

Joining the space race, carefully



IN RECENT YEARS THE RACE BETWEEN CHINA and India for manned spaceflight and for the Moon has drawn significant attention, as did North Korea's much-publicized rocket test in April. All this has overshadowed progress by South Korea, which is now on the verge of becoming a spacefaring nation in its own right.

Or so it hopes. If all goes well, South Korea's launching of a 100-kg (220-lb) satellite into LEO in July, aboard a largely Russian first-stage rocket topped by a South Korean-designed second stage, will make the country the ninth nation to launch a home-built satellite from its own territory. It would also mark a huge step up toward South Korea's goal of becoming an important presence in space.

But while its space program is important in building South Korea's reputation as a center of high technology, there is a refreshing air of realism about the first launch's prospects. Last year, Lee Mun-ki, director general of the Ministry of Education, Science and Technology's science support bureau, commented, "Considering the cases of other countries and our level of experience, you have to say the first launch is more than likely to fail." Officials said the chances of failure stood at around 70%.

Nor is much expected from the satellite, which is intended to do little more than report its position for its planned two-year life. The entire effort is a "proof of concept" exercise that the government in Seoul hopes will lead to a

home-grown launch vehicle and locally designed and built 1.5-tonne multipurpose satellite being launched in 2017. Ultimately the intention is to send up a lunar orbiter in 2020 and a lunar lander in 2025.

Learning the rocket craft

Quietly and cautiously, South Korea has navigated its way through the international maze of regulations and restrictions that govern technology transfer in rocketry, in much the same way as it has done with satellites. The country has gained experience in basic rocketry through the military, maintaining and modifying U.S.-supplied Honest John and Nike tactical missiles. By the 1990s South Korea was able to manufacture solid-fuel rocket motors weighing up to 1 tonne (2,200 lb).

In 1990, the Korea Aerospace Research Institute (KARI) was established to build sounding rockets using a modified version of the solid-fuel motor. One- and two-stage versions of the rockets, KSR 1 and KSR 2, were built in the 1990s. Next came development of a liquid oxygen/kerosene rocket motor with 12.5 tonnes of thrust (similar to the first stage of the U.S. Vanguard in the late 1950s). The intention was to launch a satellite, and the first stage was lofted just once as the KSR 3 in 2002.

By 2001 South Korea had become a signatory to the Missile Technology Control Regime, which enabled it to seek technology for peaceful space purposes from other nations. Anxiety in Washington about Seoul's possible military use of rockets against neighboring North Korea had the effect of driving South Korea's scientists into the arms of Russia. Problems developing the LOX/kerosene engine for the Korea space launch vehicle (KSLV) 1 led KARI to seek help from the U.S. But this plea was rejected, and instead South Korea signed a technical assistance agreement with Russia in 2004. Further diplomatic anxiety caused delays

In January 2008 South Korean spaceflight participants Ko San (right) and Yi So-yeon (center) took part in a space station hardware training session in the Space Vehicle Mockup Facility at NASA Johnson.



in implementing the program, and a Technology Safeguards Agreement was eventually signed by Moscow and Seoul in late 2006.

A closer look

The KSLV 1 first stage is based on the Angara booster—built at Russia’s Khrunichiev State Research and Production Space Center near Moscow—which itself has yet to fly. For the Korean version, a different (smaller) engine will be used.

A ground test vehicle was sent from

ments between Earth and the satellite. But that is not really the point. According to Cho Gwang-rae, a KARI senior researcher, speaking to reporters last year: “KSLV 1’s payload was designed to support a 100-kg satellite, and you can’t be expecting much from such a simple device....The real test will be 2017, when we will be attempting to send a real-purpose satellite with a fully domestically developed rocket. If we succeed in that, we can then say we have a space industry.”

ing. April’s launch of a rocket over Japan was said by North Korea’s government in Pyongyang to have been a successful lofting of a communications satellite into orbit. The problem was that no one else could hear the North Korean songs Pyongyang said the alleged satellite was broadcasting. U.S. officials said the rocket had not reached orbit but had splashed into the Pacific Ocean. So the event was either an unsuccessful satellite launch or a successful missile test—successful in that it went about 50% farther than the last such launching in 1998.

Enter the Russians again: In late April, Russian Foreign Minister Sergei Lavrov visited both Koreas and offered North Korea help in launching satellites. He said, “Russia is cooperating with many countries in the peaceful exploration of space, including launching satellites by our boosters. We have such agreements with South Korea, and we are ready to develop similar projects with North Korea and hope our proposal will be examined.”

Pyongyang offered no response, but it seemed likely that the offer was a move to try to get North Korea back to the table to discuss nuclear issues—its national pride would almost certainly preempt any use of Russian rockets, particularly since South Korea is already benefiting from Russian help.

