Innovation at the Interface of Science and Engineering:

The Capability Advantage

SCIENCE • ENGINEERING • INNOVATION

SANDIA NATIONAL LABORATORIES

Microsystems Engineering for Strategic Applications (MESA)

MESA is the only facility in the world that combines silicon processing with fabrication of compound-semiconductor devices under one roof.

MESA Makes It Real

The Microsystems Engineering for Strategic Applications (MESA) Complex represents the essential facilities and equipment to design, develop, manufacture, integrate, and qualify microsystems for the nation's national security needs that cannot or should not be made in industry—either because the low volumes required for these applications are not profitable for the private sector or because of stringent security requirements for such high-consequence systems as nuclear warheads.

Microsystems extend the information processing of silicon integrated circuits to add functions such as sensing, actuation, and communication—all integrated within a single package. The MESA Complex integrates the numerous scientific, engineering, and computational disciplines necessary to produce functional, robust, integrated microsystems at the center of Sandia's investment in microsystems research, development, and prototyping activities. This suite of facilities encompasses approximately 400,000 square feet and includes cleanroom facilities, laboratories, and offices.

MESA Represents Sandia's Vision for the Future of Engineering

"As the last century ended, this Laboratory chose a path to a greater future. We chose to establish a unique, world-class facility that would enable the nation's security to have an anchor in unquestioned technological leadership—leadership in the synthesis of the unlimited potential of integrated microsystems, the awesome power of modeling and simulation through advanced supercomputing, and an engineering design environment where the nation's finest will be empowered and challenged and the best solutions for national security will be developed and realized." - *Thomas O. Hunter, Sandia President and Laboratories Director*

MESA Continues Sandia's Long Tradition of Delivering Custom National Security Hardware

Sandia Invention Enables Modern Microelectronics

Willis Whitfield

The Laminar Flow Clean Room was invented by Sandia's Willis Whitfield in 1962 for the assembly of precision mechanical components. It was then applied to the pharmaceutical industry to manufacture safer drugs and to medical industry to significantly lower infection rates in hospitals. The clean room was next adopted by the semiconductor industry to enable the highly complex chips that power our modern information society.

Sandia National Laboratories

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND 2007-6815P

NNSA National Nuclear Security Administration

10/2007

The Sole Supplier

Sandia has developed and delivered custom, radiation-hardened microelectronics to the nuclear stockpile and other national-security customers since 1975. Sandia-built integrated circuits have assured that our nuclear deterrence could not be defeated by hostile nuclear environments from potential adversaries while maintaining the safety, security, and use control of our nuclear stockpile.

Most recently, MESA is providing all the custom integrated circuits for the W76-1 stockpile life extension, including the Permafrost digital controller that forms the brains of the nuclear warhead. The U.S. Navy found that Sandia's MESA facility was the only possible supplier that could meet the demanding mission requirements for this strategic nuclear warhead.

Beyond its support for the nuclear stockpile, Sandia provides microelectronics and microsystems for satellite payloads that monitor the earth for non-proliferation activities, specifically the Global Nuclear Burst Detector that flies on Global Positioning Satellites (GPS).

Beyond Microelectronics: *Integrated Microsystems*

Following the events of 9-11-2001, MESA was called on to develop and deliver the key components for the PROTECT system, the nation's first permanent detection system for chemical attacks on public places such as airports and subway systems, including the San Francisco BART system and the Washington DC Metro system. Sandia's Micro-ChemLab technology continues to provides the basis for other chemical warning systems as SnifferStar, which flies on unmanned aerial vehicles. The same technology forms the basis for the MicroHound handheld chemical detection unit for first responders and which also sniffs for drugs to support law-enforcement officials.

MESA continues to pioneer new technologies. Within the past year, MESA provided the first fully space-qualified MicroElectroMechanical Systems (MEMS) to control the temperature of nanosatellites while functioning in the radiation of space.

Sandia has developed a chip-scale atomic clock with the goal of transforming atomic clocks from laboratory rack-mounted instruments to low-power, hand-held devices that could be carried by a soldier to enable jam-proof communication and precision navigation in GPS-denied environments.

Most recently, Sandia developed the first scalable approach to quantum computation through trapped ions to one day enable massively parallel computation on a single chip rather than through rooms full of complex computer equipment.

The benefits of MESA extend beyond mere hardware. As Tom Hunter's vision stated, a key aspect of MESA is to entice and invigorate some of the nation's best scientific and technical talent to apply their skills to the esoteric needs of national security. The partnership between DOE's Center for Integrated Nanotechnology (CINT) and MESA is a prototype for bringing leading-edge capabilities to the service of our nation's security.