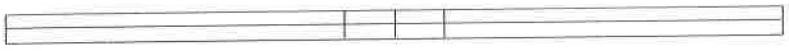
RETURN FROM SALYUT



On the evening of June 29, 1971, Viktor Patsayev, Georgi Dobrovolsky, and Vadim Volkov were busy shutting down the last of the control systems aboard Salyut and retreating to the Soyuz 11 command module for their return home. Three more cosmonauts were scheduled to return to Salyut in a matter of a few weeks, so they wrote a brief note to welcome them to the space station. Georgi stuck it to the wall of the transfer/docking module, and Viktor laughed to himself as he envisioned the new space crew reading it as they entered Salyut. Viktor thought about how much the past three weeks had enriched his own life, and he felt a little smug leaving a few words of wisdom for the future residents of Salyut. Viktor and his two comrades, Georgi Dobrovolsky, the mission commander, and Vadim Volkov, the flight engineer, were now about to complete a three-week stay in Salyut, the world's first space station. The mission had been a resounding success, and Viktor was prepared to return to a hero's welcome on Russian soil.

At 9:15 p.m. the mission controller at the manned space flight control center in Kalinin outside Moscow instructed Vadim to close the hatch between the Soyuz orbital module and the Salyut transfer/docking module for the last time. Viktor, already sitting in his position in the cramped Soyuz module, looked up to see the soles of Vadim's shoes as he worked in the transfer/docking module above his head. Vadim rechecked the hatch, and all indicator lights signaled that they had proper closure. He floated down and maneuvered himself into his seat to Georgi's right. Vadim reached up and closed the hatch between the command module and the orbital module, checked the seal, checked it once again, and then sat down and buckled himself in. Georgi informed ground personnel that they had closed the hatches and all systems looked good. Viktor, seated on Georgi's left, felt Georgi's left shoulder rubbing against him every time either one of them moved. He reminded himself that he would have to sit there for only a few hours.

After many minutes of final preparation, the command module, firmly attached to the orbital module, disengaged from Salyut. Soyuz 11, like earlier Soyuz and Vostok spacecraft that preceded its development, was highly automatic. The cosmonauts interacted very little with the onboard systems except when docking and undocking. For the most part Viktor, Georgi, and Vadim monitored the displays on the austere control panel in front of them and observed Salyut as they pulled slowly away. Salyut was a striking sight. Viktor admired her green insect-like form through the port window to his left. The large craft hung suspended against the jet black curtain of space, her skin brightly illuminated by the unfiltered rays of the sun.

Soyuz flew adjacent to Salyut for the next four hours as they approached their planned reentry point. Viktor made use of the time by stowing some additional materials and double-checking

the reentry procedures and systems. Although the cabin was cramped, it would have been far worse if they were wearing their space suits. Previous Soyuz cosmonauts had worn the characteristically white Soviet space suits - - but they were one- and two-man flights. Soyuz was basically a two-man capsule, and it had been necessary to exclude the suits from the three-man configuration for the simple reason that the men, their suits, and the support equipment did not fit inside the cabin. After all, the American Apollo capsules held a crew of three, so they could certainly do the same. All they had to do was eliminate the space suits which were not really essential anyway. Besides, their wool jump suits were far more comfortable.

Viktor Patsayev was well qualified for the tasks assigned to him. Like Vadim, he was a civilian who had longed to fly in space. He held a masters degree from the Penze Industrial Institute and had been a design engineer at the Central Aerological Observatory. Viktor previously demonstrated his ability to perform in space on Soyuz 7. Now he was flying as the Soyuz 11 Test Engineer. He was known by his comrades in the cosmonaut corps as being a bit on the quiet side, but was bright, highly competent, and always dependable.

Georgi Dobrovolsky, the commander of the mission, was a Lieutenant Colonel in the Soviet Air Force. Like other Soviet space shots this one was commanded by a military man. Vadim considered Georgi to be the most popular cosmonaut in the entire corps. He had a reputation not only as a skilled pilot, but as a man who enjoyed good company and conversation. He was a perfect candidate for the first long-duration space flight aboard a space station. The same could be said for Vladislav "Vadim" Volkov, the flight engineer. Although he was closer in age to Viktor, Vadim's personality was very much like that of Georgi - - gregarious, personable, and entertaining. Like Georgi, this was his first trip into space.

Viktor gazed out the small left-side porthole of the Soyuz command module for over a minute. The eastern coast of the Soviet Union and the Sea of Japan slid by below. Like Georgi and Vadim, viewing earth through one of the few small windows on the space station was his favorite pastime, but he rarely had the opportunity because of other, more pressing duties. He had no particular thoughts at the moment, the isolation of the past 23 days had taken its toll on his ability to concentrate during moments like this. It was such a pleasure to simply stare out the window and absorb the view. The top-down perspective of the blue water, coastal islands, and cumulus clouds was something so few people had ever seen, and it was just as absorbing now as it had been three weeks before.

