India Takes Its First Step To Put a Man Into Space

by Marsha Freeman

For more than 40 years, the only nations able to launch men into space were the United States, and the Soviet Union (later Russia). In October 2003, China sent its first astronaut, Yang Liwei, into Earth orbit. Now, India is carrying out the technology development program to become the fourth manned space-faring nation.

Since the Chinese manned launch, a number of nations have been reevaluating their current policy of depending upon the United States or Russia to put their citizens into space. Both the European Space Agency and Japan—two U.S. allies on the International Space Station—are debating whether to develop an independent manned launch capability.

During the 1980s, Japan was designing its reusable HOPE vehicle, for transport to the Space Station, and Europe planned to deploy its Hermes space plane, and possibly the German-designed Sanger space plane. These programs were ended by the mid-1990s as economic shocks, leading to budget cutbacks, eliminated new manned space programs from the scene.

Traditionally, India has focussed its broad-based space program on capabilities to economically uplift its population. It has been a pioneer in distance learning, using satellites for "tele-education," in order to provide classroom learning to remote villages and rural regions where there are too few teachers. Tele-medicine programs connect these remote regions with medical experts in hospitals in India's cities, to enhance health care where there are too few, if any, doctors.

India launches its own satellites, which provide meteorological and extreme weather monitoring, Earth remote sensing data of land and oceans, and satellite communications. So, in order to embark on this new path, to develop the array of technologies needed for a human spaceflight program, a change in policy will be necessary.

Last Fall, the Indian Space Research Organization (ISRO) presented a plan to Prime Minister Manmohan Singh for a human spaceflight program, with the first manned flight to take place in 2014. The plan is under consideration, and is expected to be approved by the government, since Indian President Abdul Kalam, who is a former ISRO scientist, is backing the manned mission program. Initial funding would begin in April if it is approved.

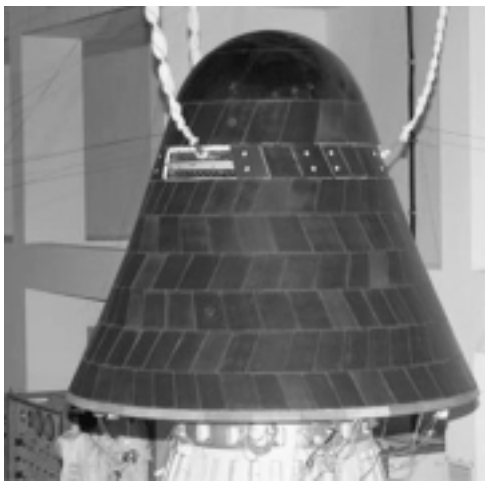
The Space-Capsule Recovery Experiment

India is already taking steps necessary to carry out human missions in space.

On Jan. 10, India's Space-Capsule Recovery Experiment, SRE-1, was launched on an Indian-made Polar Satellite Launch Vehicle from the Satish Dhawan Space Center, on an island in the Bay of Bengal. On Jan. 22, the 1,213-pound spacecraft splashed down just seven miles from its launch site. The chairman of the Indian Space Research Organization, G. Madhaven Nair, described the successful experiment as "a humble step towards sending an Indian into space."

India has had the capability to launch objects into space since the 1970s. Chairman Nair explained, after the spacecraft's recovery that, sending a satellite into space was "comparatively easy," but that in bringing back a craft from orbit, "everything was unknown."

Sending men into space requires that their spacecraft have thermal protection to shield them from the heat of reentry through the atmosphere; it must have an on-board propulsion system to change its speed and orientation in order to allow it to descend from orbit; it must have a guidance, control, and navigation system to guide the return capsule to a precise



Indian Space Research Organization

The Space-Capsule Recovery Experiment, seen here undergoing prelaunch tests, tested thermal protection materials, which tiles can be seen in this photograph, and the navigation, guidance, reentry, and other fields for manned space flight.

Indian Space Research Organization

After a 21-day mission orbiting the Earth, SRE-1 fired its onboard thrusters and splashed down in the Bay of Bengal. A flotation ring has been put into place around the capsule, as it is being brought back to shore.

landing; and a recovery system must be in place, whether on the ground or on the sea, to recover the spacecraft. With this recent test, India has demonstrated that it is mastering these prerequisites for manned-spaceflight capabilities.

The launch of the Space-Capsule Recovery Experiment was, in itself, a first for India. This Polar Satellite Launch Vehicle, standing 145 feet tall, was the first to orbit a cache of four satellites, two of them with their own payload carriers. One was the Indian Cartosat 2 Earth observation satellite, and the other, the recovery experiment. Two small, secondary satellites were launched for students in Argentina, and the Indonesian space agency.

When a spacecraft descends through the atmosphere to return to Earth, the temperature around it can reach 2,200°C. In order to keep the inside of the capsule cool enough for the electronics, scientific payloads—not to mention human passengers—thermal protection must be applied to the outside of the vehicle.

The earliest manned spacecraft used an ablative heat shield, in which a material applied to the surface of the spacecraft absorbs the frictional atmospheric heat, and as it evaporates (ablates), it carries the heat with it, protecting the inside of the spacecraft. India's experiment tested a more advanced thermal protection system, similar to that used on the reusable Space Shuttle. The SRE-1 was covered with more than 350 insulating silica tiles, which were designed and manufactured indigenously.

Much of the technology development work is carried out by the 5,000 researchers at the Vikram Sarabhi Space Center, and it is there that a team of 40 researchers produced the lightweight heat-resistant insulating materials. Space Center director B.N. Suresh told *Science* magazine, "The thermal protection system was one of the important experiments being carried out in the space recovery module. This is a precursor for all forthcoming reusable launch vehicles—and in the long run, to the manned mission, too." A back-up ablative thermal insulation system, made of carbon phenolic material, was also tested.

Plans for the Future

An unmanned space vehicle, and even, to a significant extent, a spacecraft that is manned, depend upon both the preprogrammed automatic operation of equipment, and real-time commands sent from Earth-based operators while the mission is in progress. This command and control function for the Indian space program, is managed and coordinated by ISRO's Satellite Center in Bangalore, which tracks satellites and operates India's Telemetry, Tracking, and Command Network. That network is supported by ground stations in India, Indonesia, Canada, and Norway, and by shipborne and airborne terminals.

The command, control, and navigation systems performed very well during the SRE-1 test. Dr. B.N. Suresh reported that "the accuracy with which the Space-Capsule Recovery Experiment returned to the Earth was unbelievable," landing only seven miles from the launch site. An ISRO spokesman said proudly after recovery that "both the launch and splashdown of the space capsule were completed with textbook precision."

SRE-1 carried two experiments, to take advantage of the microgravity environment during its time in Earth orbit. An Isothermal Heating Furnace was used to study metal melting and crystallization. The second experiment, designed by the National Metallurgical Laboratory, studied the synthesis of nano-crystals under micro-gravity conditions to help design better biomaterials, bearing a close resemblence to natural biological products. The SRE-1 spacecraft technology will enable India to bring samples of materials processed in orbit back to Earth.

ISRO chief Nair told *Space News* last November that the ultimate target of India's manned space program will be the Moon, with a landing in 2020. The Moon would be a base for further Solar System exploration, he said, and a source of precious materials, such as the isotope helium-3, which could be used as a fuel in fusion power plants. India will launch its first unmanned mission to the Moon, Chandrayaan-1, in 2008.