

The Soviet Union's Salyut space stations have formed the backbone of an ambitious and expansive program involving human beings in space. The ideological underpinning of Salyut is the desire to project and maintain an image of scientific, technological, and industrial world leadership in space. Overall, the Soviet approach toward implementing these goals has been one of cautious advance—a step-by-step evolution consistent with an often-stated, long-term goal of spreading Soviet influence into near-Earth space and beyond. As was the case for the U.S. Apollo program, the Soviet effort does not appear to be predicated on near-term economic benefits.

The last 5 years have witnessed a growing maturity and confidence in Soviet spaceflight planning and conduct. Present Soviet activities with Salyut are approaching the establishment of a permanent human presence in low-Earth orbit.<sup>47</sup> Whether or not continuous human occupancy is established soon, the Soviet Union can be expected at least to maintain and probably to expand human activities in space. The Salyut space station is anticipated to remain the central element for space operations involving people, although several new programs may augment the station's use and enhance the range of future Soviet options.

### Three New Initiatives

Soviet planners appear to be looking at three new initiatives: modular space stations, heavy-lift expendable boosters, and reusable launch vehicles. President Brezhnev was apparently a strong supporter of space expenditures; President Andropov's views are not fully known.<sup>48</sup> Although appraisals of Soviet spending are difficult,<sup>49</sup> one estimate puts the overall cost of the

Soyuz/Salyut program during the 1970's at nearly \$40 billion (in 1980-adjusted dollars). That is approximately the cost of the entire U.S. Moon Landing program—from the first Mercury sub-orbital flight to the final Apollo 17 Moon landing and return. Moreover, the cost to develop, launch, and maintain Salyut 6 during its nearly 5-year tour-of-duty probably exceeded \$9 billion (in 1980-adjusted dollars).<sup>50</sup> As in the United States, the economic climate in the Soviet Union might well dictate the scope, scale, and timing of any new Soviet space initiative.

### Modular Space Stations

A modular station could be composed of five to eight units, separately launched and assembled in orbit. These plans are well within current Soviet capabilities. Indeed, Soviet sources have identified Cosmos 929-class modules as prototypes:

of the kind that will be linked together to form a multi-purpose orbital station. One of the modules will be a fitted-out laboratory, others will perform purely technological duties. There will also be observatory modules and whole plants for manufacturing products in zero-g. Lounge modules will be living quarters for cosmonauts to take a rest after the heavy workload they will handle in space. . . . Each station can easily be modified by changing modules to fit changing needs of the mission . . .<sup>52</sup>

Within a constellation of such modules, Soviet cosmonauts could begin to live in orbit more comfortably and more productively. A modular space station could be the beginning of a usefully permanent human presence in space. Among other possibilities, the crew of a large, well-equipped station would no longer have to be limited to broadly trained cosmonauts. Technicians with particular specialties could be included in the station's complement. In any case, a large modular

<sup>47</sup>Rolf Engel, "Soyuz and Salyut: Stepping-stones to a Permanent Soviet Space Station?" *Interavia*, February 1982, pp. 173-177.

<sup>48</sup>According to one Western source, no major change in the Soviet determination to expand in space is to be expected. See: Theo Pirard, "Russia's Future in Space," *Space Press*, June 1983, pp. 16-17.

<sup>49</sup>See, for example: "Estimating Soviet Military Spending—An Arduous Art With Political Overtones," by Michael R. Gordon, *National Journal*, June 26, 1982, pp. 1140-1141. Gordon discusses the

controversy surrounding U.S. estimates of Soviet military spending which are used to justify increased American military budget requests,

<sup>50</sup>Engel, *op.cit.*, p.175. These estimated costs for the Soviet Program include expenditures for investment, infrastructure, and development.

<sup>51</sup>Saunders Kramer, "Salyut Mission," in *Letters to the Editor, AW&ST*, Oct. 27, 1980, p. 76.

<sup>52</sup>Dr. Feoktistov, quoted in DST-14005-022082.

station would allow human beings to achieve a more normal, leisured, and productive life in space than has hitherto been possible.

### Heavy-Lift Expendable Boosters

Currently, Salyut operations are carried out using two types of launch vehicles. The "A" series booster, which provides over 400 tonnes of thrust at liftoff, is the workhorse of the Soviet launcher family. 53 Variants of this booster are used to loft Soyuz, Soyuz T, Progress, and other vehicles. This standard launch vehicle, minus its upper stage, was used to orbit Sputnik 1 into space in 1957—an indication of its reliability and longevity.<sup>54</sup> "D" series boosters, called "Protons," have launched Salyut space stations and Cosmos 929-class modules without cosmonauts onboard. The Proton's thrust at liftoff equals about 1,000 tonnes. There are also "C" and "F" series boosters which meet other requirements, but those of the "B" series have been phased out.

