= Progress M1 @-@ 5 =

Progress M1 @-@ 5 was the Progress spacecraft which was launched by Russia in 2001 to deorbit the fifteen @-@ year @-@ old Mir space station before it naturally fell from orbit , potentially landing in a populated area . The Russian Aviation and Space Agency , Rosaviakosmos , was responsible for the mission .

Launched in January 2001 after a short delay due to a problem with Mir , on 27 January Progress M1 @-@ 5 became the last spacecraft to dock with the station . It spent two months attached to the Kvant @-@ 1 module before deorbiting the station on 23 March 2001 . Mir re @-@ entered the atmosphere with Progress M1 @-@ 5 still docked , disintegrating over the Pacific Ocean , with debris falling into the ocean at around 06 : 00 GMT . During the early stages of the unmanned Progress M1 @-@ 5 mission , a manned Soyuz was placed on standby to launch in order to complete the mission if a problem occurred . The decision to deorbit Mir attracted both praise and criticism for Rosaviakosmos , while several campaigns to save the station were conducted .

= = Background = =

Mir was the seventh and last manned space station to be launched as part of the Soviet space programme , and was the first true modular space station to be launched . The first component , the Core Module , was launched by a Proton @-@ K rocket on 19 February 1986 . This had been followed by six more modules , launched between 1987 and 1996 , all using Proton @-@ K rockets , except one which was launched aboard Space Shuttle Atlantis . Following the dissolution of the Soviet Union , Mir became the property of the Russian government , and the newly established Russian Aviation and Space Agency . It supported 28 long duration crews , visited by 40 manned Soyuz and Shuttle missions , whilst 64 unmanned Progress spacecraft were launched to support it . It was visited by 125 cosmonauts and astronauts , who performed 75 spacewalks .

During the Shuttle @-@ Mir programme , a series of American Space Shuttle missions visited Mir between 1995 and 1998 in preparation for the construction of the International Space Station . After the construction of the International Space Station began in 1998 , Russian resources were split between the two stations . In 2000 , Rosaviakosmos signed an agreement with MirCorp to lease the station for commercial use , with the Soyuz TM @-@ 30 mission , intended to prepare the station for future use and conduct some commercial research , being flown in later that year . This was to have been followed by more missions , including flights with space tourists , however due to the Russian government being concerned about MirCorp 's ability to fund these missions , Rosaviakosmos decided against funding the continued operation of Mir .

In November 2000 , Rosaviakosmos decided to deorbit Mir , and the next month Prime Minister Mikhail Kasyanov signed an order to do so . By this stage Mir was well past the end of its design life , and Rosaviakosmos General Director Yuri Koptev believed that " any of its systems could well fail at any time " . Therefore , it was decided to deorbit it whilst it was still functioning , rather than risk it falling back to Earth out of control , like Skylab in 1979 and Salyut 7 in 1991 , potentially dropping debris over a populated area . At the time , Mir was the largest spacecraft ever to reenter the Earth 's atmosphere , and there were concerns that sizeable pieces of debris , particularly from the docking assemblies , gyrodynes and external structure , could survive reentry .

Progress M1 @-@ 5 , which had originally been built to resupply and refuel either Mir or the International Space Station , was selected to perform the deorbit manoeuvre . Its mission earned it the nickname Hearse . It was a Progress @-@ M1 11F615A55 spacecraft , with the serial number 254 . An uninhabited area of the southern Pacific ocean was selected for the station to be deorbited into , as had been done with five earlier Salyut spacecraft .

= = Launch and docking = =

Progress M1 @-@ 5 was launched by a Soyuz @-@ U carrier rocket from the Baikonur Cosmodrome , Kazakhstan . It was originally scheduled for launch on 16 January 2001 , but by the

first week of January , it was targeting 18 January . It was rolled out to the launch pad on 16 January , with the rocket departing the MIK assembly facility at Site 2 of the cosmodrome at 02 : 00 GMT , and was erected at the launch pad , Site 1 / 5 , within two hours of the start of rollout . Launch was set for 06 : 56 : 26 GMT on 18 January .

On 18 January , a problem with the computers aboard Mir developed shortly before fuelling of the Soyuz @-@ U rocket was scheduled to commence , about five and a half hours before the launch was due to occur . The launch attempt was scrubbed , or cancelled , and the launch was expected to be delayed by four or five days . On 19 January , the launch was rescheduled for 24 January , giving controllers time to restart the computer and the station 's gyroscopes , which had shut down when the computer failed .

Preparations for the launch resumed on 22 January , and the launch occurred successfully at 04 : 28 : 42 GMT on 24 January . Following the launch , Progress M1 @-@ 5 spent three days in free flight before docking with the rear port of the Kvant @-@ 1 module of Mir at 05 : 33 : 31 GMT on 27 January . The docking port had previously been occupied by Progress M @-@ 43 , which departed at 05 : 19 : 49 on 25 January , and subsequently remained in orbit until Progress M1 @-@ 5 had docked with Mir . Progress M @-@ 43 , which had originally been launched to carry supplies and raise Mir 's orbit , in anticipation of manned flights which were never launched , was subsequently deorbited at 02 : 12 GMT on 29 January , burning up during re @-@ entry at 02 : 58 .

