NASAfacts

Small Pressurized Rover Concept

Background:

NASA is testing a variety of lunar rover concepts that will help future astronauts explore the moon further than ever before, construct a long-term lunar base and conduct a wealth of science experiments.

During the first use of such rovers on the Apollo missions, astronauts completed almost 20 traverses across the surface of the moon. With each successive mission, NASA improved the rovers' capacity, increasing the number and duration of exploration missions astronauts could complete on the lunar surface.

Concepts for a new generation of rovers, which astronauts will take with them when they return to the moon by 2020, are now being tested at sites around the country that have terrain similar to what might be encountered on the moon. One of these rover concepts is the Small Pressurized Rover, or SPR, that was unveiled in 2007. An SPR cabin prototype was then built and integrated with a rover chassis and completed for testing in 2008.

The Small Pressurized Rover:

Working with the concept of a long-term lunar outpost, NASA will need mobility systems for a range of activities. While some of these systems will perform unmanned tasks (think R2D2), the SPR concept could provide the astronauts' main mode of transportation, and could also allow them the flexibility to work inside of it without the restrictions imposed by spacesuits. The adaptable vehicle features pivoting wheels that enable "crab style" movement to help the rover maneuver through difficult spots. Its cantilevered cockpit does not obstruct the driver's visibility of the terrain ahead. Early concepts provide an exercise ergometer that allow crews to exercise while driving and simultaneously charge the vehicle's batteries.

Each SPR consists of a Mobility Chassis and an SPR cabin module. The SPR could be delivered to the lunar surface as a pre-integrated unit or as separate elements. The cabin's modular design enables it to be placed on a chassis. The Mobility Chassis can be configured in an unpressurized rover (UPR) configuration, with astronauts in spacesuits riding in rotating turrets and can also be used without the pressurized module. Astronauts may also ride in the turrets with the SPR in place, minimizing time for suit changes.

The modular design will also allow attachment of various tools that may be needed on a particular mission, such as winches, cable reels, backhoes and cranes.

Functional Requirements:

- The SPR must be able to hold a crew of two, but can support a crew of four in an emergency
- It can travel at about 10 kilometers per hour
- The mobility chassis wheels are able to pivot 360 degrees, allowing it to drive in any direction

SPR Specifications:

Weight: 3000 kg
Payload: 1000 kg
Length: 4.5 m
Wheelbase: 4 m
Height: 3 m
Wheels: 12x99 cm in diameter, 30.5 cm wide

Chassis Specifications:

Weight: 1000 kg
Payload: 3000 kg
Length: 4.5 m
Wheelbase: 4 m
Height: 1.3
Wheels: 12x99 cm in diameter, 30.5 cm wide

The SPR concept offers many advantages over the rovers of the Apollo days. Most notably, it will increase the potential range of exploration, provide protection for the astronauts, reduce the amount of time astronauts must wear pressurized suits and allow for more scientific research. One of the goals for testing these prototypes on Earth is to identify the benefits of the SPR and UPR configurations, and combine the best of both in a next generation design.

Range of Exploration

The SPR system consists of modular components for the vehicle as well as the science and exploration tool packages. Even in the midst of challenging terrain, emergency shelter and support can be less than an hour away. This could enable a far greater range of surface access, which leads to much more productive science return. With the presence of two or more pressurized rovers, the potential range from the habitat is more than 240 km as compared to Apollo's 10 km maximum.

Astronaut Protection

The greatest risk to human explorers on the lunar surface is the risk posed by unanticipated solar particle events (SPE). With a heavily shielded suit lock area, the small pressurized rover doubles as a storm shelter. The rapidly accessible, pressurized, radiation-hard safe haven can sustain and protect exploring crew members for up to 72 hours against SPE, acute suit malfunctions and other medical emergencies (e.g. decompression sickness treatment).

Rapid Ingress/Egress

An advantage of the SPR system is the crew lock concept, providing a rapid Extravehicular Activity (EVA) ingress/egress. The crew lock will allow the crew to enter and exit the EVA suit while never having to bring the suit inside, keeping the internal space mostly free of dust and reducing wear and tear on the suits. The crew lock will also minimize the loss of consumables when it is depressurized for EVA, extending duration of an SPR sortie.

