

S&C PureWave® Community Energy Storage System

25 kW/25 kVA, 240/120 V



Operation and Maintenance


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Introduction

Qualified Persons

 WARNING
<p>The equipment covered by this publication must be installed, operated, and maintained by qualified persons who are knowledgeable in the installation, operation, and maintenance of underground electric power distribution equipment along with the associated hazards. A qualified person is one who is trained and competent in:</p> <ul style="list-style-type: none">• The skills and techniques necessary to distinguish exposed live parts from non-live parts of electrical equipment.• The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed.• The proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment. <p>These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.</p>


Read this Instruction Sheet

Thoroughly and carefully read this entire instruction sheet before operating and maintaining the PureWave Community Energy Storage (CES) System. Familiarize yourself with the safety information and precautions on pages 3 through 6. The latest version of this instruction sheet is available online in PDF format at sandc.com/Support/Product-Literature.asp

Retain this Instruction Sheet

This instruction sheet is a permanent part of your PureWave CES. It does not include instruction sheets from the original battery manufacturer and the IntelliLink® Remote Setup Software. Designate a location where you can easily retrieve all information and refer to it.

Proper Application

 CAUTION
<p>The equipment in this publication must be selected for a specific application. The application must be within the ratings furnished for the equipment. Refer to S&C Information Sheet 658-450 for the PureWave CES guide specification.</p>

Warranty

The warranty and/or obligations described in S&C's standard conditions of sale, as set forth in Price Sheet 150, plus any special warranty provisions, as set forth in the applicable product-line specification bulletin, are exclusive. The remedies provided in the former for breach of these warranties shall constitute immediate purchaser's or end user's exclusive remedy and a fulfillment of all seller's liability. In no event shall seller's liability to immediate purchaser or end user exceed the price of the specific product which gives rise to immediate purchaser's or end user's claim. All other warranties, whether express or implied or arising by operation of law, course of dealing, usage of trade or otherwise, are excluded. The only warranties are those stated in Price Sheet 150, and THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY EXPRESS WARRANTY OR OTHER OBLIGATION PROVIDED IN PRICE SHEET 150 IS GRANTED ONLY TO THE IMMEDIATE PURCHASER AND END USER, AS DEFINED THEREIN. OTHER THAN AN END USER, NO REMOTE PURCHASER MAY RELY ON ANY AFFIRMATION OF FACT OR PROMISE THAT RELATES TO THE GOODS DESCRIBED HEREIN, ANY DESCRIPTION THAT RELATES TO THE GOODS, OR ANY REMEDIAL PROMISE INCLUDED IN PRICE SHEET 150.

The seller's warranties are contingent upon the installation and adjustment of the S&C PureWave® Community Energy Storage System in accordance with S&C's applicable instruction sheets, data sheets, and/or data bulletins.

Understanding Safety-Alert Messages

There are several types of safety-alert messages which may appear throughout this instruction sheet as well as on labels attached to the PureWave CES System. Familiarize yourself with these types of messages and the importance of the various signal words, as explained below.

⚠ DANGER
“DANGER” identifies the most serious and immediate hazards which <i>will likely</i> result in serious personal injury or death if instructions, including recommended precautions, are not followed.


⚠ WARNING
“WARNING” identifies hazards or unsafe practices which <i>can</i> result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ CAUTION
“CAUTION” identifies hazards or unsafe practices which <i>can</i> result in minor personal injury or product or property damage if instructions, including recommended precautions, are not followed.

NOTICE
“NOTICE” identifies important procedures or requirements that <i>can</i> result in product or property damage if instructions are not followed.

Following Safety Instructions

If you do not understand any portion of this instruction sheet and need assistance, contact your nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C’s website sandc.com. Or call S&C Headquarters at (773) 338-1000; in Canada, call S&C Electric Canada Ltd. at (416) 249-9171.

NOTICE	
Read this instruction sheet thoroughly and carefully before installing or operating your S&C PureWave CES System.	

Replacement Instructions and Labels

If you need additional copies of this instruction sheet, contact your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important that any missing, damaged, or faded labels on the equipment are replaced immediately. Replacement labels are available by contacting your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

Safety Information

Location of Safety Labels

WARNING

Risk of electrical shock.

Discharge capacitors before working on unit.

PE-702170 rev. 001

WARNING

Risk of electrical shock.

- Bus is energized from two (2) sources.

Crush hazard.

- Verify support is engaged before working in this area.

Keep hands clear.

- Use handle when closing door.

PE-70420-1 rev. 000

DANGER

Risk of electrical shock.

- Hazardous voltage.
- Bus is energized from two (2) sources.

Qualified personnel only.

PE-70421-1 rev. 000

WARNING

KEEP OUT. RISK OF ELECTRICAL SHOCK.

Hazardous voltage inside. Can shock, burn, or cause death.

This equipment is energized by batteries even when the ac power input is disconnected.

PE-70314

Reorder Information for Safety Labels

Location	Safety Alert Message	Description	Number
A	WARNING	Risk of electrical shock. Discharge capacitors . . .	PE-702170 rev. 001
B	WARNING	Risk of electrical shock. Bus is energized . . .	PE-70420-1 rev. 000
C	DANGER	Risk of electrical shock. Hazardous voltage. . . .	PE-70421-1 rev. 000
D	WARNING	KEEP OUT. RISK OF ELECTRICAL SHOCK. . . .	PE-70314

Annual Inspections

After the PureWave CES is commissioned and the unit is on-line, inspection and maintenance should be scheduled on an annual basis to ensure the proper operation of the system. Schedules for maintenance should be reviewed by the customer based upon the given site conditions and, if required, the frequency of the recommended maintenance should increase to ensure the reliability of their PureWave CES.

⚠ DANGER



The PureWave CES operates at high voltage. Failure to observe the precautions below will result in serious personal injury or death.

Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

1. **QUALIFIED PERSONS.** Access to PureWave CES must be restricted only to qualified persons. See "Qualified Persons" on page 2.
2. **SAFETY PROCEDURES.** Always follow safe operating procedures and rules.
3. **PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment such as rubber gloves, rubber mats, hard hats, safety glasses, and flash clothing in accordance with safe operating procedures and rules.
4. **SAFETY LABELS.** Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels.
5. **ENCLOSURE.** Do not open access doors unless the system is offline or otherwise authorized by S&C Electric Company.
6. **MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components. Ensure that the shield protectors inside the PureWave CES are in place. See Figures 1 and 2 on page 6.
7. **HIGH VOLTAGES.** High-voltage DC is present even without utility power connected. Hazardous voltages should also be expected in all interconnecting components and lines.

To maintain safety, the user should use padlocks on each door of the PureWave CES. The door and the use of the padlock provide protection to inadvertent contact with high-voltage circuits.
8. **GROUNDING.**
 - The PureWave CES base must be connected to a suitable earth ground for testing before energizing the unit, and at all times when energized.
 - The ground wire(s) must be bonded to the system neutral, if present. If the system neutral is not present, proper precautions must be taken to ensure that the local earth ground, or building ground, cannot be severed or removed.
 - The overall ground system should be sufficient to limit the Ground Potential Rise (GPR), step voltage, and touch voltage to acceptable limits as determined by the utility's practices and the National Electric Safety Code (NESC).
9. **ENERGIZED COMPONENTS.** Always consider all parts live until de-energized, tested, and grounded. For visible battery disconnection from the PureWave CES, see Figure 3 on page 6 for location of terminals.
10. **INSULATED HAND TOOLS.**
 - Insulated hand tools are required when working on or around any energized equipment. Use only properly rated tools for the energy present.
 - Tool inventories should be kept to ensure that all tools that enter the system enclosure are removed prior to energizing the system.
11. **EMERGENCY PROCEDURES AND EQUIPMENT.**
 - The owner should develop policies and procedures for handling emergency situations.
 - It is the responsibility of the owner to develop site-specific emergency action plans for response to such situations.
12. **ADDITIONAL SAFETY INSTRUCTIONS.** Consult the battery supplier for additional safety instructions and procedures regarding the battery used in the PureWave CES.

