HDR

nano frontier

Pioneering Design for the Nano World.

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Funding Fuels Nanotechnology Research

National User Lab Progresses

Since the Clinton administration announced the National Nanotechnology Initiative (NNI) in January 2000, federal funds have increased every year for this fascinating new arena of life-altering research on the tiniest scale.

Nanotechnology has already improved everyday items like tennis balls and sunscreen. Proponents say that this research may someday lead to agents for curing disease, slowing the aging process and eliminating pollution.

The National Nanotechnology Initiative (NNI) website, (http://nano.gov), says that federal investment in this research and increased understanding "promise to underlie revolutionary advances that will contribute to improvements in medicine, manufacturing, high-performance materials, information technology, and environmental technologies."

$847 Million Sought for 2004

President Bush's 2004 budget includes $847 million for NNI, a 9.5% increase over 2003. And recently, the U.S. House of Representatives passed HR 766, the Nanotechnology Research and Development Act of 2003. This bill authorizes more than $2 billion of federal research money over the next three years.

What is the Nano Frontier?

In our continuing effort to share knowledge, we have created the Nano Frontier, a quick-hitting informational newsletter that you'll receive quarterly.

HDR is an award-winning and nationally recognized architecture, engineering, planning, and consulting firm and a leader in the growing field of research labs for nanotechnology. Established in 1917, the company employs more than 3,000 professionals throughout the U.S. and abroad.

Funding Fuels Nanotechnology Research, cont'd

National User Lab Progresses

Ten federal government agencies requested funding for NNI activities, as noted here:

2004

National Science Foundation	$247 million
Department of Defense	$222 million
Department of Energy	$197 million
National Institutes of Health	$70 million
Department of Commerce	$62 million
National Aeronautics and Space Administration	$31 million
Department of Agriculture	$10 million
Environmental Protection Agency	$5 million
Department of Homeland Security	$2 million
Department of Justice	$1 million

CINT Takes Center Stage

The 2004 budget includes a significant increase - 48% over 2003 - for the Department of Energy (DOE) and its missions in national defense, energy and the environment. The DOE has given $75 million for the Center for Integrated Nanotechnologies (CINT) in New Mexico, just one of five such user centers in the U.S. that are now in various stages of design and construction. This state-of-the-art facility will include laboratory and cleanroom spaces, and offices for staff and collaborators. Research spaces will include temperature and contamination control, vibration and acoustic isolation suites, characterization, synthesis and integration laboratories.

"We're connecting the nano world to the world that we live [in]," said Terry Michalske, CINT director at Sandia National Laboratories (SNL). A primary goal of the new laboratory is to provide an interdisciplinary environment that can serve the scientific community, including government, university and private sectors.

HDR leads a team of six firms providing full architectural and engineering services for the 95,000-square-foot CINT core facility, currently in Title 2 Design Phase. Construction is slated to start in 2004 and owner occupancy is scheduled for 2006.

Initially, the technical focus of the center will be on

- Nanophotonics and nanoelectronics
- Complex functional nanomaterials
- Nanomechanics
- Nanoscale bio-microinterfaces

Environmental Control Challenges

The critical foundation for successful nanoscience research is environmental control - temperature and humidity, vibration, acoustics and pressure variations, air cleanliness, noise, electro-magnetic interference (EMI) and radio frequency interference (RFI).

In addition to the stringent requirements of a nanotechnology facility, part of the CINT mission is to be a national user facility where researchers from academia and industry will collaborate with CINT researchers on projects, or share tools unavailable at their home laboratories.

One challenge was to make the integration lab user-friendly, which made the traditional cleanroom concept very difficult, according to Tom Gerbo, AIA, who is overseeing the laboratory design at CINT. Cleanroom space also is very expensive per square foot, he noted.

"The ideal nanocenter is almost a catalytic activity; it is a place where disciplines can really work together, but not be in each other's hair."

— Terry Michalske, CINT director at Sandia National Laboratories

The idea came about during planning to create "mini" cleanroom environments with a conventional bay and chase configuration and clustered HEPA filters where they were needed for certain procedures. This approach is also being seen in the semiconductor and pharmaceutical industries, Gerbo noted. Chemistry and biological synthesis laboratories are in the center of CINT, with environmentally quiet laboratories for characterization and measurement activities and the cleanroom on either side.

Aerial and interior images of the Center for Integrated Nanotechnologies

"The ideal nanocenter is almost a catalytic activity; it is a place where disciplines can really work together, but not be in each other's hair," Michalske said.

