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## Launch Vehicle Recovery And Reuse United Launch Alliance

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*Launch Vehicle Recovery And Reuse United Launch Alliance*

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### BURGESS KORBIN

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[NASA Technical Note](#) JHU Press

This publication is divided into seven sections: future development of economical launch vehicles; space vehicle system concepts near term; space vehicle system concepts far term; European reusable launch vehicle studies; operations and economics; partially recoverable systems; and pacing technology implications.

Routledge

The reuse of expensive launch vehicle hardware will be a critical step in the development of a low cost space transportation system. Prior studies, as well as experience with the Space Shuttle Solid Rocket Boosters, have shown that recovery and reuse of launch vehicle components can be economically beneficial. Recognizing this fact, NASA/MSFC awarded Pioneer Aerospace Corporation an ARS phase 1 study contract entitled Advanced Recovery Systems For Advanced Launch Vehicles, (ARS). This paper documents the work completed during the study, and the conclusions

thereof. Pioneer first investigated the means by which a broad spectrum of launch vehicle hardware can be recovered intact at predetermined locations for refurbishment and reuse. Attention was then focused on defining the design of a single recovery system for the most likely near term payload, a Propulsion/Avionics Module, (P/AM). The study was a success in that : all objectives were satisfactorily achieved ; all documentation was submitted on schedule ; a P/AM recovery system for phase 2 demonstration was designed which offers low cost, extremely low weight, good performance, potential for pinpoint landing, and operational flexibility.

*NASA Thesaurus* AIAA  
 Recovery and Reuse of a Two Stage Launch Vehicle  
 Advanced Recovery Systems for Advanced Launch Vehicles (ARS)Phase 1 Study Results : 10th Aerodynamic Decelerator Systems Technology Conference : Cocoa Beach, FL, April 18-20  
*NASA technical note* University Press of Kentucky

The key to opening the use of space to private enterprise and to broader public uses lies in reducing the cost of the transportation to space. More routine, affordable access to space will entail aircraft-like quick turnaround and reliable operations. Currently, the space Shuttle is the only

reusable launch vehicle, and even parts of it are expendable while other parts require frequent and extensive refurbishment. NASA's highest priority new activity, the Reusable Launch Vehicle program, is directed toward developing technologies to enable a new generation of space launchers, perhaps but not necessarily with single stage to orbit capability. This book assesses whether the technology development, test and analysis programs in propulsion and materials-related technologies are properly constituted to provide the information required to support a December 1996 decision to build the X-33, a technology demonstrator vehicle; and suggest, as appropriate, necessary changes in these programs to ensure that they will support vehicle feasibility goals.

[Scramjet Propulsion](#) Smithsonian Institution

This scholarly study of NASA's Marshall Space Flight Center places the institution in social, political, scientific, and technological context. It traces the evolution of Marshall, located in Huntsville, Alabama, from its origins as an Army missile development organization to its status in 1990 as one of the most diversified of NASA's field Centers. Chapters discuss military rocketry programs in Germany and the United States, Apollo-Saturn, Skylab, Space Shuttle, Spacelab, the Space Station

and various scientific and technical projects including the Hubble Space Telescope. It sheds light not only on the history of space technology, science, and exploration, but also on the Cold War, federal politics, and complex organizations.

**Hearings, Eighty-ninth Congress, Second Session, January 25 and 26, 1966** National Academies Press

Access -- no single word better describes the primary concern of the exploration and development of space. Every participant in space activities -- civil, military, scientific, or commercial -- needs affordable, reliable, frequent, and flexible access to space. To Reach the High Frontier details the histories of the various space access vehicles developed in the United States since the birth of the space age in 1957. Each case study has been written by a specialist knowledgeable about the vehicle described and places each system in the larger context of the history of spaceflight. The technical challenge of reaching space with chemical rockets, the high costs associated with space launch, the long lead times necessary for scheduling flights, and the poor reliability of the rockets themselves show launch vehicles to be the space program's most difficult challenge.