Equipment Safety Precautions and Practices

S&C PureWave CES and battery instruction sheets must be available to all operators and other employees. If doors to the system enclosure must be opened, refer to the instruction sheet for procedures for guarding against electric shock. All enclosure doors must be padlocked when authorized personnel are not present to prevent injury to persons unaware of the risks associated with the system.

⚠ WARNING

For safety, the PureWave CES has been designed as an unmanned device.

No person should attempt to defeat any interlock or other safety device and open any PureWave CES access panels while the unit is running, the isolation breakers are closed, or there is greater than 50V on the DC link or the battery input.

The user should not attempt to connect any additional logic controls or power connections to the PureWave CES without having received written approval from S&C Electric Company.

Shield Protection

The PureWave CES contains protection for the end-user from exposure to potentially dangerous components of the unit. Figure 1 shows the shielding protection from the line connections (at the front of the unit). Figure 2 shows the protection from the DC wiring (at the back of the unit).



Figure 1. Shield protection from wiring (front of unit).



Figure 2. Shield protection from line connections (back of unit).

Visible Battery Disconnect Terminals

The PureWave CES provides a means to disconnect the battery from the unit. At the rear of the unit, there are two non-load-break disconnect terminals (positive and negative). It is here that the end-user can connect/break the connection between the unit and the battery. This ensures the operator has a visible means to proceed in taking steps to operate the unit (when connected), or take the steps needed to service the unit (when disconnected). See Figure 3.



Figure 3. Visible battery non-load-break disconnect terminals.

Control Panel

The control panel contains the master controls and the associated circuitry needed to support proper operation of the PureWave CES. See Figure 4.

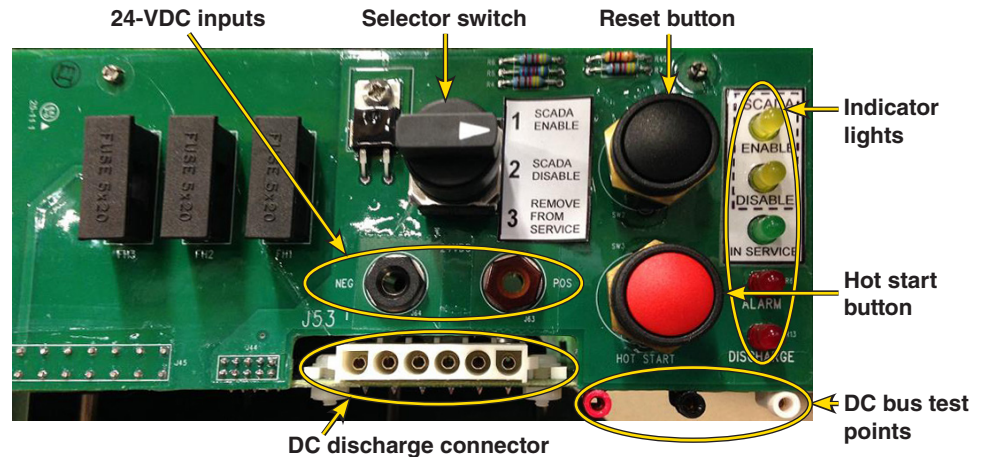


Figure 4. Control panel.

Selector Switch

A three-position rotary switch selects between three control modes of the PureWave CES unit:

1. **SCADA ENABLE** – Fully counter-clockwise position.
2. **SCADA DISABLE** – Center position.
3. **REMOVE FROM SERVICE** – Fully clockwise position.

In the “**REMOVE FROM SERVICE**” control mode, the AC and DC breakers are opened (if not already open). The inverter is inhibited. The “**IN SERVICE**” LED is off. The unit will not respond to local or SCADA real or reactive power commands. If the control is powered up and communications are functioning, unit status is available through DNP points to local and/or SCADA applications. The unit will save updates to local and SCADA commands, but will not respond to them.

When the selector switch is moved from “**REMOVE FROM SERVICE**” to “**SCADA DISABLE**,” the “**IN SERVICE**” LED is lighted. The unit will respond to local energy dispatch commands. The unit will save updates to SCADA commands, but will not respond to them.

When the selector switch is moved from “**SCADA DISABLE**” to “**SCADA ENABLE**,” any previously stored SCADA command is initiated (real or reactive power flow in or out). The “**IN SERVICE**” LED is lighted. The unit will respond to SCADA energy dispatch commands. The unit will save updates to local commands, but will not respond to them.

Indicator Lights

Five LEDs indicate the status of the PureWave CES unit:

1. **SCADA ENABLE** – A yellow LED that illuminates when rotary switch is in the “**SCADA ENABLE**” position. The unit is in SCADA mode.
2. **SCADA DISABLE** – A yellow LED that illuminates when rotary switch is in the “**SCADA DISABLE**” position. The unit can be operated via the IntelliLink program.
3. **IN SERVICE** – A green LED that illuminates whenever the rotary switch is not in the “**REMOVE FROM SERVICE**” position.
4. **ALARM** – A red LED that illuminates whenever an alarm or warning is present.
5. **DISCHARGE** – A red LED that illuminates whenever the discharge connector is installed.

Controls and Indicators

Reset Button

The reset button has two functions: resetting alarms and powering down the unit controls.

The presence of alarms is indicated by the alarm LED. Pressing the reset button (black push-button) will cause the unit to attempt to reset any active alarms. If all alarms are successfully cleared, the alarm LED will turn off.

To power down all PureWave CES unit controls, remove the utility source and turn the selector switch to “REMOVE FROM SERVICE.” Then press and hold the reset button for 14 seconds.

Hot Start Button

If the unit controls are shut down, they may be restarted without the presence of AC power. The user can provide a “jump start” using a 24-VDC battery connected to the 24-VDC terminals that are located under the selector switch on the control panel (refer back to Figure 5 for 24-VDC input locations). Then press the hot start button (red push-button). This action only powers controls for investigation; the system will not power the load without the utility source present.

Discharge Connector

The DC test points and discharge connector are mounted below the selector switch on the control panel. These are used to discharge the DC bus capacitors and to test to that a safe voltage level has been reached so that the unit may be serviced. Refer to Figure 5 for location of components to discharge the PureWave CES.

To discharge the DC bus capacitors:

- Place the selector switch in the “REMOVE FROM SERVICE” position.
- Install the DC voltage meter leads in the test points.
- Install the discharge jumper into the discharge connector.
- Observe the DC voltage meters to ensure that the DC bus capacitors discharge below 50 VDC in approximately five (5) minutes.

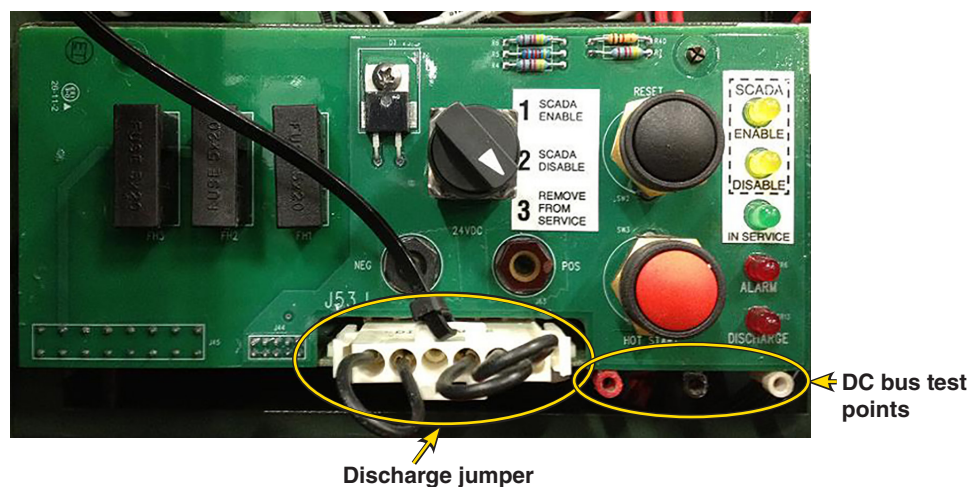


Figure 5. Discharging the PureWave CES.

⚠ DANGER

Keep the shorting jumper installed during any service operation. This will discharge the energy from the electrolytic capacitors.

Failure to install the shorting jumper may result in electric shock from the DC bus.