Free @-@ flights of Progress spacecraft typically lasted two days from launch to docking with Mir , however Progress M1 @-@ 5 took three days to reach Mir in order to conserve fuel for the deorbit burn . If it had launched on 18 January it would have spent four days in free flight .

= = After docking = =

Progress M1 @-@ 5 spent two months docked to Mir before the deorbit burn occurred . The gap between docking and deorbit was in order to allow the spacecraft to dock whilst Mir was still in a stable orbit , but then to allow some natural decay , or decrease in altitude , to occur in order to conserve the Progress ' fuel . Controllers determined that they should wait for the station 's orbital altitude to reach 250 kilometres (160 mi) before deorbiting it . In addition , RKK Energia wanted to wait until after the fifteenth anniversary of the launch of the Core Module , on 19 February .

Following the docking , Mir 's attitude control system was used to spin the station , to provide spin @-@ stabilisation in order to further conserve the fuel , as the station had descended to an altitude at which its gyroscopes could not be used for attitude control . The station would remain in this spin until the deorbit manoeuvres began .

On 20 February , Mir was predicted to descend to 250 kilometres within five days of 9 March . By 1 March , it was at an altitude of 265 kilometres (165 mi) , and descending at a rate of 1 @.@ 5 kilometres (0 @.@ 93 mi) per day . On 7 March , the Russian space agency opted to delay the deorbit burn until the station reached 220 kilometres (140 mi) as a result of natural decay , in order to allow more fuel for the burn , giving a greater range of options in the event of an anomaly during the deorbit manoeuvre . It was predicted that without intervention , the station would have naturally entered the atmosphere on 28 March .

On 12 March computers aboard Mir were reactivated ahead of deorbiting , along with the control system on 13 March . On 14 March it was announced that the procedure would be conducted on 22 March . On 19 March it was delayed one day further due to a lower than expected descent rate , with the start of the first deorbit burn being set for 00 : 31 GMT .

= = Deorbit = =

Progress M1 @-@ 5 carried 2 @,@ 678 kilograms (5 @,@ 904 lb) of fuel with which to perform the manoeuvres to deorbit Mir . These were completed on 23 March , when three deorbit burns were made ; the first two using just docking and attitude control thrusters , and the third using the main engine as well as the thrusters . The first burn began at 00 : 32 : 28 GMT , and lasted 21 @.@ 5 minutes , leaving Mir in an orbit with a perigee of 188 kilometres (117 mi) and an apogee of 219

kilometres (136 mi) . The second burn , which began at 02 : 24 GMT and lasted 24 minutes , placed Mir into a 158 @-@ kilometre (98 mi) by 216 @-@ kilometre (134 mi) orbit . The final deorbit burn began at 05 : 07 : 36 . It was scheduled to last 20 minutes , however flight controllers decided to let the Progress burn to depletion to ensure that the station re @-@ entered as expected . The last signals from Mir were received at 05 : 30 GMT , as it passed out of range of its ground station .

Mir re @-@ entered the atmosphere over the southern Pacific with Progress M1 @-@ 5 still docked at 05 : 44 GMT . It began to disintegrate at 05 : 52 , beginning with the detachment of solar panels , followed by other peripheral structures . The modules then buckled , before detaching completely . Debris came down in the ocean at around 06 : 00 GMT . Debris was intended to fall at around 47 ° S 140 ° W. An official statement announced that Mir " ceased to exist " at 05 : 59 : 24 GMT . The final tracking of Mir was conducted by a United States Army site on Kwajalein Atoll . The European Space Agency , German Federal Ministry of Defence and US National Aeronautics and Space Administration also assisted with tracking Mir during its final orbit and reentry . Former cosmonaut Vladimir Solovyov , who had been a member of the first crew to visit Mir , led the mission control team which was on station during the deorbit .

= = Contingency planning = =

Like all Progress spacecraft , M1 @-@ 5 carried two docking systems , Kurs and TORU . The automated Kurs system was the primary docking system , with TORU , which required manual input , as the backup . Because Mir was unmanned at the time of its docking , and a cosmonaut aboard the station would have been required to perform a TORU docking , or to troubleshoot any other problems during the docking , the Soyuz TM @-@ 32 spacecraft was made ready for a flight to Mir should human intervention be required . The Soyuz may also have been launched if the flight control system aboard Mir failed . Cosmonauts Salizhan Sharipov and Pavel Vinogradov were originally scheduled to have been on standby for this mission , with Talgat Musabayev and Yuri Baturin , the crew who eventually flew TM @-@ 32 to the International Space Station , as the backup crew . However , in December 2000 , they were replaced by Gennady Padalka and Nikolai Budarin , a crew which became known as Expedition Zero . These cosmonauts were chosen because of their training for a similar emergency mission to the International Space Station the previous year , which would have been launched if the Zvezda module had failed to dock . If a manned flight had been launched , controllers would have waited until after it had landed to begin the deorbit of Mir .

