AMES LABORATORY

IOWA STATE UNIVERSITY

Ames, Iowa 50011

*Ames Laboratory* **Institutional Plan** *December 2002* **2003-2007**

# Institutional Plan

# AMES LABORATORY

## 2003-2007

*December 2002*

# Contents

Director's Statement ........ 1

Mission and Roles ........ 3
- Mission ........ 3
- Roles ........ 3
- Core Competencies ........ 4
- Research Programs ........ 4
- Research ........ 5
  - Administrative Services & New Initiatives ........ 5
  - Applied Mathematics & Computational Sciences . 5
  - Chemical & Biological Sciences ........ 6
  - Condensed Matter Physics ........ 7
  - Environmental & Protection Sciences ........ 11
  - Materials Chemistry ........ 12
  - Metal & Ceramic Sciences ........ 13
  - Nondestructive Evaluation ........ 18
- Interlaboratory Interactions ........ 19
- Laboratory Directed Research & Development (LDRD) ........ 19

Scientific and Technical Vision & Strategic Plan ........ 21
- Situation Analysis ........ 21
- Vision ........ 22
- Research Goals and Strategies ........ 23

Summary of Major New Program Initiatives .. 25
- Forensic Sciences ........ 25
- Catalysis Center ........ 26
- Hydrogen Generation and New Materials ... 28
- Multi-phase Flow ........ 29
- Biorenewable Resources Consortium ........ 30
- Biochemical Characterization & Instrumentation ........ 31
- Photonic Band Gap Materials ........ 33
- Magnetic Molecules ........ 34
- Bioinspired Polymer Nanoassemblies ........ 35

Operations & Infrastructure Strategic Plan..... 37
- Operations Strategic Plan ........ 37
- Environment, Safety and Health ........ 39
- Communication and Trust ........ 42
- Management Practices ........ 44
  - Human Capital ........ 44
  - Site, Facilities & Infrastructure Management ...... 48
  - Security, Intelligence & Nonproliferation ........ 56
  - Contract Administration ........ 58
  - Performance-based Management ........ 59
  - Budget, Finance and Resources ........ 59
  - Property Management ........ 60
  - Work for Others ........ 61
  - User Facilities ........ 62

Resource Projections ........ 65

Appendix 1 (Strategic Facilities Plan updates) . 73

# Director's Statement

**Divider illustration:**
The front facade of the Laboratory's Technical and Administrative Services Building (TASF).

# Director's Statement

In many important and positive ways little has changed from the past year in the Ames Laboratory, which continues to provide the Department of Energy with the highest quality research for the lowest possible cost. The Lab's ability to perform with unique efficiency is due to a variety of factors, but the major one is its genuine partnership with its contractor, Iowa State University. In this partnership remarkable cost efficiencies are achieved by sharing. This sharing includes facilities, utilities and personnel. This cost efficiency is not done with accompanying diminution of the quality of the science as is amply demonstrated by the numerous awards which continue to be won by our scientists and the praise routinely received by the Lab from external and agency reviews.

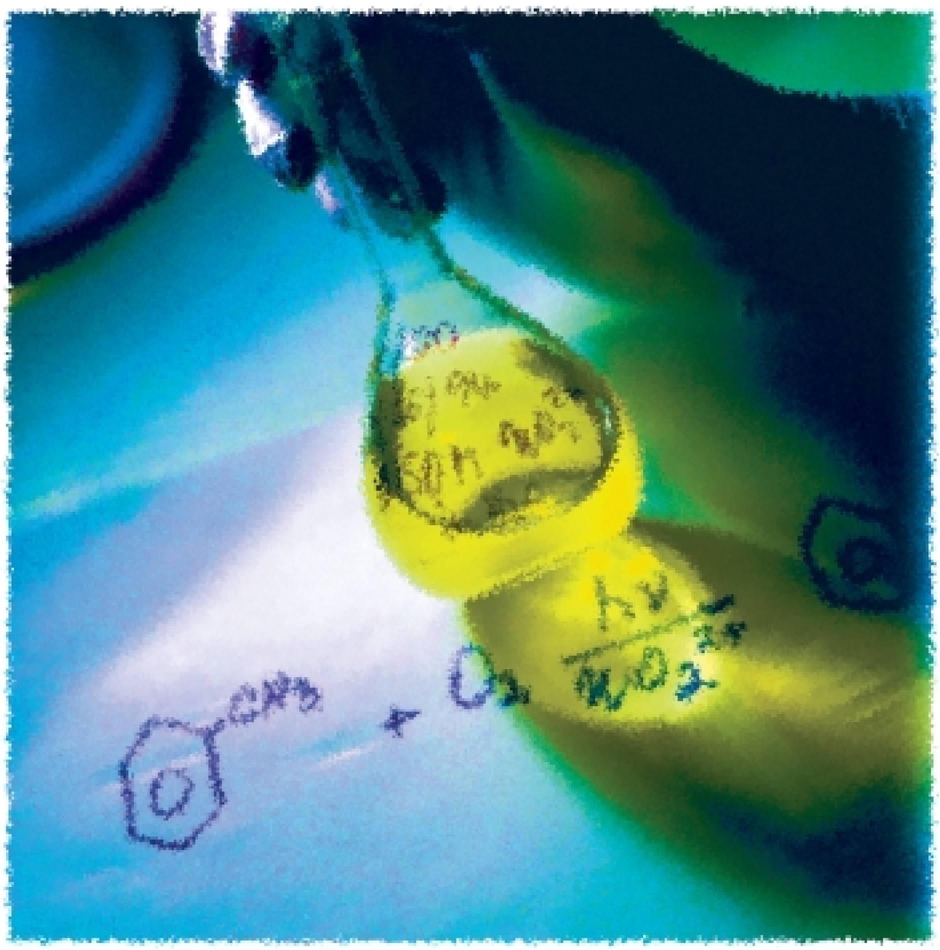
However the Lab cannot rest on its laurels to ensure an enhanced future and indeed this year we have instituted a number of new initiatives including a broad-spectrum program in forensic science and a comprehensive program in biorenewables to dramatically increase the value of agricultural products. The Lab is also exploring ways to combine its renowned strengths in the physical sciences with the powerful programs that exist in the plant sciences at ISU. I am confident that this letter next year will announce at least one major initiative in this arena in addition to at least one major new lab-wide interdisciplinary initiative in the material sciences.

Over the past few years we have worked hard to revamp the organization, leadership and to some degree scientific focus of two of our major research programs in response to changes in direction and focus within the agency. We are very pleased with the results of these extensive programmatic renovations and are confident that we will be able to translate these changes into even higher scientific achievements via multidimensional scientific teams appropriate for a national laboratory.

Every member of the Ames Laboratory, past and present, with whom I have ever spoken has possessed a deep pride in being a part of an institution that has served our nation so well and so long. There is no question that the current mix of scientific staff and support personnel in the Ames Lab has the talent, the vision and the determination to continue that tradition into the foreseeable future.

Tom Barton,
Director

# Laboratory Mission and Roles



**Divider illustration:**

Excited uranium serves as a photosensitizer, absorbing visible light to drive the partial oxidation of saturated hydrocarbons. These types of reactions may one day lead to new chemicals that can be converted into plastics and other kinds of materials.

# Mission and Roles

## Mission

The Laboratory's mission is to conduct fundamental research in the physical, chemical, materials, mathematical sciences and engineering which underlie energy generating, conversion, transmission and storage technologies, environmental improvement, and other technical areas essential to national needs. These efforts will be maintained so as to contribute to the achievement of the Department of Energy's Missions and Goals; more specifically, to increase the general levels of scientific knowledge and capabilities, to prepare engineering and physical sciences students for future scientific endeavors, and to initiate nascent technologies and practical applications arising from our basic scientific programs.

The Laboratory will approach all its operations with the safety and health of all workers as a constant objective and with genuine concern for the environment. Ames Laboratory does not conduct classified research.

The organization that ultimately became the Ames Laboratory in 1947, originated as a part of the Office of Scientific Research and Development in the early days of the atomic energy program. Initial work at Ames involved the development of a process for the production of uranium metal in large quantities. Ames Laboratory now pursues much broader priorities in addition to the materials research that has given the Laboratory international recognition.

## Roles

Ames Laboratory is one of the twelve Program-Dedicated Laboratories within the DOE Complex. It's primary role within DOE's Office of Science, Basic Energy Sciences mission is to perform research within the materials, chemical and biological sciences "in order to expand the scientific foundations for new and improved energy technologies and for understanding and mitigating the environmental impacts of energy use." [1] To this end, the Laboratory's main goal is to deliver the scientific knowledge and discoveries in the basic energy sciences that underpin DOE missions in energy, national security and environmental quality, as well as technologies to improve human health and safety.

[1] FY2003 OMB Budget Submission - Basic Energy Sciences (BES), Version 3, DOE to OMB 11/1.

Extrapolating from its long-standing and significant strengths in new and advanced materials, the Laboratory will continue to extend its capabilities in a variety of new directions where it has a competitive advantage. Leading this new thrust will be the somewhat more applied but critically important programs in biochemical characterization, biorenewable resources and forensic science instrumentation and application.

Results of its research programs and the resulting technological developments will be made available to the broadest possible spectrum of domestic industrial and private sector recipients through a variety of technology transfer mechanisms and external interactions. This will be done to stimulate local, regional and national economic development through the commercialization of new technologies based on the scientific accomplishments of the Laboratory. Our technology transfer program will be aided by joint efforts with Iowa State University's technology development and commercialization enterprise and will make a concerted effort to implement Work for Others (WFO) projects, Cooperative Research and Development Agreements (CRADA), technical assistances and scientific personnel exchanges with our various customers.

The Laboratory will also continue to make a major contribution to the training of new scientific and engineering professionals, for both academia and industry, by appointing graduate students and postdoctoral associates to positions having direct involvement in the research programs. We recognize that these scientists will join and eventually become leaders in a culture emphasizing environment, safety and health issues. Thus, an obligation of the Laboratory is to have all employees incorporate Integrated Safety Management (ISM) into their daily routines.

Ames Laboratory is ideally situated on the campus of a major research university and will continue to work with the College of Education at Iowa State University on programs benefiting pre-college math and science students. In all of our science education programs, emphasis and concerted efforts will be given to the provision of opportunities for women and members of minority groups. This effort would be considerably enhanced by funding.

## Core Competencies

The Laboratory will rely upon its strengths in materials synthesis and processing, chemical analysis, chemical sciences, photosynthesis, materials sciences, applied mathematical sciences, and environmental and protection sciences, to conduct the long-term basic and intermediate-range applied research needed to solve the complex problems encountered in energy production, utilization and efficiency, national security needs, human health and safety, and environmental restoration and waste management.

## Research Programs

Ames Laboratory's scientific component is organized into 7 research programs:

- Applied Mathematics and Computational Sciences
- Chemical and Biological Sciences
- Materials Chemistry
- Condensed Matter Physics
- Environmental and Protection Sciences
- Metal and Ceramic Sciences
- Nondestructive Evaluation

In addition to the above scientific programs, the Materials Preparation Center (MPC), a DOE User Facility sponsored by the Materials Sciences Branch of the Division of Basic Energy Sciences, is recognized throughout the international research community for its unique capabilities in the preparation, purification, and characterization of rare-earth, alkaline-earth, and refractory metal materials for preparing ultra high-purity and well-characterized metals, alloys, compounds, and single crystals. The MPC continues to make these materials available to other DOE Laboratories, to other agencies, to universities, and to the private sector. Additional information on the MPC can be found in the subsection entitled "User Facilities."

## Research

The following paragraphs give a brief overview of the Laboratory's research Programs and their current research thrusts.

### Administrative Services & New Initiatives

The Administrative Services/New Initiatives (ASNI) program serves two purposes. First, it is the home of Ames Laboratory activities that require technical expertise but are not themselves research programs. Specifically, technical management tasks performed by Ames Laboratory personnel for DOE are administered in this program. This is not now, nor will be in the future, a major focus of Ames Laboratory, which has research as its primary mission. However, the Laboratory does want to make its technical expertise available to DOE for technical management in areas where it is especially qualified to contribute.

The second purpose the ASNI program serves is as home for research activities that are fundamentally new to the Laboratory. Of course, new lines of research and novel projects are being continually developed within the specialty areas of each of the Ames Laboratory programs. However, there are areas of national need where the Ames Laboratory has not traditionally worked but has expertise and resources to contribute to the solution of important problems. These often fall within the scope of the DOE mission, but they sometimes involve another customer agency. For example, one such area is in biorenewable energy and products. The Ames Laboratory is in the process of developing a program here through a collaboration with Iowa State University. As a land-grant university with a strong tradition in agricultural research, ISU has much to contribute to this partnership. While it is being established, this effort has its home in the ASNI program. If and when it is fully established, a new program within the Laboratory will be created. Other activities that have their start in ASNI will be transferred to existing Ames Laboratory programs once they are established. For example, our new program in forensics began in ASNI, but it subsequently has been transferred to our Environmental and Protection Sciences program. Several of the new initiatives discussed in this report, such as the multiphase flow project, are intended to open up new directions for the Ames Laboratory and in their present nascent stage are being administered in ANSI.

### Applied Mathematics and Computational Sciences

Scalable Computing Laboratory (KJ-01-01)

The Scalable Computing Laboratory (SCL) focuses on high performance computing with attention to its rapidly changing nature. "Scalable" means not just parallel processing, but also the fact that usage environments, prices and expectations change, and the underlying technology of the hardware changes at rates not seen in other areas of science. In contrast to efforts aimed at "make machine X solve problem Y and get performance Z," the SCL looks at the broader problem of how to make a range of machines solve a range of problems with a range of performance tradeoffs, so that the computational research that is done has lasting scientific value. We undertake research that does not rely on legacy software and existing habits, in the hope of more quickly discovering and exploiting computational breakthroughs.

Of vital importance is the awareness that the complexity of modeling a scientific problem should be centered on the problem itself, and not the implementation of the model. To this end the "scalability" of a given machine is determined not only by how many processors can be added, or how fast the communication fabric runs, but also by how well the holistic design lends itself to programming formalisms that promote code longevity and portability.

The ability to provide a production computing environment with the capability to also afford a robust application development environment on cluster based supercomputers requires a wide range of tools and software infrastructure that is far from complete. Although the research community has made great strides in many areas, the entire infrastructure still has weaknesses that necessitate further research and development. Also, applications must adapt to this changing environment and often coerce changes across the full gamut of the software infrastructure. This effort will also focus on a subset of tools, libraries, and components of the software infrastructure applicable to many applications. In general, computational chemistry and physics codes will be used as a medium to test new and existing software algorithms and workstation clusters; this will provide the general framework for improving application scalability.

In addition, by testing new and existing software algorithms on parallel workstation clusters, we can improve the scalability of scientific applications on workstation clusters.

Current key research areas include the development of new method for hardware and software inter-connects, the development of more efficient and robust approaches to message passing and resource management, and the development of new methods for handling huge data sets in a parallel environment.

## Chemical & Biological Sciences

The Chemical and Biological Sciences Program focuses on research spanning fundamental and applied projects relevant to the mission of the DOE. Specific projects are:

### Photochemistry & Photobiology (KC-03-01-01)

The goal is to provide a fundamental understanding of the variety of processes that are basic to solar energy conversion in biological systems, with application to the development of new solar energy technologies. Energy-transfer processes in the light-harvesting structures of plants are examined with fluorescence spectroscopy and hole-burning spectroscopy. Chromophoric polymers are studied to explore mechanisms of efficient electronic energy transport and capture in solar energy conversion.

### Chemical Physics (KC-03-01-02)

Theoretical and experimental investigations are focused on the structure, bonding, reaction mechanisms and dynamics of chemically reactive systems in terms of their fundamental atomic, molecular, and electronic constituents. Theoretical efforts provide the energetics and reaction pathways governing reactions between small molecules and transition metal atoms. Theoretical investigations also focus on the description and calculation of the structure and reactivity of highly unsaturated metal clusters. The goal is the understanding of heterogeneous catalytic systems. Experimental efforts complement the theoretical efforts by providing accurate thermochemical data for molecules and transient radicals.

Catalysis & Chemical Transformation (KC-03-02-01)

Fundamental studies are being carried out relating to selective oxidation, desulfurization, hydrogenation, and in particular, processes that remove or add a heteroatom. Catalysts are being designed, synthesized and modified with many studies of mechanisms, intermediates and active sites. Oxo-transfer and hydrogenation reactions are central to this activity, which is aided by the application of molecular compounds tethered to a catalyst surface. Application of solid-state NMR allows the definitive characterization of solid catalysts.

Separations & Analysis (KC-03-02-02)

New methodologies in analytical chemistry and separations science are being developed to address advances in heterogeneous and homogeneous catalysis, nanotechnology, biomimetic systems, environmentally-benign chemistry and toxic waste clean-up. Microenvironments on surfaces are being characterized for novel catalytic and separation schemes, including mapping surface heterogeneities and studying interactions at microstructures created by monolayers and porous polymers.

Biological Imaging (KP-14-02-01)

This project is concerned with the development of two new laser-based technologies for the study of biological insult from environmental chemical carcinogens at the cellular and sub-cellular levels. One of the two technologies, referred to as hole burning imaging (HBI), can be viewed as an optical analog of magnetic resonance imaging with several important attributes for cellular analysis, including high sensitivity and spatial resolution (~1 μm). HBI would be applicable to the diagnosis of any type of cancer since it does not depend on the nature of the initial insults that lead to the cancerous cell. The laser-based instrumentation is simple and relatively inexpensive. The second technology involves the marriage of laser-induced fluorescence spectroscopy with capillary electrophoresis for on-line structural analysis of oligo- and polynucleotide-carcinogen adducts. This technology can distinguish between different stereo-chemistries and conformations of a chemically defined base-metabolite adduct (external vs. base-stacked vs. quasi-intercalated) in sequence defined oligo- and polynucleotides. Its utilization in fundamental studies with sequence defined oligonucleotides is important for the construction of DNA-carcinogen adduct maps, the relationship between adduct and mutation maps, and in vivo studies of DNA repair.

## Condensed Matter Physics

The Condensed Matter Physics (CMP) Program conducts basic research focused on the synthesis, characterization, and modeling of new materials. New ideas and theories are pursued and new phenomena investigated. The work underpins the development and optimization of materials relevant for utilization in various energy technologies. The program includes 18 principal investigators, most of them having split faculty appointments with the Physics Department of Iowa State University. Eleven of them are Fellows of the American Physical Society. There are in addition 12 permanent scientific staff, 5 postdocs, 6 long term visitors, 30 graduate students, and 12 undergrads working in the program. While we describe the various individual components of the program below, it should be emphasized that a major strength of the Laboratory is the agility, honed over many years, in the self-assembly of interdisciplinary teams from the CMP, Materials Chemistry, and Metal and Ceramic

Sciences Programs. Such teams have made tremendous contributions to research in quasicrystals, surface phenomena, high Tc superconductivity, rare earth nickel borocarbides, and a host of other systems, some of which are highlighted below. CMP is funded under three different budget codes and described in separate sections below, although the science and teams of researchers knows no boundary. All reviews of the program in the last 20 years have been "outstanding".

There is a serious problem that has changed and in some ways weakened this program over the last 10 years. Although the peer reviews we receive continue to be "outstanding", the funding has been anything but. Every year there is a 2 to 4% decrease in the overall budget, which in the last two years has escalated to 6% and 8%. With salaries not shrinking, and the majority of expenses in salaries, there is a tremendous leveraging effect on the operations money needed to perform research. It is true that we are now encouraged to compete for new initiative money, and in years past we have won perhaps more than our statistical fair share (however, not in the last two years). This type of funding has changed the way we do business, but in fact it has made the whole social fabric among the groups more difficult. World class groups doing superb research are not necessarily interested in writing a proposal for a new initiative whose boundary conditions are some distance from the excellent work that they are already involved in full time. Such groups are condemned to see their budgets atrophy. After ten years, such groups have shed students, postdocs and are barely able to afford travel. As new initiative funding does arrive for other groups, it has a label attached so almost none of it goes to help excellent established groups.

Neutron and X-ray Scattering (KC-02-02-01)

Neutron scattering studies have been instrumental in elucidating the basic science of hundreds of new materials and crystals first developed at the Ames Laboratory. Historically, it was the study of rare earth magnetism that first initiated Ames to neutron scattering during the 1950's. In the 60's and 70's Ames Laboratory operated its own reactor and developed a strong on-site tradition in neutron scattering. With the closing of the reactor, instruments were moved to ORNL, where we established the first neutron scattering user group in the United States. Currently, our neutron scattering studies are mainly conducted at the High Flux Isotope Reactor (HFIR) at ORNL, although facilities at IPNS (Argonne), NIST, and in Europe are also utilized. Of particular importance is the HFIR-HB1-A triple axis spectrometer which was designed, constructed and now operated as a User Facility jointly by the Ames and ORNL neutron scattering groups. Dr. Jerel Zarestky is the Ames Laboratory scientist, permanently located at Oak Ridge, who oversees the maintenance, upgrades, and operation of the instrument, in addition to his involvement with scientific investigations. Costas Stassis is the senior scientist overseeing the neutron scattering effort, and David Vaknin is a principal investigator equally using neutron and x-ray scattering techniques.

Alan Goldman is the director of the Midwest University Collaborative Access Team (MUCAT) which has built and is operating an undulator beam line at the Advance Photon Source. A side station has recently been built with collaboration and financial support from Jülich Germany, and funding and construction has just started for an adjacent bending magnet beam line. Instrumentation for magnetic x-ray scattering is in place and several key experiments have already been performed. In collaboration with scientists within Metal and Ceramic Sciences, Alan Goldman has recently commissioned a unique powder defractometer furnace (temperatures up to 1600 C), which allows rapid (seconds) monitoring of structural changes in materials as some parameter (e.g. temperature) is varied. David Vaknin has recently commissioned a custom built liquid surface reflectometer at the MUCAT beamline, which he is using to characterize membrane structure and functionality. With this instrument he recently developed a new technique that provides detailed information about the position and distribution of specific ions at membranes by measuring intensities at and away from ion absorption edges. Studies of ions at such interfaces are important because ions at cell membrane surfaces impact the function and conformation of nearby molecules and play an important role in the inter- and intracellular transport and recognition processes.

Experimental Condensed Matter Physics (KC-02-02-02)

Magnetism, superconductivity, photonics, surfaces, transport, conducting polymers, and the synthesis of new materials are among the major topics explored with a diverse set of techniques. Besides a host of on-site facilities (see below) and the x-ray and neutron scattering facilities already mentioned, the CMP program maintains a high resolution photoemission instrument at Stoughton Wisconsin, where Ames Laboratory senior scientist, Cliff Olson (a fellow of the APS), looks after the equipment, performs experiments, and trains graduate students from Ames. A few of the major research projects are described below.

The Ames Lab group led by Kai Ming Ho and Costas Soukoulis has played a dominating role in developing the field of Photonic Band Gap (PBG) materials. In fact, their calculation showing that PBGs with diamond (or diamond-like) lattices have 3D band gaps kept the field from withering away at a time when there was considerable pessimism about the viability of PBGs in general. The field has since exploded, with over 500 groups worldwide having web pages on the topic. The basic idea is to design new dielectric structures with periodically modulated dielectric constants, thereby influencing the properties of photons in much the same way that semiconducting crystals influence the transport properties of electrons. There is an active experimental effort at the Lab and also a strong collaboration with Sandia National Laboratory where micron-sized structures can be fabricated to bring the wavelength of the manipulated light into the visible range. Others contributing to this effort include Alan Goldman (x-rays), David Lynch and Joe Shinar (optics), and Rana Biswas (enhanced antenna performance). Costa Soukoulis has also teamed up with a DOE funded experimental group from San Diego to study a new area of photonics called "Left Handed Materials", (LHM). LHM have negative values for both the dielectric constant and the magnetic permeability for a certain frequency range. Although not found in nature, such structures can be fabricated, and it is found that such basic properties as Snell's law and the Doppler shift are "reversed" in the medium. Powerful computational techniques have been developed for PBG research and are being used to design structures with unique properties. This is one of the two areas for which the Laboratory has submitted a proposal to the nano-science and technology initiative.