The DC bus capacitor test points are red, white, and black.

- The black test point is connected to DC (-).
- The white test point is connected to the DC midpoint
- The red test point is connected to DC (+)

Capacitors are connected from DC (+) to midpoint and from DC (-) to midpoint. Use these test points to monitor the DC bus voltage while the discharge jumper is installed to verify that the voltage has been discharged to a safe level for entry and service.

Note the locations of the DC test points and the 24-VDC alternate supply points to avoid confusion.

States

Listed in Table 1 are the eight operating states of the PureWave CES. The IntelliLink program will inform the user what state the system is currently in. Depending on the alarm condition encountered, the community energy storage system can be in any of these states. Below is the description of each state.

Table 1. Operating States of the PureWave CES

States	Description
Program Reset	This state indicates that the program is initialized. This state also only occurs at power up.
Inhibit	This state indicates that there is a problem that needs attention and will affect the proper operation of the system. The system will stop operating when an INHIBIT is being displayed on the IntelliLink program. The AC breaker will remain closed during this state.
Trip Offline	This state indicates that there is a severe problem that needs attention and will affect the proper operation of the system. The system will stop operating when a TRIP OFFLINE is being displayed on the IntelliLink program. The AC breaker will be open in this state.
Ready	The state indicates that the PureWave CES is ready to protect the load in the event of a utility disturbance.
VS Run	This state indicates that the master control has commanded the PureWave CES to run. Here, the inverter controls the AC voltage and the PureWave CES is the power source in the event of a utility power outage.
CS Run	This state indicates that the master control has commanded the PureWave CES to run. Here, the inverter controls the AC current and the PureWave CES provides the required real or reactive power for power smoothing.
Conserve Energy	This state indicates that the battery is reducing power usage to prolong the ability to run on the battery. This state is entered if the battery energy is depleted and the utility source voltage is not present.
System Shutdown	This state indicates that the battery energy is depleted. The system enters "shutdown," which turns the system off. The system will return to the "Ready" state when the utility source power is restored and the batteries are charged.

Resets


In order to clear an alarm condition, the PureWave CES will require a “reset” to set the unit to the “Ready” state. This enables the community energy storage system to be ready for another event should one occur. Table 2 lists the three resets available for the PureWave CES: Auto, Manual, and Self.

Table 2. Reset Types for the PureWave CES

Reset Type	Description
Auto	<p>This type of reset will automatically be performed until a pre-determined reset count has been reached.</p> <p>The alarm is reset up to the limit defined by the Auto Reset TripCountMax control parameter. When the number of Auto Reset attempts exceeds the TripCountMax, the system goes to and remains in the ‘Trip Offline’ state until it is reset manually by the operator.</p> <p>Each alarm does not have its own Auto Reset Trip Counter. Rather, there is only one counter, such that Auto Reset attempts from different alarms all count against the same total. There is also an Auto Reset Trip Reset Timer that starts counting down from five minutes every time an Auto Reset alarm occurs. If the timer reaches zero before the maximum number of Auto Reset attempts is exceeded, the Auto Reset Count is cleared. The Auto Reset Count is not allowed to persist for more than five minutes.</p>
Manual	This type of reset will require a person to use the local user interface, a SCADA connection, or push the RESET button on the control panel of the PureWave CES to reset the system.
Self	This type of reset will clear alarms when the alarm condition clears. No reset counter is used.

Alarms

The PureWave CES contains an extensive self-diagnosis system. If any abnormal condition occurs, the system will activate an alarm. Below is a list of alarms categorized by alarm type. Alarm types are categorized as information, warning, inhibit, isolate, and trip offline.

 CAUTION
All alarms should be handled by qualified personnel who are knowledgeable in troubleshooting the PureWave CES. If there are any doubts about how to handle an alarm event, please contact S&C Electric Company.

Information Statuses

This notification provides the status of the PureWave CES and will not affect the proper operation of the system. See Table 3 for the listed information statuses.

Table 3. PureWave CES Information Statuses

Alarm	Description	Reset Type
AcBreakerOpenCmd	Indicates that the AC breaker has been commanded open.	SELF
AutoReset	Indicates that the inverter is resetting the problem.	SELF
BatteryAuxChargeActive	Indicates that the battery auxiliary charger (if present) is active.	SELF
BatteryInLowPowerMode	Indicates that the battery is in low power mode. Verify that the unit is not In Conserve Energy mode.	SELF
BatteryModuleComms	Indicates that the management system in the battery lost communication with one or more modules.	SELF
BatteryReqSocRecalcByCharge	Indicates that the battery has requested a recalculation of its state of charge by charging the battery to the top of charge.	SELF
BatteryReqSocRecalcByDischarge	Indicates that the battery has requested a recalculation of its state of charge by discharging the battery to the bottom of charge.	SELF

TABLE CONTINUED ►

Table 3. PureWave CES Information Statuses—continued

Alarm	Description	Reset Type
DcContactorOpenCmd	Indicates that the DC breaker has been commanded open.	SELF
EmergencyVoltageRegEnabled	Indicates that the autonomous voltage regulation using reactive power is enabled on the unit. The PureWave CES may generate reactive power based on the measured voltage.	SELF
InverterLimitedByBatteryLimits	Indicates that the inverter is limited by the battery output.	SELF
InverterLimitedByLocalLoadControl	Indicates that the inverter is controlled by the local load.	SELF
InverterOutputLimited	Indicates that the inverter output is limited. Reduce the load.	SELF
IslandingInhibited	Indicates that the PureWave CES been inhibited to island.	SELF
IslandingRequested	Indicates that the PureWave CES has been requested to island.	SELF
LocalLoadControlEnabled	Indicates that the PureWave CES is in SCADA DISABLE mode.	SELF
ManualReset	Indicates that the inverter has been reset manually.	SELF
McuExecutionInterrupted	Indicates an issue occurred in the execution on the communication processor.	MANUAL
McuMediaStorageCapacity	Indicates that the internal compact flash card is at its capacity.	SELF
PowerOverVarsMode	Indicates that the PureWave CES is configured to give preference to power over VARs, when approaching the system rating.	SELF
PowerScheduleMode	Indicates that the PureWave CES is operating in a power scheduling mode.	SELF
PowerSetpointRegulationMode	Indicates that the PureWave CES is operating in a power setpoint regulation mode.	SELF
PowerSmoothingMode	Indicates that the PureWave CES is operating in a power smoothing mode.	SELF
VarSetpointRegulationMode	Indicates that the PureWave CES is operating in a reactive power setpoint regulation mode.	SELF
VoltageSetpointRegulationMode	Indicates that the PureWave CES is operating in a voltage regulation mode.	SELF
VsReturnDelayActive	Indicates that the PureWave CES is in the process of returning to a grid connected mode of operation.	SELF

Warning Alarms

This type of alarm indicates a problem that may need attention but will not affect the proper operation of the system. The system will continue to operate when a “warning” is being displayed. See Table 4 for the listed warning alarms.

Table 4. PureWave CES Warning Alarms

Alarm	Description	Reset Type
AutoResetLockout	Indicates that the Auto Reset counter has been exceeded.	MANUAL
BatteryCellOverTemperature	Indicates that the battery cell has gotten too hot.	SELF
BatteryCellOverVoltage	Indicates that the battery cell has over-charged.	SELF

