Foreword

Selected papers from the 2020 Nuclear and Emerging Technologies for Space Topical Meeting (NETS 2020)

Guest Editors

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Humanity's curiosity of and intrigue for exploring space has been with our species since we first looked up into the night sky. This age-old curiosity has driven humankind to innovate technologies for millennia, including efforts ranging from the construction of Stonehenge to track the annual movements of the sun to the investigation of advanced propulsion systems capable of transporting people to distant planets. Today's technical communities dedicated to researching and developing innovative technologies for space exploration have seen a recent reinvigoration. Over the past few years, impressive progress made by industry, with exceptional support from government agencies, to reestablish and develop new capabilities has renewed confidence in humanity's ability to reach the stars—a confidence that has not been present since the days of the Apollo program. Moreover, history shows that innovation and collaboration within the scientific and engineering communities reaches unparalleled pinnacles during periods of astrophilia. Given the advancements in computational capacities for advanced modeling and simulation, unprecedented breakthroughs in commercializing advanced manufacturing techniques, and powerful collaborative relationships between industry and national scientific organizations, today we are limited only by our own imaginations.

In recent years, great efforts have been made to revitalize the field of nuclear-enabled space exploration. In less than a decade, researchers and engineers at Oak Ridge National Laboratory (ORNL) have reestablished a plutonium-238 supply chain to provide heat source material for NASA's radioisotope power systems. This multi-laboratory, interagency effort, which includes Idaho National Laboratory and Los Alamos National Laboratory, was able to successfully deliver material to help power NASA's Mars 2020 rover, *Perseverance*. In another exciting endeavor spanning government policy, national laboratories, academia, and industry partners, NASA has featured the Space Nuclear Propulsion and Fission Surface Power projects within their Technology Demonstration Mission program. Work being performed under this program hopes to develop a flightworthy nuclear propulsion engine that can enable both the advanced propulsion methods needed for crewed interplanetary missions and a sustainable surface power source needed for more capable exploration of the moon and beyond. These technologies have the potential to enable the most promising and feasible solutions for interplanetary space travel and crewed in-space exploration. Great strides have been taken to develop a sustainable and extensible U.S. policy position to enable safe launch, testing, and operation of these systems that is inclusive of many variants in the design space and industry solutions. Planning and technology development to support future demonstration activities, including that of a flight mission to the moon, are in place to occur by 2027.

It is clear that the nuclear space community is in a period of amazing progress. The Nuclear and Emerging Technologies for Space (NETS) conference series provides a platform to communicate and share such scientific and engineering innovations on an annual basis. The NETS conference is considered an eminent meeting within a specialized community composed of policymakers, engineers, scientists, and students that provides an opportunity to disseminate ideas and network with collaborators to ensure nuclear-enabled space exploration remains vital to the planning and execution of global space endeavors. The organizers of NETS 2020 would like to extend heartfelt thanks to the technical committee cochairs—Jorge Navarro (ORNL), Lawrence Heilbronn (University of Tennessee–Knoxville),

and Kelsa Palomares (Analytical Mechanics Associates)—as well as to the track chairs and cochairs mentioned below. The efforts of these individuals were critical to putting together the NETS 2020 technical program, although the COVID-19 pandemic forced the cancellation of this formal meeting.

This special issue of *Nuclear Technology* includes selected articles chosen from the NETS 2020 conference proceedings. NETS 2020, which was characterized by the theme "Nuclear-enabled crewed missions to space: Past, present, and future," consisted of four distinct technical tracks:

Track 1: Radioisotopes and power conversion systems (Michael Smith, ORNL)

Track 2: Nuclear fission power and propulsion (Paolo Venneri, Ultra Safe Nuclear)

Track 3: Mission concepts and policy for nuclear space systems (Bhavya Lal, NASA; Susannah Howieson, U.S. Department of Energy)

Track 4: Advanced and emerging technologies for nuclear space applications (Gerald Jackson, HBar Technologies; Steven Howe, Hbar Technologies/Howe Industries).

From these four tracks, 11 summaries were selected for expansion to become the peer-reviewed technical papers and technical notes enclosed in this special issue. In addition to these papers, two invited technical summaries are included that describe the technical work performed by various sponsors of this edition of *Nuclear Technology*. We hope readers find this selection of articles informative and exciting. Also, please consider participation in future NETS meetings to engage this diverse and stimulating community. More information can be obtained by contacting the American Nuclear Society's Aerospace Nuclear Science & Technology Division at http://anstd.ans.org or by visiting the NETS 2021 webpage at https://nets2021.ornl.gov.