Field Science Capability

The small pressurized rover concept allows for either a shirtsleeve or extravehicular work environment, thus enabling crews unprecedented flexibility. Activities requiring fine manipulation and unfettered visual access are best performed without the confines of an EVA suit. There are many activities, such as initial sample analysis, that are best performed in a shirtsleeve environment with small laboratory analysis tools. Local analysis allows the astronauts to assess samples in the field, and only collect and return high value samples.

A Rover for the Future

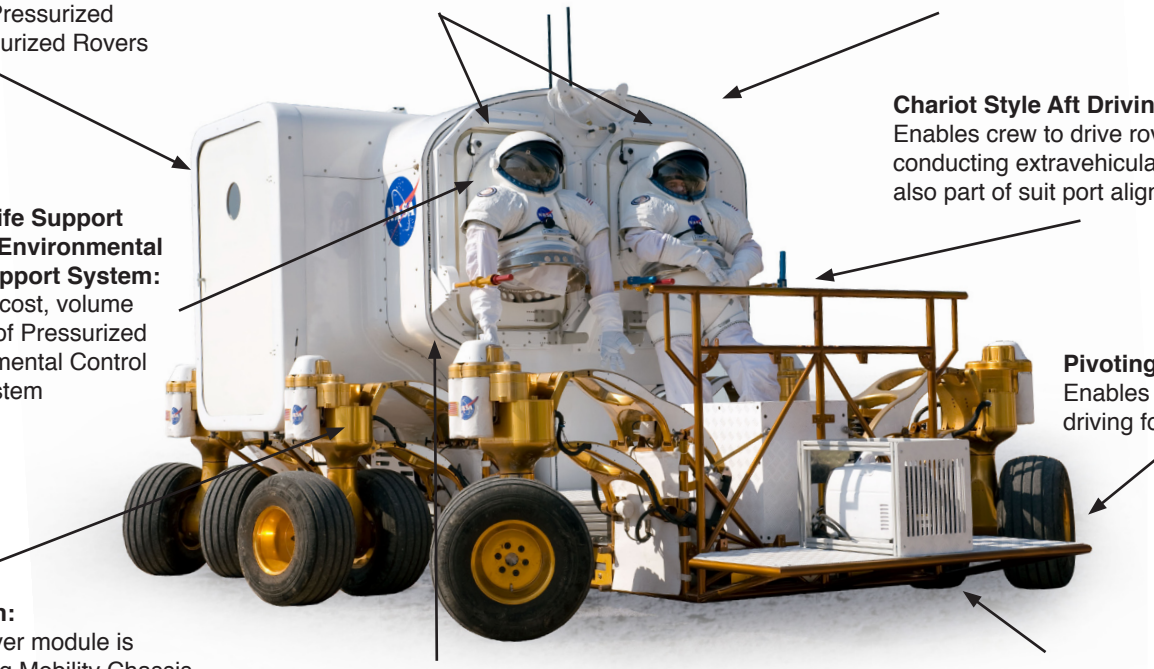
The Apollo program will always be recognized as a remarkable human achievement. The SPR concept, however, represents a significant advancement in the way NASA may explore planetary surfaces and provides astronauts a much safer and flexible rover for lunar exploration.

The Small Pressurized Rover Concept Characteristics

Docking Hatch:
Allows pressurized crew transfer from Pressurized Rovers-to-Habitat, Pressurized Rovers-to-Ascent Module and/or Pressurized Rovers-to-Pressurized Rovers

Suitports:
Allow suit donning and vehicle egress in less than 10 minutes with minimal gas loss

Pressurized Rover:
Low mass, low volume design enables two pressurized vehicles, greatly extending contingency return (thus exploration) range



Chariot Style Aft Driving Station:
Enables crew to drive rover while conducting extravehicular activities, also part of suit port alignment

Suit Portable Life Support System-based Environmental Control Life Support System:
Reduces mass, cost, volume and complexity of Pressurized Rovers Environmental Control Life Support System

Pivoting Wheels:
Enables crab-style driving for docking

Modular Design:
Pressurized Rover module is transported using Mobility Chassis. Pressurized Rover and chassis may be delivered on separate landers or pre-integrated on same lander

Ice-shielded Lock / Fusible Heat Sink:
Lock surrounded by 2.5 cm of frozen water provides SPE protection. Same ice is used as a fusible heat sink, rejecting heat energy by melting ice vs. evaporating water to vacuum.

Work Package Interface:
Allows attachment of modular work packages (e.g. winch, cable, backhoe or crane)

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NF-2008-10-464-HQ