NEW MEXICO: THE PERFECT ENVIRONMENT FOR ADVANCED MANUFACTURING

New Mexico Economic Development Department, State Data Center
May 2013

OVERVIEW

New Mexico is home to three national research facilities and three nationally-recognized research universities. The state is ranked first in non-industry investment in research and development and second in high-tech jobs, providing unparalleled capacity for research collaboration and technology commercialization in many areas that contribute to advanced manufacturing (*2010 State New Economy Index*). New Mexico has many companies utilizing technologies spun out of these institutions. Education and research opportunities at these facilities contribute graduates in many fields including engineering, optics, nanotechnologies, physics and manufacturing hardware and software development.

INCENTIVES

Consumables used in the manufacturing of a product are deductible from the gross receipts tax.

Investment Tax Credit for Manufacturers

(Investment Credit Act)

Manufacturers may take a credit against gross receipts, compensating or withholding taxes equal to 5.125% of the value of qualified equipment imported and put into use in a manufacturing plant in New Mexico, provided the manufacturer meets the criteria of hiring additional workers to earn the credit, as follows:

For Claims 1 new worker employed for each

0-$30,000,000:	$500,000 qualified equipment;
Over $30,000,000:	$1 million in qualified equipment.

The credit may (also) be claimed for equipment acquired under an industrial revenue bond. This is a double benefit because no gross receipts or compensating tax was paid on the purchase or importation of the equipment. The manufacturer simply reduces its tax payment to the state (by as much as 85% per reporting period) until the amount of investment credit is exhausted. There also are provisions for issuing a refund when the credit balance falls under $500,000. The credit does not apply against local gross receipts taxes.

High Wage Jobs Tax Credit

A taxpayer who is an eligible employer may apply for and receive a tax credit for each new high-wage economic-base job. The credit amount equals 10% of the wages and benefits paid for each new economic-base job created.

Qualified jobs:

- Pays at least $28,000/year in a community with a population of less than 40,000 for jobs created prior to June 30, 2015 or $40,000/year for jobs created after July 1, 2015

• Pays at least $40,000/year in a community with a population of 40,000 or for jobs created prior to June 30, 2015 or $60,000/year for jobs created on or after July 1, 2015• Occupied for at least 48 weeks by the employee

The new wage thresholds apply to jobs created on or before July 1, 2015. The lower thresholds apply to jobs created before July 1, 2015 for the duration of the four qualifying periods.

Qualified employers:

- Made more than 50% of its sales to persons outside New Mexico during the most recent 12 months of the employer's modified combined tax liability reporting periods ending prior to claiming this credit
- Are eligible for the Job Training Incentive Program
- Are growing with employment greater than the previous year

Qualified employers can take the credit for 4 years. The credit may only be claimed for up to one year after the end of the four qualifying periods. The credit can be applied to the state portion of the gross receipts tax, compensating tax and withholding tax. Any excess credit will be *refunded to the taxpayer*. The credit shall not exceed $12,000 per year, per job.

Qualified employees:

- Must be a resident of New Mexico
- Cannot be a relative of the employer or own more than 50% of the company

<u>Single Sales Factor</u>

Beginning January 1, 2014, New Mexico will begin phasing in a single sales factor apportionment methodology for corporations whose principal business activity is manufacturing.

For the purposes of apportioning income, "manufacturing" excludes construction, farming, power generation, and processing natural resources including hydrocarbons.

Five-Year Policy Changes:

Year	Apportionment
2014	Double-Weighted Sales
2015	Triple-Weighted Sales
2016	70% Sales
2017	80% Sales
2018	Single Sales Factor

COMPETITIVE ELECTRICITY AND NATURAL GAS PRICES

Abundant natural resources support very competitive natural gas and electric power costs. New Mexico is ranked tenth in total energy production. Natural gas production here accounts for close to one-tenth of the U. S. total. The San Juan Basin contains the nation's largest field of proved natural gas reserves.

