Evaporative Cooling
Performance Monitoring and Control System
(CMM - CMC)
Operating Manual

CMM (Control and Monitoring Master)

CMC (Control and Monitoring Client)

PEAK+

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Description

The Peak+ Control and Monitoring Master and Client (CMM, CMC) controllers monitor various inputs including ambient temperature, humidity, condenser air and leaving liquid temperature, and compressor power. The controllers calculate the amount of spray needed and send an electrical signal to the external water solenoid valves for the purpose of wetting the Peak+ Media.

Each controller is capable of handling two refrigeration circuits on each HVAC unit they are installed on. An HVAC unit with more than two circuits may require additional controllers.

The controllers measure Condenser Air (CAt) temperature (temperature behind the pads) and the Condenser Liquid temperature (CLt) (temp of refrigerant leaving the condenser) on each circuit, the compressor current (CPw) of each circuit and the condenser liquid line temperature (of each circuit). The CMM also measures the ambient Dry Bulb (DB) Temperature, the Relative Humidity (RH), and the system Water Pressure. The ambient Dew Point (DP) and Wet Bulb (WB) temperatures are calculated from the DB and RH. All measured and values are recorded by the CMM and passed on to the server.

All information is accessible on the web-hosted Peak+ Dashboard so that the user may easily see how the system is performing. Select users can also make changes to the system parameters.

The units are powered by a 24VAC transformer that connects directly to the HVAC unit (or in some instances the power was provided via a dedicated UPS Power source).

Each CMM or CMC is equipped with two switches. One is the “OFF/ON” switch and the other is the test spray switch to run a spray algorithm for visual inspection.

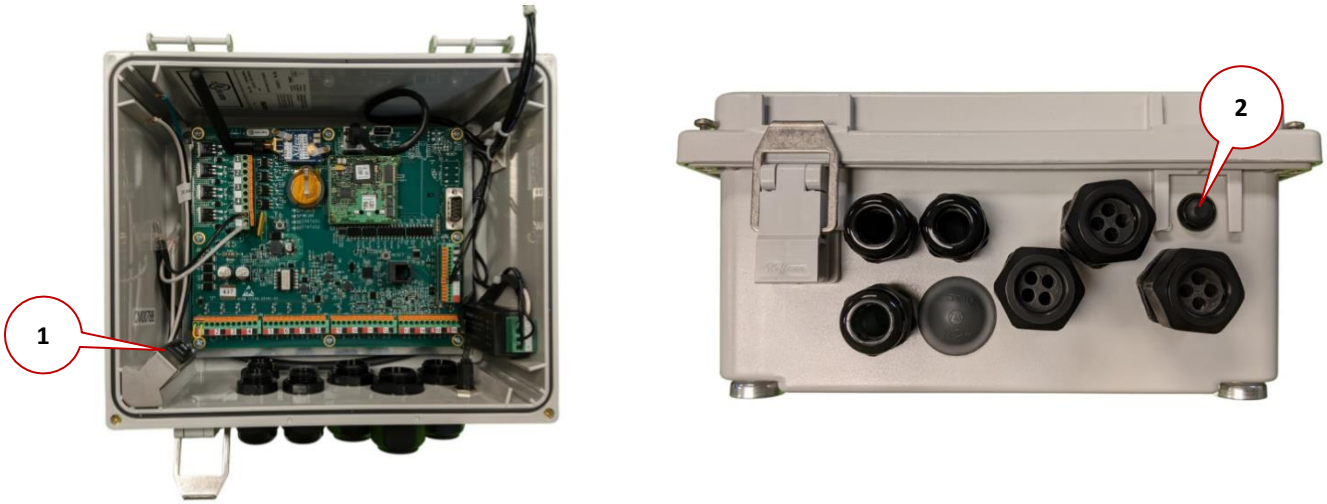


Figure 1. (Left) CMM Interior view. 1). Control power switch location.
(Right) CMM Bottom view. 2). Test spray switch location.

The “OFF/ON” switch is prewired to a black and a white 16 gauge set of wires to receive power from the 24VAC transformer.
The “Test Spray” switch is used to manually put a circuit into Test Spray mode for a preset cycle.

