"China's Space Program: A Status Report"

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On January 10, 2001, just ten days into the new millennium, China launched Shenzhou-2 ("Divine Craft-2") - the second automated test flight of their new piloted spacecraft. Unlike the first one-day test flight launched on November 19, 1999, this six-day mission made use of a bona fide prototype outfitted with all the systems required to carry passengers into space and support them. This launch is just the latest in a series of increasingly ambitious Chinese space missions that are slowly turning the planet's most populated nation into a true space power.

The Manned Space Program

Shenzhou is a three-module spacecraft similar in appearance to the Russian Soyuz orbited by China's largest launch vehicle, the CZ-2F (Chang Zheng-2F or "Long March-2F"). The service module contains support systems, consumables, power supplies, and propulsion systems. The descent capsule, which carries Shenzhou's passengers and payload back to Earth after the mission, has the same configuration as the Russian Soyuz but incorporates Chinese-designed avionics. On the top of the spacecraft is a cylindrical orbital module designed to serve as a laboratory. This module carries its own pair of solar panels to provide substantially more power for operations in orbit. Combined with its own propulsion system, the orbital module is capable of independent orbital operations after it has been jettisoned just before the rest of the spacecraft returns to Earth. All together, Shenzhou has 13% more internal volume than its Russian counterpart. Shenzhou has a total length of 8.8 meters, a diameter of 2.8 meters and a mass of about 7,600 kilograms - all larger than Soyuz.

During January's test flight of Shenzhou-2, the new spacecraft demonstrated its maneuvering capability for the first time - a skill needed for orbital maintenance as well as rendezvous and docking. In addition to an end to end tests of all the spacecraft's systems, Shenzhou-2 carried 64 experiments including biological specimens. After Shenzhou-2 returned to Earth at the conclusion of its successful 108-orbit test flight, its orbital module continued independent operations in orbit as part of an extended six-month long mission of experiments and systems tests. Already Western analysts have been surprised by the module's degree of independent functionality especially in orbit maneuvers. It appears that in the future these modules will be used as prototypes for an eventual Chinese space station.

While official statements are difficult to come by, Shenzhou will probably make at least one more automated test flight before the first piloted mission is attempted possibly as early as 2002. Such a flight will make China only the third nation after Russia and the United States to launch humans into space. This flight, however, will be just the first step in China's independent manned space program. After the Chinese establish a manned space transport capability, they intend to gain experience in other space operations such as EVAs and docking. More than likely this will include visits to free-flying Shenzhou orbital modules and possibly flights involving pairs of manned spacecraft. The final step will be a permanent manned space station launched by 2015. Much further in the future, Chinese planners are examining manned missions to the Moon and

eventual participation in an international mission to Mars.

Comsats and Commercial Launches

Most experts will admit that there are few practical applications for China's manned spacecraft flights. Like the manned programs in the United States and Russia (especially in the early days), these missions are driven by patriotism and national prestige. In addition to the high profile Shenzhou missions, China continues to develop its own space systems with much more practical applications. One of the more active areas of development involves communication satellites or comsats.

Since before the launch of their first satellite, DFH-1 (Dong Feng Hong-1 or "East is Red-1"), China has been interested in developing an indigenous comsat capability. In 1984 China launched an experimental DFH-2 comsat into geosynchronous Earth orbit (GEO) on their then new CZ-3. This prototype was followed by three more satellites successfully orbited between 1986 and 1990 allowing China to establish its own domestic comsat network. China has also been involved in various regional comsat consortia employing European- and American-built comsats. The United Stated Department of Defense has repeatedly raised warnings of the potential military applications of these satellites further complicating the China's efforts to improve its communication networks.

China continues its domestic comsat program with a mix of foreign-built comsats and their DFH-3 satellites first launched in 1994. The latest in the series, the 2,300 kilogram Zhongxing-22 ("China Star-22"), was successfully launched on a CZ-3A on January 25, 2000. China is also gauging market interest in the DFH-3 design for export.

Since 1985, China has actively sought to sell launch services using their Long March family of rockets especially in the lucrative comsat market. From the beginning, however, they encountered problems with their cut rate pricing and technology transfer concerns especially with the United States. Since 1990, China has launched 30 foreign-built satellites. The most recent was a series of six launches between 1997 and 1999 where a dozen Iridium satellites were orbited - almost of fifth of that constellation.