Under development, according to reports reaching the West, is a new booster in the "G" series capable of producing up to 5,000 tonnes of thrust at liftoff. Previous boosters in this series were apparently destroyed in three inaugural attempts (1969, 1971, and 1972): one exploded on the launch pad and two exploded in flight. Similar to the U.S. Saturn V, the redesigned G booster, possibly carrying cryogenic upper stages, is several years away from operational status, though test flights could occur between 1984 and 1986. A Pentagon analysis claims the booster will be capable of putting very heavy payloads into orbit (180 to 210 tonnes)—six to seven times the payload weight of the U.S. space Shuttle.<sup>55</sup>

Some believe the new "G" series booster will lead to the long-awaited Soviet attempt to put cosmonauts on the Moon. Others believe it will be used to orbit very large electromagnetic weapons. The new booster could also propel a 90-tonne station into orbit, to be occupied by a dozen or

more crewmembers by the end of the decade. Such facilities might, in some respects, be more attractive than space stations built from smaller modules. With relatively small-sized modules, such as the Cosmos 929-class, for example, there may be as much as 30 percent redundancy of hardware for rendezvous, docking, propulsion, electrical power, structural support, and the like. In a larger station, the weight of this otherwise employed hardware could be used instead for additional instrumentation, living quarters, manufacturing facilities, and other productive equipment. All of these uses could be fulfilled by such a launcher. As an alternative to developing such a "G" series launcher, the Proton booster might be upgraded to carry cosmonauts. This choice would allow some modest improvements and avoid the risks inherent in developing a new launcher.

### Reusable Vehicles

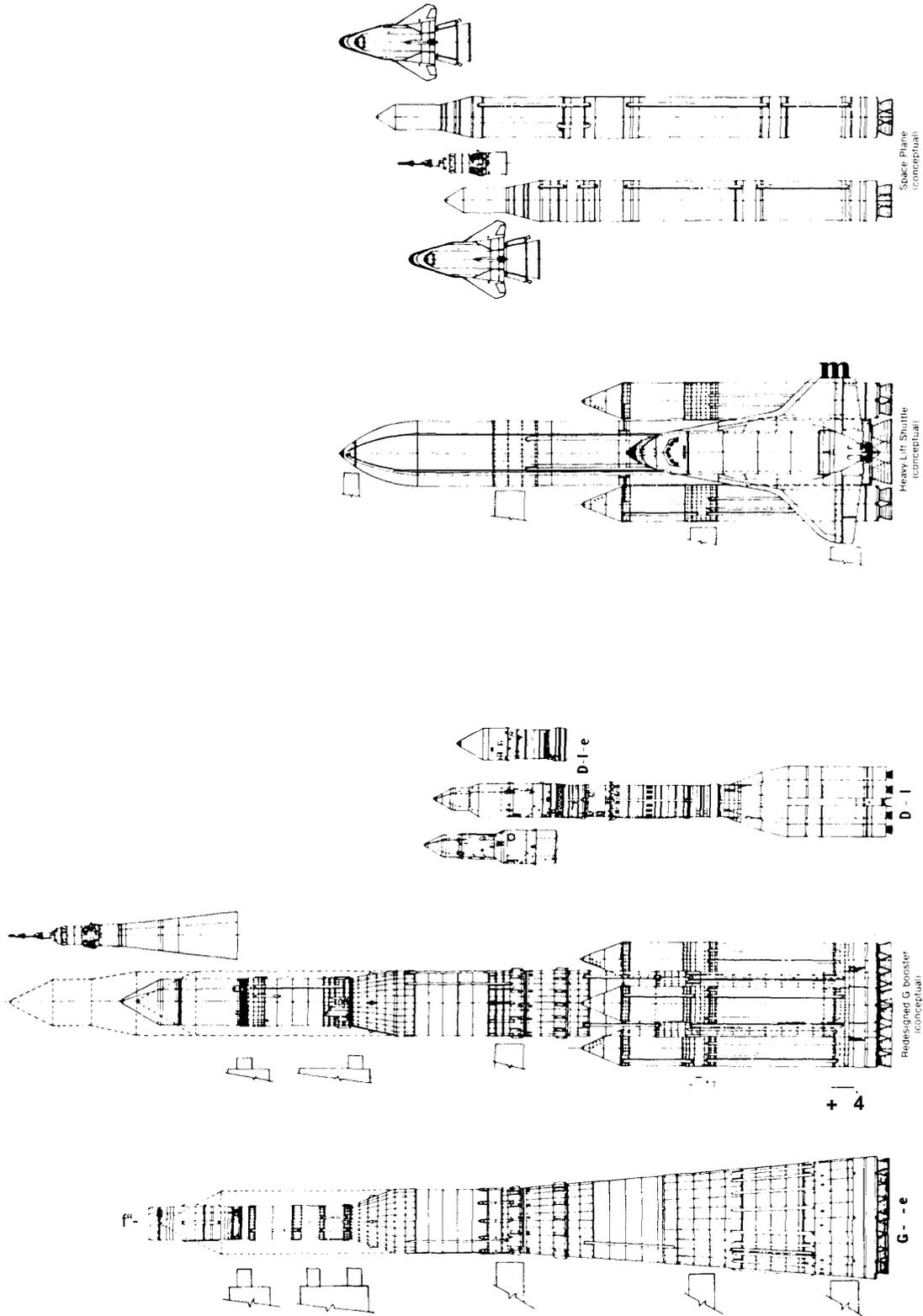
The Reusable Space Plane.—Speculation concerning a Soviet version of the L<sup>T</sup>. S. Dyna-Soar has been fueled by two Cosmos flight tests, each apparently designed to evaluate the aerodynamic and reentry characteristics of a winged space plane, weighing about a tonne. These missions—Cosmos 1374 on June 3, 1982, and Cosmos 1445 on March 15, 1983—flew identical trajectories; each was sent into space for a 2-hour test from the Kapustin Yar launch site near Volgograd, orbited the Earth, and landed in the Indian Ocean. A seven-ship Soviet task force supported both retrieval operations. Photographs of the Soviet recovery of Cosmos 1445, released by the Royal Australian Air Force, indicate the craft is of a lifting-body/blended-wing design.<sup>56</sup> Some Western experts contend that the recovered vehicles are prototypes designed to provide reentry data for a larger 10-to 20-tonne version which would carry a crew. (By contrast, the U.S. space Shuttle weighs approximately 100 tonnes.) The Soviet tests have been likened to the U.S. Asset program of the early 1960's, which made use of several

