

Keeping Sailors Safe Below Sea



Thomas Fink, general manager of the nuclear safety division at SCHOTT, discusses how utilizing high-quality components in reactor infrastructure for nuclear submarines delivers advanced levels of operational safety and peace of mind for the world's most commanding naval vessels.

For over 60 years, nuclear submarines have held the distinction as some of the most impressive vessels on the seas. Their formidable characteristics make it easy to understand why: high-speed propulsion, virtually unlimited range, and the ability to stay below surface for weeks at a time. The capability of nuclear submarines is recognized worldwide. Six countries – the United States, Russia, China, the United Kingdom, France, and India – all have nuclear submarines in their fleets, and several more countries are in various stages of establishing their own nuclear submarine programs.

Bringing nuclear power out to sea

While the capabilities of nuclear submarines are clear, the means to achieve them are unorthodox compared to diesel engine propulsion. These vessels house a nuclear reactor as a permanent onboard fixture, located just a few meters from several dozen sailors at all times. It's a unique concept that comes with a series of hazards and challenges that must be addressed for safe and successful operation. The main hurdles: space limitations, fire mitigation, and radiation leakage protection.

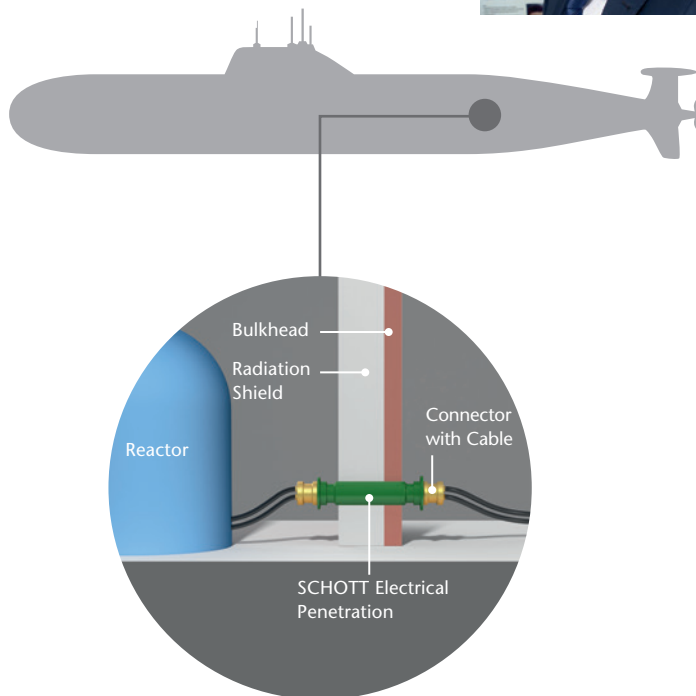
Reactor integration in submarines requires careful engineering and specialized components. The reactor is housed in a sealed-off compartment in the submarine. Bulkheads fortified with radiation shields separate the reactor from the rest of the submarine.

While a sealed reactor compartment should theoretically mitigate potential hazards, infrastructure requirements bring about challenges. Pass-through is required into and out of the reactor area via the bulkheads for power, instrumentation, and control cables. In standard applications, polymers or epoxies can be used to surround and insulate the cables at the pass-through point. But in nuclear applications, where the barrier must remain hermetic for safety and radiation protection, this sealing is insufficient.

Nuclear safety with specialty glass

Glass-to-metal sealed bulkhead penetrations provide a solution. Specialty glass can be used as an insulating material to create hermetically sealed feedthroughs. Metal and glass are fused together in a high-temperature furnace, creating a vacuum-tight bond that is nearly impenetrable. Glass-to-metal sealing is already standard in many harsh environment applications. These include nuclear power plants (60-year lifetime), automotive sensors (1000°C temperature resistant), and oil & gas equipment (4000 bar pressure resistant).

SCHOTT Eternaloc® bulkhead penetrations are a leading example of this type of glass-to-metal sealed component for nuclear submarines. Utilizing over 75 years of glass-sealing expertise, SCHOTT bulkhead penetrations deliver extreme shock, pressure, vibration, and temperature resistance – in some cases as much as 50 times greater than typical submarine component requirements. This robustness offers both peace of mind for routine operation and preparation for worst-case scenarios. In particular, SCHOTT Eternaloc® bulkhead penetrations are resistant to fire – the most dangerous event that can occur on a submarine.



SCHOTT Eternaloc® bulkhead penetrations help maintain a hermetic barrier for fire and radiation protection.

In combination with the bulkhead, glass-sealed penetrations maintain a hermetic barrier to prevent the spread of smoke, flames, and radiation. Numerous tests have proven the ability of glass-sealed bulkhead penetrations to mitigate the severity of adverse events by enabling continued monitoring and control of the reactor, preventing the cable pass-through points from becoming weak links in the infrastructure.

Hermetic protection built to last

A 40-year lifetime thanks to the non-aging properties of glass makes SCHOTT Eternaloc® bulkhead penetrations a “fit and forget” component capable of lasting for the average service lifetime of most nuclear submarines – ultimately providing increased safety and reduced total cost of ownership. SCHOTT already supplies glass-sealed Eternaloc® bulkhead penetrations to some of the world's most renowned naval forces and is an awarded supplier of submarine components for BAE Systems.

Nuclear submarines are a modern seafaring marvel and the pride of naval fleets worldwide. Their extraordinary abilities come with the need for meticulous engineering and sound construction. Utilizing advanced components in submarines – such as glass-sealed bulkhead penetrations – is a step to protect the safety of those who protect us through their service.

For more information, please visit [schott.com/submarines](https://www.schott.com/submarines)