

MARS-OZ: A Design for a Simulated Mars Base in the Arkaroola Region

David Willson (david.willson@au.tenovagroup.com) and Jonathan D. A. Clarke (jon.clarke@bigpond.com), Mars Society Australia

The centrepiece of the MSA program is the proposed MARS-OZ simulated Mars base.

The aim of the simulated base is to explore the issues of living and working on another planet. This includes facilitating research into social-psychological factors and related engineering design of crewed missions to Mars or the moon. In summary the project goals are:

- To provide planetary scientists access to a ‘Mars like’ region enabling opportunities to conduct research and training for planetary geologists and astro-biologists in field exploration and their related methodologies;
- To provide geologists, biologists, psychologists, physiologists, engineers, designers and horticulturalists a ‘test bed’ to research ideas, methodologies and equipment that can operate within the constraints of a base on Mars;
- To empirically test of the design advantages of using bent biconic lifting body shapes as a design basis for Mars bases. In particular, internal utility and accessibility of working spaces, and the mobility of the modules when wheels are attached;
- To trial and demonstrate technologies suitable for environmental low impact self-sustaining mobile structures; and
- To provide an inspirational public outreach vehicle encouraging planetary exploration and the education of public groups and school students into the science and technology of living on another planet.

These goals have driven the design of the MARS-OZ and the selection of a suitable location. In addition, the proposed base located within the Arkaroola region can provide planetary scientists and engineers opportunities to evaluate different exploration methodologies, technologies and associated risks by undertaking field trials and simulations for both individual components and integrated systems.