This design represents a substantial cost savings per square foot for the client, Gerbo said, adding that HDR shoots to keep costs for nanotechnology laboratories at around $250 per square foot. This number is in line with "regular" research laboratories with less sophisticated requirements than nanotechnology labs. The key to success is to build a conventional building but employ "very smart, thorough planning," he said.

Just Good Practice

Creating a constant, precise temperature in a nanotechnology lab requires a high volume of airflow pumped at a very low velocity. The HDR team came up with a successful scheme for temperature control that called for large air ducts covering nearly the entire ceiling.

However, according to Gerbo, solutions often present new challenges. In the case of the ceiling ducts, questions arose as to placement of other utilities. Those project aspects were then addressed.

"Throughout the planning and design of this laboratory facility, we have broken down the issues into their simplest components and dealt with them one at a time," Gerbo said. "In many ways it's just good architectural practice. It's good design from 'day one' in ways that the spaces are employed."

Vibration and electro-magnetic interference, which often affect high-end electron microscopes, were prime considerations in the placement of the facility on the site. Extensive studies of vibration-free zones were done and great care was taken to isolate vibration-generating traffic from critical functions.

Additionally, designers are using the natural stiffness of the building and placing heavy rotating equipment as far away as possible from sensitive research areas where any vibration could ruin an experiment.

Sustainable Elements

HDR has incorporated the latest sustainable design concepts and will achieve LEED™ * certification for CINT, said William Wells, AIA, HDR senior project manager. The goal is to provide a healthful, resource-efficient and productive work environment, which will serve as a model facility for the DOE and other government agencies.

SNL also hopes to obtain a designation for this building as a Federal Energy Saver Showcase.

To date, HDR has suggested these sustainable solutions:

- Storm water management and filtration on site
- Use of sustainable materials, including those with recycled content and low-emitting content
- Extensive use of native vegetation to help reduce water consumption for irrigation systems
- Efficient HVAC systems that do not include HCFC's or Halon
- Use of Energy Star-compliant roofing
- Implementing a building commissioning plan to ensure that the entire building is designed, constructed and calibrated to operate as intended

Interestingly, some experts predict that advances in nanotechnology will improve agricultural yields for an increased population, provide more economical water filtration and desalination, enable renewable energy sources, reduce the need for scarce material resources, and diminish pollution for a cleaner environment.

*The LEED™ Rating System was established by the U.S. Green Buildings Council in 1998 and HDR has been involved since its beginning. LEED means Leadership in Energy & Environmental Design. The system came about as a way of creating a standard, nationally recognized definition of a green building. Application is made and points given for incorporating green principles into a building's design. Qualifying buildings receive one of four levels of LEED certification, from bronze to platinum.

Finding the Funds

Funding is critical to the success of any research laboratory and its researchers. Universities, health departments and other institutions like them are constantly seeking both government and private monies for scientific research and facilities.

HDR continually assists clients with their funding processes, working with the institutions to complete the complex tasks associated with funding applications.

The average preparation time for a government application is two to four months, but some need much faster turnaround, according to Jerry Kinkade, HDR planning consultant who manages this work. "HDR provides drawings, narratives, cost estimates and schedules specific to the requirements of the funding agency. HDR also provides needed leadership by organizing the researchers' scientific mission, vision and goals and focusing their efforts in justifying the need for facility funding. We coordinate the matching of research activities with facilities."

The National Institutes of Health (NIH) is a leading benefactor of higher education research programs, Kinkade said. In addition to research, the NIH provides up to $2 million per grant for facilities, which must then be matched by the receiving institution.

Gary Nagamori, HDR national director of biosciences, and two other HDR professionals serve on the NIH Scientific and Technical Review Board of the National Center for Research Resources.

"Working on the NIH boards affords HDR opportunities to see national trends in scientific research and funding," Nagamori said, "as does HDR's use of former NIH employees as consultants to review grant applications." These activities allow HDR to better advise and coach its clients in successful attempts to find funding.

Private donor funding requires documents of a differing nature, specific to each benefactor's needs. Here HDR identifies buildings, spaces and functions that may be available for sponsorship. Again, HDR generates documentation, such as drawings, models, computer-aided designs and other graphics to assist in the fund-raising process.

When funding is not available or sought after, other creative avenues to maximize space utilization are available. "Developing institutional guidelines for grant dollars per square foot of research space is critical to implementing savings within existing research space and to creating the best value for investment dollars," said Chris Ertl, HDR planning consultant. "The end result is using the space more economically. A Funded Space Utilization Matrix allows the institution to audit space, support funded research, determine changing space needs, set new allocation standards and assess needs from a business perspective."

"These assessments have saved our clients millions of dollars," Kinkade said.

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