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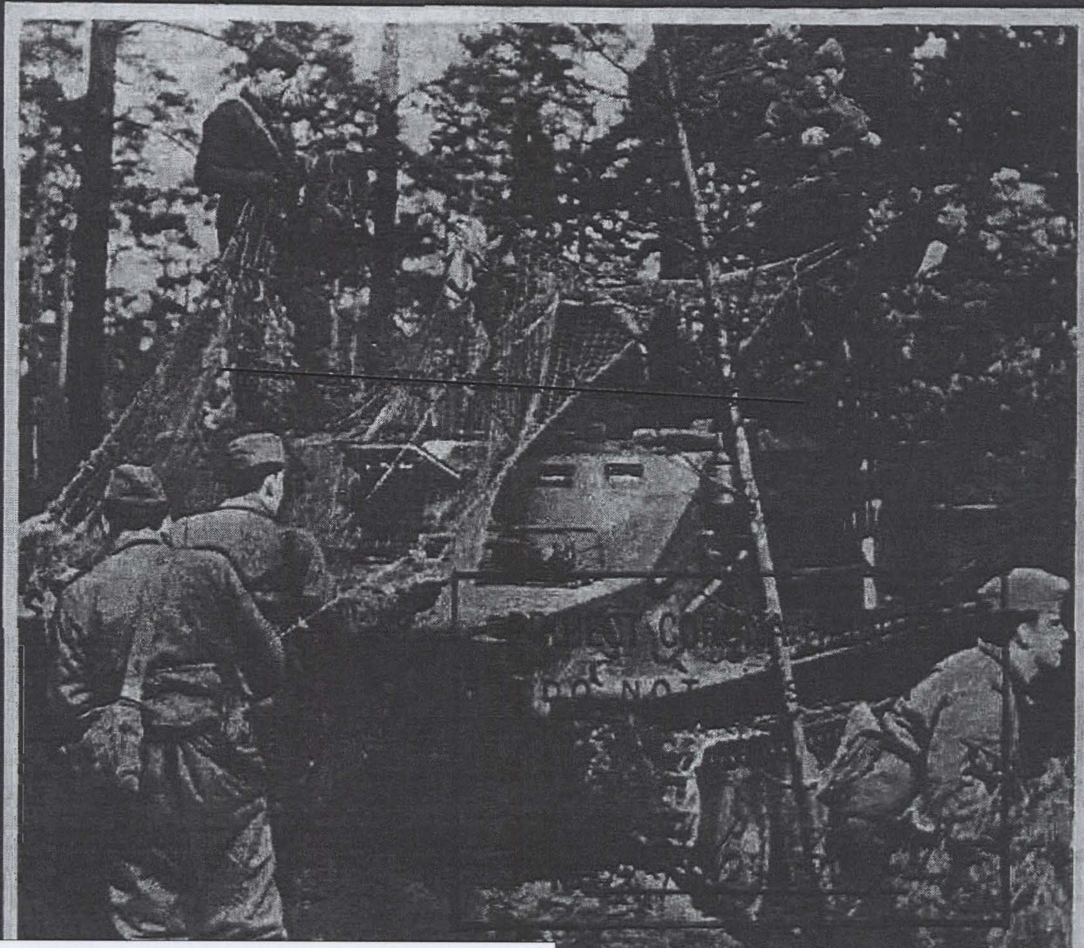

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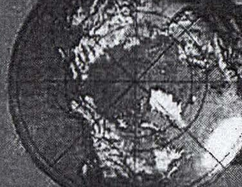

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Soviet personnel remove camouflage netting from APC in preparation for move. For details on activity that transpires during an alert, see article beginning on page 15. [U]

FOREWORD

MISSION: The mission of the monthly *Defense Intelligence Digest* is to provide all components of the Department of Defense and other United States agencies with timely intelligence of wide professional interest on significant developments and trends in the military capabilities and vulnerabilities of foreign nations. Emphasis is placed primarily on nations and forces within the Communist World.