Natural Gas Prices in Dollars per Thousand Cubic Feet			
Month of May 2012	Residential	Commercial	Industrial
New Mexico	10.33	6.25	4.44
Arizona	18.58	9.6	5.15
Colorado	10.37	8.48	6.46
Nevada	12.08	8.11	7.79
Oklahoma	17.95	12.65	NA
Texas	13.61	6.34	2.19
Utah	8.77	6.7	4.2
Average Retail Sales Price of Electricity (cents per Kilowatthour)			
Month of June 2012	Residential	Commercial	Industrial
New Mexico	11.06	8.86	5.7
Arizona	11.06	9.32	6.23
Colorado	11.01	9.04	6.77
Nevada	12.01	8.86	5.82
Oklahoma	9.46	7.2	5.13
Texas	11.19	8.39	5.67
Utah	9.63	7.98	5.46
Source: U. S. Energy Information Administration			
NA = Not available			

RESEARCH CAPACITY

Los Alamos National Laboratory (LANL)

LANL is a premier research and development institution with more than 9,000 employees and an annual budget of approximately $2.2 billion. LANL is managed by Los Alamos National Security, LLC which is comprised of four organizations: Bechtal National, University of California, BWX Technologies, and Washington Group International. Collaborative research is accomplished through LANL's institutional centers:

- Center for Bio-Security Science: threats to national security, public health and agriculture from natural emerging, and engineered infectious agents
- Center for Information Science and Technology: IS&T integration and support such as MaRIE and the new Bio-Security and Energy Security centers
- Center for Integrated Nanotechnologies (see below)
- Center for Nonlinear Studies: computational molecular biology, agent-based systems and modeling
- Energy Security Center: reliable, secure and sustainable carbon neutral energy solutions
- Institute for Complex Adaptive Matter/LANL: emergent or nonlinear behavior in materials science
- Institute for Geophysics and Planetary Physics: astrophysics, complex dynamic systems, solid earth geoscience, space physics
- Los Alamos Neutron Science Center: spallation neutron sources for research
- Lujan Neutron Scattering Center: employs pulsed spallation neutron source for neutron scattering studies of condensed-matter
- National High-Magnetic Field Laboratory: exotic, nonmagnetic materials for megabauss sensors
- Quantum Institute: quantum cryptography, quantum computing
- Seaborg Institute: plutonium and lighter actinide elements research
- Superconductivity Technology Center: electric power and electronic device applications of high-temperature superconductors

LANL collaborates with private industry on a daily basis toward the enhancement of advanced manufacturing technologies. Corporate partners include Chevron, Boeing, Procter & Gamble (P&G) and Westinghouse.

Under a Cooperative Research and Development Agreement (CRADA), LANL and P&G have collaborated for two decades, incorporating computational technologies developed for national security into cutting-edge tools for advanced manufacturing. Los Alamos researchers and P&G engineers enlisted computer codes developed to model the flow, transport, and interaction of fluids and particles to help design a more efficient diaper manufacturing process.

The Laboratory's Technology Transfer Division (LTTD) helps move technologies from the Lab to the marketplace to benefit society and the U.S. economy. This is accomplished by ensuring that Laboratory inventions receive intellectual property protection, which enables LANL to license Los Alamos technologies to industry and start-up companies. LTTD manages Lab-industry research partnerships and serves as the Laboratory's resource on industry relations.

Technology Transfer and Commercialization Examples:
Los Alamos-based Acoustic Cytometry was formed in 2006 with technology licensed from Los Alamos National Laboratory. The company developed a method to use sound waves to guide cells through cytometers, or cell meters, to allow researchers to closely examine tissue samples for medical diagnostics.

Elemetric Instruments, formerly Advanced Realtime Technologies, is a Lab spinoff that licensed an air particulate monitoring technology to detect toxic elements such as beryllium. In total, Elemetric was awarded $150,000 in commercialization grants from the Center for Commercialization of Advanced Technology, a public-private collaborative partnership between academia, industry, and government. This funding will allow Elemetric to complete its first portable, analytical, continuous real-time monitor and demonstrate the technology to interested government agencies and customers in private industry. The company is driven by the desire to address environmental, industrial hygiene, and occupational safety issues. http://www.lanl.gov/

Sandia National Laboratories (SNL)

Sandia National Laboratories is a government-owned/contractor operator facility managed by Sandia Corporation, a division of Lockheed Martin. SNL has six specific mission areas, one of which is Science, Technology, and Engineering (STE). The STE strategy is to create, integrate, and apply capabilities within six research foundations:

- Bioscience: investigates cellular and biomolecular processes and phenomena, including work in membrane science, materials synthesis, protein engineering, and state-of-the-art cellular imaging
- Computers and Information Science: R & D in high-performance computing and algorithms
- Engineering Sciences: computational and experimental work across a full spectrum of engineering mechanics disciplines including thermal, fluids, aerosciences, solid mechanics, and structural dynamics
- Materials Science and Technology: provides national leadership in materials sciences including the Center for Integrated Nanotechnologies, or CINT
- Microelectronics and Microsystems: home to MESA, the world's only fabrication facility that combines silicon processing with fabrication of compound semiconductors under one roof

