High-Temperature Mechanical Testing Platform for Accelerated, Parallelized, and Miniaturized Materials Qualification

PI: Calvin M. Stewart, The University of Texas at El Paso
Collaborators: Yirong Lin, The University of Texas at El Paso

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ABSTRACT: This GSI proposal is for the acquisition of an Instron 8862 servo-electric testing system with intelligent furnace control capable of high temperature quasi-static (tensile, creep, stress relaxation, etc.) and dynamic testing (low cycle fatigue, creep-fatigue, etc.). This instrument shall be employed towards the rapid qualification/acceptance of nuclear materials; where accelerated test methods, in development by the University of Texas at El Paso, shall be executed, verified, and validated. The results shall be codified in ASTM test standards and shared with NS&E community. The proposed accelerated tests focus on the accelerated capture of creep, fatigue, and creep-fatigue data for nuclear structural materials where the accelerated tests, completed in less than 100 hours, can be processed to replicate up to 100,000+ hours of conventional testing data. Ongoing research, leveraging our existing facilities, show an incredible 64x acceleration of creep data into the 10,000-hour range. The new instrument shall:

- extend acceleration capabilities into the 100,000-hour range;
- enable parallelized and miniaturized testing which reduce the number-of-tests and volume-of-material needed to characterize material properties;
- enable the acceleration of fatigue and creep-fatigue data based on new test methods;
- and increase the overall throughput of accelerated testing at UTEP.

The instruments will support UTEP-led NS&E research and education programs with the National Energy Technology Laboratory (NETL), U.S. National Nuclear Security Agency (NNSA), Nuclear Regulatory Commission (NRC), Kansas City National Security Campus (KCNSC), and DOE Fossil Energy Office (the eXtremeMAT program led by seven DOE National Laboratories) and support two pending education programs with the NRC and two pre-applications under the FY2021 consolidated innovative nuclear research (CINR) program. This instrument shall enhance the education, training, and development of the Mexican-American student population at UTEP. Materials under investigation include conventional and additively manufactured 304, 316H, 347L, and Inconel 718 alloys. The Nuclear Science User Facilities (NSUF) hosts several Instron systems, but none have the same heating capabilities. If awarded, UTEP would like to join the NSUF as a partner should NSUF offer an invitation.

The equipment shall support multiple years of R&D on accelerated testing and make UTEP better suited to respond to workscopes under the nuclear reactor technologies (RC), fuel cycle (FC), and crosscutting (CT) technology research and development programs.