

## GE Hitachi Nuclear Energy

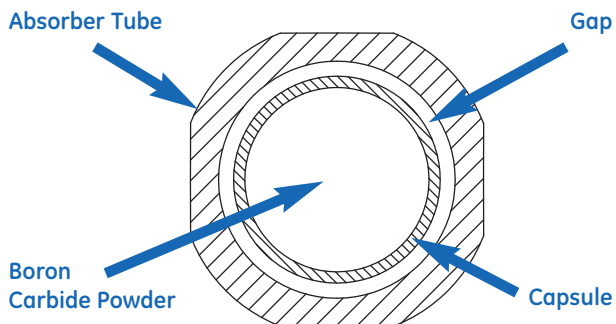
### Marathon Ultra\* Control Rod Blades

# fact sheet

Based on the GE Hitachi Nuclear Energy (GEH) Marathon control rod design, the Marathon Ultra marks the next generation in the evolution of reliable and economical boiling water reactor control rods.

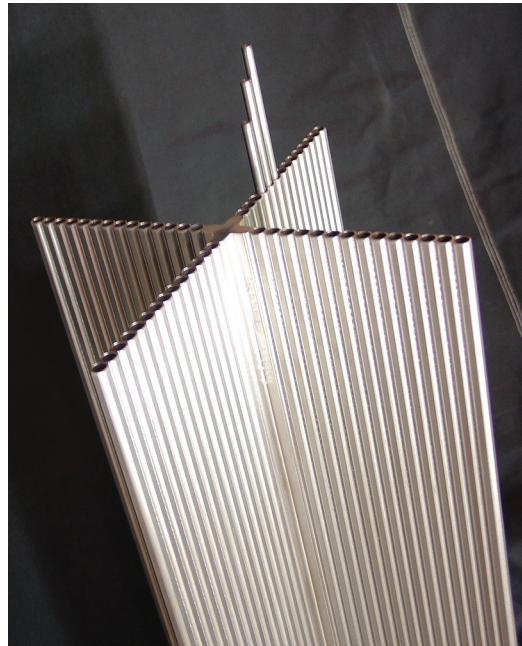
#### Reliability

The Marathon Ultra design is based on the simplified absorber tube, shown below, which offers superior capability to withstand helium pressurization loads and enhances reliability. A larger diametral gap between the capsule and the absorber tube is designed to eliminate all boron carbide swelling-induced strain on the outer absorber tube. This significantly reduces the likelihood of stress corrosion cracking.



Simplified Absorber Tube and Boron Carbide Capsule

- Utilizes high purity, stabilized stainless steel tubing to help protect against stress corrosion cracking
- A laser welding process joins the simplified absorber tubes, reducing the residual stress and strain from control rod manufacturing
- Completely crevice-free in the irradiated portions of the assemblies, eliminating a significant source of potential stress corrosion cracking



#### Flexibility

The highly flexible Marathon Ultra control rod structure is capable of multiple absorber loadings, each with unique control rod lifetimes. Currently, both the medium duty Marathon Ultra MD and the high duty Marathon Ultra HD are offered.

#### Marathon Ultra MD Features

- It is an all-boron carbide capsule loaded design
- Ideal for "shutdown" control rod locations, the Ultra is designed to combine high reliability with an economical absorber loading
- Great for original equipment control rod replacement, replacing the high cobalt pins and rollers with low cobalt materials, to lower the overall plant cobalt dose
- Designed to provide control rod lifetimes comparable to alternate long-life control rod options



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## Marathon Ultra HD Features

- The absorber loading combines boron carbide capsules with hafnium in high duty locations
- Ideal for control cell applications, the Ultra is designed for both reliability and long life

## Interchangeability Features

Marathon Ultra control rods are completely interchangeable with original equipment and other replacement control rods. The interface dimensions and outer dimensional envelope are identical to previous designs, and the total weight of Marathon Ultra control rods falls within the weight range of previous control rods.

## Economical

Marathon Ultra control rods are designed to offer a superior total life cycle cost when compared to other control rod options. The nuclear and mechanical lifetimes are designed to exceed that of alternative shutdown and long life control rods such that the number of exchanges needed during refueling outages is also reduced, thus reducing the number of control rods that need to be disposed.

The Marathon Ultra control rod is designed to minimize the end-of-life disposal cost, as well as reduce exposure levels during movements. These factors are accomplished by limiting the content of long-lived radionuclides, particularly nickel, cobalt, and niobium. The total stainless steel mass of the irradiated portions of the Marathon Ultra control rod is 20% less than original equipment control rods.



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