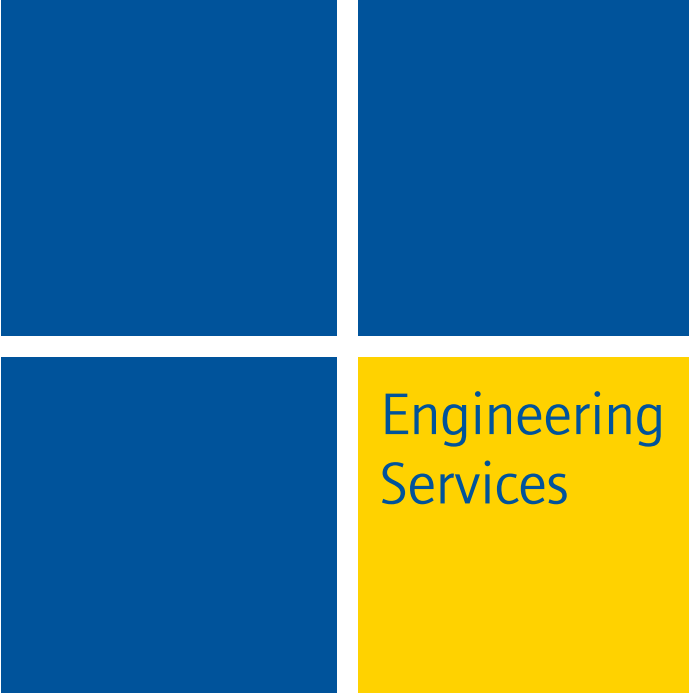


PERFORMANCE+ Fuel



Engineering
Services

Background

PERFORMANCE+ fuel helps utilities achieve exceptional fuel reliability and performance in today's challenging operating and commercial environment.

Trends in nuclear fuel operations include efficiency enhancing, as well as technologically demanding, practices such as longer cycle lengths into the 18- to 24-month range, increased discharge burnups above 50,000 MWD/MTU, higher primary coolant temperatures, and elevated lithium levels. The challenge to nuclear fuel suppliers is to provide product features that support these industry trends without sacrificing fuel reliability or operating margins.

PERFORMANCE+ fuel offers features that support and implement today's operating plant priorities. It provides utilities with the opportunity to select the combination of features best-suited to their specific goals.

Benefits

Utilities can select among the benefits of these PERFORMANCE+ features:

- A removable top nozzle aligns easily and engages without external force. It simplifies tooling and takes less time to remove and reattach. Strong, durable inserts reduce inspection requirements. Low-cobalt stainless steel reduces personnel exposure levels during refueling operations. Operating and maintenance (O&M) costs are reduced and overall reliability increased.
- Axial blankets place more enriched uranium in the inner part of the fuel rod where fuel is used most efficiently, reducing axial neutron leakage by about 50%. Enriched annular axial blankets use neutrons even more efficiently, further reducing fuel enrichment costs.
- Intermediate flow mixer (IFM) grids enhance the margin to departure from nuclear boiling (DNB) by enhancing flow mixing and heat transfer in the upper part of the core. Increased margins can be used to help upgrade energy output, or to increase the allowable peaking factor limits for greater flexibility in loading patterns, or to help accommodate longer cycle lengths.
- PERFORMANCE+ fuel utilizes ZIRLO™ material extensively in the structural grids and IFM grids, as well as in the fuel rod cladding, instrumentation tubes, and guide thimbles. ZIRLO cladding provides greater fuel reliability at extended burnups and high fuel duties.

