

Rosetta Hibernation Wake Up

20 January 2014

FAQ – Frequently Asked Questions

Q. When did Rosetta enter hibernation?

The final command to shut down the spacecraft was sent from ESOC, ESA's mission control centre, Darmstadt, Germany, on 8 June 2011, following an intensive, months-long campaign to prepare the satellite for hibernation. A special 'hibernation mode' for the spacecraft was designed by engineers at EADS Astrium, the main industrial prime contractor that built Rosetta, to allow it to survive the large distances from the Sun during its cruise. This was implemented by the mission operations team at ESOC. See <http://www.esa.int/roshibin>

Q. Was Rosetta completely shut down?

Almost. Only the computer and several heaters remained active. These have been automatically controlled to ensure that the entire satellite doesn't freeze as its orbit took it from 660 million km from the Sun out to 790 million km and back between 2011 and 2014. Everything else on board was shut down, including the transmitters.

Q. What contact did ESA have with Rosetta during hibernation?

None whatsoever - none was possible. Rosetta has orbited entirely on its own completely out of contact since 8 June 2011.

Q. How will ESA re-establish contact on 20 January? Will mission control send a signal?

No, just the opposite. Mission control will 'listen' for a signal that will be transmitted by Rosetta. This will be triggered by an 'alarm clock' timer that has been running throughout hibernation. The alarm clock will kick off an on-board wake-up procedure that will culminate with sending the first signal to Earth.

Q. What has to happen before Rosetta can transmit its first signal?

The spacecraft has been programmed to only transmit its first signal once the on-board wake-up procedure has reached a certain stage. The internal alarm clock will go off at 10:00 UTC on 20 January, triggering the exit from hibernation. This process that includes switching on the star trackers, slowing the spacecraft's hibernation spin and switching on and warming up certain systems. Once it has exited from hibernation, the spacecraft will switch itself into 'safe mode' - a standard mode of operation that ensures the basic functionality of the satellite. This, too, comprises several procedures, at the end of which Rosetta will orient itself into Earth-pointing mode and switch the transmitter on. This will all take about 6 hours; there's a great animation showing the process in YouTube <http://bit.ly/1fBE496>

Q. How will the signal be received on Earth?

Due to the incredible distance of Rosetta, 807 million km, the signal arriving at Earth will be extremely weak. To maximise the chance that ESA receives it and decodes it properly, the Agency has asked NASA to provide support with their 70-m diameter deep-space station at Goldstone, California (DSS-14). Goldstone is expected to acquire the signal between 17:30-18:30 UTC and then pass it immediately to ESOC in Darmstadt, Germany, where it will be fed to the Rosetta Flight Control Team in the Main Control Room.

ESA's 35m deep-space station at New Norcia, Australia (DSA-1) will also acquire Rosetta's signals later in the evening (around 20:34 UTC) but only the basic carrier signal; it won't be able to decode the 'telemetry' data sent by the spacecraft. In fact, NASA's DSN network will provide routine tracking and telecommanding support for several weeks, until the Earth distance decreases and ESA's 35m stations from our Estrack network (New Norcia, Cebreros and Malargüe) can take over. See <http://bit.ly/estrackvideo>

Sharing tracking capability is, by the way, completely routine for the two Agencies. As just one recent example, in August 2012, ESA supported the entry, descent and landing of NASA's MSL/Curiosity mission down to the surface of Mars. See <http://bit.ly/QB0zhY>

Q. When will the signal be transmitted?

There is no precisely fixed time; it depends on completion of the wake-up process, which in turn depends on ending the hibernation mode and then switching the spacecraft into safe mode. There is an expected uncertainty in the completion of these processes of at least +/- 15 mins and possibly more.

Q. How long will the signal take to travel to Earth?

The one-way light time on 20 January between Rosetta and Earth will be 44 minutes and 53 seconds over a distance of 807 224 610.74 km. By the way, on that day, Rosetta will also be 9 188 540 km from the comet, closing up at about 800 m/second.

