MARS SAMPLE RETURN (MSR) SAMPLE RECEIVING FACILITY (SRF) PLANNING STRATEGIES. A.D. Harrington[1], A. Hutzler[2], R.L. Mattingly[3], M.J. Calaway[4], A.L. Smith[3], F.B. Gaubert[2], and A.A. Llanos[4]
[1]NASA Johnson Space Center, [2]ESA ESTEC. [3]Jet Propulsion Laboratory. [4]Jacobs at NASA JSC. Andrea.D.Harrington@nasa.gov

Introduction: The Mars Sample Return (MSR) campaign, initiated in 2020 with the launch of the Perseverance Rover, is an international partnership between NASA and the European Space Agency (ESA) to return Martian geological samples to Earth for scientific study in the early 2030's. Not only is MSR the first mission to bring samples back to Earth from another planet, it is the first since Apollo 14 to be classified as Restricted due to the possibility that the samples could contain Martian life. As a result of this classification, the Sample Receiving Facility (SRF) must not only provide a pristine environment to ensure samples are free from terrestrial contamination for scientific investigations, it must also provide high containment (biosafety level 4 [BSL-4]-equivalent) to isolate the samples from Earth's biosphere until the samples are deemed safe for release and/or sterilized.

SRF Capabilities: Beyond just isolating the samples, the SRF will be utilized for an array of tasks and scientific objectives including:

- Receive the Earth Entry System
- Deintegrate and evaluate hardware
- Characterize unopened sample tubes
- Open sample tubes
- Perform initial sample characterization to enable cataloging and subsequent science
- Conduct a biohazard assessment
- Enable selected competed/early science under containment
- Prepare, sterilize, and distribute samples for science outside of the SRF
- Store samples under controlled conditions

The SRF is not intended to be the long-term curation facility for Martian samples. The nominal utilization period is 2-5 years. However, to account for possible delays in schedule or the identification of extant life, this period could be extended.

Mars SRF Planning Strategy: Due to the Restricted nature of the sample return mission and the additional requirement for containment, a traditional receiving/curation facility cannot be utilized for MSR. Given the anticipated complexity of the SRF, a multi-pronged approach is being utilized to hone the list of infrastructural requirements. The primary step in this processes is to complete the NASA MSR SRF Assessment Study (MSAS) (Spring 2023). The MSAS is a feasibility study that is assessing an array of modality options and scopes and will be the foundation for moving into the High-Level Conceptual Design Phase for the SRF (Summer 2023). In parallel, ESA has procured the European ExtraTerrestrial Sample Infrastructure (EETSI) study. The EETSI study is industry-led and develops preliminary conceptual designs, as well as programmatic elements such as costs, schedule and socio-economic impact. In addition to these major efforts, a number of Research and Development (R&D) tasks with infrastructural implications have been identified and initiated. The NASA MSAS, ESA EETSI studies, and R&D tasks are all using the same and latest requirements, to ensure easy interfacing and comparability. All of these efforts are in coordination with MSR Working Groups (e.g., MSR Campaign Science Group (MCSG)) and team leads, as well as with experts in high-containment.

Mars SRF Assessment Study (MSAS) Overview: This assessment will focus on the feasibility of implementing a broad range of curation and science infrastructure within the SRF while simultaneously assessing multiple building modality options (e.g., lease/renovate an existing BSL-4 facility; construct a new, traditional fixed facility; construct a new modular facility). The assessment will also consider and array of criteria, including but not limited to the ability for the SRF to meet regulatory, planetary protection, and contamination control requirements.

Mars SRF High-Level Conceptual Design Phase (MSAS2) Overview: The second part of the MSAS is a more focused examination of the down-selected option(s). The inputs for this phase of the study will be based on performance/capability, cost, and schedule output from the MSAS, as well as outputs from MSR Working Groups (e.g., MCSG) related to science goals and priorities.

ESA EETSI Study Overview: This study is developing conceptual designs for receiving and curation facilities, including an SRF for Mars samples. Based on earlier feasibility studies, the choice was made to focus on only two building modality options, traditional new-built, including or not modular areas. Curation,

regulatory and science capabilities are equivalent to the Enhanced Scenario of the MSAS.

Infrastructural R&D Priorities: An array of R&D projects with implications for final SRF design and requirement implementation strategies have been identified and/or initiated. One of the main projects is the development of the Double-Walled Isolator, which is being led by ESA. Other R&D tasks include but are not limited to: Mars sample sterilizations verification protocols, development of infrastructural contamination control and sterilization procedures, sample extraction and processing techniques, and sample isolation containers for storage, analysis, and transport. All R&D tasks are being done in collaboration with ESA, NASA/ESA Planetary Protection Offices, U.S. Regulatory agencies, and/or MSR Science Working Groups.

Summary: NASA Johnson Space Center is performing sequential assessment studies to investigate the optimal facility modality and capability requirements for the Mars SRF. ESA is conducting a parallel study that would support MSAS2. Both agencies are collaborating on multiple R&D activities which will help inform SRF site-specific design.

Supporting Documents:

Mattingly R.L., Smith II A.L., Calaway M.J., Harrington A.D. (2020) Tours of High-Containment and Pristine Facilities in Support of Mars Sample Return (MSR) Sample Receiving Facility (SRF) Definition Studies. JPL/NASA Report http://hdl.handle.net/2014/50446

MSR Science Planning Group 2 (MSPG2) Outputs available in Astrobiology: https://www.liebertpub.com/toc/ast/0/ja