TABLE CONTINUED ►

Table 4. PureWave CES Warning Alarms—continued

Alarm	Description	Reset Type
BatteryCellUnderTemperature	Indicates that the battery cell has gotten too cold.	SELF
BatteryCellUnderVoltage	Indicates that the battery cell has drained to a very low level.	SELF
BatteryDetectedWater	Indicates that the battery detected water in the container.	SELF
BatteryMaintenanceRequired	Indicates that the battery requires maintenance. Please contact S&C Electric Company.	SELF
BatteryOverCurrent	Indicates that more current was flowing into or out of the battery than the battery allowed.	SELF
BatteryRequestsShutdown	Indicates that the battery is requesting to shut down.	SELF
ConserveEnergyModeActive	Indicates that the PureWave CES is in conserve energy mode.	SELF
DcLinkDissipatorInstalled	Indicates that the DC jumper is installed. When safe to do so, remove it from the control panel.	SELF
EmergencyVoltageRegulation	Indicates that the inverter is generating reactive power to correct the line voltage.	SELF
IgbtOverTempWarningLine1	Indicates that IGBT on line 1 is too hot.	SELF
IgbtOverTempWarningLine2	Indicates that IGBT on line 2 is too hot.	SELF
InverterCurrentLimitLine1	Indicates that the inverter is working at its limit on line 1.	SELF
InverterCurrentLimitLine2	Indicates that the inverter is working at its limit on line 2.	SELF
IoDeviceCommsLoss	Indicates that the PureWave CES is experiencing loss of communications.	SELF
MaintenanceChargeOrDischarge	Indicates that the PureWave CES is providing a maintenance charge or discharge to the battery.	SELF
McuMediaInitFailure	Indicates that the internal compact flash card did not initialize properly. Please contact S&C Electric Company.	SELF
McuMediaOperationFailure	Indicates that the internal flash card had an internal anomaly. Please contact S&C Electric Company.	SELF
McuMediaUnavailable	Indicates that the internal flash card is not available for logging. Please contact S&C Electric Company.	SELF
MisconfiguredSchedule	Indicates that the PureWave CES has an improper schedule configuration.	SELF
ScadaCommError	Indicates that there is a problem with the radio or hardwired SCADA communications.	SELF
TotalSystemShutdownImminent	Indicates that the PureWave CES is about to enter system shutdown after being in the Conserve Energy state too long.	SELF

Inhibit Alarms

This type of alarm indicates a problem that needs attention and will affect the proper operation of the system. The inverter will stop operating when an “inhibit” is being displayed. The DC breaker and AC breaker will remain closed. See Table 5 for the listed inhibit alarms.

Table 5. PureWave CES Inhibit Alarms

Alarm	Description	Reset Type
AcBreakerUnsuccessfulClose	Indicates that the AC breaker did not close as expected.	MANUAL
AcBreakerUnsuccessfulOpen	Indicates that the AC breaker did not open as expected.	MANUAL
AllPhaseLegsTripped	Indicates there is a serious alarm present on both phases of the PureWave CES output.	SELF
AnyAppBoardPowerSupplyUV	Indicates that the application board power supply is below the required voltage value.	AUTO
DcBreakerUnsuccessfulOpen	Indicates that the DC breaker did not open as expected.	MANUAL
DischargeLimitInVsExceeded	Indicates that there is too much load on the PureWave CES.	SELF
DoorOpen	Indicates that the access door to the unit is open.	SELF
DownstreamFault	Indicates there is a physical fault on the network between the PureWave CES and the load.	SELF
DspFpgaHeartbeatLost	Indicates that there is a problem with the control assembly that will require for it to be replaced.	MANUAL
ExecutionTimeOverrun	Indicates a serious issue with the control processing of the PureWave CES.	MANUAL
IgbtGateDriveAlarmLine1	Indicates a physical issue with the power electronics.	AUTO
IgbtGateDriveAlarmLine2	Indicates a physical issue with the power electronics.	AUTO
IgbtOverTempTripLine1	Indicates that the IGBT on line 1 is too hot.	SELF
IgbtOverTempTripLine2	Indicates that the IGBT on line 2 is too hot.	SELF
IgbtThermistorBrokenLine1	Indicates that the IGBT on line 1 has a broken thermistor(s).	SELF
IgbtThermistorBrokenLine2	Indicates that the IGBT on line 2 has a broken thermistor(s).	SELF
IgbtThermistorShortedLine1	Indicates that the IGBT on line 1 has a shorted thermistor(s).	SELF
IgbtThermistorShortedLine2	Indicates that the IGBT on line 2 has a shorted thermistor(s).	SELF
InverterOverCurrentLine1	Indicates that the inverter is working over its limit on line 1.	AUTO
InverterOverCurrentLine2	Indicates that the inverter is working over its limit on line 2.	AUTO

TABLE CONTINUED ►

Table 5. PureWave CES Inhibit Alarms—continued

Alarm	Description	Reset Type
InverterOverload	Indicates that there is too much load on the inverter.	AUTO
IslandDetectedInCs	Indicates that an island was detected while the PureWave CES was operating in the Current Source state.	SELF
McuCommsError	Indicates that an issue occurred in the execution on the communication processor.	SELF
OutputFaultInVs	Indicates that a fault on the output of the PureWave CES was detected while operating in the Voltage Source state.	SELF
OverFrequency	Indicates that the PureWave CES is above the 'over-frequency' threshold.	SELF
OverVoltage	Indicates that the AC connection is above the 'over-voltage' threshold.	SELF
ParamCalChangeActivation	Indicates that either a configuration parameter or analog calibration value is being saved and activated.	SELF
ParamCalNvError	Indicates that corrupt memory was found in the inverter settings that can cause a malfunction in the inverter.	SELF
SystemInhibit	Indicates that the PureWave CES is in the inhibit state due to user command.	SELF
UdmOverVoltage	Indicates that the utility has a disturbance and an island is needed to continue to supply the load.	SELF
UdmUnderVoltage	Indicates that the utility has a disturbance and an island is needed to continue to supply the load.	SELF
UnderFrequency	Indicates that the PureWave CES is under the 'under-frequency' threshold.	SELF
UnderVoltage	Indicates that the AC connection is below the 'under-voltage' threshold.	SELF
VeryOverVoltage	Indicates that the inverter detects a very high input voltage.	SELF
VeryUnderFrequency	Indicates that the inverter detects a very low input frequency.	SELF
VeryUnderVoltage	Indicates that the inverter detects a very low input voltage.	SELF

Isolate Alarms

This type of alarm indicates a problem that needs to be addressed and will affect the proper operation of the system. The system will operate on a limited basis when “isolate” is displayed in the IntelliLink program. The inverter is capable of running reactive power only. See Table 6 for the listed isolate alarms.

Table 6. PureWave CES Isolate Alarms

Alarm	Description	Reset Type
BatteryAnySystemAlarm	Indicates the battery has entered into a serious alarm state.	MANUAL
BatteryBmsComms	Indicates that there is no longer good communication between the PureWave CES and the battery. This will cause the PureWave CES to stop charging and discharging the battery.	SELF
DcBreakerUnsuccessfulClose	Indicates that the DC breaker did not close as expected.	MANUAL
DcLinkMidpointUnbalanced	Indicates the DC link between the PureWave CES and the battery is no longer adequately balanced around zero volts.	SELF
DcLinkOV	Indicates that the internal DC bus voltage exceeded the “over-voltage” threshold.	SELF
DcLinkUV	Indicates that the internal DC bus voltage is under the “under-voltage” threshold.	SELF

Trip Offline Alarms

This type of alarm indicates a problem that needs attention and will affect the proper operation of the system. The system will not operate when a “trip offline” is being displayed in the IntelliLink program. The DC breaker and AC breaker will also open. See Table 7 for the listed trip offline alarms.

Table 7. PureWave CES Trip Offline Alarms

Alarm	Description	Reset Type
ExcessGenerationInVs	Indicates that excess power generated by distributed generation while the PureWave CES was operating in an island has charged the battery to its maximum state of charge.	SELF
SystemDisconnect	Indicates that the PureWave CES is not configured for SCADA or local control.	SELF
WaterInPcs	Indicates that water has been detected in the PureWave CES.	AUTO

System Overview

The PureWave CES shall function and operate as an intelligent distributed energy storage system to help utilities meet their rapidly changing Smart Grid challenges. By positioning discrete amounts of utility-controlled storage where needed throughout their distribution system, the PureWave CES shall enable utilities to rapidly respond to changing electricity-use patterns, integrate renewables, manage renewable resource intermittency, manage peak loads including plug-in electric vehicle loads, and provide reliable backup power within a fraction of a second for improved power quality. With the PureWave CES system’s ability to provide high-speed transfer from the grid to battery power, outages are often barely perceptible to customers.

