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CREEP-FATIGUE DATA AND EXISTING EVALUATION PROCEDURES FOR GRADE 91 AND HASTELLOY XR

ASME STANDARDS TECHNOLOGY, LLC

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FOREWORD

This report describes the results of investigation on Task 5 of DOE/ASME Materials Project based on a contract between ASME Standards Technology, LLC (ASME ST-LLC) and Japan Atomic Energy Agency (JAEA). Task 5 is to collect available creep-fatigue data and study existing creep-fatigue evaluation procedures for Grade 91 steel and Hastelloy XR. Part I of this report is devoted to Grade 91 steel. Part II of this report is devoted to Hastelloy XR.

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EXECUTIVE SUMMARY

This report describes the results of investigation on Task 5 of DOE/ASME Materials Project based on a contract between ASME Standards Technology, LLC (ASME ST-LLC) and Japan Atomic Energy Agency (JAEA). Task 5 is to collect available creep-fatigue data and study existing creep-fatigue evaluation procedures for Grade 91 steel and Hastelloy XR. Part I of this report is devoted to Grade 91 steel. Existing creep-fatigue data were collected (Appendix A) and analyzed from the viewpoints of establishing a creep-fatigue procedure for VHTR design. A fair amount of creep-fatigue data has been obtained and creep-fatigue phenomena have been clarified to develop design standards mainly for fast breeder reactors. Following this, existing creep-fatigue procedures were studied and it was clarified that the creep-fatigue evaluation procedure of the ASME-NH has a lot of conservatisms and they were analyzed in detail from the viewpoints of the evaluation of creep damage of material. Based on the above studies, suggestions to improve the ASME-NH procedure along with necessary research and development items were presented. Part II of this report is devoted to Hastelloy XR. Existing creep-fatigue data used for development of the high temperature structural design guideline for High Temperature Gas-cooled Reactor (HTGR) were collected. Creep-fatigue evaluation procedure in the design guideline and its application to design of the intermediate heat exchanger (IHX) for High Temperature Engineering Test Reactor (HTTR) was described. Finally, some necessary research and development items in relation to creep-fatigue evaluation for Gen IV and VHTR reactors were presented.