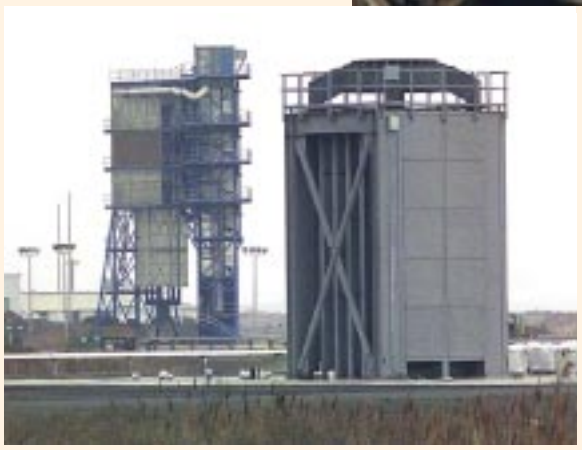
Spaceport Infrastructure Handbook



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The Boeing Company
Canaveral Port Authority
Engineered Arresting Systems
European Space Agency
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Foreword

Where were you in 1968? That was the year Sir Arthur C. Clarke, distinguished Fellow of Britain's Royal Astronomical Society, published *2001 A Space Odyssey*, intended as a prophetic novel in the genre of Jules Verne or H.G. Wells.

This highly acclaimed book, and later the movie, described a brave new world of space travel. With a crew of three, the V-shaped Orion III space planes would travel routinely to orbiting space stations, while even more sophisticated rockets traveled from the space stations to the colonized Moon and even to Mars, our solar system's *second* most hospitable planet.

The novel's 2001 Spaceport, launch site of the Orion III space plane, was located at Cape Canaveral, near the mothballed Kennedy Space Center, "a national monument and place of pilgrimage." The Saturn V rockets and Vehicle Assembly Building of the original space center had been replaced by "a broad, dead-straight scar across the Florida landscape—the multiple rails of a giant launching track."

Pure fantasy or prophetic science? Clarke, in those heady early days of the U.S. Apollo Project, believed that "the barriers of distance are crumbling; one day we shall meet our equals, or our masters, among the stars." The novel's interplanetary spacecraft were described as "scientifically exact projections of future space vehicles."

Where are those space planes today? Where are the spaceports to support them? The year 2001 has come and gone; interplanetary travel is still a dream, but the prophecies of Sir Arthur Clarke continue to inspire visionaries of space exploration.

Although the predictions of the novel *2001* have not all been actualized, we have made significant progress. The Space Shuttle completes several missions each year and routinely transports scientists to and from the International Space Station (ISS). And the year 2001 did see the first commercial uses of the ISS, including its first public space traveler.

NASA has made tremendous advances in space science, space exploration, aeronautics, and biological and physical research since the publication of *2001, A Space Odyssey.* When cost-effective launch systems are available, the era of space commercialization will truly begin. Until then, we will continue to plan the spaceports that will support this fleet.

The *Spaceport Infrastructure Handbook* is a promising indication that we are continuing to pursue our visions of space exploration and exploitation. The many contributors to this handbook are united in their belief that space is indeed a great place to live and work. To get there, we will need safe and efficient spaceports.

Francis T. Hoban
Director
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Preface

Far better it is to dare mighty things, to win glorious triumphs, even though checkered by failure, than to take rank with those poor spirits who neither enjoy much nor suffer much, because they live in the gray twilight that knows not victory nor defeat.

—Theodore Roosevelt
1899

This handbook was undertaken by the Continuing Career Program (CCP), a national program engaged in innovative, web-based research and collaboration with technical experts throughout the United States. The CCP is administered by the School of Public Policy, George Mason University (GMU), under a cooperative agreement (NCC5-360) with the National Aeronautics and Space Administration (NASA). The CCP has become a model for NASA and other organizations to maintain access to the considerable knowledge and experience of retiring managers and technical experts.

The authors are 10 former NASA employees who were selected for the CCP program upon their retirement from NASA. In authoring this handbook, the CCP core team partnered with GMU faculty and other aerospace experts who provided guidance and technical expertise. Their combined experience and knowledge represent two generations of lessons learned in US spaceport operations. Any merit this work provides to future spaceport planners is a credit to thousands of people in the US space program who have contributed to the continuing improvement of existing spaceport operations.

Spaceports are complex industrial facilities that present equally complex technical, operational, and economic challenges. Understanding spaceport requirements will allow stakeholders to make realistic and better informed assessments of the potential for spaceport development in their communities. These stakeholders include visionary educators, students, investors, local and state government officials, decision makers, the interested public, and those in the professions of engineering, aviation and space exploration.

This handbook presents the infrastructure requirements of spaceports at three points in time: 2002, 2020, and 2050. The future of space endeavors is unclear even in the short term. What is clear is that shifting national priorities and world concerns will heavily affect the investment in and direction of space activities between now and the year 2020 as well as in the mid 21st century.

The first section of this handbook looks at the situation today. It is a compilation of the design, construction and operation of contemporary spaceports, primarily based on the operational environment of NASA's Kennedy Space Center. The next sections offer ideas about potential mission requirements and the resulting future spaceport designs, customers, vehicles, and missions in 2020 and 2050. This discussion of missions and launch systems in the future

represents the best thinking and research of the CCP Fellows as to the possibilities and opportunities that may exist for spaceport operators and others interested in the future of space.

The responsibility for the following material rests entirely with the contributors from the NASA/GMU Continuing Career Program. Their opinions do not necessarily reflect the views of either NASA or GMU.

Additional information about this handbook and the CCP is available from the CCP Program Office at GMU in Herndon, Virginia, (703) 733-2807 or at its website, **http://gmupolicy.net/ccp**

Acknowledgments

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We cannot turn our backs on the needs and concerns of our world. On the contrary, universities must be on the cutting edge, and when possible, lead change.

—Alan G. Merten,
GMU President,
1998

Our goal in writing this handbook was to educate the interested public and advance the state-of-the-practice in spaceport operations. We are grateful for the collaborative support we have received to this end. From GMU, we are indebted to Kingsley Haynes, Roger Stough, Kenneth Button, John Evans, Raj Kulkarni, Steve Pierson, Ethenia Phillips, Mary Clark, Mary Anne Perkins, and Margaret Solar. Their tireless support made this project possible.

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