FACILITY

MSRF (Preliminary Information)

Full Name	Materials Science Research Facility
Sponsoring Agency	NASA
Builder/Main Contractor	NASA/Marshall Space Flight Center

Contact Information

Project Manager	David A. Schaefer NASA/MSFC, MG 21 Huntsville, AL 35812 (256) 544 1996
Project Scientist	Dr. Frank R. Szofran NASA/MSFC, ES 75 Huntsville, AL 35812 (256) 544 7777

Facility Characteristics

Facility Type	The Materials Science Research Facility (MSRF) is a Modular facility comprising autonomous Materials Science Research Racks (MSRR) for research in the microgravity environment of the International Space Station (ISS). The facility will house materials processing furnaces and common subsystems and interfaces required to operate the furnaces. Each MSRR is a stand-alone autonomous rack and will be comprised of either on-orbit replaceable Experiment Modules, Module Inserts, investigation unique apparatus, and/or multiuser generic processing apparatus, and will support a wide variety of scientific investigations.
Targeted Research Fields	Accommodates investigations in basic materials research and applications in the fields of solidification of metals and alloys, thermo-physical properties, polymers, crystal growth studies of semiconductor materials, and research in ceramics and glasses.
Accommodation	ISS Standard Payload Rack (ISPR)

Launch Date	Beginning in September 2001 and planned for phased rack deployment through 2004 time frame
Status	The first MSRR (MSRR-1) is being developed collaboratively by NASA and the European Space Agency (ESA). Preliminary design activities are underway. Special studies are also being conducted to define the MSRR-2 and MSRR-3 configurations.

Summary

The MSRF Project is currently in the definition stage and the information provided herein is considered preliminary at this time.

The Materials Science Research Facility (MSRF) is designed to accommodate the planned and evolving cadre of peer-reviewed science investigations. The facility will provide the apparatus for satisfying near-term and long-range Materials Science Discipline goals and objectives to be accomplished in the microgravity environment of the U.S. Laboratory on the International Space Station (ISS).

MSFC will develop the Rack Subsystems and be responsible for rack integration for the Experiment Modules, NASA Module Inserts, and investigation unique apparatus in the MSRF racks. Commonality of components and modularity in design will be stressed wherever possible. replaceable Experiment Modules,

The initial MSRF concept is three Materials Science Research Racks (MSRR-1, MSRR-2, MSRR-3) which will developed for a phased deployment beginning on UF-3 in September, 2001. Concepts for the required Experiment Modules which satisfy the goals and objectives of the Materials Science program, are being developed. It is anticipated that the useful life of each rack will be from a minimum of five (5) to up to ten (10) years. The operational life of the Experiment Modules (EM) is planned for a minimum of five (5) years. The EMs will be designed to be serviceable and maintainable on orbit for their operational duration to satisfy the peer-selected scientific flight investigations. Flexibility is to be included in the design for ORU replacement of key components in order to extend useful life.

The Experiment Modules for each rack will be designed to be “smart” furnaces with the avionics packages designed to support each investigation. The Experiment Modules for MSRR-2 and MSRR-3 will be designed with optimum flexibility to support on-orbit maintenance and change out of key components.

Facility Performance Data

MSRR-1 System Description

One EM for the first MSRR (MSRR-1) planned for ISS is being developed collaboratively by NASA and the European Space Agency (ESA) and is currently scheduled for launch on UF-3 in late 2001. The NASA/ESA Experiment Module or ESA Materials Science Laboratory (MSL) with a Module Insert will be integrated into a International Standard Payload Rack (ISPR) which will be shared with a NASA Commercial payload. The MSL will accommodate various Module Inserts that will be built by both NASA and ESA for on-orbit changeout.

The NASA/ESA Experiment Module for the first Materials Science Research Rack (MSRR-1) is a multi-user, multi-purpose facility for accommodating Materials Science research in the United States Laboratory Module of the International Space Station (ISS). Experiment Module (furnace) Inserts with various heater types, which are replaceable on-orbit, can be accommodated in a sealed furnace chamber. The MSL Experiment Module is a “smart” furnace that will operate autonomously and can accommodate telescience operations for real time interaction during operation.

The MSRR-1 NASA/ESA accommodation is modular, consisting of an Experiment Module and exchangeable Module Inserts. The inserts will process the sample and will contain heating elements. The Module Inserts can be changed out on orbit. They are envisioned for Bridgman-type crystal growth, isothermal applications, and a variety of other experiments.

The Experiment Module will be integrated into a half-rack of an ISPR (the other half of the rack will be used by the Space Products Development Office Experiment Module) forming the MSRR-1 configuration. The NASA Experiment Module provided by SPD will subsequently be replaced on orbit with other NASA Materials Science research investigation apparatus.

The NASA/ESA Experiment Module is composed of all necessary experiment unique support systems and houses the various replaceable Module Inserts. The core facility contains the Module Inserts and includes all items directly interfacing with the scientific sample. These include the furnace core, adiabatic zone, hot and cold zones, translation system, sample support structure, vacuum chamber, electrical equipment, and the supporting electrical, mechanical, vacuum, water, and gas supply lines.

The temperatures and the axial temperature profiles required for sample processing are controlled by an assembly of furnace thermal zones and heat

extraction zones. The furnace canister is designed to operate with either a vacuum or an inert gas environment.

Additional features of the NASA/ESA Experiment Module support precise temperature stability and control, high resolution temperature resolution and measurement, furnace translation capability, mass spectrometer failure detection system, rotating magnetic field, current pulsing capability for sample interface demarcation, and shear cell motor drive capability. The Experiment Module will be designed for manual sample exchange.

General System Performance Capabilities (Module Insert Dependent)

(1) NASA Quench Module Insert

TBS

(1) NASA Diffusion Module Insert

TBS

Facility Resource Requirements

TBS