NASA braces for 'terror' in Mars landing

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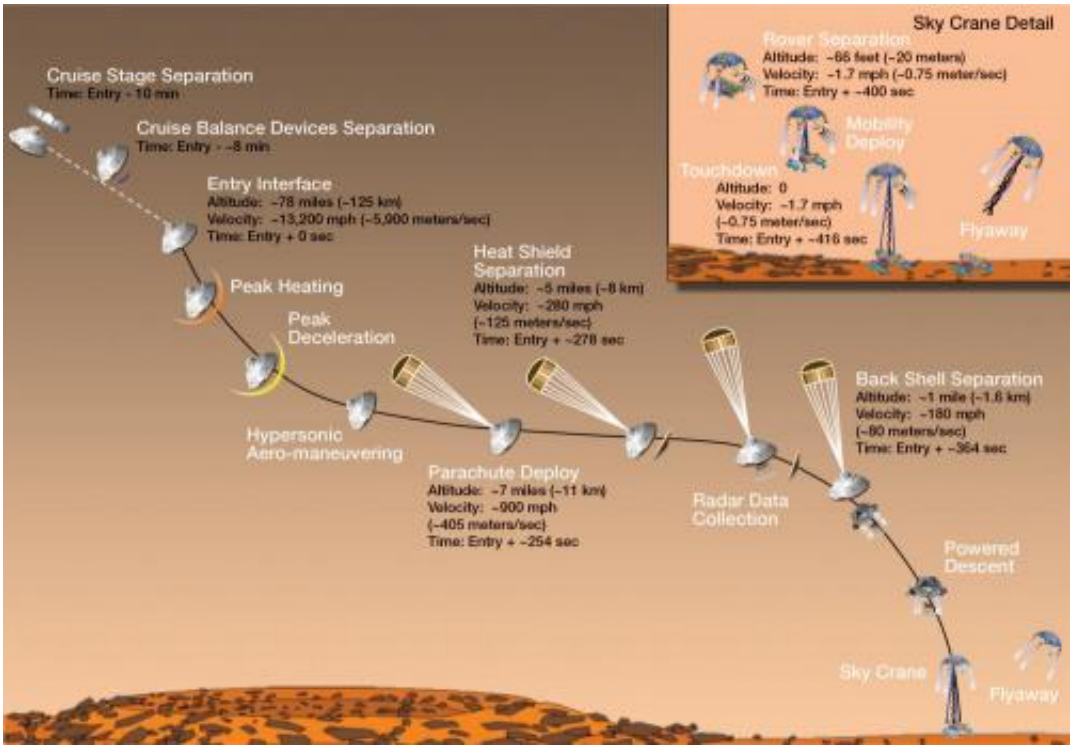

Image credit: NASA

The biggest, baddest space rover ever built for exploring an alien planet is nearing its August 6 landing on Mars, and the US space agency is anxious for success despite huge risks.

A popular Internet video by NASA called "Seven Minutes of Terror" depicts the high drama involved with the first-ever attempt to use a rocket-powered sky crane to lower the car-sized machine gently onto the

surface of the Red Planet.

The $2.5 billion Mars Science Laboratory project combines a sophisticated rover, Curiosity, with a mobile chemistry kit to zap rocks and sift soil in the hunt for clues that life may once have existed on Mars.

"It is pretty crazy looking, I am the first to admit," said Bill Nye, a well-known US science personality and president of the Planetary Society.

"But these people who did it are the best in the world, so I think they made engineering decisions that are pretty sound."

The rover aims to explore the Gale Crater on Mars, which contains a low mountain and multiple layers of sediment that NASA scientists have said they expect will reveal the unknown history of Mars.

Scientists know much more about Mars today than they did 50 years ago, namely that ample amounts of water once existed there, increasing the likelihood that microbial life did too.

Future hopes for Mars exploration include drilling to see if water still runs beneath the surface.

For now, the one-ton (900 kilogram) rover's toolkit contains a detector for water at 50 centimeters (20 inches) beneath the surface, plus lasers, sifters, drills and cameras to analyze rocks and send back images of the Martian surface as never before seen.