Assuming the KSLV 1 launch goes well, and that its succeeding KSLV delivers the planned 1.5-tonne satellite in 2017, the next big hurdle for South Korea will be manned spaceflight. So far, only one Korean national has journeyed into space—bioengineer Yi So-yeon. She went on an 11-day mission to the international space station in April 2008, traveling on a Russian Soyuz.

Ripple effects

This first was unusual for male-dominated Korean society, but Yi had been pushed from being the standby into the prime spot after the intended prime candidate was involved in a controversy at the Russian training school over security regulations.

Yi became the 49th woman in space but just the second female Asian astronaut; the first was Japanese surgeon Chi-



KSLV 1 was scheduled to launch in July, delivering a 100-kg satellite to LEO.

Russia to the newly built launch complex at Naro, in Korea’s southern Cholla Province, last August for integration and qualification testing. Khrunichiev reported in April that assembly of the flight vehicle for KSLV 1’s first stage had been completed and the vehicle was undergoing work in a test stand.

The second stage for the KSLV 1 is a solid-fuel rocket developed and made in South Korea to KARI’s design, with Korean-made navigation and telemetry equipment on board. Total length of the KSLV 1 is 33 m, with the first stage occupying 25.8 m of that. Total weight is 140 tonnes.

All this just to put into space a 220-lb satellite? Actually, Science and Technology Satellite 2, as the spacecraft is called, has dual-channel radiometers to measure the Earth’s brightness, and a laser reflector array for precise measure-

International picture

South Korea has a long history of putting up scientific research and telecommunications satellites made variously by U.S. and European manufacturers, or built by Korean organizations and launched by European, U.S., or Russian rockets. Its four commercial satellites have been known as Koreasats, starting with Koreasat 1 in 1995 and so far culminating with Koreasat 5 in 2006. (The designation Koreasat 4 was avoided because the number four is regarded as unlucky, representing death in some Asian cultures.) The Koreasat family also goes under the Korean name Mungunghwa, which is the name of Korea’s national flower, the rose of Sharon.

South Korea’s efforts to play by international rules, complicated politically by its border with North Korea, contrast markedly with North Korea’s rocket test-

aki Mukai, who made two shuttle trips, in 1994 and 1998. The third is likely also to be Japanese; aerospace engineer Naoko Yamazaki is due to fly in the space shuttle Atlantis next year on an ISS supply mission.

The relevance of these women becoming astronauts has little to do with women's liberation in its real sense; all three had excellent academic qualifications and had gone through the same selection procedures as their male colleagues. It has, however, much to do with local public perceptions of women and their place in society.

So for two heavily male dominated societies, what do their governments get for their investments in these women? Financial reward? Well, as an example, the Korea Aerospace University predicted that Yi's trip would boost the national economy by \$381.2 million (478 billion won) from sales generated in items such as telescopes, books about

space, and model spacecraft (her Soyuz trip was charged to the government at 26 billion won).

But the real payoff in all three cases is more likely in the "halo" effect that their experiences have on other people—the general public, and youth in particular. It is one thing for a former military test pilot to try to communicate what his or her time in space was really like; it is quite another for a civilian, and an extroverted female at that, to talk in everyday terms to a lay audience.

Consider this comment from Yi last year about her intentions now that she has achieved her dream of becoming an astronaut: "Before becoming an astronaut I was not as aware of the strides that we need to bring in our educational systems, and how important it really is to provide the young people—students in schools and colleges—with the right tools and, above all, inspiration. I am considering furthering research and being very



Koreasats have been launched by a variety of companies, including Sea Launch.

active in inspiring the young generation."

Yi has further advice for would-be astronauts: "Enjoy what you do. Compete in the selection process and enjoy it. It helped me immensely to make it all the way. There is a proverb in Chinese that goes, '[The] person who does [not do] his/her best cannot like it and the person who does not like it cannot do his/her best.'"

Next steps

The KSLV 1 project is expected to cost about \$377 million, including \$198 million to be paid to Russia, whose services have been contracted for at least two missions. The second mission is expected to take place about nine months after the first, assuming it is successful. If not, then Korean officials anticipate needing about a year to analyze what went wrong and how to fix it.

Despite the apparently cautious or even downbeat official comments, KARI scientists and engineers are under huge pressure to deliver, with national pride and the public's hopes at stake. Yi's flight last year has whetted the national appetite for proof that South Korea truly does have the ability to stand up and be counted among the world's leaders of high-technology projects. KSLV 1 will be carrying a lot more than just a little satellite when it leaves the launch pad.

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