The other nano-science and technology initiative proposal was submitted on the topic of magnetic molecules. Recent advances in the synthesis of large molecules containing interacting magnetic ions and the ability to grow large single crystals of these molecular magnets has opened a new field of research, one that allows the exploration between microscopic, atomistic magnetism and the complex cooperative phenomena encountered in larger magnetic systems. Phenomena such as magnetic tunneling and quantum coherence have motivated major collaborative investigations by F. Borsa (NMR), R. Modler (ultra-low T), C. Stassis (inelastic neutron scattering), L. Miller (synthesis), D. Lynch (optics), A. Goldman (x-rays), P. Canfield (temperature and field dependent magnetization and specific heat), and M. Luban and B. Harmon (theory). This is an exciting new area in magnetism, with Ames Laboratory researchers in a commanding position in the United States, yet one that very much needs additional funding to remain competitive.

The interplay between superconductivity and magnetism was greatly advanced with the discovery and subsequent investigation of the $RNi_2B_2C$ family of magnetic superconductors. It is a wonderful example of what can be accomplished in a short time when materials synthesis, detailed measurements of physical properties, and theoretical expertise can be marshaled cooperatively and quickly (within months of their discovery). Nearly every group in the CMP ultimately contributed! A very similar effort was ignited by the discovery of superconductivity in $MgB_2$. In less than a month after the discovery in Japan, the Canfield group had measured the isotope effect, the physical properties, and had made wires. Three Physical Review Letters published in three weeks! A remarkable accomplishment which established Ames Laboratory as leaders in this exciting new area.

Theoretical Condensed Matter Physics (KC-02-02-03)

Theory and experiment are perhaps best classified as approaches to science. Simulation or computation is now regarded by many as a third approach, although it is perhaps better to think of computing as a remarkable enabling tool for both theory and experiment. All of the "theorists" at Ames Laboratory are deeply engaged with experimental groups, and certainly computers are essential to both. It is not unusual to have a graduate student split between theory and experiment, with his/her thesis containing extensive comparison between experimental and calculated results. Computing beyond ordinary PCs is also a big deal. ISU lays claim to the development of the first electronic digital computer, invented by John V. Attanasoff, a Physics professor motivated to help his students solve quantum mechanics problems in 1937-40. We are still following that tradition. In partnership with scientists in the Applied Mathematics program, a large number of cost effective "almost supercomputing" clusters have been built, and codes have been parallelized to run on them. For much larger supercomputing needs, the facilities at NERSC or at ORNL are utilized via a T3 line. Among the codes recently developed, tight binding molecular dynamics (Ho, Wang) has been adapted by a large number of groups worldwide. Its impact resulted in a Materials Science Award for Outstanding Sustained Research. Spin Dynamics (Antropov, Harmon) is more recent, but it too has been adapted by a number of groups and has been employed by collaborators at ORNL to win the Gordon Bell prize for the fastest application (sustained one TeraFLOPS). Codes to solve the full Maxwell's equations for photonic band gap materials (Ho, Soukoulis) were first developed in Ames in 1990, and the field has exploded a hundred-fold since.

Although also using computers, John Clem and Vladimir Kogan are more traditional, using strong analytical skills to elucidate aspects of type II superconductors. They have been particularly active with high temperature superconductors. Marshall Luban also combines keen analytical skills with computing, when going after exact solutions for the behavior of magnetic molecules. Likewise Costa Soukoulis uses analytical and numerical techniques in his studies of disordered systems (e.g., random lasers). Jörg Schmalian uses many body techniques to study correlated electron systems (e.g., the pseudogap in high temperature superconductors) and is studying defect induced inhomogeneities and glassiness in such systems. With the amazing increases in computational power and with the many successful applications, the field of computational materials science has grown enormously. Unfortunately it is not yet a fully developed community. Two years ago the Computational Materials Sciences Network (CMSN) was set up to support teams of researchers to come together across interdisciplinary and inter-institutional lines and work together on large and important problems. Ames has been the lead lab in coordinating CMSN. So far, five separate projects have been funded with about 15 to 20 scientists working in each.

## Environmental & Protection Sciences

The Environmental and Protection Sciences (EPSCI) Program focuses on providing applied analytical solutions to problems in security and environmental quality.

### National Security

A collaborative effort between Ames Laboratory and researchers at Lawrence Berkeley National Laboratory and Lawrence Livermore National Laboratory, funded by NA-22 involves the development of Laser Ablation – Inductively Coupled Plasma – Mass Spectrometry (LA-ICP-MS) instrumentation and methods for the direct analysis of materials related to nuclear proliferation. The project examines the process of laser ablation and methods for detecting and correcting for fractionation effects in the laser-sampling, material transfer, material vaporization, and ionization processes. We have developed analytical methodology and statistical methods for data examination that allow for standardless analyses of solid samples and the determination of material matching probabilities based on trace isotopic composition.

A project originally funded by NA-22 but now funded through a WFO by the FDA Center for Veterinary Medicine involves the development of a database of veterinary laboratories and experts who would be able to respond with analyses in the event of a terrorist attack on livestock. This project utilizes the veterinary expertise of the ISU College of Veterinary Medicine and the ISU Veterinary Diagnostics Laboratory to catalog information on a number of toxic agents and zoonotic diseases and on veterinary laboratories that may be used to diagnose an outbreak that would threaten our food supply and economic security.

The Midwest Forensics Resource Center is a cooperative effort of the Ames Laboratory and crime laboratories in a 9-state region (including WI, MN, ND, SD, NE, KS, MO, IL, and IA). The Center pools the needs of these laboratories and addresses them through a four-part program of work in Casework, Training, Research, and Education. Funding began this summer through an interagency agreement with the National Institute of Justice in its Crime Laboratory Improvement Program.

A project began this FY for the FBI involves the development of image-reduction and statistical tools for the comparison of toolmarks produced in hard metals (such as on a screw driver, pry bar, or blade) by various industrial machining methods. These data analysis methods will provide a statistical underpinning for forensic toolmark examiners to claim some level of uniqueness in a match between a tool and a scratch pattern found at a crime scene. These methods may be used to determine the probability of two tools being produced with indistinguishable surface patterns that could be transferred to a scratched surface.

Environmental Quality

A research project funded on a WFO contract for ORNL (as a subcontract for a SERDP project), involves the development of optimal sampling strategies for unexploded ordinance. During the decommissioning of military bases, an important step is the remediation of firing ranges or other places where munitions were used. In order to effectively direct those remediation efforts, efficient sampling strategies must be used. For this project, the Laboratory will develop optimal sampling strategies that are based on spatial statistical models.

**Materials Chemistry (KC-02-03)**

The Materials Chemistry Program at Ames Laboratory has a single overarching goal which is to synthesize and understand the principles governing the stabilities and properties of two classes of solid state materials: polymers and metal-rich inorganic compounds. In both classes, development of heretofore-unknown materials is emphasized. Within the class of metal-rich inorganic compounds, a specific goal is to understand the electronic and atomic structure of quasicrystals - metallic alloys with long-range positional order but without periodicity - both in the bulk and at the surface.

Research Highlights

Quasicrystals

This highly-interdisciplinary project, which involves personnel from all three of the Materials Sciences Programs, focuses on understanding the relationship between the atomic/electronic structure of quasicrystals* and their physical properties, particularly at surfaces and interfaces. However, we have also established world-class efforts in synthesis and sample preparation, powder processing and coating technology, magnetism, and bulk atomic and electronic structure. We are internationally recognized for our achievements/investigations in these areas.

One of our recent highlights has been to understand the initial stages of nucleation and growth during Al epitaxy on a fivefold quasicrystalline surface. The Al atoms (at room temperature) arrange into closed pentamers resembling starfish. This is illustrated by Figure 1. Because of our extensive background in structure determination of the clean surface, we were able to deduce the sites that the stars must occupy and, in turn, that information allowed us to deduce the steps by which the atoms arrange themselves into the starfish. It was truly a major piece of detective work. One of the exciting aspects of this work is that it may be the first glimpse into the mechanism by which a quasicrystal grows—a long-standing mystery! (While many elegant models exist for the arrangement of atoms, there is no good model to explain how they might fall into this quasiperiodic arrangement, since the intuitively-tractable rule of periodicity cannot be implemented.) This was the first

* Quasicrystals are metallic alloys that are well-ordered on an atomic scale, but the order does not result from periodicity, at least not from periodicity in dimensions up to three. Rather, the order results from a different type of rule, a rule that is commonly cast in terms of tilings such as the Penrose tiling. In conjunction with being aperiodic, these materials usually exhibit rotational symmetries that are forbidden for periodic materials. The most abundant symmetry among the known quasicrystals is icosahedral, which has distinctive and forbidden five-fold rotational axes. The next-most-abundant is decagonal, which has a distinctive and forbidden ten-fold rotational axis. About 200 different quasicrystalline compositions have been discovered to date, the majority of which contain 60 to 70 atomic percent of aluminum. Our surface work thus far has focused on the ternary, aluminum-rich icosahedral and decagonal alloys.

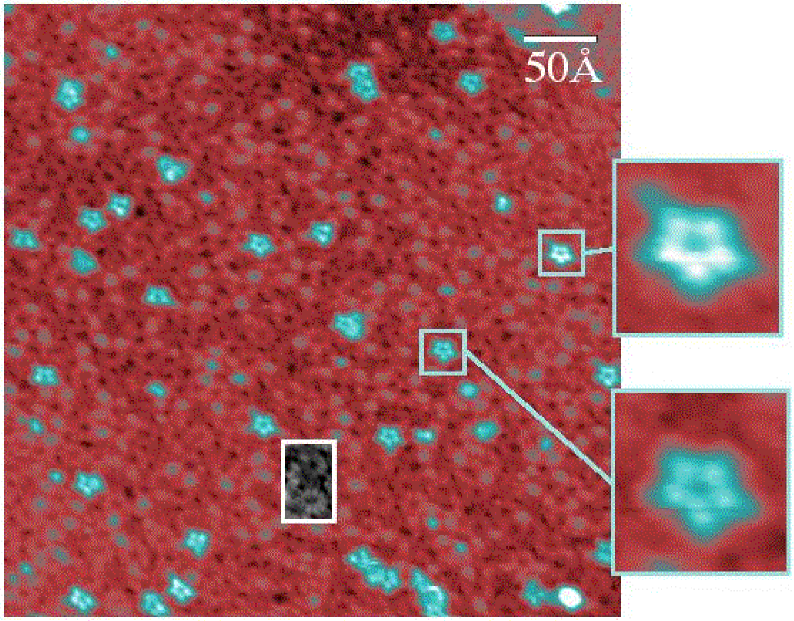



Figure 1. Scanning tunneling micrograph (450x450 $Å^2$) of the 5f Al-Cu-Fe surface, after deposition of 0.04 of a layer of Al. Blue areas represent deposited Al; red areas, the substrate. The rectangle with contents in gray is an image in different contrast, chosen to reveal the flower structure of the nascent substrate. The rectangles to the right of the main figure are expanded views of two selected starfish.

observation of the arrangement of extrinsic metal atoms on a quasicrystal surface; we feel we have opened up a whole new avenue of research with these data.

Polymers

The Materials Chemistry program at Ames Laboratory has developed a new class of polymers that is sensitive to the environment (pH and temperature) and can therefore act as sensors, or drug delivery or gene therapy devices.

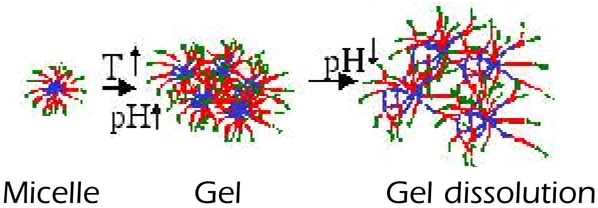
These new pentablock copolymers are synthesized by oxyanionic polymerization techniques and are composed of blocks of polyethylene oxide (PEO), polypropylene oxide (PPO), and polydiethylaminoethylmethacrylate (PDEAEM). Because of the unusually low critical solution temperature exhibited by PEO, and the cationic properties of PDEAEM, coupled with the hydrophilic/hydrophobic properties of the different blocks, these polymers have been tailored to exhibit unique phase behavior.

These new block copolymers are sensitive to both pH and temperature. They form nanoscale micelles in aqueous solutions, which then self-assemble further with increasing solution temperature and pH to form physical, macroscale reversible gels.

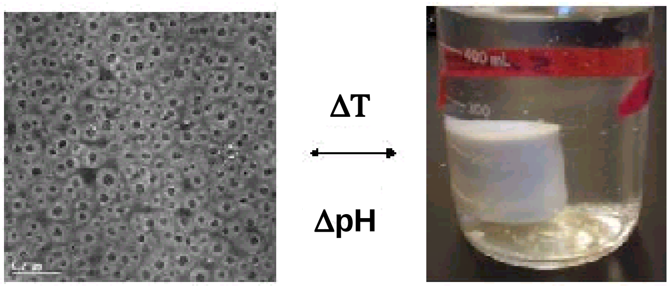
This is depicted in the Figure 2, where the different colors in the schematic on the left side represent different polymer blocks. The red lines represent PEO, blue lines represent PPO and green lines represent PDEAEM. As we increase temperature and concentration, the polymer chains form nanoscale micelles. These micelles are seen in the cryo-TEM image on the left (pH = 7.4, T = 25$^0$C). As the temperature and pH increase further, they form macroscale gels completely by self-assembly (pH = 8.5, T = 70$^0$C); in the photograph on the right. This self-assembled gel is a solid. However, the process is completely reversible and the self-assembled gel goes back into solution by lowering the pH and temperature. This process can be repeated many times.

## Metal & Ceramic Science (KC--02-01)

The Metal and Ceramic Sciences Program (formerly called Metallurgy and Ceramics) receives approximately 80% of its total budget (~ $6M for FY2002) from the Metal, Ceramic, and Engineering Sciences Program in the Materials Sciences and Engineering Division of the DOE's Office of Basic Energy Sciences (BES). The core research areas for which the Ames Labora-




Synthesis of novel pentablock copolymers based on PEO, PPO and PDEAEM.




Self-assembly of polymers into nanoscale micelles (left) in aqueous solutions and further macroscale self-assembly into thermoreversible gels (right).

Figure 2. Synthesis of Block copolymers with Unique Self-Assembly Properties.

tory Metal and Ceramic Sciences Program receives BES funding (KC0201) are: (1) Structure and Composition of Materials; (2) Mechanical Behavior and Radiation Effects; (3) Physical Behavior of Materials; and (4) Synthesis and Processing Science. As of the start of FY2003, an additional core research area from which funding is received, is Engineering Physics (KC-02-06). The remaining 20% of the Program's research budget is received from other offices within the DOE (~11%), industry (~7%), and other federal agencies (~2%).

Mission Relevance:

The research activities within the Metal and Ceramic Sciences Program all contribute in some manner to the DOE mission in all areas of national security, fossil energy, fusion energy, nuclear energy, transportation systems, industrial technologies, energy efficiency, and environmental management. These contributions stem in part from the basic precept that the properties and performance of all materials are critically dependent upon their structure and composition. To that end, an overarching theme of the research conducted within the Metal and Ceramic Sciences Program is to further understanding of the complex linkages between the synthesis, structure, properties and performance of novel and advanced materials.

Overview of Main Research Efforts:

The Metal and Ceramic Sciences Program is committed to conducting world-class research that seeks to further basic understanding of materials phenomena at reduced dimensionality and increasing levels of compositional, structural, and functional complexities. Central to this is the teaming of researchers, both within and outside of the Program, to infuse a truly integrated approach that couples experiment to theory through modeling and simulation. The program currently consists of the following four major areas of research focus:

- Magnetism – Aimed at understanding the interaction of competing energy contributions in determining critical magnetic phenomena.
- Science of Amorphous and Aperiodic Materials – Aimed at understanding (i) the correlation between short-range atomic order and the devitrification and deformation behavior in amorphous systems and (ii) the role of crystal chemistry (i.e., structure, bonding and lattice energies) in controlling the structural stability of aperiodic systems.
- Solidification Science – Aimed at understanding of the dynamic processes of nucleation, interface destabilization and morphological evolution in terms of the

fundamental response of crystal-melt interfaces to local conditions.

- Extraordinary Responsive Rare Earth Materials – Concerned with the unique magnetic-martensitic phase transformation in $R_5(Si_xGe_{1-x})_4$ materials, where R is Gd and other lanthanides, to achieve understanding of the underlying electronic structure and the microscopic interactions bringing about extremely strong couplings of the magnetic moments with the lattice.

A multi-researcher effort entitled, "Predicting Metallic Liquid Structures and the Associated Competition Between Crystallization and Vitrification During Cooling", commenced at the start of FY2003. This effort will strongly complement many of the studies being conducted in the "Science of Amorphous and Aperiodic Materials" and "Solidification Science" focus areas by establishing accurate fundamental descriptions of the short-range order, atomic motions and transport properties in selected metallic liquid and solid systems.

There are also a number of research efforts within the Program that are outside the scope of the main research areas. Examples of those research efforts include: "Mechanics and Mechanisms of Deformation and Microstructural Evolution", "ab initio Studies of Defect Structures and Phase Transformations", "Anomalously Ductile Intermetallic Compounds", and "Mechanochemistry of Ionic and Molecular Materials."

The Materials Preparation Center (MPC), which is managed by the Metal and Ceramic Sciences Program, enables fundamental research by providing users high-purity materials of tightly controlled chemistries that are not available from commercial suppliers. Users may also conduct a materials processing research activity funded by, and in collaboration with, the MPC through a recently established, BES sponsored Process Science Initiative (PSI).

Scientific Thrusts Within Main Areas of Research:

The scope of the main areas of BES research in the Metal and Ceramic Sciences Program are described in the following:

Magnetism: Research in this focus area is directed towards understanding the interplay between competing energy contributions in determining critical magnetic phenomena. Of particular interest are materials systems containing magnetic rare earths, transition metals, or both, where characteristic structural dimensions are on the order of the magnetic interaction lengths, or the energy difference between crystalline states is of the same order as the energy difference between magnetic states. Systematic experimental and theoretical studies are designed to formulate and validate a consistent predictive theory describing, and therefore enabling the control of magnetic phenomena at various length scales. The goal is to describe, understand and manipulate physical interactions propagating over spatial scales from atomistic to macroscopic and temporal scales that vary over several orders of magnitude. The experimental program is strongly linked to theory and modeling.

Technical Highlights:

- In a study of the anisotropy of the magnetocaloric effect of single crystal Dy, two new magnetic phases were discovered between 110 and 125 K in a magnetic field of 3 to 7 kOe and between 178 and 182 K in magnetic fields of 6 to 12 kOe.
- The fundamental relationships between the two characteristics of the magnetocaloric effect (i.e., the isothermal entropy change and the adiabatic temperature change) and the most basic thermodynamic property of solids (i.e., their heat capacity at constant pressure as a function of

temperature in constant magnetic field) have been derived theoretically and validated by comparing with experiment.

- Developed an extension to the magnetomechanical law of approach for describing and modeling magnetoelastic effects.
- A formalism has been developed to incorporate stress into the effective field as a perturbation to the anisotropy in order to allow micromagnetic modeling of stress dependent magnetization processes.

Science of Amorphous and Aperiodic Materials: The main goals of this focus area are to gain an increased fundamental understanding of (i) the correlation between short-range atomic order and the devitrification and deformation behavior in amorphous systems and (ii) the role of crystal chemistry (i.e., structure, bonding and lattice energies) in controlling the structural stability of aperiodic systems. Experimental synthesis techniques will be closely coupled with dynamic structural characterization methods, together with theoretical and computational studies, to examine the nature, specific atomic configurations and energetics associated with the devitrification of selected amorphous systems and the formation and stability of selected aperiodic systems. Numerical simulations to describe deformation within an amorphous system will also be developed to better elucidate the origin and transport of shear bands.

Technical Highlights:

- Structural determination of metastable crystalline devitrification phase from amorphous $Zr_{70}Pd_{20}Cu_{10}$.
- Discovery of expanded solubility of transition metals in $Zr_{70}Pd_{30}$ at high temperature.
- First report of synthesis-dependent formation of quasicrystals in amorphous $Zr_{70}Pd_{30}$ and $Zr_{70}Pd_{20}Cu_{10}$.
- Discovery of quasicrystalline formation in $Zr_{70}Pd_{20}Cu_{10}$ at 273 K under high strain deformation.
- Synthesis of largest (~0.75 $cm^3$) $Cd_{84}Yb_{16}$ phase-pure quasicrystalline single grain.
- Determination of basic atomic cluster structure in rare earth-Mg-Zn face-centered icosahedral quasicrystals.

Solidification Science: This focus area has the overall objective of understanding the dynamic processes of nucleation, interface destabilization and morphological evolution in terms of the fundamental response of crystal-melt interfaces to local conditions. Development of models and theories in this focus area will involve description of physical interactions that operate over spatial and temporal scales that vary over several orders of magnitude, from the microstructural scale ($10^{-6}$ – $10^{-3}$ m) down to the atomistic ($10^{-8}$ – $10^{-10}$ m). Thermodynamic and kinetic properties that ultimately govern the dynamics of morphological transitions, and which originate at the atomistic or even electronic level, will

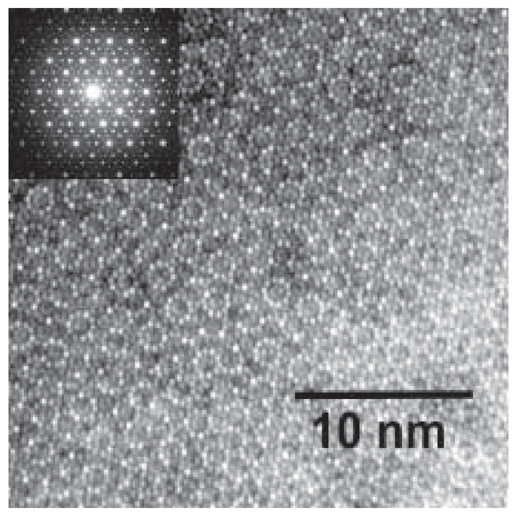



Figure 3. Transmission electron microscope (TEM) image and corresponding selected area diffraction pattern (SADP) showing the quasicrystalline structure of CdYb.

the atomistic or even electronic level, will be determined in order to achieve substantive theoretical advancement and the development of predictive capability.

Technical Highlights:

- First reported quantitative experimental measurement of anisotropy in the crystal-melt interfacial free energy in Al-Cu and Al-Si binary alloys.
- Theoretical prediction of anisotropy for the free energy of the crystal-melt interface for pure aluminum.
- Theoretical solution for the full equilibrium morphology of a grain boundary groove at a solid liquid interface with generally anisotropic interfacial free energy.
- Theoretical basis established for an oscillating interface approach to the measurement of interfacial mobility in pure metals and alloys.
- Utilization of the theoretical banding cycles in Sn-Cd and Pb-Bi for the experimental determination of nucleation undercoolings for the primary and "peritectic" phases. A nucleation map was developed for the two-phase system that identifies the experimental regimes for nucleation at (i) the S/L interface, (ii) the ampoule wall, or (iii) the interface-wall junction. (Figure 4.)

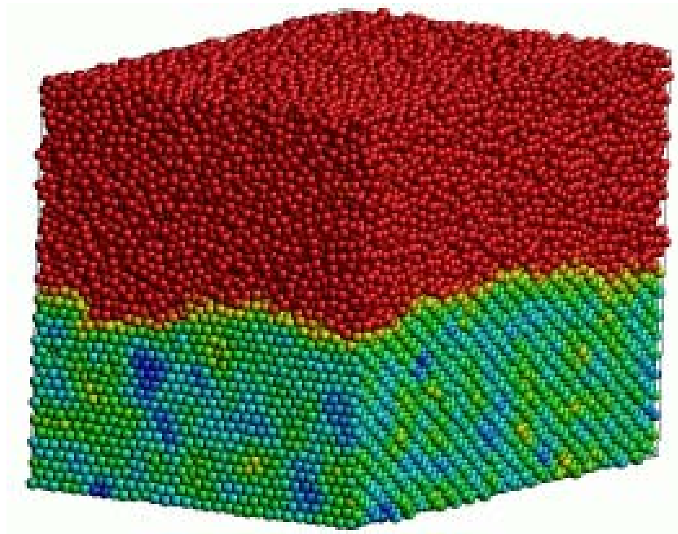


Figure 4. Molecular dynamics simulation of coexisting solid and liquid phases for understanding the anisotropic properties of solid-liquid interfaces.

<u>Extraordinary Responsive Magnetic Rare Earth Materials:</u> Research is directed towards analytical and systematic experimental studies of the unique magnetic-martensitic phase transformation in $R_5(Si_xGe_{1-x})_4$ materials, where R is Gd and other lanthanides, to achieve understanding of the underlying electronic structure and the microscopic interactions bringing about extremely strong coupling of the magnetic moments with the lattice. Another goal is the development and validation of models of the magnetic-martensitic transformation, which will allow for the design of novel material systems exhibiting extremely large responses to small changes of magnetic field, temperature and pressure.

