RPI, CRDM, and Reactor Head Cable and Connector Upgrade Services

Repair, Replacement, and Automation Services

Background

Many plants have experienced erratic rod positions directly attributable to Analog and Digital Rod Position Indication (ARPI and DRPI) System cable and connector degradation. This has led to false rod deviation alarms and increased calibration time. Several utilities have indicated instances of recessed contacts, bent (oval-shaped) coupling units, and completely worn key ways.

Control rod drive mechanism (CRDM) cable and connector difficulties have also been cited for causing delays during plant start-up and have forced unscheduled down-time.

Benefits

Westinghouse offers unique customer-specific RPI/CRDM cable and connector upgrades and installation services that enhance the reliability of these systems, eliminate coupling difficulties associated with original equipment connectors, and provide experienced field service personnel during advisory evaluations and installation.

Description - Connector Upgrades

ARPI and DRPI Systems utilize low voltage and current signals to determine rod position. The cables and connectors installed on the detector coil assemblies of either system provide the interface for these signals. Since cable resistance is small, connectors are a critical component. A slight increase in connector resistance will greatly affect the operating characteristics of the system.

The original connectors are an aluminum alloy threaded-type construction. The connector does not offer positive stop, thread-mating indication or wear-resistant, full-length connector keys. Even under ideal conditions, the small diameter of the connector makes it difficult to mate, resulting in damage due to cross-threading, galling, or over-tightening. Valuable critical path time is often sacrificed attempting to mate damaged connectors. Galled threads, worn key ways, failed contact plating, loss of contact retention, and deformed coupling nuts are all indicative of ARPI/DRPI and CRDM connectors that need to be replaced.

Many CRDM connectors have pins and sockets that are secured by three sharp, radially protruding tabs. During connector assembly, these tabs deflect and spring outward locking onto a shoulder within the hard plastic insert. With continued use of the connector, these tabs dig deeper into the shoulder of the insert if the pins and sockets are misaligned or the connector is dirty, damaged, or loose. Eventually, loose contacts develop and often result in dropped rods or the inability to lift rods.

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

Westinghouse

Westinghouse has coordinated the development of a direct replacement connector in response to these concerns. The enhanced connector features:

- A keyed, quarter-turn, bayonet-locking aluminum/SS connector providing an audible, visual, and tactile indication of full coupling
- A connector plug utilizing an enlarged coupling nut for quick, easy coupling
- Durable, nuclear-grade elastomer (Viton and silicone rubber) inserts, grommets, gaskets, and bushings rated for continuous service up to 200°C (392°F)
- Crimp-type, copper alloy contacts with gold plating (CRDM contacts are silver-plated)
- Cable strain relief designed to provide 360-degree cable seal and support
- Receptacle pin contacts recessed to provide scoop-proof mating
- Shock and vibration resistance
- Connectors are fully field repairable

In conjunction with the connector upgrade, the existing ARPI and DRPI top plates are replaced with new top plates designed to accept the larger upgrade connector.

Description - Cable Upgrades

With years of operation in a high-temperature, highly irradiated environment, head cables become extremely susceptible to degradation that may allow moisture to penetrate the conductors and connectors. Improved cable, supplied by Westinghouse during an upgrade of either ARPI, DRPI, or CRDM Systems, is stainless-steel-jacketed with Tefzel-insulated connectors. Features of the enhanced cable are:

- 600-V insulation
- Smaller outer diameter
- Lightweight and flexible material construction

Westinghouse reactor head cable is temperature rated to withstand 200°C (392°F) continuous conditions at an integrated exposure of $2x10^8$ gamma. Improved cables are thermally stable at elevated temperatures and possess a high insulation resistance in moist environments. The superior grade construction materials also make the cables highly resistant to irradiation and mechanical damage. The upgraded cable can prevent the possibility of head cable failure.

Deliverables

With the customer, Westinghouse develops a site-specific plan to replace original cable and connectors with upgraded materials. Qualified, experienced Westinghouse personnel assist in scheduling replacements in the most cost-effective and time-efficient manner. During the installation phase of the upgrade, Westinghouse will provide an experienced crew qualified in the replacement of RPI and CRDM cables and connectors. Generally, all on site work is done in two visits, with hardware installation and testing occurring during the first visit. Upon completion of the installation and reconnection procedures, the new cables and connectors undergo a final test during the second visit to the site.

All test data are documented and submitted to the customer for future cable and connector trend analysis.

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