



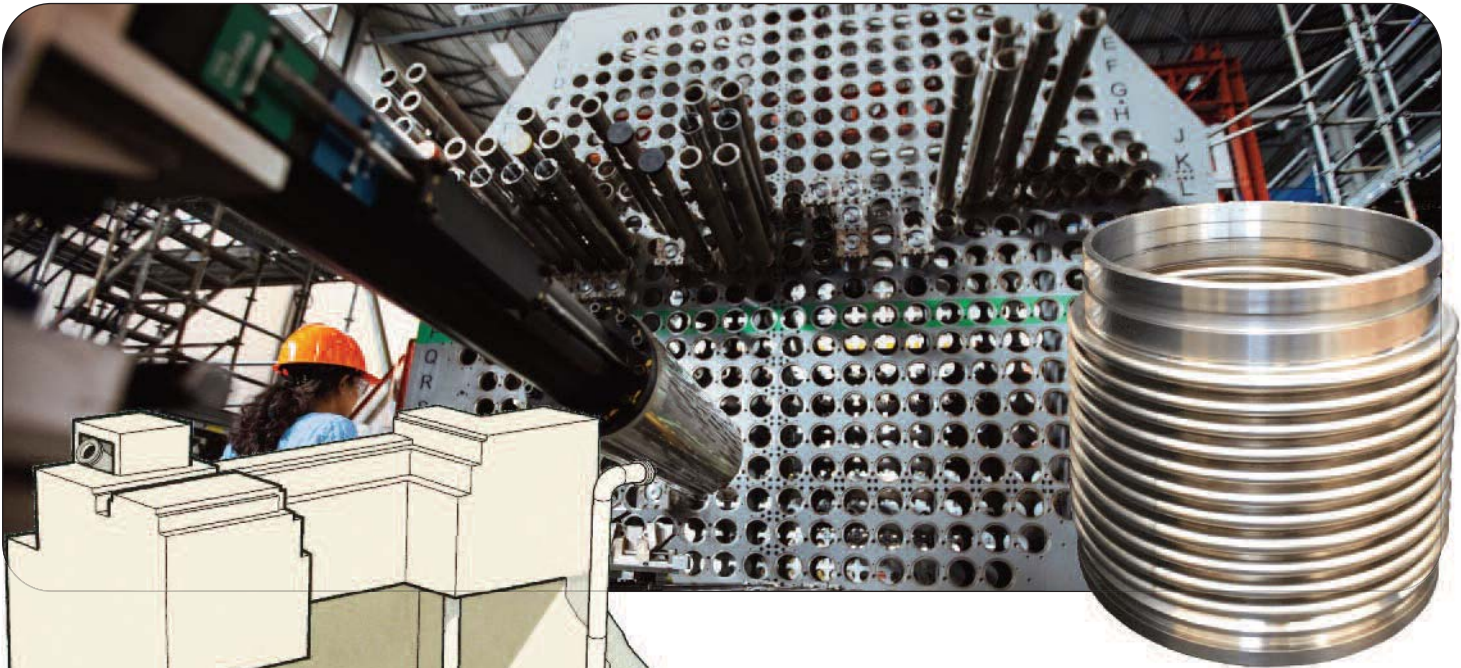
Annulus Seal Metallic Bellows

Serving The Nuclear Industry



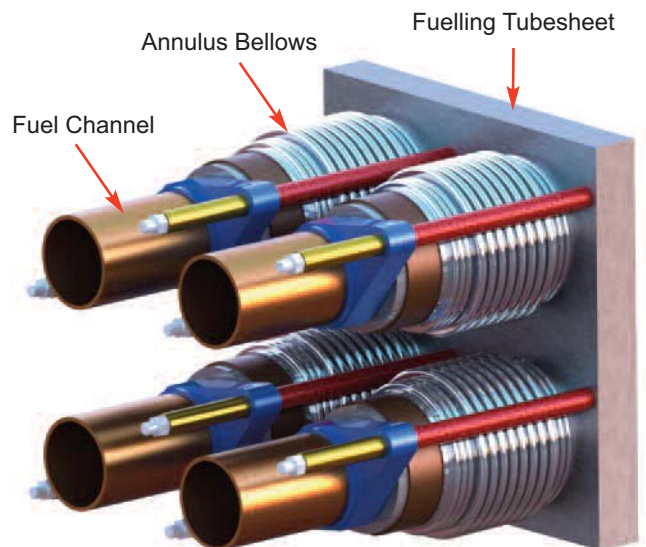
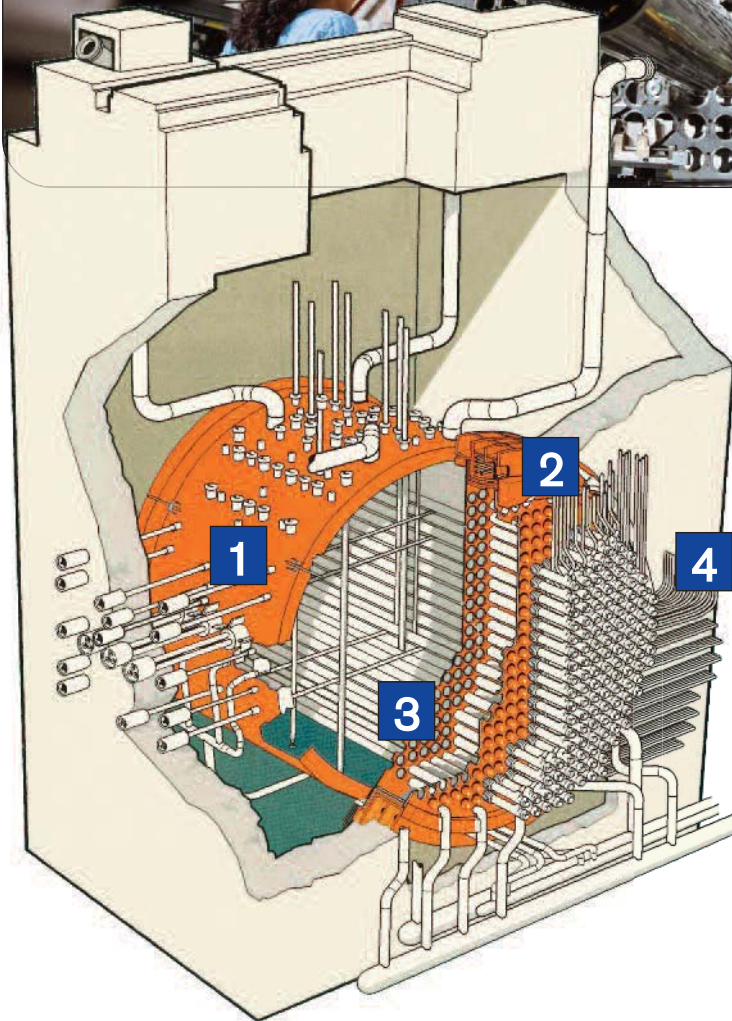
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Annulus Seal Bellows



Calandria Fuel Channel Assembly

In a PHWR reactor, the high pressure coolant and fuel is contained in several hundred small diameter horizontal channels (Fuel Channels). The Fuel Channels are insulated from the moderator by the gas in the annulus formed between the pressure tube and the concentric calandria tube. The calandria tubes are part of the calandria vessel pressure boundary that is the container for the low pressure, low temperature, heavy water moderator.



