The Powerware 9315 Hot-Tie Control system is designed to operate with two Powerware 9315 Hot-Sync Capacity/Redundant Systems. Each system will include two or more Powerware 9315 UPM (modules) and a System Bypass Module (SBM). The primary function of the Powerware 9315 Hot-Tie Control is to provide increased maintainability of the two Powerware Hot-Sync Capacity/Redundant systems by controlling a momentary, uninterrupted transfer of a one system’s load to the other system and isolating the off-line system. After completion of the transfer, preventive maintenance can be performed on the complete off-line system (SBM, modules, cabling, etc.) without disturbing the critical power paths to the load. A scheduled shut down of the off-line system’s critical load is never required nor is a transfer to bypass power needed. After preventive maintenance is finished, the Powerware Hot-Tie Control can be used to return the loads to the individual systems and reconfigure the two systems to dual path operation.

The Powerware 9315 Hot-Tie Control system consists of a Hot-Tie Control cabinet and Hot Tie Switchboard supplied by others. The Hot Tie Switchboard distributes power from Switchboard System Bypass Module-A (SSBM-A) and Switchboard System Bypass Module-B (SSBM-B) to Critical Load-A and Critical Load-B. To create the most flexible configuration each UPS will have a sufficient number of UPMs to support the combined loads of both systems plus one UPM for redundancy (n+1). This combination provides outstanding protection and maintenance flexibility, which can be utilized to minimize equipment downtime and maximize availability of protected power at the load.

To achieve this primary function, the Powerware 9315 Hot–Tie Control performs the following actions:

- Monitoring UPS System Status.
- Monitoring Switchboard Breaker Status.
- Synchronization of the Two Critical Load Buses.
- Control of SIS-A, SIS-B, and the TIE breaker.
- Control of MBP-A, MBP-B, MIS-A, and MIS-B Breakers (with optional MBP only).
Figure 1.0  Normal Operation

Figure 2.0  Momentary Simultaneous Closure
Figure 3.0  SIS-A Opens to Complete Transfer

Figure 4.0  With Optional Maintenance Bypass
Monitoring UPS System Status:
System redundancy, CBS, and CBP breaker positions for both Hot-Sync Capacity systems are monitored by the Powerware 9315 Hot–Tie Control and integrated into its control functions.

Monitoring Switchboard Breaker Status:
Breaker positions of the System Isolation breakers, SIS-A and SIS-B, and the TIE breaker are monitored by the Powerware 9315 Hot–Tie Control and integrated into its control functions.

Synchronization of the Two Critical Load Buses:
To facilitate the uninterrupted transfer of load from one system load bus to the other, the Powerware 9315 Hot–Tie Control forces the synchronization of the load buses of the two Powerware Hot-Sync systems.

To achieve critical load bus synchronization, the Powerware 9315 Hot–Tie Control provides a three-phase synchronization reference to each system. Each system uses this reference to regulate the inverter phase relationship so that the two system outputs can maintain synchronization with each other.

Under steady state operating conditions, each system remains in synchronization with its own bypass source through the Powerware 9315 Hot–Tie Control. If the bypass sources of the two systems are in phase, the critical load outputs of the two systems are also in phase.

When the transfer of load from one UPS to the other UPS is initiated, the Powerware 9315 Hot–Tie Control will first change the synchronization reference of one of the systems from its own bypass voltage to the critical bus voltage of the other system. The Powerware 9315 Hot–Tie Control automatically selects which system’s synchronization reference needs to be changed based upon which system is receiving the load and the “online” or “on bypass” status of each system.

After critical load bus synchronization is achieved (< 6 electrical degrees apart), a preset time delay of 5 seconds must be completed before the momentary, simultaneous closure of the SIS-A, SIS-B, and TIE breakers is automatically initiated to begin the load transfer (Figure 2.0). This time delay provides assurance that the two critical load buses maintain acceptable synchronization. MIS-A automatically opens to complete the transfer of load from System-A to System-B (Figure 3.0) for example. After completion of the load transfer, the Powerware 9315 Hot–Tie Control returns the synchronization reference of each system to its own bypass voltage.
Features

The Powerware 9315 Hot–Tie Control automatically performs the required closure and tripping of the SIS-A, SIS-B, and TIE breakers in the switchboard to achieve the load transfers.

