Rod Control System
Double Gripper Holding Modification

Repair, Replacement, and Automation Services

Background

Single failures in the rod control system can result in dropped rods. Double gripper holding can reduce the potential for dropped rods when they are not moving by keeping both the stationary gripper and movable gripper (MG) coils energized at a reduced current. Since rods are not moving more than 99% of the time, this modification can be very effective. Certain features included in the design can also help prevent dropped rods when they are moving.

Failures Addresed

The double gripper holding modification prevents group rod drops and subsequent plant trips caused by regulation, phase control, or firing card failure. Loss of current to one gripper coil resulting from an open fuse or open circuit would not drop a rod. In both scenarios, the urgent alarm would be actuated.

Double gripper - L-bracket inside view

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Westinghouse

For more information, call your local Westinghouse Electric Company sales representative.

Features

In the modified system, the actual stationary and MG currents are sensed, actuating the urgent alarm when any control rod drive mechanism (CRDM) loses either gripper current while the rods are not in motion. Losing the gripper current of a rod in motion would also actuate the urgent alarm, but in this case, the prevention of a dropped rod cannot be ensured.

New printed circuit cards with LEDs are installed in the two unused slots in the existing card frame. These LEDs are actuated when there's a loss of current to any gripper coil. One of the cards has a LED that indicates urgent alarm actuation from the double gripper feature. This alarm is sealed and can be reset from the existing control board or local pushbutton.

The double gripper holding modification consists of a field kit that's installed in each power cabinet during a refueling outage. New field cables aren't required and logic cabinet changes aren't needed, except for a timing adjustment to account for the energized MG coils.

System Operation

Current to hold the MG coils energized is provided from the auctioneered output of the three stationary gripper thyristor bridges forming a MG hold bus. Three contactors connect the MG hold bus to each group of MG coils. Contactors, rather than solid-state power switches, are used to reduce additional heat input to the power cabinet. The MG thyristor bridge is not used for this application.

When motion is demanded, the contactor of the selected group is energized, disconnecting the MG hold bus from that group of coils, and the MG thyristor bridge is activated. Eleven seconds after rod motion stops, the contactor of the selected group is de-energized, connecting the MG coils to the hold bus. Also, full current is commanded from the stationary gripper thyristor bridges for a short time to ensure latch-in of the MGs. Eleven seconds was selected to avoid operating the contactor on each step when the slowest rod speed of six steps/minute (one step every ten seconds) is demanded by the T_{avg} control system.

Double gripper - L-bracket outside view

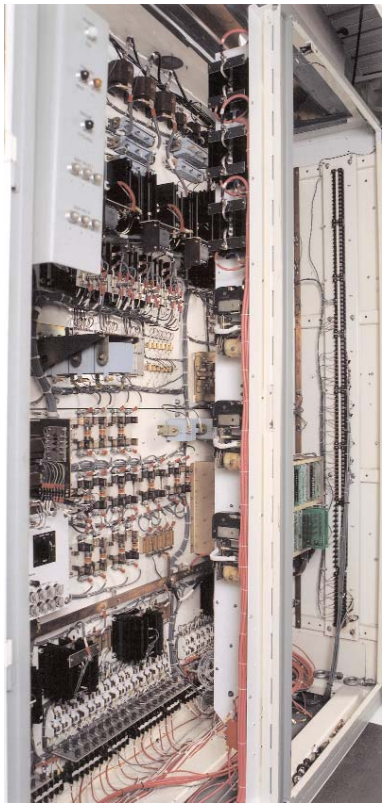
Hardware

Components for one power cabinet are pre-assembled on an L-shaped bracket that is installed behind the center post of the two doors. One bracket assembly is provided for each power cabinet. The bracket assembly extends from top to bottom of the center post and is held in place by the same four bolts that fasten the center post to the cabinet. Due to the higher stationary bridge currents, the stationary gripper thyristors and fuses are replaced with higher rated devices. A fuse assembly replaces the existing fuseholders and new thyristors replace the existing nine devices, reusing the heat sinks. Two new printed circuit cards are installed in the two unused slots in the existing card frame.

