An inflatable U.S. $pace $tation

How much will the planned, permanently inhabited U.S. space station cost? Likely to be NASA's costliest venture to date, it is of particular concern to some scientists and others who wonder how much money – during and after its construction – will remain for unmanned planetary missions and other activities.

Besides hinging on the final design, economic inflation and the time allotted for construction, the answer depends on the basic definition of "cost" – and perhaps on who is doing the defining. Now, a committee of the National Research Council (NRC) has concluded that by the time the station has been put together in space, it will have cost nearly twice the space agency's latest estimate, which is already twice what it was when the plan was initiated 3½ years ago.

When President Reagan directed NASA early in 1984 to undertake the job, the agency estimated that it would cost about $8 billion. By the beginning of this year, the envisioned amount was up to $12 billion, and a careful cost review by NASA itself upped the sum to $14.5 billion. In an effort to manage both the growing price tag and increasingly vocal opposition in Congress and elsewhere, an alternative, two-stage design was proposed, which among other things would postpone the station's completion until 1996, two years beyond Reagan's originally proclaimed goal of accomplishing the job within a decade. And NASA's current estimate for that, says the NRC panel, reads $16 billion.

However, the NRC panel, set up at White House request in part to evaluate NASA's cost estimates, reads the bottom line as $27.5 billion. And that is in 1984-sized dollars. Adjusted for inflation into the smaller dollars of 1988, the total becomes a still higher $32.8 billion.

Much of the difference between the NRC committee's analysis and NASA's represents not additional costs but the space agency's way of organizing its budget, the panel says in a report to the White House. The many shuttle launches required to get the pieces of the station into orbit for assembly, for example, are listed in NASA's financial plan under the "space transportation system" rather than under "space station." NASA says it has reviewed all such costs with both Congress and the Office of Management and Budget.

The report notes, however, that including such factors – as the NRC did – when estimating the station's costs not only aids planning and management, but also "is useful for understanding the full resource commitment."

Some items cited in the report are not in the NASA plan at all. They include funds to develop and purchase an unmanned "orbital maneuvering vehicle" to be carried up in the space shuttle for changing the orbits of payloads already in space, for example. But the report notes that a second such vehicle will be needed "to manage satellites and payloads in close proximity to the Station; the second unit is not in NASA's financial plan."

Also missing from the plan so far is an item whose potential significance was underscored by the Challenger disaster: a way of returning the crew to earth in an emergency if the shuttles are for some reason unavailable. The idea has been to maintain a "safe haven" aboard the station, backed up by shuttle rescue, but NASA is also studying the possibility of a separate "crew-return vehicle." The NRC panel "believes that such vehicles will be needed."

Other factors that could affect costs, according to the panel, include NASA's minimal planning for backup hardware (loss of key components could produce major delays), as well as the "unprecedented challenge" posed by coordinating management interactions among the four NASA centers principally involved, and 39 shuttlefuls of hardware that must be assembled in orbit, largely by space-walking astronauts. Adds the report, "NASA's most recent and relevant experience" with such matters, called "systems integration," is with the shuttle, a far less complex task. "Thus, the experience with systems integration of the Shuttle is not likely to be a reliable guide to integration of Space Station." – *J. Eberhart*

SPACE STATION COST – from NRC Space Station Committee, using NASA estimates:

$ 8 billion	As presented in Reagan's 1984 State of the Union address
$12 billion	By early 1987, NASA's estimate (in 1984 dollars) had grown
$14.5 billion	After detailed NASA cost review
$16 billion	NASA's current estimate, incorporating two-phased deployment (phase 1, $12.2 billion; phase 2, $3.8 billion)
	Items in (or to be added to) NASA's space station R&D budget:
	$0.3 billion unmanned "telerobotic" service vehicle
	$0.1 billion Orbital Maneuvering Vehicle
	$1.5 billion crew emergency rescue vehicles
	$1.9 billion (phase 1, $1.8 billion; phase 2, $0.1 billion)
$17.9 billion	Overall space station R&D cost estimate (phase 1, $14.0 billion; phase 2, $3.9 billion)
	Other items in total cost of developing and deploying station:
	$2.4 billion space transportation (shuttle launches, etc.)
	$0.1 billion shuttle modifications for berthing at station
	$2.5 billion NASA personnel costs (direct and indirect)
	$4.4 billion operations prior to full station capability
	$0.2 billion related facilities
	$9.6 billion (phase 1, $7 billion, phase 2, $2.6 billion)
$27.5 billion	Estimated total station program costs (phase 1, $21 billion; phase 2, $6.5 billion – still in 1984 dollars)
$32.8 billion	The above total inflation-adjusted to 1988 dollars (phase 1, $25 billion; phase 2, $7.8 billion)

Receptor families reunited

In brain chemistry, function, not structure, has traditionally dictated how scientists identify the cellular components called receptors – the membrane proteins that use different mechanisms to regulate the transport of information-carrying chemicals into brain cells. But two new studies suggest grouping receptors together into structural "superfamilies."

West German researchers at three universities have identified the sequence of amino acids that form the receptor for glycine, itself an amino acid that inhibits nervous activity in cells of the brain stem and spinal cord. Other scientists, at the Laboratory for Molecular Biology in Cambridge, England, and at Genentech in South San Francisco, have used similar techniques to determine the amino-acid structure of the gamma-aminobutyric acid (GABA) receptor. GABA likewise inhibits nerve cell activity. The results show that the two newly sequenced receptors are surprisingly similar in structure.

Both groups also report in the July 16 NATURE that the respective receptors have a significant number of amino-acid arrangements that are identical to those in receptors for yet another cell-signaling chemical called acetylcholine, which excites, rather than inhibits, muscle and nerve activity. □