<sup>54</sup>Appendix A describes this booster in more detail. See also Glushko, Valentin, Petrovich, "Development of Missile Construction and Cosmonautics in the U. S. S. R.," *Mashinostrayeniye* (Moscow Machine Industry Publishing House, 1982), p. 66.

<sup>55</sup>James Oberg, "Beyond Sputnik's Booster," *Omni*, October 1982, pp. 22, 189.

<sup>56</sup>*Soviet Military Power* (Washington, D. C.: U.S. Department of Defense, 1981), pp. 79-80.

<sup>56</sup>See the following: Craig Covault, "Soviets Orbit Shuttle Vehicle," *AW&ST*, June 14, 1982, pp. 79-80; "Soviets Launch Winged Spacecraft," *AW&ST*, Mar. 21, 1983, p. 18; "Soviets Recover Spaceplane in Indian Ocean," *A W&ST*, Mar. 28, 1983, p. 15; and "Soviets Recover Spaceplane," *4 W&ST*, Apr. 4, 1983, p. 16. See also: U.S. Department of Defense, *Soviet Military Power*, March 1983, pp. 66-68.



Credit: C. P. Vick, 1983

Projected Soviet Space Vehicles, the redesigned G booster, the heavy-lift shuttle, and the space plane, compared with earlier boosters, the unsuccessful G-1-e and the current D-1

