

Improving Nuclear Fuel Reliability:

MODULE NO. 5

REACTOR WATER CHEMISTRY

Reactor water chemistry is an extremely important factor when considering fuel cladding integrity and the reliability of nuclear fuel assemblies. This is equally true for BWRs and PWRs, as evidenced by a number of chemistry-related fuel rod failures in both reactor types over the last few years. Fuel reliability does not involve only breached cladding and failures. For example, crud deposition due to water chemistry transients or the presence of particular chemical species can restrict plant flexibility, as with axial offset anomalies (AOA) in some PWRs.

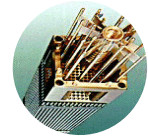
A thorough understanding of reactor water chemistry and its potential impact on fuel reliability and the implementation of effective chemistry control are crucial to achieving top decile fuel performance.

This module addresses the basic principles of water chemistry control, current BWR and PWR water chemistry guidelines and the impact of variations in water chemistry on fuel reliability.

The objectives for the standard Reactor Water Chemistry Module are as follows, but the training sessions may be customized to meet your specific needs. This module can be conducted in one day.

BOILING WATER REACTORS

- ◆ Describe and Discuss the Basic Principles of BWR Water Chemistry
 - Typical chemical specifications
 - Reasons for addition and exclusion of various substances
- ◆ Describe and Discuss Normal BWR Water Chemistry
 - Electrical conductivity
 - Typical values for reactor water impurities (Cr, Cu, Fe, Ni, Zn, SiO₂, O₂ and ⁶⁰Co)
 - Hydrogen and oxygen injection
 - Zinc injection
 - Noble metal chemical addition
 - Ni/Fe control
 - Review of applicable EPRI and INPO guidelines
- ◆ Present and Discuss Chemistry-related Performance Problems Including Examples from NAC Stoller's Experience
 - Excessive uniform and nodular corrosion
 - Normal, and enhanced, spacer shadow corrosion
 - Primary and secondary hydriding
 - Crud deposition
 - Intrusions from ion exchange resins and/or as a result of condenser leaks into the feedwater



PRESSURIZED WATER REACTORS

- ◆ Describe and Discuss the Basic Principles of PWR Water Chemistry
 - Typical chemical specifications
 - Reasons for addition and exclusion of various substances
- ◆ Describe and Discuss Normal PWR Water Chemistry
 - Li-B system
 - pH control through various regimes
 - Zinc injection
 - Soluble and insoluble organic elements and compounds
 - Al, Ca, Cu, Mg, Ni and Si
 - Review of applicable EPRI and INPO guidelines
- ◆ Provide and Discuss Chemistry-related Performance Problems Including Examples from NAC Stoller's Experience
 - Excessive uniform corrosion
 - Hydriding of the cladding outer surface
 - Crud deposition
 - Axial offset and deviation anomalies