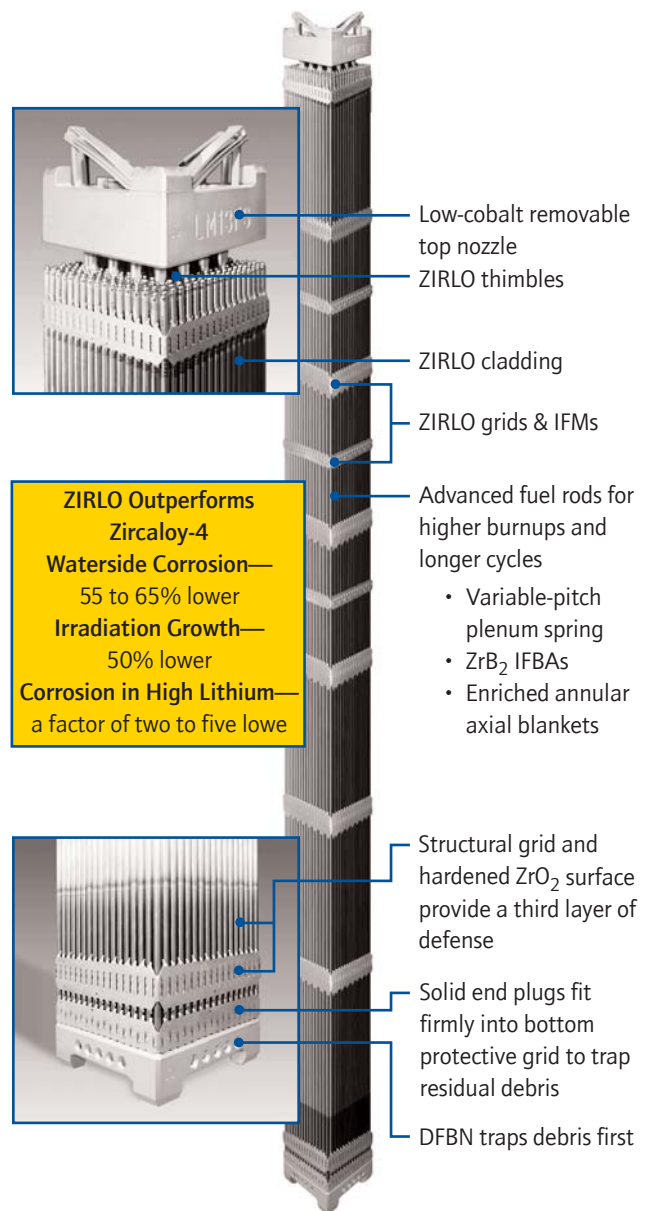
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It has greater dimensional stability, greater resistance to corrosion and irradiation growth and creep, and greater resistance to elevated lithium levels than other available cladding materials.

- ZrB_2 diboride integral fuel burnable absorbers (IFBAs) can help to reduce fuel cycle costs (FCCs) and storage requirements, increase reactor availability, and increase loading pattern flexibility. IFBAs provide a smaller residual reactivity penalty than other burnable absorbers, reducing uranium requirements and resulting in up to a 3 % reduction in FCCs. Since the absorber is part of the fuel rod, there is no need to handle separate discrete burnable absorbers during refueling, or worry about their subsequent disposal.
- Mechanical modifications to the assembly, when combined with the greater creep resistance of ZIRLO cladding, enhance fuel performance under the more severe duty of extended burnups and high fuel duties. For example, a small, variable-pitch plenum spring provides added space for fission gas. Annular axial blanket pellets, with 25 % less fuel rod volume, also increase available space for gas release.
- PERFORMANCE+ fuel offers triple protection against debris-induced fuel rod damage. The debris filter bottom nozzle (DFBN) traps the vast majority of debris before it enters the assembly. A protective grid at the bottom of the assembly reduces the potential for both debris-induced and grid-to-rod fretting damage. And a hardened layer of ZrO_2 applied during hard fabrication protects the lower end of the rod and increases wear-resistance early in life when fuel is most susceptible to debris-induced damage. The results: reduced O&M costs, fewer inspections, reduced personnel exposure, and less radwaste disposal.

Description

The challenge for nuclear plant operators is to reduce fuel-cycle expenses and lower operating costs while maintaining excellent performance records. PERFORMANCE+ fuel has evolved as a response to customers' needs for increased power plant availability, enhanced reliability, and greater operating flexibility. Advances have been made in the three basic elements of the fuel assembly—the fuel cladding, the fuel rod, and the fuel assembly skeleton.



ZIRLO Outperforms Zircaloy-4
Waterside Corrosion—
 55 to 65% lower
Irradiation Growth—
 50% lower
Corrosion in High Lithium—
 a factor of two to five lower