Q. When does ESA expect the Rosetta signal to arrive?

The first opportunity for receiving the signal on Earth is expected between 17:30 and 18:30 UTC. Goldstone will start listening for the signal at 14:35 UTC.

Q. How will ESA announce receipt of signal?

Via the @ESA_Rosetta account in Twitter (http://www.twitter.com/esa_rosetta) and via the ESA website <http://www.esa.int>.

Q. How does ESA re-establish flight control over Rosetta?

The team will begin working in the Main Control Room starting around 14:00 UTC on 20 January. Upon receipt of signal and the establishment of two-way communication, the team will be on shift 24 hrs/day. The engineers will start downloading telemetry -- housekeeping information -- to carefully assess the satellite's health and status. The first priority will be to assess how much power the solar arrays can deliver. This information is needed to schedule all other procedures. Later, a carefully planned set of new commands will be uploaded, bringing the spacecraft back into full nominal operation in a stepwise process. In the coming weeks, the science teams will begin recommissioning and checking out their instruments as well.

Q. What happens if the signal does not arrive during the 17:30-18:30 UTC window?

The wake-up procedure comprises a number of on-board events that might not complete due to, for example, a fault in an electronic unit. If this should happen, Rosetta is programmed to simply restart the entire wake-up process, which lasts about six hours.

Q. Can we see Rosetta from Earth?

No, it's too far away - and we don't expect it to come close enough to Earth again to be visible with any telescope. The last time we could see it from Europe was during the second Earth Swing-by in November 2007, when it was very close.

Q. Why wake up now? Rosetta doesn't arrive at comet 67P/Churyumov-Gerasimenko until August 2014, correct?

Correct. The actual date was selected based on needing enough time to get everything tested, checked out and ready for arrival at the comet later in August; basically, we're waking up as soon as we can after year-end holidays and as soon as we can get decent telemetry when Rosetta is still 800 million km away.

From the science standpoint, there is a lot to prepare for rendezvousing and landing on the comet – first we have to switch on and check that all 11 instrument packages on the orbiter and 10 on lander are working, then we need time to track the comet so we can prepare our rendezvous manoeuvres. We also want to study the comet on the approach phase in case certain areas are active – we'd want to avoid getting too close to those! Choosing a landing site for Philae will also take careful consideration, and then we have to finalise the commands to deliver the lander to the surface, based on that selection. We certainly have plenty to do before we arrive at the comet in August!

Q. How hard is it for Rosetta to wake up? What might have gone wrong after 31 months of hibernation?

It's not hard per se for Rosetta to wake up; working together with industry, the Rosetta flight control team at ESOC worked hard to design a 'hibernation mode' prior to hibernation entry in June 2011. This ensured that most of the spacecraft's systems were properly shut down - except for the on-board computer with the timer alarm and several of the heaters, which were set to periodically cycle on so that the spacecraft wouldn't freeze up completely.

What 'might have gone wrong' is a tough question to answer on a speculative basis. What we can say is that the plan going into hibernation was solid and we catered for a lot of unknowns. Yes, 31 months of cold and no power could have affected some of the on-board systems, and in spaceflight there are always unknowns. The need for hibernation was known already during the design phase, so Rosetta was built to handle this. All things considered, we really do expect a nominal wake up.

Wake Up Ground Station Timeline 20 Jan

All times UTC (CET = UTC +1)

14:00	Rosetta flight control team on console in Main Control Room
14:35	NASA DSS-14 70m station Goldstone (California) begins listening
17:30	Expected receipt of signal window (AOS)
18:15	NASA DSS-43 70m station Canberra (Australia) begins listening
20:34	ESA DSA-1 35m station New Norcia (Australia) begins listening

More information about ESA's Rosetta mission at: www.esa.int/rosetta

Up-to-date information on the Rosetta blog at: blogs.esa.int/rosetta

General information about ESA's Space Science missions can be found at: www.esa.int/science