from, and the constraints that stay in place. Written for the BMS technician and the consulting engineer. Every strategy is a setpoint calculation the BMS can run and your team can read. The final setpoints for a given site are derived from its calibrated model and published in a site-specific functional description.

Inputs

Setpoints are calculated from variables already measured or calculated in the BMS. No new instrumentation is assumed.

Variable	Unit	Definition
Field demand	kWr	Instantaneous cooling delivered to the field. The primary control variable: staging, sequencing and the condenser water loop all respond to it rather than to chiller loading percentage.
Wet-bulb temperature	°C	Outside ambient wet bulb, measured, or calculated from dry-bulb temperature and relative humidity.
Chiller status	`on / off`	Enabled status of each chiller, which determines the current stage of operation.
Chiller load	kWr	Instantaneous cooling output of each chiller.

Field demand, in order of reliability of the available points

1. Common supply and return temperature and flow known for the field: kWr = field L/s × (return °C − supply °C) × 4.187
2. Supply, return and flow known per chiller: kWr = chiller L/s × (return °C − supply °C) × 4.187, summed across running chillers
3. Chiller load percentage and capacity known: kWr = load % × rated capacity (kWr), summed across running chillers

Recommendations suite

Most engagements implement three or four of the six. Which ones, and in what order, follows the plant's own data: the Optimisation Journey sets out what each stage of data access unlocks.

Dynamic condenser water temperature reset	Setpoint calculated from chiller status, field demand and wet-bulb temperature, as an approach above wet bulb that changes with the stage and the load. Reset dynamically, minutely (adjustable), between the minimum and maximum temperature constraints set by the client or the incumbent, and rate-limited to 0.2 °C per minute. Chiller power rises with condenser water temperature; tower fan and pump power fall. The setpoint sits at the bottom of that total, which is rarely where either component alone is happiest. Increases the efficiency of the whole plant.
Dynamic condenser water flow reset	Setpoint calculated as a function of chiller load, modulating between the minimum and maximum flow constraints set by the client or the incumbent, rate-limited to 1 L/s per minute. Targets the condenser water pump share of plant energy, typically 10–15%.
Chiller sequencing strategy	Order of operation of available chillers and groups of identical chillers, determining which machines are enabled as stage up and stage down demand setpoints are reached. Where machines differ in design (fixed speed against VSD, for example) the sequence falls out of their two performance surfaces rather than a rotation rule. Improves efficiency and mechanical performance: runtime per cycle, short cycling, starts and stops, and runtime balance between low-load and high-load chillers.
Chiller stage up and stage down demand setpoints	Staging on field demand (kWr), not chiller loading percentage. Stage-up and stage-down bands overlap: that overlap is the hysteresis that stops hunting, with a stabilisation delay of 15 minutes to stage up and 20 minutes to stage down (adjustable). Supplemented by the constraints and emergency staging conditions set by the client or the incumbent, including runtime delay timers, minimum decoupler flow, cooling call, bypass valve position, hot-day stage up, lead/lag rotation, and any other chiller safety and reliability measure. All of these stay where they are.

Dynamic chiller load balancing	Where chillers on a common header have different efficiency curves, no fixed split is right across the year. The load balancer publishes the split as a lookup table against field demand and wet bulb, so the BMS reads it rather than calculates it.
Dynamic chilled water temperature reset	Supply temperature reset against field demand and ambient conditions, within limits that hold comfort and dehumidification. Where the M&V boundary requires chilled water temperature to the field to be held, this strategy is simulated for its energy saving and reported rather than implemented.

What does not change

All existing hardware and software is retained: servers, controllers, network, panels, valves, actuators, sensors and the BMS application itself. Nothing is installed.

Implementation is by the incumbent controls technician or an approved agent, tested offsite and commissioned outside normal hours. Exergenics does not write to the BMS.

All existing safety mechanisms, interlocks and control strategies outside the chilled water plant stay in place unless the functional description states otherwise.

For M&V, points associated with chiller optimisation are trended at 15-minute intervals or better and retained for a minimum of three years: physical inputs and outputs, chiller and drive high-level interface points, meters and the site weather station.