- Pulsed Power: focuses on creating, diagnosing, and modeling intense, submicrosecond repetitive pulses of X-rays and energetic beams for a wide variety of applications with Z-machine and other capabilities

Engineering Sciences

The mission of Engineering Sciences is to provide validated, science-based, engineering solutions across the product life cycle to meet the mission needs of SNL. Engineering Sciences develops foundational knowledge in the areas of:

- thermal transport
- fluid mechanics
- aero-sciences
- solid mechanics
- structural dynamics
- material mechanics
- electromagnetics, and
- electrical sciences.

Engineering Sciences leverages foundational knowledge in material sciences, nano-sciences, and micro-sciences developed within SNL.

SNL Materials Science and Engineering Center

This Center provides the knowledge of materials structure, properties, and performance and the processes to produce, transform, and analyze materials to ensure mission success for SNL customers and partners, both internal and external to the laboratories.

Materials Science & Engineering Capabilities	
Electronic and Optical Materials	Materials Reliability Analysis
Thin Films and Coatings	Polymer Performance and Aging
Nanostructured Materials	Polymer Synthesis, Processing & Characterization
Ceramic Synthesis and Processing	Process Diagnostics and Control
Catalysis and Reaction Processes	Spray Coating
Data Acquisition & Instrument Control	Welding and Brazing
Surface Cleaning and Processing	Materials Characterization
Corrosion	Failure Analysis

SNL Manufacturing Science and Technology Center (MST)

MST develops and applies advanced manufacturing processes for realization of products in support of Sandia's primary mission of ensuring that the nation's nuclear weapons stockpile is safe, secure, and reliable. Components for the stockpile are typically complex electro-mechanical or electronic parts designed to withstand harsh environments with high reliability. The Center focuses on enhancing manufacturing capabilities in four key areas:

- Manufacturing of engineering hardware
- Emergency and specialized production of weapon components
- Development of robust manufacturing processes
- Design and fabrication of unique production equipment

Manufacturing Science & Technology Center Technologies	
Adhesive Bonding	Materials Characterization
Ceramic Chemistry	Mechanical Measurements & Calibration
Ceramic Processing	Mechanical Testing
Composites	Meso-Machining
Dielectric Characterization	Model Based Manufacturing
Electro Microfluide Dual Inline Package	Molding, Thermoforming, & Compounding
Electronic Fabrication	Plating and Lithography
Electronic Packaging	Quality Assurance & Testing
Encapsulation	Rapid Prototyping
Glass Melting & Sealing	Sol-Gel Glasses
Ion Beam Manufacture	Thin Films
Joining & Heat-Treating	Vacuum Engineering
Magnetics Laboratory	Vacuum Processes
Manufacturing Liaison	Welding, Fabrication & Metal Forming
Manufacturing Information Integration & Infrastructure	

Research at MST includes R & D to develop processes required for the manufacture of specialized materials and components that can no longer be obtained in the commercial market.

Within Sandia, most manufacturing R & D is carried out by the Manufacturing Science & Technology Center, the Materials and Process Sciences Center, the Integrated Manufacturing Systems Center and the Intelligent Systems and Robotics Center. Much of the R & D involves cooperative programs among these Centers. Examples:

- The Advanced Machine Processes for Microfabrication is a three-year R & D project with an objective to fabricate subminiature parts with non-planar surfaces from engineering materials such as steels, kovar, plastics, and ceramics. Focused ion beam and ion accelerators are being used to produce micron-sized features and tools in a variety of metals. An excimer laser is being investigated as a means to fabricate micron-sized features in ceramics, magnetic materials, and polymers.
- A solution-derived ferroelectric ceramic is being developed for use as a compact electrical power source. This unique “chem prep” process gives greater compositional and microstructure control and, thus, a more predictable output when compared to the traditional mixed oxide, powder process. This effort was initiated to secure a supply of material which is now unavailable.

One example of a cooperative R & D agreement (CRADA) with industry is the Laser Engineered Net Shaping (LENS™). This technology development effort was an outgrowth of a previous CRADA. This effort uses computer-controlled lasers that, in hours, weld air-blown streams of metallic powders into custom parts and manufacturing molds. The companies are teaming with Sandia to bring this technology to market in a two-year effort.