[Subject Terms for Indexing Scientific and Technical Information](#) National Academies Press

While the Moon was once thought to hold the key to space exploration, in recent decades, the U.S. has largely turned its sights toward Mars and other celestial bodies instead. In The Value of the Moon, lunar scientist Paul Spudis argues that the U.S. can and should return to the moon in order to remain a world leader in space utilization and development and a participant in and beneficiary of a new lunar economy. Spudis explores three reasons for returning to the Moon: it is close, it is interesting, and it is useful. The proximity of the Moon not only allows for frequent launches, but also control of any machinery we place there. It is interesting because recorded deep on its surface and in its craters is the preserved history of the moon, the sun, and indeed the entire galaxy. And finally, the moon is useful because it is rich with materials and energy. The moon, Spudis argues, is a logical base for further space exploration and even a possible future home for us all. Throughout his work, Spudis incorporates details about man's fascination with the moon and its place in our shared history. He also explores its religious, cultural, and scientific resonance and assesses its role in the future of spaceflight and our national security and prosperity.

*Reusable Launch Vehicle Recovery and Reuse of a Two Stage Launch Vehicle* Advanced Recovery Systems for Advanced Launch Vehicles (ARS) Phase 1 Study Results : 10th Aerodynamic Decelerator Systems Technology Conference : Cocoa Beach, FL, April 18-20 The reuse of expensive launch vehicle hardware will be a critical step in the development of a low cost space transportation system. Prior studies, as well as experience with the Space Shuttle Solid Rocket Boosters, have shown that recovery and reuse of launch vehicle components can be economically beneficial. Recognizing this fact, NASA/MSFC awarded Pioneer Aerospace Corporation an ARS phase 1 study contract entitled Advanced Recovery Systems For Advanced Launch Vehicles, (ARS). This paper documents the work completed during the study, and the conclusions thereof. Pioneer first investigated the means by which a broad spectrum of launch vehicle hardware can be recovered intact at predetermined locations for refurbishment and reuse. Attention was then focused on defining the design of a single recovery system for the most likely near term payload, a Propulsion/Avionics Module, (P/AM). The study was a success in that : all objectives were satisfactorily achieved ; all documentation was submitted on schedule ; a P/AM recovery system for phase 2 demonstration was designed which offers low cost, extremely low weight, good performance, potential for pinpoint landing, and operational flexibility. Reusable Launch Vehicle Technology Development and Test Program

This book is a completely rewritten, updated, and expanded follow-on to the 3rd edition of Space mission analysis and design.

**Exploring the Unknown**

"The launch of Sputnik 1 in 1957 ushered in an exciting era of scientific and technological

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- [Can't Hurt Me: Master Your Mind And Defy The Odds By David Goggins](#)
- [November 9: A Novel By Colleen Hoover](#)

advancement. As television news anchors, radio hosts, and journalists reported the happenings of the American and the Soviet space programs to millions of captivated citizens, words that belonged to the worlds of science, aviation, and science fiction suddenly became part of the colloquial language. What's more, NASA used a litany of acronyms in much of its official correspondence in an effort to transmit as much information in as little time as possible. To translate this peculiar vocabulary, Paul Dickson has compiled the curious lingo and mystifying acronyms of NASA in an accessible dictionary of the names, words, and phrases of the Space Age." "This dictionary captures a broader foundation for the language of the Space Age based on the historical principles employed by the Oxford English Dictionary and Webster's Third New International Dictionary. Word histories for major terms are detailed in a conversational tone, and technical terms are deciphered for the interested student and lay reader. This is a must-own reference for space history buffs." --Book Jacket.

[NASA's Search for a Reusable Space Vehicle](#)

Long before the NASA was the throes of planning for the Apollo voyages to the Moon, many people had seen the need for a vehicle that could access space routinely. The idea of a reusable space shuttle dates at least to the theoretical rocketplane studies of the 1930s, but by the 1950s it had become an integral part of a master plan for space exploration. The goal of efficient access to space in a heavy-lift booster prompted NASA's commitment to the space shuttle as the vehicle to continue human space flight. By the mid-1960s, NASA engineers concluded that the necessary technology was within reach to enable the creation of a reusable winged space vehicle that could haul scientific and applications satellites of all types into orbit for all users. President Richard M. Nixon approved the effort to build the shuttle in 1972 and the first orbital flight took place in 1981. Although the development program was risky, a talented group of scientists and engineers worked to create this unique space vehicle and their efforts were largely successful. Since 1981, the various orbiters -Atlantis, Columbia, Discovery, Endeavour, and Challenger (lost in 1986 during the only Space Shuttle accident)- have made early 100 flights into space. Through 1998, the space shuttle has carried more than 800 major scientific and technological payloads into orbit and its astronaut crews have conducted more than 50 extravehicular activities, including repairing satellites and the initial building of the International Space Station. The shuttle remains the only vehicle in the world with the dual ability to deliver and return large payloads to and from orbit, and is also the world's most reliable launch system. The design, now almost three decades old, is still state-of-the-art in many areas, including computerized flight control, airframe design, electrical power systems, thermal protection system, and main engines. This significant new study of the decision to build the space shuttle explains the shuttle's origin and early development. In addition to internal NASA discussions, this work details the debates in the late 1960s and early 1970s among policymakers in Congress, the Air Force, and the Office of Management and Budget over the roles and technical designs of the shuttle. Examining the interplay of these organizations with sometimes conflicting goals, the author not only explains how the world's premier space launch vehicle came into being, but also how politics can interact with science, technology, national security, and economics in national government.