- To initiate Test Spray, depress and hold Test Spray button for approximately 10 seconds. Circuit #1 will become active with a 2 second spray time and a 10 second gap time for a default total of 120 seconds (this can be changed for larger systems). The spray will stop once the “Max Test Spray Time” has elapsed or when you push the button to advance. The controller will not automatically advance to Circuit #2 if it stops because it reached that time period.
- To advance to the second circuit, press the Test spray button (for 1 full second). The second circuit will then run until the it reaches the Max Test Spray Time, or when the button is pushed again to complete the test spray and return to normal operation.

There are two output spray channels. Each output channel can drive multiple spray solenoid valves.
There is a wiring diagram located in the plastic pouch of each CMM or CMC.

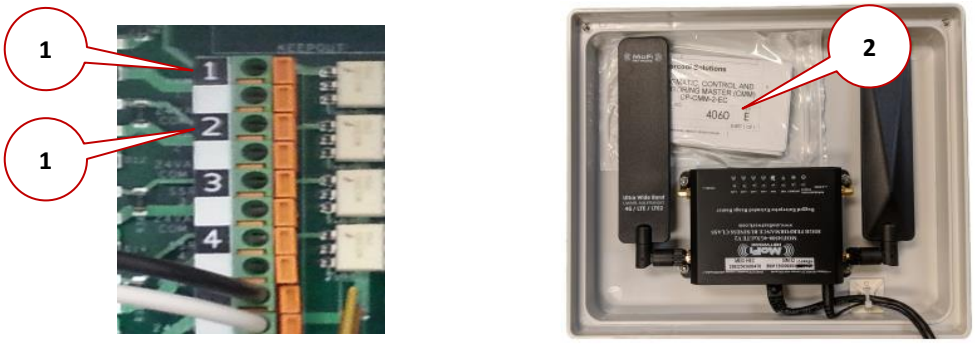


Figure 2. 1). Output spray channels 1 & Figure 2. 2). Location of CMM & CMC Wiring and Connection Schematic

All of the analog sensors are connected at the labeled connector along the bottom of the board. Each sensor connection is listed in the CMM or CMC schematic drawing provided inside the controller. It is numbered and color coded for its location.

Figure 3. Controller Analog Sensor terminals. See Wiring and Connection Schematic for wiring details.

CMM/CMC Controller Power Supply

The Power Supply Kit includes a multi-voltage transformer, fuse block with din rail and fuses, wires, connectors, and mounting hardware is provided with each CMM/CMC Controller. Power to controller transformer is facilitated from main line power service block of the applied system.

SENSORS

All sensors are provided with 25-ft cables per-labeled at each end and tinned on termination ends for easy connection into the spring action terminals. Excess sensor cable lengths should be coiled and secured inside the cabinet of the applied unit. Do Not shorten the cables.

A system outdoor ambient and humidity (S0.OAr-OAt) weather station is provided for each CMM and mounts magnetically on or near the machine. The weather station should be placed so that it would not be directly affected by condenser discharge air or other exhaust heat sources, and should be level with the condenser air temperature sensors.

Figure 4: Weather Station (CMM only)

A system water pressure transducer (S0.WDp) is to be mounted vertically on the system water piping in the vicinity of the CMM controller (typically upstream of the unit water service shutoff valve- but may be otherwise specified on layouts). The Transducer has a 1/8” FNPT fitting.

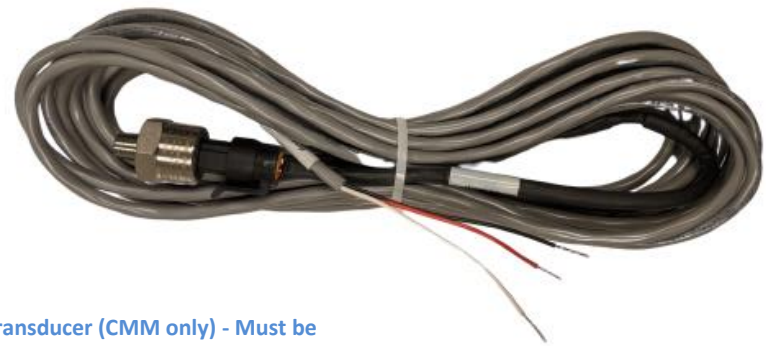


Figure 5: Water Pressure Transducer (CMM only) - Must be mounted in the Vertical Position

A set of condenser liquid line temperature (C1.CLt, C2.CLt) sensors is provided with each controller. Each circuit specified sensor is to be mounted on the designated circuit liquid line prior to the expansion valve of the applied system. Sensor mounting surface area must be cleaned with emery cloth prior to mounting and secured with a wire tie and insulated using a high-quality insulating cork tape.

