

tonium-powered system called SNAP-9A aboard a U.S. satellite that had failed to get into orbit. A particularly widely reported reentry was that of the Soviet Cosmos 954 satellite in 1978, which deposited radioactive debris over a large area of northwestern Canada.

One concern that has been raised about the possible reentry of satellite nuclear material is that of contamination by more toxic fission products such as strontium-90 or cesium-137. In Cosmos 1402's case, notes Leifer, "we could not detect any fission products in the samples." On the other hand, says Steven Aftergood of the Los Angeles-based Committee to Bridge the Gap, the administration's Strategic Defense Initiative is funding the development of much higher-powered space-borne reactors, "despite President Reagan's pledge that [SDI] would offer a non-nuclear defense."

— J. Eberhart

## NRC to vote on new evacuation rule

The Nuclear Regulatory Commission (NRC) is poised to approve a rule change that would allow the licensing of nuclear power plants without state or local input into emergency planning. After reviewing more than 50,000 comments from concerned citizens — most of them opposed to the rule change — the staff of the NRC recommended at an Oct. 22 briefing that the full commission approve the proposal. A final vote is expected this week.

Operating licenses for the completed Shoreham nuclear power plant on Long Island and the Seabrook plant in New Hampshire have not been issued because state and local authorities are refusing to submit the emergency evacuation plans currently required by the NRC (SN: 3/7/87, p.150). The rule change would allow utility companies to submit their own emergency plans for NRC approval, and would formalize NRC's so-called "realism doctrine." That doctrine assumes that in a real emergency, local and state governments would in fact assist in implementing an evacuation.

"Obviously, state and local participation in off-site emergency planning is very important," said William C. Parler, general counsel for the NRC. However, he asserted, the commission has the legal authority to bypass local input when utility companies can provide "reasonable assurance" that the public health and safety will not be endangered.

According to federal law, no operating license may be issued for a nuclear power plant unless there is "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency."

Several commissioners and staff people suggested at the briefing that it would

## Hologram: New dimension for X-rays

With the electron microscope, scientists can see the hairs on a housefly's feet and uncover other marvels of the microscopic universe. But the world imaged in electron micrographs is largely a dead and unnatural one because samples must be chemically fixed, thinly sliced, dehydrated or altered in other ways. Biologists have hoped for X-ray microscopes, which, while using a longer wavelength and hence having a lower resolution than their electron counterparts, would enable scientists to study unaltered, living samples in detail.

In the last few years, researchers have made significant strides toward this goal, and some X-ray microscopes that produce two-dimensional images are attracting biological customers. Now two research teams report in the Oct. 23 *SCIENCE* that they have passed important milestones in X-ray holography, the main microscopy technique for producing three-dimensional images. One group, using the National Synchrotron Light Source (NSLS), has produced a hologram of unprecedented resolution; the other has made the first X-ray-laser hologram.

The synchrotron group, led by Malcolm Howells at the Lawrence Berkeley (Calif.) Laboratory, made holograms of rat pancreas granules. The smallest resolvable feature in these holograms is 400 angstroms, 25 times smaller than the best previous holograms and equal to the resolution of the best X-ray microscopes. Howells attributes this increased resolution in part to an improved X-ray source: NSLS last year added an undulator — a series of magnets that deflect synchrotron electrons side to side, creating a brighter, more coherent X-ray beam. The improved resolution is also due to the group's use of high-resolution resist, rather than film, for recording the hologram.

"The key step preventing X-ray holography from being a useful technique was the inability to record the hologram," says Howells, "and now we've accomplished that step with the undu-

lator and resist."

At the moment, however, their holograms appear two-dimensional because the depth of focus is about the same as the thickness of their sample. They hope to achieve three-dimensionality by pushing the resolution down to 100 angstroms. One potential difficulty is the technique's long exposure time — 80 minutes in their recent work. To avoid blurred images from moving samples, says Howells, "we definitely have to find a way to hold the sample still."

In contrast, the X-ray laser that James E. Trebes and his colleagues at Lawrence Livermore (Calif.) National Laboratory used to make holograms is so bright and coherent that hologram exposures on film take less than a nanosecond. In principle, this will enable researchers to freeze the action of a moving sample without blurring the image. So far, Trebes's group has demonstrated the feasibility of X-ray laser holography by making, again, two-dimensional-appearing holograms of a gold bar and carbon fibers, with a resolution of a few microns.

The researchers plan to develop a laser source that will image biological samples at much higher resolutions, which will, among other things, help achieve three-dimensionality. "That's the nice thing about Howells's work," says Trebes. "He's shown that you can really make a high-resolution hologram. This was in some doubt before."

One of the key ingredients in the system devised by Trebes's group is a multilayered X-ray mirror that can separate X-rays from other wavelengths made in the lasing process and is flat enough to maintain the beam's coherence. Another critical part is the X-ray laser, which is produced when Livermore's Nova laser zaps selenium foil, creating a plasma that produces X-rays.

"For the last three years, X-ray lasers have been a lab curiosity, a research topic in themselves," says Trebes. "This paper announces that X-ray lasers have arrived and it's time to start using them [for imaging]." — S. Weisburd

be difficult — but not impossible — for a utility to make an adequate emergency plan without the assistance of state and local authorities. But neither was it Congress's intention, they said, to give state or local authorities veto power over the licensing of nuclear plants. One commissioner expressed concern that even if local agencies ultimately cooperated in an emergency, the lack of any coordinated exercises in advance might render emergency measures less effective.

An earlier version of the proposal's environmental impact statement had

stated that "the public in the vicinity of the few affected plants would be placed at a somewhat greater risk relative to what would be the case if either the governments cooperated or the NRC adhered to its current emergency planning rules."

In fact, Parler said at the latest briefing, the new rule as it stands does not require any comparison between emergency plans with or without government cooperation. However, the "reasonable assurance" standard of public protection would be unchanged under the new rule, he said. — R. Weiss