MARS SAMPLE RETURN – A REQUIREMENTS STUDY FOR A SAMPLE RECEIVEING FACILITY

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Introduction: Mars sample return (MSR) missions are key elements in the future exploration of Mars. The construction and commissioning of a MSR sample receiving facility (MSR-SRF) will take 10-11 years, including a period of 2-4 years for commissioning and testing prior to any Mars samples entering the facility [1,2]. Internationally agreed Planetary Protection treaties [3] define that any samples returned from Mars must be treated as being potentially hazardous until proven otherwise. Any SRF will have to maintain the highest level of containment, whilst also ensuring that the samples are not contaminated with any potentially detrimental terrestrial materials e.g. organic compounds. We describe here our work on developing a set of functional requirements for such a facility and the design concepts generated under an ESA funded study led by SEA. The results of this study (as well as the results of another parallel study) will be taken into account by ESA to define the requirements for a follow-on procurement. Therefore, the views expressed herein should not be taken to reflect the official opinion of the European Space Agency.

Rationale and Discussion: The initial stage of our work was a comprehensive literature review from which we developed >300 'candidate requirements' for the SRF during its various modes of operation. We also facilitated a workshop, with international participants from a range of disciplines. Combination of workshop discussions and analysis of the candidate requirements resulted in the development of 82 'functional requirements'. These requirements are 'solution independent' and do not prescribe particular solutions or concepts for the facility design. The most important requirement is to contain the sample until such time any potential biohazard has been identified. Another top-level requirement is 'protect the science' i.e. during the samples' residence within the facility they must be protected from effects or substances that would compromise their scientific integrity. Thus, contamination control was afforded a very high priority in our study. Areas within the SRF are dedicated to different aspects of the receiving and biohazard testing of samples, which can be broadly defined into five areas; receiving, cleaning, opening, curation and biohazard testing. Our concept utilises complete robotic manipulation in some areas e.g. curation and cleaning, whilst other areas (some biohazard testing protocols) require suited laboratories. We have also carefully considered the environment (P,T, atmospheric composition) of operation for sample handling in order to best preserve the scientific integrity of the samples whilst being able to access them for biohazard testing and preliminary scientific investigation.

References: [1] iMARS Working Group 2008. *Preliminary Planning for an International Mars Sample Return Mission.* [2] Beaty D. W. et al. 2009. *Astrobiology* 9:745-758 [3] COSPAR Planetary Protection Policy 2002.