

Case study: Use of Fluoropolymer Sealing Elements in Valves Classified as “Important to Nuclear Safety”.



Key Facts:

- There are 126 nuclear power units in Europe, with 56 located in France.
- There are more than 50 valves per unit on emergency circuits in the nuclear island. Valves on emergency circuits are classified as “Important To Nuclear Safety (ITNS)”. These valves require a very low friction sealing material to achieve the requirements of nuclear safety standards and to ensure the safe operation of the units during emergencies.
- Polytetrafluoroethylene (PTFE) is a well-known Fluoropolymer and the only sealing component available today capable of meeting the strict requirements for these valves. The selection of PTFE followed extensive qualification tests conducted over many years, using specific procedures developed by the nuclear industry itself, including irradiation resistance tests and long term service tests.

Expanded graphite is commonly used as the sealing component for valve stems in the nuclear industry due to its established performance characteristics, including low permeability and resistance to temperature and radiation. However, its coefficient of friction is not sufficiently low for valves on some emergency circuits or for control valves on the reactor cooling circuit. Failure of these valves due to the higher friction of graphite packing sets (resulting from stem breaks, or no/slow movement) was observed during testing many years ago, during the testing phase of these circuits. Such a failure can lead to an unacceptable unavailability of these emergency circuits during a critical event.

PTFE is traditionally used in the sealing industry due to its unique combination of low permeability and high temperature resistance, as well as excellent chemical and wear resistance and its self-lubricating properties. Its low coefficient of friction (one fifth of that of expanded graphite) makes it the optimal choice for sealing these critical valves, while fully complying with the nuclear safety design standards established in the 1990's, even under accident and emergency situations.

Other design options, such as increasing the actuator power to accommodate the higher friction coefficient packing set (eg expanded graphite) are not feasible as they would involve a global unit redesign and a new qualification process, which is an impractical task for existing plants.

Currently, no low friction materials other than PTFE exist for these critical applications. Developing and qualifying new materials for these critical nuclear valves would take more than 10 years, without any guarantee of reaching the same level of safety performance.