

in the orbiter (not the launcher) so that they could be flown back to earth and reused. The Soviets put the engines on the rocket, simplifying and lightening the orbiter. (Some speculate that internal equipment, such as the electric system, is more massive than the fuel cells used on the U.S. shuttle, and that this may reduce the weight advantage.) There have been conflicting statements about the reusability of the Soviet engines, but Western commentators assume they will be essentially thrown away on each flight. "With only eight to ten flights per year, it's cheaper to throw them away," says Jerry Grey, director of science and technology policy for the American Institute of Aeronautics and Astronautics.

■ Putting engines on the Energia rocket has another advantage: it makes it usable without the orbiter and crew, so that it can be available for heavy, unmanned cargo trips. "If we had thought that one out more carefully we might have done the same," says Grey. It provides more flexibility. NASA has commissioned design studies for a U.S. unmanned cargo vehicle called Shuttle-C.

■ The wings of the Soviet craft are slightly forward of those on the U.S. shuttle. There are minor differences in the vertical tail stabilizer, the payload bay, the nose, and the windows. The crew compartment looks bigger. The Soviet stabilizer is split into two panels, allowing an extra measure of redundancy in steering, but also adding complexity. One expert sees this as an indication that the Soviets have less confidence in their controls.

■ Both shuttles use tens of thousands of ceramic tiles to protect against overheating during reentry, but one report indicates that the Soviets have used a more porous, whisker-like ceramic. *Aviation Week and Space Technology* reports, however, that the basic tile technology has been taken from U.S. research.

■ The overall Soviet design should permit a smoother landing, says Oberg, but also a faster one, making the final touchdown riskier.

■ Both shuttles have identical, large, delta-shaped wings. Early U.S. blueprints called for a small, straight-winged vehicle that might have cost one-fourth as much as the one that was built, according to Grey. The big bay and wings were added to satisfy military requirements that the shuttle be able to carry large loads and have a wide "cross-range" or ability to land at airstrips hundreds of miles off-center from the orbital path. This provided more flexibility. But by 1984 the U.S. Air Force began hedging its bets on the shuttle by purchasing unmanned rockets. Since then the Pentagon has moth-

balled its West Coast shuttle base. Thus, even as the United States demonstrated that its shuttle would have a limited military role, the Soviets copied a wing design based on military requirements. This suggests that the Soviets consider a big cross-range essential or that they do not have enough confidence to try an original design.

John Pike of the Federation of American Scientists speculates that the Soviets would like to build five orbiters eventually. They would add a new capability to bring heavy payloads down from orbit, and Pike suggests that in the mid-1990s they might be used to build and supply a large new space station.

"I just don't see any use for it yet," says Grey. "They must be planning to do something very impressive."

The Soviets will reveal their plans in time. But one top official—Roald Sagdeev, director of the Soviet Space Research Institute—has already tagged the U.S. shuttle, and by extension, the Soviet shuttle, as a bad investment. In a scathing article on the "bureaucratization of science" in the summer 1988 volume of *Issues in Science and Technology*, Sagdeev writes: "The U.S. space scientists must wait for the expensive and much-delayed shuttle to lift their payloads into space. The U.S. aerospace industry, like the Soviet industry bureaucracies, used its influence to subvert the logic of science." He concludes, "We have put too much emphasis on manned flight at the expense of unmanned efforts that produce more scientific information at lower cost."

■ ELIOT MARSHALL

Technology Legislation Previewed

A bipartisan task force, consisting of 16 members of the House Committee on Science, Space, and Technology, has outlined a broad set of legislative proposals designed to boost American technological competitiveness.* The proposals, which collectively would result in a stronger federal role in the development of commercial technology, are likely to appear next year in specific pieces of legislation.

The proposals are the fruit of an 18-month study launched last year in response to mounting concern over the ballooning trade deficit—an imbalance that the task force notes is growing by more than \$340 million each day. In general, the task force is recommending more industrial input into federal policy-making related to commercial technology, as well as more direct government support for industry in the areas of product design, development, and manufacturing—areas that the Reagan Administration initially argued should be the responsibility of the private sector. "Industry just hasn't done it," says Ronald Williams, who directed the staff work for the study.

Among the proposals are the following:

■ **A new government body.** Reflecting general dissatisfaction with the current arrangements for establishing technology policy, the task force calls for a new organization to advise the President and Congress on federal research and development priorities. The exact nature of such an entity is not spelled out, but the task force says it considered arrangements ranging from a new Department of Science and Technology to an

expanded Office of Science and Technology Policy. The structure will be worked out when specific legislation is drafted.

■ **Support for consumer electronics.** Because the consumer electronics industry "has essentially been surrendered to the Japanese," a bold initiative is needed, the task force says. It calls for the establishment of a National Advanced Technology Center for Consumer Electronics that would work with the private sector on joint development projects. In particular, the task force points out that American manufacturers are unlikely to be able to compete in the market for high definition television, a key technology that will pave the way for a variety of applications including education and personal communications.

■ **Construction technology.** The construction industry is investing in new technology at a level "far below the minimum needed to stay abreast of other industrial nations." Consequently, the task force suggests that the Corps of Engineers should get involved in civilian R&D programs likely to benefit the private sector.

■ **More freedom for federal labs.** Echoing an oft-repeated suggestion, the task force calls for more interaction between the federal laboratories and the private sector. In particular, it recommends that lab directors and personnel be given far more autonomy in cutting deals with industry to avoid the lengthy delays involved in going through Washington.

The task force was headed until earlier this year by Representative Buddy MacKay (D-FL). When he decided to make a bid for the Senate, Representative George Brown (D-CA) took over. ■ COLIN NORMAN

**Technology Policy and Its Effect on the National Economy*, House Report 100-1093.