The PureWave CES is rated at 25 kW/25 kVA. Each PureWave CES unit shall consist of

- 1) a power conversion system (PCS) suitable for outdoor installation on a user-furnished concrete pad or the user-furnished box pad, and
- 2) an energy storage unit consisting of either a select 25-kWh or 50-kWh lithium-ion battery pack suitable for subsurface installation underneath the PCS, in a user-furnished concrete vault. The PureWave CES shall be connected to the 120/240 VAC split-phase secondary of a 25-kVA outdoor utility distribution transformer (supplied by others) at a frequency either 50 Hz or 60 Hz.

The PCS shall consist of an inverter area housing an AC circuit breaker, an inverter, user-accessible AC termination area, user-accessible DC termination area, and user-accessible controls area.

System Design

In normal operation, the PureWave CES shall operate in current-source mode, providing such functionality as voltage regulation, power factor correction, peak shaving, and load following. If the utility power source is interrupted, the AC breaker in the unit shall open, isolating and islanding the load from the utility source. The energy storage unit and inverter shall then power the islanded load for up to either 1 hour with a 25-kWh battery pack or 2 hours with a 50-kWh battery pack. The energy storage unit will support the load until utility service is resumed or the energy storage unit of the PureWave CES is depleted. See Figure 6.

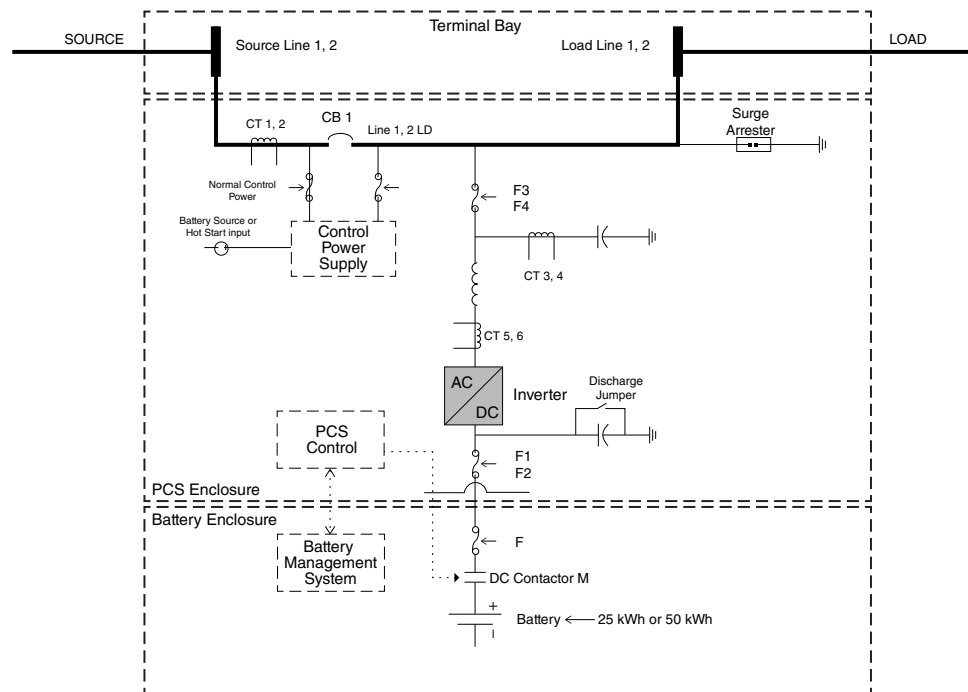


Figure 6. PureWave CES System one-line diagram.

Entering the System Enclosure

⚠ WARNING

Do not enter the system enclosure unless trained, certified, and authorized to do so. Potentially lethal voltages are present inside the system enclosure. High-voltage DC is present even without the utility power connected.

The enclosure is meant to provide access for field troubleshooting purposes only when the unit is properly grounded. Never, under any circumstances, open the enclosure doors on the PureWave CES while it is online or has not been fully discharged and grounded.

The PureWave CES enclosure houses the control, inverter, and cable termination areas. These areas can be accessed by unlocking all padlocks and opening the doors of the enclosure using a penta-socket wrench. Location of the door locks and components are illustrated in the following Figures 7, 8, and 9.

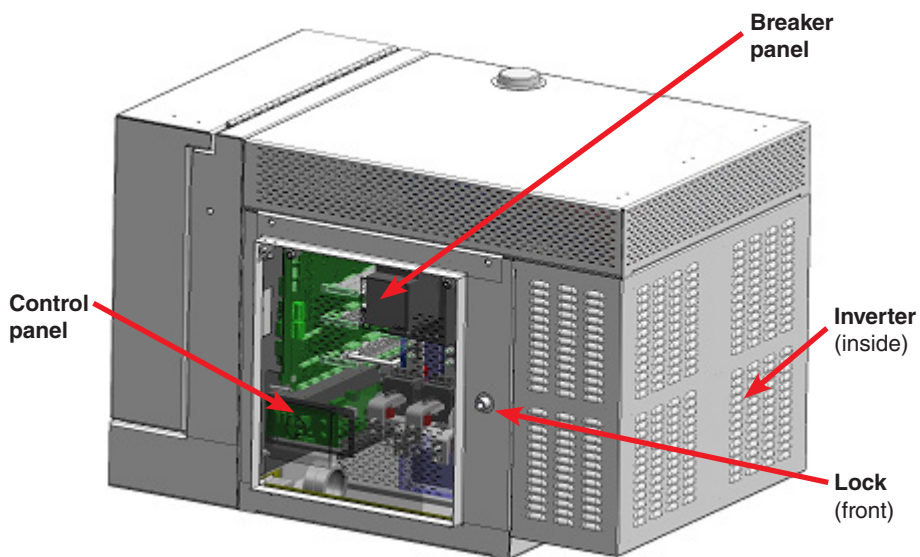


Figure 7. View of inside the enclosure at the front.

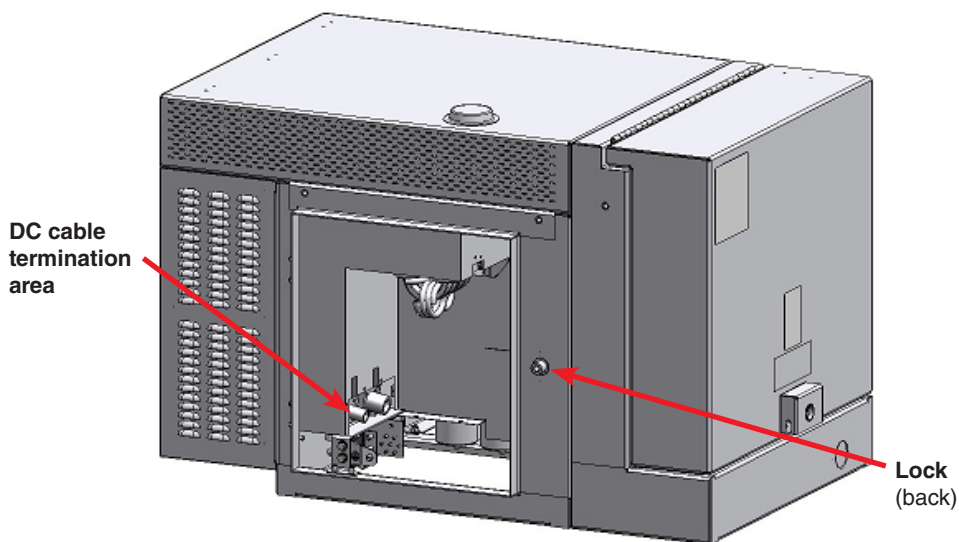


Figure 8. View of inside the enclosure at the back.

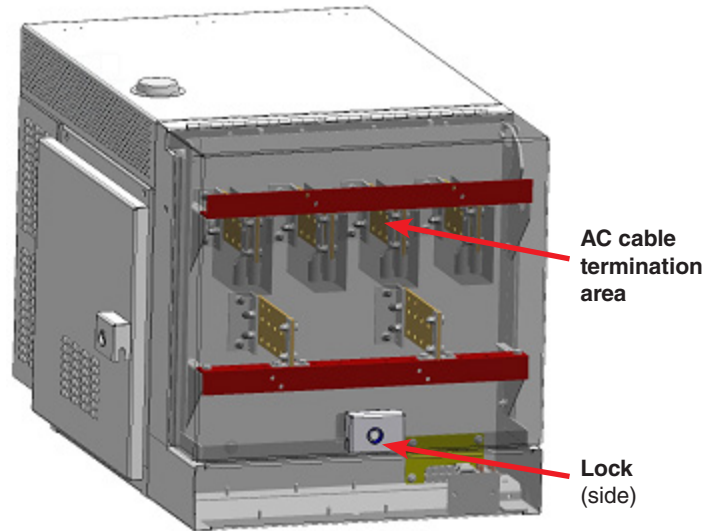


Figure 9. View of inside the enclosure at the side.