Technical Highlights:

- In-situ X-ray diffraction of $Gd_5(Si_xGe_{1-x})_4$ for xH”0.5 showed that the low temperature martensitic transformation is rapid, complete and fully reversible when it is coupled with the ferromagnetic ordering-disordering process on cooling-heating. A second, high temperature martensitic phase change was discovered between ~500 and 700 K on heating, and it is sluggish, incomplete and irreversible in the paramagnetic state, even though the crystallographic phase change appears to be the same as for the low temperature phase transition.
- Syntheses of a number of R-Si-Ge (R = lanthanide) single-crystal compounds were accomplished to investigate the processing-structure-property relationships of these materials.

$Gd_5Si_4$ and $Gd_5Ge_4$ showed that the interslab Si-Si or Ge-Ge interactions exhibit strong antibonding character near the Fermi level in the $Gd_5Si_4$-type structure. Furthermore, differences in orbital energies reveal that Ge-Ge bonds are "weaker" than Si-Si bonds in these structures and will "break" at lower temperatures, which is consistent with the transition temperatures observed for the $Gd_5(Si_xGe_{1-x})_4$ series.

- The electronic properties of ferromagnetic orthorhombic and paramagnetic monoclinic phases of $Gd_5(Si_2Ge_2)$ were calculated using tight-binding linear-muffin-tin-orbital (TB-LMTO) method with combine-correction contribution.
- Exchange coupling calculations were used to obtain the effective Heisenberg Model parameters. The free energy as a function of temperature was calculated in the mean-field approximation in both phases. The phase transition calculated in this approximation is a first order magneto-structural transformation with a large value of $|\partial M/\partial T|$, thus explaining the giant magnetocaloric effect.

*Interactions:*

The research staff in the Metals and Ceramic Sciences Program (as well as other programs at Ames Laboratory) are active participants in many of the basic science projects in the distributed Center of Excellence for Synthesis and Processing of Advanced Materials (CSP) and the Computational Materials Science Network (CMSN), two major collaborative research efforts supported by the Materials Sciences and Engineering Division of BES. Funding for CSP and CMSN projects is generally referred to as glue funding (typically less than $20K per year per investigator), since it serves primarily to promote collaborations via travel and attending meetings. The research staff also maintains strong interactions with other DOE laboratories, especially the Advanced Photon Source (APS) at Argonne National Laboratory, and with numerous national and international universities and research institutes. The extensive number of multi-authored publications by the researchers in the Program is testimony to the vitality of many of these interactions.

*Materials Synthesis and Processing:*

An important and unique feature of the Ames Laboratory is its Materials Preparation Center (MPC), which is managed by the Metal and Ceramic Sciences Program. The MPC is a user facility that is primarily dedicated to the preparation, purification, and characterization of metallic materials. Established in 1981, the MPC consolidates and makes available to scientists in university, industry, and government facilities the synthesis and processing capabilities developed at Ames Laboratory during the course of its extensive involvement with basic materials research. The MPC enables fundamental research by providing users, on a full cost recovery basis, high-purity materials of tightly controlled chemistries that are not available from commercial suppliers. Users may also conduct a materials processing research activity funded by, and in collaboration with, the MPC through a recently established, BES sponsored Process Science Initiative (PSI). More details on the PSI can be found in this booklet in the section entitled "Materials Preparation Center" and at the MPC's web site www.mpc.ameslab.gov.

## Non-Destructive Evaluation

The Non-Destructive Evaluation Program at Ames Laboratory is at the forefront of research efforts to develop in-service flaw detection techniques for forecasting lifetimes under varied service conditions. Scientists in this program are working with government and industry to meet world needs for reliability in manufacturing materials and structures. Research initiatives include the development of the Magnescope, a device that measures a material's magnetic properties to assess damage and potential for failure from destructive mechanisms such as fatigue and corrosion, and a device called Ultraform that uses ultrasonic waves to predict a metal's ability to be stretched and formed into complex shapes. The Ultraform technology could mean a decrease in both waste and downtime for auto and beverage can industries.

## Interlaboratory Interactions

Ames effectively partners with researchers at other DOE Laboratories and Facilities. A sampling of these interactions include:

- The Materials Preparation Center prepares high-purity metals for many of the other DOE Laboratories (see sections entitled "User Facilities" and "Resource Projections.")
- Ames Laboratory researchers in the Applied Mathematics Program are collaborating members of three large interlaboratory SciDAC projects for high performance computing software development.
- Scientists at the Ames Laboratory are members of several interlaboratory research projects supported by the DOE/MS Center for Synthesis and Processing and by the Computational Materials Sciences Network (CMSN). (http://cmpweb.ameslab.gov/ccms/)
- Research on photonic band gaps with Sandia National Laboratory. (http://www.public.iastate.edu/~cmpexp/groups/ho/pbg.html)
- Construction and instrumentation of undulator and bending magnet beamlines at the APS (Advance Photon Source) at Argonne in collaboration with about ten midwest university groups. (http://epics.aps.anl.gov/welcome.html)
- Surface structure determination using electron diffraction of quasicrystals in collaboration with scientists from Lawrence Berkeley National Laboratory. (http://www.quasi.iastate.edu/)
- Scientists in Ames Laboratory's Environmental and Protection Sciences Program are participating in a collaboration with LBNL and LLNL to improve the practice of laser ablation sampling for mass spectrometric analyses of nuclear nonproliferation samples.

## Laboratory Directed Research & Development (LDRD)

The LDRD program at the Ames Laboratory is structured and administered so as to provide critical intial operating and capital support for promising new and highly innovative ideas in the areas of research activity embraced by the Laboratory's and the Department's missions. Although LDRD-funded projects may (and in many cases will) become candidates for continued funding from DOE programmatic sources or other funding sources, the time required for proposing and securing such support is of a magnitude that would tend to curb the enthusiasm of creative staff members. The ability to promptly explore the best, truly new suggestions and approaches from our scientific and technical staff contributes greatly to the Ames Laboratory's vitality and magnifies its significance to the Department.

Projects for possible support by the Ames Laboratory's LDRD Program will be sought from all technical segments of the Laboratory. Proposals will be initially evaluated by members of the Ames Laboratory's scientific and technological management. Final review and approval for funding is the responsibility of the Laboratory Director, as is the overall management of the LDRD Program.

The Ames Laboratory's LDRD program will be conducted to (1) stimulate the generation of new and promising scientific innovations, (2) evaluate the potential of new ideas and those pertinent to the Laboratory's missions, (3) demonstrate the technological merit of promising basic research results, and (4) to enable the Laboratory to more effectively identify new thrusts and initiatives that will contribute to its long-term strategic development and that of DOE.

Proposals are invited and received by the Laboratory Director from principal investigators or interdisciplinary research teams from all programmatic areas of the Laboratory. These proposals must present clearly a brief description of the new idea or approach, what new information and benefits are anticipated by the end of the defined project term, and the magnitude and type of resources required.

The principal investigators named in successful LDRD proposals report to the Laboratory Director throughout the conduct of the project, receive technical oversight from their normal programmatic management and coordinate with the appropriate support offices of the Laboratory as required. An annual written progress report is submitted by the principal investigators to the Laboratory Director for his use in evaluating the quality of the project and in the preparation of the required reports to DOE.

Currently, there are no LDRD projects being funded at Ames, however, funding for innovative and promising projects has been secured through the Institute of Physical Research and Technology (IPRT), the University's administrative unit that oversees Ames Laboratory as well as other ISU Research Centers.

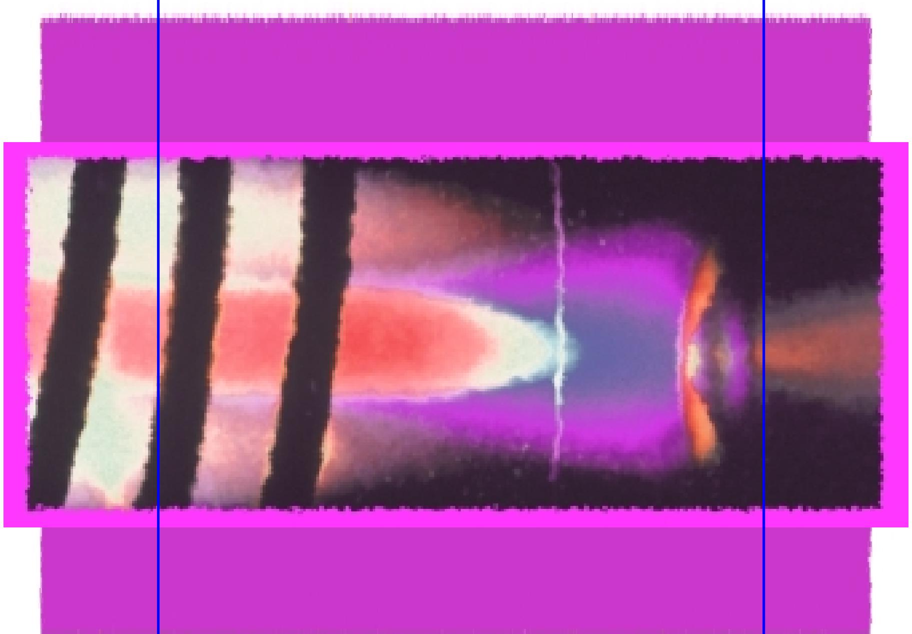
# Scientific

AND

# TECHNICAL VISION

AND

# STRATEGIC PLAN



**Divider illustration:**

A brilliant emission from a hot argon ICP. Using an innovative technique that combines inductively coupled plasma-mass spectrometry (ICP-MS) with chromatography, ultratrace metals in biological systems can be identified at parts-per-trillion levels.

# Scientific and Technical Vision & Strategic Plan

## Situation Analysis

Ames Laboratory will focus on basic research and mission-related applied research to solve the complex problems encountered in energy production, utilization and efficiency, national security needs, human health and safety, and environmental restoration and waste management. The Laboratory embraces the goal of helping to maintain the Nation's economic security and homeland defense by training new science, math and engineering professionals, by transferring technologies resulting from our basic and applied research programs, and by nurturing partnerships with industry, academia, state and other federal agencies.

The observable trends which impact Ames' situation include: a renewed emphasis on technologies for homeland defense; the need for new and innovative materials synthesis and processing (an Ames forte); an increased concern over the safety and health of our citizens; the characterization and remediation of environmentally degraded sites worldwide; the demand for increased federal laboratory - industrial partnering; and the combining of practical hands-on scientific training with formal education. All of these are critically important to the country's technological, economical and sociological objectives. Ames has unique strengths and organizational advantages which permit the Laboratory to contribute in an extraordinary fashion, and in fact, we have already made significant progress in each of these areas. Our customers (the DOE; the academic community; other governmental entities; and industry) are all benefiting from this progress.

Unfortunately, other equally observable trends raise some doubt regarding the level to which we will be able to implement these mission elements. These include the decrease in federally base-funded research for its national laboratories; the increasing difficulty that institutions face in acquiring, upgrading and maintaining facilities and state of the art equipment; and the aging of the American workforce. Ames will strive to counteract these negative trends by expanding its cooperative research activities, by forging new interactions with its contractor, Iowa State University (ISU) to the mutual benefit of the Laboratory and the University, and by expanding the awareness of, and hence the support base for, the Laboratory within state, regional, national and international communities.

The goals and strategies listed within reflect the long-term characteristics of a broad multi-partner operating environment and Laboratory Management's present vision of the future. Our mutual coordination of missions and activities within this broad strategic environment will assure that the Laboratory's diverse stakeholders all derive added-value from the Laboratory's basic and applied research and other mission-related activities.

## Vision

Our vision of the future integrates science, technology, environmental and safety, security, education, economic and management themes. The execution of this vision, and the very existence of the Laboratory, are predicated upon a single critical premise, that Ames Laboratory will continue to enjoy the long-term, mission-oriented, interactive, collaborative arrangements inherent in its M&O contract, and with its contractor, Iowa State University. Within the operating environment created by this premise, Ames Laboratory will:

Deliver successful interdisciplinary basic research in the physical, chemical, materials, biological, environmental, mathematical and computational sciences, which meets the demands created by evolving national needs and advancing 21st century technologies by:

- Forming multi-disciplinary teams (both internal and external) to pursue funding for new initiatives and mission critical research;
- Creating a research environment within the Laboratory that nurtures creativity, intellectual pursuit, and cutting-edge technologies; and
- Mentoring young scientists on the DOE goals and processes, thereby enabling them to build or expand their scientific reputation and effectiveness within the DOE complex.

Successfully develop and integrate advanced science and technology into its mission related applied research programs by:

- Encouraging seamless interfaces between applied and basic research for ideas, methods, and personnel to flow;
- Fullfilling the Laboratory's technology transfer mission by seeking appropriate partnerships with industry, academia and other federal agencies for projects making use of the Laboratory's unique capabilities and expertise;
- Successfully operate an integrated science-math educational support system that provides skilled research professionals and educators, and produces a more science oriented public; and
- Developing agile, cost-effective and creative management systems, based upon advanced information technologies and sophisticated person-to-person management methods that will:
  - ◆ Assist in the operation and management of DOE programs in partnership with DOE program offices;
  - ◆ Form the basis for on-going functional area self assessments and reviews;
  - ◆ Allow the Laboratory to exceed the national standard for personnel administration, professional development, human resources and advanced environment, safety and health (ES&H) policies and procedures, as determined by our M&O contractual performance measures; and

- Provide a safe and secure environment for its employees and developing technologies.

## Research Goals and Strategies

Ames Laboratory has identified four goals to be accomplished within the next five years and has developed strategies for their achievement:

### GOAL 1. Enhance and strengthen the Laboratory's Scientific and Technical Programs (Critical)

**Strategic Issue(s): (1)With the possibility for continued pressure on the base research funding, what mission-related opportunities within industry and other governmental agencies exist for Ames to pursue? (2)How can Ames implement cost-effective management techniques in order to provide its research programs the continued opportunity to excel? (3)In what ways can the Laboratory make major research contributions for assuring homeland and energy security?**

Strategy: The Laboratory will promote interdisciplinary research activities and pursue new interdisciplinary research opportunities. It will strive to create an atmosphere in which the scientific and technical staff are increasingly aware of new interdisciplinary research thrusts and have the opportunity and incentives to pursue them.

Strategy: Ames Laboratory will continue to nurture the excellence of its scientific and technical work by managing an environment in which that work can be completed in a cost-effective manner and by developing rapid responses to new funding mechanisms and opportunities.

Strategy: The Laboratory will maintain and seek opportunities to expand its core research competencies in such areas as materials and chemical sciences, computational and theoretical sciences, forensic sciences and the biosciences by identifying new programmatic alternatives and thrusts and actively pursuing these through the various available funding mechanisms.

Strategy: Ames Laboratory will actively seek funding for major integrating activities that address national needs.

### GOAL 2: Expand the Laboratory's Industrial Relations

**Strategic Issue(s): How can Ames Laboratory foster industrial collaborations to enhance its programmatic and technology transfer activities?**

Strategy: Ames Laboratory will encourage participation by non-DOE entities in its basic and applied research programs where the need for the unique expertise and facililities of the Laboratory can be utilized.

Strategy: Ames Laboratory will foster an open atmosphere (within the limits of federal law, DOE policy, and established confidentiality procedures) aimed at encouraging industry to participate in cooperative research and development efforts.

Strategy: The Laboratory will encourage its scientists, researchers and staff to develop research relationships with non-DOE entities, pursue Work For Others, 100% funds-in CRADA's and other forms of partnership with public and private sector organizations to maintain our core competencies while meeting the Department's technology transfer mission.

Strategy: The Laboratory will encourage the creation and development of spin-off companies that are based upon Ames Laboratory intellectual property.

Strategy: The Laboratory will seek to participate fully in University, State and Federal programs and partnerships, and actively pursue funding opportunities for technology development and company assistance, including DOE's Office of Industiral Technology Program, the Iowa Companies Assistance Program (ICAP), the SBIR and STTR programs, and other related University, State and Federal initiatives.

## GOAL 3: Increase Laboratory Outreach

**Strategic Issue(s): How can Ames Laboratory increase its visibility and maintain public trust in the DOE mission and activities carried out in the Ames area?**

Strategy: Ames Laboratory will continue its efforts to enhance the Laboratory's internal and external communications in order to maintain the openness and trust it has achieved with public concerns.

Strategy: Ames Laboratory will participate in DOE, multi-laboratory, university, and advanced business communications efforts.

Strategy: The Laboratory will maintain effective public affairs output to DOE and ISU stakeholders, the Laboratory's own staff, business and industry, and the wider public residing in Ames, the state of Iowa and our multi-state region.

Strategy: The Laboratory will nurture the constituencies with whom it works for the purpose of seeking guidance from them and providing them with appropriate Laboratory services.

Strategy: Ames Laboratory will continue to identify, develop and submit applications for scientists, researchers, staff and students to nationally recognized award programs.

## Goal 4: Continue and Strengthen the Laboratory's Education Programs

**Strategic Issue(s): (1) Decreased funding limits the number of graduate and postdoctoral researchers that can participate in programmatic research. (2) The elimination of funding for K-12 educational activities curtailed a number of strong, innovative programs that had been established at Ames.**

Strategy: Ames Laboratory will continue support for undergraduate and graduate students, and postdoctoral researchers as significant participants in its scientific programs, as funding allows.

Strategy: Ames Laboratory will continue to foster close working relationships with Historically Black Universities and Colleges, ISU's Women in Science and Engineering Program, ISU's College of Education, and with other efforts, seeking to attract nontraditional or under represented population segments to science and engineering.

Strategy: The Laboratory will work toward increasing the number of students entering scientific disciplines.

# Summary of

# Major Program Initiatives

**Divider illustration:**

Part of the mission of Ames Laboratory's Midwest Forensics Research Center is to develop new instrumentation or methodologies in support of criminalistic laboratories.

# Summary of Major New Program Initiatives

NOTE: Initiatives are provided for consideration by the Department of Energy. Inclusion in this plan does not imply Department approval of or intent to implement an initiative.

## Forensic Science

### Mission

As part of its mission in enhancing homeland security, Ames Laboratory has established a regional center for forensic science, the "Midwest Forensics Resource Center"(MFRC). The primary missions of the MFRC are to pursue state-of-the-art basic forensic research and applied forensic technology developments. Applied forensics developments will include assisting crime laboratories with the scientific analysis of difficult casework materials, facilitating scientific training for forensic scientists, and establishing programs of graduate and undergraduate education in forensics science at universities in the upper Midwest.

### Background

The Ames Laboratory forensic science initiative began with meetings between the Directors of the Ames Laboratory and the FBI's Laboratories. Their rapport led to a series of related events. The Deputy Director of the FBI Laboratory and four of his top scientists visited Ames during late 1997. They reviewed the Ames Laboratory's scientific capabilities, requested R&D proposals in forensic science from the Laboratory, and agreed to fund several of them.

The FBI also asked the DOE Office of National Security and Nonproliferation (DOE-NN) to "jumpstart" their R&D program by funding critical projects. DOE-NN agreed, and several FBI/DOE-NN projects were funded between 1998 and 2000. These projects included investigations of material source identification and bomb blast effects on metals, the restoration of serial numbers obliterated from metals, the development of statistical methods for various classes of evidence, and the development of a veterinary rapid response system to combat attacks on the nation's animal food supply.

The success of these R&D projects led the Ames Laboratory, in partnership with ISU, into a program of forensics outreach to state crime laboratories in Iowa and the surrounding region. That outreach produced a regional coalition of state crime laboratories. The MFRC developed a mission statement and prototyped its mission-related-services over a two year period between 2000 and 2002. That prototype period, in turn, was rewarded with federal funding in 2002, administered through a WFO with the National Institute of Justice (NIJ).

### Approach

The Ames Laboratory/MFRC will continue its outreach to state crime labs in Iowa, Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, Kansas, Missouri and Illinois. It will meet the nation's and the region's common forensic needs through a program of work that involves:

- Conducting forensics research,
- Releasing RFP's for forensic research,
- Developing a special casework resource system (which will allow crime laboratory staff to identify the outside resources that can assist them to analyze unusual casework materials),
- Providing a venue for regional training in forensics, and developing training where none is currently available,
- Assisting crime laboratories to establish graduate and undergraduate programs in forensic science at neighboring universities, and
- Investigating special topics in forensic practice (such as the forensics-related needs of rural law enforcement, the forensic response to attacks against the nation's animal food supply, the role of the Laboratory in the nation's forensic resource community, and related topics).

Ames Laboratory/MFRC staff prototyped this program of work over the last two years, and believe that they will be able to document both scientific and tangible contributions to the nation's forensics community.

### Summary

The MFRC is based upon the traditional core strengths of the Ames Laboratory, e.g. basic research in analytical chemistry and metallurgical science. Its current and projected partners are also interested in the Laboratory's applied strengths in environmental and protection sciences, chemical and biological sciences, non-destructive evaluation, the computational sciences, and analytical instrumentation. They believe that the Laboratory's core strengths have already played a productive role in the scientific investigation of basic problems in forensics science, and they expect these strengths to play a greater role in the future. They want the MFRC to apply its scientific strengths to practical problems in the applied forensics technology developments, and to address casework problems in which conventional techniques have failed. They have also asked that the MFRC employ its expertise in partnership development and consortium-building to help establish new university curricula in forensics, and to facilitate the training of forensics professionals.

It is the Laboratory's intention to expand its scientific efforts in the fields of forensic science and technology through the MFRC. The Laboratory will also explore innovative ways that it can employ its unique relationship with ISU (the Ames Laboratory's M&O contractor) to provide forensics scientists with the education and training needed to serve local, state and national forensic agencies.

## Catalysis Center

### Mission

The Center will focus on green chemistry and catalysis with the overall goal of preventing pollution at the source. Research areas will include catalytic routes to cleaner fuels, biocatalysis, bioremediation, catalytic routes to green feedstocks, and new reactions in green chemistry. To this end, the Center will develop unifying themes among existing programs, and seek to promote new initiatives by bringing together various related scientific subdisciplines that do not have a strong tradition of collaborative work with each other.

The Center will also serve as a resource for DOE catalysis efforts by bringing together scientists, equipment, and facilities at Ames Laboratory and Iowa State University. The scientists at the Center will conduct research in homogeneous and heterogeneous catalysis and biocatalysis directed toward green chemistry. One of the important aspects of the proposed work will be the catalytic conversion of agricultural plant materials to useful products. This will complement and support the Biorenewable Resources Consortium (see page 30), which Ames Laboratory has established with the USDA-sponsored Iowa Agriculture and Home Economics Experiment Station and the recently-founded Plant Sciences Institute (PSI) on the Iowa State University campus. Both efforts will seek to exploit the strong scientific and organizational ties between the Ames Laboratory and Iowa State University to provide a natural framework for bringing together the strengths of the University in agriculture and biology with the natural sciences resident in the Ames Laboratory and also in many of the University's departments. Additional strengths derive from various University Centers (such as the Center for Crops Utilization Research, Center for Sustainable Environmental Technologies, and the PSI) dedicated to the development and utilization of biorenewable resources. However, the overlap between the catalysis center and the Biorenewable Resources Consortium will be minimal. Green chemistry extends into chemical and environmental areas that have little to do with biorenewable resources.

The strong scientific ties between the Ames Laboratory and ISU, as well as their physical proximity, will also facilitate the pursuit of the educational missions of the Center. Both graduate and undergraduate students will be involved in research. Educational activities in the Center will serve to both train students and generate an interest not only in catalysis but also for energy and environmental issues in general.

### Justification

Energy production and utilization, the slow-down or reversal of global warming, and preservation and restoration of the environment are among the most pressing technological and scientific challenges of the present time. Governmental regulations that address these and other problems are becoming increasingly strict and are impacting the competitiveness of American industry in global markets.

As diverse as they might seem, these challenges and problems are related and should be addressed together in a rational, multi-front approach. Cutting energy consumption, by designing more efficient industrial processes and simultaneously replacing fossil fuels and feedstocks with renewable sources of energy and materials, will have multiple positive impacts and help ensure an adequate energy supply for future generations. These goals can and should be achieved in an environmentally responsible manner and without increasing the levels of atmospheric carbon dioxide above acceptable limits.

Any successful and comprehensive approach to energy and environmental issues will have to rely heavily on catalysts (substances that reduce the activation barriers and increase the rates of chemical transformations, but themselves remain unchanged in the process). Important chemical reactions can be carried out catalytically under milder conditions, with less energy expenditure, in a shorter time, and using more environmentally friendly chemicals and solvents than without the aid of catalysts.