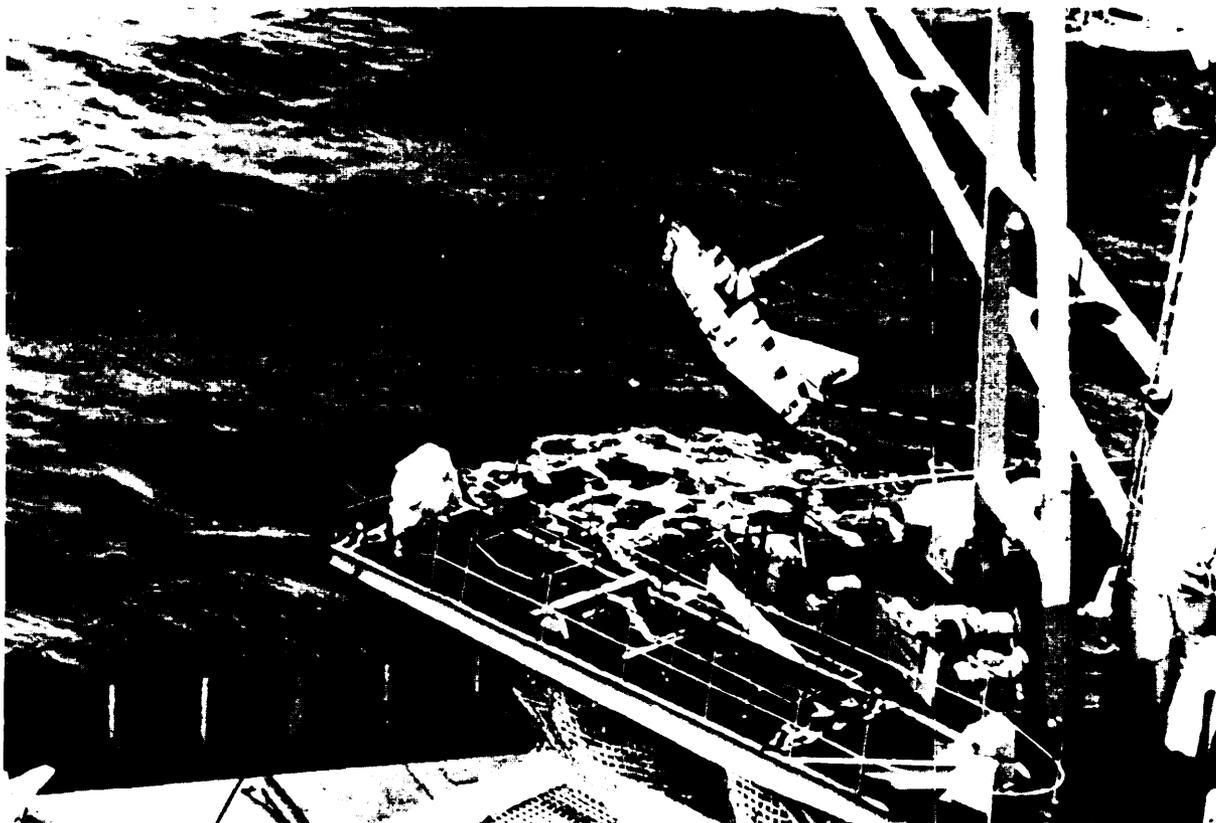


Photo credit Australia Department of Defence

Recovery of Cosmos-1445 by the SSVRS 201 YAMAL is believed to be a quarter-scale testbed version of the Soviet space plane

gliders on suborbital flights into the Atlantic, to gather heating and structural load information on winged space vehicle designs.

Some Western observers believe this program may have begun as early as 1976. Drop tests of the Soviet space plane from aircraft, akin to those carried out in the U.S. space Shuttle program, have been reported.

The Soviet space plane is expected to be capable of ferrying three persons between the ground and the Salyut station or other platforms in low-Earth orbit. It should be able to provide a means of rapid evacuation from the station and sufficient cross-range to allow landing at any major airport. However, its design may make little, if any, cargo space available, thus affording no solution to the Soviets' inability to return heavy payloads from space stations to Earth. Although less versatile

than the U.S. Shuttle, its greater simplicity might be well-adapted to quick launch and turnaround as well as rapid response to occasional reconnaissance requirements. Operation of the vehicle may begin within 2 to 3 years.

The Reusable Heavy-Lift Shuttle.—According to an assessment by the Department of Defense, the Soviet Union is apparently building a "heavy-lift" space shuttle similar in design to the U.S. Shuttle but capable of lofting twice as much payload into orbit. As detailed in a 1983 report on Soviet military power,<sup>57, 58</sup> the heavy shuttle, like the U.S. Shuttle, will be a delta-winged orbiter mounted on an external tank with strap-on

<sup>57</sup>*Soviet Military Power*, 2d ed. (Washington, D. C.: U.S. Department of Defense, March 1983), pp. 64-69.