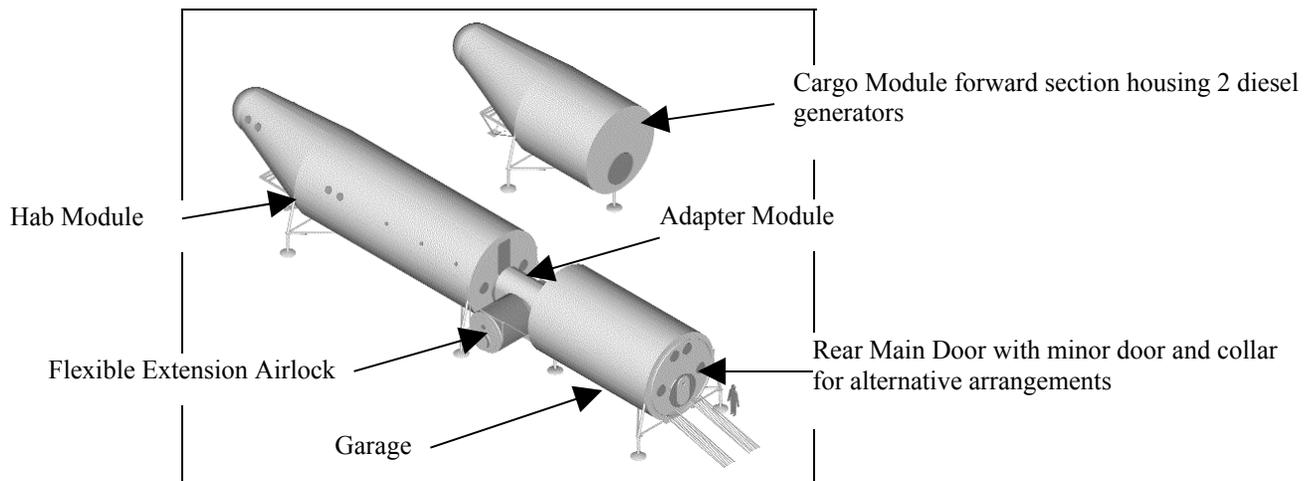
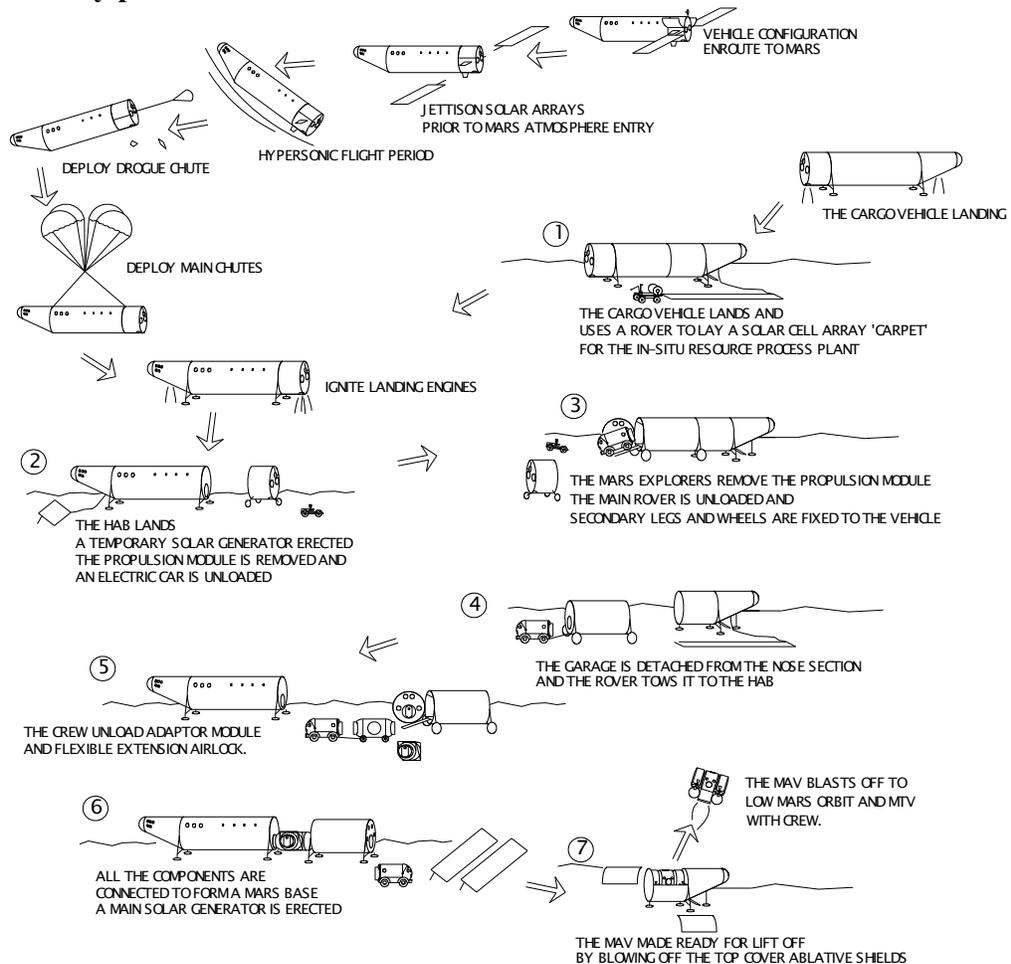
In particular field trials of unmanned rovers, manned rovers and space suit designs can be conducted over a wide range of terrain.

The preferred site for the MARS-OZ simulated base lies on the Arkaroola lease, Australia’s first and largest private nature preserve. The Sprigg family who run the property have a long history of supporting scientific research and eco-tourism. They are supportive of the establishment of a Mars analogue facility and the many visitors to the region provide an excellent opportunity for outreach. Arkaroola is eight hours by road north of Adelaide. In an emergency the all weather airstrip at Balcanoona would permit air evacuation by the Royal Flying Doctor Service. The same airstrip can also be used by charter operators.

