

# Permanent Cavity Seal Rings – Narrow Gap and Wide Gap

## Background

The annulus gap between the reactor vessel and the containment cavity floor must be sealed to permit the flood-up required for refueling and reactor internal maintenance activities. This sealing is accomplished by installing a temporary pool seal into the annulus gap. The installation of these “temporary” seals is a critical path process that lengthens outage duration as well as increases worker exposure. These seals have also been known to experience leakage, which negatively impacts both outage and normal operation processes.

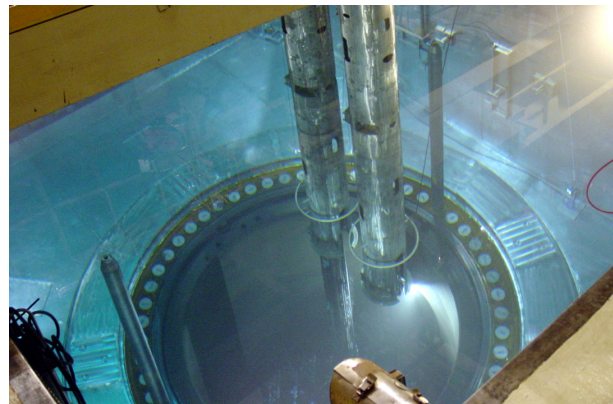
## Description

To help plants improve refueling outage efficiency, Westinghouse has developed a permanent cavity seal ring (PCSR) product line. The product line features a wide gap permanent cavity seal ring (WGPCSR) for application at plants with a reactor annulus larger than one foot in width. To service plants having a reactor annulus width of less than one foot, Westinghouse offers the narrow gap permanent cavity seal ring (NGPCSR).

Both the WGPCSR and the NGPCSR are stainless steel structures that are permanently installed to span the annulus gap between the reactor vessel and the cavity floor. Incorporated

in the designs are unique flexure members, which accommodate thermal growth during operation, as well as seismic movement. Structural members provide the necessary support for weight and pressure loads. All members are field welded into position to develop a leak-free seal around the reactor.

The permanent cavity seal ring products include hatches with captured bolts, each with a lifting handle. Prior to plant operation, the hatches are easily removed. The openings then allow sufficient air flow for plant operation. Before refueling, the hatches are installed. Each hatch incorporates two captured O-rings separated by a leak test port, allowing pneumatic testing of the seals prior to refueling.



**Flooded containment cavity with reactor vessel head removed and permanent cavity seal ring in place**

As an option, Westinghouse may add neutron shielding as an integral part of the permanent cavity seal rings. This eliminates the need for temporary solutions used during refueling outages; for example, water bags.

### **Benefits**

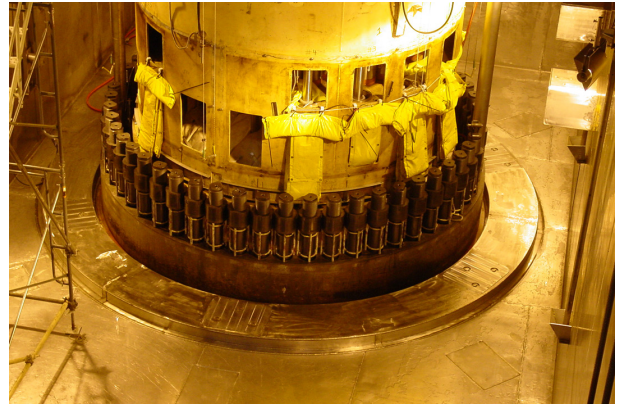
- Eliminates need to install or tear down temporary cavity seal ring
- Reduces outage duration
- Reduces worker exposure
- Eliminates leakage
- Eliminates rapid drain down mitigation
- Eliminates boric acid corrosion and scarring issues on vessel and instrumentation
- Provides working platform for outage workers
- Improves outage activity efficiency
- Lasts the life of the plant

### **Deliverables**

The delivery for either a wide or narrow gap permanent cavity seal ring is 12 months. Included in the package are qualified procedures and Westinghouse oversight for installation by utility personnel. Westinghouse can also provide qualified installers for a complete turnkey package.

### **Experience**

Westinghouse has provided products from its permanent cavity seal ring family to several nuclear power plants in the United States and Europe as backfit and original equipment installation.



**View of permanent cavity seal ring prior to cavity flooding with hatches installed**