The reentry burn began precisely at 1:35 a.m., Moscow time, after Soyuz obtained the proper reentry position over earth and oriented herself so the cosmonauts faced backwards, away from the direction of travel. The retro rockets on the command module ignited, sending a noisy shudder throughout the small spacecraft. The harsh shaking was disturbing, but Viktor's concern faded as the motion subsided into a forceful and prolonged rumble for the remaining seven minutes of the reentry burn. Viktor was privately relieved about the successful ignition - - even though they had not anticipated any difficulties with the scheduled reentry maneuver. He sat back in his seat, facing the emptiness of space, as Soyuz 11 dropped out of orbit and approached the upper layers of the atmosphere above the Soviet Union. The reentry burn slowed their fall, and Viktor became aware of the return of weight to his arms, something he had not experienced during his three-week stay in space. In less than 30 minutes they would decelerate from a speed of more than 27,000 kilometers per hour to a dead stop.

The flight controllers in Kalinin and the landing crews located 500 kilometers southwest of Sverdlousk made final preparations for the landing. Soyuz 11 should be nearing the atmosphere about now. The retro rockets would separate automatically from the command module, exposing the reentry shield just behind the backs of the three men. The forces on the cabin would increase to just under four gs, and flames from the heat of reentry would glow outside the portholes on the left and right sides of the small craft. Communication would not be possible due to the conditions of the fiery reentry.

The computers on board Soyuz, as programmed, shut down the retro rockets. The sudden silence within the cabin startled Viktor, but again, it was not an unexpected event. He noted the return of complete weightlessness as his arms lifted up away from his bent legs. The instrument assembly module, the command module, and the orbital module fell freely toward the atmosphere. Everything was going according to plan. They were no longer decelerating from the retro burn, just falling at thousands upon thousands of kilometers per hour through the black night. Seconds later the computers sent a signal to the explosive bolts connecting the command module with the orbital module. The bolts exploded, as instructed, and the command module fell away from the orbital module.

Water vapor and dust particles suddenly appeared out of nowhere, suspended in the cabin. A torturous pain spread across Viktor's face and forehead. The spacecraft began to spin unexpectedly. Flight computers, sensing that the craft was no longer oriented properly, instructed the positioning rockets to fire and keep the rear of the craft aimed toward the atmosphere below. Viktor, Georgi, and Vadim looked at the suddenly rotating attitude display on the console directly in front of them and realized that something had gone very, very wrong.

"The orienting rockets are firing!" Georgi shouted. "We're

rolling!"

Vadim, nearly at the same moment, shrieked, "We're losing pressure!"

Ground controllers on earth, including listeners at a Western tracking station eavesdropping on the flight, heard terse and unintelligible shouting from the craft, followed by a loss of radio telemetry. Loss of telemetry was normal during reentry, but usually not for another minute or so. Listeners on the ground weren't quite sure what, if anything, was going on.

After about 10 seconds of complete puzzlement and confusion, Viktor realized that the atmosphere within the command module was rapidly escaping into the vacuum outside. The force of the escaping air was acting just like an orienting jet on the capsule! The real orienting rockets must be firing to maintain the prescribed position of the spacecraft. But what was it? What was wrong? God, the hatch! It was his worst nightmare come true. Integrated into the center of the hatch that now separated the men from the vacuum outside was a pressure equalization valve, designed to open automatically when Soyuz entered the atmosphere and deployed her parachute. Firing of the explosive bolts during separation inexplicably caused the valve to open to the outside, enabling the cabin atmosphere, kept at sea level pressure, to blast through the opening into the vacuum.

Viktor pushed down with the full force of his legs and left hand, lunging toward the hatch above their heads with his right arm extended. The restraints dug deep into his right shoulder, holding him back in his seat. He clawed frantically at the latch on his restraining belts with his hands, finally getting his fingers on the buckle and pulling up to get some slack in the straps. With the straps loosened he pressed down again with his feet and right hand. Thrusting his torso upward, he grasped the hatch wheel with his left hand, pulled himself up as far as the

restraints would allow, and grabbed a small handle connected to the open pressure equalization valve with his right hand.

The cabin had already lost most of its oxygen and pressure in the 15 seconds that had now passed since they separated from the orbital module. They continued their free fall through space toward the upper layers of atmosphere. Viktor, like Georgi and Vadim, experienced the results of rapid decompression in space. Thousands of small pockets of air and gas trapped inside the sinus cavities of his face had expanded, shattering much of the bone behind his cheeks and forehead. The oxygen in his blood was boiling away, escaping through his veins and arteries into adjoining tissues. Every cell in his body, now unrestrained by the pressurized atmosphere, was expanding. His arms and legs had ballooned to half again their normal size!

But they were still conscious and capable of action, if only for half a minute more. Viktor knew that recovery from rapid depressurization was possible if they could quickly restore cabin pressure. Decompression to a vacuum state was an unimaginable assault on the human body, but survival was quite possible. At least that was what he had been told during training. He knew they had to act fast, just as he knew that precious seconds had already been lost trying to figure out what was going on in the spacecraft.