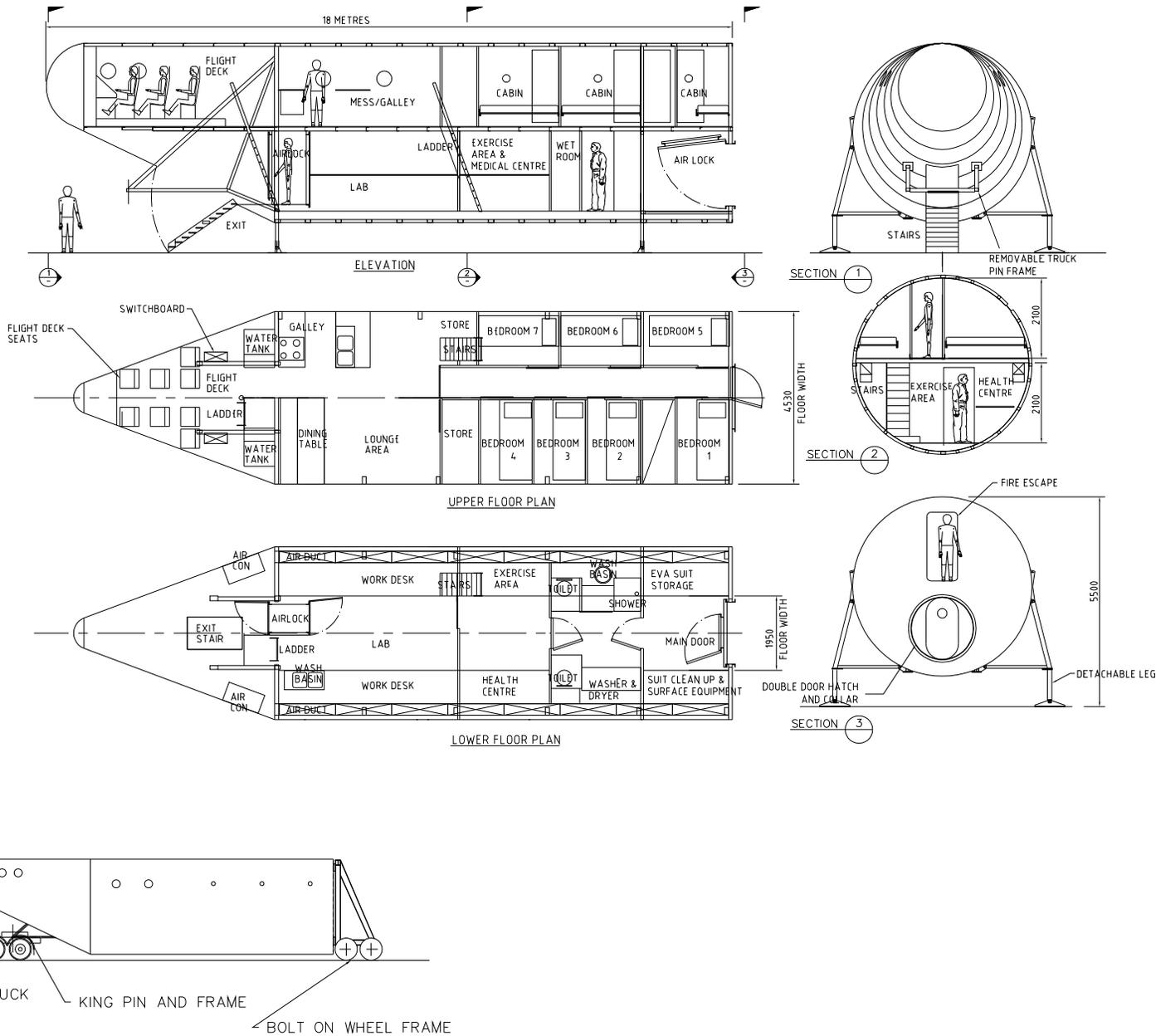
The MARS-OZ base configuration.

The facility consists of two 20 tonne road-transportable modules designed round concept mission using a “Mars Semi Direct” architecture and horizontally landed bent biconic spacecraft. The facility is designed to house up to 8 people at a time, and can undergo progressive expansion with additional modules, as required. A rover to match the base is being built in Perth, Western Australia.

