

# Control Rod Drive Mechanism/Rod Position Indication System Cable and Connector Upgrades

## Background

As the majority of plants approach the first or second decade of commercial operation, normal age degradation of materials and support components can lead to functional problems elevating the cost of continued operation and increasing the probability and length of planned and/or unscheduled outage time.

Numerous plants have reported and are currently experiencing erratic rod position signals 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 also 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 in causing delays during plant start-up and have forced unscheduled down-time.

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

## Description

### Connector Upgrades

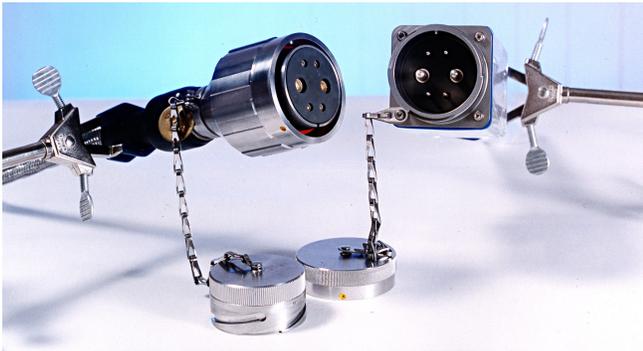
ARPI and DRPI systems utilize low voltage and current signals to determine rod position. The cables and connectors installed on the detector coil assemblies of either system provide the interface for these signals.

Original connectors are an aluminum alloy and have a threaded-type construction. The connector does not have a positive stop or thread-mating indication signal, nor does it possess wear-resistant, full-length connector keys. Even under ideal conditions, the small diameter of the connector makes it difficult to mate, resulting in damage. Valuable critical path time is often sacrificed attempting to mate damaged connectors.

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.

In response to these concerns and to enhance the overall reliability of each system, Westinghouse has coordinated the development of a direct replacement connector. These improved connectors feature:

- A keyed, quarter-turn, bayonet-locking stainless steel or aluminum connector providing an audible, visual and tactile indication of full coupling
- A connector plug utilizing an enlarged coupling nut for quick, easy coupling while wearing anti-C clothing
- Durable, nuclear-grade elastomer inserts, grommets, gaskets and bushing, 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 and clamps designed to provide 360-degree cable seal and support
- Detector receptacle pin contacts that are recessed to provide "scoop-proof" mating



CRDM detector enhanced connector developed to provide easier coupling

### Cable Upgrades

With years of operation in a high-temperature, highly irradiated environment, reactor 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 braid jacketed with insulated conductors. Features of the enhanced cable are:

- 600-V insulation
- Small outer diameter
- Lightweight and flexible material construction
- Mid-temperature cable rated up to 200 C (392 F)



CRDM/DRPI/ARPI reactor head cable assemblies

### Installation Services

In conjunction with the customer, Westinghouse will develop a site-specific plan to replace original cable and connectors with upgraded materials. Qualified, experienced Westinghouse personnel will assist the customer in scheduling the replacement in the most cost-effective and time-efficient manner. Generally, all on-site work is done in two phases.

### Optional Services

- Stainless steel body connectors to reduce the aluminum inventory inside containment
- Standard-temperature cable rated to 105 C (221 F)
- High-temperature cable rated to 538 C (1,000 F)

### Benefits

#### Connector Upgrades

The enhanced connectors offer customers immediate and long-term benefits. The new plug-receptacle pair reduces the time and difficulty of connector coupling, providing reduced radiation exposure to personnel during reactor vessel head disconnect and reconnect.

#### Cable Upgrades

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, ozone, oil, chemical and mechanical damage. With regular maintenance activities, the upgraded cable can prevent the possibility of reactor head cable failure.

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