Georgi and Vadim, seeing Viktor lunge toward the hatch, realized instantly that the pressure equalization valve was the source of trouble. They focused their attention on the atmospheric controls, yelling to each other and screaming at Viktor to move quickly as he began to close the valve above their heads. The atmospheric controls were largely automatic, and they knew all too well that it would take precious seconds - - maybe minutes - - to restore the atmospheric pressure in Soyuz.

Viktor turned the small handle connected to the pressure

equalization valve with his right hand as fast as physically possible, thinking only about grasping the small bar with his fingers, twisting as hard as he could, letting go, rotating his hand, and doing it all again each half second. He kept turning and turning. With each twist of the handle his chest collapsed and then expanded, sucking the last molecules of oxygen from the air that remained. Priceless time slid by with each rotation. His thoughts became even more frantic. "God, how many turns? Must be 20 or 30. Is it broken? No, it can't be. It's still turning and there is resistance. It's taking too long!" The seconds..10..20..and then 30..continued to pass by. "There isn't enough time! This can't be happening, it simply can't be happening." He looked down beneath his raised right arm and saw that both Georgi and Vadim were not moving and their arms were floating out away from their bodies. He looked back up to the hatch and realized that he could not continue to apply the necessary torque to the handle.

The movement of his wrist slowed and then stopped, but his chest heaved wildly. It was not going to work. He could no longer move. From the deepest reaches of his brain came a desperate cry, but there was only a neurological impulse. There was no air to inhale or exhale, no air to vibrate past his vocal cords, and no air in which to transmit the sound that could not be made.

Ground crews sat ready in helicopters, poised to take off to rendezvous with the spacecraft upon landing. As the Soyuz entered the uppermost layers of the atmosphere they could see a bright yellow scratch in the dark morning sky above. The heat shield was aglow from the friction of the air. The tension grew among the helicopter crews. They made their last preparations for flight and began to take off, first lifting up a few meters and then tilting forward and sliding above the flat ground and gaining altitude as they moved away. Their spotlights, focused

on the earth, raced across the endless open field as they sped forward in the darkness. A few shouts of enthusiasm from dozens of people standing near the makeshift helicopter landing pads were heard above the roar of the turbine engines.

Without light the ground crews could not see the final stages of landing, but everyone at the scene knew the sequence well. At an altitude of nine kilometers a single drogue chute deployed automatically on Soyuz, followed by the single main chute at eight kilometers. With the main chute now deployed, the automatic sequencer on board Soyuz 11 jettisoned the heat shield, exposing the solid fuel landing rockets. The spacecraft and its billowing parachute were easy to see on the radar of the hovering helicopters. Soyuz 11 floated silently toward the ground from high altitude, far above the noise and commotion.

Soyuz continued her descent to the flat plane below and the helicopters raced toward the point of landing - - 1000 meters, 500 meters, 100 meters. She was right on target. The landing rockets fired two meters above the ground, making a bright flash in the darkness and kicking up a large cloud of dust. They cushioned the impact of the craft on the hard, dry soil. The capsule settled to the ground, rolled on its side, and the enormous parachute spilled its air into the darkness and collapsed onto the dirt.

The helicopters landed a short distance away, and the specially trained landing crews jumped out and ran toward the capsule. These men had prepared for this moment for years and were fully versed for all contingencies and emergencies. Upon first inspection the craft looked in excellent shape, despite the normal black scarring from the heat of reentry. Designated crews took their positions near and around the capsule while others radioed that the landing was successful. Camera and lighting crews jumped out of still more helicopters as they landed. Ground crewmen deployed reclining chairs next to the capsule for the three cosmonauts. They would not be expected

or allowed to walk after such a long stay in zero gravity. The medical team was ready, as on all landings, and three local young women in elaborate native costumes stood by with large bouquets of camomiles to present to the men once they were outside. The entire area was now well illuminated by all of the aircraft at the site.

Two ground personnel released the locking mechanism and swung open the heavy hatch. There was no movement inside the capsule. They stood and stared in absolute horror, realizing that Viktor Patsayev, Vadim Volkov, and Georgi Dobrovolskiy were dead, sitting in their cramped seats. Investigators would later determine that one of the cosmonauts had managed to close the valve in the hatch only half-way before losing consciousness. The valve was intended to be used in just this type of emergency, yet it would have taken another minute of rapid turning of the handle for it to be completely closed and for the Soyuz to be air-tight once again. The precise conditions under which the control would be used had not been considered during design and construction.

Three and a half months later on October 11, 1971, Salyut ground controllers in Kalinin reoriented the Salyut 1 space station and fired her retro rockets. She slowly descended into the upper reaches of the atmosphere where the friction began to incinerate her metal skin. A long arching streak of light could be seen in the sky as she entered the atmosphere. The charred tons of metal that were once Salyut plunged into the Pacific Ocean after 2,800 orbits of earth.

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