Organizations within MSTC fall under Manufacturing Enterprise and Manufacturing Process Science & Technology.

SNL Manufacturing Enterprise is comprised of approximately 125 tradespersons and support personnel performing the following services:

1. Machining:

- Heavy Machining — Machines with capacity of 50,000 pounds and 84 inches long
- Project Machining — Machining services and project management
- Rapid Turnaround — Rapid response to manufacturing needs
- Miniature Machining — Microscopic machining
- Composite Machining, Grinding, & Polishing — Machining of non-metals
- Explosive Processes — Explosives machining by remotely operated equipment

2. Manufacturing Liaison:

The electronic and mechanical liaison group works with inside shops and over 2,000 outside suppliers.

3. Welding, Fabrication, & Assembly:

Onsite or remote welding, assembly and repair

4. Precision Metal Forming:

Aircraft quality sheet metal fabrication

5. Heat Treatment:

Hardening, normalizing, annealing

6. Machine Repair:

Preventative maintenance and repair of machine shop equipment

7. Abrasives:

Grinding and lapping of materials

8. Mechanical Measurements:

In-process and final dimensional measurements of components

9. Calibration:

Length, mass, force, and dimensional reference standards

SNL Electronic Fabrication provides solutions for the packaging design, production acceptable prototype fabrication, or deliverable production fabrication.

Capabilities:

- Final electronic product packaging from sketches and verbal instructions
- Provide CAD drawing package after project completion if no formal prints are available
- Complete system development and fabrication through concurrent engineering
- Concurrent engineering in prototype and production fabrication
- Integrate commercial equipment into prototype system design
- Implementation and modification of commercial equipment
- Packaging of prototype into finalized product assembly

Within Manufacturing Process Science and Technology there are four specific business areas:

1. The Thin Film, Vacuum, and Packaging Technologies organization offers expertise in a variety of materials processes with a mission to work with partners requiring thin film engineering, vacuum system design and fabrication, brazing, as well as electronic module manufacturing and packaging technologies. The team has extensive experience with coating processes, including sputter deposition, electron beam evaporation and electroplating, routinely depositing over 25 elements as well as numerous compounds and expertise in vacuum system design and manufacturing. This includes engineering new and existing vacuum systems, instrumentation and processing tools. Components can also be prepared (cleaned) for use in a vacuum. The joining team can advance electronics and other manufacturing processes by performing special brazing and diffusion bonding operations. The electronic microcircuit and packaging effort provides an important resource for engineering a variety of microelectronic circuit assemblies. From layout to fabrication of prototype samples, we offer opportunities for concurrent development and testing of these assemblies. An important aspect of these efforts is assisting partners in selecting an appropriate manufacturing technology.

2. The Organic Materials Department in the Advanced Manufacturing and Processing Laboratory provides innovative prototype fabrication, full service small lot production, materials technology, processing expertise, and a broad range of organic material characterization and mechanical testing techniques. This department can encapsulate, join and bond, foam, analyze and image, and build composite structures. The team partners with businesses to find the right combination of materials, processing, and fixturing that will result in the highest value for the lowest price.

3. The Ceramics and Glass Processing Department at Sandia National Laboratories provides a broad range of processing options for many types and compositions of prototype ceramic, glass, and glass-ceramic components. Capabilities range from chemical synthesis of powders and glasses, through powder processing, billet formation and machining, to complete component fabrication and testing.

4. The Meso Manufacturing and Systems Development team offers comprehensive meso manufacturing services and direct engineering support for industrial application. Recent projects include novel femtosecond laser milling and turning of energetic material microstructures, diamond turning of complex optics, and µEDM of multi-axial flexures.

SNL Microsystems and Engineering Sciences Applications (MESA)

The MESA Complex is designed to integrate the numerous scientific disciplines necessary to produce functional, robust, integrated microsystems and represents 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.
www.sandia.gov

Center for Integrated Nanotechnologies (CINT)

CINT is a collaboration of Los Alamos and Sandia National Laboratories. The vision of CINT is to provide the Scientific Basis for Integration of Nanoscale Materials and for Enhanced Performance. Integration is the key to exploiting the novel properties of nanoscale materials and subsequently creating new nanotechnologies to benefit society. Hence, the CINT scientific community is built around nanomaterials

integration. The scientific staff and capabilities at CINT are organized into four interdisciplinary Science Thrusts:

