

Boiling Water Reactor Control Rod, CR 82M-1

Background

The boiling water reactor (BWR) control rod of today must meet high operational demands and at the same time contribute to decreased operational costs for the plant operator.

Description

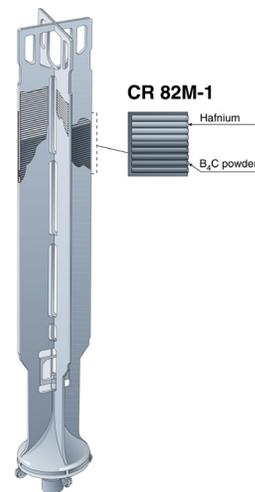
The Westinghouse BWR control rod design consists of four stainless steel sheets welded together to form a cruciform-shaped rod. Each sheet has horizontally drilled holes to contain the absorber materials (B₄C powder and hafnium). This design allows significantly more B₄C to be contained in the rod compared to the original control rods of most reactors.

CR 82M-1 Design

The hafnium tip of the CR 82M-1 design protects the control rod from absorber material swelling when operated in the shutdown mode, i.e., withdrawn from the core. The flexible B₄C inventory allows for either matched or high-reactivity worth control rods. As structural material, American Iron and Steel Institute (AISI) 316L stainless steel is an irradiation-resistant steel, not readily sensitized to irradiation-assisted stress corrosion cracking (IASCC). With an extremely low-cobalt content (< 0.02%) in the wing material, these control rods can play a significant role in as-low-as-reasonably-achievable (ALARA) efforts. The design, with horizontally drilled absorber holes, limits the washout of B₄C in the event of an anomaly in a wing, thus maintaining full reactivity worth.



Westinghouse CR 82M-1 control rod for all types of BWRs



Westinghouse BWR control rod CR 82M-1

Benefits

CR 82M-1 is an evolutionary design based on 40 years of control rod operation experience, and is characterized by:

- Long-service lifetime
- Reactivity worth equal to or higher than the original control rods
- Low-cobalt content
- Structural material with high resistance to stress corrosion cracking (SCC)
- Hafnium tip protecting the control rod during long-term use as a shutdown rod
- Horizontally drilled absorber holes proven to retain the boron carbide powder
- Easy waste disposal

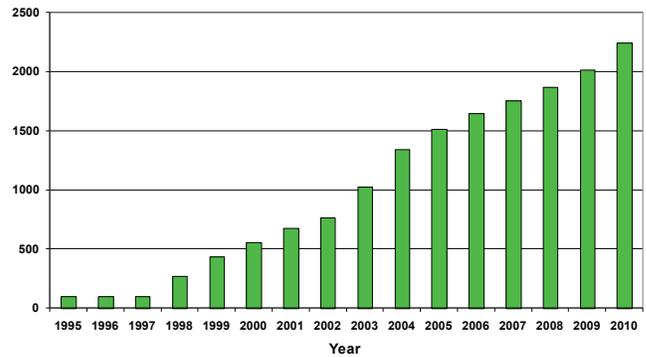
Experience

Westinghouse began developing BWR control rods in the mid-1960s. The first control rod, CR 70, was in operation in a BWR plant in 1970. After 40 years, many original rods are still in operation.

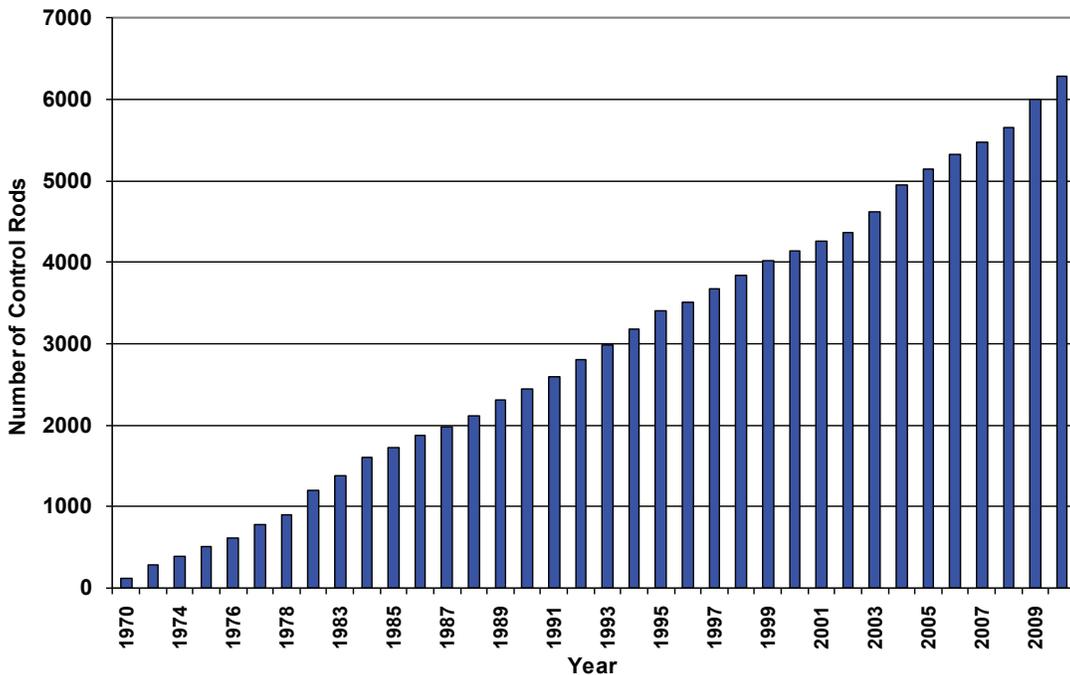
A vast majority of hafnium-tipped rods (CR 82), the first to be used in the United States in 1983, are still in operation. The CR 82M-1 design was introduced in 1995. The main feature of the CR 82M-1 rod is the change of structural material to 316L stainless steel with high resistance to SCC and a very low-cobalt content.

Westinghouse has delivered a total of more than 6,200 BWR control rods, worldwide. Out of these, more than 2,200 are the CR 82M-1 design.

Westinghouse BWR control rods are licensed in the United States, Germany, Spain, Switzerland, Sweden, Finland and Taiwan.



Deliveries of CR 82M-1
(accumulated to December 2010)



Deliveries of Westinghouse BWR control rods
(accumulated to December 2010)