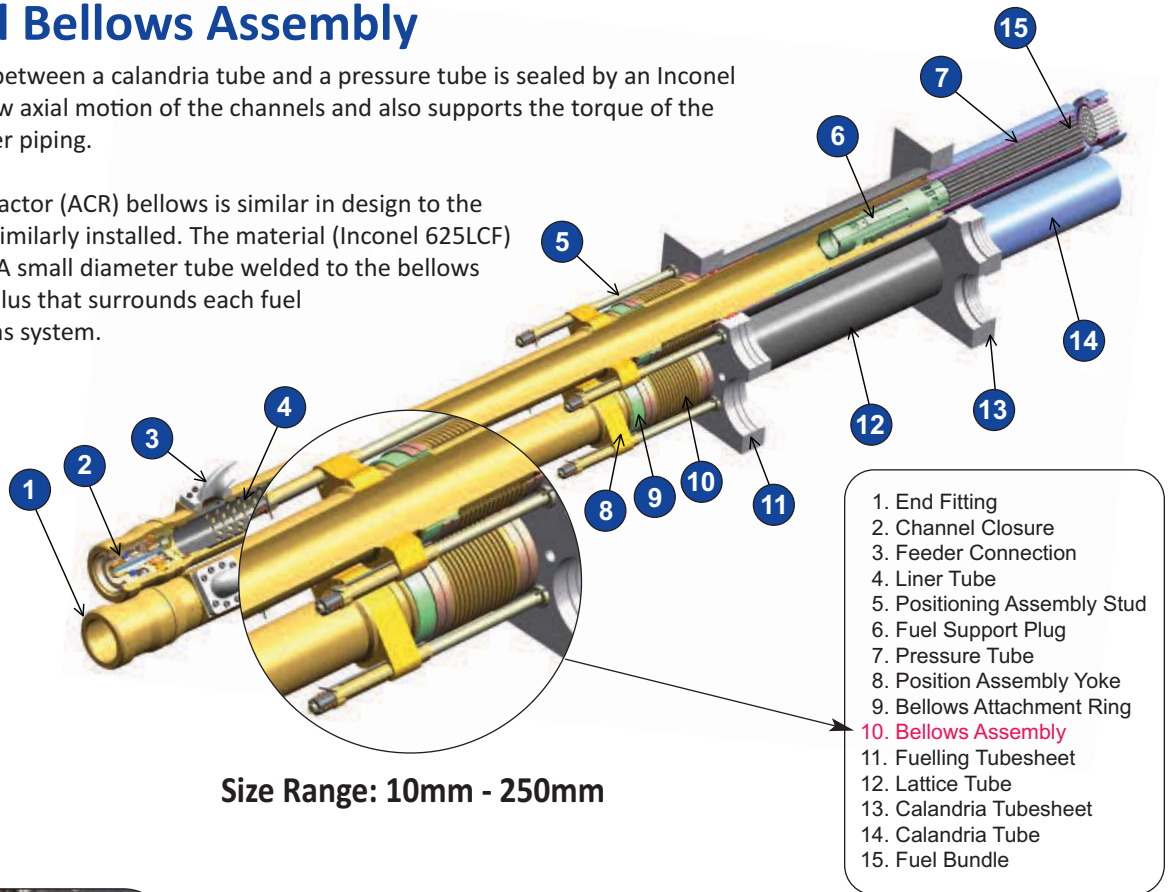
Calandria & End Shield Assembly In Reactor Vault

1. Calandria
2. Calandria End Shield
3. Fuel Channel Assemblies
4. Feeder Pipes

Annulus Seal Bellows Assembly

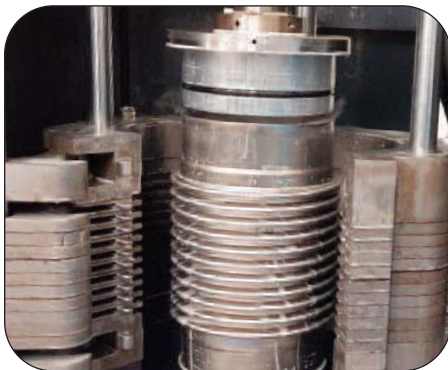
Each end of the annulus between a calandria tube and a pressure tube is sealed by an Inconel bellows. The bellows allow axial motion of the channels and also supports the torque of the end fitting from the feeder piping.

The Advanced CANDU Reactor (ACR) bellows is similar in design to the CANDU 6 bellows and is similarly installed. The material (Inconel 625LCF) is the same as CANDU 6. A small diameter tube welded to the bellows connects the sealed annulus that surrounds each fuel channel to the annulus gas system.



Size Range: 10mm - 250mm

1. End Fitting
2. Channel Closure
3. Feeder Connection
4. Liner Tube
5. Positioning Assembly Stud
6. Fuel Support Plug
7. Pressure Tube
8. Position Assembly Yoke
9. Bellows Attachment Ring
10. Bellows Assembly
11. Fuelling Tubesheet
12. Lattice Tube
13. Calandria Tubesheet
14. Calandria Tube
15. Fuel Bundle



Thorburn's Precision hydro formed bellows manufactured with various ply thicknesses

Annulus Seal Bellows

An important component within the calandria fuel channel is the annulus seal metallic bellows which form part of the annulus gas system. Thorburn's annulus seal metallic bellows assemblies are manufactured with multiple ply Inconel SB443 alloy 625LCF and formed using a proprietary hydro forming process. The bellows seams are welded using a fusion welding process without filler metals. The collar plies are fused using resistance welding while the collars are welded to the Bellows Attachment Ring and the Fuelling Tubesheet using GTAW or robotically using an orbital welding process. Thorburn's metallic bellows assemblies are designed and manufactured to ASME B31.1, N285.0, ASME Sec III, Class 2 & 3, as required.



