

# 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

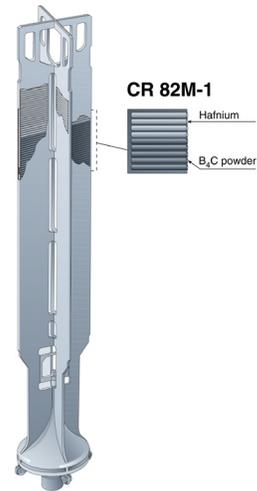
The Westinghouse BWR control rod design consists of four stainless steel sheets welded together to form a cruciform-shaped rod. Each sheet has horizontally drilled holes to contain the absorber materials (B<sub>4</sub>C powder and hafnium). This design allows significantly more B<sub>4</sub>C to be contained 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the CR 82M-1 design protects the control rod from absorber material swelling when operated in the shutdown mode; i.e., withdrawn from the core.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 B<sub>4</sub>C inventory allows for either matched or high-reactivity worth control rods. As structural material, American Iron and Steel Institute 316L stainless steel is an irradiation-resistant steel, not readily sensitized to irradiation-assisted stress corrosion cracking. 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 efforts. The design, with horizontally drilled absorber holes, limits the washout of B<sub>4</sub>C 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 45 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

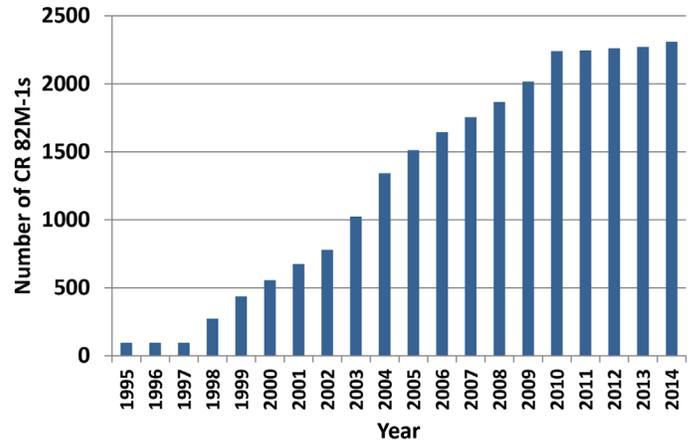
## Experience

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 45 years, many original rods are still in operation.

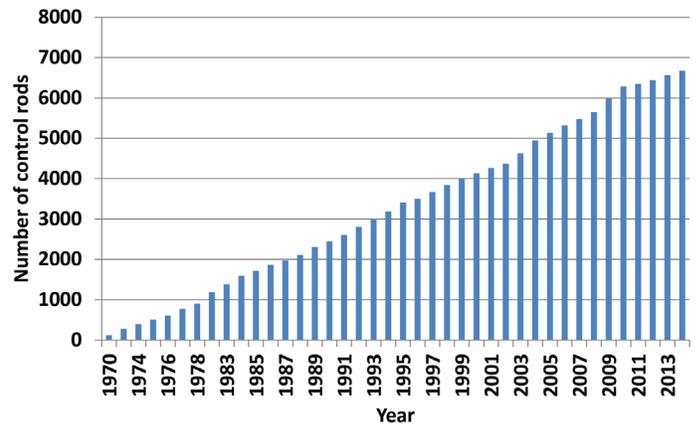
A vast majority of hafnium-tipped rods (CR 82), the first to be used in the United States in 1983, are still in operation. The CR 82M-1 design was introduced in 1995. The main feature of the CR 82M-1 rod is the change of structural material to 316L stainless steel with high resistance to SCC and a very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

Westinghouse has delivered more than 6,700 BWR control rods worldwide. Out of these, more than 2,300 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 2014)



Deliveries of Westinghouse BWR control rods  
(accumulated to December 2014)