<sup>58</sup>Craig Covault, "Soviets Building Heavy Shuttle," *AW&ST*, Mar. 14, 1983, pp. 255-259.

boosters. However, its ratio of payload weight to total vehicle weight is judged to be higher than that of the U.S. vehicle, and the specific impulse of its liquid-fuel strap-on boosters could be higher than the Shuttle's solid-fuel engines. In addition, the U.S. Shuttle carries 40,000 lbs of main engines and propulsion equipment on the Orbiter itself, whereas the Soviet shuttle would carry them on its main tank. This general configuration, whereby the Soviet shuttle would not have to recover its high-energy main engines, would result in a large payload bonus, though this advantage would have to be weighed against the cost of replacing the (unrecovered) engines. Overall, although its precise configuration and propellants are not known, the Soviet shuttle, with liquid strap-on boosters, could provide a payload capability of perhaps twice that of the 65,000 lbs of the U.S. Shuttle.<sup>59</sup>

Although the smaller space plane has been undergoing tests for several years, the heavy-lift shuttle design is relatively new and would require, perhaps, a decade of development and testing before it would be ready for regular use. Advanced versions of the vehicle could evolve into a two-stage, fully reusable system.<sup>60</sup> At the Tyuratam spaceport near the Aral Sea, where Soviet cosmonauts are often launched, a large runway has been built and could be used to support operations for either type of reusable spacecraft.<sup>61</sup>

<sup>59</sup>See Picard, op. cit. It should be noted, however, that previous Soviet practice has been to rely on space structures that, relative to comparable U.S. structures, are heavy. If this practice is continued in the heavy-lift shuttle, and if this vehicle does indeed rely exclusively on liquid propellants, then a payload capacity double that of the U.S. Shuttle would imply a thrust at lift-off of some 3,000 to 4,000 tonnes.

<sup>60</sup>Craig Covault, "Soviets Developing Fly Back Launcher," *AW&ST*, Nov. 6, 1978, pp. 1Q-20.

<sup>61</sup>For further views on a Soviet space shuttle system, see: "A Soviet Space Shuttle?" by Kenneth Gatland, *Spaceflight*, September-October, 1978, pp. 325-326. Also, "The Soviet Space Shuttle Program," by Lt Carl A. Forbrich, *Air Univ. Review*, May-June 1980, pp. 55-62, and "The Soviet Space Shuttle: Sifting Fact From Rumor," by James Oberg, reprinted in *Insight*, the newsletter of the National Space Institute, June-July 1980, pp. 4, 9.

<sup>62</sup>Pictures of the runway have now appeared in *AW&ST*, Mar. 21, 1983, pp 20-21.

## General Considerations

Although both types of Soviet reusable spacecraft may be realized in the relatively near future, Western experts disagree on the roles these vehicles might play with cosmonauts aboard. Some have suggested that the space plane could serve the Soviet military as a "space fighter."<sup>63</sup> Others think that the Soviets plan to use it as a replacement for Soyuz T vehicles. The heavy-lift shuttle, on the other hand, could well have an important role in boosting a new and larger generation of space-station modules into orbit.

The Soviets have bitterly criticized the U.S. space Shuttle as evidence of the "militarization of space" despite the official U.S. position that the craft is not a weapon. Soviet criticism may arise from a genuine fear of its use for military operations, or it may be a smoke screen to be maintained only until the Soviet Union can unveil a similar vehicle.<sup>64</sup> Soviet protests against U.S. military reconnaissance satellites, for instance, subsided once the U.S.S.R. had launched comparable spacecraft.

<sup>63</sup>"Soviet Militarization of Space," *Air Force Magazine*, March 1982, p. 42.

<sup>64</sup>Soviet sensitivities as to the military usefulness of the U.S. Space Shuttle and its potential for sparking Soviet "technological inferiority" are evidenced in: *Soviet Elites—World View and Perceptions of the U.S.*, by G. Guroff and Steven Grant, Office of Research, International Communications Agency, R-18-81, Sept. 29, 1981, p. 17. Report observes:

The U.S. space shuttle, in particular, seems to have left Soviets including some at the highest levels, almost speechless. When they saw on television (private showings) what the U.S. had done, it was clear to many that their erstwhile "lead" in the manned space race had disappeared, and that their own program was years behind that of the U.S. Given the wide publicity of Soviet space efforts, many Soviets felt until then that the U.S. had all but abandoned space to the Soviet Union.

Many believe that they are incapable of doing what the U.S. has done with the shuttle. This feeling translates for most Soviets into the hurtful belief that if the U.S. wants to, it can change the military balance in its favor almost overnight that it can pull some weapon rabbit out of its technological hat at any moment and leave the Soviet Union far behind in the arms race.

Soviet concern regarding U.S. intentions to develop a space weapons capability could be amply fueled by such documents as *High Frontier—A New National Strategy*, a Project of the Heritage Foundation, Washington, D.C. 1982, which calls for, among other elements, a military "high performance spaceplane" for inspecting or retrieval of "suspect" space objects.

American perceptions of the Soviet military presence in space is typified by: "Twenty-five Years After Sputnik—The New Soviet Arms Buildup in Space," *The New York Times Magazine* (let 3, 1982, pp. 30-34, 89, 92-93, 98, 100.