Advancement of Supercritical Carbon Dioxide Technology through Round Robin Testing and Fundamental Modeling

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ABSTRACT:

Growing interest in supercritical carbon dioxide (S-CO_2) cycles for advanced reactors is driving the need for corrosion data on candidate plant materials. The S-CO_2 Brayton cycle is being considered for power conversion systems for a number of nuclear reactor concepts including the sodium fast reactor, fluoride salt-cooled high temperature reactor, high temperature gas reactor, and several types of small modular reactors. Multiple organizations have developed test facilities to address the corrosion data knowledge gap in high temperature, high pressure S-CO_2 environments but to date, there has been no formal test program among these organizations to validate the consistency of the data they produce. A demonstration of comparable and reproducible results enables a coordinated effort to explore the S-CO_2 parameter space relevant to advanced reactor technology. This proposal establishes a round robin test plan for S-CO_2 corrosion testing and the organization of a S-CO_2 Materials Group to guide future materials testing directions. Furthermore, this proposal outlines efforts to elucidate the mechanisms of S-CO_2 corrosion by performing identical tests in supercritical steam, testing model alloys with various composition and environmental conditions, accompanied by modeling efforts to study rate controlling mechanisms of corrosion and to help understanding the effects of impurities.