- Nanoscale Electronics & Mechanics - Control of electronic transport and wave functions, and mechanical coupling and properties using nanomaterials and integrated structures
- Nanophotonics & Optical Nanomaterials - Synthesis, excitation and energy transformations of optically active nanomaterials and collective or emergent electromagnetic phenomena (plasmonics, metamaterials, photonic lattices)
- Soft, Biological & Composite Nanomaterials - Solution-based materials synthesis and assembly of soft, composite and artificial bio-mimetic nanosystems
- Theory & Simulation of Nanoscale Phenomena - Assembly, interfacial interactions, and emergent properties of nanoscale systems, including their electronic, magnetic, and optical properties

CINT capabilities are provided to users through the CINT scientists and other technical contacts. Capabilities for nanoscience integration research:

- Computer Cluster
- Near-IR fluorescence imaging and spectroscopy
- Multi-Photon Laser Scanning Confocal and Fluorescence Lifetime Imaging Microscope
- IR Variable angle spectral ellipsometer
- AFM Imaging
- High-Resolution X-Ray Diffraction System
- Atomic Layer Deposition System
- DC Sputtering/Thermal Evaporation System
- Low-Pressure Chemical Vapor Deposition
- Ultrafast Laser System for Rapid Prototyping
- Graphene Reactor

<u>Core & Gateway Facilities</u>

The CINT user community can access research capabilities in the Core Facility at Sandia National Laboratories and the Gateway Facility at LANL. Together, these facilities provide laboratory and office space for researchers to synthesize and characterize nanostructured materials, theoretically model and simulate their performance, and integrate nanoscale materials into larger-scale systems in a flexible, clean-room environment.

- Materials Synthesis: Molecular beam epitaxy; physical and chemical vapor deposition; pulsed laser deposition; inorganic, organic and polymer synthesis; nanoparticles and nanowires; thin film deposition; membranes and monolayers; mesoporous materials; biomaterial synthesis and biomolecular recognition
- Characterization: Scanning probe microscopies; electron microscopies; optical spectroscopy and microscopy; single molecule spectroscopy; ultrafast laser spectroscopies; nano/micro-mechanics; raman microscopy; terahertz spectroscopy; transport
- Nano-Micro Integration: Optical and electron beam lithography; soft nanolithography; focused ion beam; etching and deposition
- Theory and Simulation: atomistic theory; predictive capability development; interpretation and design of experiments; multi-scale material modeling; and large scale computing
- Discovery Platforms™: Modular, micro-laboratories designed and batch fabricated expressly for the purpose of integrating nano and micro length scales and for studying the physical and chemical properties of nanoscale materials and devices

The 130, 000 square foot CINT Core Facility at Sandia National Laboratories features low vibration for sensitive characterization, chemical and biological synthesis labs, a clean room for device integration, interaction areas and conference rooms, visitor office space, and high-speed communications.

The CINT Gateway Facility, located at Los Alamos National Laboratory in the center of the Materials Science Complex, brings together materials science and bioscience capabilities. The 36,500 square foot laboratory and office building, features approximately 11,000 square feet of laboratory space for chemical and biological synthesis and characterization, biomaterials fabrication and characterization, optical microcopy and spectroscopy, physical synthesis, thin film fabrication, spatially resolved scanned probe characterization, advanced computation, and visualization. http://cint.lanl.gov/

New Mexico State University (NMSU)

Manufacturing Technology and Engineering Center (M-TEC)

M-TEC is a research and public service project providing engineering assistance for the state through Engineering New Mexico and the College of Engineering at NMSU. M-TEC supports economic development by providing technical assistance, outreach, training and engineering services throughout the state. M-TEC has expertise in engineering, manufacturing, product development, prototype and other related areas and uses these resources and facilities located in the College of Engineering to assist business and individuals. A business or individual seeking technical assistance can apply online to access the service. M-TEC works with new businesses, individuals and existing organizations that are seeking to start or expand a business.

Expertise and Engineering:

Design and Engineering

- Product development
- Solid modeling
- Mechanical machinery design
- Electrical machinery design
- Automation and controls
- Test and evaluation
- Finite Element Analysis (FEA)
- Hardware/Software interface
- Manufacturing process solutions
- Database design and implementation

Manufacturing and Prototyping

- Machining
- Welding
- Fabrication
- Bench Models
- Prototypes
- Mock-ups
- Quality assurance

The manufacturing lab at M-TEC houses an extensive machining shop including large 4 axis CNC mills. This lab is also equipped with a small foundry along with fabrication and sheet metal equipment.

