A facility’s central chiller plant uses a significant portion of the total energy, typically 20%. Managing this load, while still maintaining occupant comfort, should be a primary strategy for overall energy management. Johnson Controls® Central Plant Optimization™ 10 (CPO 10) provides such a strategy. The application uses proven, tested best practices to select the most efficient combination of chillers, pumps, and cooling towers needed to match the building load. The application then commands the selected devices to the appropriate state or speed, providing the necessary sequencing of pumps, isolation valves, and main equipment, while observing all the timing delays for safe and stable operation of the central chiller plant.

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
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<tr>
<td>Control Sequences Created by the System Selection Tool (SST) within Controller Configuration Tool (CCT)</td>
<td>Allow you to select from tens of thousands of possible equipment combinations, piping configurations, and control strategies, each resulting in the automatic creation of a software program using proven best practices.</td>
</tr>
<tr>
<td>CCT Editor Allowing Customization of Individual Components of the Program Created Using SST</td>
<td>Addresses special situations that cannot be described in SST and easily customizes the program, without the need to build the entire program from scratch.</td>
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<tr>
<td>Advanced Control Algorithms</td>
<td>Evaluate all possible combinations of devices considering capacities, efficiencies, runtimes, and number of starts, resulting in the most efficient operating state, rather than simply selecting the next available device as the building load increases.</td>
</tr>
<tr>
<td>Total Automation of All Equipment</td>
<td>Best practice program properly sequences all devices in a safe and stable fashion.</td>
</tr>
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</table>
**Creating a Complex Program without Programming**

The System Selection Tool (SST) is a control program generator that relies on defining the characteristics of the chiller plant and its control strategies. The tool supports:

- Up to eight chillers, centrifugal (all constant or variable speed), screw compressor, or reciprocating of mixed sizes, piped in parallel
- Up to eight primary chilled water pumps of mixed sizes, all dedicated or headered, and all constant or variable speed
- Up to eight secondary chilled water pumps that are mixed in size, are piped in parallel, and are variable speed
- Up to eight condenser water pumps that are mixed in size, all dedicated or headered, and all constant or variable speed
- Up to eight cooling towers piped in common to the chillers, are single speed (with optional vernier control), multispeed, or variable speed, with a variety of tower/sump valve arrangements
- Also supports Air cooled chillers

The tool offers a variety of primary control strategies including measuring building chilled-water flow and differential temperature, the chillers’ kW load, flow through a decoupler pipe in a primary/secondary system, or differential temperature only in a constant speed chilled water pump system. You can also select dozens of secondary strategies, such as open loop control of the cooling towers (as defined by the American Society of Heating, Refrigerating and Air-Conditioning Engineers [ASHRAE]), or closed loop control of condenser-water setpoint.

After making the selections, SST generates a complete program by linking together appropriate software modules, each of which has been thoroughly tested and documented. This process removes the variability commonly found in totally custom-generated programs using a traditional software program editor.

Once the software modules are linked, the tool allows the entry of all equipment parameters, such as chiller and pump capacities, minimum/maximum chilled and condenser water temperatures and flows, rated efficiencies, and sensitivity of chiller capacity to changes in lift temperature. You can run the resulting program in a simulator mode to verify proper operation before you download the program into Metasys Field Equipment Controllers (FEC) or Network Control Engine (NCE).

![Figure 2: System Selection Tool](image)

**More Flexibility**

While SST is very flexible, you may still have unique situations that SST cannot accommodate. In these instances, the power of CCT is advantageous. By editing the individual software modules, you can provide customized control capabilities, or add new modules. The CCT editor marks these edited modules so you can easily identify the parts of the program that are factory tested and documented, and which portions are job-specific.
Sophisticated Control Algorithms

The CPO 10 application is much more than a simple out of the box program. The application uses many sophisticated algorithms to determine the most efficient set of equipment necessary to match the building load. For example, if the building load increases beyond the capacity of the current operating chillers, The CPO 10 application can calculate the estimated efficiency of all possible chiller combinations. The application then selects the most efficient combination, and determines the most efficient combination of chilled water pumps, condenser water pumps, and cooling towers necessary to complement the chosen chillers.

The selections give preference to equipment with the least runtime and/or number of starts for equipment with comparable capacities and rated efficiencies, which reduces equipment maintenance costs. The CPO 10 application proceeds to turn on or off the necessary equipment, including isolation and bypass valves, providing the appropriate timing to keep the entire plant stable.

As actual chiller lift (the difference between entering condenser water temperature and leaving chilled water temperature) varies from the design lift, The CPO 10 application adjusts the rated capacity of the chillers using the manufacturer's specifications, allowing the plant to take advantage of the added capacity before starting additional equipment. In addition, for variable speed chillers, the upper and lower optimal percent load points (the percent of full load capacity where the chiller is no longer efficient) shift down as measured lift decreases, increasing the accuracy of selecting the most efficient chillers.

For variable primary flow systems, the CPO 10 application can monitor the main chilled water coil valves throughout the facility to reset the pump's differential pressure setpoint if no valves are fully open, resulting in lower pump speeds and lower energy consumption. To prevent an unreliable signal from a single valve from incorrectly taking control of the reset program, the application uses the average and standard deviation of the positions to perform statistical tests, resulting in 97.5% assurance that the valves are 100% or 90% open.
If building load continues to climb late in the work day, the CPO 10 application can be programmed to coast, which means the application does not start any additional chillers, with the expectation that the cooling load soon begins to decrease. The program also accounts for problems in the chiller plant. Equipment taken out of service or exhibiting alarm conditions is easily removed from consideration for selection. If the system cannot maintain the chilled water setpoint for a specified time period, the application automatically derates the operating chillers to smaller capacities, then finds a more efficient set of equipment to meet the load. This situation may occur when outdoor temperatures exceed design days, or in cases where tube fouling causes loss of chiller capacity.

Conclusion
Johnson Controls has combined expertise from designing YORK® chillers and Metasys® controls to bring the best, world-class program to operate your chiller plant. The result is Johnson Controls Central Plant Optimization™ 10, which saves energy and improves reliability in your facility.

Related Documentation
For information on how to configure Johnson Controls Central Plant Optimization™ 10, refer to the Johnson Controls Central Plant Optimization™ 10 Application Note (LIT-12011575). For information on how to use System Selection Tool, refer to the Controller Configuration Tool Help.