The MARS-OZ base assembly process on Mars



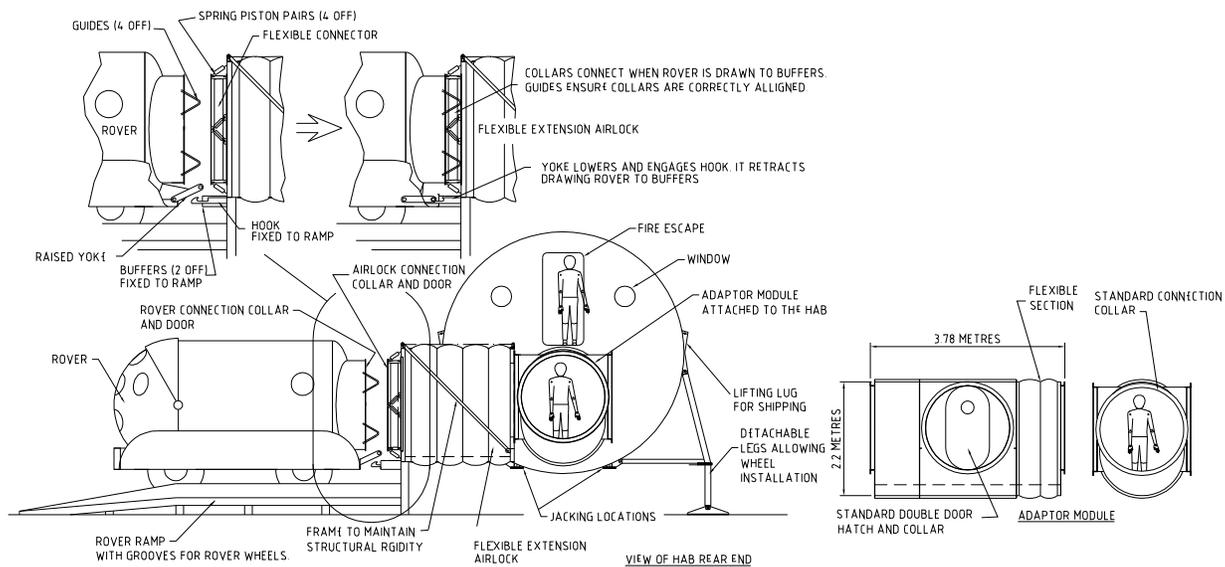
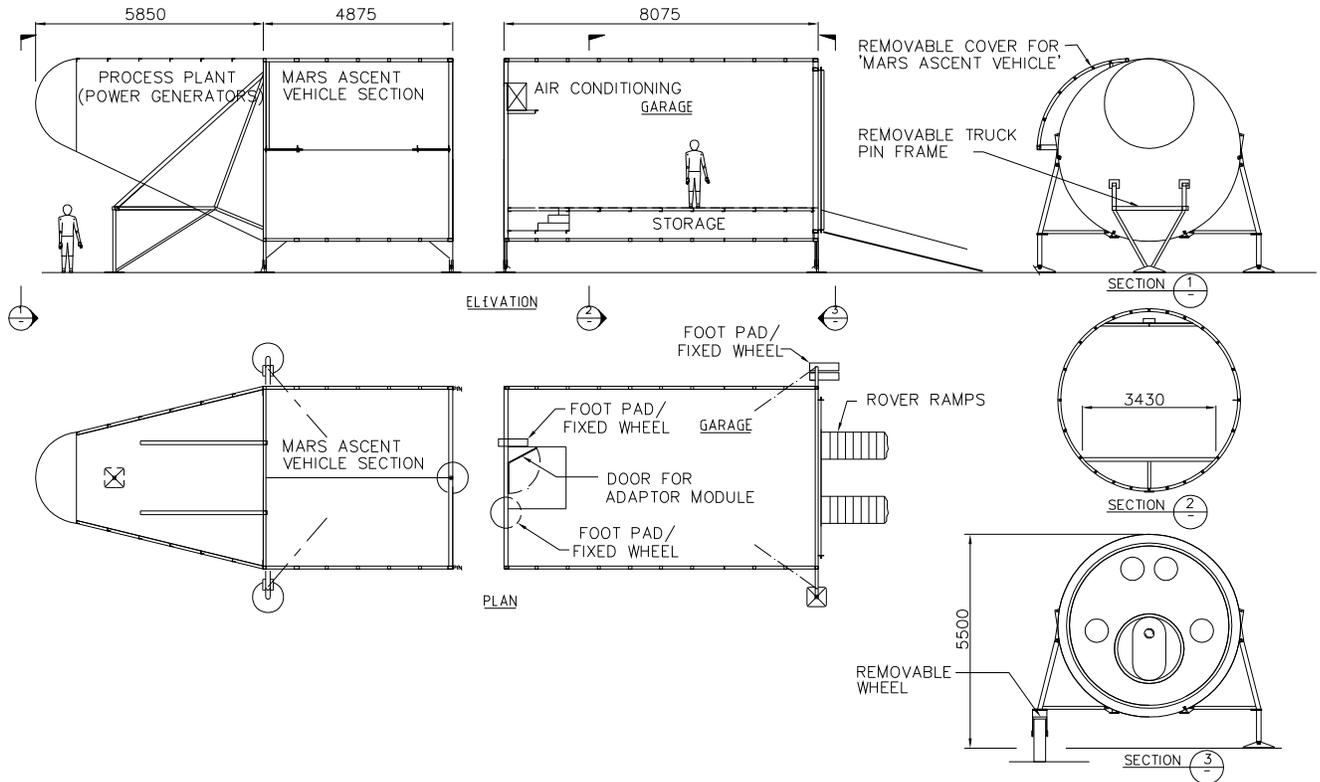
The Mars Oz Hab