M-TEC's mechanization's lab is used to design and build custom automation and control systems for M-TEC projects. The lab is equipped with PLC Controllers, Microcontrollers, Digital Signal Processing and Printed Circuit Board (PCB) design equipment. Custom PCB's are also populated in this lab.

The Electro-Mechanical Controls lab is set up as an instructional lab to teach industrial controls and automation. The lab consists of multiple computer workstations interfaced with programmable logic controllers along with robotic arms and other pneumatic and stepper motor controlled devices.

The QA lab contains measurement and inspection equipment that is used for quality control, statistic process control and ISO 9000 standards, along with surface measurement and non-destructive testing capabilities. http://mtec.nmsu.edu/

New Mexico Tech (NMT)

MicroElectronics Testing and Technology Obsolescence Program (METTOP)

METTOP Microelectronics Semiconductor Testing and Design Center is a research and training division of NMT. METTOP provides cost-effective means to manage issues of diminishing manufacturing sources and material shortages. METTOP's mission is to test, evaluate and assess the wide range of microelectronic components that comprises so many of today's sophisticated military, space and commercial systems. These resources include a Credence® Sapphire S system with a 768+ pin capacity. This mixed signal test system is capable of testing advanced integrated circuit technologies at speeds of up to 1.6 GHz per pin.

The Sapphire system with engineering support is available on an hourly basis for customer tests (prototype verification, failure analysis, design validation). Other test systems with engineering support are also available to interested customers.

Electronic Test Equipment: Mainframe Testers

- Credence® Sapphire Mainframe High Speed ATE Tester
- Teradyne® Mixed Signal Tester #A575/A585
- Credence® Personal KALOS II Memory Tester #PK

Benchtop/Lab Test Equipment

- Acterna® Communications Signals Analyzer #FB-8000
- Agilent Technologies® Arbitrary Waveform Generator #33250A, Precision Semiconductor Parameter Analyzer #4156C, and Universal Test Fixture #16442B
- BK Precision® Digital IC Tester #575
- Keithley® 2400 Series SourceMeters, and Picoammeters
- Quick Circuit® #QC-7000 Printed Circuit Board Milling System
- Remstar®/Megastar® Microelectronics Storage
- Tektronix® Arbitrary Waveform Generator #AWG710B, Data Timing Generator #DTG5274, Digital Oscilloscopes #3054B and #3052B, Digital Sampling Oscilloscope #TDS8200, High Power Curve Tracer #371B, Logic Analyzer #TLA721, and Programmable Curve Tracer #370B
- Temptronic® ThermoSpot® #TP27D-1, and ThermoStream® #TP04310A-3C44-4
- Miscellaneous power supplies, fixtures, chambers, and lab equipment

Current Research Activities:

- Lead (Pb) Free Research and Testing
- Component and Circuit Card Assembly MIL-STD-883 Thermal Testing
- Microelectronics Prognostics Advanced Failure Notification and Analysis
- Radiation Effects on Microelectronics Survivability and Vulnerability Assessments
- Methods of Mitigation of Radiation Effects on Microelectronic Circuits
- Radiation Emission Microscopy Techniques for Advanced Failure Analysis of Microcircuits
- Hardware Anti-Tamper Research Development Test and Engineering
- Microelectronics Security: Counterfeit and Trojan Microcircuits Detection
- RF Devices Testing

- METHOD 1019 Ionizing Radiation (TOTAL DOSE) Testing including
    1. Accelerated aging test for estimating low dose rate ionizing radiation effects on devices
    2. Time-dependent and Annealing Effects Testing

http://mettop.emrtc.nmt.edu/aboutus.php

University of New Mexico (UNM)

UNM Manufacturing Training and Technology Center (MTTC)

The 57,000 square foot Manufacturing Training and Technology Center supports teaching and training, research and development, start-up companies and manufacturing prototyping, and extension service activities. The MTTC houses offices, labs, classrooms, prototyping bays, CAD rooms, an auditorium, a café, and a 6,200 square foot cleanroom. The MEP has computers, robot hardware and control software, CAD/CAM packages, factory simulators, dynamic systems modeling software, and extensive semiconductor processing equipment.

