Safran in the age of electric satellites

Developed by Snecma (Safran) within the scope of the “Nouvelle France Industrielle” program, the PPS® 5000 thruster is intended to be used in conjunction with forthcoming generations of “all-electric” propulsion satellites. Thales Alenia Space France and Airbus Defence & Space have already been selected for their new generation satellite platforms.

In early 2013, Boeing received its very first order for satellites featuring an all-electric propulsion system. This sparking off something of a revolution in the aerospace sector. All-electric satellites rely solely on electricity to get into orbit and then maintain their geostationary orbit, whereas “conventional” satellites rely on chemical propulsion. "Following this order, all contractors began designing this new type of satellite," recalls Nicolas de Chanaud, Deputy Manager of the Plasma Propulsion Program at Snecma. "They included Thales Alenia Space and Airbus Defence and Space – we were already supplying both with plasma propulsion systems." This collaboration was further strengthened in March and May 2014 with the signature of two cooperation agreements, making the Snecma PPS®5000 plasma thruster the benchmark engine for their new generation "all-electric" satellite platforms, dubbed Spacebus and Eurostar respectively. "We also get a great deal of support from CNES* and ESA** for the development of this new thruster," states Nicolas de Chanaud.

Low thrust, high performance

Electric thrusters use the power produced by the satellite’s solar panels to inject gas, usually xenon gas, to produce thrust. "Electric propulsion systems make it possible to cut the weight of a communications satellite by an astonishing 40%," says Nicolas de Chanaud. "A few kilograms of gas is all it takes to propel a satellite, which is in stark contrast to chemical engines requiring several tons of fuel. Operators that choose this type of propulsion system are going to be using a less powerful launcher, which means a cheaper one too. Given the current economic situation, cutting launch-related costs has become a pivotal criterion for some customers."

Considering that these propulsion systems have limited electric power on board, the overall thrust available remains low. With this in mind, it takes between three and six months to achieve geostationary orbit, as opposed to ten or so days using more powerful, fuel-guzzling chemical propulsion systems. “The electric solution meets the needs of operators managing several satellites in orbit since they can plan for replacements well in advance,” says Nicolas de Chanaud. This technology is also suited to space exploration. Snecma’s first plasma thruster, the PPS®1350, provided the thrust for the ESA SMART-1 lunar probe, launched in 2003 with just 80 kg of xenon gas. Its mission drew to a close in 2006 after clocking up almost 5,000 hours!

A wide power range

"Different kinds of electric thruster are available," emphasizes Nicolas de Chanaud. “At Snecma, we opted for the plasma propulsion system, with a view to becoming the leader in electric thrusters for satellites." (See box). Currently under development, the future plasma thrusters manufactured by Snecma will cover a wide power range from 500 W to 20 kW. "In addition to thrusters, we boast world-class expertise in systems, including managing and distributing onboard electric power as well as managing gas. This puts us in a position to offer modular solutions to our customers."

How plasma propulsion works

The plasma thrusters manufactured by Snecma use xenon. The gas is injected into a discharge channel where it is bombarded with electrons so the atoms are positively charged. Using the same principle of physics that makes two opposite magnets repel, the positive ions in the xenon placed in an electric field are emitted from the thruster at very high speed (approx. 20 km/s) to produce thrust.

* CNES: Centre National d'Etudes Spatiales (the French Space Agency)
** ESA: European Space Agency