Energy Storage System

The energy storage (batteries) component of the PureWave CES shall be designed and constructed for installation underground in a vault, which shall be located directly beneath the unit. The batteries shall be contained in a watertight NEMA Type 6P enclosure, providing protection against water seepage and prolonged submersion at installation depth. The battery pack shall include a battery monitoring system. See Figure 10 for illustration. Please refer to the battery manufacturer manual for more information.

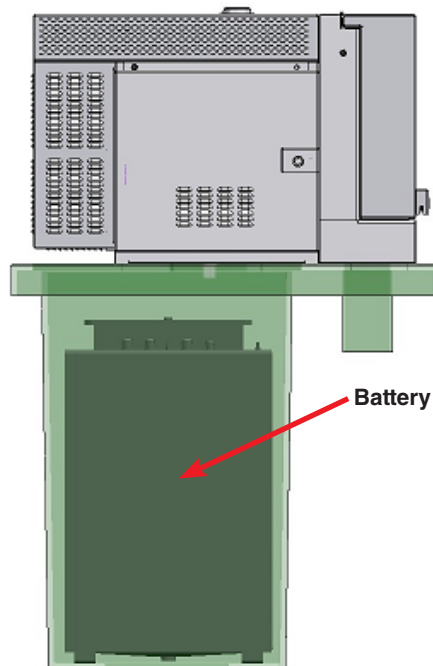


Figure 10. View of battery enclosure (stored underground).

IntelliLink® Remote Setup Software Configuration

The operation, control, and monitoring of the PureWave CES is accomplished through the IntelliLink Remote Setup Software. This program can be accessed via secure Wi-Fi connection or wide-area network radio using a PC with the IntelliLink software. This software also works in conjunction with the IntelliTeam Distributed Energy Management (DEM) system for PureWave CES fleet systems.

Configuring your PC for IntelliLink when onsite:

1. Connect the PC to the Ethernet port as shown in Figure 11.

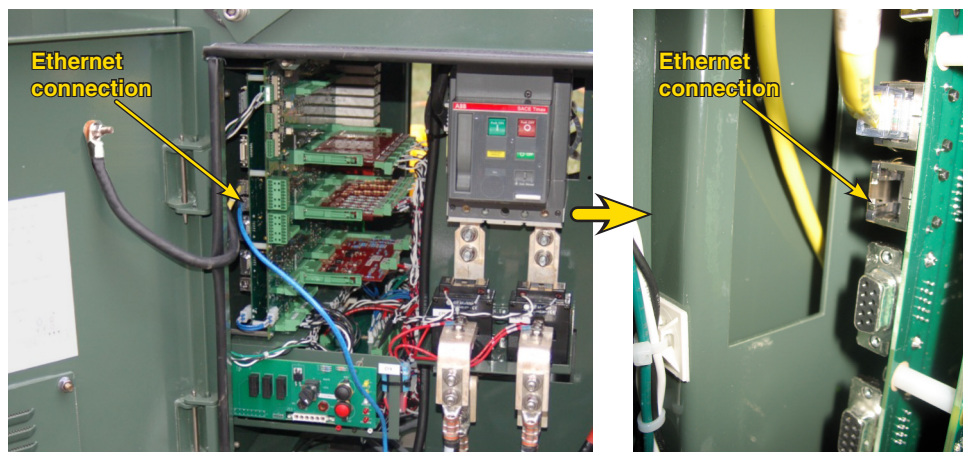


Figure 11. Ethernet connection location.

2. Turn on the PC and set the computer to the fixed IP on the same subnet as the PureWave CES add-on Ethernet port:
 - a. IP = 192.168.10.4
 - b. Mask = 255.255.255.0
 - c. No gateway
3. Find the IntelliLink icon and double-click on it to access the configuration screen. The following are the configuration steps to the IntelliLink program. See Figure 12 on page 20 for location of the fields to enter the data:
 - a. Destination DNP address = as configured in unit (default = 12)
 - b. Connection Type = UDP/IP
 - c. Peer IP = 192.168.10.2
 - d. Peer port = 20000
 - e. Our Port = 20001 (if SCADA is used on the same PC in the UDP channel definition, the value must be different).
 - f. Click on the “IntelliLink” button to connect.
4. Once connected, the user will be required to enter a login and password for authorized access to the program.

NOTICE

Login and password information for access to the IntelliLink program can be obtained from your designated administrator.

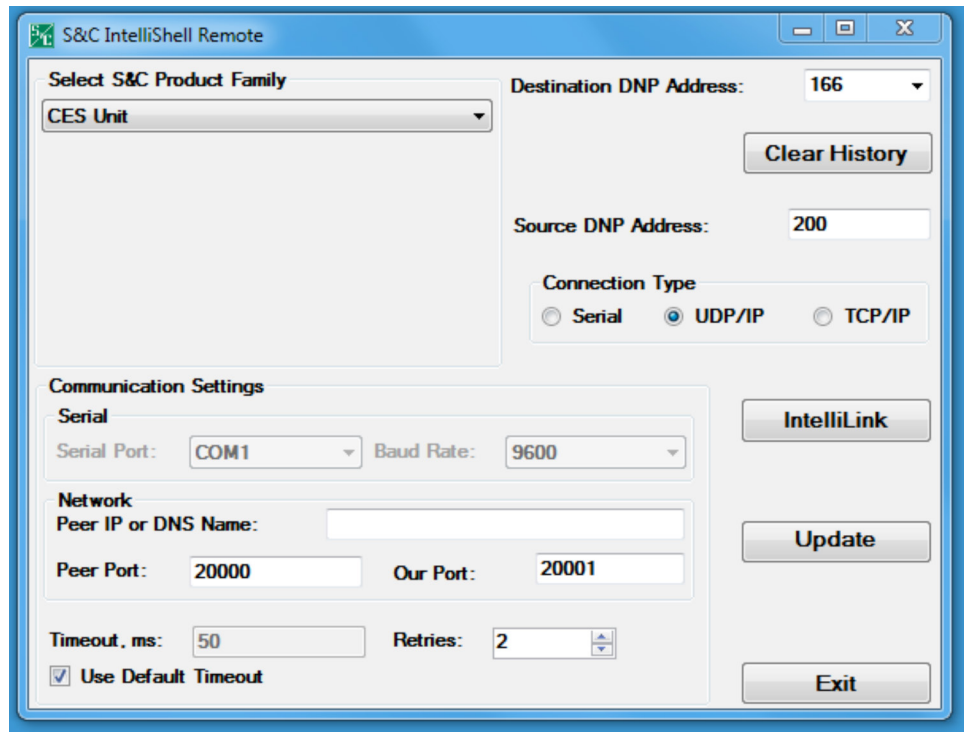


Figure 12. Location of data fields for IntelliLink configuration.

IntelliLink Program

Once connected and logged into the IntelliLink program, the Operation Status screen will appear. See Figure 13. This is the default screen, which is found under the “Operation” menu and “Status” sub-menu.