It is expected to land August 6 at 0531 GMT. NASA hopes it will get communications during the final minutes though a series of pings or tones that indicate when key milestones have been met.

The spacecraft must separate, a supersonic parachute must deploy to lower the rover down, then a rocket-powered sky crane must activate to power the vehicle closer to the surface before lowering it with nylon tethers.

It may be 15-20 minutes after the landing itself until NASA knows exactly what happened to its rover, which is twice the size of its vehicles Spirit and Opportunity. They launched in 2004 and landed with the help of airbags.

"This is really the first field test for the system. That is what has got me biting my nails," said Howard McCurdy, a space historian and professor at American University.

"I can think of 100 ways it could go wrong. I can think of three or four ways it could go right."

The mission has been in the works for 12 years, and was conceived following the crash of NASA's Mars polar lander in 1999 when the US space agency regrouped and made plans for future attempts.

G. Scott Hubbard, professor at Stanford University and former NASA Mars program director who led the planning for the Mars Science Laboratory, said he feels something like a "proud papa," but is still plenty nervous.

"They have tested this as much as you can possibly test it on Earth. You have to feel confident that you have done everything you can to ensure mission success," Hubbard told AFP.

"But on the other hand, Mars is notorious for throwing you the unexpected. So there is a blanket of tension that sits over the top of everything."

Indeed, more than half of global space agency attempts to send landers to Mars since 1960 have failed.

Bad surprises have ranged from dust storms to technical failures.

"Mars is hard," said Nye, pointing out that Russia, despite all its firsts in the realm of space exploration, is "0 for 21 on Mars. Europe is 0 for 1. NASA is a little over 50 percent."

But Mars remains a key focus of exploration because as Earth's nearest neighbor, it is also the planet most likely to have harbored life in the past.

"It is not crazy to suggest that life started on Mars, got slung into space, and we are all descendants," said Nye. "That is worth finding out."

If the landing succeeds, experts say it would give new urgency and direction to NASA's Mars program, which currently has one more orbiter, Maven, planned for launch in 2013 to hunt for methane in Mars's atmosphere, but nothing after.

NASA recently bowed out of a joint project with Europe, called ExoMars, due to budgetary constraints, and faces more than $300 million in cuts to planetary science annually in the coming years.

"Other missions down the road have not yet been identified, so if this is successful, it will give momentum to doing more work on Mars," said McCurdy.

If it fails, Hubbard said it could spark a reexamination of the US program, and may open the way for other space agencies to take the lead.

"I think the program would continue," he said, describing Mars as "certainly the ultimate goal for human exploration beyond low Earth orbit."

Key facts about NASA's Mars Science Laboratory

Here are some key facts about the mission of NASA's Mars Science Laboratory, the most sophisticated robotic vehicle ever built for planetary exploration, which aims to land on the red planet August 6.

MISSION: To study the Gale Crater near Mars's equator for signs that life -- likely in the form of fossil microbes -- may once have existed, and for clues about past and present habitable environments on the Red Planet. It is designed to function for 98 Earth weeks, or about one Martian year.

LAUNCH:

The mission launched from Cape Canaveral, Florida on November 26, 2011 atop a two-stage Atlas V 541 rocket by United Launch Alliance, a joint venture of Boeing and Lockheed. The journey to Mars has taken about 8.5 months, or 254 days.

LANDING:

"Seven minutes of terror" is a popular Internet video featuring top NASA scientists who describe the final touchdown scheduled for August 6 at 0531 GMT.

This is the first attempt of its kind to land a heavy vehicle on Mars by using a rocket-powered sky crane.

Entry, descent and landing begins when the spacecraft reaches the top of

Mars's atmosphere, traveling at a speed of 13,200 miles per hour (5,900 meters per second).

Ten minutes before the spacecraft enters the atmosphere, it sheds its cruise stage, or the parts that carried propellant tanks and antennae to keep the spacecraft on course to Mars and enable communications.

It then goes through a period of peak heating as it enters the Mars atmosphere. A parachute is deployed, the heat shield separates and the rocket-powered sky crane deploys nylon cords to lower the rover to the surface.