Industry, government, and science and technology agencies of the industrialized world have recognized the enormous potential role of catalysis in the future. In the Technology Vision 2000 (a joint project of the American Chemical Society, the American Institute of Chemical Engineers, the Chemical Manufacturers Association, the Council for Chemical Research, and the Synthetic Organic Chemical Manufacturers Association), catalysis occupies a prominent place in the vision statement outlining the technology agenda for the chemical industry. Similarly, successful responses to governmental initiatives, such as the Presidential Green Chemistry Challenge, established in 1995, or the Presidential Executive Order of August 1999 for "Developing and Promoting Biobased Products and Bioenergy," are unrealistic without new developments in catalysis. The May, 1999 NSF/DOE workshop on Molecular and Environmental Science classified catalysis/biocatalysis as one of the seven enabling research areas, which are expected to have a significant impact on technological challenges of national interest.

The joining of the expertise and resources of the Ames Laboratory and a number of academic departments and centers at Iowa State University makes possible a truly interdisciplinary approach to problems in catalysis. This center will, in time, have the critical mass and the wider resource base needed to respond quickly to DOE initiatives related to catalysis.

## Hydrogen Generation and New Materials

### Mission

The Ames Laboratory proposes this "Clean Energy for the Future" initiative to address several critical issues which have prevented the successful development of hydrogen as a fuel for the future. The effort includes a companion demonstration project that will utilize scientific developments arising from the project and put these improvements into practice in a rural setting.

### Background

Hydrogen has long been touted as a fuel for the future and much critical work, especially in the area of hydrogen storage, has been undertaken at Ames Laboratory. However, despite optimistic forecasts regarding hydrogen as a resource for future U.S. fuel needs, there are still impediments to its development as a sustainable, safe energy source. This initiative will address four significant obstacles and will develop a rural demonstration site to test the scientific developments that result.

The program goals are to:

- improve and perfect wind turbines and other energy sources for hydrogen generation,
- address inefficiencies in electrolysis,
- develop effective solid and liquid hydrogen storage systems for a variety of uses,
- investigate transportation and delivery infrastructures for hydrogen, and
- establish a rural demonstration project to test and further develop existing technologies.

The results of this initiative may produce significant impact at the state and national levels; initially, it has the potential to make the State of Iowa self-sufficient in energy, using only abundant renewable resources. Energy dependency is a critical issue the nation over, and a successful Iowa hydrogen economy model could potentially demonstrate a clean, sustainable energy technology that could be implemented nationwide.

### Approach

This project will involve the development of new and improved processes for hydrogen generation and materials that meet the performance specifications these processes require. It will also feature a full-scale demonstration system for rural hydrogen power generation and utilization. The materials-related research will consist of a linked series of projects that seek to improve the efficiency, simplify the production, and lower the cost of the array of technologies needed for implementation of a hydrogen-based clean energy economy. The hydrogen energy cycle demonstration project will permit a full assessment of individual and system-related costs and needs for improvement of the components in the hydrogen energy cycles for community-distributed power generation in a rural setting. As the component improvements resulting from the research become available for testing, the existing demonstration facilities will be used for actual system trials and for evaluating benefits.

The series of technologies that are linked in the most promising system designs for generation of applied electrical power in a hydrogen energy carrier network include:

- power sources for hydrogen generation, e.g., wind turbines and photovoltaic arrays,
- hydrogen synthesis methods that do not consume petroleum hydrocarbons, e.g., electrolysis, and biomass decomposition,
- hydrogen purification and storage, e.g., catalytic purification methods, separation membranes, and solid state (hydride compounds) or cryogenic (liquid) storage,
- hydrogen transport, e.g., pipelines (low and high pressure) and bulk granular hydrides (near-ambient pressure), and
- hydrogen/electrical power conversion, e.g., fuel cells and hydrogen-fired turbines.

The research areas selected for the initial project include studies related to wind turbines, electrolysis, solid-state hydrogen storage, hydrogen liquefaction, and bulk granular hydrides. This new initative can be linked with and lend further support to ongoing Ames Laboratory/Iowa State University studies in biomass digesters, gas purification catalysis and filtration, magnetic refrigeration, and fuel cell processing.

## Multi-phase Flow

### Mission

The goal of this initiative is to advance our understanding of three-dimensional gas-solid reacting flows using basic theory and modeling. In a gas-solid reactor one or more reactants will usually be fed into the reactor in the solid phase and another reactant will be fed in the gas phase. Typically, the gas-phase reactant must then enter the solid phase in order for reaction to occur, but more complicated mechanisms involve mass transfer and reactions in both phases. Selectivity for the desired products depends on the rates of interphase (i.e., between phases) and intraphase (i.e. within a phase) mass transfer relative to reaction rates. Our objective is to better understand fluidized beds and thereby to improve design and performance of multiphase reactor design. Potential benefits range from optimization of conditions for clean and efficient coal combustion to cost savings on pilot plant construction and operation of multiphase chemical reactors. In the longer term, we plan to establish a broad effort in granular and multiphase systems.

### Background

This initiative was begun by coordinating two separate efforts that were initially funded about three years ago. One, through the National Energy Technology Laboratory (NETL), was to improve kinetic theory models for gas-solid flows; the other, also through DOE via Air Products, was for studying gas-liquid flows using computational fluid dynamics. The coordination was facilitated through a program of multiphase-flow-phenomenon seminars that have been held weekly since that time. Various Ames Laboratory/ Iowa state University researchers with overlapping interests in this broad area have been invited to participate in these meetings. Ames Laboratory researchers met with NETL scientists in August 2000 to discuss the participation of Ames in an MFIX research team led by NETL and the DOE Fossil Energy program. MFIX is a computational fluid mechanics code for multiphase systems. The collaboration thus established continues, and telephone discussions between Ames and NETL occur on approximately a weekly basis. These are held to plan and coordinate research activities and to discuss new results. Recently funding has been obtained through a BES Center for Synthesis and Processing "glue" proposal involving Ames, Argonne, LANL and Sandia,. New research directions for our program have begun to emerge from this funding.

### Approach

From inception of this initiative the approach has been to use existing funded efforts to seed a major, new program in multiphase flow and granular systems. This involves internal coordination, as discussed above, and seeking sources of funding for new projects that cement existing collaborations and expand the scope of present activities. Our main approach initially has been to focus rather specifically on implementing, synergically, two different computational fluid mechanics codes for multiphase flow in order to improve them and to derive maximum benefit from their individual strengths. One of these is MFIX (NETL) (previously mentioned) and the other is CFDLIB (LANL). The parallelization and optimization of these codes (done in collaboration with the Scalable Computing Laboratory of the Ames Laboratory) to take advantage of cluster computing should have a major impact on a very wide section of the engineering community. This is important in its own right, but it will also help enhance the reputation of our effort and facilitate the growth of our program. This strategy for growth has already achieved some limited success.

## Biorenewable Resources Consortium

### Mission

The Biorenewable Resource Consortium (BRC) is dedicated to the development and utilization of agriculturally derived alternatives to petrochemicals and other nonrenewable fossil resources as a means to address our national dependency on nonrenewable resources. The partnership is directed by the Department of Energy's Ames Laboratory with the Iowa Agriculture and Home Economics Experiment Station and the University's Plant Sciences Institute.

### Approach

The expertise and facilities resident at Iowa State University is uniquely positioned to assess and develop biorenewable alternatives to the use of petrochemicals through conventional crops and biomass—and thus enhance value-added agriculture and U.S. competitiveness and advance rural economic development. ISU has long been a recognized leader in agriculture, the physical sciences, and engineering with an impressive faculty ranging from world-renowned scientists to young researchers. On campus there are three major, mission-oriented research and development laboratories: Ames Laboratory of the U.S. Department of Energy, the Iowa Agriculture and

Home Economics Experiment Station, and the Plant Sciences Institute. This combination of preeminent resources is unique among American universities and provides an unprecedented opportunity to assess and develop biorenewable alternatives in an integrated and systematic way. This national investment in biorenewables promises a huge payoff to the taxpayer in improving the international competitiveness of the U.S., forming new industries, increasing farmers' profitability, enhancing sustainability, viability, and economic development in rural communities, and reducing net carbon dioxide emission and thus improving our environment.

Specific research and development areas of the Biorenewable Resource Consortium (BRC) include

- Chemicals and materials such as biodiesels, alcohols, and organic acids produced via biocatalytic, catalytic, and green chemistry technologies from crops, crop residues, and lignocellulosic materials.
- Biopolymers with useful properties produced from crops and crop residues.
- New crop development in concert with materials development.

Interdisciplinary research teams are the basis for organizing research activities administered by the BRC. A team is tasked with simultaneously addressing the major technical and market issues associated with moving a bioresource process along a path to commercialization.

The BRC has and will provide funding for a portfolio of interdisciplinary projects that it will manage by monitoring the articulation of projects to accomplish the goals of the BRC and assessing the technical and scientific quality of the funded projects. To this end, the BRC will establish interdisciplinary research teams that will adopt a concurrent research approach to problem solving to assure that research is coordinated, of high quality, and carried out in a timely manner. Since the BRC will not be a university research unit, it will not compete with the various participating research centers and departments and will be able to draw on expertise throughout campus and beyond. In addition, the BRC communicates with the Midwest Biobased Materials Consortium a, fledging group that seeks to work regionally in this critical area.

Over the long term, the research thrusts of the BRC will change and evolve in parallel with the challenges and opportunities presented by development of biorenewable industries.

## Biochemical Characterization and Instrumentation

### Mission

The mission of the proposed initiative into Biochemical Characterization and Instrumentation is to further the understanding of genomic variation and organization which will result in new technological approaches, methodology and instrumentation applicable to a wide range of biomolecular analyses.

### Background

Sequencing all the coding and regulatory regions of the human genome may occur within the next five years. In addition, the entire genomic sequences of tens of prokaryotic genomes as well as those of several eukaryotes including Arabidopsis thaliana and Drosophila melanogaster may have been obtained. These primary sequences will provide a stimulating ferment for studies on genomic variation and organization, gene function and expression, protein-DNA interactions, protein-protein interactions, as well as flux control and cross-coordination of metabolic pathways. There will be a tremendous need for re-sequencing thousands of genomes either in their entirety or in part to unravel among others the polygenic factors underlying disease susceptibilities and predispositions. For example, three major variants of the apolipoprotein E gene, explain a large fraction of the risk for Alzheimer's disease, as well as risk for cardiovascular disease. The National Institutes of Health have also begun to provide funding for the discovery of thousands of single-nucleotide polymorphisms that may help in localizing disease causing genes by linkage disequilibrium mapping.

There has been significant progress in the development of the necessary technology, including denaturing HPLC, mass spectrometry and oligonucleotide arrays, but there is definitely need for further improvements. To understand the details of cell regulation, it will be necessary to monitor the expression level of up to a hundred thousand genes in the higher eukaryotes simultaneously, with a quantitative sensitivity level of one copy per cell and a qualitative sensitivity to distinguish alternatively spliced forms. The data obtained may then be used to suggest functions of genes based on their spatial localization or time course of expression, to recognize by means of mathematical cluster analysis subtypes of expression profiles as a function of disease or response to environmental factors or medical treatment, and eventually to decipher the circuitries controlling cell cycle and developmental pathways. Primary sequencing may reveal the presence of a gene, but not necessarily its function.

While null phenotypes may provide crude insights into the function of an entire gene, more targeted disruptions will be required to understand the function of individual domains of a protein. Despite tremendous efforts dedicated to the finding of single mutations in total genomes by a variety of subtraction techniques, such analysis may remain an elusive goal. The almost infinite number of carbohydrate structures, which are known to play a key role in cell recognition and immune response, will require significant refinement in our present armory of enzymes and instrumental tools including mass spectrometry and magnetic resonance analysis. The same is true for the identification of protein shapes and their interaction with each other or with nucleic acids.

In conclusion, the major challenges in the years ahead will be the identification of sequence variants for elucidating polygenic traits that account for the most common diseases such as cancer, diabetes and cardiovascular disease, as well as the functional characterization of genes. In contrast to the primary sequencing effort, the aforementioned studies will not require the establishment of huge production facilities. However, every effort should be made to put an infrastructure in place that avoids unnecessary duplication and guarantees rigid quality control. Only through a major commitment to interdisciplinary training in such diverse fields as chemistry, physics, plant biology, molecular biology, cell biology, genetics and mathematics will scientists be able to unravel the wealth of information to be expected in the coming years and develop an in-depth understanding of the workings of nature.

## Approach

Building upon existing research in Ames' Chemical and Biological Sciences Program, and several proposals recently submitted to the Office of Biological and Environmental Research, Ames is proposing a major new initiative in the area of biochemical characterization and instrumentation. Biological research at Ames is nurtured by the symbiotic interaction with the internationally-recognized programs in biological spectroscopy (particularly those of G. Small in the Chemical Sciences Program), analytical instrumentation development (for example, the genome sequencer development program of E. Yeung and the microsensor programs of M. Porter) and the computational expertise of the Laboratory's Scalable Computing Laboratory (leaders in development and use of low-cost parallel processing clusters). In addition to the Laboratory's infrastructure, which virtually demands interdisciplinary interaction, the unique intermarriage of the Ames Laboratory and Iowa State University provides all of the advantages expected in a research university with current and historical strengths in a wide variety of biological and biochemical research areas. The Laboratory offers all of the advantages of the structure and expertise of a National Laboratory in combination with the attractive features of a research-oriented university to provide a unique and outstanding environment for cross disciplinary interactions that generate novel solutions to a variety of important biological questions.

THE FOLLOWING THREE INITIATIVES HAVE BEEN SUBMITTED FOR CONSIDERATION AND FUNDING THROUGH THE NANO-SCIENCE AND TECHNOLOGY INITIATIVE. NOTE: RIGHT BEFORE GOING TO PRINT, THE LABORATORY LEARNED THAT THE MAGNETIC MOLECULES PROPOSAL HAS BEEN FUNDED.

## Photonic Band Gap Materials

### Mission

Ames Laboratory scientists pioneered the field of photonic band gap (PBG) materials over ten years ago. Since that time the field has exploded, with over 100 active groups in the world. While funding resources from BES have decreased over these ten years, the success, reputation, and skills of the Ames PBG researchers have increased tremendously.

The field is now pushing into the infrared, optical, and ultraviolet regimes, where fabrication techniques for 3D structures at the submicron (nano) level are involved and costly to investigate. The resources required to maintain leadership and make timely progress are considerable. For this reason the Laboratory has proposed a new initiative aimed at obtaining the resources to maintain and extend the competitive advantage the Ames Laboratory has in this emerging area of science.

### Background

Photonic band gap (PBG) materials are artificially designed periodic dielectric structures that can be used to control light (photons) in a manner similar to that used by semiconductors to control electrons. The strong confinement of light inside a PBG crystal leads to novel optical properties which hold great promise for the revolutionary integration of optical devices for use in many important application in optical communication, sensing and imaging, and energy-efficient lighting and display. The Ames group was the first to take advantage of the fact that the behavior of light in PBG dielectric structures can be accurately predicted by modern computational techniques, and they were the first to design, patent, and fabricate simple structures which greatly accelerated development of the field in the early 1990's. The early PBG crystals had repeating structures at millimeter length scales and below, and pioneering studies were carried out in the short microwave spectrum. Collaboration with Sandia National Laboratory allowed micron size structures to be fabricated and the PBG properties to be extended to the range of frequencies optimal for modern optical fibers. The success of this group and one or two others prompted a huge surge of activity throughout the world, with Europe and Japan fielding several world class efforts to push PBG structures to smaller dimensions so that applications in the visible-optical region can be achieved. Whole new strategies must be developed.

### Approach

This initiative is founded on an exceptionally strong group of researchers. The approach is to expand the team to include key scientists at Sandia National Laboratory and at the University of Utah to bring in the expertise for fabricating ultra-small scale integrated photonic structures and for filling those structures with media for performing the first experiments using PBG materials for lasing and switching phenomena. A large proposal has been sent in response to the DOE laboratory call for nano-science, and funding for collaborative parts of the research have been solicited from DARPA under their nano-science call. The proposal to DOE consists of six parts:

1. Light emission in 3D photonic crystals – an aspect of photon-electron interaction.
   - To create a PBG micro-cavity to enhance the emission intensity of Si by 1000.
2. Light transport in photonic crystals: an aspect of photon-photon interaction.
   - To design and fabricate PBG waveguides, splitters, couplers operating at 1.55μ.
3. Thermal emissivity of photonic crystals: an aspect of photon-phonon interactons.
   - To explore the thermal emissivity of certain PBG structures for possibleapplications.
4. Tunability of Photonic crystals.
   - To insert magneto-optic material in the PBG matrix and fine tune the response with H.
5. Development of new PBG crystals operating at higher optical and UV frequencies.
   - To mask and mold fabrication techniques to reduce the structure size of PBG crystals.
6. Theory and simulation methods.
   - Develop faster transfer matrix and finite difference time domain techniques.

## Magnetic Molecules

**(Note: This initiative received funding at the end of FY2002.)**

### Mission

The last ten years have seen a Renaissance in the field of magnetism. This includes new questions and challenges at the nano-scale level where quantum effects such a tunneling of magnetic moments have been observed and can be manipulated. One of the rapidly expanding subfields within nano-magnetism is that of magnetic molecules. These materials offer an ideal "laboratory" to understand how complexity develops as the number of interacting magnetic ions grows from three or four to thirty, forty or more. Each molecule has a fixed number of magnetic ions, and single crystals of the molecules can be grown large enough that powerful neutron and x-ray techniques can be used to probe their structure and elementary excitations. This is an area where Ames Laboratory has pioneered initial studies. A team of scientists is now proposing a larger nano-science project, which will establish Ames as the leading center in the US for magnetic-molecule research. The mission is to synthesize new molecules, characterize their magnetic interactions with a variety of experimental and theoretical methods, and to make predictions of new molecules with unique and possibly exploitable properties. Already these systems are being used to understand quantum coherence and are being considered at qubits for quantum computing.

### Background

Exact quantum mechanical methods are available to study small numbers of interacting atomic magnetic moments, but these approaches break down as the size of the moments and their number become large. In mesoscopic systems one is often forced to use classical models for the moment interactions or use micromagnetics (which uses the average magnetization on a scale much larger than atomic moments) to describe interactions in bulk systems. As devices and magnetic memory bits shrink, the micromagnetic approaches are not able to describe dynamic pheomena (such a bit switching) and new attention is now focused on the nano-scale. It is at this scale that magnetic anisotropy, and exchange couplings are determined, and interesting quantum phenomena are realized. Ames scientists have been studying magnetism at these small length scales and realized that the newly developing field of magnetic molecules offers the possibility of ideally controlled prototype systems to further the understanding of key interactions and how they evolved as system sizes become larger and more complex. Magnetic molecules are particularly ideal for studies of quantum (de)coherence and phenomena such as the tunneling of magnetic moments at low temperatures. Ames Laboratory is qualified for successfully pursuing a comprehensive research program on magnetic molecules due to its combined strengths in the synthesis, and the experimental and theoretical study of these compounds.

### Approach

Our goal is to understand both the static and dynamical properties of a wide variety of magnetic molecules which will be obtained by in-house synthesis or in some cases from external collaborators. Systematic investigations will be made using neutron and x-ray scattering, NMR, EPR, mSR, optical, and thermodynamical measurements, leading to theoretical models and a firm understanding of the interactions and phenomena. In some cases model Hamiltonians will be used and in other cases first principle calculations will be employed (to determine exchange and anisotropy interactions). The Ames team will consist of about ten senior scientists and their groups, along with collaborators from ORNL, Florida State, and the University of Tennessee. There are also nine foreign collaborators that we have already published papers with and who are eager to proceed with the new project.

## Bioinspired Polymer Nanoassemblies

### Mission

The overall goal of this initiative is to design and synthesize materials based on novel block copolymer nano-assemblies that are inspired by, and mimic living systems in their ability to sense their surroundings, switch among several states in response to the environment, self-assemble and build complex structures hierarchically and enable selective transport across membranes. This work lays the foundation to create a body of knowledge, both experimental and theoretical, that will provide answers to several important questions at the interface of materials, nano-technology, and biology; and it will elucidate fundamental nanostructure-function relationships including polymer-biomolecule interactions.

### Approach

The underlying feature in the design of these polymer nano-assemblies is the creation of functional nano-environments with the polymers that can be tailored to interact with biomolecules to elicit specific biological responses. Accordingly , we will design, synthesize, and characterize the structure of three classes of polymeric nano-assemblies that exhibit several different characteristics of living systems. The polymeric nano-assemblies include (a) cationic stimuli-sensitive multiblock copolymers that self-assemble to form nanoscale micellar structure, (b) biodegradable diblock copolymers with tailored nanostructures, and (c) dendrimers and block copolymer hybrids that self-assemble to form controlled nano-architectures. A wide variety of nanoscale probes will be used to answer some fundamental questions about the structure of these nanoscale systems with novel properties. Using these probes, in conjunction with combinatorial methods for high-throughput screening, we will study the specific interactions between the bioinspired polymer nano-assemblies and biological moieties. Testing methodologies suitable for the combinatorial approach will be developed to verify that the desired function is exhibited. There are 12 senior scientists who will work on this project along with collaborators from ANL and ORNL.

# Operations
# and Infrastructure Strategic Plan

**Divider illustration:**
As part of the new initiative in Biorenewable Resources, Ames researchers are working on developing new bio-based energy sources and products.

# Operations and Infrastructure Strategic Plan

## Operations Strategic Plan

GOAL: Implement Self-identified Organizational Improvements and Increase Existing Organizational Efficiencies (Critical)

**Strategic Issue(s): (1) How will Ames assure that its workforce is educated to perform their jobs safely and correctly? (2) How will Ames efficiently and effectively implement increased security and cybersecurity methods into the Laboratory, while permitting open communication between its employees and others worldwide? (3) How can Ames improve overall organizational efficiency to meet or exceed performance expectations?**

Strategy: Ames Laboratory will continue the improvement of its ES&H systems through a full and effective implementation of DOE's Integrated Safety Management policy.

Strategy: Ames will implement appropriate hardware/software systems to provide a secure cyber network and protect existing computational equipment, while allowing open communication in "fundamental research" and administrative functions.

Strategy: Ames will work with our staff and our partners to assure protection of proprietary, confidential and sensitive information as required under DOE Orders, Federal Regulations and confidentiality agreements by:

- Maintaining a Laboratory Sensitive Technology List;
- Developing Security Plans for those items included on the Sensitive Technology List;
- Performing export control and sensitive subject review of foreign visits and assignments, and proposals; and
- Educating staff as to their responsibilities in regards to such items.

Strategy: Ames will provide greater opportunities for employees to complete training in new and emerging management areas such as computer-based management applications, diversity and security, and to participate in integrated management processes and other emerging skill-areas.

Strategy: Ames Laboratory will participate in DOE initiatives to streamline reporting, performance evaluation metrics, Laboratory data-collection and analysis using web-based systems or other cost- and time-effective tools.

Strategy: Commit to a rigorous program of performance measurement. Consistent with such commitment, the Ames Laboratory will:

- Enlist regular peer reviews of its research programs, and incorporate the results of those reviews in its ongoing operational plans;
- Undergo regular, intense, performance audits of its non-research areas and incorporate the suggestions from those audits in its ongoing operational, administrative and support functions;
- Undergo Laboratory-wide performance reviews administered by DOE site evaluation teams and incorporate the suggestions from those teams in ongoing Laboratory operations;
- Adopt new management and performance measurement tools being developed by the DOE; and
- Develop new performance measures as determined by self-assessment, the ISU/IPRT partnership and the DOE.

GOAL: Provide State of the Art Information Management Systems and Support for Operational Areas which will Allow Efficient Utilization of Staff and Timely and Effective Reporting Data as Needed.

**Strategic Issue(s): (1) How will implementation of I-MANAGE be achieved? (2) How will the Laboratory provide state of art networking needs? (3) What will be the new direction for administrative applications and systems at the Lab?**

Strategy: Modify or develop financial systems as required to allow Laboratory financial data to integrate with DOE's new I-MANAGE financial system.

Strategy: Implement a state-of-the-art computer network system and maintain an efficient allocation of computing resources through high-speed network services to promote an effective research environment.