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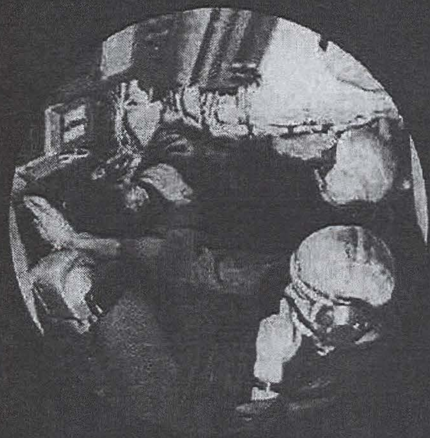
Joseph F. Carroll

JOSEPH F. CARROLL
Lt General, USAF
Director

Progress and Prognosis

for



SOVIET SOYUZ

Setback, delays, and success characterize development of a major workhorse in Soviet space program

AFTER more than 2 years and 12 flights, the Soyuz spacecraft is considered operational and ready to support manned Soviet missions of more than four days duration.

Soyuz capabilities now are compatible with the requirements for a space station ferry vehicle. An experimental space station similar to Soyuz 4 and 5 could be established preceding rendezvous and docking missions to demonstrate ferrying capability and extend duration in orbit.

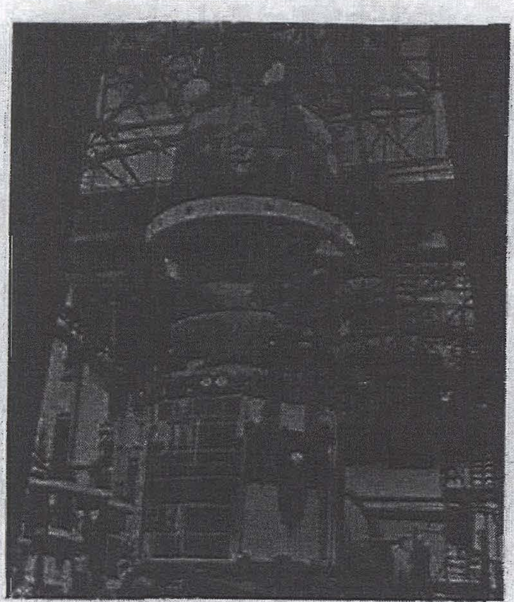
Another possibility involves several Soyuz spacecraft docked to a central body. There is speculation that a Soviet manned circumlunar mission could be accomplished with a slightly modified Soyuz. The basic re-entry module of the spacecraft tested on the circumlunar Zond program (Zond 4, 5, and 6) is believed of similar design—if not identical—to the Soyuz re-entry module.

