OVERVIEW OF NUCLEAR THERMAL PROPULSION ENGINE MODELING AND DESIGN ACTIVITIES AT OAK RIDGE NATIONAL LABORATORY. Bruce G. Schnitzler, Oak Ridge National Laboratory, MS 6165, Oak Ridge, TN 37831 schnitzlerbg@ornl.gov

Introduction: Advancement of U.S. scientific, security, and economic interests through a robust space exploration program requires high performance propulsion systems to support a variety of robotic and crewed missions beyond low Earth orbit. Past studies, in particular those in support of the Space Exploration Initiative (SEI), have shown nuclear thermal propulsion systems provide superior performance for high mass high propulsive delta-V missions. The recent NASA Design Reference Architecture (DRA) 5.0 Study re-examined mission, payload, and transportation system requirements for a human Mars landing mission in the post-2030 timeframe. Nuclear thermal propulsion was again identified as the preferred in-space transportation system. An extensive nuclear thermal rocket technology development effort was conducted from 1955-1973 under the Rover/NERVA Program. Both graphite and refractory metal alloy fuel types were pursued. Recent activities have included parallel evaluation and design efforts of engine concepts based on both legacy fuel types. Calendar year 2012 work was summarized in a formal report, *Small Reactor Designs Suitable for Direct Nuclear Thermal Propulsion*, INL/EXT-13-28027. Four concepts were recommended as point-of-departure or baseline designs on which continuing work could be focused. Two were thermal neutron spectrum engine configurations based on extensions of the Small Nuclear Rocket Engine (SNRE) design to higher and lower thrust levels. Two were fast spectrum cermet fueled designs based on the heritage GE-710 fuel element design and minor modifications to that element design. This presentation will provide an overview of ongoing engine evaluation and design work at Oak Ridge National Laboratory. Two primary focus areas are being addressed. The first area includes revisions to the fast spectrum baseline designs. All 2012 fast spectrum concepts utilized a baseline cermet fuel composition derived from earlier work at Argonne National Laboratory. A new cermet reference fuel definition was developed by consensus among the DOE participants. The impacts on reactor size and system level performance are being evaluated and interim results will be presented. The second focus area addresses propellant consumption during engine operation at conditions other than at full power. Propellant use during cooldown is recognized as a complex problem and rigorous treatment is beyond current programmatic needs. An approximate method has been adopted that can provide estimates of propellant use during the early shutdown period lasting a few minutes while pumps are running. The methodology will be described and interim results will be presented.