Progress M @-@ 43 , which had been launched in 2000 , undocked from Mir the day after Progress M1 @-@ 5 launched , and was kept in orbit until Progress M1 @-@ 5 docked . In the event that Progress M1 @-@ 5 had been unable to dock , Progress M @-@ 43 would have returned to the station and provide supplies of food and oxygen for the Soyuz crew . Progress M @-@ 43 was deorbited after Progress M1 @-@ 5 docked successfully .

If Progress M1 @-@ 5 had launched on 16 January , the Soyuz launch would have occurred on 10 February if it had been required . It was stood down around 22 February , after the decaying altitude of Mir made it too dangerous to send a crew to it .

If Mir 's main computer had failed after Progress M1 @-@ 5 had docked , then the flight plan would have been modified to use either the station 's BUPO rendezvous system , or the Progress for control . Under this plan , the third deorbit burn would have been conducted 24 hours after the first two burns , with the station being spin @-@ stabilised again between the second and third burns . Controllers also planned for a failure of Mir 's power system , which would have resulted in the deorbit being delayed one day , with all guidance and control functions being handled by the Progress spacecraft .

It was reported that Rosaviakosmos had taken out an insurance policy worth 200 million US dollars to cover damage caused by falling debris . The risk of debris from the station reaching land was estimated to be 3 % . Countries located near the target zone monitored events surrounding the deorbit to determine whether precautions should be taken . In New Zealand the Satellite Reentry Committee was responsible for this , whilst Emergency Management Australia handled preparations

in Australia . The head of the Japanese Defense Agency , Toshitsugu Saito , postponed a trip to the United States in case any debris fell on Japan , as the station was scheduled to pass over several Japanese islands on its final orbit . Residents of Okinawa were warned to stay indoors as the station passed overhead . Members of the South Pacific Forum requested assurance from Russia that they would not be hit by falling debris . Chan Sek Keong , the attorney general of Singapore , called for greater regulation of space debris .

= = Reaction = =

The reaction to Russia 's announcement and subsequent execution of its plan to deorbit Mir was mixed . Several cosmonauts expressed regrets at the loss of the station , but support for the decision to end the programme ; Vladimir Titov described the station as " a good ship " , but said that he agreed with the decision to prioritise the International Space Station , while Vladimir Dezhurov said that he felt " sad about Mir but we have to look into the future . "

In November 2000 , shortly after plans to deorbit Mir were announced , members of the Liberal Democratic Party of Russia passed a resolution in the Duma , the lower house of the Russian parliament , aimed at preventing it . On 8 February 2001 , a protest against the deorbiting of the station was held in Moscow , and a petition was subsequently sent to Russian president Vladimir Putin . Gennady Zyuganov , the First Secretary of the Communist Party of the Russian Federation , described deorbiting the station to be " incorrect and harmful " , and the act of a " helpless , weak @-@ willed , inefficient and not very responsible " government . Iran attempted to buy the space station , with president Mohammad Khatami offering to fund it for two to three years in return for Russian assistance with cosmonaut training , however by this stage it was too late for such a transaction to be completed .

The major Russian ORT TV station organised a national televised debate as to what should be done with the station . Former cosmonaut Georgi Grechko suggested that it should be kept in orbit long enough to salvage any useful equipment from it , for transfer to the International Space Station or other spacecraft , however Konstantin Feoktistov argued that it would cost more to retrieve the equipment than to replace it . Anatoly Artsebarsky argued that Mir should be kept because he believed that once it had been deorbited , the US would try to marginalise Russian involvement in the ISS . An online opinion poll showed 67 % support worldwide for keeping it in orbit .

Rosaviakosmos and RKK Energia responded to criticism of the decision in an open letter in mid February , which explained that the " actual condition of the onboard systems ... [does] not make possible the safe and reliable operation of Mir " , and that attempts to prolong its life " may lead to the loss of control of Mir .. and , as a result , to catastrophic consequences not only for Russia but for the whole world . "

The US Government welcomed the decision to deorbit Mir , as it freed up Russian resources for the International Space Station programme . The Space Frontier Foundation , however criticised the Russian government for yielding to what it claimed was pressure from the American government . SFF co @-@ founder Rick Tumlinson claimed that " Mir was bulldozed to make way for [the] International Space Station " . It had previously run a campaign called " Keep Mir Alive " , which aimed to either secure the continued operation of Mir , or to have it placed into a higher orbit , allowing it to be stored until its operation became viable .

In anticipation of the reentry of Mir , the owners of Taco Bell towed a target , measuring 12 by 12 metres (40 ft × 40 ft) out into the Pacific Ocean off the coast of Australia . If the target was hit by a falling piece of Mir , every person in the continental United States would be entitled to a free Taco Bell taco . The company bought a sizeable insurance policy for this " gamble . " No piece of the station struck the target . A group of enthusiasts from the United States , led by Bob Citron , chartered an aircraft to fly over the Pacific and view the reentry .