Located at the Manufacturing Technology and Training Center (MTTC), a few blocks south of the University of New Mexico's main campus, the UNM Artificial Muscle Microgripper Lab is a state of the art facility that researches artificial muscle microgrippers made from Ionic Polymer Metal Composites (IPMC). The activities in the research lab are focused on the design and improvement of microgrippers made from Ionic Polymer Metal Composites (IPMC) artificial muscle. IPMC are a type of electroactive polymer that bend in response to electrical stimulation. They are produced in sheets that resemble gold foil in appearance but are flexible and resilient like rubber. They can be cut to virtually any dimension and have the ability to operate in the wet or dry condition. IPMC are closely related to Teflon, so they are chemically inert and can withstand high and low temperatures. Lightweight, mechanically simple, and silent, they make excellent microgrippers. http://www-mep.unm.edu/mttc.php

The research component of the UNM Manufacturing Engineering Program includes a DOE University research program in robotics. UNM has been developing a cycle-time reduction system for cleanup and remediation of hazardous waste sites, as well as for advanced manufacturing and forensics needs, with DOE. The system is called the Robotics and Automation Design-and-Drive System, or RADDS. The goal of RADDS is to reduce the amount of time between a site-defined need and a site-delivered turnkey implementation of the robotic and/or automation hardware that solves the problem.
http://www-mep.unm.edu/

The University of New Mexico Nanoscience and Microsystems program bridges the distinct properties of the nanoscale to microsystem functionality. The integrated academic and research activities highlight our capabilities and unique breadth in materials synthesis and self-assembly, nanolithography, interrogative platforms, and functional micro/macrosystems. Special emphasis is placed on translating these technologies to radical changes in the way we diagnose, treat and ultimately prevent cancer. The Nanoscience and Microsystems Program highlights three technical thrusts: Informational Nanotechnology, Nano-Bio Interfaces and Complex Functional Systems. The program requires that Nanoscience and Microsystems fellows complete a curriculum of integrated courses.

The UNM Center for Micro-Engineered Materials (UNM CMEM) Industry/University Cooperative Research Center program serves as a focal point for materials science research and education at UNM. The research performed by CMEM faculty is highly leveraged because of close collaboration with research scientists from SNL, LANL and CINT. The Center owns or has access to state-of-the-art facilities to synthesize and characterize a broad range of materials including a one-of-a-kind Small-Angle X-ray Scattering Center. CMEM serves as a focal point for material science research and education at UNM

and it manages the UNM site of the UNM/Rutgers Ceramic and Composite Materials Center, a National Science Foundation Industry-University Cooperative Research Center.

Nanoscience at UNM is a user-friendly facility providing rapid access to state-of-the-art equipment for academia and industry to enable nanoscience research. Areas of expertise include:

- Nanoscale interferometric lithography
- Self-assembly of nanocomposite soft/hard materials
- Nanoscale catalysis, and nano-geo-bio-chemistry.
- Epitaxial growth of self-assembled quantum nanostructures (quantum dots)
- Field-emitter tips
- Photonic crystal lasers
- Nanomechanics
- Fiber sensors, molecular electronics, and nanomagnetics
- Synthesis and characterization of nanophase catalytic material
- Mesoporous natural materials and their potential for environmental remediation
- Geomicrobiology and biogeochemistry
- Interactions of microbes and minerals in extreme biological environments
- Mineralogy and geochemistry of low temperature nanophase materials
- Volcanic aerosols
- Early solar system processes involving nanophase materials

http://nnin.unm.edu/

The New Mexico Center for Particle Physics (NMCPP) exists to promote cooperative program(s) in the general research areas of particle physics and particle astrophysics within UNM and with neighboring institutions in New Mexico. Additionally, the NMCPP web pages provide an opportunity to bring these research programs to the attention of prospective undergraduate and graduate students. The NMCPP conducts research in the following areas:

- High Energy/Elementary Particle Physics
- Medium Energy Physics
- Nuclear/Particle Theory
- Particle Astrophysics

http://nmcpp.phys.unm.edu/

UNM's Center for High Technology Materials (CHTM) is a nationally recognized center for photonics and microelectronics research. Over 80% of CHTM's annual research budget of approximately $7M is funded by external research contracts. This strong funding record has allowed CHTM to furnish its facilities with modern equipment and to maintain a focus on leading-edge research topics that are relevant to government and industry.

CHTM offers high quality and advanced research capabilities, where, for example, a novel semiconductor device can be designed, fabricated and evaluated completely in-house (see vertical integration below). Several spin-off businesses have grown from research projects at CHTM.