A preset time delay is built into the tripping of each breaker to ensure conditions initiating the breaker tripping are acceptably maintained (i.e. coincidence between the main and auxiliary contacts of the breaker which closes during the transfer).

After a breaker has been tripped, a preset delay of 7 seconds must be completed before the breaker can be reclosed. This delay allows for the recharging of the breaker’s closing mechanism.

Other Control Functions:

In order to maintain a fault tolerant arrangement, fault conditions or abnormal operating conditions are accounted for in the Powerware 9315 Hot–Tie Control. Some of these provisions are listed below:

1. The Powerware 9315 Hot–Tie Control only allows critical load transfers to an online UPS system. The UPS system, which is transferring the load, may be online or on bypass.

2. The Powerware 9315 Hot–Tie Control only allows the transfer of the UPS-A critical load to UPS-B or the transfer of the UPS-B critical load to UPS-A if the receiving UPS system is redundant with the capacity to handle the load from both systems. The UPS receiving its own critical load during a transfer to NORMAL is not required to be redundant.

3. Dual redundant logic power supplies are incorporated within the Powerware 9315 Hot–Tie Control. This redundancy ensures the Powerware 9315 Hot–Tie Control can operate during the loss of one of the logic power supplies. These power supplies are powered from each system’s critical load bus.

4. With a complete loss of logic power to the Powerware 9315 Hot–Tie Control (due to either component failure or power supply fault), each system synchronizes to its own bypass source.

5. If the PLC operation stops, each system synchronizes to its own bypass source. PLC operation can stop for the following conditions:
   - PLC Mode switch in STOP position
   - PLC shutdown due to loss of PLC power supply
   - PLC shutdown due to fatal program error
Hot-Tie Touch Control Panel

The controls and indicators for the Powerware 9315 Hot-Tie Control are located on a password protected touch control panel. The operating status of the UPS can be observed and controlled by using this touch sensitive color display screen. The MAIN operating screen (Figure 5.0) displays an active mimic bus of the entire UPS along with the “buttons” necessary to conduct transfers. All system conditions and resources are displayed on this screen. However, if the operator wishes to implement a change in system status, a password screen will be displayed requiring a valid password to be entered before changes can be made to the system’s operating status. Active operator options are displayed as green “buttons” and include:

- **Current Bar Graph.** A screen that displays two bar graphs representing system level currents.

- **Current Trend.** Two curves representing system load currents over the last ten minutes.

- **Sync Control.** A screen that provides the control “buttons” for Powerware Sync Control if this option is included in the Hot-Tie Control.

- **Settings.** This screen is used to access the various operator changeable screens and settings. Active alarms and alarm history, password processing, and system setting screens are accessed from the Settings screen.

Date and time are displayed on each screen.

**Figure 5.0**

Optional Maintenance Bypass included in display
Options

Maintenance Bypass (MBP) can be included in the System-A and System-B Switchboards and then controlled from the Hot-Tie Touch Control Panel, Figure 4 and 5.

To put System-A into maintenance bypass first ensure that System-A and System-B are not tied together by the TIE breaker. Transfer System-A to its own bypass using the controls on the System-A SBM. The A-Maint. Transfer ‘button’ on the Hot-Tie Control Panel Display will turn green indicating that it is O.K. to perform the maintenance bypass operation. Touching that green ‘button’ will cause the system to close MBP-A and open MIS-A successfully transferring LOAD-A to Maint. Input-A. To put system-B into the maintenance bypass mode follow the same procedure with the System-B controls.

System-A or System-B may be in Maintenance Bypass individually with the other system ‘on-line’ or both systems may be in Maintenance Bypass at the same time as long as the TIE breaker is open.