Touchdown should occur at 1.7 miles per hour.

VEHICLE: A car-sized robotic rover with six wheels, nicknamed Curiosity. It weighs about one ton (900 kilograms) and cost $2.5 billion. The concept first emerged in 2000 and was developed at NASA's Jet Propulsion Laboratory in Pasadena, CA.

TOOLKIT: Ten instrument-based science investigations are on board:

1) Mast camera (MASTCAM) contains two megapixel color cameras that act as the left and right eye of the rover, and are capable of returning stills, video and 3D images.

2) Chemistry and Camera (CHEMCAM) is a rock-zapping laser and telescope combination that can target a rock 23 feet (seven meters) away, burn it and analyze the light that emerges to identify the chemical elements inside.

3) Alpha Particle X-Ray Spectrometer (APXS) is on the robotic arm and can identify chemical elements in rocks and soil.

4) Mars Hand Lens Imager (MAHLI) is a color camera on the end of the robotic arm for use in getting closeups of the ground or wider scenes of the landscape.

5) Chemistry and Mineralogy (CheMin) analyzes powdered rock and soils with X-ray diffraction.

6) Sample Analysis at Mars (SAM) has three tools to check for carbon-based compounds that are the building blocks for life, examine the chemical state of other elements important for life and search for clues about planetary changes.

7) Rover Environmental Monitoring Station (REMS) records daily and seasonal changes in the weather on Mars.

8) Radiation Assessment Detector (RAD) monitors high energy atomic and subatomic particles from the Sun that could pose a danger to astronauts if a human mission to Mars ever occurs.

9) Dynamic Albedo of Neutrons (DAN) can detect underground water beneath the rover at a distance of 50 centimeters (20 inches).

10) Mars Descent Imager (MARDI) records full-color video of the final few minutes of the rover's descent onto the Martian surface. A few images are expected back within days of the landing, but the full video may take longer.

EXPLORATION SITE: Gale Crater, a 96-mile wide crater that contains a three-mile high mountain, shaped like a broad mound so the six-wheeled rover can climb at least halfway up the site.

Successes and failures in past Mars attempts

Fewer than half of the attempts by global space agencies to reach Mars have succeeded since 1960, with the United States in the clear lead. Here is a list of past key Mars missions:

SUCCESSES

December 1971: The Soviet space agency's Mars 3 lander reaches the Red Planet's surface but its instruments stop working after 20 seconds, likely due to massive dust storms at the time of landing.

July/August 1976: US space agency lands two probes, Viking 1 and 2, the first to send images and perform chemical analysis of the soil on the Red Planet.

September 1997: NASA's Mars Pathfinder succeeds in the first deployment of a lander and small free-ranging robotic rover on the Mars surface.

January 2004: The US space agency's rovers Spirit and Opportunity land successfully on Mars. Opportunity continues to send back data today.

May 2008: NASA's Mars Phoenix works for 155 days in the planet's arctic region.

FAILURES

November 1960: Soviet space agency launches Sputnik 22, an attempted Mars flyby mission, but it disintegrates after entering Earth's orbit.

November 1971: Soviet space agency's Mars 2 crashes on Red Planet's surface.

March 1974: Soviet space agency's Mars 6 goes silent before landing.

Mars 1974: Soviet space agency's Mars 7 is lost before entering Mars' orbit.

November 1996: Russian space agency's Mars 96 fails at launch.

December 1999: NASA's Mars Polar Lander crashes on Mars.

December 2004: European Space Agency's Beagle 2 attempts Mars landing but contact is lost before touchdown.

There have also been multiple attempts to send orbiters to circle the Red Planet or do flybys. Today there are three orbiters in operation around Mars, two US-launched (Mars Odyssey and Mars Reconnaissance Orbiter) and one European (Mars Express).

Most recently was Russia's failed attempt to launch its Phobos-Grunt spacecraft, a $165 million spacecraft designed to travel to the Martian moon of Phobos, scoop up soil and return the sample to Earth by 2014. Mission control lost radio contact with the craft hours after the November 2011 launch, and in January the 13.5 ton vessel plunged into the ocean.