Nuclear reactors in space

One has come down, but more are still to come

Washington

SPACE-BASED nuclear reactors — like that carried by the Soviet Cosmos 1402 satellite, which has just made an unscheduled re-entry into the Earth's atmosphere — are becoming an increasingly important part of US military preparations for war in space.

At present, only the Soviet Union is putting nuclear reactors into Earth orbit. But now the United States, having lost interest after putting up a single reactor in 1965, is back at work again. Two separate projects are under way to design a reactor with a lifetime of seven years that will yield 100 kW of electricity. A working US reactor could be in orbit by the early 1990s.

Behind the renewed US interest are three separate military goals. The first, and apparently the most important to defence planners, is "survivability" of critical surveillance and communications satellites in time of war. "A reactor is hardenable", said a Department of Energy (DoE) source, "solar is not". Solar panels provide a large and vulnerable target for a Soviet anti-satellite (ASAT) weapon. Defense Department planners are increasingly concerned about the Soviet Union's crude but functional ASAT, which can disable a satellite simply by exploding. The Defense Department view is that a nuclear-powered satellite would also be considerably more manoeuvrable than one equipped with cumbersome and fragile solar panels.

The second goal is the development of radar ocean surveillance satellites, similar to Cosmos 1402. According to Rear Admiral Eugene Carroll, USN (Ret.), now deputy director of the Center for Defense Information in Washington, the Soviets use these satellites to target the US fleet for attack by SS-11 ground-based inter-continental ballistic missiles. The high power requirements of the radar, and possibly the Soviet Union's inferior solar technology, require the use of a nuclear power source. The Cosmos 1402 reactor reportedly generates 100 kW thermal with an electric output in the range 5–20 kW.

The power requirements of US satellites may be even greater. They will probably be designed for higher resolution so as to pick up the smaller ships of the Soviet fleet (which has no giant aircraft carriers), while US radar satellites would probably be put in orbits higher than that of 250 km chosen for Cosmos 1402 so as to escape ASAT attack and for longevity. Soviet practice has been to plan for a lifetime of only a few months and then to remove the nuclear reactor from the Earth's atmosphere by boosting the satellite to a higher orbit.

"As you move towards radar in space, you can make a case for 10 or 100 kilowatts", says Herbert York, a former Director of Defense Research and Engineering. And at the current price of solar cells, that is just the power range at which nuclear power begins to be cheaper than solar, although the exact breakpoint seems to depend on the ideology of the observer. The largest solar array the United States is planning is a 25-kW unit to be launched on a forthcoming shuttle flight.

The third goal, and perhaps the least significant at this stage, is the production of exotic laser and particle-beam weapons. These would need vast amounts of power that only a nuclear reactor could supply.

The renewed interest in space-based reactors has set off a row between DoE on the one hand and the National Aeronautics and Space Administration (NASA) and the Defense Advanced Research Projects Agency (DARPA) on the other. DoE is already working on a 100-kW reactor design at its Los Alamos National Laboratory.

By law, DoE has authority over all nuclear programmes in the government, a result of the early decision to maintain civilian control over nuclear activities, including weapons research and construction. Nevertheless, NASA and DARPA have joined together and recently circulated a request for contractors to design a 100-kW space reactor. A NASA official said the request had drawn "a lot of interest" from the industry. Proposals were due at the end of January, and the selection of a contractor is to be made shortly. The design requirements are classified.

The military's intentions seem, however, to be a good deal fuzzier than their interest would indicate. According to Dan Deudney of the Worldwatch Institute, plans for a radar surveillance satellite have not gone beyond the drawing board; an earlier design, known as "Clipper Bow", was abandoned not long ago. A NASA official involved with the NASA/DARPA project acknowledged, "We really don't know yet what the applications are".

Meanwhile, more criticisms over the deployment of nuclear reactors in space are cropping up, and not just because of the dangers exemplified by the Cosmos 1402 accident or the 1978 crash of the similar Cosmos 954 in Canada.

Dr Robert Bowman, who as director of Advanced Space Programs Development for the US Air Force twice cancelled the military space reactor programme, argued at a Washington press conference last month that "reactors have vulnerabilities of their own" with respect to ASAT attack. Bowman, who has left the Air Force, said that the low efficiencies of nuclear reactors — typically 5 per cent — mean that large heat radiators are required to dissipate the excess heat. These radiators "stick out like a sore thumb in the infrared", he said.

But the critics seem chiefly concerned that space-based reactors open the door for uncontrolled escalation of the arms race in space. "We can do all the verification and monitoring we need to with photovoltaics", says Deudney, "but we can't fight a war with photovoltaics." And Admiral Carroll sees a link between nuclear reactors and the ASAT arms race: "Absent an ASAT threat, there is no reason why higher space power requirements cannot be met by larger solar arrays."

Negotiations on an ASAT ban were suspended by President Carter in 1980 in retaliation for the Soviet intrusion into Afghanistan, and have not been resumed. The United States is developing a "direct ascent" ASAT that will be fired by the F-15 fighter plane. Although it will have an altitude range limited to about 1,000 km, it will — unlike the ground-launched Soviet system — be able to hit satellites in any orbital inclination. And Carroll warns that once it is deployed, it could make agreement on an ASAT treaty almost impossible by drastically increasing the difficulty of verification. The ASATs would not be readily distinguishable from other F-15 armaments; and on-site inspections of F-15 bases would be out of the question. The ASAT is due to be flight-tested this spring, with deployment in 1987. "Time is running all too short", Carroll said.

For at least the next decade, US military satellites will continue to be solar-powered; the military has shown little interest in further use of the relatively inefficient radioisotope thermoelectric generators (RTGs), which are used to power planetary missions and which have been used for military satellites such as the Transit navigation system. These devices, which are not reactors, use the heat from the radioactive decay of plutonium to generate electricity. Future US use of nuclear reactors in space, however, may well hinge on the progress made in controlling the arms race in space.

Stephen Budiansky

Cosmos 1402 safe

THE nuclear fuel core of the ill-fated Cosmos 1402 apparently burned up safely over the South Atlantic last Monday, although there was some doubt about the exact point of destruction, since the reactor fragment was tumbling wildly during its final moments.

A satellite of similar type, Cosmos 1412, carrying larger radar systems to monitor naval movements, is reported by French experts to have concluded its operations at the end of January. In this case, however, the reactor was successfully disconnected from the main spacecraft and boosted into a high parking orbit with a perigee of 901 km.

Vera Rich

0028-0836/83/060458-02$01.00