

Preface

On June 1, 1991, during the 12th Soviet Technical Forum convened at the London headquarters of the British Interplanetary Society, I presented a paper on the mid-1970s proposal for an American Space Shuttle to dock with a Soviet Salyut space station by 1981. This program was a logical follow-on to the highly successful first international docking mission, the 1975 Apollo-Soyuz Test Project. Despite serious discussions between the two sides, the project never developed to flight status, but 20 years later, under the Shuttle-Mir Program, a Shuttle finally docked with the successor to the Salyut series of stations. The Mir docking missions that followed were precursors to a far more ambitious plan to assemble a large international facility in space over a period of several years, mostly by using the resources of the Shuttle fleet.

Research carried out for that presentation, and the published papers that followed, identified common elements of a Shuttle mission that were basically generic to all flights involving space stations. Using this research as a starting point, I was able to piece together how the design of the Space Shuttle, its additional components and procedures, and its basic mission profile became integral to the creation of a large permanent scientific research station in Earth orbit. What has also become evident from investigations over the subsequent two decades is that the story of sending a Shuttle to a space station was a complex one in which the frequent changes of plan caused the people involved tremendous disappointment and frustration.

Originally, this writing project was to have been confined to a single volume, but it soon became apparent that it was, in fact, a story of two halves, and therefore, two separate titles have been produced. Firstly, in *Linking the Space Shuttle and Space Stations*, the development of key components in the Shuttle system are described. These include the massive infrastructure on the ground to prepare the vehicles for launch, the major hurdle of developing a suitable rendezvous and docking system, and the most appropriate flight profile. The story includes a number of ultimately abandoned plans that were intended to gain experience in docking a Shuttle to a smaller space station ahead of the more complex task of assembling a much larger space complex.

In the early 1970s, initial concepts for the Space Shuttle orbiter envisaged the vehicle possessing an integral docking system, but this was not present in the final design. It was during this time frame that the United States, through NASA, was discussing with the

Soviet Union the possibility of developing a common docking apparatus and perhaps undertaking a joint mission to evaluate the design. This plan became the Apollo-Soyuz Test Project. So successful was this mission in July 1975 that it prompted interest on both sides to develop a subsequent, more advanced joint docking mission. *Linking the Space Shuttle and Space Stations* includes an account of the concept for docking a Shuttle orbiter with a second-generation Salyut space station. Unfortunately, a downturn in superpower politics ruled this out. This book also discusses a later plan by NASA for the Shuttle to rendezvous with the vacated Skylab, with a view to reactivating or updating its systems in order to reoccupy it. But this idea had to be abandoned because delays of qualifying the Shuttle system meant that Skylab fell back into the atmosphere before the new spacecraft entered service.

When President Ronald W. Reagan announced in January 1984 that NASA should assemble a space station (later called Freedom) within a period of 10 years, this followed years of debate, delay, and changes of configuration. Similar hurdles were to plague the project in years to come. Although frustrating to the designers, these years of endless indecision gave NASA the opportunity to acquire hands-on experience in using the Shuttle Remote Manipulator System (RMS) to deploy, grapple, and retrieve a variety of payloads and to support the first US spacewalks since Skylab. This was a valuable breathing space not only to qualify the Shuttle RMS and EVA hardware but also to demonstrate the limitations of both systems in the face of an expanding, much more complex, and ultimately hugely over budget Space Station Freedom.

By the early 1990s, a change was essential to ensure that the construction of space station hardware could finally begin. Firstly, the design was dramatically reduced. Secondly, Russia joined the international partnership bringing a vast experience of space station operations from a succession of Salyuts and the current Mir complex. This provided NASA with a stepped approach to creating what would become the International Space Station (ISS). During the 1990s, NASA gained further experience of RMS operations and EVAs from Shuttles that rendezvoused with a variety of free-flying payloads.

As the first elements of the ISS arrived at the launch site for processing, a series of missions to Mir afforded NASA and its astronaut corps much needed experience in rendezvousing with a large space station, performing difficult maneuvers around it, and physically latching on to it.

This book does not focus on the details of the Shuttle-Mir missions nor the seven periods of residency by NASA astronauts on Mir (these are related in a forthcoming title), so it is sufficient to say simply that they provided valuable experience prior to embarking on the assembly of the ISS. Shuttle-Mir offered American astronauts the opportunity to fly the first long-duration missions since Skylab, two decades earlier. It also saw the relocation of many tons of bulky logistics to and from the aging Mir space station and demonstrated the need for a coordinated launch manifest that not only addressed national interests but also international concerns.

Although the Shuttle did little assembly work at Mir, indeed it installed only one component – this was supplied by Russia to simplify the docking of orbiters – the docking missions enhanced confidence not only on orbit but also on the ground that the International Space Station could be assembled using the Space Shuttle system. This would mark the realization of an idea that was first proposed some 30 years previously.

Linking the Space Shuttle and Space Stations explores the lessons that were learned in the early 1970s and then lost and regained. It also reviews various plans to use the Shuttle in conjunction with small modular space stations through to the latter half of the 1990s. And it concludes the successful Shuttle-Mir missions which opened a new era of international cooperation in space. This was also the period in which the infrastructure and flight procedures were established that would eventually support a huge effort to embark on one of the most ambitious construction projects in history, a story that is related in the companion volume *Assembling and Supplying the ISS: The Space Shuttle Fulfills Its Mission*.

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