Transportation mode of MARS-OZ modules, using detachable wheels and a prime mover. Two such prime movers will be required to set up the base on the chosen site.

The Mars base can be moved to different locations or used for intercity displays.

The Cargo module showing forward section (housing generator and mock up ascent stage) and detachable garage module.

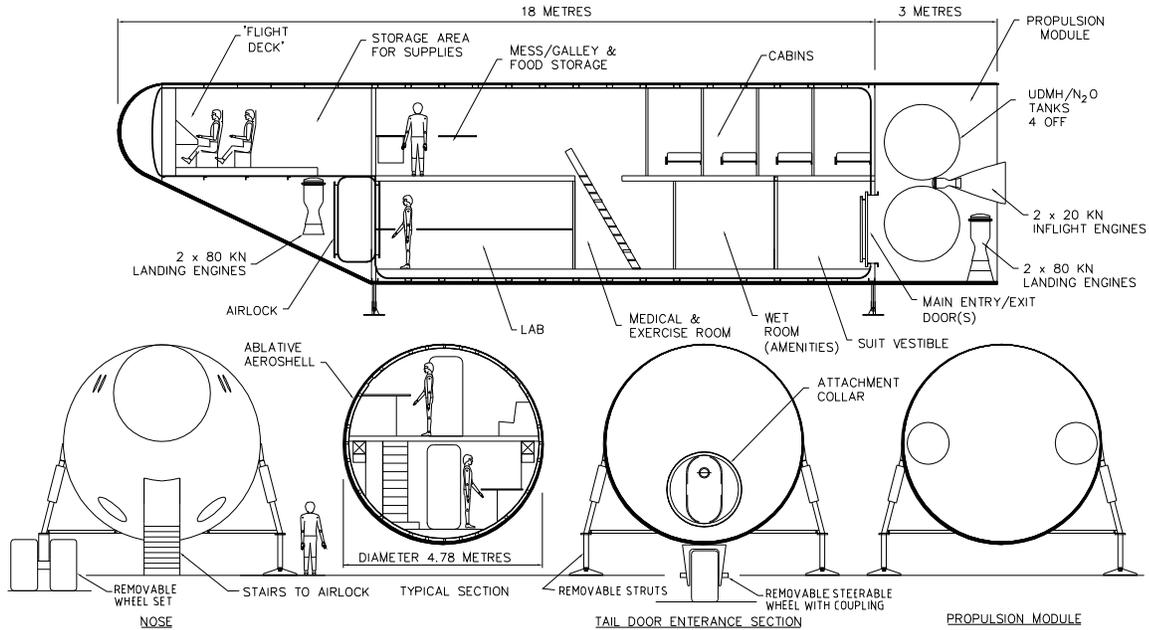


View of Hab rear, adaptor module and flexible extension airlock and rover docking system.