Vertical Integration is a key to CHTM's strong research capability. To create a useful semiconductor device a clear understanding of device theory is necessary. CHTM faculty are experienced in the theory and practice of a wide range of photonics and microelectronics devices and have access to powerful computing power when required for device simulation. The structure of modern semiconductor devices

can comprise literally hundreds of individual layers that must be grown with a tight tolerance. CHTM boasts 2 MOCVD reactors and 5 MBE systems for the materials growth of advanced epitaxial semiconductor structures. CHTM's cleanroom offers a full range of process equipment for the fabrication of advanced semiconductor devices. Characterization provides critical feedback at all stages of fabrication and CHTM laboratories are extremely well equipped with electrical and optical test equipment for the evaluation of materials, devices and systems. http://www.chtm.unm.edu/index.html

UNM's Optical Science & Engineering (OSE) Program conducts research in many areas that impact advanced manufacturing, including advanced materials; atomic optics; biomedical optics; fiber optics; laser cooling; laser physics; lithography; nano-photonics; nonlinear optics; optics education; optical imaging; optical sensors; optoelectronics; photonic integrated circuits; quantum optics; spectroscopy; and ultrafast phenomena. Pioneering research has originated from the program in areas ranging from the quantum theory of lasers to ultrashort pulse physics to optoelectronic devices, to cite only a few examples. The research facilities are located in the Department of Physics and Astronomy, the Department of Electrical and Computer Engineering, and at UNM's Center for High-Technology Materials. www.optics.unm.edu/

WORKFORCE DEVELOPMENT

Job Training Incentive Program (JTIP)

JTIP funds three types of customized training for newly-created jobs:

- Custom classroom training at a public education institution
- Structured on-the-job training (OJT)
- A combination of the two

Reimbursable expenses include 50 to 75 percent of the trainee's wages for up to six months and/or the cost of custom classroom training.

INDUSTRY PRESENCE

Intel

Rio Rancho

Intel has had a major manufacturing presence in Rio Rancho since 1980. Intel New Mexico employees manufacture and test technology products for mobile, desktop, server and workstation computing at the Fab 11X manufacturing complex. Fab 11X includes 400,000-square-feet of clean room space, making it the largest clean room operated by Intel globally, and one of the largest in the world.

Originally opened in 2002, Fab 11X was Intel's first 300mm high-volume manufacturing factory to produce 90 nanometer (nm) chips. In 2007 Intel upgraded the facility to produce 45nm chips, and made a second multi-billion dollar investment in 2010 to upgrade the facility to produce Intel's next generation, 32nm chip technology. www.intel.com

Sagebrush Technology, Inc.

Albuquerque

Sagebrush designs and manufacturers computer controlled, precision motion control devices ('gimbals') that enable the effective and efficient utilization of detectors, cameras, lasers, optics, radars, telescopes, antennas and other sensors. Sagebrush products are used in diverse applications worldwide in the defense, communications, surveillance, marine navigation and medical equipment industries. www.sagebrushtech.com

Ethicon Endo-Surgery (EES)
Albuquerque
EES, a subsidiary of Johnson & Johnson, is a company that designs and manufactures medical devices and surgical instruments with the intent of minimizing the invasiveness of surgery. Product categories include breast care, surgical stapling and endoscopic surgery.
www.ees.com/

STAR Cryoelectronics
Santa Fe
STAR Cryoelectronics develops, manufactures and markets ultra-sensitive Superconducting Quantum Interference Device (SQUID) sensors and advanced PC-based SQUID control electronics products. The ultra-sensitive SQUID sensors available from STAR Cryoelectronics are based on Low-Temperature Superconductor (LTC) and High-Temperature Superconductor (HTS) technologies. STAR provides an extensive range of standard and custom SQUID sensors and packaging options available for applications in biomedical imaging, non-destructive testing of materials, geophysical exploration, and basic research.
http://www.starcryo.com/

Compass Components, Inc. (CCI)
Deming
Established in 1979, Compass provides engineering, manufacturing, and distribution services to customers throughout the United States. Compass Southwest Operations is a 90,000 square foot facility that produces cables and harnesses, and electro-mechanical assemblies. CCI's manufacturing services include same day quick turn prototypes; dual sourced manufacturing; JIT/KanBan delivery programs; 100% electrical test and inspection; stocking programs; material stocking programs; ultrasonic welding; and hot stamp wire marking.
http://www.ccicms.com/