Figure 6. Condenser Liquid and Condenser Air temperature sensor (CLt/CAt)

A set of condenser air temperature (C1.CAt, C2.CAt) sensors is provided with each controller. Each circuit specified sensor is to be mounted in the sensor bracket provided on the downstream side of the designated Peak+ Frame of the applied system. Note the CAt and CLt sensors are identical other than the labels.

A set of compressor current transducers (C1.CPw, and C2.CPw) is provided with each controller. Each circuit specified transducer is to be clamped on the load side power wiring to the circuit compressor(s). Care must be taken to capture same phase of each compressor in the case of multiple compressors) on a designated circuit of the of the applied system. Note that in VFD applications the transducer must be upstream of the VFD.

Figure 7. Compressor power transducers (CPw)

Programming, Sequence of Operation, and Monitoring the CMM/CMC

Programming and Setup:
Programming of the controllers is facilitated at Peak+ and is site specific for each applied system. Before commissioning, accounts will be set up for the end user. There can be two types of user accounts: view only, and Admin. Admin users will have access to the parameters and be able to make changes to system operation. It is recommended to reach out to Peak+ before making changes as there may be a better approach and more time-affective way to achieve the desired change.

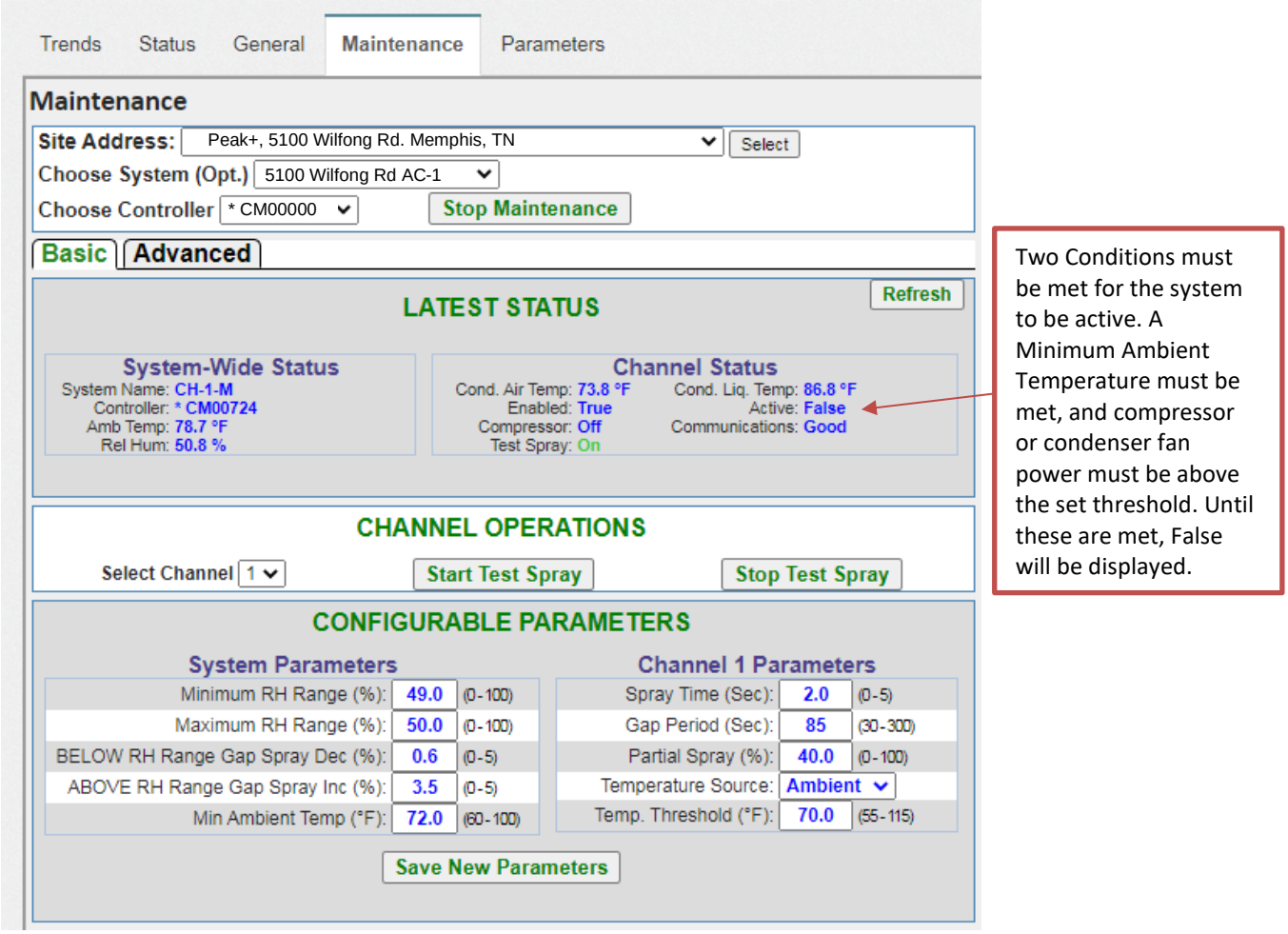


Figure 8. Maintenance and Parameter Setup Screen

<u>System Parameters</u>:

Minimum RH Range Minimum RH Range (X%). This is the lowest value of the "normal range." this is where no action is taken on the GAP length (time between spray pulses). Enter a value between 1 and 70%. See diagram on next page for details. Typically 40-49%.

Maximum RH Range Maximum RH Range (Y%). This is the lowest value of the "normal range." this is where no action is taken on the GAP length (time between spray pulses). Enter a value between 30 and 99%. Typically 50-55%.

Below RH Range Gap Spray Dec. Below RH Range Gap Spray Dec. This parameter describes the action taken when the relative humidity is very low (dry). The evaporation rate is high. For each % below the normal range, the time between spray pulses (GAP) will be reduced by ___%. Enter a value between 0.5 and 5 (Typically 0.6%).

