

MARS SAMPLE RETURN (MSR) SAMPLE RECEIVING FACILITY (SRF) ASSESSMENT STUDY (MSAS). A.D. Harrington¹, R.L. Mattingly², M.J. Calaway³, A.L. Smith², J. Villarreal¹, and F.M. McCubbin¹, ¹NASA Johnson Space Center, ²Jet Propulsion Laboratory, California Institute of Technology. ³Jacobs at NASA Johnson Space Center. 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 2030s. Not only is MSR the first mission to bring samples back to Earth from another planet, it is the first time since Apollo 14 to have a mission classified as a *Category V: Restricted Earth Return* by the NASA Planetary Protection Office due to the possibility that the samples could harbor extraterrestrial life. As a result of this classification, the Sample Receiving Facility (SRF) must not only provide a pristine environment to ensure samples are protected from terrestrial contamination for scientific investigations, it must also provide high-containment (biosafety level 4 [BSL-4]-equivalence) 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
- Hardware de-integration and evaluation
- Sample tube characterization
- Open sample tubes
- Perform initial sample characterization and cataloging
- Conduct a biohazard assessment
- Preliminary examination of samples for science and sample catalog preparation
- Selected competed/early science
- Prepare, sterilize, and distribute samples for science outside of the SRF
- Sample isolation/storage for future science

The SRF is not intended to be the long-term curation facility for Martian samples. The nominal utilization period is anticipated to be 2-5 years. However, to account for possible delays in schedule or the identification of extant life, this anticipated period of time must be flexible to accommodate schedule extensions and contingency plans.

MSR SRF Assessment Study (MSAS) Overview:

Due to the biological high-containment requirements of the sample return mission, a traditional receiving/curation facility cannot be utilized for MSR. Therefore, NASA is planning to assess an array of possibilities for the MSR SRF. The assessment is intended to generate information that will inform the selection of facility modalities (outlined below) for high-level conceptual design development. This assessment study will focus on SRF requirements for accommodating curation, science, and sample safety assessment infrastructure. The results will inform the selection of the modality that will move forward with the conceptual then site-specific designs.

The following facility modalities are under consideration:

- 1) Lease and renovation of existing space
- 2) Construction of a new, traditional fixed facility
- 3) Construction of a modular facility (new or within an existing building)
- 4) Construction or renovation of a hybrid facility to address requirements with multiple modalities that may include a combination of modalities 1-3.

The assessment will also consider the following aspects of the SRF for each modality:

- Ability to meet requirements
 - Regulatory
 - Planetary protection
 - Contamination control
 - Science and curation
- Ability to meet changing needs for equipment, timelines, and facility use
- Timelines for design, construction, commissioning, installation of equipment, testing, training, and operational readiness drills
- Cost for construction and operation, including those associated with hazard resilience
- Ease of access for international users
- Decommissioning, repurposing, sale, or lease following use of the facility
- Uncontained preparatory laboratory spaces
- Uncontained ancillary spaces
- Waste management

MSAS Structure: In order to properly scope the SRF, the MSAS is broken down into two phases. The first phase will investigate the ability of the modalities to accommodate two different facility capability endmembers: 1) a minimal facility focusing on biohazard assessment and curation tasks with a small footprint and 2) an enhanced facility with additional capabilities to enable expedited processing and the completion of time-sensitive and some sterilization-sensitive science. The investigation of these two end-members will enable the first down-selection of modality options as well as help weigh the final priorities for SRF requirements. The second phase, if necessary, will further refine the facility requirements, cost, schedule, and performance of the chosen modality(ies). Upon completion of the study, the chosen modality and refined requirements will be utilized for site-specific design.

Summary: Beginning in 2022, NASA Johnson Space Center is performing the MSAS to investigate the most optimal facility modality for the MSR SRF as well as start to define programmatic early estimate of costs and schedules before the initial design phase begins. NASA is partnering with industry contractors (architectural and engineering firms with BSL-4 and cleanroom technology experience as well as other contracted infrastructure and construction specialists) along with selected experts from NASA, ESA, existing U.S. BSL-4 facilities, and other U.S. government agencies to carry out the assessment study. The MSAS should also aid in the future refinement of the science requirements (e.g., contamination control, equipment accommodations) before site-specific design commences.

Supporting Documents:

R.L. Mattingly, A.L. Smith II, M.J. Calaway, A.D. Harrington (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>