

after noting that project cost estimates had been substantially exceeded and that launch schedules had not been met, to consider the need for strengthening the Space Administration's management practices relating to research and development projects.

We noted that, in the early stages of the Nimbus project, the Space Administration's Goddard Space Flight Center required the Nimbus spacecraft integration contractor to work on prototype spacecraft design and test planning when only tentative design information was available about the spacecraft subsystems. These subsystems—integral parts of the spacecraft—were being designed and fabricated by other Space Administration contractors for integration into the spacecraft. The Goddard Center subsequently authorized the integration contractor to give recognition to delays in completion of the spacecraft subsystems. The integration contractor, however, had to perform substantial reanalysis, redesign, and rework relating to integration and spacecraft testing at an estimated cost of about \$1.1 million because much of the tentative subsystem design information it had used in meeting the requirements or the integration schedule proved to be inaccurate.

On the basis of our review, we believe that this situation occurred because the Goddard Center did not give timely recognition to the effects of expected delays in delivery of subsystem hardware on the integration effort at the time these delays became known. Also, we believe that the Goddard Center did not assure itself at that time that any benefits which might have been expected from adhering to outmoded schedules would have offset the added costs which could have resulted from using tentative design data. In our opinion, postponement of the start of spacecraft design and test planning would have evidenced a recognition of the situation as it existed at that time; that is, undertaking spacecraft design and test planning based on tentative design data involved the unnecessary risk of increasing project costs.

Because accounting records normally maintained for the performance of cost-type research and development contracts do not contain this type of information, a reasonable approximation cannot be made of costs that might have been avoided by a more timely adjustment of the integration schedule. We believe, however, that the magnitude of the expenditure of about \$1.1 million subsequently made for reanalysis, redesign, and rework indicate that substantial costs might have been avoided.

The Space Administration, whose comments are included in the report, did not agree with our finding regarding the need for more timely adjustment of schedules under the circumstances that existed. In this regard, we noted that the Space Administration recently issued a new agencywide policy directive for the planning, approval, and conduct of future major research and development projects. This policy, known as Phased Project Planning, was evolved because of the undesirable results that occurred in the form of increased costs over those predicted, and delays or slippages in established schedules, when major research and development projects were allowed to proceed almost directly from feasibility studies to full-scale hardware development.

The new policy directive provides that future research and development projects similar to Nimbus will normally be conducted in four