Above RH Range Gap Spray Inc. This describes the action taken when the relative humidity is high (humid), where the evaporation rate is slower. For each % above the normal range, the GAP will be increased by ___%. Enter a value between 1 and 9 (Typically 3-4%).

RH	0%	X%	Y%	100%
	|-------- more spray ----------|--- no change ---|---------- less spray ----------|			

Channel Parameters: – Each channel has an identical set of parameters that define that channel's operation. The parameters below need to be entered for each channel used.

Temperature Source: (Condenser liquid temperature or ambient temperature)
The ambient temperature is used in most cases.
If Condenser Liquid Temperature is selected, then it will use the leaving liquid line temperature for the given circuit instead.

Temperature Threshold: (minimum temp to allow spraying)
For ambient temperature, 70F is typically used. For liquid temp (attached to the condenser output), an input temperature of about 75 degrees would be used, though it depends on refrigerant and other factors.

Spray Time: (0.9- 5 seconds).
This is the time the valves are open and water is flowing to the spray nozzles. The taller the filter, the longer the pulse. (Typically, between 1 and 3 seconds).

Gap Period: (5 to 999 seconds).
This is the starting gap time at normal humidity range and the temperature threshold. The calculated gap time will increase or decrease from this starting point.

Partial Spray (5% to 95%). This is for systems with a shared airway between two circuits. This is the percentage of the channels original spray rate it will spray when its own channel is off but the other channel is on. Each channel's partial spray length is based on its own spray rate, not the opposite channel it is tied to.

CMM/CMC Controller Sequence of Operations:

Each channel corresponds with a designated refrigerant circuit and has its own program. If minimum ambient temperature is met and there is a signal from the corresponding compressor(s) or Fan(s) then that channel is active for spray. Spray time and base gap time are pre-set at factory or by user with administrative rights. Reduction in gap between sprays is calculated by the amount over the ambient temperature. This amount is multiplied by a set reduction rate; this quantity is the total percent of the set gap time that is reduced.