GOAL: Reduction of Radiological Materials Inventory and Legacy Radiological Contamination (Critical)

**Strategic Issue(s): Ames Laboratory's contribution to the government's research and development mission's of the 1940's and 50's included extensive activities involving separation and purification of thorium and uranium. Resulting radiological legacy contamination and materials inventories have been reduced during the past fifty years. Recent and future efforts are focused on further reducing radiological material inventories and legacy contamination concerns. Efforts to reduce inventories of legacy radiological materials include reassignment of materials to other DOE facilities and disposal though approved vendors. Efforts to reduce legacy contamination are focused on decontamination of thorium-contaminated spaces in Harley Wilhelm Hall. The remaining areas of contamination include sub-basement tunnels, utility chases and abandoned ventilation system components and utility components. Protection of building occupants during the remediation activities and minimization of impact to on-going mission related research activities are of principal concern. Another facility, previously**

**UTILIZED AS A WASTE FACILITY DURING OPERATION OF THE AMES LABORATORY RESEARCH REACTOR (ALRR), IS PRESENTLY UTILIZED AS A LOW LEVEL WASTE HANDLING AND PACKAGING FACILITY AS PART OF A BENEFICIAL USE AGREEMENT WITH IOWA STATE UNIVERSITY.**

*Strategy: Plan, estimate and request funding for decontamination and closure of the Iowa State University owned building presently used as the Laboratory's low-level waste facility. Relocate the Laboratory's low-level waste activities into renovated space within a DOE-owned building.*

GOAL: ENVIRONMENTAL MANAGEMENT SYSTEM (EMS): IMPLEMENTATION AND DOCUMENTATION AS PART OF INTEGRATED SAFETY MANAGEMENT (ISM) SYSTEM (CRITICAL)

**STRATEGIC ISSUE(S): (1) WHAT WILL THE LABORATORY'S EMS GAP ANALYSIS REVEAL? (2) HOW WILL AMES IMPLEMENT AN EFFICIENT EMS WITHIN THE LABORATORY'S MANAGEMENT SYSTEM AND CULTURE?**

*Strategy: Ames Laboratory's environmental management policies and practices are mature and proven. An Environmental Management Review of the Laboratory's EMS was performed by the Environmental Protection Agency (EPA) in late 2002. Preliminary results indicate Ames Laboratory's policies and practices are very supportive of an effective EMS. Continued efforts will build upon the solid foundation of the Laboratory's ISM System.*

## Environment, Safety and Health

Ames Laboratory maintains mature and effective programs designed to ensure the protection of its workers, the public and surrounding environment. In cooperation with DOE-Ames Area Office, Ames Laboratory periodically establishes meaningful ES&H goals, objectives, and performance measures. Work Smart Standards are incorporated into the M&O contract for operation of the Laboratory. Ames policies, practices and programs support an ISM System, and Ames effectively applies the ES&H/Infrastructure Management Planning process to produce a prioritized list of ES&H and infrastructure activities.

Ames is well positioned to address ES&H requirements and programs. Significant ES&H concerns at Ames Laboratory include the uncertainty regarding the availability of direct Landlord funding for remediation of legacy contamination of facilities and relocation of a low-level waste management facility. Direct funding for these activities would provide Ames Laboratory with acceptable pathways to effectively closeout these concerns.

Goals and Objectives

The Ames Laboratory continues to exert specific and direct efforts to maintain an effective safety management system. Ames does not conduct production operations nor does it conduct activities with the potential for significant impacts to the environment. As such, the Laboratory has a limited number of air permits and is not required to maintain wastewater discharge permits.

The Laboratory's goal is to conduct activities in a safe manner and maintain the health of its employees while protecting or improving the quality of the environment. A Laboratory objective is to maintain full compliance with pertinent ES&H regulations, requirements and standards, and to continuously work toward the improvement of its ES&H processes. This objective is supported throughout the Laboratory and is the foundation of the Laboratory's ISM System. Fundamental to attainment of this vision is close cooperation and coordination between safety, health physics, industrial hygiene, environmental and occupational medicine professionals, and the technical and scientific staff.

The Laboratory and the DOE-Ames Area Office implement contract performance measures designed to improve ES&H performance through specific program actions and the tracking and analysis of leading and intermediate indicators. Additionally, ES&H performance measures are established for the Laboratory's line management. Individual employee performance evaluations also include a performance factor that addresses ES&H responsibilities.

Current Systems

The Laboratory's Environment, Safety, Health & Assurance Office combines ES&H discipline specialists with quality assurance and training personnel, and allows an integrated and effective approach to the implementation of a myriad of ES&H requirements through direct application of the principles of quality management and training efforts.

Ames Laboratory annually prepares an integrated ES&H/Infrastructure Management Plan. The Activity Data Sheets for the current plan address waste management activities, decontamination of facilities, dedicated environment, safety and health activities, and infrastructure activities. These Activity Data Sheets document the ES&H and Infrastructure needs at Ames Laboratory.

The Laboratory maintains effective ES&H programs and is thereby positioned to respond to new requirements. The Laboratory's Work Smart Standards are implemented in accordance with the performance-based elements of the M&O contract. The Laboratory's readiness review process is utilized to identify and correct safety deficiencies related to on-going and new research and support activities. Additionally, the Laboratory maintains an effective assessment and audit program to detect deficiencies in quality and effectiveness of program elements. These efforts include an internal audit function, quality assurance activities and self-assessment processes. The Laboratory embraces the Department's efforts to improve safety performance, and promotes the principles and functions of ISM. Currently Ames Laboratory is undertaking efforts to develop and document its EMS as part of its ISM System.

Long-Range Plans

Ames Laboratory's safety management systems are maintained to ensure continued compliance and improvement in the future. The Laboratory's ES&H mechanisms, as embodied in the ISM System, coupled with the cultural change to line management responsibility, provide a foundation capable of addressing future initiatives in an environmentally sound manner while protecting workers and the public. The Laboratory utilizes an activity-based readiness review program to identify, document and address potential hazards associated with research and support activities. Once the hazards are identified, the appropriate standards are utilized to develop strategies to control the hazards. A skilled, trained research and support staff implements the appropriate controls and provides a tiered oversight function through operational observations and walk-throughs. These mechanisms are fully integrated into the Laboratory's planning, budgeting and management system and thereby prepare the Laboratory to address the initiatives, programs and projects of the future.

Ames Laboratory's environmental management policies and practices are mature and proven. Now Ames will coordinate its environmental systems through a formal Environmental Management System (EMS) as part of its IMS which will strengthen the Laboratory's overall ES&H efforts.

Significant Concerns

Ames Laboratory has concern related to potential ES&H issues resulting from historical activities. The Assistant Secretary for Environmental Restoration and Waste Management (EM) funded the remediation of a closed Chemical Disposal Site (CDS) at Ames Laboratory during the early 1990's. State regulators released the CDS for unrestricted use, with annual monitoring through 2002. In 1999, the Department of Energy - Ames Area Office issued an Assistance Grant to Iowa State University for continued groundwater monitoring through March, 2002 and for proper closure of the monitoring wells associated with the former CDS. After analysis of the 2002 annual monitoring date, Iowa State University decided to close most of the monitoring wells and continue limited sampling and analysis. The uncertainties associated with the long-term stewardship issues for the site could be a concern for the Department of Energy.

Another concern at Ames, is legacy contamination in an Ames Laboratory research building, Harley Wilhelm Hall. During the late 1940's and early 1950's, research activities involving Thorium-232 and Beryllium were conducted in Wilhelm Hall. Although these activities ceased long ago, legacy contamination has been identified. The contamination is controlled and limited to remote areas of the building. Significant characterization results indicate that the contamination does not pose a health hazard to current occupants of the building. Ames Laboratory initiated efforts to characterize the Thorium contamination and assess remediation options. Recent analysis has identified legacy Beryllium contamination in remote, unoccupied areas of Wilhelm Hall. An Activity Data Sheet documents the Laboratory's effort to detail funding needs to undertake remediation. Additional planning efforts will continue during the 2003/2004 period.

Limited sampling and characterization efforts have been performed in Gilman Hall, the Iowa State University (ISU) building utilized during the late 1940's for Manhattan Project work involving Thorium, Uranium and Beryllium. The results indicate Beryllium contamination in limited areas of restricted access mechanical spaces. ISU has developed appropriate hazard control practices to ensure the safety of its employees. Additional efforts of characterization and remediation could produce issues of liability for DOE.

Another issue is closure of an Ames Laboratory waste facility, owned by Iowa State University, and relocation of low-level waste activities into renovated space in a DOE-owned building within Ames Laboratory. Currently, low- level radiological waste is staged in the Waste Handling Facility located approximately 1.5 miles northwest of campus in a non-DOE building (owned by Iowa State University). The facility was utilized as a waste facility for the Ames Laboratory Research Reactor during the 1960's and 70's. Upon decommissioning of the Reactor and transfer of the real property to Iowa State University, Ames Laboratory continues to work with Iowa State University to define the issues related to closeout of this facility and identify potential DOE liabilities. The project includes the establishment of new low-level waste handling activities in existing Ames Laboratory space and decontamination of the Waste Handling Facility (owned by Iowa State University). This effort will reduce the Department's responsibility for a legacy facility and reduce the risks associated with the transfer of low-level waste to a remote site via public roads.

## Communication and Trust

Ames Laboratory works to foster strong partnerships with numerous national, state and local stakeholders. Examples include members of the U.S. Congress, Iowa legislators, industry leaders, Iowa State University officials and students as well as officials from the City of Ames, the Ames Economic Development Committee and the Ames Chamber of Commerce. The Laboratory interacts with citizens through its normal media relations activities, Lab-management speeches and Community Advisory Group interactions. It interacts with graduate students through its research programs and outreach events.

Fostering Partnerships with Stakeholders

Iowa State University is contracted to operate the Ames Laboratory for the Department of Energy. Through this arrangement, Ames Lab is a member of ISU's Institute for Physical Research and Technology, a consortium of 10 research centers. As one of the IPRT centers, Ames Laboratory shares information on its activities with members of the IPRT Industrial Advisory Board. Established by the director of IPRT, who also serves as the director of the Ames Laboratory, the Board offers insight and advice to the director, who uses the information to formulate future research plans. The 13 members of the Board include top-level research and development officials from Fortune 500 and other companies located throughout the United States. Members of the IPRT Industrial Advisory Board meet on a biannual basis.

Through key IPRT events, the Laboratory provides information on the impact of its research and technology transfer efforts on economic development in Iowa. In 2002, Ames Laboratory's director and manager of Public Affairs participated in numerous legislative events, including the IPRT Legislative Breakfast at the State Capitol, a visit to the legislature sponsored by the Ames Chamber of Commerce and the Ames Chamber of Commerce Legislative Luncheon hosted by IPRT at the Laboratory. In addition, Ames Laboratory hosts individual and group tours by legislators and others on an as-requested basis. In the past, the Laboratory has also hosted Ames Chamber Business After Hours events. These on-site events provide opportunities for the Laboratory to showcase its cutting-edge research to Ames Chamber members.

In addition to the above-mentioned interactions with the Ames Chamber of Commerce, the Laboratory also interacts with the Ames Economic Development Commission to discuss issues of mutual concern. This interaction normally involves an annual meeting with members of the commission and the Laboratory director and manger of Public Affairs. It also involves the completion of a survey on pertinent issues related to workforce, quality of life and business climate.

On the national level, the Laboratory's most recent interaction has been with U.S. Representative Tom Latham. In 2002, the Laboratory hosted a visit from the congressman during which he announced $5 million in federal funding for three new Laboratory research initiatives. This event also included participation from numerous state and local dignitaries, including the President of ISU, the Dean of the College of Agriculture, the Story County Sheriff and the administrator of the Iowa Department of Criminal Investigation. Meetings of the Midwest Forensics Resource Center also attract visitors from around the nation. Attending these meetings are law enforcement representatives from nine Midwestern states, three universities, the Federal Bureau of Investigation, the National Institute of Justice, the Department of Energy and the

Bureau of Alcohol, Tobacco and Firearms.

The Laboratory reaches out on both national and state levels to foster relationships with scientists and industry leaders through exhibits and displays at national outreach events and conferences.. Laboratory scientists and staff work these exhibits and displays, promoting Laboratory research and answering questions on how to partner with the Ames Laboratory on research projects. In 2002, Laboratory research and technology was showcased at the Pittsburgh Conference in New Orleans, LA. In addition, an Ames Laboratory poster display was produced for the Federal Laboratory Consortium's National Meeting in Little Rock, AK. Ames Laboratory magnetic refrigeration technology was selected by the DOE for a display as part of the G8 Ministers of Energy Conference in Detroit, MI. On the state level, the Laboratory was promoted in an IPRT display at the Iowa Industry and daVinci Conference in Des Moines.

As a research laboratory associated with an institution of higher learning, Ames Laboratory works to build strong partnerships with graduate students at ISU. Graduate students constitute approximately 15 percent of the Laboratory's total workforce. These students work with scientists on cutting-edge research projects in real-world laboratory settings. These students, who go on to industry, universities and other research laboratories are considered one of the Laboratory's strongest forms of technology transfer.

The Laboratory works to spark an interest among Iowa high school students in science and math through its sponsorship of the Ames Laboratory/ISU Science Bowl, and other events. In 2002, 47 Iowa high school teams participated in the Ames Lab/ISU Science Bowl regional competition. In addition to Science Bowl, other education outreach opportunities participated in by Ames Laboratory personnel include career talks and hands-on sessions for the ISU Women in Science and Engineering's Taking the Road Less Traveled career conferences, Science Night activities at local schools, and hands-on activities at the Ames Public Library. These events provide an entertaining and educational forum for providing activities that stimulate interest in science.

### Gaining Public Trust

Dedicated to openness in all operations, Ames Laboratory reaches out to Ames citizens through key citizen groups, such as the Ames Laboratory Community Advisory Group. Established in 1994 the CAG's mission is to provide informed recommendations and advice to the director of the Laboratory regarding environmental restoration and related Laboratory issues. The group is comprised of citizens whose backgrounds represent a diverse segment of the population of Ames. Current and past members have included environmental activists, a retired physician, a commissioner for the Ames Park and Recreation Board, scientists, engineers and ISU students. This group provides the Laboratory with important knowledge of local issues concerns and ethics, and through their advice assisted the Laboratory and the DOE in the cleanup of the Lab's inactive waste sites.

In 2002, the Director and selected Laboratory staff met with members of the Ames Laboratory CAG to discuss issues related to the Former Workers Medical Surveillance Program. Earlier, Ames Laboratory hosted a briefing on this program for ISU officials. To assist all stakeholders, the Laboratory has established a Beryllium section on its Web page. This section includes fact sheets and other information.

In an effort to make all information related to Ames Laboratory waste-site issues available to stakeholders, a repository at the Ames Public Library contains numerous documents, reports and informational pieces related to the cleanup of the Laboratory's former waste sites.

Recognition of Science and Technology Contributions

Gaining recognition of Ames Laboratory's and DOE's contributions to science and technology is accomplished in many ways, primarily through the distribution of news releases to external audiences. On average, Public Affairs produces 20 releases per year. These releases reach key national, regional and local audiences. Included in those audiences are DOE officials, national, regional and local leaders, media and the public.

Each year Public Affairs produces Inquiry, an annual science and technology magazine, highlighting current Ames Laboratory research and technology. Inquiry magazine is distributed to numerous DOE and national, state and local stakeholders. The magazine provides valuable insight into the variety and diversity of research conducted at Ames Laboratory.

Public Affairs produces a science report, which is distributed quarterly to targeted science media. The report is seen as a supplement to Inquiry, offering an opportunity to disseminate information about current research on a more regular basis than can be accomplished with the annual science magazine. The report uses a story format to highlight research projects, giving science writers a more in-depth look at the research.

Ames Laboratory has a strong presence on the Internet. The Laboratory's homepage is accessible at www.external.ameslab.gov. Through the website, users can link to other websites, including the DOE, other DOE national laboratorys and Iowa State University. The homepage is being continually expanded to include new information and details about various programs and projects, and has become an important tool for linking scientists and others around the world to the cutting-edge research and technology.

Environmental Ethics and Issues

The Laboratory relies on the citizens of Ames to help ensure it operates in an environmentally ethical fashion. The Laboratory's Community Action Group is considered a good source for valuable input in this area. The Laboratory also makes information related to environmental issues available to the public through its information repository at the Ames Public Library. In addition, all individuals are invited to ask Laboratory personnel questions at any time related to environmental or other issues. The Laboratory has established a Feedback section on its website that allows citizens to ask questions ranging from the general to specific.

## Management Practices

Human Capital

*Laboratory Personnel*

A review of the age and experience distribution of the Ames Laboratory scientific staff shows a very adequate element of expertise for development of new initiatives as well as continuance of current research thrusts. In the 35-50 age range we have a large number of principal investigators, in fact, the number represents nearly 20% of our scientific staff. This represents a solid element of abilities in developing new initiatives as well as providing excellent leadership for research groups. More than one-half of the permanent scientific staff positions are occupied by individuals under the age of 50, providing the Laboratory with the potential for a strong experienced workforce for a number of years. In addition to the permanent scientific staff, the Ames Laboratory research staff includes 77 graduate students and 31 postdoctoral associates providing for a continuous flow of new approaches and fresh ideas in the research community.

With another decline in our workforce numbers this past year we were still able to retain the level of diversity in the workforce. Our minority numbers increased a couple percentage points to 30%, and the female population inched up as well to 27%. We have made significant strides in diversity with our employment activities in the scientific positions resulting in an employee representation from 33 different countries.

The vast majority of the diversity data is generated by our visiting scientists, postdoctoral associates, and graduate assistants which account for about one-third of our paid positions. However, we plan to introduce new efforts in our recruiting for our permanent scientific staff positions to enhance the diversity of the workforce even more in the future. The success of these efforts is, of course, dependent on an increase in staff numbers, a phenomenon we haven't experienced in quite some time.

Support groups will continue their efforts in increasing efficiency to provide the necessary operational support with less-than-desired FTE levels. The current composition of the permanent staff is presented in Table 1.

We do not envision significant modifications in the above nature of our staff due to future operations factors nor will equipment acquisitions or construction plans result in major shifts in the types of personnel required by the Laboratory. Staff growth may, however, be required to support new initiatives and program alternatives. We will, as always, attempt to utilize the already present expertise of the workforce to fulfill the manpower needs of changing program thrusts.

*Personnel Training*

The Laboratory's Training Program provides Ames Laboratory employees with a variety of training and coordination services. An emphasis has been placed on environment, safety and health related issues. New employees receive an initial orientation to the Laboratory by attending a session of General Employee Training (GET). Furthermore, new employees receive Emergency Awareness Training as well as participate in a mandatory Training Needs Assessment Process which delineates additional training needs. Training information is recorded on the Ames Laboratory Training Records System (ALTRS) and is used to ensure employee compliance with job related DOE and other regulatory agency requirements. All employees receive Employee Training Profiles annually, which allows them to manage their training needs effectively.

In addition to the internal training efforts, the continuing educational opportunities for Laboratory employees are significantly enhanced by the fact that the Laboratory's Contractor is Iowa State University. The University has many programs available which permit permanent Laboratory staff members to expand their education and training through formal coursework and other experiences. One such program provides limited funds to partially defray costs of continuing education or professionally-related foreign travel for selected employees. Additionally, a tuition grant program provides funds to full-time permanent professionals to help pay the fees of pertinent coursework. The opportunities to participate in seminars, lectures, and training sessions are numerous and provide professional development opportunities for nearly every employee. A major component of the technical staff, the graduate assistant, is in pursuit of advanced degrees from Iowa State University.

*Affirmative Action/Equal Employment*

Table 1. Laboratory Staff Composition.

| Occupational Codes | Total | PhD | MS/MA | BS/BA | Other |
|---|---|---|---|---|---|
| Professional Staff | | | | | |
| Scientists | 71 | 57 | 7 | 7 | 0 |
| % of Total | 33% | 85% | 39% | 18% | 0% |
| Engineers | 6 | 2 | 2 | 2 | 0 |
| % of Total | 3% | 3% | 11% | 5% | 0% |
| Management | | | | | |
| & Administration | 51 | 8 | 8 | 22 | 13 |
| % of Total | 24% | 12% | 44% | 56% | 14% |
| Support Staff | | | | | |
| Technicians | 15 | 0 | 0 | 0 | 15 |
| % of Total | 7% | 0% | 0% | 0% | 17% |
| All Other | 71 | 0 | 1 | 8 | 62 |
| % of Total | 33% | 0% | 6% | 21% | 69% |

*Opportunity Program*

The Ames Laboratory is an equal opportunity/affirmative action employer. The Laboratory is affiliated with Iowa State University and complies with all policies and procedures the University has established in regard to affirmative action and equal employment opportunity. See Table 2.

Permanent staff at the Ames Laboratory are employees of Iowa State University under the contractual provisions between ISU and DOE. All permanent employees are in one of three employee groups. These three groups include Faculty, Professional and Scientific, and Merit. Specific policies regarding employment for each of these three categories are discussed below.

*Faculty*

Individuals with faculty rank (either tenure-track or adjunct) at ISU are part of this employee group. In almost all cases, the academic ISU department with which the faculty member is affiliated is considered the home department, and all employment requirements are handled by that academic department. The University requires that all faculty positions be advertised in the Iowa State University Job News which is published weekly by the University. In addition, faculty positions are normally advertised in professional journals and/or The Chronicle of Higher Education. Applicants send their resumes directly to the employing department. An acknowledgment letter is then sent to the applicant with an Applicant Statistical Data form, which allows the applicant to identify his/her membership in a protected class. This form is returned directly to the University Affirmative Action Office. At the end of the advertising period, the employing department provides the Affirmative Action Office with a list of all job applicants and documentation on how each candidate compared with job-related selection criteria.

Approval to make the offer is documented through the Pre-Employment Monitoring Form.

*Professional and Scientific*

The Professional and Scientific (P&S) classification plan covers all exempt employees at the University who do not have faculty rank. All individuals within the P&S system have a written job description (Position Information Questionnaire) which is reviewed and point-counted for classification at an appropriate level. There is a specific salary range affiliated with each pay grade.

The advertising requirements for P&S employees are similar to those for faculty appointments. All positions must be announced in Iowa State University Job News for a minimum of fifteen or thirty days (depending upon the level of the position), and is distributed to various organizations statewide. Many of these groups are agencies or advocate groups which would typically represent members of protected classes. If it is determined that the position should be announced at a broader level than statewide, the Laboratory places the advertisement in various newspapers, trade journals, or sends notices to other individuals/organizations which would likely provide candidates for the position. Essentially all positions at the Associate Scientist level or higher within the Laboratory (normally positions that require a Ph.D. and are Principal Investigator track) would be advertised nationally in trade journals. Outside of the scientific division, if a position is at the level of manager or above, the position would normally be advertised in publications with national distribution. All advertisements for positions at the Ames Laboratory have the EEO/AA statement as part of the text of the announcement. Similar to the process for faculty, the applicants send their resume to the employing department (Ames Laboratory Human

Table 2. Equal Employment Opportunity (CY2001)

| Occupation Codes | Total | | | | Total Minority | | | | White | | | | Black | | | | Hispanic | | | | Native American | | | | Pacific Islanders | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M # | M % | F # | F % | M # | M% | F # | F % | M # | M % | F # | F % | M # | M % | F # | F % | M # | M % | F # | F % | M # | M % | F # | F% | M # | M % | F # | F % |
| Official/Manager | 46 | 85% | 8 | 15% | 3 | 6% | 0 | 0% | 43 | 80% | 8 | 15% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 3 | 6% | 0 | 0% |
| Professional | 174 | 78% | 49 | 22% | 63 | 28% | 13 | 6% | 111 | 50% | 36 | 16% | 0 | 0% | 0 | 0% | 2 | 1% | 1 | 0% | 0 | 0% | 0 | 0% | 61 | 27% | 12 | 5% |
| Technicians | 17 | 94% | 1 | 6% | 0 | 0% | 0 | 0% | 17 | 94% | 1 | 6% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Clerical | 1 | 3% | 30 | 97% | 0 | 0% | 0 | 0% | 1 | 3% | 30 | 97% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Craft/Laborers | 12 | 100% | 0 | 0% | 0 | 0% | 0 | 0% | 12 | 100% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Operatives | 7 | 88% | 1 | 13% | 1 | 13% | 0 | 0% | 6 | 75% | 1 | 13% | 1 | 13% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Service Workers | 6 | 50% | 6 | 50% | 0 | 0% | 0 | 0% | 6 | 50% | 6 | 50% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Totals | 263 | 73% | 95 | 27% | 67 | 19% | 13 | 4% | 196 | 55% | 82 | 23% | 1 | 0% | 0 | 0% | 2 | 1% | 1 | 0% | 0 | 0% | 0 | 0% | 64 | 18% | 12 | 3% |

Resources Office) and are sent an acknowledgment letter with a statistical data form. At the end of the advertising period, Ames Laboratory provides the Affirmative Action Office with a complete list of applicants and documentation concerning how the applicants compared with established job-related criteria. Approval to make the offer is documented by the Pre-Employment Monitoring Form. In addition, if the offered salary is above the first quartile of the salary range, approval is required from the University Provost Office.