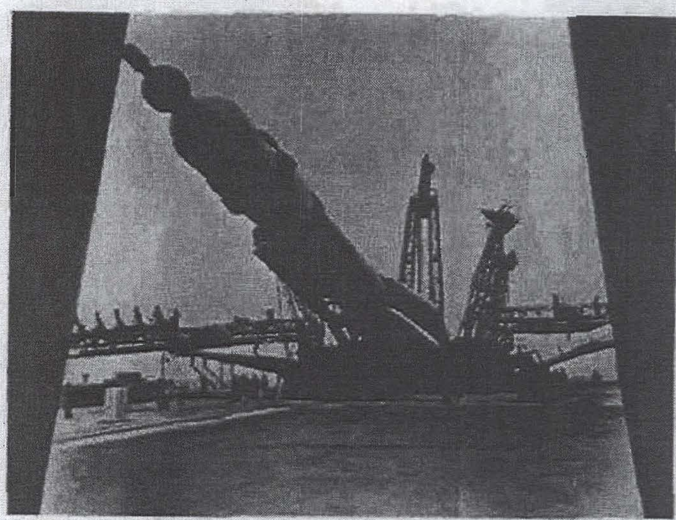
Prologue to success

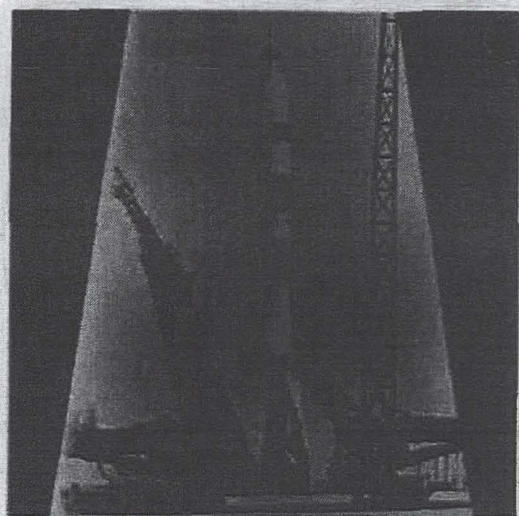
After the Voskhod 2 flight in early 1965, significant progress was made in the Soviet manned space program. Tests had proved that man could exist in space for short periods. Fairly detailed tasks were called for, such as extra-vehicular activity (EVA), and technical disciplines and cooperation between crew members.

Flight tests of a new spacecraft began with the launches of Cosmos 133 (28 November 1966) and Cosmos 140 (7 February 1967). Cosmos 133 possibly experienced re-entry problems and may not have been entirely successful. Cosmos 140, on the other hand, was apparently completely successful and provided the Soviets with sufficient confidence to include a man on the next flight.

In April 1967, the Soviets appeared ready to embark on such a venture. But the unsuccessful flight of Soyuz 1 that month, resulting in the death of Colonel V. Komarov, presumably disrupted plans for the 1967–1968 period. This failure probably caused







repercussions in the Soviet hierarchy and a year-and-a-half delay in that program.

The Soyuz 1 was launched 23 April 1967. The flight experienced some orbital problems, which probably caused the intended mission (possibly rendezvous and docking) to be cancelled early in flight. Upon re-entry, the parachutes—according to the Soviets—became entangled and the vehicle crashed, killing Colonel Komarov.

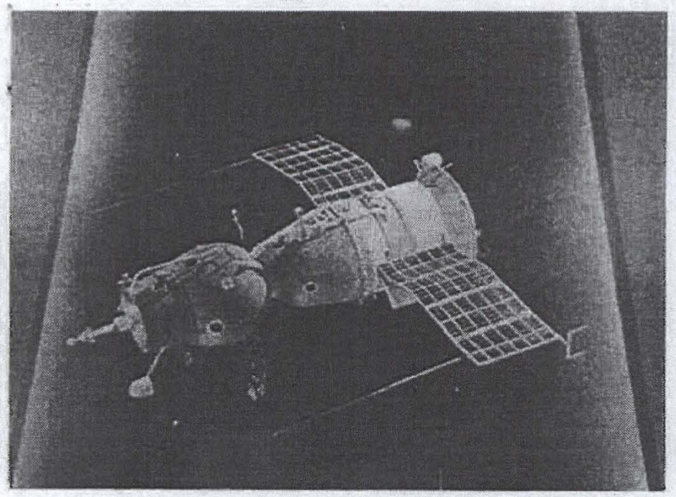
Some months later, on 27 October, the Soviets launched Cosmos 186. It completed the orbital maneuvers required to automatically rendezvous and dock with Cosmos 188 launched on the 28th. This was the first successful rendezvous and docking of two unmanned spacecraft. These maneuvers were performed before Cosmos 188 had completed one orbit and were almost entirely outside the visibility of Soviet tracking sites. Data indicate that Cosmos 188 may have experienced some re-entry and recovery problems.

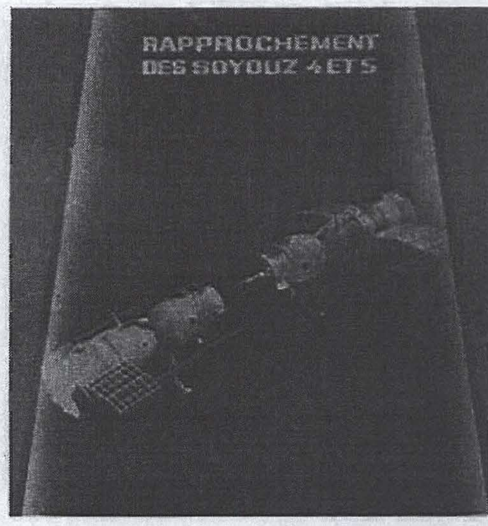
Cosmos 212, launched 14 April 1968, and Cosmos 213, launched the next day, duplicated the missions of 186 and 188. The rendezvous activity of Cosmos 212, the active vehicle, was similar to that of Cosmos 186 with a few exceptions: Cosmos 186 required 23 propulsion events of the main engine to rendezvous with the 188; Cosmos 212 needed only 12 main engine propulsion burns to rendezvous with the 213. Cosmos 212 and 213 apparently were completely successful.