[A Dictionary of the Space Age](#)

On June 15, 2011, the Air Force Space Command established a new vision, mission, and set of goals to ensure continued U.S. dominance in space and cyberspace mission areas. Subsequently, and in coordination with the Air Force Research Laboratory, the Space and Missile Systems Center, and the 14th and 24th Air Forces, the Air Force Space Command identified four long-term science and technology (S&T) challenges critical to meeting these goals. One of these challenges is to provide full-spectrum launch capability at dramatically lower cost, and a reusable booster system (RBS) has been proposed as an approach to meet this challenge. The Air Force Space Command

asked the Aeronautics and Space Engineering Board of the National Research Council to conduct an independent review and assessment of the RBS concept prior to considering a continuation of RBS-related activities within the Air Force Research Laboratory portfolio and before initiating a more extensive RBS development program. The committee for the Reusable Booster System: Review and Assessment was formed in response to that request and charged with reviewing and assessing the criteria and assumptions used in the current RBS plans, the cost model methodologies used to fame [frame?] the RBS business case, and the technical maturity and development plans of key elements critical to RBS implementation. The committee consisted of experts not connected with current RBS activities who have significant expertise in launch vehicle design and operation, research and technology development and implementation, space system operations, and cost analysis. The committee solicited and received input on the Air Force launch requirements, the baseline RBS concept, cost models and assessment, and technology readiness. The committee also received input from industry associated with RBS concept, industry independent of the RBS concept, and propulsion system providers which is summarized in Reusable Booster System: Review and Assessment.

**Subject Terms for Indexing Scientific and Technical Information**

Committee Serial No. 2. Considers H.R. 4450 and H.R. 6470, superseded by H.R. 10340, to provide FY68 authorizations for NASA RPD programs, including the Apollo Program, for construction of facilities at field centers, and for administrative operations.

**Reusable Booster System**

The global space sector has always been regarded as a cutting-edge field, futuristic and at the forefront of innovation. In recent years, the sector has undergone massive change, giving rise to a high-technology niche worth over \$330 billion in revenues worldwide and growing. That process, encompassing a greater and more diverse set of actors, has been described as the "democratization of space." Above and Beyond: Exploring the Business of Space provides a comprehensive and current overview of the business of space and its distinctive competitive dynamics. The book explores the commercialization of space, taking the reader on a journey from the era of the Space Race up to the present and beyond. Focusing on both state and commercial actors, the book provides an exhaustive panoramic view of an area of growing human endeavour and ambition that is both informative and fascinating. As the business of space continues to develop and grow at a remarkable pace, the book offers a thoughtful and timely analysis of its past, present and future scenarios. While providing a critical assessment of the business of space, this book offers valuable insights to academics, policy makers and anyone with a keen interest in the sector, as well as useful lessons from emerging commercial and traditional space actors that have broader applicability to other industries and their managers.

[Programmatic Environmental Impact Statement for Commercial Launch Vehicles](#)

Committee Serial No. 3. Considers H.R. 15856, a revised version of H.R. 15086; pt.3: Continuation of hearings on H.R. 15086 (subsequently replaced by H.R. 15856), to authorize NASA funding for FY69. Focuses on progress of lunar and other planetary exploration programs of the Office of Space Science and Applications; pt.4: Focuses on progress of technological utilization, and data tracking acquisition programs of the Office of Advanced Research and Technology; Index: Index to hearings considering H.R. 15086, (subsequently replaced by H.R. 15856), to authorize NASA funding for FY69.

*A History of the Johnson Space Center*

**Federal Register**

[Space Mission Engineering](#)

**Hearings**

**The Value of the Moon**

**To Reach the High Frontier**

- [Saved: A War Reporter's Mission To Make It Home By Benjamin Hall](#)
- [Things We Never Got Over \(knockemout\) By Lucy Score](#)
- [Never Lie: An Addictive Psychological Thriller](#)