Despite the fact they have not experienced a single launch failure since 1996, China's commercial launch industry has never been able to build any momentum and accounts for less than 10% of the international launch market. Although more commercial launches are planned, a general slowness in the launch market, continued strained relations with the United States and a dearth of available Chinese payloads will leave the Long March underutilized for the next few years. Despite their lack luster sales, China is actively developing a new generation of expendable and reusable launch vehicles to replace the venerable Long March family.

Earth Observation Satellites

Another area where China has developed an independent space capability is weather satellites. Their first, FY-1 (Fengyun-1 or "Wind and Cloud-1"), was launched into a sun-synchronous, polar orbit in 1988 using a CZ-4A. China has maintained this series most recently with the launch of FY-1C on an improved CZ-4B in 1998. In 1997 China successfully launched their first GEO weather satellite, FY-2B, with a replacement orbited June 25, 2000. Currently China is developing the FY-3 series to replace the older FY-1 satellites and intends to launch ten weather satellites by the end of the decade.

With its huge expanses of territory, China has also been interested in obtaining Earth resource data from orbiting spacecraft. Between 1975 and 1996 China used their FSW-1 (Fanhui Shi Weixing-1 or "Retrievable Test Satellite-1") and later FSW-2 satellites to return payloads of photographic film from orbit. Like the West,

China was also interested in remote sensing data gathered by electro-optic sensors and radioed directly back to the ground. In July of 1988, China and Brazil started the joint CBERS (China-Brazil Earth Resource Satellite) program with China assuming 70% financial responsibility. After many funding problems and delays, the 1540-kilogram CBERS-1 or ZY-1 (Ziyuan-1 or "Resource-1") was successfully orbited using a CZ-4B on October 14, 1999. It is equipped with three visible and near-infrared camera systems yielding resolutions as high as 20 meters. On September 1, 2000 the improved ZY-2 was launched into polar orbit. Officials have been tight lipped about its capabilities leading many to believe that it possess upgraded cameras with resolutions high enough to be of military reconnaissance value.

China has started launching indigenous navigation satellites akin the American GPS (Global Positioning Satellite). The first, Beidou ("Northern Dipper") Navigation Testing Satellite-1 (BNTS-1) was launched into GEO on a CZ-3A on October 31, 2000 with the second orbited the following December 21. In additional to its civilian uses, BNTS has obvious military applications as well. An operational Beidou constellation employing of quartet of satellites is currently planned.

China is also preparing a new series of 400- to 500-kilogram oceanographic research satellites. The first, HY-1 (Haiyang-1 or "Ocean-1"), is currently scheduled for launch in July 2001. China plans to launch two to four of these satellites over the next five years.

Small Satellite Programs

Like most other spacefaring nations, China has been active in the development of small satellites for a variety of applications. In May 1999 China launched its 297-kilogram SJ-5 (Shijian-5 or "Practice-5") to study the effects of microgravity on fluids. On June 28, 2000 the 50-kilogram Tsinghua-1 was launched as piggyback payload on a Russian Kosmos-3M rocket. A joint program between Tsinghua University of Beijing and the University of Surrey in the UK, Tsinghua-1 was designed to obtain remote sensing data. Also in June, Tsinghua University and several high-tech companies formed the Aerospace Tsinghua Satellite Technology Co. Ltd. with a focus on developing and marketing microsats as well as detector technologies. They have signed a contract with the Chinese government to build a ten-kilogram remote sensing satellite as a piggyback payload for launch by the end of 2001.

Other institutes are also active in this area: Harbin Institute of Technology in the northeastern Heilongjiang Province is currently leading development of the 150-kilogram TS-1 (Tansou-1 or "Exploration-1") also designed to perform remote sensing. The Chinese Academy of Sciences has a department dedicated to microsats currently developing CX-1 (Chuanxin-1 or "Innovation-1"). These and other small payloads will be orbited by a new, all-solid launch vehicle called KTZ-1 (Kaituozhe-1 or "Trailblazer-1") which should make its debut in 2002.

By far the most advanced small satellite concepts being developed by China involve antisatellite or ASAT weapons. They are developing a "parasitic satellite" that would be deployed from a carrier satellite, attach itself to an enemy satellite and remain dormant until activated during a conflict. Weighing as little as a fraction of a kilogram, these parasites would interfere with a satellite's operation or even disable it. Reports indicate that China has already performed ground tests of this innovative ASAT technique. Despite its modest resources, China promises to be a major player in space as the new millennium unfolds.

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