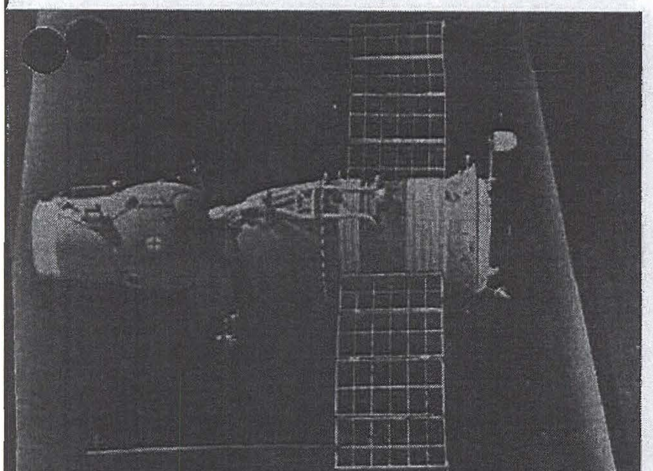
Cosmos 238, launched 28 August 1968, performed at least five orbital maneuvers during its four-day mission. This flight probably served as a further test of the Soyuz propulsion and re-entry systems. The success of Cosmos 238 was the final re-man-rating flight of the Soyuz.

Soyuz 2 and 3 were launched on 25 and 26 October 1968, respectively. Soyuz 3, piloted by G. T. Beregovoy, automatically rendezvoused with the unmanned Soyuz, only after manual docking was unsuccessful, but did not dock. Soyuz 2 was deorbited after three days, while the flight of Soyuz 3 lasted four days. A longer mission may have been planned for the manned vehicle but possibly was terminated prematurely to avoid a high intensity solar flare that occurred approximately 15 hours after deorbit.

Soyuz 4







Soyuz 5

Soyuz 4, manned by Lieutenant Colonel V. Shatalov, was launched on 14 January 1969 and was followed the next day by Soyuz 5, manned by Lieutenant Colonels B. Volynov, Y. Khrunov, and a civilian flight engineer, A. Yeliseyev. Soyuz 4 automatically rendezvoused with Soyuz 5, after which manual docking of the two vehicles was performed by Shatalov. Following the rigid docking, Khrunov and Yeliseyev transferred from Soyuz 5 to Soyuz 4, an operation which reportedly took an hour. The Soviets hailed this mission as the world's first docking of two manned spaceships, the first crew transfer, and the first experimental cosmic station. This mission probably represents fulfillment of the original intent of the Soyuz 1. If so, the Soyuz 1 failure delayed the program almost two years.

Launch innovation

A standard SL-4 launch vehicle consisting of an SS-6 space booster with a Venik upper stage has been used exclusively in the Soyuz program. This basic launch vehicle also was used in the Voskhod tests.

Soyuz configuration

The Soyuz weighs approximately 15,000 pounds, is 29 feet long, and 7.5 feet in diameter.

The spacecraft comprises three main compartments: a cylindrical instrument compartment with a flared aft end; a bullet-shaped pilot cabin; and an orbital compartment shaped as an elongated spheroid with a cylindrical docking section on the front.

The instrument compartment consists of a pressurized section that houses the thermal regulation, power supply, attitude control, telemetry systems, and a nonpressurized section housing the orbital maneuvering and retro propulsion systems.

The pilot cabin serves as the re-entry module and contains all controls for monitoring the flight. The cabin, connected to the orbital compartment by a hatch, is in the center of the spacecraft, between the orbital and instrument compartments.

The orbital compartment, in addition to being used as a cosmonaut rest and work area, serves as storage for various equipment. The total habitable volume of the pilot module and orbital module is about 318 cubic feet. Before walking into space during the Soyuz 4 and 5 mission, the cosmonauts changed into special suits in this compartment.