*Merit Employees*

Non-exempt permanent employees are part of the Board of Regents Merit System. The job descriptions and pay plan are standardized through this system which is in place in all five educational institutions within the Regents' system. All merit employment is coordinated at Iowa State University through the Merit Employment Office, which is a unit of the Iowa State University Personnel Department. All applicants are evaluated based on the requirements for a particular classification and receive a score for that position. The top six scores are referred to a department when a vacancy exists. The employing department is required to establish job-related selection criteria, and rate each candidate on that criteria. A separate Pre-employment Monitoring Form is processed through the Merit Employment Office.

*Special Effort Related to Affirmative Action*

The Ames Laboratory participates in a fellowship program for minority graduate students. The Laboratory provides financial support through a graduate assistantship for these students, as well as a mentor to provide guidance in academic matters.

The University sponsors a program for women in science and engineering which offers summer research opportunities for undergraduate women pursuing degrees in these areas.

Iowa State University, as an institution, has a Diversity Plan supported by senior management. Some of the areas addressed include the recruitment and retention of a diverse workforce, creating an awareness of the value of diversity across the campus, and creating a climate within the University community which promotes and supports diversity.

## Site, Facilities and Infrastructure Management

*Laboratory Description*

The government-owned buildings of the Ames site are located on approximately 10 acres of University land that has been leased to the Federal government on a long-term (99 year) basis. The impact of any major changes in the Laboratory's or the University's activities and physical facilities that affect the site must, of course, be carefully evaluated. The Laboratory's interests in the University's overall site planning considerations are represented by the interactions of Laboratory officers and senior staff members with the major University committees and bodies that are responsible for campus planning, physical facilities, long-range development, and space utilization.

The organization that ultimately became the Ames Laboratory originated as a part of the Office of Scientific Research and Development in the early days of the atomic energy program. The initial work at Ames was carried out in the Iowa State University Chemistry Building in 1942 and involved the development of a process for the production of uranium metal in large quantities. Following the early uranium production efforts at Ames, Iowa State University established the Institute for

Atomic Research in 1945. With the creation of the Atomic Energy Commission, the Ames Laboratory was established as one of the AEC multiprogram laboratories in 1947, to be operated by Iowa State University through the Institute. In 1949, the University completed (and still owns) the three-story Office and Laboratory Building, containing about 14,000 net usable square feet (nusf) to contain the new Institute and Laboratory. This building presently houses only portions of the Chemical and Biological Sciences Program efforts; the remainder of the building is used for University functions.

Expansion of the Ames Laboratory was accommodated in new buildings funded by the Atomic Energy Commission. The Metallurgy Building, completed in 1949 and now named Wilhelm Hall, contains approximately 56,500 gusf in a four-story brick structure. The building provides light laboratory space for both experimental and theoretical groups. The Record Storage Facility (2,000 gusf) is located adjacent to Wilhelm Hall. The building was built in 1949 for use as a vehicle maintenance and storage garage. It was later remodeled to house the Administrative Division's computer services group. This group moved into the Technical and Administrative Services Building upon its completion and the building was converted into a record storage facility.

The Research Building, now named Spedding Hall, was constructed between 1950 and 1952. This five-story brick structure, which contains 107,600 gusf, is designed for laboratory use.

To accommodate the Laboratory's development of unique materials processing and fabrication operations, the Metals Development Building, a single and two-story structure containing nearly 69,700 gusf of floor space, was completed in 1961. It was expanded in 1967 for machine shop facilities and light laboratory space. Engineering and Facilities office space was added in 1984 and a second floor which houses the electronics shops space was added in 1988.

Several small auxiliary buildings were constructed with GPP funds during the 1960's. These buildings house storage space, material receiving areas, warehouse functions and shop facilities.

At the end of FY1994, the Technical and Administrative Services (TASF) Building was completed. The approximately 47,000 gusf building is adjacent, and physically connected to Spedding Hall on land currently leased from Iowa State University, and houses the management, administrative, and technical support groups.

The ages of Ames Laboratory buildings are shown in Figure 5. The average age of space is for the entire Ames Laboratory facility is 40 years. The average age of space in the three primary research buildings is 48 years.

The general nature of the Ames buildings is satisfactory; however, some rehabilitation is required as discussed below. The major buildings are well designed and of a permanent type. It has historically been the Laboratory management's policy to devote adequate attention and resources to facilities maintenance although, in recent years, budget restrictions and the increasing demands of aging buildings have rendered this policy more difficult to follow. This high quality maintenance program has yielded dividends consisting of maximized preservation and minimized emergency repair expenditures.

The replacement values of the Ames Laboratory's government-owned facilities are presented in Table 3. The replacement values for each building are escalated annually using construction cost escalation factors provided by DOE. They are also adjusted for major capital improvements such as building additions.

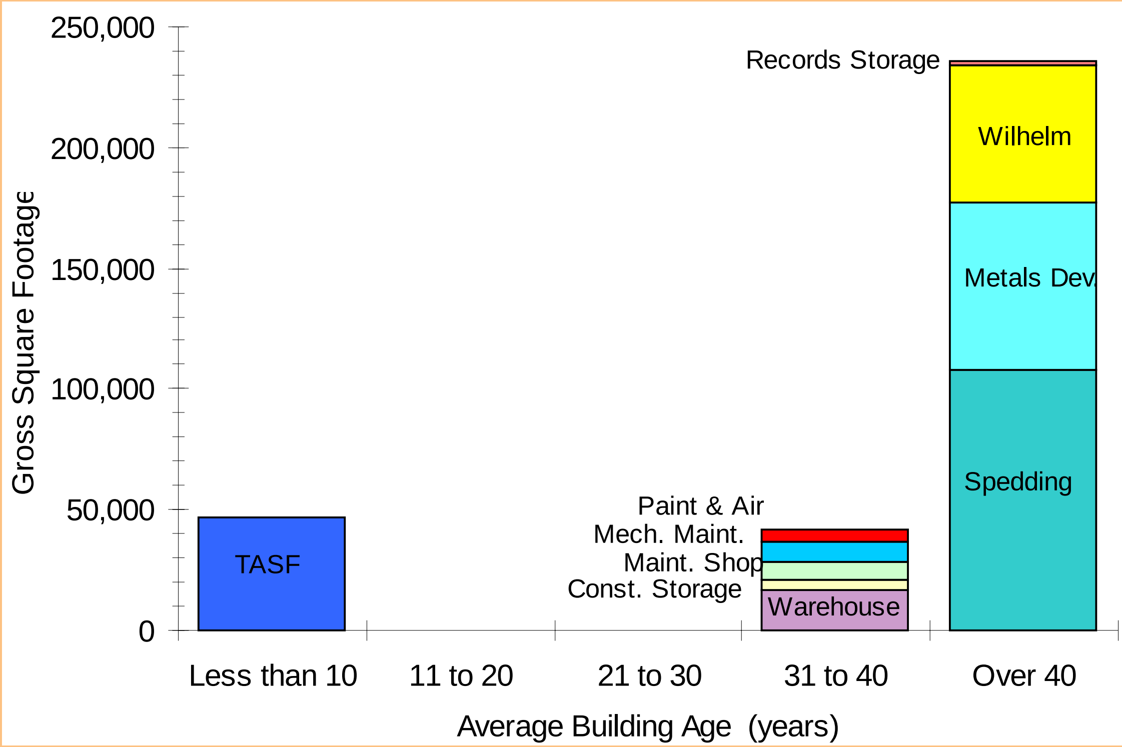



Figure 5. Age of Laboratory Building (Years).

The Condition Assessment Survey (CAS) program at the Laboratory is the method used to identify the Maintenance and Repair Deficiencies of the infrastructure. The program assesses all Laboratory facilities over a three-year cycle with approximately one-third of the building space inspected each year. The initial cycle was completed in 1999. Subsequently this pattern continues with each building being re-inspected every three years. The condition assessment survey process is orga-

Table 3. Facilities Replacement Value.

| Facility Type | Replacement in Current $M |
|---|---|
| Buildings (See Note.) | 66.8 |
| Construction Work in Progress | 3.3 |
| Utilities | * |
| All Other | 45.9 |
| TOTAL | 116.0 |

Note: Replacement Value of Buildings is based on RPV in FIMS. All other replacement values from Ames Laboratory's Annual Report on Property Valuation.

* ISU maintains water and natural gas infrastructure; City of Ames maintains the electrical infrastructure.

nized around four main building segments. Inspections are carried out for each of these focus areas. These segments are identified as areas, systems, infrastructure, and exterior. Area inspections include all those spaces that are used in accomplishing the Ames Laboratory mission or areas used to support the mission. Examples of these spaces are offices, research space, and common or public use space. Systems inspections include all utilities that service the building from where they enter the building to where they enter a work area. Infrastructure inspections examine the structural aspects of the building. The exterior inspections assess the condition of the exterior skin of the building to include the immediate grounds outside the building such as steps, areaways and shipping docks.

The CAS process develops a list of deficiencies, proposed corrections and associated cost estimates within each of these segments. Deficiencies are categorized for severity with respect to safety, mission, cost avoidance, and aesthetics. They are entered and tracked in a database. This information determines the Facility Condition Index (FCI) and adjectival rating for each of the buildings inspected in the current year. The FCI is defined as the dollar value of the deficiencies divided by the Replacement Plant Value (RPV) expressed as a percentage. The FCI for buildings inspected in past years is updated by removing the deficiencies corrected since the survey and escalating the cost values of the remaining deficiencies. The adjectival rating is defined and reported in the Laboratory's Self Assessment and Performance Measures Report. In the most recent report, the FCI was 2.42% with an adjectival rating of "outstanding." Our current FCI is 2.29% and will be reported in the CY2002 Self-Assessment & Performance Measurement Report.

The total cost of the deficiencies that have not received funding for correction is entered by building in the Facility Information Management System (FIMS) as the deferred maintenance. In the most recent reporting period, the Deferred Maintenance totaled $1.6M. Figure 6 shows the overall distribution of space by rating. One hundred percent of all space is rated good or excellent. The condition of Laboratory space by use is graphically depicted in Figure 7.

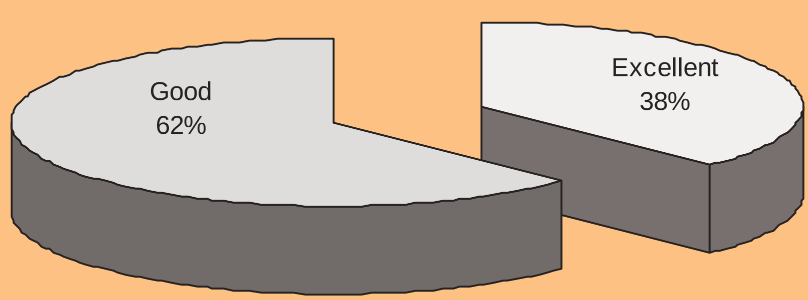



Figure 6. Condition of Laboratory Space based upon Facility Condition Index Ratings.

Laboratory operations utilizes not only the Federally-owned buildings of the main site, but also space (3700  nusf) in University-owned buildings adjacent to the main site.  It is anticipated that this will continue to be the norm for the near future.  (See Table 4)

The overall condition of the Ames Laboratory facility continues to be very good.  The Laboratory's 2001 Self-assessment and Performance Measures Annual Report and the DOE's Summary rating gave Facilities Management an "Outstanding" rating.

*Site and Facilities Trends*

The infrastructure of the laboratory remains very stable.  The inventory of permanent buildings remains unchanged.  Only one building has been added to the inventory in the past 30 years.  No temporary buildings or trailers are used at the site.  The rented space shared with university continues to provide excellent flexibility and synergy resulting in benefits to both organizations.  The amount of research space has remained relatively stable while administrative functions have been consolidated in the Technical and Administrative Services (TASF) Building reducing the net amount of space rented.  The new centers being funded are expected to increase the need for space to house the new initiatives.  Space in University buildings provides excellent short term flexibility.  In fact, the space rental agreement is essentially a form of third party financing.  As a result, however, DOE research is housed in facilities subject to the University's policies, practices and resource limitations.  In many cases these buildings are much older than Laboratory buildings and, because of the resource limitations of the University, have not been as well maintained over their lifetimes.  As such, the facilities are not as well suited to new research activities and it is more difficult to provide adequate support to the research effort.

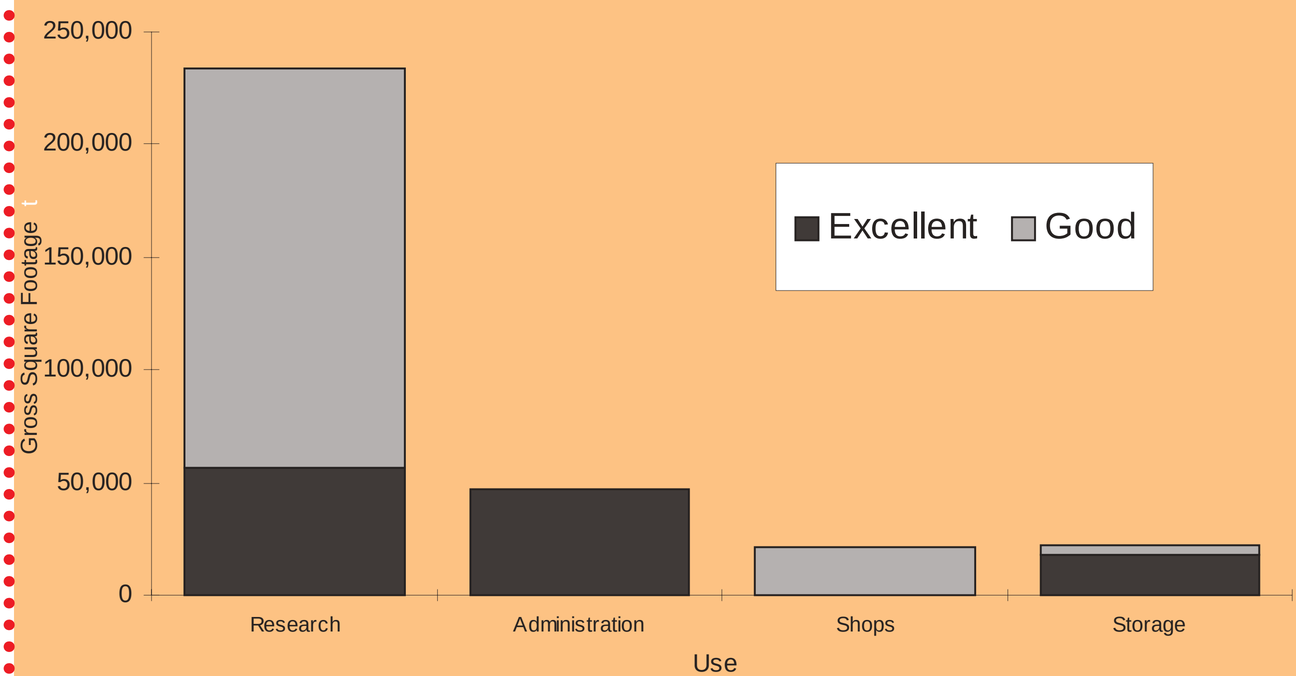



Figure 7.  Use and Condition of Laboratory Space.

Table 4. Laboratory Space Distribution.

| Laboratory Space Distribution | |
|---|---|
| Location | Area (Net Usable Sq. Ft.) |
| Main Site | 211,596 |
| Net Leased - University | 3,727 |
| Beneficial Use - University | 6,034 |
| Leased - Off Site | 0,000 |
| TOTAL | 221,357 |

The condition of facilities at the laboratory is excellent due to management's priority on facilities maintenance over the lifetime of the buildings. Over the past three years, deferred maintenance totals have been reduced and the FCI has been lowered. This is the result of the judicious use of corrective maintenance expenditures, capital improvement projects that also eliminate deficiencies, an aggressive preventive maintenance program that minimizes new deficiencies, and the reassessment of facilities as the Laboratory's condition assessment program becomes more mature and consistent.

While they are well maintained, they are not necessarily the best suited for research efforts in the 21st century. The buildings were well designed for research as it was done in the 1950's and 1960's, but not necessarily well adapted for current research paradigms. The trend to more sophisticated and sensitive electronics is expected to continue. This trend places a greater demand on utility systems to provide clean power, more cooling, humidity control, and more precise control. The trends toward more collaborative efforts with cross discipline work teams require more dynamic and flexible research facilities. Computing, communication, networking, and teleconferencing needs will continue to put a greater demand on infrastructure. To provide a facility and an environment that will allow the Laboratory to conduct world class research far into the future, the aging facilities will need to be re-invented not just well maintained.

*Site and Facilities Plans*

A major element in the plan for the alleviation of the projected research space shortage involves the construction of a building to house the proposed new initiatives. Although the majority of the space provided by this building would be utilized by the new work to be undertaken by these organizations, there would be some relocation of activities presently underway that are especially supportive of these initiatives and for which consolidation in one building would be desirable. The proposed building would also provide office space for some principal investigators who are currently located in existing space.

*General Purpose Facilities Plans*

In order to upgrade aging infrastructure to provide facilities suitable for world class research, GPP funding of approximately $0.8M has been requested for FY2003 and $0.9M for FY2004. Even at this funding level, projects will need to be phased over two or three years because of funding limitations. If current funding levels of $0.5M per year continue, this problem is further exacerbated. For example, one project alone costs more than three years worth of GPP funding. Because this project will require the majority of the GPP funds over four years it severely limits the ability to complete smaller projects creating a larger backlog of projects or it requires large projects to be deferred indefinitely or broken into many phases. When projects have to be done in multiple phases it results in greater costs and greater disruption to research activities in the buildings.

Future years GPP budget requests continue in the $0.7M to $0.8M range. Projects identified will upgrade heating, ventilating and air conditioning (HVAC) systems, electrical distribution systems, upgrade fume hood exhaust systems, systematically upgrade 1950's style research space to provide more dynamic and flexible space, improve safety systems, adapt space for changing needs and improve handicapped accessibility. Without this level of funding, it will not be possible to accomplish the improvements needed to adapt aging facilities to accommodate world-class research into the future.

Ames Laboratory has received General Purpose Equipment funding at a level of only approximately $155K per year for the past 10 years and our anticipated FY2003 funding is again $155K. This level of funding is problemmatic where large dollar items need to be procured. These large purchases require funds to be banked for several years in order to procure the item.

*Inactive Surplus Facilities Plan*

Ames Laboratory does not currently have any surplus facilities in the FIMS inventory and does not foresee any surplus facilities in the near future. However, the building that currently houses the waste handling function is not in the FIMS inventory. The Laboratory retained "beneficial occupancy" of the building from ISU after the Ames Laboratory Research Reactor was decommissioned resulting in an arrangement that is essentially a zero cost lease. Our use of the building continues to incur operational and maintenance costs to the laboratory as well as operational inefficiencies resulting from the remote location. A project has been defined to adapt space in one of the existing service buildings that will allow the laboratory to vacate the 9,000 square foot building and eliminate the need to transport low level waste to a remote site via public roads. Significant corrective maintenance costs will be incurred in the near future if the laboratory continues to occupy the facility.

*Facilities Resource Requirement - Major Construction*

The major new initiatives described previously in this document will require facilities resource allocations. Construction of a building ( The Emerging Technologies Building) will be required to house the proposed new initiatives. The building site will be convenient to the other Ames Laboratory buildings and various ISU buildings in which many of the scientific groups that will interact with the staff of these proposed initiatives are presently located. This planned construction has not been funded nor is it currently validated.

To ensure that the Laboratory has adequate space for future expansion, University officials have agreed to designate acceptable specific areas for the expansion of the Ames Laboratory in the University's long-range site plan.

The tabular summary of the resources needed for this major construction project is detailed in Table 5.

*Summary of 10-Year Infrastructure Plans*

*Infrastructure Vision, Goals and Objectives*

The Ames Laboratory will strive to provide and maintain infrastructure to meet its current needs and conduct world-class research far into the future. Ames Laboratory facilities will be safe, secure, and environmentally responsible. The facility will be managed to maximize effectiveness and efficiency, building on the strengths of the unique partnership with ISU so that the Ames Laboratory will continue to be the most cost-effective Laboratory in DOE. The Laboratory is committed to a long-term perspective toward maintaining the facilities, thus avoiding decisions with short-term benefits that have long-term consequences. The facility will be maintained in excellent to outstanding condition as described by the Facility Condition Index. Infrastructure improvements will be done to keep pace with advancing technology and new paradigms of scientific collaboration so the research efforts are not restricted. The facility and facility management activities must be flexible and adaptable to enable Program efforts to respond efficiently to new developments and changing priorities in the increasingly dynamic research environment.

*Executive Summary*

Ames Laboratory, a Department of Energy (DOE) research facility, has unique advantages in its relationship with Iowa State University (ISU). The Laboratory facilities integrated with the ISU campus infrastructure provide a campus-like atmosphere for its employees. This integration makes it very cost effective to operate the Laboratory. The average age of the research buildings is 48 years, but Laboratory management has devoted adequate funding for the upkeep of these government buildings so they remain in excellent condition. In recent years, however, Laboratory support from DOE has diminished at a time when the aging buildings require greater resources to maintain. In addition, research infrastructure requirements continue to change at a faster pace than in the early years of the Laboratory. Today's research requires greater flexibility that does not exist in our current structures. Therefore, this plan outlines Ames Laboratory's proposal for investments needed to meet the research needs for the 21$^{st}$ century. This proposal includes the addition of a new research facility, vacating a building used for low level waste handling, remodeling existing research facilities, consolidating research groups into contiguous space, cleaning up Harley Wilhelm Hall, and an increased annual commitment to the care and maintenance of the existing facilities. The funding required to accomplish these goals is included.

The modest investment proposed in this plan will allow the Ames Laboratory to achieve the vision of creating research facilities suited for world-class research well into the 21$^{st}$ century. This is in keeping with the tradition at the Laboratory to have a long-term perspective on the facility needs of our researchers and on our fiduciary responsibility to maintain and preserve the assets entrusted to us by the Federal Government.

*Energy Management*

The planning and management of utility usage at the Ames Laboratory maintains cost effective and reliable energy sources so that the research effort can be maximized. The In-House Energy Management Plan describes the efforts of the laboratory in this area. The utility supplies to

Table 5. Major Construction Projects

| ($ in Millions-BA) | TEC | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | FY2006 | FY2007 |
|---|---|---|---|---|---|---|---|---|
| TOTAL FUNDED & BUDGETED | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Proposed Construction | | | | | | | | |
| Program Line Item Projects | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 26.000 | 0.000 |

the laboratory are stable and have reserve demand capacity. Rates continue to be quite favorable. While natural gas prices have continued to be volatile, natural gas makes up a very small portion (<2%) of the laboratory's energy use. The total cost of energy use is less than $3.00 per gross square foot. Of the nine buildings that comprise the Ames Laboratory, only the TASF Building is eligible for the Energy Star label. However, the TASF Building does not have the utility metering required to establish whether the building actually meets the Energy Star performance requirements. There are currently no plans to pursue an Energy Star label for this building as the project would not be cost effective.

*Assets Management*

The plans, processes and procedures for asset management are contained in the Life Cycle Asset Management Plan (46300.002), the Ames Laboratory Purchasing Policy and Procedure Manual, and the Property Management Policy and Procedures Manual. The acquisition or disposition of real property assets are infrequent occurrences at the laboratory. Since 1970 only one real property asset has been added to the inventory. That project is the only line item construction project at the Laboratory since the early 1960's. Disposal or transfer of Real Property assets has occurred only once in the past 40 years. All Real Property assets of the Laboratory are retained and maintained to support the ongoing research mission with rare exception. Management has an excellent understanding of the space utilization and facility conditions of all of the real property assets from which to assess needs for new facilities or disposal of excess facilities. If there is a need to dispose of real property in the future, a specific plan will be generated with assistance from CH property management personnel and submitted to the Ames Area Office for review and approval. Likewise whenever a line item construction project is initiated, a specific acquisition plan will be developed incorporating all the current requirements such as sustainable design, energy conservation, executive orders, Department of Energy Acquisition Regulations (DEAR), and Federal Acquisition Regulations (FAR). The plan will be submitted to the Ames Area Office for review and approval.

