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Sealing Nozzle for Incore Flux Measurement System

A reliable, easy-to-install, maintenance-free solution—ensuring leak-tight performance, operational flexibility, and seamless integration with existing infrastructure, while reducing outage time.

Challenge

In the demanding environment of nuclear reactor maintenance, ensuring leak-tight connections between thimble tubes and guide tubes presents several significant challenges. During critical operations such as fuel unloading and reloading, operators must achieve and maintain reliable leak-tightness under both high (155 bar) and low (2.5 bar) pressure conditions. Traditional fittings often require complex installation procedures and frequent maintenance interventions, leading to increased downtime and operational inefficiencies. Furthermore, the sealing solution must remain effective even when thimble tubes are partially withdrawn for fuel handling, a scenario that can compromise the integrity of conventional seals. Finally, any new sealing technology must be fully compatible with existing guide and thimble tubes to prevent the need for costly and time-consuming modifications to the reactor infrastructure.

Solution

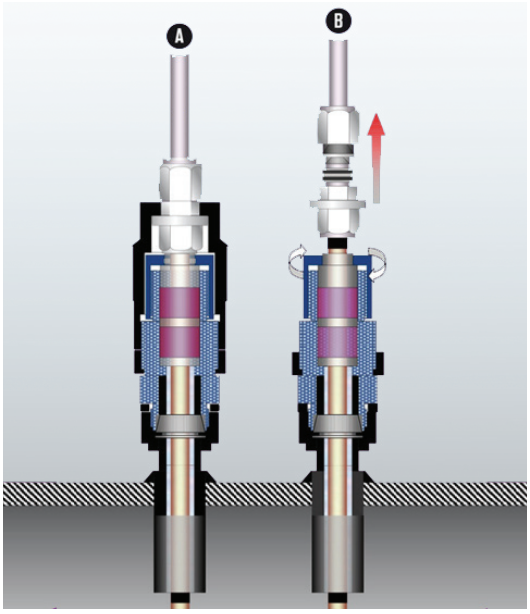
Our sealing nozzle is designed to directly resolve the key challenges faced by operators in maintaining leak-tight connections between thimble tubes and guide tubes. This solution delivers reliable leak-tightness at both high and low pressures, ensuring safe operation during fuel handling—even when thimble tubes are partially withdrawn. Its maintenance-free design and integrated Swagelok-type coupling allow for quick, straightforward installation without the need for costly modifications or frequent interventions. Fully compatible with existing guide tubes, the sealing nozzle reduces outage times and maintenance efforts, providing operational flexibility and proven performance across numerous reactors worldwide.



sealing nozzle



sealing nozzles on-site



A *Tight: resists to reactor coolant pressure*

B *Loose: resists to hydrostatic pressure during withdrawal and insertion of thimbles*

Customer benefits

- Flexible scheduling for thimble tubes withdrawal and insertion operations (no longer depending on water level in the reactor vessel)
- Significant outage time savings:
  - Over 4 hours (prior tubes withdrawal)
  - Over 10 hours at the end (prior pressure test)
- Easy switching between high-pressure or low-pressure modes, just by tightening or loosening nuts
- Reliable operation:
  - No leakage problems after several disassembly / assembly cycles
  - No local thimble tube strain
  - No risk of thimble tube ejection as the thimble tube is mechanically held by the seal nozzle
- Shorter maintenance times with proven components

Technical Information

The sealing nozzle is equipped with two sets of polymer seals arranged in series.

The seals are axially compressed by a gland using two nuts (high-pressure and low-pressure nuts).

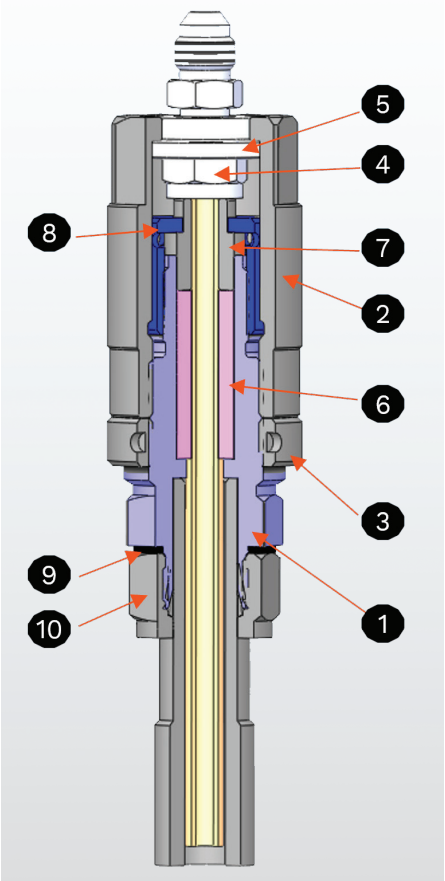
This axial compression causes the seals to expand radially, pressing simultaneously against the inner surface of the sealing nozzle and the outer surface of the thimble tube, ensuring leak-tight performance.

The two nuts serve the following functions:

- The first nut (item 9) applies limited compression to the seals, providing low-pressure leak-tightness while allowing the thimble tube to be pushed or pulled.
- The second nut (item 2) applies a higher level of compression, ensuring high-pressure leak-tightness.

The use of polymer seals, rather than metal-to-metal contact, extends the service life of the sealing nozzle.

Framatome offers two similar sealing nozzle designs—one horizontal and one vertical—to accommodate different plant configurations.



1. Seal Nozzle casing
2. High pressure nut
3. High pressure lock-nut
4. Swagelok union fitting
5. Upper washer
6. Sealing pack
7. Gland
8. Low pressure nut
9. Spacer
10. Swagelok fitting

Key figures

Over 50 years of proven reliability in France

+ 80 PWR reactors worldwide equipped with Framatome's sealing nozzles

References

Framatome's sealing nozzle design, proven reliable, efficient, and safe over 50 years of use in French reactors, is now installed on more than 80 PWR reactors worldwide, including those designed by Framatome and other manufacturers:

- Belgium: 7 units
- China: 39 units
- France: 58 units
- Slovenia: 1 unit
- South Africa: 2 units
- South Korea: 3 units
- Spain: 5 units

Contact: IC@framatome.com
www.framatome.com

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