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The Mars Robotic Exploration Preparation (MREP) Programme: Missions and related technology developments

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Abstract

The European Mars Robotic Exploration Preparation (MREP) programme was widely supported by ESA participating states at the last Council at Ministerial level. The general approach of MREP is to consider a Mars Sample Return mission as a long-term objective and to progress step by step towards this ambitious mission through short and medium term technology developments. In parallel, long term generic enabling technologies are being developed with respect to propulsion and nuclear power systems. Intermediate missions would validate these technologies wherever possible. Mission candidates considered in the current technology development plan, currently under review, are (1) Mars network science mission (INSPIRE), (2) Phobos sample return mission (PHOOTPRINT), (3) Mars precision lander with a small rover and (4) Mars Sample Return.

Missions 1 to 3 are scientifically rewarding alternatives to cope with possible MSR delays, while mission 4, and possibly mission 3, may become MSR segments under Europe lead.

These missions involve a wide range of enabling capabilities which development is well ongoing, such as:

- Mars Entry, Descent and Landing of small or medium-sized landers, including GNC (hazard avoidance, high precision), aerothermodynamics, airbag-based or soft landing, etc.,
- Sampling, fetching and sample transfer techniques,
- Precision landing on low-gravity bodies,
- High-speed Earth re-entry, including thermal protection system and aerothermodynamics, etc.
- Autonomous rendezvous and capture in Mars orbit, including GNC, capture mechanisms, etc.
- Planetary protection, including bio-sealing, monitoring, etc.

The ongoing systems studies and technology development relating to the ESA MREP candidates missions are presented here.