The acquisition of other assets is a joint responsibility of the requestor of the asset and the Purchasing and Property Services Department. ESH&A reviews are incorporated into all of these processes. The purchasing and contracting policies and procedures of the Laboratory ensure that the applicable DOE Regulations, Department of Energy Acquisition Regulations (DEAR), and Federal Acquisition Regulations (FAR) are followed so that procurements are fair, competitive and least cost. These policies and procedures are described in the Ames Laboratory Purchasing Policy and Procedure Manual. Personal property acquisition goes through the standard requisitioning, bidding and purchasing described in that document. When personal property is no longer useful to the mission of the Laboratory, it is disposed of in accordance with DOE and Federal requirements. The "owner" of the equipment initiates the process through the Purchasing and Property Services Department. They manage the process in accordance with the Property Management Policy and Procedures Manual.

Security, Intelligence & Nonproliferation

Ames Laboratory ensures the security of its personnel, visitors, intellectual assets, property and cyber resources through development and implementation of effective and efficient processes and practices. The Laboratory maintains a Site Security Plan that describes the practices utilized to protect the government-owned facilities, equipment and nuclear materials at Ames Laboratory. The Laboratory also maintains a Cyber Security Program Plan that provides an overview of its unclassified computer security controls. The Safeguards and Security Program is built upon institutionalized systems and line management responsibilities. The Laboratory's Integrated Safeguards and Security Management (ISSM) System is functionally and operationally mature and will be fully documented and auditable, in accordance with the Department's ISSM policy, before the next scheduled Safeguards and Security Inspection.

Ames does not conduct classified research; there is no classified or unclassified controlled nuclear information stored at Ames. The Laboratory does not maintain security clearances for staff members. Ames conducts minimal research efforts involving unclassified work with small quantities of Category IV nuclear materials and therefore has implemented an approved Nuclear Materials Control and Accountability Plan. All materials balance areas are properly secured with locking systems. The primary materials balance area is also equipped with intrusion detection devices. Ames Laboratory maintains a security force comprised of unarmed uniformed personnel charged to observe, detect and report security, safety and fire protection incidents 24-hours a day, seven days a week.

The Laboratory's Safeguards and Security Oversight Committee is comprised of management level personnel including Environment, Safety, Health and Assurance, Environmental and Protection Sciences, Plant Protection, Information Systems, Facilities Services, Deputy Director, Export Control Officer and the Chief Operations Officer.

As discussed earlier in this Plan, the Laboratory conducts activities in both federal and Iowa State University owned buildings. The Laboratory does not have buildings off site. There are no man-made barriers (i.e. fences, walls, alarmed clear-zones, guard shacks, etc.) nor natural barriers (wooded areas, mounds, berms, etc.) surrounding the Ames Laboratory site. The buildings (both federally-owned and leased) are integrally located with the general educational and research facilities of Iowa State University. During off-hours and weekends and during times of elevated security conditions, the doors to all federally-owned Ames Laboratory buildings are blank-locked to prevent entry, or entry is controlled by a Marlok electronic system or a standard key system. The physical controls maintained are consistent with the nature of the site, afford adequate protection of government property, and are sufficient in light of the fact that there is no classified work being conducted at Ames Laboratory. During 2002, Ames implemented an Office of Science badge program that provides an additional element of personnel identification during times of elevated security conditions.

Ames Laboratory collaborates with and benefits from the scientific contributions made by jointly appointed Iowa State University faculty members, students, and several of the University's Colleges and major research centers. The nature of the research conducted at Ames, the broad dissemination of the results of this research via unrestricted publication in national and international scientific (refereed) journals and conferences, and the integration with Iowa State University justify the operation of Ames Laboratory as an open site. Even so, the site is managed so that neither the work nor the property is placed at risk. Ames Laboratory and Iowa State University in cooperation with the Ames Group, DOE-CH and the Office of Science developed an innovative program for accomplishing mission objectives and addressing security requirements through a graded approach.

The Laboratory's Cyber Security Program has undergone substantial growth and has made significant progress during the past few years. Past efforts include development and operation of a firewall system with network intrusion detection capabilities. Access controls are installed on the Ames Laboratory firewall zone to halt attacks from external entities identified by the Ames Laboratory intrusion detection systems within the firewall zone. Although systems have matured significantly, present and future efforts continue with installation, operation and observation of hardware and software components.

All foreign visits and assignments are entered into the DOE Foreign Access Central Tracking System (FACTS). Since Ames Laboratory is exempt from indices checks, all foreign visitors are allowed on site as soon as their visit is approved locally, except when hosted by the few Ames Laboratory staff that hold security clearances (sponsored by other Laboratories). Many of the foreign visitors and nationals on assignment participate in the research that is fully disclosed through the publication process. Foreign travel is managed and approved via DOE's Foreign Travel Management System (FTMS). This system allows for proper approvals and notifications to the responsible program office, security, counterintelligence and various other offices involved in foreign travel. The Chicago Office of Counterintelligence handles all briefings and debriefings for both foreign visits and assignments and foreign travel.

For collaborative research with industrial partner(s) or non-federal work for others (WFO), care is taken during the entire process, from proposal stage to obtaining final approval to perform the work, to make sure that the work not only contributes to the missions of the DOE through its funded research programs, but that the investment made by DOE for research is being used to further national goals while maintaining the nation's science base. One of these goals is to further US industry/laboratory partnerships through various technology transfer mechanisms. When a foreign national forms the basis of the original concept of the technique for the CRADA or WFO request, that foreign national will be the Principal Investigator on the agreement unless prohibited under the Export Control Regulations. Export Control licenses will be requested from the Department of Commerce when required. Principal Investigators, as well as their research staffs, are instructed on the importance of protecting proprietary or partner confidential data, CRADA data and potential intellectual property when performing research under CRADA and WFO agreements, and while hosting visiting foreign nationals.

## Contract Administration

The goal of Contract Administration at the Ames Laboratory is to interpret and administer the prime contract between the U.S. Department of Energy and the Contractor, Iowa State University. The primary champions in this endeavor are the Laboratory Director and the Chief Operations Officer. The Ames Laboratory Oversight Committee featuring major individuals in the Contractor's system is the primary means of monitoring contract administration at the Laboratory.

The Chief Operations Officer has at his disposal the primary functionaries who have as a large part of their job descriptions the administration of the contract. This includes the Purchasing and Property Management, Accounting, Budget, Information Services, Human Resources, and the Facilities and Engineering Services Offices, who have as a primary mission the performance of their assigned tasks within the constraints of the contract. The allowability of costs are constantly questioned and satisfied as a routine part of their mission.

The Director has other key elements reporting directly to him that have principal missions of support and conformance to the prime contract. Such elements include Environmental Safety, Health and Assurance (through the Deputy Director), Public Affairs, Internal Audit, and Industrial Outreach. The Manager, Office of Industrial Outreach and Technology Administration is primarily responsible for collecting data regarding the contract's ordained performance measures (Appendix B of the contract) and self assessment agreements.

Finally the Ames Laboratory Oversight Committee has as its standing members the Vice Provost, the Vice President for Business and Finance, several faculty members from the university and the staff positions of Facility Management and Environmental Safety and Health. Their mission is to monitor the contract through periodic meetings and probing queries.

All of these groups converge during the negotiations for the contract three to five years apart. Their mission then becomes the creation of a contract that is fair to all entities, especially, the U.S. taxpayer. In short, contract administration is an ongoing primary mission of the Laboratory and the Contractor.

## Performance-based Management

Under the terms of the contract between ISU and DOE, the parties agreed to utilize a performance-based management system for laboratory oversight, and ISU, as the contractor, is required to annually provide a written assessment of the Contractor's and Laboratory's performance. A semi-annual and annual report are submitted to DOE as required under the Contract.

## Budget, Finance and Resource

The number one goal of the Laboratory in dealing with financial resources is to provide to users the necessary information which will aid them in the decision making process. Because information flow in finance is a two way street, the processes and systems are constantly reviewed to enhance the data flow in both directions. The Laboratory strives to receive and provide financial data in a timely and accurate manner. Training is necessary to enable participants in the financial process to develop and utilize the data correctly.

Top Laboratory management is committed to active participation in the financial process. One of the steps taken to insure requested resources match the work proposed is a review and analysis of research proposal budgets. On-going reviews of indirect cost pools and corresponding budgets along with approval of all changes in those budgets also occur.

The Laboratory is committed to shifting an ever increasing number of processes and systems onto the computer. Given the size of the Laboratory and its resources, this task is a constant balancing act between the centralized financial functions and decentralized tasks. The Laboratory periodically reviews its processes, and where possible, computerizes what it can. Further, where data is developed in paper form, routed for approval, and submitted for data entry, the Laboratory is working on acquiring or developing systems to allow the requester of the action to input the data directly into the computer for subsequent electronic routing, approval and processing.

One recent project in computerizing Laboratory processes is the conversion of the Laboratory's payroll system from a legacy system to a third party package that was already being used to budget for Laboratory personnel costs. Conversion allowed for the reduction in maintenance efforts required to keep the legacy system operational and it allowed for better reporting and quering capabilities. Use of the third party software was also extended to include employee benefit details which are not currently accessible from the legacy system.

The Laboratory continues to work on developing electronic forms that utilize the electronic authorization and routing software previously developed for the Absence Request System.

Data transfer mechanisms and linked files are being utilized to reduce the amount of data entry required in various processes. The Laboratory is slowly trying to encourage standardization of hardware and software to reduce system development and maintenance costs. Reduction of redundant databases is a constant emphasis that requires a better understanding of where data is stored, who uses it, when it's updated, and for what it is used.

Further automation of budget processes is an ongoing effort, which requires constant communication between DOE and Laboratory management. Where possible, data is developed and transferred into appropriate models and databases. Standardization of formats by DOE would greatly enhance this effort.

One major new initative that the Laboratory will be working on in the future is the new DOE I-MANAGE project. This new initiate will create a new reporting format and will tie the budget formulation process and the budget execution process together into one system. DOE-HQ and one or two field sites are in the process of installing this system and will serve as beta sites for the software. DOE has set milestones for the entire complex to be converted to the new system in two to three years.

Another major project may involve the migration of existing systems off the HP3000. Last fall Hewlett Packard announced the termination of support for the HP3000 line in 2006. The Information Systems group, along with other functional offices are examining alternatives for future IT directions. This review has just begun and presently there are no findings to report.

As the Laboratory moves toward a more automated environment, a number of challenges exist. Services such as email, electronic forms, etc., imply that each employee has access to electronic media. This currently is not the case. Further, with the proliferation of third party software packages, getting all the packages, and versions, to work together is a constant challenge. Hardware and software upgrades are expensive to acquire and install. Program development, as well as program acquisition, is also expensive and requires constant maintenance. Additional costs are incurred just trying to maintain processes and systems that meet DOE requirements. Differences within DOE as to how resources are requested and reported create additional strain on existing systems.

The Laboratory has accepted these challenges and feels that by the wise application of existing resources, working with DOE, and sharing with other laboratories, it can achieve its goals and provide the financial processes and systems that will be needed in the future.

### Property Management

The Procurement Office is responsible for the effective management of personal property at the Laboratory. Included in this responsibility is:

- The identification and tagging of non-expendable property;
- Control of sensitive property;
- Conducting a capital and accountable equipment inventory biennially;
- Preparing loan agreements for various equipment items and follow-up; and

- Aiding in the identification and reporting, transfer or sale of excess property to DOE.

Procedures for the above responsibilities are outlined in the Ames Laboratory Property Services Policy and Procedures Manual.

## Work for Others

The Ames Laboratory engages in a broad range of research collaborations with a broad range of partners. Within that range, projects are undertaken when a proposed project: requires Laboratory personnel; is related to and supportive of the Laboratory's DOE mission; does not conflict with or interfere with the achievement of DOE programmatic requirements; does not compete directly with capabilities available in the domestic private sector; does not create a potential future burden on DOE resources; and complies with other Work For Others guidelines.

The Laboratory plans and conducts this work to accomplish R&D goals that may be otherwise unattainable, to increase the number of technologies transferred from the Laboratory to the marketplace, and to maintain core competencies that enhance the Laboratory's science and technology base. Some of the projects undertaken over the last year involved DOE contractors, while others involved other (non-DOE) federal agencies or non-federal partners.

### *Other Federal Agencies & Sister Labs*

Reimbursable work for DOE contractors includes projects with: Oak Ridge National Laboratory on sensor networks, and the broader DOE research community, for whom the Ames Laboratory's Material Preparation Center (see "User Facilities" section) prepares samples of ultra-high purity or novel alloys for researchers at various facilities. As in the past, the Laboratory's work for other DOE contractors tends to consist of relatively short term, low volume, low budget projects that call upon science and technology capabilities at Ames that are well-documented within the R&D community.

Ames Laboratory reimbursable work for non-DOE federal sponsors includes projects with:

- National Institutes of Health (NIH), to develop a novel DNA sequencing technique and technology;
- Environmental Protection Agency (EPA) to utilize Laboratory-developed capillary electrophoresis interfaced with on-line, low temperature laser excited fluorescence technology for the detection of DNA adducts in treated mice.
- National Institute of Justice to develop a Midwest Forensics Research Center (MFRC); and
- Department of Defense (DoD) on structural amorphous auminum alloys for aircraft components.

As in the case of the Laboratory's work for DOE contractors, these projects call upon science and technology capabilities that are well-documented within the nation's R&D community, although this class of project tends to be of slightly longer duration, somewhat larger budget, and relatively infrequent occurrence.

Currently, as in the past, the Laboratory's most steady Work For Others activities tend to originate with DOE contractors who have "first hand" knowledge of the Laboratory's science and technology capabilities. Several somewhat larger Work For Others projects (for non-DOE federal sponsors) have developed over the past few years as those agencies have undertaken projects in technology areas where the Laboratory has established a history of innovation and capability.

As a result of the events of September 11th, and the continued threat to national security, the need for new technologies, instruments and methods to deter terrorism and to assist in post terrorist attacts has been brought to the forefront of National concern. Ames had been developing over the past several years, research with forensic scientists and with national, regional, state and local law enforcement. In addition, the Laboratory has developed new technologies that have potential use in human health and safety research. In part, as a result of these collaborations, beginning in FY2002, and hopefully into the outyears, it is anticipated that WFO with other federal agencies will show a major increase at Ames Laboratory. On-going communication and coordination with DOE-CH and Headquarters on the impact of this increase in WFO on the Laboratory is continuing.

*Non-Federal Entitites*

WFO - non-federal activities continues at approximately 5-7 ongoing projects per year. These projects are typically in the range of $15,000 - $400,000 in total and are normally less than 3 years in duration. The Laboratory also anticipates that the recent increase in non-federal partners' inquiries concerning Work For Others opportunities will continue.

User Facilities

The Materials Preparation Center (MPC), a DOE User Facility, has responded to over 3540 requests for specialized materials preparation and characterization services during it's twenty years of operation. Designated a DOE User Facility in 1981, the Center provides a variety of high purity metals, alloys, and metallic compounds including pure actinide metals, rare earth elements, single crystals, hydrogen storage and magnetic refrigeration alloys, atomized powders, and custom alloy preparations. Characterization services include metallography, inorganic analytical analysis, Auger microscopy, SEM/TEM, with X-ray, thermal, and magnetic characterization services.

External sales for FY2002 totaled $505K, a 14.4% decrease over FY2001. During FY2002, MPC completed 172 orders, a 218.6% decrease over FY2001, with a breakdown of 9.9% to federal laboratories, 26.7% to academic institutions, 41.9% to industry, and 21.5% to foreign universities and institutes. This sales revenue decrease is typically attributed to overall downturn in the US economy with U.S. industries showing the largest decrease in activity. Slight increases were realized in work performed for foreign institutes and U.S. universities.

During FY2002, the MPC supplied a variety of specialized material products to 113 different clients at 87 academia, national and industrial laboratories worldwide. The MPC continued to provide Sn-Ti alloy to Outokumpu Advanced Superconductors (formerly Intermagnetics General Corporation) for the fabrication of Sn-Ti/Nb superconductors for the Korean K-Star Tokamack and the Nation High Magnetic Field Laboratory at Florida State University. Working with the Jet Propulsion Laboratory (JPL), MPC continued its' effort related to the preparation of $LaNi_{4.8}Sn_{0.2}$. cryocooler metal hydride sorbent alloy for the Planck space vehicle. Metal powders were prepared for Howmet Corporation for cold spray coating research at Sandia National Laboratory. Two amorphous metal alloy projects were continued under DARPA funding in FY 2002, one project with Texas A&M on Kinetic Energy Penetrators and one project with the U. S. Air Force Research Laboratory on Structural Amorphous Aluminum alloys for aircraft airframe and engine components.

In FY2002, $300K of capital equipment funding and $854K of operations funding was provided to the MPC. The Process Science Initiative (PSI) project received $300K of the operations funding to support the PSI program projects. The remaining operation funding provided the MPC with the financial resources to maintain, upgrade and improve equipment and facilities to develop increased processing and characterization capability. Equipment funding was used to continue replacement and repair of older equipment and upgrade facilities within the MPC and to purchase additional equipment necessary to continue revitalization and expansion of processing and characterization capabilities. Capital equipment items were purchased during FY2002 to expand the current melting capability and improve our magnetic materials characterization capability. Items purchased to expand our melting capability included a Plasma Melting Furnace System and a TriArc Melting furnace. Additional funding was needed to complete the installation of a Low Temperature - High Field Magnet Module for a new x-ray diffractometer and a new reciprocating sample device for one of our magnetometers.

Under the auspices of the MPC the Iowa Companies Assistance Program (ICAP), a technology outreach program funded by the State of Iowa, was continued during FY2002. ICAP promotes industrial interaction between Ames Laboratory/ISU and Iowa's Manufacturers and businesses by providing access to the technology, facilities and expertise of ISU and the Ames Laboratory. ICAP offers 40 hours of free technical assistance or technical coaching to solve specific manufacturing and materials problems. Funding provided for this program by the State of Iowa was cut by 30% for FY 2003 due to state budget shortfalls in revenue.

*Process Science Initiative*

The unique PSI program, established in FY2000, enables the implementation of one year short-term projects concerned with the development of 1) fundamental investigation of the mechanisms and models for core materials processing research capabilities of the MPC through computational process modeling and process parameter measurements, or 2) synthesis of "high-risk" new alloys or novel materials. The PSI program is open to all US researchers regardless of their affiliation or scientific discipline. Funding is made available by competitively-selected proposals. The research is carried out at the Ames Laboratory utilizing the Materials Preparation Center and supporting Ames Laboratory scientific staff and students in collaborative scientific research with the proposal author. The research results must be non-proprietary in nature and, moreover, must be made available in the public domain in the form of scientific publications. During FY 2002 seven PSI projects were funded for a total of $269.2K. The project titles were:

- Processing of Stiochiometric Bulk and Thin Film Lithium Niobate (Jag Kasichainula, North Carolina State University)
- Synthesis and Characterization of New Biocompatible Mesoporous Materials with Organic Functional Groups and Different Particle Morphologies (Victor Lin, Iowa State University)
- Synthesis of Highly Stable Amorphous Alloy Powders with High Oxygen Sensitivity (K. T. Hartwig, Texas A&M)
- Linkage of Gas Atomizer Flow Characterization and Modeling with Atomization Process Physics (Figliola, Richard, Clemson University)
- The Role of Nanoscale Interfical Crystallization on Adhesion and Processing Semicyrstalline Polymers (Balaji Narasimhan, Iowa State University)

*• Nanoscale Magnetic Materials Processing Via Severe Plastic Deformation (J. Shields, University of Nebraska-Lincoln)*

*• Development of Plasma Sprayed X-Al203 coatings (Rodney Trice, Rice University)*

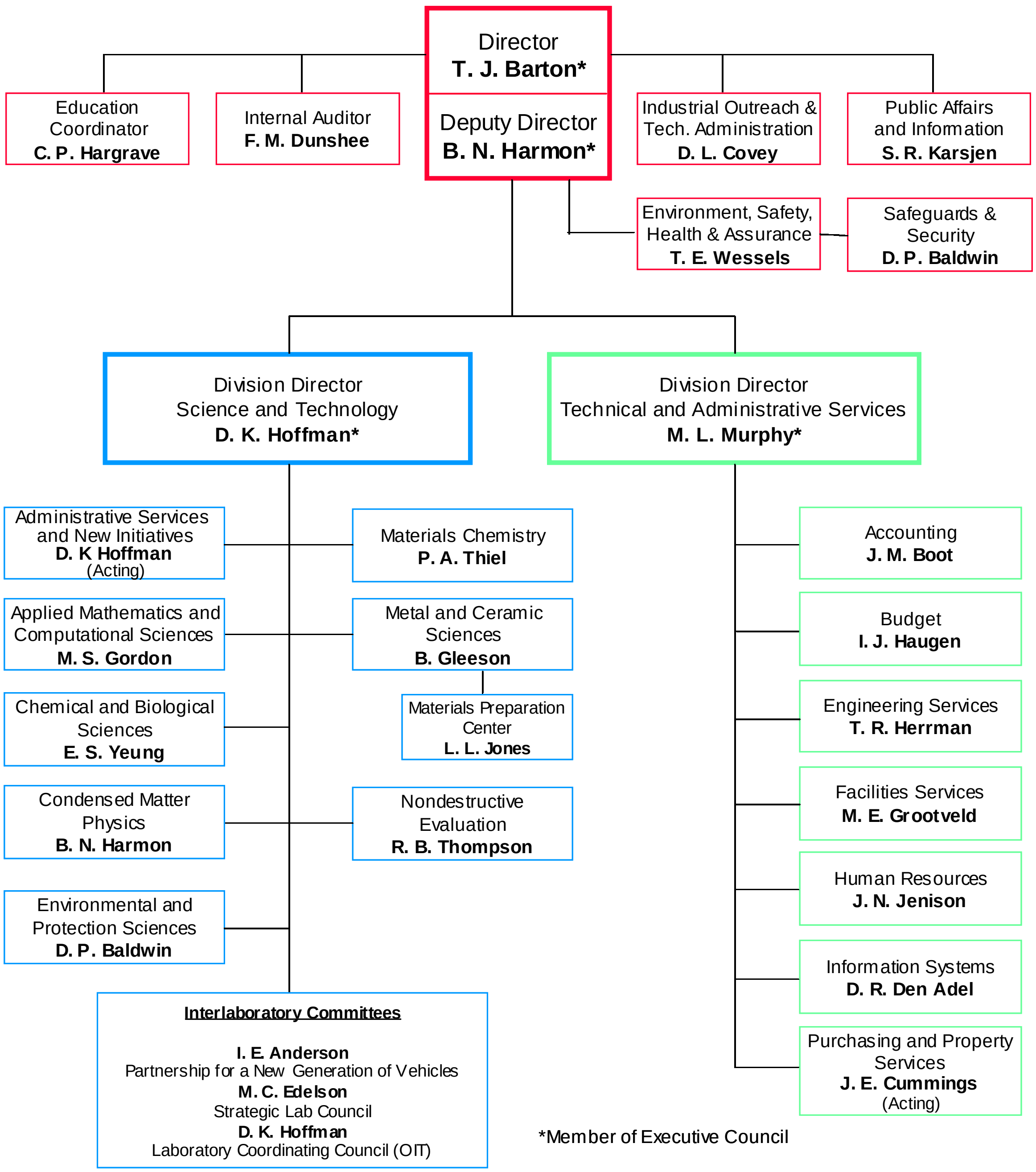
# Resource
# PROJECTIONS

**Divider illustration:**

Although a DOE Single-Program Laboratory, research funding at Ames Laboratory comes from many sources, including DOE, DOD, NIH, NIJ and various industrial partners.

