HEAD: We have lift-off

SUBHEAD: SA rocketeers do it their way

IF you make your way to Verneukpan on a certain day in mid-June, you may just see history being made. Early one morning, on a date yet to be determined, a man will press a button to send South Africa's biggest and most powerful amateur-built rocket soaring 10 000 m into the sky.

At least that's what members of the South African Rocketry Association (SARA) are fervently hoping will happen. As big-league players such as Nasa, the European Space Agency and other organisations will attest, the practice of rocketry - whether conducted by professionals or enthusiastic amateurs - is fraught with risk. It's not just the size or complexity of the rocket that determines the level of danger, either. The combination of highly volatile (read potentially explosive) fuels and high velocities is distinctly scary.

Albert Smuts, founder and chairman of SARA, is clear on why they are going to all this trouble: "The project was undertaken to prove that a small group of private individuals, with sponsorships from various organisations, could successfully build and operate a large-scale, fully recoverable rocket system."

Rocketry in South Africa has a somewhat chequered history. According to Smuts, it really started in the1950s, with young engineers such as Desmond Prout-Jones and Professor Cedric Smith building and flying homemade rockets.

"In fact, you could safely describe them as the fathers of South African rocketry. During the 1970s and 1980s, a number of rockets were built by the military, some of them reportedly so powerful that they were capable of placing satellites in orbit - and we all know what happened to the rocket programme after that."

The 4 m rocket with which SARA hope to set a new altitude record is powered by a liquid polymer motor, a design characterised by the separation of the oxidiser from the fuel until ignition. This contrasts with solid rocket motors, where both oxidiser and fuel are packed together in solid form, and liquid rocket engines, where both oxidiser and fuel are injected into a combustion chamber as liquids or gases. The most common LPRM comprises a liquid oxidiser injected into a motor casing containing solid fuel.

At present, says Smuts, there are no commercial applications for large LPRMs. So why go that route?

"This type of rocket motor is inherently safe because the propellant alone is relatively inert, and kept separate from the other components until ignition time. Combined with other factors, this results in lower production, storage and transportation costs when compared with other, more dangerous rocket propulsion systems.

"LPRMs are a cost-effective means of producing high amounts of thrust while maintaining high levels of safety. They are also environmentally friendly because they produce less pollution that other designs. The combination of vigorous thrust, improved safety and low emissions - and the potential to achieve higher altitudes - is very compelling."

Although Smuts and his colleagues don't suffer from delusions of grandeur, they haven't lost sight of the "ultimate application" that drives them to devote every spare moment to rocketry.

"Rocket motors exist to propel rockets into space. Even though the end goal and scope of our project is the development and testing of a new hybrid motor, it's imperative that we don't lose sight of its real purpose, which is to penetrate the atmosphere to the edge of space and beyond."

By the time we went to press, the team had:

- A "reasonable" estimate of the airframe's weight and stability.
- Determined that a reloadable cartridge fuel grain would help to insulate the engine.
- Eliminated the uneven burning normally associated with an injected oxidiser (that is, more burning occurs at the top of the fuel grain) through the optimisation of the injector design.
- Discovered that the use of silica-phenolic for the nozzle provided favorable ablative results.
- Solved ignition problems by using a high heat energy input system.

Their primary goal is pretty straightforward: to design a vehicle - using lightweight, inexpensive, state-of-the-art equipment and materials - that will soar to the highest altitude possible (in this case, 10 000 m). To do that, they'll need to produce an estimated 1 500 N of thrust for 15 seconds, taking into account mass flow, thrust, thrust duration, wind and myriad other factors - any one of which could have a critical effect on the mission.

But SARA are thinking bigger. Their secondary goal is to integrate the motor into an airframe to produce a complete launch vehicle capable of carrying a 1 kg payload to 45 000m. A third goal, with a time scale as yet unspecified, is to use the same design and materials to build and launch a larger rocket capable of climbing to 100 000 m.

As Smuts says: "This altitude has never been reached by any amateur-built, liquid polymer-fuelled rocket in South Africa. It would also be the highest altitude achieved by an South African-designed and fabricated liquid polymer-fuelled rocket."

But even that effort will be eclipsed by their most ambitious proposal yet: to design, build and launch a manned rocket capable of reaching space itself - a cool 100 km from the Earth's surface, a start to South African space tourism. It could take a few years, concedes Smuts, but the achievement would create a spark in some unlikely places. What he'd really like is to ignite an interest in rocketry among young people.

"Some people are inclined to disregard rocketry as being too difficult and too expensive. They're wrong. The truth is that you don't need to be a rocket scientist to build and launch your own, modest-sized machine - and it could cost you less than a radio-controlled plane. Rocketry is a great way to learn about science, mathematics, aerodynamics, engineering and electronics - and it gives you a huge amount of satisfaction."

A while ago, as part of a sponsorship deal with Anglo Platinum, SARA hosted a "Rocket Learner Programme" in Rustenberg during which 10 high-schoolers were taught the essentials of rocket science. All participants were provided with course materials and armed with enough information on the theory and practice of rocketry to built their own craft, using liquid polymer motors and electronic recovery systems. The course covered a vast array of subjects, ranging from the history of rocketry to Newton's laws, aerodynamics, propellant chemistry, guidance systems and thermodynamics.

Says Smuts: "It was an amazingly rewarding exercise, and we'd like to do it again."