Thorburn's 6 ply bellows with sizes 10mm to 250mm

Multi-Ply Bellows

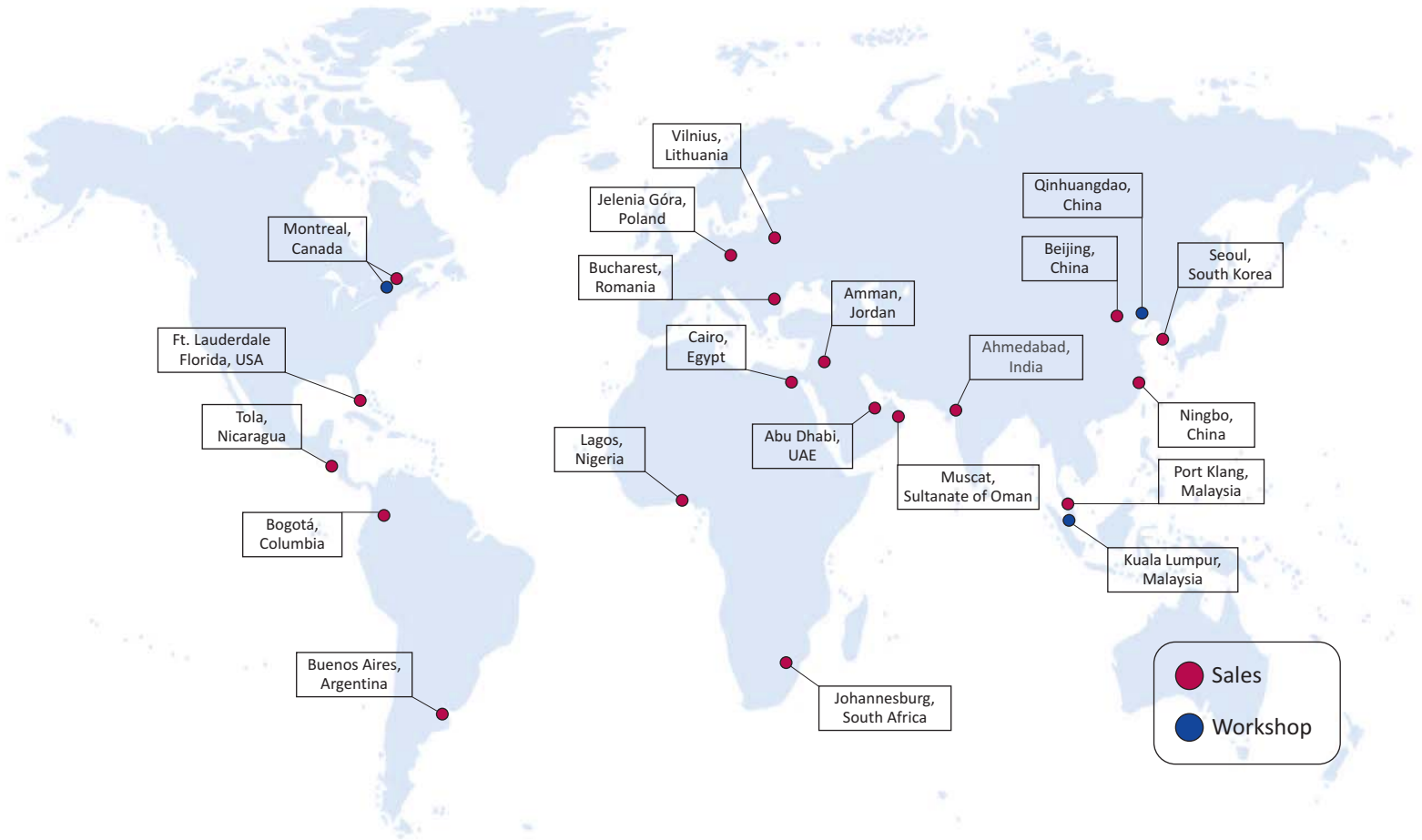
Thorburn uses multi-ply bellows for increased cycle life and when lower forces are required while still maintaining the same pressure capacity. The multi-plyes act in unison as far as hoop pressure loading is concerned but act individually when cycle life and forces are calculated. Bellows can be designed with various convolution heights to simplify installation.

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