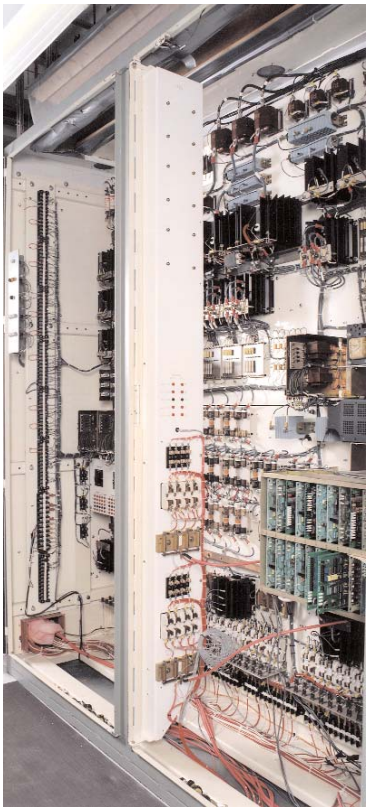
Installation

Westinghouse can supply full-scope installation services. These services include the actual installation of the components in each power cabinet and a full post-installation system test using dummy loads. The Westinghouse installation crews receive hands-on training using the Westinghouse rod control system power cabinet test system. This is an actual operational rod control system power cabinet used for testing and development.

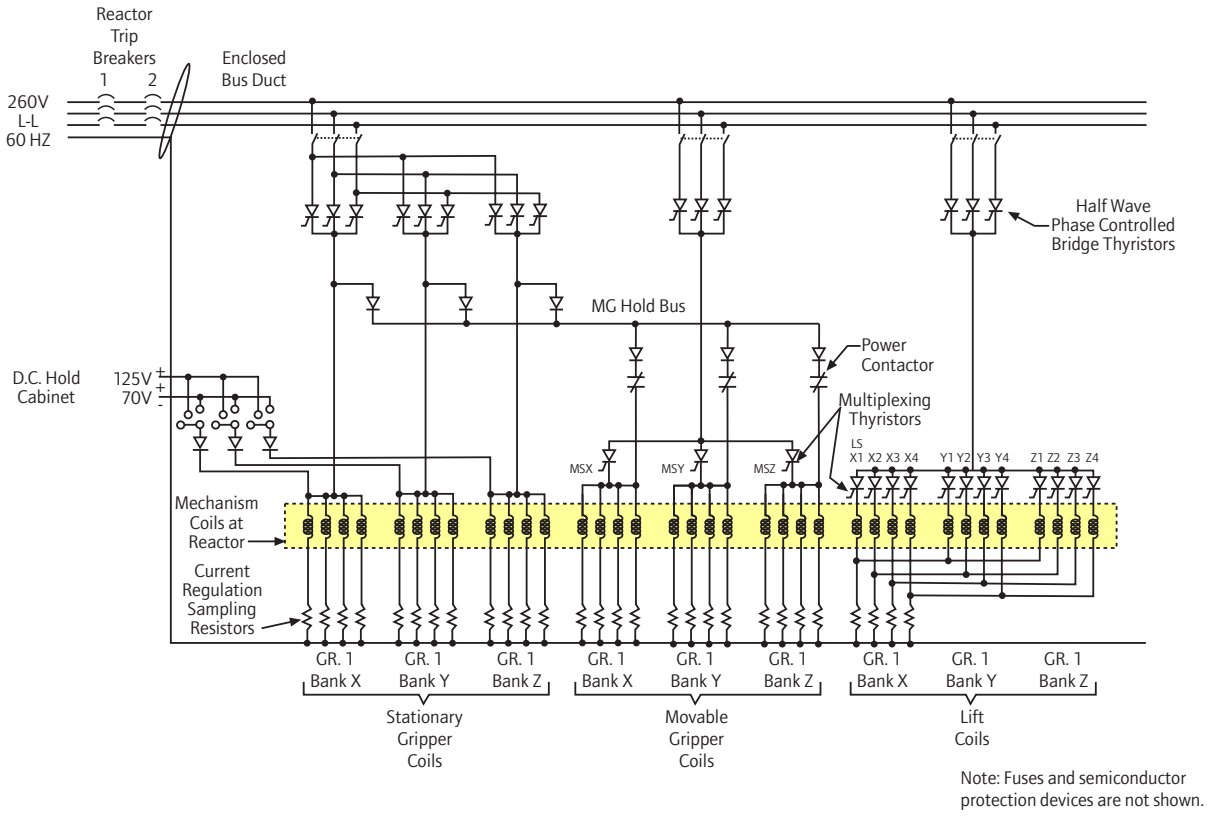
Start-up support can also be provided. Westinghouse engineers will provide 24-hour coverage to monitor initial operation during startup and to assist in resolving problems.



Double gripper - L-bracket installed in test cabinet - left-hand view



Double gripper - L-bracket installed in test cabinet - right-hand view



Power cabinet simplified power circuit

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