The orbital compartment, which also serves as an airlock, has an external hatch for entry before launch and for exit during the mission.

Spacecraft subsystems

The spacecraft has a superoxide type of life support system with an oxygen-nitrogen atmosphere providing a shirt-sleeve environment. The Soviets have stated that the Soyuz life support system can support a 30-day mission; however, the duration of manned flights to date has been less than five days.

The propulsion system consists of two liquid bipropellant engines—main and backup—fed from common tankage. Each engine can be used to perform orbital maneuvers or retrofire. The propulsion system is capable of a number of restarts and of burn times of one second to several minutes. Total burn-time capability is probably about seven minutes, which equates to a velocity change of approximately 1,000 feet per second. The Soviets announced that each engine has a thrust of 880 pounds.

The Soyuz attitude-control system has four means of establishing attitude reference—solar sensors, ion vector indicators, inertial sensors, and visual monitors. Two hot-gas systems are used for attitude-control torquing. One is also used for translational motion during the final phase of rendezvous and docking.

The Soyuz rendezvous and docking is a significant systems achievement for the Soviets and paves the way for future orbital operations required for space station missions. The system is versatile, having an automatic as well as manual capability for terminal rendezvous and docking. The entire rendezvous profile is normally carried out without real-time participation by ground controllers. But the use of the system is limited in that a time-phased launching of the two spacecraft is required to achieve nearly coplanar, in-phase conditions upon injection of the second vehicle into orbit.

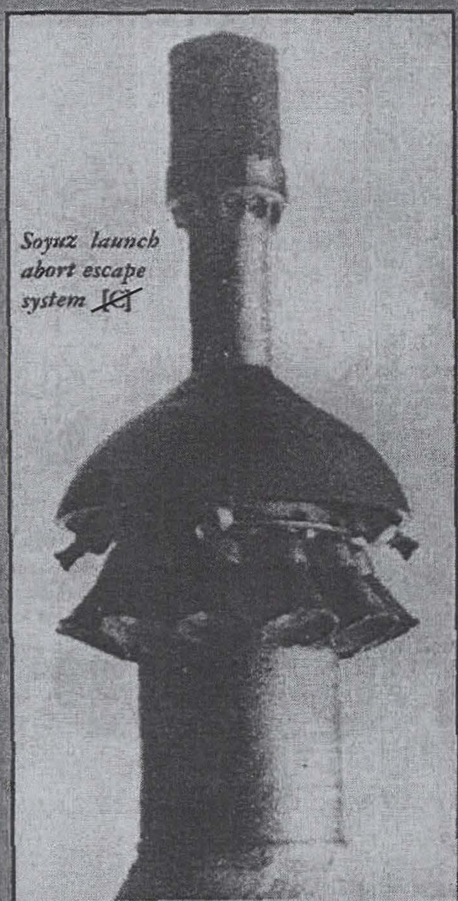
The rendezvous/docking technique demonstrated by Soyuz indicates some operational constraints inherent in this type of system. Performance limitations of the radar and propulsion systems and the cooperating target requirement nearly rule out this technique for inspection missions of other spacecraft or the emergency rescue of cosmonauts.

The electrical power supply for Soyuz consists of a solar cell array supplemented by chemical batteries. The solar-cell array consists of two panels, each 75 square feet, having a maximum power output of about 1200 watts. This is the first manned spacecraft equipped with operational solar cells.

The Soyuz has the most advanced communication system ever used on Soviet manned flights.

50X1 and 3, E.O.13526

After retrofire, the pilot's cabin (re-entry module) separates from the orbital and instrument compartments. The re-entry module then enters and descends through the atmosphere using the principle of controlled aerodynamic descent. The re-entry module is a lifting body that has a lift-to-drag (L/D) ratio of between .15 and .30. Within the limits of these ratios the re-entry module is provided with maneuvering capabilities that could extend the range from re-entry to impact by 300 to 750 nautical miles and permit lateral maneuvering up to 150 nautical miles. By using the lifting body technique the re-entry stresses are reduced to between 3 and 4 g's as compared with 8 to 10 g's experienced during a typical ballistic re-entry. [EN



Soyuz launch abort escape system (C)