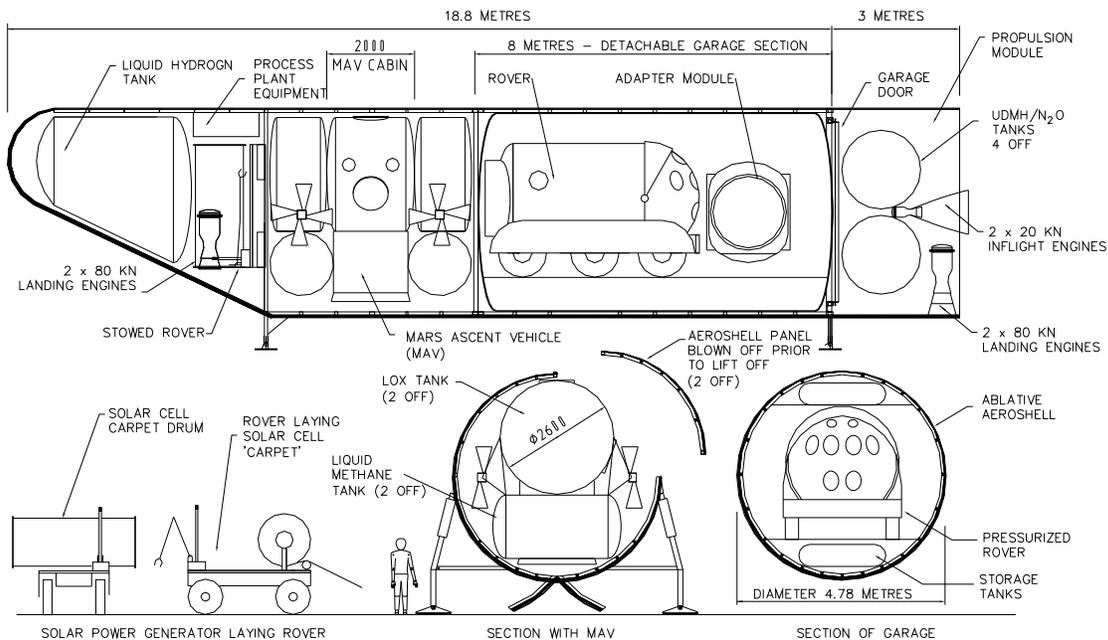
Details of Horizontally Landed Bent Biconic Spacecraft Concepts for Mars Missions

We have adopted a 62 tonne horizontally landed bent biconic spacecraft as the basis of the Mars-Oz vehicles. A detailed design concept has been completed of these vehicles for use in a real Mars mission and published in the Journal of the British Interplanetary Society May/June 2005 issue. The following drawings describe this concept.

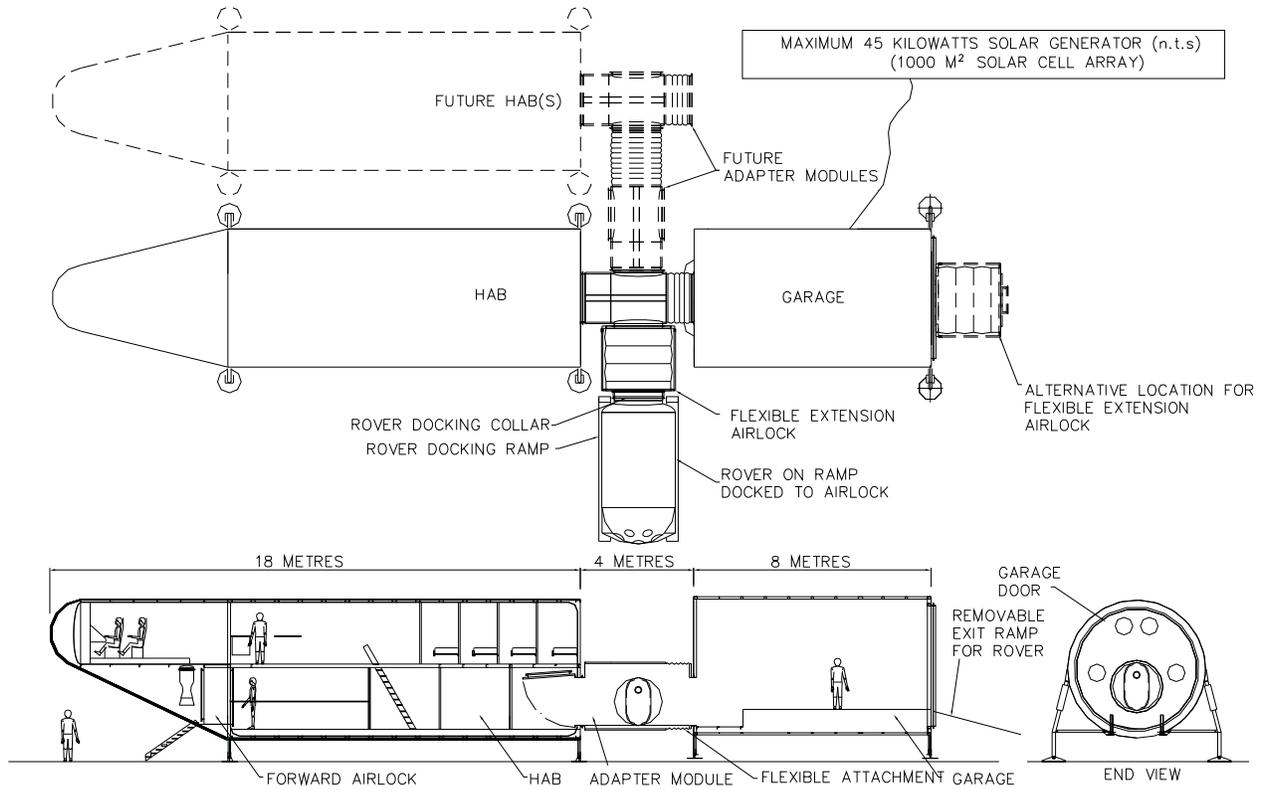
The Vehicles as per a Real Mars Mission:-



