

Materials and Corrosion in Light Water Reactors

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“Since the beginning of nuclear industry, corrosion issues have been a major concern. Less than two years after start-up, stress corrosion cracking occurred on the stainless steel tubing of the steam generator of the prototype for the Nautilus in USA (1953); more recently, last year in 2022, several French Pressurised Water Reactors were shut down due to stress corrosion cracking of stainless steels pipes in a safety injection circuit. We propose to underline the complex corrosion mechanisms linked to the aggressive environments (high temperature and high pressure water environments) and to present briefly the three main corrosion phenomena occurring in Light Water Reactors (LWRs), after a short overview of the basic designs and materials of the boiling water reactors (BWRs) and pressurized water reactors (PWRs):

- general corrosion of zirconium cladding which limits the life-time of fuel elements to generally 3 cycles;
- flow-accelerated corrosion (FAC) of carbon steel components, which is the only corrosion phenomenon that has led to several deaths in PWRs;
- stress corrosion cracking (SCC) of nickel base alloys (“the Coriou effect”) and of stainless steels including irradiation-assisted stress corrosion cracking (IASCC); SCC phenomena has led to the replacement of major components like steam generators or pressurised vessel heads.

Finally, the corrosion future will be discussed as BWRs and PWRs are extending their period of operation up to 60 and 80 years, and even more.”

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