If relative humidity is in the set normal range, then there is no further change in gap time. If RH is below normal range, then gap time is reduced further. A percent reduction is calculated by set reduction rate multiplied by the amount below normal. This quantity is added to the reduction rate calculated based on ambient temperature and the total is the percent reduction in the set gap time. See example below. If RH is above the normal high set point, the gap time is increased by the same method above. A different rate can be set for Over RH normal increase and below normal decrease. There is a minimum gap time in place to prevent from spraying constantly.

If there is no signal from corresponding compressor(s) or fan(s), but the opposite circuit is active, partial spray will be active for that channel. Partial spray percentage is pre-set by factory or by user with administrative rights. This percent is the percentage of the set spray time. The gap time is still calculated as above, based own that circuits parameters. This is only for systems with circuits sharing a single airway. Percentage determined by amount of air pulled through frames while other circuit is running. If no airway is shared, then percentage is set to 0.

Example: If ambient input is used, the lowest ambient temp is set to 70°, the gap setting is 100 seconds and over temperature gap reduction rate is set to 2%.

Here, an input reading from the ambient sensor is 85°. That's 15° over the input setting.

15° x 2% = 30%

100 – (0.3 x 100) = 70 seconds.

The spray gap would be reduced from 100 to 70 seconds.

A smaller % setting for ambient inputs might be better.

If RH is below normal:

RH low is 49%, and the reduction rate is 1%.

An input reading from the RH sensor is 20% (29 below normal).

29 x 1% = 29%

This is added to over ambient reduction.

30% + 29% = 59%

Resulting gap between sprays: 100 – (0.59 x 100) = 41 seconds

Monitoring:
Each system owner will receive a login and password issued by Peak+ to monitor each CMM and/or CMC attached to all their HVAC equipment and view the collected data. Monitoring of collected data and the graphics will be performed through the Peak+ Dashboard Portal.

Dashboard and Trend View

Shown below is the Dashboard. From this screen the user can see the trend view for any site system. There are three parameters displayed on the Trend View page shown below; ambient dry bulb temperature (S0.OAt) ambient wet bulb temperature (S0.OAr.wb), and water distribution pressure (S0.WDp). These can be turned off if desired, and a selected number of other parameters can be displayed (see next page).

