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Research and development results on advanced materials for light water reactors and future works

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In the nuclear power industrial field, all materials for nuclear power plants must be materials that have sufficient experience in other industrial fields, or those that have been sufficient comprehensive test data accumulated. Author has been studying on the many kinds of advanced materials for many components of the light water reactors, during more than 47 years. For example, Thermally Treated Alloy 690 which is applying to steam generator tubes, control rod drive mechanism tubes, etc., for pressurized water reactors (PWRs) in a world, irradiation assisted stress corrosion cracking (IASCC) resistant modified 316 stainless steel which is applying to baffle former bolts and barrel bolts of core internals for Japanese PWRs, Iron base wear resistant alloy which is applying to valve sheets for Japanese PWRs, etc. And also, author has developed on new conceptual stress corrosion cracking (SCC) resistant austenitic stainless steel. The SCCs were detected in non-sensitized but heavily cold worked austenitic stainless steels for some components of boiling water reactors (BWRs). So, author idealized that the SCC should be caused by low stacking fault energy of that stainless steel, and developed the highly SCC resistant austenitic stainless steel which has high stacking fault energy, based upon the comprehensive basic study, as shown in Figure 1. Author has studied on the comprehensive long-term corrosion tests and SCC tests, mechanical tests, weldability tests, inspectability tests, etc., for these advanced materials, to apply to the components of commercial PWRs or BWRs. Even after these advanced materials have been applied practically, author has been continuing the studies on the long-term corrosion, SCC test, etc., as pro-active research up to the end of plant life for light water reactors. That is a feature of the field of nuclear industry, and the material used for nuclear power plants must never be disposable on the spot.

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