

# Spirit Copes With Decreasing Solar Energy

7 July 2006

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With electrical power from Spirit's solar array down to about 300 watt-hours per Martian day, or sol, the science team is able to plan only one major activity per sol and often needs to devote one sol to recharging the rover's batteries.

A hundred watt-hours is the amount of electricity needed to light one 100-watt bulb for one hour. Spirit remains healthy and continues to make progress on the winter science campaign.

Engineers successfully uploaded half of a new flight software upgrade and planned to take advantage of overflights by NASA's Odyssey orbiter to transmit more flight software files via UHF frequencies.

The rover team created a new technique for correcting drift (changes with time) in the rover's inertial measurement unit, which affects the pointing accuracy of the miniature thermal emission spectrometer.

The IMU provides roll, pitch, and yaw information to the rover. Typically, rover handlers minimize error by having the rover complete a sequence of steps known as a "get fine attitude" based on the changing position of the sun relative to the rover.

The rover then takes images with the hazard avoidance and navigation cameras, which provide guidance for positioning the robotic arm and driving as well as documenting the correction.

The entire process takes about one hour, which at present is roughly equivalent to a week of winter science operations. Between these updates, the rover's onboard computer keeps track of attitude changes, but error builds up in this calculation over time.

The new process involves sending a command to Spirit with the position reported by the rover after the last quick "get fine attitude," on sol 855 (May 30, 2006). Rover drivers confirmed that the rover had not moved since then by checking images

from the hazard avoidance cameras.

Following the usual attitude adjustment, the team planned to direct the rover to take two new images with the navigation camera and compare those to images from sol 855 as an additional means of verifying the accuracy of the adjustment.

## Sol-by-sol summaries

**Sol 881 (June 25, 2006):** Rover handlers spent one hour transmitting flight software files to Spirit via X-band frequencies using the rover's high-gain antenna.

**Sol 882:** Spirit completed a "bitty cloud" search designed to look for changes in the Martian sky, a photon transfer observation to measure electronic noise (unwanted signals) picked up by CCDs (charge-coupled devices -- imaging sensors that convert light into electrical current) in the left eye of the rover's panoramic camera, and observations of ground targets and atmosphere with the miniature thermal emission spectrometer.

**Sol 883:** Spirit conducted a 5-hour observation of the rock target "Halley" with the Mössbauer spectrometer. The rover also conducted morning atmospheric studies.

**Sol 884:** Spirit completed a photon transfer observation of the right eye of the panoramic camera.

**Sol 885:** Plans called for Spirit to conduct atmospheric studies of the Martian sky and ground using the panoramic camera and miniature thermal emission spectrometer. The rover's schedule also included another 5-hour study of Halley with the Mössbauer spectrometer.

**Sol 886:** Plans called for Spirit to conduct more "bitty cloud" observations, collect remote observations of the sky and ground with the miniature thermal emission spectrometer, set the rover attitude, and calibrate the high-gain antenna.

Sol 887: Plans called for Spirit to acquire a single frame of column 21 of the "McMurdo panorama."

Sol 888 (July 3, 2006): Plans called for Spirit to recharge the batteries and make morning atmospheric studies.

Odometry:

As of sol 884 (June 28, 2006), Spirit's total odometry remained at 6,876.18 meters (4.27 miles).

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