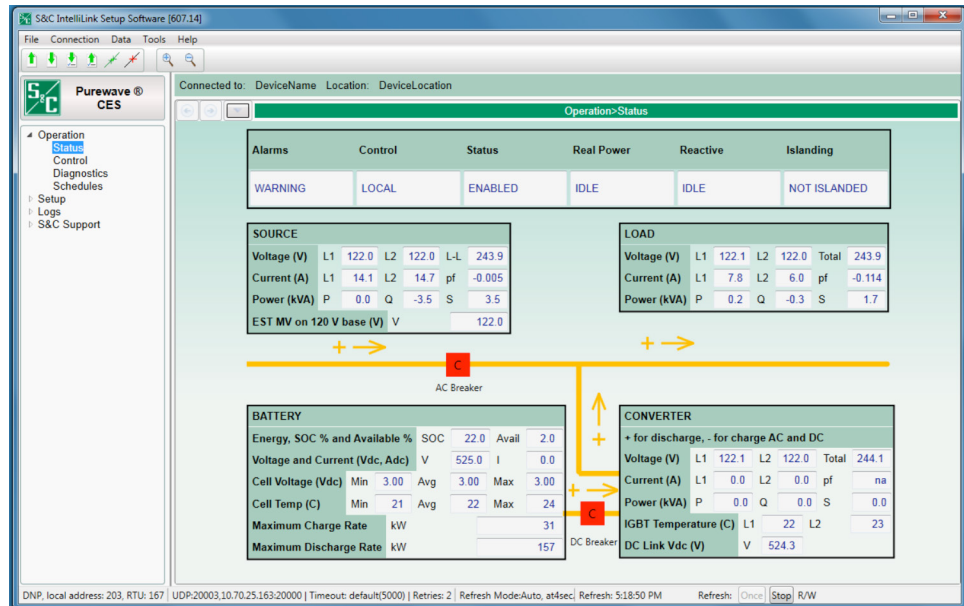


Figure 13. IntelliLink operation status screen.

Initial Power Up and Testing

The screens provided by the IntelliLink program allow users to manipulate the PureWave CES. Some of which include the following:

- a. seeing the current status of the PureWave CES;
- b. enabling Intelligent Load Management, a load following function that continuously adjusts the PureWave CES output or consumption to remain at or within the configured limits;
- c. controlling its power output and operating mode;
- d. performing diagnostics, logging, and analyzing active alarms;
- e. scheduling discharge and charge profiles for any day of the week; and,
- f. configuring settings and security permissions.

Refer to the IntelliLink program and its user guide to view all screens and to obtain further details of the program's functionality for the PureWave CES.

The following procedure provides the means for powering on and testing the PureWave CES.

1. Verify that all power and control connections have been properly installed and secured (bolts tightened).
2. Verify that the selector switch is in the "REMOVE FROM SERVICE" position.
3. Remove the DC bus discharge jumper.
4. Install the clear dead-front safety panel.
5. Power up the source side cables from the associated transformer. The PureWave CES should proceed with initialization of its control.

NOTICE

If communications are in place and the PureWave CES is configured in the SCADA system, then these tests are to include visibility of data and response to SCADA commands. Check that the same data are indicated in the SCADA system as in IntelliLink.

Proceed with initial system testing as follows:

Test Setup:

1. Connect the IntelliLink computer to the Ethernet port.
2. Move the selector switch to the "SCADA DISABLE" position.
3. Verify that there are no alarms and note the state of charge (SOC). If alarms exist, attempt to clear them and perform troubleshooting if necessary.
4. Verify voltages from "Source Line 1" and "Source Line 2" to neutral, comparing readings from IntelliLink and a volt meter.
5. Verify that the AC breaker shows 'closed' on the IntelliLink one-line diagram and that the physical AC breaker indicator indicates it is closed.
6. Verify voltages from "Load Line 1" and "Load Line 2" to neutral, comparing readings from IntelliLink and a volt meter.
7. Verify that the IntelliLink real and reactive power commands are zero for the inverter and that corresponding readings appear on the IntelliLink one-line diagram.

Reactive Power Control Testing:

1. Command a reactive power output of + 1 kVAR (capacitive). Confirm the output on the IntelliLink one-line diagram.
2. Command a reactive power output of + 5 kVAR (capacitive). Confirm the output on the IntelliLink one-line diagram.
3. Command a reactive power output of - 5 kVAR (inductive). Confirm the output on the IntelliLink one-line diagram.
4. Command a reactive power output of 0. Confirm the output on the IntelliLink one-line diagram.

Real Power Control Testing:

1. Command a real power output of + 1 kW (discharge). Confirm the output on the IntelliLink one-line diagram. Verify that the DC breaker indicates 'closed' on the IntelliLink one-line diagram.
2. Command a real power output of + 5 kW (discharge). Confirm the output on the IntelliLink one-line diagram.
3. Command a real power input of - 5 kW (charge). Confirm the output on the IntelliLink one-line diagram.
4. Command a real power output of 0. Confirm the output on the IntelliLink one-line diagram.

Island Control Testing:

NOTICE

Ensure that the state of charge is adequate to perform islanding. If not, charge the PureWave CES system prior to this test.

1. Command the unit to island using the IntelliLink control screen.
2. Confirm that the AC breaker is open and that the load is supported by the PureWave CES. Confirm that adequate voltage is being supported.
3. Command the unit to transition back from island to grid connected operation.
4. Confirm that the AC breaker is closed and that adequate voltage is present on the AC bus.

SCADA Enable Control:

NOTICE

Leave the IntelliLink computer connected to verify all SCADA operations.

1. Move the selector switch to "SCADA ENABLE."
2. Repeat the reactive power control test from the SCADA system.
3. Repeat the real power control test from the SCADA system.
4. Repeat the island control test from the SCADA system.

Test Conclusion:

1. Note and report any anomalies from the testing to S&C Electric Company.
2. Perform charging or arrange a SCADA charge schedule to achieve the desired state.
3. Leave the unit in "SCADA ENABLE" or "REMOVE FROM SERVICE," depending on deployment plans.
4. Secure the PureWave CES by removing all equipment and closing and locking all access doors.

PureWave CES Bypass Procedures

⚠ DANGER

Proper personal protective equipment (PPE) is required when conducting the following procedures.

Normal Bypass Procedure: The following procedure is to remove the PureWave CES from service without isolating it or interrupting end-users. It may be used for minor work within the unit or for work on local secondary or service conductors that require assurance that the unit will not operate.

This procedure does not de-energize the AC circuit within the controls area. The unit first checks the AC breaker to be closed. If an abnormal condition is detected, the load is dropped long enough to remove the unit from service, after which the loads are restored using a bypass.

1. Verify that the PureWave CES is not configured to trip the AC breaker if the door is opened. To prevent the AC breaker from tripping if it is configured, change the alarm type via the IntelliLink program to an “Information” or “Warning” (see IntelliLink user guide). After either one of these methods is complete, proceed to Step 2.
2. Open the AC cable termination area access door.
3. Verify that there is no voltage between the “Source Line 1” bus bar and “Load Line 1” bus bar. If this voltage is less than 10 volts, proceed to Step 4. If the voltage is higher than 10 volts, proceed to the Non-standard Bypass Procedure section below.
4. Verify that there is no voltage between the “Source Line 2” bus bar and the “Load Line 2” bus bar. If this voltage is less than 10 volts, proceed to Step 5. If the voltage is higher than 10 volts, proceed to the Non-standard Bypass Procedure section below.
5. Install a bypass jumper from the “Source Line 1” bus bar to the “Load Line 1” bus bar. See Figure 14.
6. Install a bypass jumper from the “Source Line 2” bus bar to the “Load Line 2” bus bar. See Figure 14.

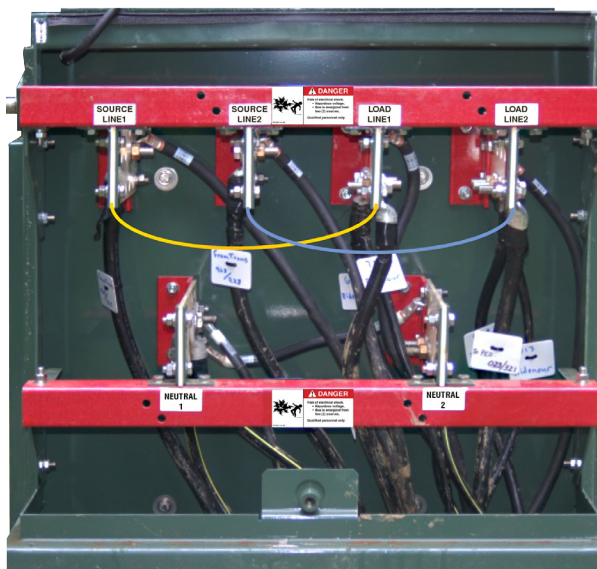


Figure 14. Location of bypass jumpers in AC cable termination area.