The HAB weighing 62 tonnes



The Cargo Vehicle with a 3 tonne rover and a 3.9 tonne (dry mass) Mars Ascent Vehicle.



The Mars Base on Mars

The Mars-Oz Mission Concept

The Mars-Oz concept employs a Hab, a Cargo vehicle and Mars Transfer Vehicle (MTV) . The Mars Transfer Vehicle is not discussed in these pictures. The table below summarizes the vehicle functions

Vehicle functional description

| Vehicle | Function Detail |
|------------------------------------|---|
| Habitat (Hab) | Travels to the Martian surface, direct from earth and becomes the core of the Mars base. It consists of a cabin, propulsion module, heat shield, landing engines and parachutes. |
| Cargo Vehicle | Transports equipment to the Martian surface direct from earth 2 years prior to the arrival of the crew. The equipment consists of a Mars Ascent Vehicle (MAV) for the crew to reach low mars orbit, hydrogen stock fuel, an in-situ resource utilisation processing plant, a pressurised rover and surface supplies for the crew. It also has a propulsion module, heat shield, landing engines and parachutes. |
| Mars Transfer Vehicle (MTV) | Travels to low Mars orbit from earth. It transports the crew back to Earth from low mars orbit. It consists of a cabin, landing capsule with heat shield, and propulsion module for earth return. |

The Advantages of the Horizontally Landed Bent Biconic Spacecraft

We find the horizontally landed bent biconic spacecraft is best suited for building Mars bases compared to other vehicle concepts.

They have superior cargo carrying capacity, easier loading and unloading, provides the biggest potential for growth by simply lengthening, offer good static and ground stability and simpler to provide radiation protection. These vehicles must function for many years as part of a growing and changing Mars base. It is therefore desirable that the vehicle design is optimized as part of a Mars base rather than for traveling to Mars.

Heavy Launcher type.

The vehicles are of a size that can be launched by the proposed Ares V or the former Energia launch systems. The 62 tonne mass limit ensures a 100 tonne trans-Mars booster can also be launched into Earth low orbit via the same launch system.

A LEO assembly is required in 2 parts. First the Hab or Cargo Vehicle is launched into LEO followed by a second launch providing the trans-Mars booster. The booster rendezvous with the Hab in LEO and then throws the assembly on to a trajectory to Mars.

The Mars Society Australia's Present Plans

The Mars Society Australia is seeking partners and sponsors for the simulated Mars base, Mars-Oz in Arkaroola.