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## Mars Surface System Common Capabilities and Challenges for Human Missions

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## ABSTRACT

NASA has begun a process to identify and evaluate candidate locations where humans could land, live and work on the martian surface. These locations are referred to as Exploration Zones (EZs). Given current mission concepts, an EZ is a collection of Regions of Interest (ROIs) that are located within approximately 100 kilometers of a centralized landing site. ROIs are areas that are relevant for scientific investigation and/or development/maturation of capabilities and resources necessary for a sustainable human presence. The EZ also contains a landing site and a habitation site that will be used by multiple human crews during missions to explore and utilize the ROIs within the EZ.

In parallel with this process, NASA continues to make progress on the Evolvable Mars Campaign examining alternatives that can pioneer an extended human presence on Mars that is Earth independent. This involves ongoing assessments of surface systems and operations to enable a permanent, sustainable human presence. Because of the difficulty in getting equipment and supplies to the surface of Mars, part of these assessments involve identifying those systems and processes that can perform in multiple, sometimes completely unrelated, situations. These assessments have been performed in a very generic surface mission carried out at a very generic surface location.

As specific candidate EZs are identified it becomes important to evaluate the current suite of surface systems and operations as they are likely to perform for the specific locations and for the types of operations – both scientific and development – that are proposed for these EZs. It is also important to evaluate the proposed EZs for their suitability to be explored or developed given the range of capabilities and constraints for the types of surface systems and operations being considered within the EMC. This means looking at setting up and operating a field station at a central location within the EZ as well as traversing to and exploring the scientific ROIs within the boundaries of the EZ.

The proposed paper will describe the current status of common systems and operations as they can be applied to actual EZ locations on Mars. Initially these EZs will be the four locations identified MEPAG's Human Exploration of Mars Science Analysis Group (HEM-SAG) that will be used as representative of the EZs that will emerge from the process that NASA has initiated. An example process that could be commonly applied is an approach for developing a field station site plan that would be demonstrated by applying this process to each of the four HEM-SAG sites. Examples of common systems include (a) mobility systems that can be used to off-load and move payloads to specific locations at the central field station location that could also be used to traverse long distances to reach some of the more remote ROIs or (b) robotic systems that can support various activities (such as system set up and maintenance) at the field station that could also be used to explore scientific ROIs and used to support site-specific ISRU production activities.

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