# Resource Projections

## Organization



# Resource Projections

## Laboratory Funding Summary

| ($ in Millions-BA) | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | FY2006 | FY2007 |
|---|---|---|---|---|---|---|---|
| DOE Effort | 19.965 | 23.202 | 23.218 | 24.089 | 23.889 | 23.889 | 23.889 |
| Work for Others | 1.025 | 4.086 | 5.372 | 6.027 | 6.247 | 6.747 | 6.747 |
| **TOTAL OPERATING** | 20.990 | 27.288 | 28.590 | 30.116 | 30.136 | 30.636 | 30.636 |
| | | | | | | | |
| Capital Equipment | 2.475 | 2.429 | 2.322 | 4.355 | 2.570 | 2.570 | 2.570 |
| General Plant Projects | 0.500 | 0.730 | 0.795 | 0.895 | 0.830 | 0.810 | 0.725 |
| General Purpose Equipment | 0.155 | -0.076 | 0.265 | 0.235 | 0.530 | 0.250 | 0.250 |
| Total Laboratory Funding | 24.120 | 30.371 | 31.972 | 35.601 | 34.066 | 34.266 | 34.181 |
| | | | | | | | |
| Proposed Construction | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 26.000 | 0.000 |
| **TOTAL PROJECTED FUNDING** | 24.120 | 30.371 | 31.972 | 35.601 | 34.066 | 60.266 | 34.181 |

## Laboratory Personnel Summary

| (Personnel in FTE) | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | FY2006 | FY2007 |
|---|---|---|---|---|---|---|---|
| DIRECT | | | | | | | |
| DOE Effort | 180.2 | 182.3 | 230.6 | 229.0 | 227.1 | 227.2 | 226.5 |
| Work for Other than DOE | 11.0 | 13.1 | 25.1 | 25.8 | 25.7 | 27.2 | 27.2 |
| | | | | | | | |
| **TOTAL DIRECT** | 191.2 | 195.4 | 255.7 | 254.8 | 252.8 | 254.4 | 253.7 |
| **TOTAL INDIRECT** | 97.4 | 95.1 | 107.8 | 109.8 | 109.8 | 109.8 | 110.8 |
| **TOTAL PERSONNEL** | 288.6 | 290.5 | 363.5 | 364.6 | 362.6 | 364.2 | 364.5 |

## Funding By Secretarial Officer

| ($ in Millions-BA) | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | FY2006 | FY2007 |
|---|---|---|---|---|---|---|---|
| **Assistant Secretary for Energy Efficiency and Renewable Energy-EE** | | | | | | | |
| Total Operating | 0.365 | 0.355 | 0.290 | 0.290 | 0.290 | 0.290 | 0.290 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - EE | 0.365 | 0.355 | 0.290 | 0.290 | 0.290 | 0.290 | 0.290 |
| **Assistant Secretary for Environmental Management - EM** | | | | | | | |
| Total Operating | 0.901 | 0.856 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - EM | 0.901 | 0.856 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Assistant Secretary for Fossil Energy- FE** | | | | | | | |
| Total Operating | 0.515 | 0.610 | 0.600 | 0.640 | 0.640 | 0.640 | 0.640 |
| Capital Equipment | 0.000 | 0.000 | 0.040 | 0.045 | 0.045 | 0.045 | 0.045 |
| TOTAL - FE | 0.515 | 0.610 | 0.640 | 0.685 | 0.685 | 0.685 | 0.685 |
| **Administrator For National Nuclear Security Administration - NA** | | | | | | | |
| Total Operating | 0.492 | 0.180 | 0.670 | 0.640 | 0.640 | 0.640 | 0.640 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - NN | 0.492 | 0.180 | 0.670 | 0.640 | 0.640 | 0.640 | 0.640 |
| **Office of Science - SC** | | | | | | | |
| Total Operating | 17.877 | 18.704 | 18.555 | 19.669 | 19.469 | 19.469 | 19.469 |
| Capital Equipment | 2.925 | 2.429 | 2.860 | 4.476 | 2.691 | 2.691 | 2.691 |
| General Plant Projects (GPP) | 0.500 | 0.730 | 0.795 | 0.895 | 0.830 | 0.810 | 0.725 |
| General Purpose Equipment (GPE) | 0.155 | -0.076 | 0.265 | 0.235 | 0.530 | 0.250 | 0.250 |
| TOT. OFFICE OF SCIENCE - SC | 21.457 | 21.787 | 22.475 | 25.275 | 23.520 | 23.220 | 23.135 |
| Proposed Construction | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 26.000 | 0.000 |
| TOTAL PROJECTED - SC | 21.457 | 21.787 | 22.475 | 25.275 | 23.520 | 49.220 | 23.135 |
| **Office of Security and Emergency Operations - SO** | | | | | | | |
| Total Operating | 0.110 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - SO | 0.110 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Other DOE Facilities (Net Reimbursable DOE Work)** | | | | | | | |
| Total Operating | -0.295 | 2.497 | 3.103 | 2.850 | 2.850 | 2.850 | 2.850 |
| Capital Equipment | -0.450 | 0.000 | -0.578 | -0.166 | -0.166 | -0.166 | -0.166 |
| TOT. OTHER DOE FACILITIES | -0.745 | 2.497 | 2.525 | 2.684 | 2.684 | 2.684 | 2.684 |
| **TOTAL DOE** | 23.095 | 26.285 | 26.600 | 29.574 | 27.819 | 27.519 | 27.434 |
| **Reimbursable Work for Others** | | | | | | | |
| DOD | 0.064 | 0.077 | 0.040 | 0.000 | 0.000 | 0.000 | 0.000 |
| DOC | 0.000 | 0.000 | 0.040 | 0.042 | 0.042 | 0.042 | 0.042 |
| DOH&HS | -0.008 | 0.255 | 0.323 | 0.483 | 0.483 | 0.483 | 0.483 |
| EPA | 0.000 | 0.097 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Other Federal Agencies | 0.000 | 2.810 | 3.780 | 4.280 | 4.500 | 5.000 | 5.000 |
| Private Industry | 0.969 | 0.847 | 1.189 | 1.222 | 1.222 | 1.222 | 1.222 |
| All Other Non-Federal | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL WORK FOR OTHERS | 1.025 | 4.086 | 5.372 | 6.027 | 6.247 | 6.747 | 6.747 |
| Total GPP | 0.500 | 0.730 | 0.795 | 0.895 | 0.830 | 0.810 | 0.725 |
| Total GPE | 0.155 | -0.076 | 0.265 | 0.235 | 0.530 | 0.250 | 0.250 |
| TOTAL LABORATORY | 24.120 | 30.371 | 31.972 | 35.601 | 34.066 | 34.266 | 34.181 |
| Proposed Construction | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 26.000 | 0.000 |
| **TOTAL PROJECTED FUNDING** | 24.120 | 30.371 | 31.972 | 35.601 | 34.066 | 60.266 | 34.181 |

| Full Time Equivalents (FTE) | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | FY2006 | FY2007 |
|---|---|---|---|---|---|---|---|
| **Assistant Secretary for Energy Efficiency and Renewable Energy - EE** | | | | | | | |
| TOTAL DIRECT | 1.2 | 2.6 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| **Assistant Secretary for Environmental Management - EM** | | | | | | | |
| TOTAL DIRECT | 5.5 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Assistant Secretary for Fossil Energy - FE** | | | | | | | |
| TOTAL DIRECT | 4.3 | 4.7 | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 |
| **Administrator For National Nuclear Security Administration - NA** | | | | | | | |
| TOTAL DIRECT | 3.6 | 3.4 | 4.3 | 4.2 | 4.2 | 4.2 | 4.2 |
| **Office of Science - SC** | | | | | | | |
| TOTAL DIRECT | 164.8 | 165.4 | 181.1 | 183.2 | 181.3 | 181.4 | 180.7 |
| **Office of Security and Emergency Operations - SO** | | | | | | | |
| TOTAL DIRECT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other DOE Facilites** | | | | | | | |
| TOTAL DIRECT | 0.8 | 2.0 | 37.3 | 33.7 | 33.7 | 33.7 | 33.7 |
| **Reimbursable Work for Other Federal Agencies-40** | | | | | | | |
| TOTAL DIRECT | 3.7 | 4.5 | 17.3 | 18.7 | 18.6 | 20.1 | 20.1 |
| **Private Industry** | | | | | | | |
| TOTAL DIRECT | 7.3 | 8.6 | 7.8 | 7.1 | 7.1 | 7.1 | 7.1 |
| **All Other Non-Federal** | | | | | | | |
| TOTAL DIRECT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TOTAL DIRECT** | **191.2** | **195.4** | **255.7** | **254.8** | **252.8** | **254.4** | **253.7** |
| **TOTAL INDIRECT** | **97.4** | **95.1** | **107.8** | **109.8** | **109.8** | **109.8** | **110.8** |
| **TOTAL LAB PERSONNEL** | **288.6** | **290.5** | **363.5** | **364.6** | **362.6** | **364.2** | **364.5** |

## Assistant Secretary for Energy Efficiency and Renewable Energy - EE

| TRANSPORTATION SECTOR - EE | | | | | | | |
|---|---|---|---|---|---|---|---|
| **($ in Millions - BA)** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** |
| Total Operating | 0.365 | 0.355 | 0.290 | 0.290 | 0.290 | 0.290 | 0.290 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - EE | 0.365 | 0.355 | 0.290 | 0.290 | 0.290 | 0.290 | 0.290 |
| | | | | | | | |
| DIRECT PERSONNEL (FTE) | 1.2 | 2.6 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |

## Assistant Secretary for Environmental Management - EM

| DEFENSE ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT - EW | | | | | | | |
|---|---|---|---|---|---|---|---|
| **($ in Millions - BA)** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** |
| Total Operating | 0.901 | 0.856 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - EW | 0.901 | 0.856 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | | | | |
| DIRECT PERSONNEL (FTE) | 4.7 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| NON-DEFENSE ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT - EX | | | | | | | |
|---|---|---|---|---|---|---|---|
| **($ in Millions - BA)** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** |
| Total Operating | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - EX | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | | | | | | | |
| DIRECT PERSONNEL (FTE) | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

## Assistant Secretary for Fossil Energy - FE

| COAL AND POWER SYSTEMS - AA | | | | | | | |
|---|---|---|---|---|---|---|---|
| **($ in Millions - BA)** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** |
| Total Operating | 0.515 | 0.610 | 0.600 | 0.640 | 0.640 | 0.640 | 0.640 |
| Capital Equipment | 0.000 | 0.000 | 0.040 | 0.045 | 0.045 | 0.045 | 0.045 |
| TOTAL - AA | 0.515 | 0.610 | 0.640 | 0.685 | 0.685 | 0.685 | 0.685 |
| | | | | | | | |
| DIRECT PERSONNEL (FTE) | 4.3 | 4.7 | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 |

## Administrator for National Nuclear Security Administration - NA

| NONPROLIFERATION AND NATIONAL SECURITY PROGRAM DIRECTION - NN | | | | | | | |
|---|---|---|---|---|---|---|---|
| **($ in Millions - BA)** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** |
| Total Operating | 0.492 | 0.180 | 0.670 | 0.640 | 0.640 | 0.640 | 0.640 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - NN | 0.492 | 0.180 | 0.670 | 0.640 | 0.640 | 0.640 | 0.640 |
| | | | | | | | |
| DIRECT PERSONNEL (FTE) | 3.6 | 3.4 | 4.3 | 4.2 | 4.2 | 4.2 | 4.2 |

| FIELD SECURITY - FS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **($ in Millions - BA)** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** |
| Total Operating | 0.264 | 0.397 | 0.444 | 0.429 | 0.429 | 0.429 | 0.429 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - FS | 0.264 | 0.397 | 0.444 | 0.429 | 0.429 | 0.429 | 0.429 |
| | | | | | | | |
| TOTAL DIRECT | 3.2 | 3.8 | 4.2 | 4.2 | 4.2 | 4.2 | 4.2 |

| BASIC ENERGY SCIENCES - KC | | | | | | | |
|---|---|---|---|---|---|---|---|
| **($ in Millions - BA)** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** |
| Total Operating | 14.874 | 15.365 | 15.209 | 16.165 | 16.165 | 16.165 | 16.165 |
| Capital Equipment | 2.450 | 2.358 | 2.385 | 4.071 | 2.286 | 2.286 | 2.286 |
| General Plant Projects | 0.500 | 0.730 | 0.795 | 0.895 | 0.830 | 0.810 | 0.725 |
| General Purpose Equipment | 0.155 | -0.076 | 0.265 | 0.235 | 0.530 | 0.250 | 0.250 |
| TOTAL - KC | 17.979 | 18.377 | 18.654 | 21.366 | 19.811 | 19.511 | 19.426 |
| | | | | | | | |
| Proposed Construction | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 26.000 | 0.000 |
| TOTAL PROJECTED BES | 17.979 | 18.377 | 18.654 | 21.366 | 19.811 | 45.511 | 19.426 |
| | | | | | | | |
| DIRECT PERSONNEL (FTE) | 138.9 | 135.8 | 148.9 | 151.4 | 151.7 | 151.8 | 151.1 |

| COMPUTATIONAL AND TECHNOLOGY RESEARCH - KJ | | | | | | | |
|---|---|---|---|---|---|---|---|
| **($ in Millions - BA)** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** |
| Total Operating | 1.843 | 2.112 | 2.267 | 2.395 | 2.195 | 2.195 | 2.195 |
| Capital Equipment | 0.305 | 0.071 | 0.375 | 0.405 | 0.405 | 0.405 | 0.405 |
| TOTAL - KJ | 2.148 | 2.183 | 2.642 | 2.800 | 2.600 | 2.600 | 2.600 |
| | | | | | | | |
| DIRECT PERSONNEL (FTE) | 15.9 | 17.3 | 23.0 | 22.6 | 20.4 | 20.4 | 20.4 |

| BIOLOGICAL AND ENVIRONMENTAL RESEARCH - KP | | | | | | | |
|---|---|---|---|---|---|---|---|
| **($ in Millions - BA)** | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** |
| Total Operating | 0.896 | 0.830 | 0.635 | 0.680 | 0.680 | 0.680 | 0.680 |
| Capital Equipment | 0.170 | 0.000 | 0.100 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - KP | 1.066 | 0.830 | 0.735 | 0.680 | 0.680 | 0.680 | 0.680 |
| | | | | | | | |
| DIRECT PERSONNEL (FTE) | 6.8 | 8.5 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |

## Office of Security and Emergency Operations - SO

| NUCLEAR SAFEGUARDS AND SECURITY - GD | | | | | | | |
|---|---|---|---|---|---|---|---|
| ($ in Millions - BA) | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | FY2006 | FY2007 |
| Total Operating | 0.110 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Capital Equipment | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TOTAL - GD | 0.110 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| DIRECT PERSONNEL (FTE) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

## Subcontracting and Procurement

| ($ In Millions-Obligated) | FY2001 | FY2002 | FY2003 |
|---|---|---|---|
| Subcontracting and Procurement from: | | | |
| Universities | 0.50 | 0.70 | 0.50 |
| All Others | 4.10 | 5.28 | 4.50 |
| Transfers to other DOE Facilities | 0.00 | 0.65 | 0.00 |
| Total External Subcontracts and Procurement | 4.60 | 6.63 | 5.00 |

## Small and Disadvantaged Business Procurement

| ($ in Millions - BA) | FY2001 | FY2002 |
|---|---|---|
| Procurement from S&DB | 2.6 | 3.5 |
| Percent of Annual Procurement | 65.0 | 65.4 |
| Show total dollars obligated within each fiscal yr | 2.5 | 5.800 |

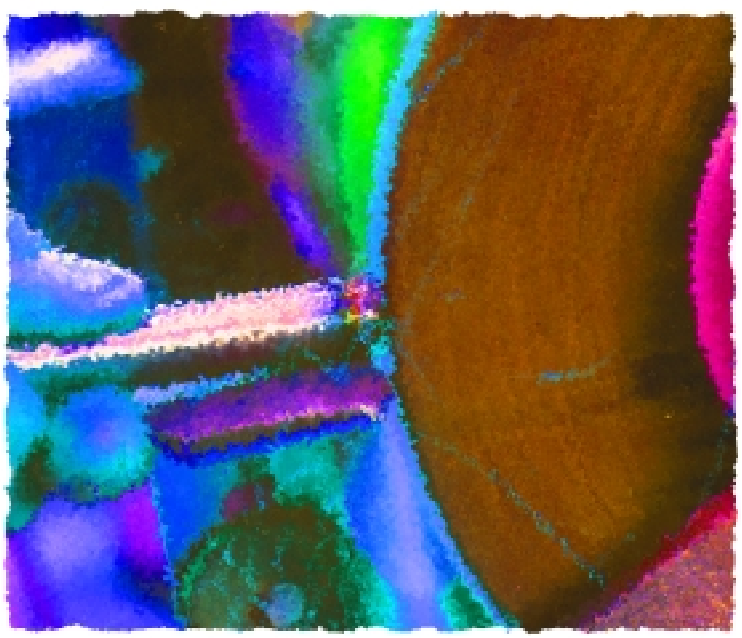
## Experimenters at User Facilities, 2001

| | Number of Experimenters | Number of Organizations | Percentage of Use |
|---|---|---|---|
| Laboratory | 2 | 2 | 2% |
| Other DOE Laboratories | 13 | 7 | 7% |
| U.S. Universities | 33 | 25 | 24% |
| U.S. Industry | 46 | 40 | 38% |
| International | 32 | 30 | 29% |
| Total | 126 | 104 | |

## Laboratory Directed Funding

| ($ in Millions - BA) | FY2001 | FY2002 | FY2003 | FY2004 | FY2005 | FY2006 | FY2007 |
|---|---|---|---|---|---|---|---|
| Total | 0.017 | 0.000 | 0.200 | 0.200 | 0.200 | 0.200 | 0.200 |

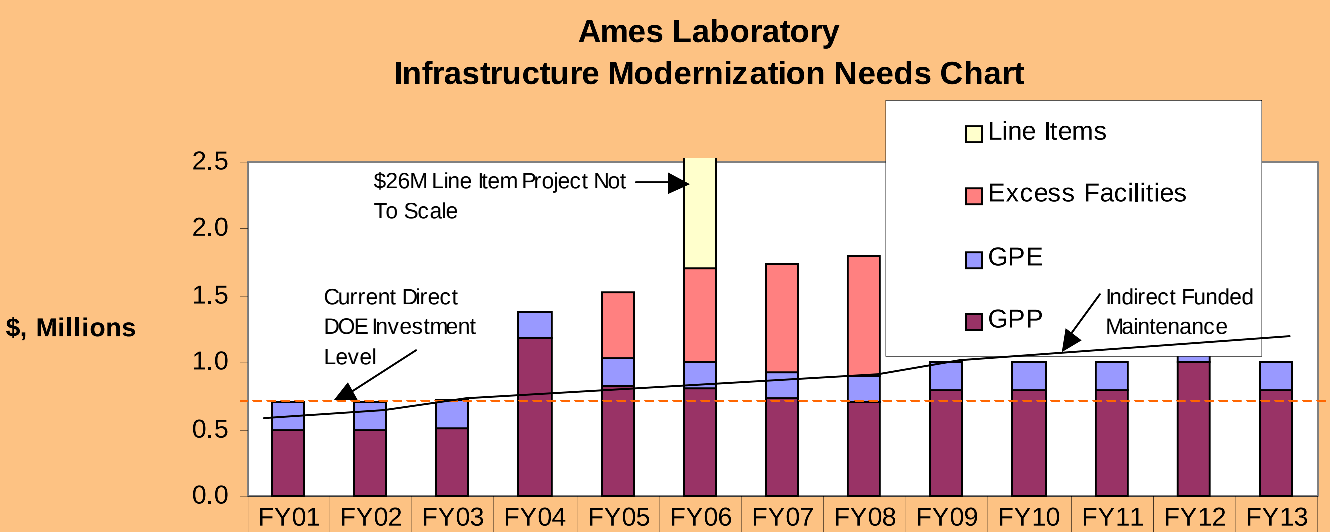
# Appendix



**Divider illustration:**
Ames Laboratory scientists created the second-hardest bulk substance after diamond. Nicknamed BAM, the substance could be used in cutting and machining applications, such as on the surface of a grinding wheel.

# Appendix 1

Updates to the Ames Laboratory Strategic Facilities Plan (Issued 10/30/2000)




| | FY01 | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 | FY10 | FY11 | FY12 | FY13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line Items | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 26.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excess Facilities | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.7 | 0.8 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GPE | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| GPP | 0.5 | 0.5 | 0.5 | 1.2 | 0.8 | 0.8 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 1.0 | 0.8 |

Infrastructure Modernization Needs Funding Chart.

| Laboratory: Ames Laboratory | | |
|---|---|---|
| **Project/Activity** | Space Added+ | Space Removed |
| | | |
| **REAL PROPERTY MAINTENANCE**** | | |
| **(% of RPV)** | | |
| | | |
| **GPP: Major projects planned***** | | |
| Upgrade HVAC/Fume Hood System, Spedding Hall | | |
| Fume Hood Upgrade, Wilhelm Hall | | |
| Upgrade Electrical Service, Metals Development Bldg. | | |
| Low Level Waste Handling Facility Relocation | | 9000++ |
| Upgrade Spedding Elevator | | |
| Upgrade HVAC, Front Section, Metals Dev. Bldg | | |
| Upgrade HVAC System, Spedding Hall | | |
| Records Holding Area | | |
| Upgrade Handicapped Access | | |
| Upgrade Freight Elevator, Metals Development Bldg. | | |
| Install Fire Sprinklers, Main. Shop Building | | |
| Misc. Small Projects/Systematic Space Modernization | | |
| | | |
| **Total GPP** | | |
| | | |
| **GPE** | | |
| **General GPE Needs** | | |
| **Total GPE** | | |
| | | |
| **INFRASTRUCTURE LINE ITEM CONSTRUCTION (SLI)***:** | | |
| Emerging Technologies Building | 50000 | 15000++ |
| **Total Line Items** | | |
| | | |
| **Total GPP/GPE/GPF:** | | |
| | | |
| **DOE Direct Funded Excess Facilities Clean-up and Disposition****** | | |
| **Non or slightly contaminated: list any projects***** | | |
| Wilhelm Hall Remediation++++ | | |
| **Subtotal for Non-or slightly contaminated** | | |
| **All other contaminated: list any projects***** | | |
| **Subtotal for all other contaminated** | | |
| **Total Excess Facilities** | | |
| | | |
| **Third Party Funding** | | |
| **List any planned projects***** | | |
| **Total Third Party** | | |

* These columns consistent with actual FY 2002 budget and the President's FY 2003 budget as well as with information provided in response to the FY 2004 Field Budget Call.

** Indirect funded

*** See project descriptions in attached list.

**** Include all contaminated facilties not transferred to EM

+ provide where applicable

++ Facility vacated is not in FIMS inventory but is maintained by Ames Laboratory as part of Benefical Occupancy arrangement with Iowa State University

+++ Reduction in rented space. New building will allow consolidation of research activities currently in rented space as well as space to accommodate emerging programs

++++ Project will not result in building being removed from inventory but will allow unrestricted use of the building for ongoing research activity

| | | | Modernization Needs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TEC | 2002* | 2003* | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| | | | | | | | | | | | | |
| | 0.6 | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 1.0 | 1.1 | 1.1 | 1.1 | 1.2 |
| | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.2 | 0.2 | | | | | | | | | | | |
| 0.6 | 0.3 | 0.3 | | | | | | | | | | |
| 0.2 | | 0.2 | | | | | | | | | | |
| 0.3 | | 0.0 | 0.3 | | | | | | | | | |
| 0.2 | | | 0.2 | | | | | | | | | |
| 0.4 | | | 0.4 | | | | | | | | | |
| 1.8 | | | 0.3 | 0.8 | 0.6 | | | | | | | |
| 0.2 | | | | | 0.2 | | | | | | | |
| 0.2 | | | | | | 0.2 | | | | | | |
| 0.2 | | | | | | 0.2 | | | | | | |
| 0.1 | | | | | | | 0.1 | | | | | |
| | | | | | | 0.3 | 0.6 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| | | | | | | | | | | | | |
| | 0.5 | 0.5 | 1.2 | 0.8 | 0.8 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 26.0 | | | | | 26.0 | | | | | | | |
| | 0.0 | 0.0 | 0.0 | 0.0 | 26.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | | | | | | |
| | 0.7 | 0.7 | 1.4 | 1.0 | 27.0 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | 0.5 | 0.7 | 0.8 | 0.9 | | | | | |
| | | | | 0.5 | 0.7 | 0.8 | 0.9 | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 0 | 0.0 | 0.0 | 0.5 | 0.7 | 0.8 | 0.9 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Ames Laboratory Infrastructure Modernization Needs Chart Data

| | FY01 | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 | FY10 | FY11 | FY12 | FY13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GPP | 0.5 | 0.5 | 0.5 | 1.2 | 0.8 | 0.8 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 1.0 | 0.8 |
| GPE | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Excess Facilities | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.7 | 0.8 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Line Items | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 26.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 0.7 | 0.7 | 0.7 | 1.4 | 1.5 | 27.7 | 1.7 | 1.8 | 1.0 | 1.0 | 1.0 | 1.2 | 1.0 |
| | | | | | | | | | | | | | |
| Indirect Maintenance | 0.6 | 0.6 | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 1.0 | 1.1 | 1.1 | 1.1 | 1.2 |
| Total Direct Investment | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |

This work was performed at Ames Laboratory, Iowa State University for the United States Department of Energy under Contract W-7405-ENG-82.