NASAfacts

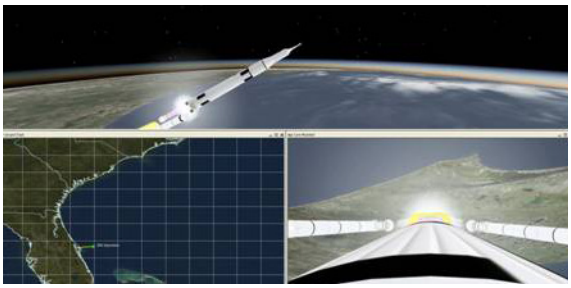
SLS System Integration Lab and Thrust Vector Control Test Lab at Marshall Center's Propulsion Research Laboratory

The MSFC System Integration Lab (SIL) supports development of NASA's Space Launch System — a new U.S. heavy-lift launch vehicle for NASA's next generation of human space exploration beyond low-Earth orbit. The SIL and the Thrust Vector Control Test Lab provide integrated test environments for the Space Launch System's flight software and avionics hardware. The avionics system is distributed across the entire SLS launch vehicle, including Core Stage, Boosters, and Core Stage Engines. The avionics system, along with the flight software, maintains control over the integrated launch vehicle throughout the entire SLS mission profile.

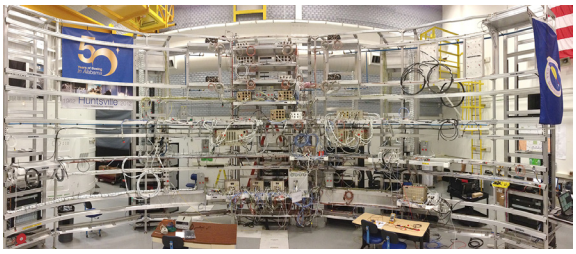
Core Stage Avionics development and interface/ integration testing currently underway in the System Integration Lab (SIL) Software Integration Testing Facility-Development (SITF-D). (NASA/MSFC)

SLS System Integration Lab Capability

The SLS SIL supports end-to-end integrated avionics and software integration, check-out, verification, and validation. This capability includes a Real-Time Environment for Modeling, Integration and Simulation (ARTEMIS) — a suite of models, simulations, and hardware interfaces used for simulating SLS avionics hardware and software. The Managed Automation Environment for Simulation, Test, and Real-Time Operations (MAESTRO) is an automation environment tool that configures and controls the test operations, sets up test configurations, executes and monitors tests scenarios, and provides data archiving for retrieval and analyses.



Using the ARTEMIS and MAESTRO tools, engineers in the System Integration Lab can create real-time launch vehicle simulations of the Space Launch System – NASA's new heavy-lift launch vehicle designed to take astronauts, cargo, and science experiments to destinations in deep space. (NASA/MSFC)



The SLS avionics hardware, software, and operating systems were integrated and powered up for an inaugural run at "First Light."

The lab design resulted from benchmarking state-of-the-art integration facilities, as well as teaming with industry experts in Real-Time Modeling and Simulation development of SIL facilities.

Key design features of the lab include:

- Real-time launch vehicle simulation of the Space Launch System
- Trajectory simulation that can track real-time, multiple-vehicle configurations and stages
- Rapid vehicle re-configurability including vehicle geometry, aerodynamics, Guidance, Navigation & Control (GN&C) algorithms and data, GN&C sensor location and types/ locations of flight control end effectors

- Modular lab design to provide a variety of simulation designs to meet the unique needs of each program and project
- Rapid integration of MatLab/Simulink tools

The SIL Lab has extensive capabilities to support all program/project phases. Early hardware/software integration and testing reduces risks and saves overall cost and schedule throughout a program/project life cycle. By performing early hardware/software integration, potential architecture and interface-related problems can be identified, and thus reduce associated risk as early in the design cycle as possible when problems are the least expensive to resolve while also improving the design and requirements.

Thrust Vector Control Test Lab Capability

The Thrust Vector Control Test Lab supports the development, certification and qualification testing of control mechanisms, primarily Thrust Vector Control (TVC) actuators and systems — electro-mechanical or electro-hydraulic mechanisms that vector the vehicle's propulsion system, guiding the vehicle during flight. For the SLS, the TVC facility houses flight-like TVC systems for development and qualification testing of the Core Stage and Boosters. This capability enables failure investigations and future software updates throughout the system life cycle.
The Thrust Vector Control Test Lab enables significant risk reduction, cost and schedule efficiency throughout a program/project life cycle by performing early integration and testing of engine hardware.

The Thrust Vector Control Test Lab houses flight-like TVC systems for development and qualification testing of the Core Stage and Boosters. (NASA/MSFC)

The lab also provides dynamic actuator testing with inertial simulators that simulate the nozzle forces acting on the TVC actuators to define the systems' dynamic characteristics. Static load benches, housed in the lab, apply a constant force to verify the static operating characteristics of the actuator. The static load benches can apply loads up to 100,000 pounds. The lab has supported testing of TVC systems for a wide range of propulsion systems, from MC-1 class engines providing 60,000 pounds of thrust, to solid rocket boosters providing 3 million pounds of thrust.

Battery modules and a 300-volt variable electric power supply provide power for electric actuators, while a variable-flow hydraulic power supply provides up to 3,500 psi hydraulic pressure and up to 500 gallons per minute flow to hydraulic components. The lab also provides control and data acquisition systems to send commands to the actuators and evaluate how the actuators perform.

The System Integration Lab and the Thrust Vector Control Test Lab can also be integrated together to develop and test multiple components of avionics and software to provide an even more comprehensive early integration to support programs and projects.

The lab has also supported the Space Shuttle Program's solid rocket boosters and space shuttle main engines, the J-2X engine, and commercial and military projects.

For more information on the Propulsion Research Laboratory, visit

http://www.nasa.gov/centers/marshall/pdf/143036main_prl.pdf

For more information on the Space Launch System, visit

http://www.nasa.gov/exploration/systems/sls/

National Aeronautics and Space Administration

George C. Marshall Space Flight Center
Huntsville, AL 35812
www.nasa.gov/marshall