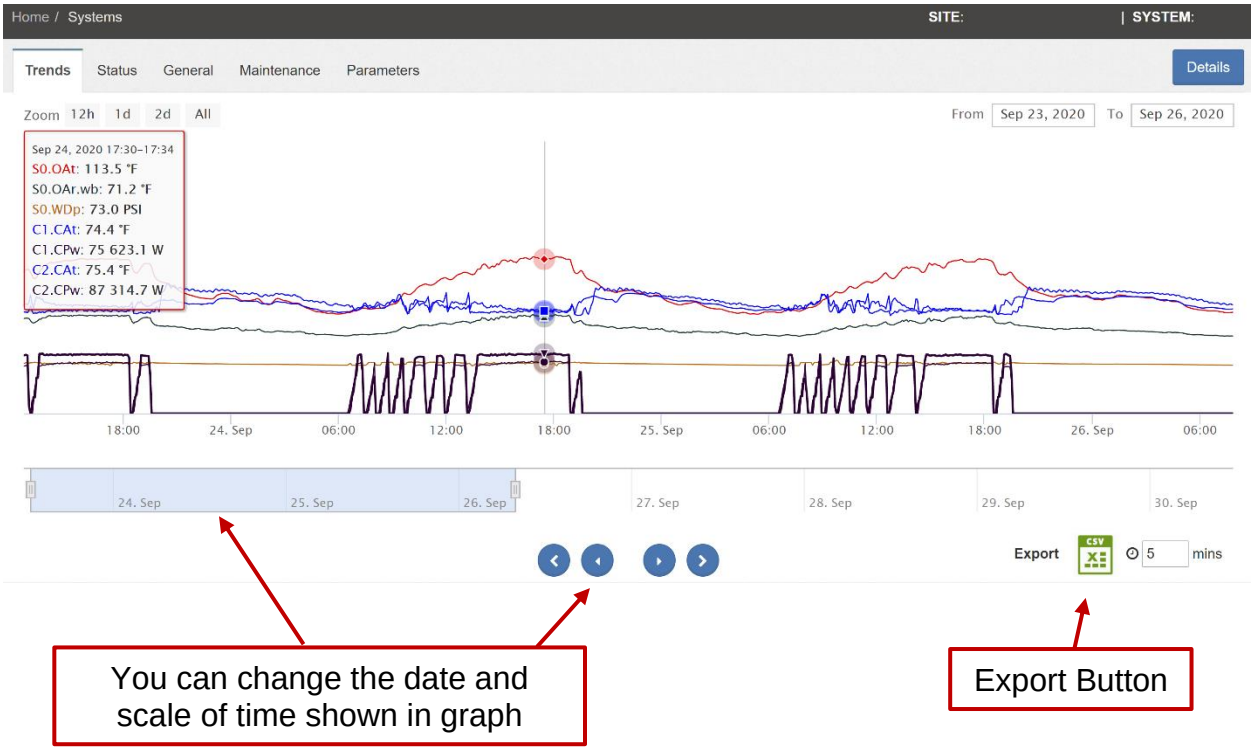
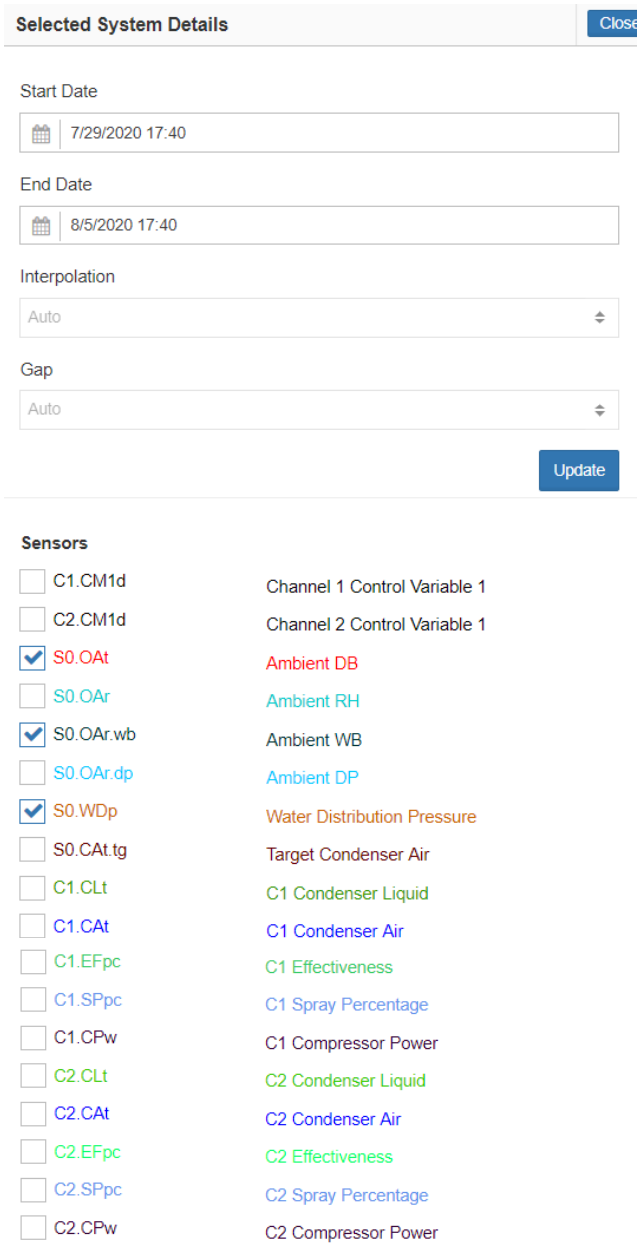


Figure 10. Dashboard Trend View

The Trend view can show a variety of parameters over the course of an hour to a whole year. The range of time displayed can be changed by changing the date, and length of time to be shown. User can also zoom in to a specific time on the graph by clicking and dragging, highlighting the time of interest. All data can be exported as a .CSV (comma delimited) file. This is useful for producing user graphs and reports. Only the parameters the user has selected in the check boxes will be exported to the file.



This screen is shown when "details" is clicked. A specific date range can be selected and the available parameters that can be displayed are listed below. Depending on individual systems, some options might not be available, and other options can be added.

Figure 11. Parameter Selection Menu

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