7. On the control panel, turn the selector switch fully clockwise to the “REMOVE FROM SERVICE” position. With the selector switch in that position, the AC breaker and DC breaker should both be open.
8. Proceed with the work as planned.

Non-standard Bypass Procedure: The following procedure will cause an outage to the end user. The proceeding steps should be done only when the voltage readings of Steps 2 or 3 of the Normal Bypass Procedure reads higher than 10 volts.

1. On the control panel, turn the selector switch fully clockwise to the “REMOVE FROM SERVICE” position. With the selector switch in that position, the AC breaker and DC breaker should both be open.
2. De-energize the source to the PureWave CES, typically by removing the fuse (or opening the fuse cutout) from the associated transformer.
3. Confirm that there is no voltage on the source or load side of the unit by measuring the voltages between
 - a. “Source Line 1” to neutral,
 - b. “Source Line 2” to neutral,
 - c. “Load Line 1” to neutral, and
 - d. “Load Line 2” to neutral.
4. Install discharge jumper and wait until the voltage is zero.
5. Take the “Source Line 1” cable and the “Load Line 1” cable and bolt them together. Insulate the bolted cables.
6. Take the “Source Line 2” cable and the “Load Line 2” cable and bolt them together. Insulate the bolted cables.
7. Re-energize the source typically by replacing the fuse to the associated transformer. This restores service to the interrupted end-users.
8. Proceed with the work planned.

Outage Procedure

The following procedure will cause an outage to the end user. These steps should be used to remove the PureWave CES from service temporarily to permit work on the down line secondary system, where a visible break is required. It may be used for troubleshooting the local secondary or service conductors.

⚠ DANGER

Proper personal protective equipment (PPE) is required when conducting the following procedures.

1. On the control panel, turn the selector switch fully clockwise to the “REMOVE FROM SERVICE” position. With the selector switch in that position, the AC breaker and DC breaker should both be open. This step will drop down-line end-users.
2. Install the discharge jumper. See Figure 15. Confirm that there is no voltage on the load side of the unit by measuring AC and DC voltage between
 - a. “Load Line 1” to neutral, and
 - b. “Load Line 2” to neutral.
3. Remove the fuse (or open the fuse cutout) from the source transformer to provide the visible break.
4. Proceed with the work planned.

⚠ WARNING

There are capacitors in the PureWave CES that may have some residual charge. If there is no load connected to the unit, wait 5 minutes for the capacitors to discharge with the discharge jumper installed. Measure the DC link to ensure that the voltage is under user-policy threshold.

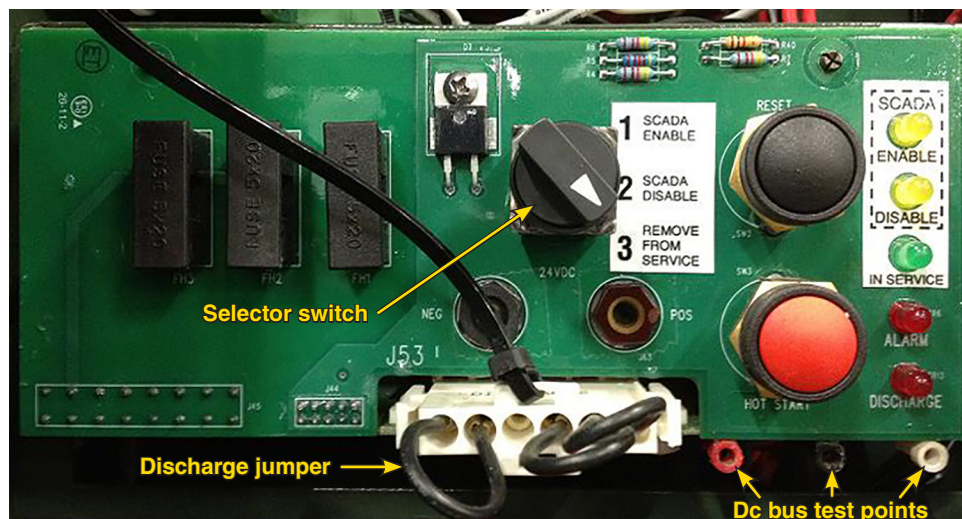


Figure 15. Selector switch in “REMOVE FROM SERVICE” with discharge jumper.

The PureWave CES is capable of servicing the distributed power generation needs of its customers when operated within its design limitations and specifications as listed herein. Non-proprietary PureWave CES System operation specifications beyond those identified in this instruction sheet may be obtained from S&C Electric Company.

Table 8. System Specifications

Description	Value or Range
Reactive Power	25 kVA
Secondary Voltage	240/120 V
Frequency	50 Hz or 60 Hz
Efficiency	> 85%
Dimensions (PureWave CES enclosure)	50"L x 34"W x 31"H (1270 mm x 864 mm x 787 mm)
Weight	750 lbs (340 kg)

Table 9. Environmental Specifications

Description	Value or Range
Ambient Operating Temperature	-4°F to 113°F (-20°C to 45°C) up to 122°F (50°C) operation at lower altitudes
Storage Ambient Temperature	-22°F to 122°F (-30°C to 50°C) for up to 6 months
Humidity	10% to 100% condensing
Altitude	Sea level to 1,000 meters De-rated above 1,000 meters, and above 45°C
Seismic	Uniform Building Code Zone 4
Audible Noise	48 dbA at 10 meters from the PureWave CES


Maintenance Checklist

The following checklist provides the PureWave CES inspection activities that are to be performed on an annual basis. The amount of dust and dirt accumulated in the units varies from site to site. Therefore, schedules for maintenance should be reviewed by the customer based upon the given site conditions and, if required, the frequency of the recommended maintenance may increase to ensure the reliability of their PureWave CES.

S&C Electric Company has extended service agreements and spare parts kits available for the PureWave CES. Please contact S&C Electric Company – Power Quality Products at (414) 423-8776.

PureWave CES Annual Maintenance Checklist

The PureWave CES requires a minimal amount of maintenance to help ensure high system reliability and efficiency. The following checklist can be used as a reference to assist in properly maintaining the unit(s).

 WARNING
Before performing maintenance on the PureWave CES, one must take caution in making sure the equipment is de-energized. Taking this necessary step will minimize serious injury or even death. Proper personal protective equipment (PPE) must be worn.

Preparation

- Review the steps in this checklist to prepare the proper tools that will be needed to complete these maintenance tasks.
- Communicate with S&C Electric Company to identify any additional tasks that are expected to be accomplished during the Annual Maintenance visit.
- Coordinate with the site facilitator to obtain keys for the padlocks (if applicable) to unlock the access doors to the PureWave CES enclosure(s).

Arrival

- Discuss maintenance plan with site facilitator (if applicable).
- Record the following information:

Site Name: _____

Serial Number: _____

Control Mode (current switch position): _____

Current System State: _____

Visual Inspection

Enclosure

- Check painted surfaces for signs of deterioration or rust.

Power electronic assemblies

- Check for any damaged components or foreign debris.
- Check for signs of thermal or electrical stress.
- Check capacitors for any signs of damage.

Cooling Fans (if equipped; 2 inverter heat-sink, 2 roof assembly)

- Check for any damaged components or foreign debris.
- Check for signs of thermal or electrical stress.
- Check for proper operation.

Physical Inspection

Enclosure

- Perform general cleaning of enclosure and surrounding area.
- Perform tightness checks of electrical connections.
- Inspect all latching mechanisms.
- Check gaskets and seals around all access doors and the enclosure.

Controls

- Check control boards for build-up of particulate and/or fungal growth. Clean with electronics spray cleaner/degreaser, if necessary.
- Verify door alarm functionality.
- Verify the DC power supply voltage levels (adjust if necessary).
- Review the event log for trends or possible malfunctions.

Maintenance Completion

- Verify that any damaged or inoperable components have been repaired or replaced.
- Verify that all applicable maintenance tasks are complete.
- Address and/or report any concerns the site facilitator may have.
- Place the PureWave CES System in the desired control mode and state. Record these below:

Control Mode (current switch position): _____

System State: _____

- Close and padlock all access doors.

Annual Maintenance Performed By: _____

Date: _____